2020-21 EDITION

CDS

COMBINED DEFENCE SERVICES ENTRANCE EXAMINATION

CHAPTERWISE SECTIONWISE

SOLVED PAPERS

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Compiled & Edited by
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ARIHANT PUBLICATIONS (INDIA) LIMITED

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COMBINED DEFENCE SERVICES
ENTRANCE EXAMINATION

ABOUT THE EXAMINATION

A career in Defence services is the much sought after occupation today for those young and courageous youths of the country who are willing to dedicate their lives to defend the country and its people, the Combined Defence Services Examination is the first test before they can join one of the best defence forces in the world i.e. the Indian Armed Forces.

UPSC conducts the Combined Defence Services Exam twice every year generally in February and August for recruiting officers for the Indian Military Academy, Naval Academy, Air Force Academy and Officers Training Academy. Male candidates can join IMA, Naval and Air Force but for female candidates OTA in army is available.

The examination comprises of two stages-the first stage consists of written test and those who qualify the written test are called for interview by Service Selection Board (SSBs) for Intelligence and Personality Test.

NATIONALITY

A candidate must be either
(i)   Indian citizen, or
(ii)   A subject of Bhutan, or
(iii) A subject of Nepal, or
(iv)   A Tibetan refugee who came over to India before 1st January, 1962 with the intention of permanently setting in India, or
(v)   A person of Indian origin who has migrated from Pakistan, Burma, Sri Lanka and East African countries of Kenya, Uganda, the United Republic of Tanzania, Zambia, Malawi, Zaire and Ethiopia and Vietnam with the intention of permanently setting in India.

Provided that a candidate belonging to categories (ii), (iii), (iv) and (v) above shall be a person in whose favour a certificate of eligibility has been issued by the Government of India. Certificate of eligibility, will not , however, be necessary in the case of candidate who are Gorkha subjects of Nepal.

AGE LIMIT, SEX AND MARITAL STATUS

(i)   For IMA and Indian Naval Academy-unmarried male candidates having age not less than 18 years on 1st July and not more than 23 years on 2nd July in accordance with the year of examination are eligible.

(ii)   For Air Force Academy-male candidates having age not less than 19 years as on 1st July and not more than 23 years as on 2nd July in accordance with the year of examination. (upper age relation of upto 26 years for candidates holding Commercial Pilot License issued by DGCA).

(iii) For Officer's Training Academy-male candidates (married or unmarried) and female candidates (unmarried and issueless widows or divorces who have not remarried) having age not less than 18 years as on 1st July and not more than 24 years as on 2nd July in accordance with the year of examination are eligible.

EDUCATION QUALIFICATION

(i)   For IMA/OTA a degree from a recognised university or equivalent.
(ii)   For Naval Academy degree in engineering from a recognised university.
(iii) For Air Force Academy degree from a recognised university (with Physics and Mathematics at 10+2 level) or Bachelor of Engineering.

EXAMINATION PATTERN

(a)   The written examination will be as follows:

Subject	Duration	No. of Q.	Max. Marks
English	2 hours	120	100
General Knowledge	2 hours	120	100
Elementary Mathematics	2 hours	100	100

Note- For admission in OTA, candidates are required to give only English and General knowledge papers of 200 marks.

One third of the marks will be deducted for each wrong answer.

(b)   The SSB procedure consists of two stage selection process. Only those candidates who clear the stage I are permitted to appear for stage II.

(i)   Stage I comprises of Officer Intelligence Rating (OIR) tests and Picture Perception, Description Test (PP and DT)

(ii)   Stage II comprises of Interview, Group Testing Officer tasks, Psychology Tests and the Conference. These tests are conducted over 4 days.

Subjectwise - Chapterwise
TREND ANALYSIS

PAPER I
ELEMENTARY MATHEMATICS

Mathematics is a scoring subject for all competition exams as this is the only subject in which you can get full marks. CDS Mathematics paper contains 100 questions carrying 100 marks to be attempted in 120 minutes. Both open ended as well as close ended questions are asked in the exam. Based on the analysis of previous years question papers It can be concluded that the exam paper generally asks questions on following topics. Here along with the topic name we have also indicated the approximate number of questions, which are generally asked from there topics.

Arithmetic *(35-40 Questions)*

Based on the analysis of previous years papers, around 3-4 questions are based on HCF and LCM of numbers and 1-2 questions asked from each of the topics like Simple and compound interest, Time and work, Partnership, Profit and loss, Real numbers (statement based), Speed, time and distance and so on. Hence, it constitutes around 1/3rd marks of the paper. So, prepare well for this.

Algebra *(15-20 Questions)*

Questions are asked from this section includes Quadratic equations (8-10 questions), Linear equations (4-6 questions) and Polynomials (4-6 questions). A good hold on the equations will help you get on edge over this section.

Geometry *(15-18 Questions)*

Mostly theory based questions are asked from geometry i.e. beyond the routine formula based questions. Around 6-8 questions are asked from Properties of angles and an equal number of questions are there from Triangle similarity. There are also around 4-6 questions from Circles and their properties.

Mensuration *(10-15 Questions)*

The major part of this section is constituted by Area of triangles and quadrilateral (8-10 questions) and the remaining questions are asked from Surface area and Volume of 3D figures.

Trigonometry *(8-10 Questions)*

This can become your strength in the paper, if your basics are good. Direct questions are asked from this topic including 2-4 questions from Heights and distances.

Statistics *(3-4 Questions)*

Based on the analysis of previous years paper, around 3-4 questions are asked from Mean, Median and Mode.

PAPER II ENGLISH

CDS English paper contains 120 questions carrying 100 marks to be attempted in 120 minutes. Based on the analysis of previous years question papers It can be concluded that the exam paper generally asks questions on following topics. Here along with the topic name we have also indicated the approximate number of questions, which are generally asked from there topics.

Sentence improvement (20 to 25) test the area related to idiomatic expression, Proverbs and saying, Prepositional or conjunctional error etc. Sentence arrangement (8-10 questions) and para jumbles (10 questions) test the comprehensing ability. There are 10 questions on Fill in the blanks in which the suitable word is to be selected. A passage with blanks under Selecting the word's
(20 questions) tests the ability to pick the correct word that has the word in the option related to Nouns, Verbs, Preposition or Conjunction. Spotting the errors (15 questions) checks the other aspects of grammar like Syntax, Word usage or Voice and narration etc. There are short passages that contain 20 questions to test Global, Analytical and reading skills. Synonyms (8-10 questions) and Antonyms (8-10 questions) are asked either in the Word form or in the Sentence form. Another 5 questions are asked from One word substitution also.

PAPER III GENERAL KNOWLEDGE

Paper III of the CDS examination is General Knowledge which includes two sections Science and General Studies. CDS General Knowledge paper contains 120 questions carrying 100 marks to be attempted in 120 minutes. Based on the analysis of previous years question papers It can be concluded that the exam paper generally asks questions on following topics. Here along with the topic name we have also indicated the approximate number of questions, which are generally asked from there topics.

SCIENCE

Physics *(10-12 Questions)*
From Physics section around 10-12 questions are asked in the CDS examination as per the analysis of previous year papers. Physics can become and easy subject, if one has clarity of basic concepts.

- From Electrostatics section, 2-3 questions are asked from topics like Electric flux, Conductors and insulators, Electric potential etc.

- 2-3 questions have been asked from topics like Gravitation, Conservation of mechanical energy, Thermodynamics etc.

- The optics section has been given a prominent place as 3-4 question have been asked related to Reflection of light, Wave front and Huygen's principle etc.

Chemistry *(8-10 Questions)*
From Chemistry section around 8-10 questions are asked in the CDS examination as per the analysis of previous years papers. The section has been divides into three sub sections:

- From physical section, 2-3 questions are asked from topics like Structure of atom, Nature of matter, Concept of elements, Atoms and molecules etc.

- From inorganic section, 3-4 questions have been asked from p-block elements, Alkali and Alkaline Earth metals, f and d-block elements.

- From organic section, 3-4 questions are asked from topics like Hydrocarbons, Covalent bond, Haloalkanes and Haloarenes etc.

Biology (6-8 Questions)
The Biology section has been given the weightage of 6-8 questions in the CDS examination. These questions are asked from various concepts of Biology.

- Around 1-2 questions are asked from 'Diversity of living orgnaisms' which includes topics like living world, Plant kingdom etc.

- From 'Health and nutrition' section, 2-3 questions are asked related to Blood group, Vitamin and its deficiency, Various diseases etc.

- From 'Genetics and Evolution' section, 2-3 questions are asked related to Principles of inheritance and variation, Molecular basis of inheritance etc.

GENERAL STUDIES

History *(18-20 Questions)*
Going through the previous years paper of CDS exam, we have found that History section has been given an important weightage with around 18-20 questions. The areas which are given importance includes:

- About 4-5 questions are asked from Harappan civilization, Mauryan empire, Gupta era etc. Medieval India has been given weightage of 2-3 questions with focus on Early Medieval period, Delhi sultanate, Mughal empire (mainly Akbar and his policies).

- Around 3-4 questions are asked from Modern India section which includes Causes and consequences of 1857 revolt, Formation of congress, events related to Freedom struggle in India and Post independence era.

- Art and culture has been given a prominent place in the question paper with around 7-8 questions. The focus is on Art and Architecture of Ancient, Medieval and Modern era, Classical dance, Music, Books and authors etc.

Geography *(15-20 Questions)*
After analysing previous year question papers, it can be concluded that around 15-20 questions are asked from Geography. Questions are asked from various topics related to the basic concepts of the subject.

- Indian Geography has been given a weightage of about 8-10 questions which focuses on topics like Origin of Earth, Drainage pattern, Disaster related issues, location of important industries etc.

- Around 4-5 questions are asked from World geography topics like location of rivers, Irrigation methods and important Industries in the world etc.

- Around 4-5 questions are asked from Environment and Ecology topics like Natural vegetation, National parks, Wildlife sanctuary acts and Summits related to environment etc.

Polity *(20-22 Questions)*
Analysing the previous year's paper, we have come to the conclusion that this section has been given a vital role in the question paper with around 20-22 questions.

- Around 4-5 questions are focused on the topics like Constitutional development after independence which includes Preamble, Fundamental rights, Directive principles of state policy etc.
- Around 6-7 questions have been asked from the topic Executive and legislature which includes President, two houses of Parliament, State legislature etc. Judiciary has been given a weightage of 3-4 questions with emphasise on Writ jurisdiction, Appointment of judges etc.
- Apart from this, 3-4 questions are asked from topics like Constitutional amendment acts, Constitutional and non-constitutional bodies, Important judgements etc.

Economy *(8-10 Questions)*
With a deep analysis of the previous year's paper, we have come to the conclusion that about 8-10 questions are asked from this section. The focus is on topics like Basic concepts of economy (National Income, Demand and Supply), Problems in economy (Poverty and Unemployment), Important economic curves, Banking sector in India, Schemes and policies of the Government of India etc.

General Knowledge and Current Affairs
(15-20 Questions)
The General knowledge and current affairs section plays an important role in the CDS exam with approximately 15-20 questions. Questions are asked from fields like Persons in news, Sports, Books and authors, International relations, important National and international events, Awards in different field, basic knowledge of Armed forces in India etc.

CDS
COMBINED DEFENCE SERVICES

SOLVED PAPER
2020 (II & I)

CDS

Combined Defence Service

SOLVED PAPER 2020 (II)

> **PAPER I Elementary Mathematics**

1. $x^3 + x^2 + 16$ is exactly divisible by x, where x is a positive integer. The number of all such possible values of x is

(a) 3   (b) 4
(c) 5   (d) 6

⊙ **(c)** We have, $x^3 + x^2 + 16$ is exactly divisible by x.

$$\therefore \frac{x^3 + x^2 + 16}{x} = x^2 + x + \frac{16}{x}$$

$x^2 + x + \dfrac{16}{x}$ is positive integer

$\therefore$ x is factor of 16.

i.e., 1, 2, 4, 8, 16

$\therefore$ Number of all possible value of x is 5.

2. The number of (a, b, c), where a, b, c are positive integers such that $abc = 30$, is

(a) 30   (b) 27
(c) 9   (d) 8

⊙ **(b)** We have,

$abc = 30$, where a, b, c are positive integer.

$\therefore 30 = 1 \times 1 \times 30 = 3$ ways
$\quad 30 = 1 \times 2 \times 15 = 6$ ways
$\quad 30 = 1 \times 3 \times 10 = 6$ ways
$\quad 30 = 1 \times 5 \times 6 = 6$ ways
$\quad 30 = 2 \times 3 \times 5 = 6$ ways

$\therefore$ Total number of (a, b, c)
$\qquad = 3 + 6 + 6 + 6 + 6$
$\qquad = 27$ ways

3. If the roots of the quadratic equation $x^2 - 4x - \log_{10} N = 0$ are real, then what is the minimum value of N?

(a) 1   (b) $\dfrac{1}{10}$
(c) $\dfrac{1}{100}$ (d) $\dfrac{1}{10000}$

⊙ **(d)** Given equation
$x^2 - 4x - \log_{10} N = 0$ has real roots

$\therefore (4)^2 + 4(\log_{10} N) \geq 0$
$\log_{10} N \geq -4$
$\quad N \geq (10)^{-4}$
$\quad N \geq \dfrac{1}{10^4}$

$\therefore$ Minimum value of $N = \dfrac{1}{10000}$

4. The number of different solutions of the equation $x + y + z = 12$, where each of x, y and z is a positive integer, is

(a) 53   (b) 54
(c) 55   (d) 56

⊙ **(c)** We have,

$x + y + z = 12$, where x, y, z is a positive integer.

$\therefore$ Total number of different solution
$= {}^{12-1}C_{3-1} = {}^{11}C_2 = \dfrac{11 \times 10}{2} = 55$

5. If $I = a^2 + b^2 + c^2$, where a and b are consecutive integers and $c = ab$, then I is

(a) an even number and it is not a square of an integer
(b) an odd number and it is not a square of an integer.
(c) square of an even integer.
(d) square of an odd integer.

⊙ **(d)** We have, $I = a^2 + b^2 + c^2$

a, b are consecutive integer and $c = ab$

$\therefore \quad b = a + 1$
and $c = a(a + 1) = a^2 + a$
$\therefore I = a^2 + (a + 1)^2 + (a^2 + a)^2$
$\quad I = a^2 + a^2 + 2a + 1 + a^4 + a^2 + 2a^3$
$\quad I = a^4 + 2a^3 + 3a^2 + 2a + 1$
$\quad I = a^4 + a^2 + 1 + 2a^3 + 2a^2 + 2a$
$\quad I = (a^2 + a + 1)^2$

$a^2 + a + 1$ is an odd integer.

$\therefore$ I is a square of an odd integer.

6. If the number $23P62971335$ is divisible by the smallest odd composite number, then what is the value of P?

(a) 4   (b) 5
(c) 6   (d) 7

⊙ **(a)** Given,

$23P62971335$ is divisible by smallest odd composite number.

$\because$ Smallest odd composite number is 9.

$\therefore$ Given number is divisible by 9.

For divisibility by 9, sum of its digits is multiple of 9.

$\therefore 2 + 3 + P + 6 + 2 + 9$
$\quad + 7 + 1 + 3 + 3 + 5 = 41 + P$

$\therefore$ The possible value of P is 4.

7. What is the remainder when the sum $1^5 + 2^5 + 3^5 + 4^5 + 5^5$ is divided by 4?

(a) 0　　(b) 1　　(c) 2　　(d) 3

⟩ **(b)** Given number,

$1^5 + 2^5 + 3^5 + 4^5 + 5^5$

$1 + 2^5 + (4-1)^5 + 4^5 + (4+1)^5$

$1 + 2^5 + 4^5 + 4m - 1 + 4n + 1$

where m and n are integer.

$1 + 2^5 + 4^5 + 4m + 4n = 1 + 4k$

$2^5 + 4^5 + 4m + 4n$ is divisible by 4.

∴ Remainder = 1

8. What is the digit in the unit place of 3^{99}?

(a) 1　　　　(b) 3

(c) 7　　　　(d) 9

⟩ **(c)** Given number

$3^{99} = 3^3 \cdot 3^{96} = 27(3^4)^{24}$

$= 27(81)^{24}$

$= 27(80 + 1)^{24}$

$= 27(80k + 1)$

$= 27 \times 80k + 27$

∵ $27 \times 80k$ has unit digit is 0

and unit digit of 27 is 7.

∴ Unit digit of $3^{99} = 7$

9. LCM of two numbers is 28 times their HCF. The sum of the HCF and the LCM is 1740. If one of these numbers is 240, then what is the other number?

(a) 420　　　　(b) 640

(c) 820　　　　(d) 1040

⟩ **(a)** Let LCM of two number be x and HCF of two number be y.

Given,

$x = 28y$　　　　… (i)

and $x + y = 1740$　　　　… (ii)

From Eqs. (i) and (ii), we get

$x = 1680$ and $y = 60$

We know that,

LCM × HCF

　　　= Product of two numbers

∴ Other number $= \dfrac{1680 \times 60}{240} = 420$

10. $(x^n - a^n)$ is divisible by $(x - a)$, where $x \neq a$, for every

(a) natural number n

(b) even natural number n only

(c) odd natural number n only

(d) prime number n only

⟩ **(a)** $x^n = (x + a - a)^n$

$x^n = (x - a)^n + {}^nC_1(x - a)^{n-1}$

$(a) + {}^nC_2(x - a)^{n-2}a^2 + \ldots + a^n$

$\Rightarrow x^n - a^n = (x - a)$

$[(x - a)^{n-1} + {}^nC_1(x-a)^{n-2}a + \ldots]$

Clearly, $x^n - a^n$ is divisible by $x - a$ for every natural number n.

11. If 17^{2020} is divided by 18, then what is the remainder?

(a) 1　　(b) 2　　(c) 16　　(d) 17

⟩ **(a)** We have,

$(17)^{2020} = (18 - 1)^{2020}$

　　　　$= 18k + (-1)^{2020} = 18k + 1$

∴ If 17^{2020} is divided by 18,

then remainder = 1

12. What is the value of

$$\dfrac{1}{1 + \sqrt{2}} + \dfrac{1}{\sqrt{2} + \sqrt{3}} + \dfrac{1}{\sqrt{3} + \sqrt{4}}$$
$$+ \ldots + \dfrac{1}{\sqrt{99} + \sqrt{100}}?$$

(a) 1　　　　(b) 5

(c) 9　　　　(d) 10

⟩ **(c)** Given,

$$\dfrac{1}{1 + \sqrt{2}} + \dfrac{1}{\sqrt{2} + \sqrt{3}} + \dfrac{1}{\sqrt{3} + \sqrt{4}}$$
$$+ \ldots + \dfrac{1}{\sqrt{99} + \sqrt{100}}$$

$$= \dfrac{\sqrt{2} - 1}{2 - 1} + \dfrac{\sqrt{3} - \sqrt{2}}{3 - 2} + \dfrac{\sqrt{4} - \sqrt{3}}{4 - 3}$$
$$+ \ldots + \dfrac{\sqrt{100} - \sqrt{99}}{100 - 99}$$

$$= \sqrt{2} - 1 + \sqrt{3} - \sqrt{2} + \sqrt{4} - \sqrt{3}$$
$$+ \ldots + \sqrt{100} - \sqrt{99}$$

$$= \sqrt{100} - 1 = 10 - 1 = 9$$

13. If $x^m = \sqrt[14]{x\sqrt{x\sqrt{x}}}$, then what is the value of m?

(a) $\dfrac{1}{8}$　　(b) $\dfrac{1}{4}$　　(c) $\dfrac{3}{4}$　　(d) $\dfrac{7}{4}$

⟩ **(a)** We have,

$x^m = \sqrt[14]{x\sqrt{x\sqrt{x}}}$

$\Rightarrow x^m = \sqrt[14]{x\sqrt{x \cdot x^{1/2}}}$

$\Rightarrow x^m = \sqrt[14]{x(x^{3/2})^{1/2}}$

$\Rightarrow x^m = \sqrt[14]{x \cdot x^{3/4}}$

$\Rightarrow x^m = (x^{7/4})^{\frac{1}{14}}$

$\Rightarrow x^m = x^{\frac{1}{8}}$

$\Rightarrow m = \dfrac{1}{8}$

14. The sum of all possible products taken two at a time out of the numbers $\pm 1, \pm 2, \pm 3, \pm 4, \pm 5$ is

(a) 0　　　　(b) -30

(c) -55　　　　(d) 55

⟩ **(c)** Given number, $\pm 1, \pm 2, \pm 3, \pm 4, \pm 5$

We know that,

$(x_1 + x_2 + x_3 \ldots x_n)^2$

$$= \sum_{i=1}^{n} x_i^2 + 2 \sum_{1 \le i < j \le n}^{n} x_i x_j$$

∴ $(-1 + 1 - 2 + 2 + 3 - 3$

　　　　$+ 4 - 4 + 5 - 5)^2$

$= 2(1^2 + 2^2 + 3^2 + 4^2 + 5^2) + 2(\Sigma x_i x_j),$

$0 = 55 + \Sigma x_i x_j$

$\Sigma x_i x_j = -55$

15. A train of length 110 m is moving at a uniform speed of 132 km/h. The time required to cross a bridge of length 165 m is

(a) 6.5 s　　　　(b) 7 s

(c) 7.5 s　　　　(d) 8.5 s

⟩ **(c)** Length of train = 110 m

Length of bridge = 165 m

Total length = 110 + 165

　　　　　= 275 m

Speed of train = 132 km/h

　　　　$= 132 \times \dfrac{5}{18}$ m/s

Time required to cross the bridge

$= \dfrac{\text{Total distance}}{\text{Speed}}$

$= \dfrac{275 \times 18}{132 \times 5}$

$= 7.5$ s

16. The simple interest on a certain sum is one-fourth of the sum. If the number of years and the rate of annual interest are numerically equal, then the number of years is

(a) 2.5　　　　(b) 3

(c) 3.5　　　　(d) 5

⟩ **(d)** Given, SI $= \dfrac{1}{4}P$

and　　　　$R = T$

∴　　　　SI $= \dfrac{PRT}{100}$

$\Rightarrow$　　　$\dfrac{1}{4}P = \dfrac{PT^2}{100}$

$\Rightarrow$　　　　$T^2 = 25$

∴　　　　$T = 5$

∵ Number of years = 5

17. A 60-page book has n lines per page. If the number of lines were reduced by 3 in each page, the number of pages would have to be increased by 10 to give the same writing space. What is the value of n?

(a) 18   (b) 21
(c) 24   (d) 30

⊘ **(b)** Total number of line in 60 page
= $60n$ … (i)

Total number of line when number of line were reduced 3 in each page and number of pages increased by 10 = $(n - 3)(70)$ … (ii)

From Eqs. (i) and (ii),
$60n = (n - 3)70$
$60n = 70n - 210$
$n = 21$

18. If x men working x hours per day can do x units of work in x days, then y men working y hours per day in y days would be able to do k units of work. What is the value of k?

(a) $x^2 y^{-3}$ (b) $x^3 y^{-2}$
(c) $y^2 x^{-3}$ (d) $y^3 x^{-2}$

⊘ **(d)** Given,

x men working x hours per day can do x units of work in x days
∴ $x^3 = x$
⇒ $x^2 = 1$ … (i)

y men working y hours per day in y day would be able to do k units of work.
∴ $y^3 = k$
⇒ $\dfrac{y^3}{k} = 1$ …(ii)

From Eqs. (i) and (ii),
$$x^2 = \frac{y^3}{k} \Rightarrow k = x^{-2} y^3$$

19. Let $d(n)$ denote the number of positive divisors of a positive integer n. Which of the following are correct?

1. $d(5) = d(11)$
2. $d(5) \cdot d(11) = d(55)$
3. $d(5) + d(11) = d(16)$

Select the correct answer using the code given below:

(a) 1 and 3   (b) 1 and 2
(c) 2 and 3   (d) 1, 2 and 3

⊘ **(b)** Here, $d(n)$, denotes the number of positive divisors of a positive integer n.

∴ $d(5) = 2, d(11) = 2$,
$d(55) = d(5 \times 11) = 2 \times 2 = 4$
$d(16) = d(2^4) = (4 + 1) = 5$
∴ $d(5) = d(11)$ 1st is true.
$d(5)\,d(11) = 2 \times 2 = 4$
           $= d(55)$ 2nd is true.
$d(5) + d(11) = 2 + 2 = 4 \neq d(16)$ …
3 rd is false.
∴ 1 and 2 are correct.

20. If $A_n = P_n + 1$, where P_n is the product of the first n prime numbers, then consider the following statements :

1. A_n is always a composite number.
2. $A_n + 2$ is always an odd number.
3. $A_n + 1$ is always an even number.

Which of the above statements is/are correct?

(a) only 1   (b) only 2
(c) only 3   (d) 2 and 3

⊘ **(d)** Given $A_n = P_n + 1$, where P_n is the product of first n prime number
P_n is always an even number.
$[\because P_1 = 2]$
∴ A_n is an odd number.
∴ $A_n + 1$ is always an even number.
∴ $A_n + 2$ is always an add number.

21. A shopkeeper sells his articles at their cost price but uses a faulty balance which reads 1000 gm for 800 gm. What is the actual profit percentage?

(a) 20%   (b) 25%   (c) 30% (d) 40%

⊘ **(b)** Here, 200 gm is gained in 800 gm.

∴ Profit % = $\dfrac{\text{Profit}}{\text{CP}} \times 100$

           $= \dfrac{200}{800} \times 100 = 25\%$

22. A river 3 m deep and 40 m wide is flowing at the rate of 2 km/h and falls into the sea. What is the amount of water in litres that will fall into the sea from this river in a minute?

(a) 4000000 L   (b) 400000 L
(c) 40000 L   (d) 4000 L

⊘ **(a)** Speed of flow of water = 2 km/h

Width of river = 40 m
Depth of river = 3 m
Volume of water in one minutes

       $= 40 \times 3 \times 2000 \times \dfrac{1}{60}$

       $= 4000 \text{ m}^3$
       $= 4000000 \text{ L}$

23. If a television set is sold at ₹ x, a loss of 28% would be incurred. If it is sold at ₹ y, a profit of 12% would be incurred. What is the ratio of y to x ?

(a) 41 : 9   (b) 31 : 9
(c) 23 : 9   (d) 14 : 9

⊘ **(d)** Let the cost of television be ₹ 100.

If television set sold at 28% loss,
then selling price of television
$(x) = 100 - 28 = 72$

If television sold at 12% profit
then selling price of television
i.e., $(y) = 100 + 12 = 112$

∴ $\dfrac{y}{x} = \dfrac{112}{72}$

          $= \dfrac{14}{9}$

     $y : x = 14 : 9$

24. By increasing the speed of his car by 15 km/h, a person covers a distance of 300 km by taking an hour less than before. What was the original speed of the car?

(a) 45 km/h
(b) 50 km/h
(c) 60 km/h
(d) 75 km/h

⊘ **(c)** Let the speed of car = x km/h

Speed of car after increasing 15 km/h
$= (x + 15)$ km/h
Time taken by car on original speed
          $= \dfrac{300}{x}$

Time taken by car after increasing speed
          $= \dfrac{300}{x + 15}$

Difference between time = 1 h
∴ $\dfrac{300}{x} - \dfrac{300}{x + 15} = 1$

⇒ $300(x + 15 - x) = x(x + 15)$
⇒ $x^2 + 15x - 4500 = 0$
⇒ $(x + 75)(x - 60) = 0$
         $x = 60, x \neq -75$
∴ Original speed of car = 60 km / h

25. Three persons start a business with capitals in the ratio $\dfrac{1}{3}:\dfrac{1}{4}:\dfrac{1}{5}$. The first person withdraws half his capital after 4 months. What is his share of profit if the business fetches an annual profit of ₹ 96800?

(a) ₹ 32000　　(b) ₹ 34500
(c) ₹ 36000　　(d) ₹ 36800

⟩ **(a)** Three person start a business with capital in the ratio
$\dfrac{1}{3}:\dfrac{1}{4}:\dfrac{1}{5} = 20:15:12$

Total share of capital in a year by 1st person is
$= (20 \times 4)x + (10 \times 8)x = 160x$
2nd person $= (15 \times 12)x = 180x$
3rd person $= (12 \times 12)x = 144x$
∴ Ratio of their profits
$= 160:180:144$

Profit share of 1st person
$= \left(\dfrac{160}{160 + 180 + 144}\right) \times 96800$
$= \dfrac{160}{484} \times 96800 = $ ₹ 32000

26. If x varies as y, then which of the following is/are correct?

1. $x^2 + y^2$ varies as $x^2 - y^2$

2. $\dfrac{x}{y^2}$ varies inversely as y

3. $\sqrt[n]{x^2 y}$ varies as $\sqrt[2n]{x^4 y^2}$

Select the correct answer using the code given below :

(a) 1 and 2　　(b) 2 and 3
(c) only 3　　(d) 1, 2 and 3

⟩ **(b)** Given x varies as y

∴　　$x = ky$
1. $x^2 + y^2 = k^2 y^2 + y^2 = y^2(k^2 + 1)$
and $x^2 - y^2 = k^2 y^2 - y^2 = y^2(k^2 - 1)$
∴ $x^2 + y^2$ not varies with $x^2 - y^2$.

2. $\dfrac{x}{y^2} = \dfrac{ky}{y^2} = \dfrac{k}{y}$

∴ Clearly, $\dfrac{x}{y^2}$ varies inversely as y.

3. $\sqrt[n]{x^2 y} = (x^2 y)^{\frac{1}{n}} = (k^2 y^3)^{1/n}$

and $\sqrt[2n]{x^4 y^2} = (x^4 y^2)^{\frac{1}{2n}}$

$= (x^2\ y)^{\frac{1}{n}} = (k^2 y^3)^{1/n}$
∴ $\sqrt[n]{x^2 y}$ is varies as $\sqrt[2n]{x^4 y^2}$.

27. Ena was born 4 yr after her parents marriage. Her mother is 3 yr younger than her father and 24 yr older than Ena, who is 13 yr old. At what age did Ena's father get married?

(a) 25 yr　　(b) 24 yr
(c) 23 yr　　(d) 22 yr

⟩ **(c)** Present age of Ena = 13 yr
Present age of her mother
$= (13 + 24) = 37$ yr
Age of Ena mother's when Ena born
$= 37 - 13 = 24$ yr
Age of Ena mother get married
$= 24 - 4 = 20$ yr
∴ Age of Ena father's
$= (20 + 3) = 23$ yr.

28. Mahesh is 60 yr old. Ram is 5 yr younger to Mahesh and 4 yr elder to Raju. Babu is a younger brother of Raju and he is 6 yr younger. What is the age difference between Mahesh and Babu?

(a) 18 yr　(b) 15 yr　(c) 13 yr　(d) 11 yr

⟩ **(b)** Here, age of Mahesh = 60 yr
Ram is 5 yr younger to Mahesh.
∴ Age of Ram = 60 − 5 = 55 yr
Ram is 4 yr elder to Raju
∴ Raju's age = 55 − 4 = 51 yr
Babu's is 6 yr younger to Raju
∴ Babu's age = 51 − 6 = 45
∴ Difference of age between Mahesh and Babu = 60 − 45 = 15 yr

29. The number of items in a booklet is N. In the first year there is an increase of $x\%$ in this number and in the subsequent year there is a decrease of $x\%$. At the end of the two year, what will be the number of items in the booklet?

(a) Less than N
(b) Equal to N
(c) More than N
(d) It depends on the value of N

⟩ **(a)** Number of items in a booklet = N
Number of items in booklet after first year
Increase at rate of $x\% = N + x\%$ of N
$= N\left(1 + \dfrac{x}{100}\right)$
Number of items in booklet in 2nd year

Decrease at rate of $x\%$
$= N\left(1 + \dfrac{x}{100}\right) - N\left(1 + \dfrac{x}{100}\right)\dfrac{x}{100}$
$= N\left(1 + \dfrac{x}{100}\right)\left(1 - \dfrac{x}{100}\right) = N\left(1 - \dfrac{x^2}{10000}\right)$
Which is less than N.

30. If $ab + xy - xb = 0$ and $bc + yz - cy = 0$, then what is $\dfrac{x}{a} + \dfrac{c}{z}$ equal to?

(a) $\dfrac{y}{b}$　(b) $\dfrac{b}{y}$　(c) 1　(d) 0

⟩ **(c)**　Given,　$ab + xy - xb = 0$　and
$bc + yz - cy = 0$
$\Rightarrow x(y - b) = -ab$ and $c(b - y) = -yz$
$\Rightarrow \dfrac{x}{a} = \dfrac{-b}{y-b}$ and $\dfrac{c}{z} = \dfrac{-y}{b-y} = \dfrac{y}{y-b}$
∴ $\dfrac{x}{a} + \dfrac{c}{z} = \dfrac{-b}{y-b} + \dfrac{y}{y-b} = \dfrac{y-b}{y-b} = 1$

31. What is the HCF of the polynomials $x^6 - 3x^4 + 3x^2 - 1$ and $x^3 + 3x^2 + 3x + 1$?

(a) $(x + 1)$　　(b) $(x + 1)^2$
(c) $x^2 + 1$　　(d) $(x + 1)^3$

⟩ **(d)** Given polynomial, $x^6 - 3x^4 + 3x^2 - 1$
$= (x^2 - 1)^3 = (x + 1)^3(x - 1)^3$
and $x^3 + 3x^2 + 3x + 1 = (x + 1)^3$
HCF $= (x + 1)^3$

32. The HCF and the LCM of two polynomials are $3x + 1$ and $30x^3 + 7x^2 - 10x - 3$ respectively. If one polynomial is $6x^2 + 5x + 1$, then what is the other polynomial?

(a) $15x^2 + 4x + 3$　(b) $15x^2 + 4x - 3$
(c) $15x^2 - 4x + 3$　(d) $15x^2 - 4x - 3$

⟩ **(d)** HCF and LCM of two polynomials are $3x + 1$ and $30x^3 + 7x^2 - 10x - 3$
and one polynomial is $6x^2 + 5x + 1$.
We know,
HCF × LCM = Product of two polynomials
∴ Other polynomial
$= \dfrac{(3x + 1)(30x^3 + 7x^2 - 10x - 3)}{6x^2 + 5x + 1}$
$= \dfrac{(3x + 1)(30x^3 + 7x^2 - 10x - 3)}{(3x + 1)(2x + 1)}$
$= \dfrac{30x^3 + 7x^2 - 10x - 3}{2x + 1}$
$= \dfrac{(15x^2 - 4x - 3)(2x + 1)}{2x + 1}$
$= 15x^2 - 4x - 3$

33. If $(p+2)(2q-1) = 2pq - 10$ and $(p-2)(2q-1) = 2pq - 10$, then what is pq equal to?

(a) -10 (b) -5
(c) 5   (d) 10

⊙ **(c)** Given,

$(p+2)(2q-1) = 2pq - 10$

and $(p-2)(2q-1) = 2pq - 10$

$\therefore 2pq + 4q - p - 2 = 2pq - 10$

$\Rightarrow \quad 4q - p = -8 \quad\quad \dots$ (i)

and $2pq - 4q - p + 2 = 2pq - 10$

$-4q - p = -12$

$4q + p = 12 \quad\quad \dots$(ii)

From Eqs. (i) and (ii), $p = 10, q = \dfrac{1}{2}$

$\therefore pq = 10 \times \dfrac{1}{2} = 5$

34. What is the value of
$$\dfrac{a^2 + ac}{a^2 c - c^3} - \dfrac{a^2 - c^2}{a^2 c + 2ac^2 + c^3}$$
$$-\dfrac{2c}{a^2 - c^2} + \dfrac{3}{a+c}?$$

(a) 0   (b) 1
(c) $\dfrac{ac}{a^2 + c^2}$ (d) $\dfrac{6}{a+c}$

⊙ **(d)** We have,
$$\dfrac{a^2 + ac}{a^2 c - c^3} - \dfrac{a^2 - c^2}{a^2 c + 2ac^2 + c^3}$$
$$-\dfrac{2c}{a^2 - c^2} + \dfrac{3}{a+c}$$
$$= \dfrac{a(a+c)}{c(a+c)(a-c)} - \dfrac{(a+c)(a-c)}{c(a+c)(a+c)}$$
$$-\dfrac{2c}{(a+c)(a-c)} + \dfrac{3}{a+c}$$
$$= \dfrac{a}{c(a-c)} - \dfrac{a-c}{c(a+c)}$$
$$-\dfrac{2c}{(a+c)(a-c)} + \dfrac{3}{a+c}$$
$$= \dfrac{a(a+c) - (a-c)(a-c)}{c(a+c)(a-c)}$$
$$\dfrac{-2c^2 + 3c(a-c)}{}$$
$$= \dfrac{a^2 + ac - a^2 - c^2}{c(a+c)(a-c)}$$
$$\dfrac{+2ac - 2c^2 + 3ac - 3c^2}{}$$
$$= \dfrac{6ac - 6c^2}{c(a+c)(a-c)}$$
$$= \dfrac{6c(a-c)}{c(a+c)(a-c)}$$
$$= \dfrac{6}{a+c}$$

35. What is the square root of $4x^4 + 8x^3 - 4x + 1$?

(a) $2x^2 - 2x - 1$
(b) $2x^2 - x - 1$
(c) $2x^2 + 2x + 1$
(d) $2x^2 + 2x - 1$

⊙ **(d)** We have,

$4x^4 + 8x^3 - 4x + 1$
$= 4x^4 + 4x^2 + 8x^3 - 4x + 1 - 4x^2$
$= 4x^4 + 4x^2 + 1 + 2(2x^2)(2x)$
$\quad\quad -2(2x) - 2(2x^2)$
$= (2x^2)^2 + (2x)^2 + (1)^2 + 2(2x^2)(2x)$
$\quad\quad -2(2x)(1) - 2(2x^2)(1)$
$= (2x^2 + 2x - 1)^2$
$\therefore \sqrt{4x^4 + 8x^3 - 4x + 1}$
$= \sqrt{(2x^2 + 2x - 1)^2}$
$= 2x^2 + 2x - 1$

36. The sum of the digits of a two digit number is 13 and the difference between the number and that formed by reversing the digits is 27. What is the product of the digits of the number?

(a) 35   (b) 40
(c) 45   (d) 54

⊙ **(b)** Two digits number be $10x + y$.

Given, $x + y = 13 \quad\quad \dots$ (i)

and $(10x + y) - (10y + x) = 27$

$x - y = 3 \quad\quad \dots$(ii)

From Eqs. (i) and (ii),

$x = 8, y = 5$

$\therefore \quad xy = 8 \times 5 = 40$

37. If $\dfrac{x}{b+c} = \dfrac{y}{c+a} = \dfrac{z}{b-a}$, then which one of the following is correct?

(a) $x + y + z = 0$
(b) $x - y - z = 0$
(c) $x + y - z = 0$
(d) $x + 2y + 3z = 0$

⊙ **(b)** Let $\dfrac{x}{b+c} = \dfrac{y}{c+a} = \dfrac{z}{b-c} = k$

$\therefore \quad\quad x = k(b+c)$

$y = k(c+a)$

$z = k(b-a)$

$x - y - z = k$

$(b+c-c-a-b+a) = 0$

$\therefore \quad x - y - z = 0$

38. X, Y and Z travel from the same place with uniform speeds 4 km/h, 5 km/h and 6 km/h respectively. Y starts 2 h after X. How long after Y must Z start in order that they overtake X at the same instant?

(a) $\dfrac{3}{2}$ h   (b) $\dfrac{4}{3}$ h
(c) $\dfrac{9}{8}$ h   (d) $\dfrac{11}{8}$ h

⊙ **(b)** Distance travelled by X in t hours $= 4t$

Distance travelled by Y starts 2 h after X

$= 5(t-2)$

Distance travelled by X and Y are same.

$\therefore \quad\quad 4t = 5t - 10$

$\Rightarrow \quad\quad t = 10$ h

Let Z starts n hours after Y.

$\therefore$ Distance travelled by $Z = 6(8-n) = 48 - 6n$

Distance travelled by X and Z are same.

$\therefore \quad 40 = 48 - 6n$

$\Rightarrow 6n = 8 \Rightarrow n = \dfrac{4}{3}$ h

39. $1 - x - x^n + x^{n+1}$, where n is a natural number, is divisible by

(a) $(1+x)^2$ (b) $(1-x)^2$
(c) $1 - 2x - x^2$ (d) $1 + 2x - x^2$

⊙ **(b)** Given,

$1 - x - x^n + x^{n+1}$
$= 1 - x^n - x + x^{n+1}$
$= 1(1 - x^n) - x(1 - x^n) = (1-x)(1 - x^n)$
$= (1-x)(1-x)(1 + x + x^2 \dots + x^{n-1})$
$= (1-x)^2(1 + x + x^2 + \dots + x^{n-1})$

$\therefore (1-x)^2$ is a factor of $1 - x - x^n + x^{n-1}$.

40. A person sold an article for ₹ 75 which cost him ₹ x. He finds that he realised $x\%$ profit on his outlay. What is x equal to?

(a) 20%   (b) 25%
(c) 50%   (d) 100%

⊙ **(c)** Given cost price of articles = ₹ x

Profit % = $x\%$

Selling price = ₹ 75

Profit % = $\dfrac{\text{Profit}}{\text{CP}} \times 100\%$

$x\% = \dfrac{75 - x}{x} \times 100\%$

$\Rightarrow x^2 + 100x - 7500 = 0$

$\Rightarrow (x + 150)(x - 50) = 0$

$x = 50$

41. A car did a journey in t hours. Had the average speed been x km/h greater, the journey would have taken y hours less. How long was the journey?

(a) $x(t - y)t\,y$ (b) $x(t - y)t\,y^{-1}$

(c) $x(t - y)t\,y^{-2}$ (d) $x(t + y)t\,y$

⊙ **(b)** Let the speed of car $= S$ km / h

Distance travelled by car $= D$

Time taken $= t$ hour

∴ $S = \dfrac{D}{t}$ … (i)

When speed of car increased x km/h.

∴ Speed of car $= (S + x)$

Distance be same $= D$

Time $= (t - y)$

∴ $S + x = \dfrac{D}{t - y}$ … (ii)

From Eqs. (i) and (ii),

$x = \dfrac{D}{t - y} - \dfrac{D}{t}$

$x = \dfrac{D(t - t + y)}{t(t - y)}$

$D = x(t - y)\,ty^{-1}$

42. When a ball is allowed to fall, the time it takes to fall any distance varies as the square root of the distance and it takes 4 s to fall 78.40 m. How long would it take to fall 122.50 m?

(a) 5 s   (b) 5.5 s   (c) 6 s   (d) 6.5 s

⊙ **(a)** Given, $t = k\sqrt{d}$

When, $t = 4$ and $d = 78.40$

∴ $k = \dfrac{4}{\sqrt{78.40}}$

When, $d = 122.50$

∴ $t = \dfrac{4}{\sqrt{78.40}} \times \sqrt{122.50}$

$= 4\sqrt{\dfrac{122.50}{78.40}}$

$t = 4 \times \sqrt{\dfrac{1225}{784}}$

$= 4 \times \dfrac{35}{28} = 5$ sec

43. If $6^{3 - 4x}\,4^{x + 5} = 8$ (Given $\log_{10} 2 = 0.301$ and $\log_{10} 3 = 0.477$), then which one of the following is correct?

(a) $0 < x < 1$ (b) $1 < x < 2$

(c) $2 < x < 3$ (d) $3 < x < 4$

⊙ **(c)** Given, $6^{3 - 4x}\,4^{x + 5} = 8$

$\dfrac{6^3 \cdot 4^x \cdot 4^5}{6^{4x}} = 2^3$

$\Rightarrow \dfrac{2^3 \cdot 3^3 \cdot 2^{2x} \cdot 2^{10}}{2^{4x} \cdot 3^{4x}} = 8$

$\Rightarrow 3^{4x} \cdot 2^{2x} = 2^{10} \cdot 3^3$

Taking log both sides,

$4x \log 3 + 2x \log 2$
$\qquad\qquad = 10\log 2 + 3\log 3$

$\dfrac{(2x - 10)}{3 - 4x} = \dfrac{\log 3}{\log 2} = \dfrac{0.477}{0.301}$

$\Rightarrow \dfrac{2x - 10}{3 - 4x} = 1.58$

$\Rightarrow 2x - 10 = (3 - 4x)(1.58)$

$\Rightarrow 2x - 10 = 4.74 - 6.32x$

$\Rightarrow 8.32x = 14.74$

$\Rightarrow x = \dfrac{14.74}{8.32} = 1.77$

∴ $1 < x < 2$

44. The Euclidean algorithm is used to calculate the

(a) square root of an integer

(b) cube root of an integer

(c) square of an integer

(d) HCF of two integers

⊙ **(d)** Euclidean algorithm is used to calculate the HCF of two integers.

45. If radius of a sphere is rational, then which of the following is/are correct?

1. Its surface area is rational.

2. Its volume is rational.

Select the correct answer using the code given below

(a) only 1

(b) only 2

(c) Both 1 and 2

(d) Neither 1 nor 2

⊙ **(d)** Radius of sphere is rational

Surface area of sphere $= 4\pi r^2$, which is irrational

Volume of sphere $= \dfrac{4}{3}\pi r^3$, which is also irrational.

46. If $\operatorname{cosec}\theta - \sin\theta = m$ and $\sec\theta - \cos\theta = n$, then what is $m^{\frac{4}{3}}n^{\frac{2}{3}} + m^{\frac{2}{3}}n^{\frac{4}{3}}$ equal to?

(a) 0   (b) 1

(c) mn (d) $m^2 n^2$

⊙ **(b)** We have, $\operatorname{cosec}\theta - \sin\theta = m$ and $\sec\theta - \cos\theta = n$

$\dfrac{1 - \sin^2\theta}{\sin\theta} = m$

and $\dfrac{1 - \cos^2\theta}{\cos\theta} = n$

$\dfrac{\cos^2\theta}{\sin\theta} = m$ and $\dfrac{\sin^2\theta}{\cos\theta} = n$

$m^{4/3}n^{2/3} + m^{2/3}n^{4/3}$

$= m^{2/3}n^{2/3}[m^{2/3} + n^{2/3}]$

$\left(\dfrac{\cos^2\theta}{\sin\theta}\right)^{2/3}\left(\dfrac{\sin^2\theta}{\cos\theta}\right)^{2/3}$

$\qquad\qquad \left[\dfrac{\cos^{4/3}\theta}{\sin^{2/3}\theta} + \dfrac{\sin^{4/3}\theta}{\cos^{2/3}\theta}\right]$

$= (\sin\theta\cos\theta)^{2/3}\left[\dfrac{\cos^2\theta + \sin^2\theta}{(\sin\theta\cos\theta)^{2/3}}\right]$

$= 1$

47. If $\cos\theta + \sec\theta = k$, then what is the value of $\sin^2\theta - \tan^2\theta$?

(a) $4 - k$ (b) $4 - k^2$

(c) $k^2 - 4$ (d) $k^2 + 2$

⊙ **(b)** Given, $\cos\theta + \sec\theta = k$

$(\cos\theta + \sec\theta)^2 = k^2$

$\cos^2\theta + \sec^2\theta + 2 = k^2$

$1 - \sin^2\theta + 1 + \tan^2\theta + 2 = k^2$

$\qquad\qquad 4 - k^2 = \sin^2\theta - \tan^2\theta$

∴ $\sin^2\theta - \tan^2\theta = 4 - k^2$

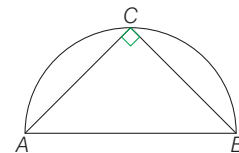**48.** ABC is a triangle inscribed in a semicircle of diameter AB. What is $\cos(A + B) + \sin(A + B)$ equal to?

(a) 0   (b) $\dfrac{1}{4}$

(c) $\dfrac{1}{2}$ (d) 1

⊙ **(d)** We have,

ABC is a triangle inscribed in a semi-circle of diameter AB.

∴ $\angle ABC$ is a right angle at C.

∴ $A + B = 90°$

$\cos(A + B) + \sin(A + B)$

$\qquad = \cos 90° + \sin 90°$

$\qquad = 0 + 1$

$\qquad = 1$

49. Consider the following statements :

1. $\sin\theta = x + \dfrac{1}{x}$ is possible for some real value of x.

2. $\cos\theta = x + \dfrac{1}{x}$ is possible for some real value of x.

Which of the above statements is/are correct?

(a) only 1   (b) only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ **(d)** We have,

1. $\sin\theta = x + \dfrac{1}{x}$

$\sin\theta \in [-1, 1]$

$x + \dfrac{1}{x} \in (-\infty, -2] \cup [2, \infty]$

∴ 1st is incorrect.

2. $\cos\theta = x + \dfrac{1}{x}$

$\cos\theta \in [-1, 1]$

$x + \dfrac{1}{x} \in [-\infty, -2] \cup [2, \infty)$

∴2nd is also incorrect.

50. What is the magnitude (in radian) of the interior angle of a regular pentagon?

(a) $\dfrac{\pi}{5}$ (b) $\dfrac{2\pi}{5}$ (c) $\dfrac{3\pi}{5}$ (d) $\dfrac{4\pi}{5}$

⊙ **(c)** Interior angle of a regular pentagon

$= \dfrac{(5-2)}{5} \times \pi = \dfrac{3\pi}{5}$

51. The difference between two angles is 15° and the sum of the angles in radian is $\dfrac{5\pi}{12}$. The bigger angle is k times the smaller angle. What is k equal to?

(a) $\dfrac{4}{3}$ (b) $\dfrac{3}{2}$ (c) $\dfrac{6}{5}$ (d) $\dfrac{7}{6}$

⊙ **(b)** Let the angle be x and kx.

∴ $kx - x = 15°$ …(i)

and $kx + x = \dfrac{5\pi}{12}$

⇒ $x(k + 1) = 75°$ …(ii)

From Eqs. (i) and (ii),

$\dfrac{k-1}{k+1} = \dfrac{15}{75}$

⇒ $5k - 5 = k + 1$

⇒ $4k = 6 \Rightarrow k = 3/2$

52. Consider the following statements :

1. The equation $2\sin^2\theta - \cos\theta + 4 = 0$ is possible for all θ.

2. $\tan\theta + \cot\theta$ cannot be less than 2, where $0 < \theta < \dfrac{\pi}{2}$.

Which of the above statements is/are correct?

(a) only 1
(b) only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ **(b)** We have,

1. $2\sin^2\theta - \cos\theta + 4 = 0$

Put $\theta = 90°$

$2 \times 1 - 0 + 4 = 6 \neq 0$

∵ 1st is incorrect.

2. $\tan\theta + \cot\theta$

$\tan\theta + \dfrac{1}{\tan\theta} \geq 2$

∴ 2nd is correct.

53. A road curve is to be laid out on a circle. What radius should be used if the track is to change direction by 42° in distance of 44 m?

(Assume $\pi = \dfrac{22}{7}$)

(a) 60 m   (b) 66 m
(c) 75 m   (d) 80 m

⊙ **(a)** Given, θ = 42°

Length of an arc = 44

We know, $l = \dfrac{\theta}{360} \times 2\pi r$

∴ $r = \dfrac{360° \times l}{\theta \times 2\pi}$

$= \dfrac{360 \times 44 \times 7}{42 \times 2 \times 22}$ $\left[\pi = \dfrac{22}{7}\right]$

$r = 60$ m

54. What is the maximum value of $3\sin\theta - 4$?

(a) -4 (b) -1 (c) 0   (d) 1

⊙ **(b)** We know that,

$-1 \leq \sin\theta \leq 1$

$-3 \leq 3\sin\theta \leq 3$

$-3 - 4 \leq 3\sin\theta - 4 \leq 3 - 4$

$-7 \leq 3\sin\theta - 4 \leq -1$

∴ Maximum value of $3\sin\theta - 4 = -1$

55. If $\sin\theta + \cos\theta = \sqrt{2}$, then what is $\sin^6\theta + \cos^6\theta + 6\sin^2\theta\cos^2\theta$ equal to?

(a) $\dfrac{1}{4}$ (b) $\dfrac{3}{4}$

(c) 1   (d) $\dfrac{7}{4}$

⊙ **(d)** Given,

$\sin\theta + \cos\theta = \sqrt{2}$

It is possible only $\theta = 45°$

∴$\sin^6\theta + \cos^6\theta + 6\sin^2\theta\cos^2\theta$

$= \sin^6 45° + \cos^6 45° + 6\sin^2 45°\cos^2 45°$

$= \left(\dfrac{1}{\sqrt{2}}\right)^6 + \left(\dfrac{1}{\sqrt{2}}\right)^6 + 6\left(\dfrac{1}{\sqrt{2}}\right)^2\left(\dfrac{1}{\sqrt{2}}\right)^2$

$= \dfrac{1}{8} + \dfrac{1}{8} + 6 \times \dfrac{1}{2} \times \dfrac{1}{2}$

$= \dfrac{1 + 1 + 12}{8} = \dfrac{14}{8} = 7/4$

56. What is the least value of $9\sin^2\theta + 16\cos^2\theta$?

(a) 0   (b) 9
(c) 16   (d) 25

⊙ **(b)** We have,

$9\sin^2\theta + 16\cos^2\theta$

$= 9\sin^2\theta + 9\cos^2\theta + 7\cos^2\theta$

$= 9(\sin^2\theta + \cos^2\theta) + 7\cos^2\theta$

$= 9 + 7\cos^2\theta$

∴$0 \leq \cos^2\theta \leq 1$

∴ Minimum value of $9 + 7\cos^2\theta = 9$

57. If $\cos 47° + \sin 47° = k$, then what is the value of $\cos^2 47° - \sin^2 47°$?

(a) $k\sqrt{2 - k^2}$ (b) $-k\sqrt{2 - k^2}$
(c) $k\sqrt{1 - k^2}$ (d) $-k\sqrt{1 - k^2}$

⊙ **(a)** Given,

$\cos 47° + \sin 47° = k$

$\Rightarrow \cos^2 47° + \sin^2 47°$
$\qquad\qquad + 2\sin 47°\cos 47° = k^2$

$\Rightarrow \sin 2(47°) = k^2 - 1$

$\Rightarrow \sin^2(2\theta) = (k^2 - 1)^2$ [let $47° = \theta$]

$\Rightarrow 1 - \cos^2 2\theta = (k^2 - 1)^2$

$\Rightarrow \qquad \cos^2 2\theta = 1 - (k^2 - 1)^2$

$\Rightarrow \qquad \cos 2\theta = \sqrt{1 - (k^4 - 2k^2 + 1)}$

$\Rightarrow \qquad \cos 2\theta = \sqrt{2k^2 - k^4}$

$\qquad\qquad = k\sqrt{2 - k^2}$

$\cos^2\theta - \sin^2\theta = k\sqrt{2 - k^2}$

∴$\cos^2 47° - \sin^2 47° = k\sqrt{2 - k^2}$

58. If $\operatorname{cosec}\theta - \sin\theta = p^3$ and $\sec\theta - \cos\theta = q^3$, then what is the value of $\tan\theta$?

(a) $\dfrac{p}{q}$ (b) $\dfrac{q}{p}$ (c) pq (d) p^2q^2

⊘ **(b)** We have,

$\operatorname{cosec}\theta - \sin\theta = p^3$ and

$\sec\theta - \cos\theta = q^3$

$\dfrac{1-\sin^2\theta}{\sin\theta} = p^3$ and $\dfrac{1-\cos^2\theta}{\cos\theta} = q^3$

$\dfrac{\cos^2\theta}{\sin\theta} = p^3$ and $\dfrac{\sin^2\theta}{\cos\theta} = q^3$

$\therefore \dfrac{\cos^2\theta}{\sin\theta} \times \dfrac{\cos\theta}{\sin^2\theta} = \dfrac{p^3}{q^3}$

$\Rightarrow (\cot\theta)^3 = \dfrac{p^3}{q^3} \Rightarrow \cot\theta = \dfrac{p}{q}$

$\therefore \quad \tan\theta = \dfrac{q}{p}$

59. If $0 \le \alpha, \beta \le 90°$ such that $\cos(\alpha - \beta) = 1$, then what is $\sin\alpha - \sin\beta + \cos\alpha - \cos\beta$ equal to?

(a) -1 (b) 0   (c) 1   (d) 2

⊘ **(b)** Given,

$\cos(\alpha - \beta) = 1$, where $0 \le \alpha, \beta \le 90°$

$\therefore \alpha - \beta = 0, \alpha = \beta$

$\therefore \sin\alpha - \sin\beta + \cos\alpha - \cos\beta$

$= \sin\alpha - \sin\alpha + \cos\alpha - \cos\alpha = 0$

60. Consider the following statements.

1. The value of $\cos 61° + \sin 29°$ cannot exceed 1.

2. The value of $\tan 23° - \cot 67°$ is less than 0.

Which of the above statements is/are correct?

(a) only 1   (b) only 2

(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ **(a)** We have,

1. $\cos 61° + \sin 29°$

$= \cos(90° - 29°) + \sin 29°$

$= \sin 29° + \sin 29° = 2\sin 29°$

$\because \sin 29° < \sin 30°$

$\Rightarrow 2\sin 29° < 2\sin 30°$

$\Rightarrow 2\sin 29° < 2 \times \dfrac{1}{2} < 1$

1st is correct.

2. $\tan 23° - \cot 67°$

$= \tan 23° - \cot(90° - 23°)$

$= \tan 23° - \tan 23° = 0$

$\therefore$ 2nd is incorrect.

61. In a quadrilateral $ABCD$, $\angle B = 90°$ and $AB^2 + BC^2 + CD^2 - AD^2 = 0$, then what is $\angle ACD$ equal to?

(a) 30°   (b) 60°

(c) 90°   (d) 120°

⊘ **(c)** Given, in quadrilateral $ABCD$

$\angle B = 90°$

and $AB^2 + BC^2 + CD^2 - AD^2 = 0$

In $\triangle ABC$, $\angle B = 90°$
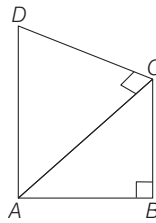
$\therefore AB^2 + BC^2 = AC^2$

$\therefore AB^2 + BC^2 + CD^2 - AD^2 = 0$

$\Rightarrow AC^2 + CD^2 = AD^2$

$\therefore \angle C = 90°$

[By converse of Pythagoras theorem]

$\therefore \angle ACD = 90°$

62. In a $\triangle ABC$, $AC = 12$ cm, $AB = 16$ cm and AD is the bisector of $\angle A$. If $BD = 4$ cm, then what is DC equal to?

(a) 2 cm   (b) 3 cm

(c) 4 cm   (d) 5 cm

⊘ **(b)** Given, in $\triangle ABC$

$AC = 12$ cm, $AB = 16$ cm

$BD = 4$, AD is the bisector of $\angle A$.

By angle bisector,
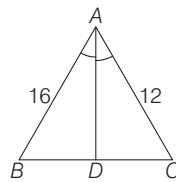
$\dfrac{AB}{AC} = \dfrac{BD}{CD}$

$\Rightarrow \quad \dfrac{16}{12} = \dfrac{4}{CD}$

$\therefore \quad CD = 3$

63. $ABCD$ is a cyclic quadrilateral. The bisectors of the angles A, B, C and D cut the circle at P, Q, R and S respectively. What is $\angle PQR + \angle RSP$ equal to?

(a) 90°   (b) 135°

(c) 180°   (d) 270°

⊘ **(c)** Here, $ABCD$ is cyclic quadrilateral, the bisector of the angles A, B, C and D cut the circle at P, Q, R and S respectively.
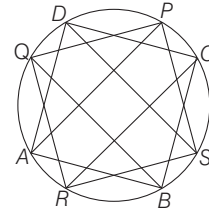
$\therefore PQRS$ is also cyclic quadrilateral

$\therefore \angle PQR + \angle RSP = 180°$

64. ABC is an equilateral triangle. The side BC is trisected at D such that $BC = 3\,BD$. What is the ratio of AD^2 to AB^2?

(a) 7 : 9   (b) 1 : 3

(c) 5 : 7   (d) 1 : 2

⊘ **(a)** Here, ABC is an equilateral triangle.

$\therefore AB = BC = AC$

and $BC = 3BD$

Draw an altitude AE on BC

$\therefore BE = EC$
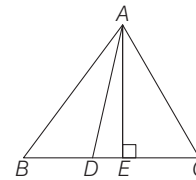
In $\triangle ABE$,

$AE^2 + BE^2 = AB^2$

$AE^2 = AB^2 - BE^2$ ...(i)

In $\triangle ADE$,

$AE^2 = AD^2 - DE^2$ ...(ii)

From Eqs. (i) and (ii),

$AB^2 - BE^2 = AD^2 - DE^2$

$AB^2 - AD^2 = BE^2 - DE^2$

$= (BE + DE)(BE - DE)$

$\Rightarrow AB^2 - AD^2 = CD \cdot BD$

[$\because BE = CE$]

$\therefore \quad BE + DE = CD$

$\Rightarrow \quad AB^2 - AD^2 = \dfrac{2BC}{3} \times \dfrac{BC}{3}$

$\Rightarrow \quad AB^2 - AD^2 = \dfrac{2BC^2}{9}$

$\Rightarrow 9AB^2 - 9AD^2 = 2AB^2$

$\Rightarrow \quad 7AB^2 = 9AD^2$

$\Rightarrow \quad \dfrac{AD^2}{AB^2} = \dfrac{7}{9}$

$\therefore \quad AD^2 : AB^2 = 7 : 9$

65. Consider the following statements :

1. The diagonals of a trapezium divide each other proportionally.
2. Any line drawn parallel to the parallel sides of a trapezium divides the non-parallel sides proportionally.

Which of the above statements is/are correct?

(a) only 1   (b) only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ **(c)** 1. Diagonals of a trapezium divide each other proportionally are true
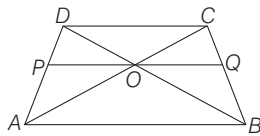
In trapezium ABCD

AB is parallel to CD

∴ In △AOB and △COD

∠COD = ∠AOB

[Vertically opposite angles]

∠OCD = ∠OAB

[Alternate interior opposite angles]

∴ △AOB ∼ △COD

$\frac{AO}{CO} = \frac{OB}{OD}$

∴Diagonals of trapezium divide each other proportionally.

2. In △DAB

PO is parallel to AB.

∴ $\frac{DP}{PA} = \frac{DO}{OB}$ ... (i) [By B.P.T]

In △BCD,

OQ is parallel to DC.

∴ $\frac{DO}{OB} = \frac{CQ}{QB}$ ...(ii)

[By B.P.T]

From Eqs. (i) and (ii),

$\frac{DP}{PA} = \frac{CQ}{QB}$

∴ Any line drawn parallel to the parallel sides of a trapezium divides non-parallel sides proportionally.

66. If H, C and V are respectively the height, curved surface area and volume of a cone, then what is $3\pi VH^3 + 9V^2$ equal to?

(a) C^2H^2 (b) $2\,C^2H^2$
(c) $5\,C^2H^2$ (d) $7C^2H^2$

⊙ **(a)** Here, H, C and V are respectively the height, curved surface area and volume of a cone.

∴$3\pi VH^3 + 9V^2$

$= 3\pi\left(\frac{1}{3}\pi r^2 H\right)H^3 + 9\left(\frac{1}{3}\pi r^2 H\right)^2$

$\left[\because V = \frac{1}{3}\pi r^2 H\right]$

$= \pi^2 r^2 H^4 + \pi^2 r^4 H^2$

$= \pi^2 r^2 H^2[r^2 + H^2] = H^2\pi^2 r^2 l^2$

$= H^2(\pi r l)^2 = H^2C^2$ [∵ $C = \pi r l$]

$= C^2H^2$

67. How many solid lead balls each of diameter 2 mm can be made from a solid lead ball of radius 8 cm?

(a) 512   (b) 1024
(c) 256000   (d) 512000

⊙ **(d)** Here, $R = 8$ cm, $r = 0.1$ cm

Volume of sphere whose radius is 8 cm, $V_1 = \frac{4}{3}\pi(8)^3$

Volume of sphere whose radius is (0.1) cm, $V_2 = \frac{4}{3}\pi(0.1)^3$

∵ $V_1 = nV_2$

$\Rightarrow \frac{4}{3}\pi(8)^3 = n \times \frac{4}{3}\pi(0.1)^3$

$\Rightarrow$ $n = 512 \times 1000$

∴ $n = 512000$

68. The two sides of a triangle are 40 cm and 41 cm. If the perimeter of the triangle is 90 cm, what is its area?

(a) $90\,cm^2$ (b) $135\,cm^2$
(c) $150\,cm^2$ (d) $180\,cm^2$

⊙ **(d)** Here, sides of triangle are 40 cm, 41 cm and perimetre of triangle is 90 cm.

∴ Third sides of triangle
$= 90 - (40 + 41) = 9$

∴$40^2 + 9^2 = 1600 + 81 = 1681 = 41^2$
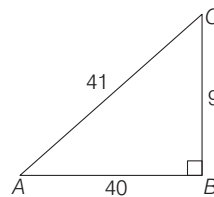
∴△ABC is a right angle.

Area of △ABC $= \frac{1}{2} \times AB \times BC$

$= \frac{1}{2} \times 40 \times 9 = 180$ cm^2

69. The diagonals of a rhombus differ by 2 units and its perimeter exceeds the sum of the diagonals by 6 units. What is the area of the rhombus?

(a) 48 sq units   (b) 36 sq units
(c) 24 sq units   (d) 12 sq units

⊙ **(c)** Let the diagonal of rhombus.

$AC = 2x$ and $BD = 2y$
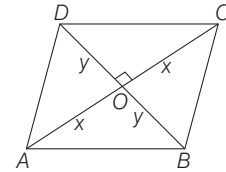
∴$OA = OC = x$, $OB = OD = y$

∴$AC - BD = 2$

$\Rightarrow$ $x - y = 1$ ...(i)

$DC^2 = OC^2 + OD^2 = x^2 + y^2$

Given perimetre of rhombus exceeds the sum of diagonal by 6 units.

∴$4\,DC = AC + BD + 6$

$\Rightarrow 4\sqrt{x^2 + y^2} = 2x + 2y + 6$

$\Rightarrow 2\sqrt{x^2 + y^2} = x + y + 3 \Rightarrow 4(x^2 + y^2)$

$= x^2 + y^2 + 9 + 6x + 6y + 2xy$

$\Rightarrow 3(x^2 + y^2) = 6(x + y) + 9 + 2xy$

$\Rightarrow 3[(x - y)^2 + 2xy] - 2xy = 6(x + y) + 9$

$\Rightarrow 3 + 4xy = 6(x + y) + 9$ [∵ $x - y = 1$]

$\Rightarrow 2xy = 3x + 3y + 3$ ... (ii)

From Eqs. (i) and (ii), we get $x = 4$, $y = 3$

Area of rhombus $= \frac{1}{2}(2x)(2y) = 2xy$

$= 2 \times 4 \times 3 = 24$ sq units

70. What is the area of a right-angled triangle, if the radius of the circumcircle is 5 cm and altitude drawn to the hypotenuse is 4 cm?

(a) $20\,cm^2$ (b) $18\,cm^2$ (c) $16\,cm^2$ (d) $10\,cm^2$

⊙ **(a)** ABC is a right angle triangle.

BC is hypotenuse.
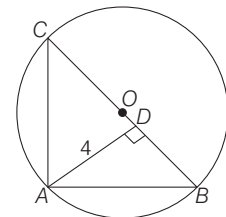
Given, $OB = OC = r = 5$ cm

∴ $BC = 2r = 10$ cm

Altitude $AD = 4$ cm

∴Area of △ABC $= \frac{1}{2} \times AD \times BC$

$= \frac{1}{2} \times 4 \times 10 = 20$ cm^2

71. In a triangle, values of all the angles are integers (in degree measure). Which one of the following cannot be the proportion of their measures?

(a) 1 : 2 : 3   (b) 3 : 4 : 5
(c) 5 : 6 : 7   (d) 6 : 7 : 8

⊘ **(d)** In triangle, angle of triangle are integers.

∴ Sum of angle of triangle is $180°$.

(a) $x + 2x + 3x = 180°$
$$6x = 180°$$
$\Rightarrow x = 30°$ is integer

(b) $3x + 4x + 5x = 180°$
$$12x = 180°$$
$\Rightarrow x = 15°$ is integer

(c) $5x + 6x + 7x = 180°$
$$18x = 180°$$
$\Rightarrow \qquad x = 10°$ is integer

(d) $6x + 7x + 8x = 180°$
$$21x = 180°$$
$$x = \frac{180°}{21} \text{ is not integer}$$

∴ Only option (d) is not integer.

72. The length of a rectangle is increased by 10% and breadth is decreased by 10%. Then, the area of the new rectangle is

(a) neither increased nor decreased
(b) increased by 1%
(c) decreased by 1%
(d) decreased by 10%

⊘ **(c)** Let the length of rectangle $= x$ m

and breadth of rectangle $= y$ m

∴ Area of rectangle $= xy$

When length is increased by 10%

∴ New length $= \dfrac{110x}{100}$

When breadth is decreased by 10%

∴ New breadth $= \dfrac{90y}{100}$

Area of new rectangle
$$= \frac{9900}{10000} xy = \frac{99}{100} xy$$

Difference $= xy - \dfrac{99xy}{100} = \dfrac{1}{100} xy$

Percentage decrease in area of new rectangle $= \dfrac{xy / 100}{xy} \times 100\%$

$$= 1\%$$

∴ Area of new rectangle is decreased by 1%.

73. The surface areas of two spheres are in the ratio 1 : 4. What is the ratio of their volumes?

(a) 1 : 16   (b) 1 : 12
(c) 1 : 10   (d) 1 : 8

⊘ **(d)** Let the surface areas of two spheres is s_1 and s_2 and their radii is r_1 and r_2 respectively.

∴ $s_1 = 4\pi r_1^2$, $s_2 = 4\pi r_2^2$

$$\frac{s_1}{s_2} = \frac{r_1^2}{r_2^2}$$

$\Rightarrow \quad \dfrac{1}{4} = \left(\dfrac{r_1}{r_2}\right)^2 \qquad [\because s_1 : s_2 = 1 : 4]$

$\Rightarrow \quad \dfrac{r_1}{r_2} = \dfrac{1}{2} \therefore \dfrac{V_1}{V_2} = \dfrac{4/3\pi r_1^3}{4/3\pi r_2^3}$

$$= \left(\frac{r_1}{r_2}\right)^3 = \left(\frac{1}{2}\right)^3$$

$$= \frac{1}{8}$$

∴ $V_1 : V_2 = 1 : 8$

74. The length, breadth and height of a brick are 20 cm, 15 cm and 10 cm respectively. The number of bricks required to construct a wall with dimensions 45 m length, 0.15 m breadth and 3 m height is

(a) 12450   (b) 11250
(c) 6750   (d) None of these

⊘ **(c)** Given, $l = 20$ cm, $b = 15$ cm

$h = 10$ cm

Volume of one brick
$= 20 \times 15 \times 10 = 3000 \text{ cm}^3$

Dimension of walls is 45m, 0.15 m and 3 m,

∴ Volume of wall
$= (45 \times 0.15 \times 3) \text{ m}^3$
$= (20.25) \text{ m}^3 = 20.25 \times 10^6 \text{cm}^3$

Number of bricks
$$= \frac{\text{Volume of wall}}{\text{Volume of one brick}}$$
$$= \frac{20.25 \times 10^6}{3000}$$
$$= \frac{2025 \times 10^4}{3 \times 10^3} = 6750$$

75. If the sum of all interior angles of a regular polygon is twice the sum of all its exterior angles, then the polygon is

(a) Hexagon   (b) Octagon
(c) Nonagon   (d) Decagon

⊘ **(a)** Interior angle of regular polygon whose side n is $\left(\dfrac{n-2}{n}\right)\pi$.

Exterior angle of regular polygon whose side n is $\pi\left(1 - \dfrac{n-2}{n}\right) = \pi\left(\dfrac{2}{n}\right)$

∴ $\left(\dfrac{n-2}{n}\right)\pi = 2\left(\dfrac{2\pi}{n}\right)$

$\Rightarrow \qquad\qquad n - 2 = 4$
$\Rightarrow \qquad\qquad n = 6$

Hence, the polygon is hexagon.

76. A bicycle wheel makes 5000 revolutions in moving 11 km. What is the radius of the wheel? (Assume $\pi = \dfrac{22}{7}$)

(a) 17.5 cm   (b) 35 cm
(c) 70 cm   (d) 140 cm

⊘ **(b)** We have,

A bicycle wheel makes 5000 revolution in moving 11 km.

∴ In one revolutions distance covered by wheel of bicycle is $\dfrac{11}{5000}$ km

$$= \frac{11000}{5000} = \frac{11}{5} \text{m}$$

Radius of wheel of bicycle $= r$ cm

∴ $2\pi r = \dfrac{11}{5} \times 100$ cm

$$r = \frac{11 \times 20 \times 7}{2 \times 22}$$
$$= 35 \text{ cm}$$

77. The volumes of two cones are in the ratio 1 : 4 and their diameters are in the ratio 4 : 5. What is the ratio of their heights?

(a) 25 : 64   (b) 16 : 25
(c) 9 : 16   (d) 5 : 9

⊘ **(a)** Given, $\dfrac{V_1}{V_2} = \dfrac{1}{4}$ and $\dfrac{r_1}{r_2} = \dfrac{4}{5}$

∴ $\dfrac{\frac{1}{3}\pi r_1^2 h_1}{\frac{1}{3}\pi r_2^2 h_2} = \dfrac{1}{4}$

$\Rightarrow \left(\dfrac{r_1}{r_2}\right)^2 \times \dfrac{h_1}{h_2} = \dfrac{1}{4}$

$\Rightarrow \left(\dfrac{4}{5}\right)^2 \times \dfrac{h_1}{h_2} = \dfrac{1}{4}$

$\Rightarrow \qquad \dfrac{h_1}{h_2} = \left(\dfrac{5}{4}\right)^2 \times \dfrac{1}{4} = \dfrac{25}{64}$

∴ $h_1 : h_2 = 25 : 64$

78. In a triangle ABC, if $2 \angle A = 3 \angle B = 6 \angle C$, then what is $\angle A + \angle C$ equal to?

(a) 90°   (b) 120°
(c) 135°   (d) 150°

⟩ **(b)** Given, in triangle ABC

$$2 \angle A = 3 \angle B = 6 \angle C$$

∵ $\angle A + \angle B + \angle C = 180°$

$$\Rightarrow \frac{3}{2} \angle B + \angle B + \frac{1}{2} \angle B = 180°$$

$$\Rightarrow 3\angle B = 180° \Rightarrow \angle B = 60°$$

∴ $\angle A + \angle C = 180° - \angle B$

$$= 180° - 60° = 120°.$$

79. If the perimeter of a circle and a square are equal, then what is the ratio of the area of the circle to that of the square?

(a) $1 : \pi$ (b) $2 : \pi$ (c) $3 : \pi$ (d) $4 : \pi$

⟩ **(d)** Given,

Perimetre of a circle and square are equal.

∴ $2\pi r = 4x \Rightarrow \pi r = 2x$

Area of circle $= \pi r^2$

Area of square $= x^2 = \left(\frac{\pi r}{2}\right)^2 = \frac{\pi^2 r^2}{4}$

Ratio of area of circle to square

$$= \frac{\pi r^2}{\dfrac{\pi^2 r^2}{4}} = \frac{4}{\pi} = 4 : \pi$$

80. The lengths of the sides of a right-angled triangle are consecutive even integers (in cm). What is the product of these integers?

(a) 60   (b) 120   (c) 360   (d) 480

⟩ **(d)** Let the sides of a right angle triangle is $x - 2, x, x + 2$.

∴ $(x + 2)^2 = x^2 + (x - 2)^2$

$$x^2 + 4x + 4 = x^2 + x^2 - 4x + 4$$

$$x = 8$$

∴ Sides of triangle are 6, 8, 10.

Product of sides of triangle
$$= 6 \times 8 \times 10 = 480.$$

81. A circle is inscribed in a triangle ABC. It touches the sides AB and AC at M and N respectively. If O is the centre of the circle and $\angle A = 70°$, then what is $\angle MON$ equal to?

(a) 90°   (b) 100°   (c) 110°   (d) 120°

⟩ **(c)** Given,

A circle inscribed in a triangle ABC.
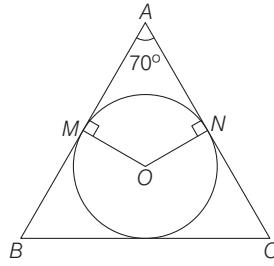
Circle touches sides AB and AC at M and N respectively.

∴ MA and NA is tangent of circle

∴ $\angle OMA = \angle ONA = 90°$

∴ $\angle A + \angle MON = 180°$

$70° + \angle MON = 180°$

$\angle MON = 110°$

82. The sum of the squares of sides of a right-angled triangle is 8450 square units. What is the length of its hypotenuse?

(a) 50 units   (b) 55 units
(c) 60 units   (d) 65 units

⟩ **(d)** In right angle triangle ABC, $\angle C = 90°$

Given, $AB^2 + BC^2 + AC^2 = 8450$
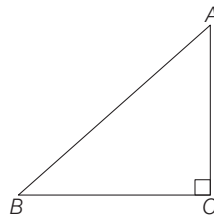
$AB^2 + AB^2 = 8450 \Rightarrow 2AB^2 = 8450$

∴ $AB = \sqrt{4225} = 65$ units

83. A triangle and a parallelogram have equal areas and equal bases. If the altitude of the triangle is k times the altitude of the parallelogram, then what is the value of k?

(a) 4   (b) 2   (c) 1   (d) $\frac{1}{2}$

⟩ **(b)** Let base of triangle and parallelogram be b and altitude of triangle and parallelogram be h_1 and h_2 respectively.

Given, area of triangle = Area of parallelogram and $h_1 = kh_2$

$$\Rightarrow \quad \frac{h_1}{h_2} = k$$

∴ $\frac{1}{2} bh_1 = bh_2$

$$\frac{h_1}{h_2} = 2$$

84. Areas of two squares are in the ratio $m^2 : n^4$. What is the ratio of their perimeters?

(a) $m : n$ (b) $n : m$
(c) $m : n^2$ (d) $m^2 : n$

⟩ **(c)** Given, ratio of area of two squares is $m^2 : n^4$.

$$\frac{A_1}{A_2} = \frac{m^2}{n^4} \Rightarrow \frac{x_1^2}{x_2^2} = \frac{m^2}{n^4} \Rightarrow \frac{x_1}{x_2} = \frac{m}{n^2}$$

Ratio of perimeter of square
$= 4x_1 : 4x_2 = x_1 : x_2 = m : n^2$

85. AD is the median of the triangle ABC. If P is any point on AD, then which one of the following is correct?

(a) Area of triangle PAB is greater than the area of triangle PAC.
(b) Area of triangle PAB is equal to area of triangle PAC.
(c) Area of triangle PAB is one-fourth of the area of triangle PAC.
(d) Area of triangle PAB is half of the area of triangle PAC.

⟩ **(b)** We have,
AD is median of the $\triangle ABC$.
P is any point on AD.
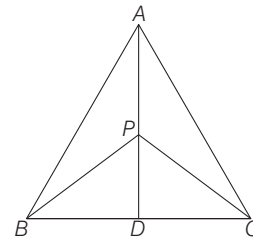
Area of $\triangle ABD$ = Area of $\triangle ADC$

In $\triangle PBC$, PD is also median of $\triangle PBC$

∴ Area of $\triangle PBD$ = Area of $\triangle PCD$

Area of $\triangle PAB$ = Area of $\triangle ABD$ − Area of $\triangle PBD$

Area of $\triangle PAC$ = Area of $\triangle ABD$ − Area of $\triangle PDC$

∴ Area of $\triangle PAB$ is equal to Area of $\triangle PAC$.

86. What is the area of a segment of a circle of radius r subtending an angle θ at the centre?

(a) $\frac{1}{2} r^2 \theta$

(b) $\frac{1}{2} r^2 \left(\theta - 2\sin\frac{\theta}{2}\cos\frac{\theta}{2}\right)$

(c) $\frac{1}{2} r^2 \left(\theta - \sin\frac{\theta}{2}\cos\frac{\theta}{2}\right)$

(d) $\frac{1}{2} r^2 \sin\frac{\theta}{2}\cos\frac{\theta}{2}$

> **(b)** Area of segment of a circle of radius r subtending an angle θ at the centre
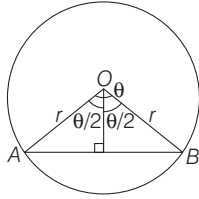
= Area of sector – Area of ΔOAB

$= \dfrac{1}{2}r^2\theta - \dfrac{1}{2}r^2\sin\theta$

$= \dfrac{1}{2}r^2(\theta - \sin\theta)$

$= \dfrac{1}{2}r^2\left(\theta - 2\sin\dfrac{\theta}{2}\cos\dfrac{\theta}{2}\right)$

$\left[\because \sin\theta = 2\sin\dfrac{\theta}{2}\cos\dfrac{\theta}{2}\right]$

87. ABC is a triangle right-angled at C. Let P be any point on AC and Q be any point on BC. Which of the following statements is/are correct?

1. $AQ^2 + BP^2 = AB^2 + PQ^2$

2. $AB = 2PQ$

Select the correct answer using the code given below :

(a) only 1
(b) only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

> **(a)** Given, ABC is a right angled at C and P and Q any point on AC and BC respectively.

In ΔAQC
$$AQ^2 = QC^2 + AC^2 \quad \dots(i)$$
In ΔBPC,
$$BP^2 = BC^2 + PC^2 \quad \dots(ii)$$
Adding Eqs. (i) and (ii),
$$AQ^2 + BP^2 = QC^2 + AC^2 + BC^2 + PC^2$$
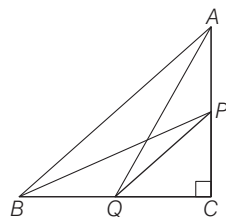
$AQ^2 + BP^2 = AC^2 + BC^2 + QC^2$
$\qquad\qquad + PC^2 = AB^2 + PQ^2$

$\therefore$ Ist statement is correct.

If P and Q are mid-point of AC and BC respectively, then $AB = 2PQ$

$\therefore$ 2nd statement is incorrect.

88. Four circular coins of equal radius are placed with their centres coinciding with four vertices of a square. Each coin touches two other coins. If the uncovered area of the square is 42 cm^2, then what is the radius of each coin? (Assume $\pi = \dfrac{22}{7}$)

(a) 5 cm
(b) 7 cm
(c) 10 cm
(d) 14 cm

> **(b)** Let radius of coins = r

$\therefore$ Sides of square = $2r$
Area of shaded region
= Area of square
$\quad$ – Area of four quadrants
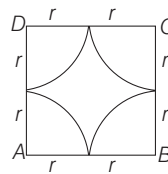
$= (2r)^2 - \pi r^2$

$= 4r^2 - \pi r^2$

$= r^2\left(4 - \dfrac{22}{7}\right) = \dfrac{6r^2}{7}$

$\Rightarrow \dfrac{6r^2}{7} = 42$

$\Rightarrow \quad r^2 = 49$

$\Rightarrow \quad r = 7$ cm

89. The radii of the flat circular faces of a bucket are x and $2x$. If the height of the bucket is $3x$, what is the capacity of the bucket?

(Assume $\pi = \dfrac{22}{7}$)

(a) $11x^3$
(b) $22x^3$
(c) $44x^3$
(d) $55x^3$

> **(b)** Given,

Radius of flat circular faces of a bucket are x and $2x$ and height of bucket is $3x$.

Volume of bucket

$= \dfrac{1}{3}\pi h(R^2 + r^2 + Rr)$

$\therefore$ Capacity of bucket

$= \dfrac{1}{3}\pi(3x)\{(2x)^2 + (x)^2 + (2x)(x)\}$

$= \pi x(4x^2 + x^2 + 2x^2)$

$= 7\pi x^3$

$= 7 \times \dfrac{22}{7}x^3 = 22x^3$

90. If p, q, r, s and t represent length, breadth, height, surface area and volume of a cuboid respectively, then what is $\dfrac{1}{p} + \dfrac{1}{q} + \dfrac{1}{r}$ equal to?

(a) $\dfrac{s}{t}$
(b) $\dfrac{2t}{s}$
(c) $\dfrac{s}{2t}$
(d) $\dfrac{2s}{t}$

> **(c)** We have, p, q, r, s and t represent the length, breadth, height, surface area and volume of cuboid

$\therefore s = 2(pq + qr + rp), \ t = pqr$

$\dfrac{s}{t} = 2\left(\dfrac{pq + qr + rp}{pqr}\right)$

$= 2\left(\dfrac{1}{p} + \dfrac{1}{q} + \dfrac{1}{r}\right)$

$\Rightarrow \dfrac{1}{p} + \dfrac{1}{q} + \dfrac{1}{r} = \dfrac{s}{2t}$

91. Fifteen candidates appeared in an examination. The marks of the candidates who passed in the examination are 9, 6, 7, 8, 8, 9, 6, 5, 4 and 7. What is the median of marks of all the fifteen candidates?

(a) 6
(b) 6.5
(c) 7
(d) 7.5

> **(a)** The marks of the candidates who passed in examination are 9, 6, 7, 8, 8, 9, 6, 5, 4, 7

Rearranging marks in ascending order of all the fifteen candidates

–, –, –, –, –, 4, 5, 6, 6, 7, 7, 8, 8, 9, 9

Median of marks of all the fifteen candidates

$= \dfrac{(15 + 1)\text{th observation}}{2}$

= 8 th observation

= 6

92. If the yield (in gm) of barley from 7 plots of size one square yard each, were found to be 180, 191, 175, 111, 154, 141 and 176, then what is the median of yield?

(a) 111 gm
(b) 154 gm
(c) 175 gm
(d) 176 gm

> **(c)** Given data

180, 191, 175, 111, 154, 141, 176

Rearranging in ascending order

111, 141, 154, 175, 176, 180, 191

Median $= \left(\dfrac{7 + 1}{2}\right)$ th observations

= 4 th observations

= 175

93. Which one of the following measures of central tendency will be used to determine the average size of the shoe sold in the shop?

(a) Arithmetic mean
(b) Geometric mean
(c) Median
(d) Mode

⊙ **(a)** Average size of the shoe sold in shop by Arithmetic mean.

94. When the class intervals have equal width, the height of a rectangle in a histogram represents

(a) Width of the class
(b) Lower class limit
(c) Upper class limit
(d) Frequency of the class

⊙ **(d)** The height of a rectangle in a histogram represents frequency of the class.

95. The ages of 7 family members are 2, 5, 12, 18, 38, 40 and 60 yr respectively. After 5 yr a new member aged x year is added. If the mean age of the family now goes up by 1.5 yr, then what is the value of x?

(a) 1   (b) 2
(c) 3   (d) 4

⊙ **(b)** We have,

Ages of 7 family members are

2, 5, 12, 18, 38, 40, 60

Mean
$= \dfrac{2 + 5 + 12 + 18 + 38 + 40 + 60}{7}$

$= \dfrac{175}{7}$

$= 25$

Ages of 7 family members after 5 yr

7, 10, 17, 23, 43, 45, 65

After 5 yr new member ages x years is add

$\therefore$ Mean
$= \dfrac{\begin{matrix}7 + 10 + 17 + 23 \\ + 43 + 45 + 65 + x\end{matrix}}{8}$

$= \dfrac{210 + x}{8}$

New mean $= 25 + 1.5 = 26.5$

$\therefore 26.5 = \dfrac{210 + x}{8}$

$\Rightarrow 212 = 210 + x \Rightarrow x = 2$

96. The mean weight of 100 students in a class is 46 kg. The mean weight of boys is 50 kg and that of girls is 40 kg. The number of boys exceeds the number of girls by

(a) 10   (b) 15   (c) 20   (d) 25

⊙ **(c)** We have, 100 student in a class.

Let number of boys $= x$

and number of girls $= y$

$\therefore \qquad x + y = 100 \qquad \qquad \dots(i)$

Mean of weight of boys $= 50$ kg

$\therefore$ Total weight of boys $= 50\,x$ kg

Mean of weight of girls $= 40$ kg

$\therefore$ Total weight of girls $= 40y$ kg

Mean of weight of 100 students

$\qquad\qquad\qquad = 46$ kg

$\therefore$ Total weight of 100 students $= 4600$ kg

$\therefore \qquad 50x + 40y = 4600 \qquad \dots(ii)$

From Eqs. (i) and (ii),

$\qquad x = 60,\, y = 40$

$\therefore \qquad x - y = 60 - 40$

$\qquad\qquad\qquad = 20$

97. What is the algebraic sum of the deviations from the mean of a set of values 25, 65, 73, 75, 83, 76, 17, 15, 7, 14?

(a) – 1   (b) 0
(c) 1   (d) 2

⊙ **(b)** We know that, algebraic sum of the deviation from the mean of any data is zero.

98. The mean of five observations x, $x + 2$, $x + 4$, $x + 6$, $x + 8$ is m. What is the mean of the first three observations?

(a) m (b) $m - 1$ (c) $m - 2$ (d) $m - 3$

⊙ **(c)** Given data x, $x + 2$, $x + 4$, $x + 6$, $x + 8$

Mean $= m$

$\therefore m = \dfrac{\begin{matrix}x + x + 2 + x + 4 \\ + x + 6 + x + 8\end{matrix}}{5}$

$5m = 5x + 20$

$x = m - 4$

$\therefore$ Mean of x, $x + 2$, $x + 4$

$= \dfrac{x + x + 2 + x + 4}{3}$

$= \dfrac{3x + 6}{3} = x + 2 = m - 4 + 2 = m - 2$

99. What is the median of 2, 4, 6, ... , 100?

(a) 48   (b) 49   (c) 50   (d) 51

⊙ **(d)** Given, data

2, 4, 6, ... , 100

Here, $n = 50$

$\therefore$ Median $= \dfrac{(25\text{th} + 26\text{th})\text{ Observation}}{2}$

$\therefore 25$ th observation $= 25 \times 2 = 50$

26 th observation $= 26 \times 2 = 52$

$\therefore$ Median $= \dfrac{50 + 52}{2} = \dfrac{102}{2} = 51$

100. The harmonic mean and the geometric mean of two numbers are 10 and 12 respectively. What is their arithmetic mean?

(a) $\dfrac{25}{3}$ (b) $\sqrt{120}$

(c) 11   (d) 14.4

⊙ **(d)** Given, HM $= 10$,

$\qquad\qquad$ GM $= 12$

We know that,

$\text{AM.HM} = (\text{GM})^2 \Rightarrow \text{AM}\,(10) = (12)^2$

$\Rightarrow \qquad \text{AM} = \dfrac{144}{10} = 14.4$

PAPER II English

PASSAGE - I

Post colonial cultural analysis has been concerned with the elaboration of theoretical structures that contest the previous dominant western ways of seeing things. A simple analogy would be with feminism, which has involved a comparable kind of project: there was a time when any book you might read, any speech you might hear, any film that you saw, was always told from the point of view of male.

The woman was there, but she was, always an object, never a subject. From what you would read, or the films you would see, the woman was always the one who was looked at. She was never the observing eye. For centuries it was assumed that women were less intelligent than men and that they did not merit the same degree of education. They were not allowed a vote in the political system.

By the same token, any kind of knowledge developed by women was regarded as non-serious, trivial, gossip or alternatively as knowledge that had been discredited by science, such as superstition or traditional practices of childbirth or healing. All these attitudes were part of a larger system in which women were dominated, exploited, and physically abused by men. Slowly, but increasingly, from the end of 18th century, feminists began to contest this situation. The more they contested it, the more it became increasingly obvious that these attitudes extended into the whole of the culture; social relations, politics, law, medicine, the arts, popular and academic knowledge.

1. Post colonialism is
- (a) a contestation of the then existing dominant western practices
- (b) a contestation of western practices in colonial states
- (c) a contestation of the superstitious practices
- (d) an approval of indigenous practices

⊙ *(a)* Post colonialism as defined in the passage is 'that contest the previous dominant western ways of seeing things'. Accordingly, option (a) is the correct answer.

2. What does '.......... she was always an object, never a subject' mean ?
- (a) Women were given respect and worshipped
- (b) Women were not given any right equal to men
- (c) Women were treated at par with men
- (d) Women liked to be treated inferior to men

⊙ *(b)* The given phrase refers to the inequality that was meted out against women wherein she was never given any right as equal to men.
Hence, option (b) correctly elucidates this fact and thus is the correct answer.

3. Why was 'she never the observing eye'?
- (a) She was beautiful, so she was observed by men
- (b) She liked to be observed by men
- (c) Women were assumed to be less intelligent than men
- (d) Women were assumed to be more intelligent than men

⊙ *(b)* The word 'observing eye' in the phrase refers to the qualities of wit and intelligence. Then the statement that women were never the observing eye indicates that women were assumed to be less intelligent than men.

4. The contestation to dominance of the male resulted in
- (a) participation of women in social relations, politics, law, medicine, the arts, popular and academic knowledge
- (b) participation of men in social relations, politics, law, medicine, the arts, popular and academic knowledge
- (c) participation of women in social movements
- (d) contestations with males in life leading to divorce

⊙ *(a)* The given passage clearly states that to contradict or fight against the male dominance, women began coming out of their homes and started participating in social relations, politics, law, medicine, the arts, popular and academic knowledge.

5. Which word in the passage is opposite of 'contrast'?
- (a) Contestations
- (b) Trivial
- (c) Discredited
- (d) Analogy

⊙ *(d)* The word contrast means different. Its opposite is analogy which means similarity.

PASSAGE - II

How wonderful is the living world! The wide range of the living types is amazing. The extraordinary habitats in which we find living organisms, be it cold mountains, deciduous forests, oceans, fresh water lakes; deserts or hot springs, leave us speechless. The beauty of a galloping horse, or a migrating bird, the valley of flowers or the attacking shark evokes awe and a deep sense of wonder. The ecological conflict and cooperation among members of a population and among populations of a community or even a molecular traffic inside a cell make us deeply reflect on - what indeed is life? This question has two implicit questions within it. The first is a technical one and seeks answer to what living is as opposed to the non-living, and the second is the philosophical one, and seeks answer to what the purpose of life is. What is living? When we try to define 'living', we conventionally look for distinctive characteristics exhibited by living organisms. Growth, reproduction, ability to sense environment and mount a suitable response come to our mind immediately as unique features of living organisms. One can add a few more features like metabolism, ability to self-replicate, self-organise, interact and emergence to this list.

6. Why are the living types amazing?
- (a) The extraordinary diversity of habitats makes it amazing
- (b) The living organisms are acting as per their interests

    (c) The human thinking makes the living types amazing
    (d) The evolution of life makes it amazing

> *(a)* The given passage states "The wide range of the living types is amazing". This indicates that the diversity of organism and habitats makes the living types amazing.

7. Why does the author say, 'ecological conflict and cooperation'?

    (a) Because living organisms are structured this way
    (b) Because ecological mechanism works with conflict and cooperation
    (c) Because humans want to fight and live together
    (d) Because living organisms sometimes fight and sometimes live together

> *(d)* The author states this to highlight the tendency of all living organisms to fight in certain occasions and to live peacefully in others.

8. Which of the following statements is true of the passage?

    (a) Meaning of life could be reflected as to what living is as opposed to the non-living and what the purpose of life is
    (b) Meaning of life could be reflected as to how living organisms live and non-living organisms exist
    (c) Meaning of life could be reflected as to where the life begins and where it ends
    (d) Meaning of life could be reflected on how various living organisms differ

> *(a)* The given passage states that the meaning of life could be reflected as to what living is as opposed to the non-living and what the purpose of life is.

9. Distinctive characteristics exhibited by organisms indicate that

    (a) they are living organisms
    (b) they are non-living organisms
    (c) they can be either living organisms or non-living organisms
    (d) they know the purpose of life

> *(a)* According to the given passage, the distinctive characteristics indicate that an organism is a living being.

10. Which word in the passage means 'unique'?

    (a) common   (b) characteristics
    (c) distinctive   (d) general

> *(c)* The synonym of unique is distinctive.

Directions (Q.Nos. 11-20) *Each item in this section has a sentence with three underlined parts labelled as (a), (b) and (c). Read each sentence to find out whether there is any error in any underlined part and indicate your response on the Answer Sheet against the corresponding letter, i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d).*

11. He has been   one the most revered member
    (a)   (b)
of the committee of enquiry. No error.
         (c)   (d)

> *(b)* Preposition 'of' will be added after "one…the" to make the sentence grammatically correct.

12. Rahul asked me   whether I was interested
         (a)   (b)
to joining the group for the trip. No error.
          (c)   (d)

> *(c)* Preposition 'in' will replace 'to' to make the sentence grammatically correct.

13. 'Where there is a will then there is a way' is an old epithet.
         (a)   (b)   (c)
No error.
    (d)

> *(b)* Conjunction 'then' will be removed to make the sentence grammatically correct.

14. Indian feminism grew out of the women's movements
                 (a)
of the late nineteenth century,
            (b)
reached full maturity in the early twentieth century.
              (c)
No error.
    (d)

> *(c)* Article 'the' will be removed to make the sentence grammatically correct.

15. The greatest merit of democracy is that everyone feels free
           (a)   (b)
and can pursues his/her interest. No error.
          (c)   (d)

> *(c)* 'Pursues' will be replaced by 'pursue' to make the sentence grammatically correct.

16. All stake holders of education
           (a)
have the right to ask for accountability
            (b)
in every aspects of its implementation. No error.
          (c)   (d)

> *(c)* 'Aspects' will be replaced by 'aspect' to make the sentence grammatically correct.

17. Learning many languages
         (a)
promotes linguistic, cultural and social harmonies
            (b)
among people speaking different languages. No error.
          (c)   (d)

> *(b)* 'Harmonies' will be replaced by 'harmony' to make the sentence grammatically correct.

18. One should not act according to one's
         (a)   (b)
whims and fancies on public places. No error.
         (c)   (d)

> *(c)* Preposition 'on' will be replaced by 'in' to make the sentence grammatically correct.

19. Economists believe that India had taken a new turn in 1990
         (a)   (b)
with the liberalisation to her economy. No error.
         (c)   (d)

> *(c)* Preposition 'to' will be replaced by 'of' to make the sentence grammatically correct.

20. Irrigation works have a special importance
                    (a)
in an agricultural countries like India,
                    (b)
where rainfall is unequally distributed throughout the seasons.
                    (c)
No error.
     (d)

⊙ *(b)* Article 'an' will be removed to make the sentence grammatically correct.

Directions (Q. Nos. 21-30) *Each of the following items, in this section consists of a sentence, parts of which have been jumbled. These parts have been labelled as* P, Q, R *and* S. *Given below each sentence are four sequences namely (a), (b), (c) and (d). You are required to re-arrange the jumbled parts of the sentence and mark your response accordingly.*

21. history of life   evolutionary Biology is   forms on earth
           P   Q   R
     the study of
           S

The correct sequence should be
(a) S P Q R   (b) Q S P R   (c) R P Q S   (d) P S Q R

⊙ *(b)* The correct and meaningful sentence is given by QSPR.

22. life is considered   the origin of   the history of universe
              P   Q   R
     a unique event in
           S

The correct sequence should be
(a) Q P S R   (b) P S Q R   (c) S Q P R   (d) R S P Q

⊙ *(a)* The correct and meaningful sentence is given by QPSR.

23. productive resources is   how we manage
              P   Q
     and competitiveness   critical to strategic growth
              R   S

The correct sequence should be
(a) P Q R S   (b) R S P Q   (c) S R P Q   (d) Q P S R

⊙ *(d)* The correct and meaningful sentence is given by QPSR.

24. in service firms   operations strategy
            P   Q
     from the corporate strategy   is generally inseparable
              R   S

The correct sequence should be
(a) S R Q P   (b) Q P S R   (c) R S P Q   (d) P S Q R

⊙ *(b)* The correct and meaningful sentence is given by QPSR.

25. are travelling,   a recent survey has revealed
            P   Q
     that they are worried about their safety
                        R
     even as more and more Indians
                        S

The correct sequence should be
(a) S P Q R   (b) Q S R P   (c) P R S Q   (d) R P S Q

⊙ *(a)* The correct and meaningful sentence is given by SPQR.

26. the imagination of children   stories can exercise.
                 P   Q
     more than the stories   because they tell
              R   S

The correct sequence should be
(a) Q R S P   (b) S P Q R
(c) Q P S R   (d) R S Q P

⊙ *(c)* The correct and meaningful sentence is given by QPSR.

27. as a record of   and suffering of humans
            P   Q
     the achievements, experiments   history is considered
                 R   S

The correct sequence should be
(a) S P R Q   (b) R Q S P
(c) P Q R S   (d) Q R S P

⊙ *(a)* The correct and meaningful sentence is given by SPRQ.

28. can be invented   it appears   has been invented   that all that
            P   Q   R   S

The correct sequence should be
(a) Q S P R   (b) Q R S P
(c) R S Q P   (d) S P Q R

⊙ *(a)* The correct and meaningful sentence is given by QSPR.

29. during the last century   Indian social, political and cultural life
                 P   Q
     as a testimony of   Indian cinema stands
            R   S

The correct sequence should be
(a) S P Q R   (b) Q R S P
(c) P Q R S   (d) S R Q P

⊙ *(d)* The correct and meaningful sentence is given by SRQP.

30. of all searches for knowledge   should be the beginning
                 P   Q
     an exploration into truth   and experiments of life
              R   S

The correct sequence should be
(a) R Q P S   (b) S P Q R   (c) R S P Q   (d) Q R S P

⊙ *(a)* The correct and meaningful sentence is given by RQPS.

Directions (Q. Nos. 31-39) *Given below are some idioms/phrases followed by four alternative meanings to each. Choose the response (a), (b), (c) or (d) which is the most appropriate expression and mark your response in the Answer Sheet accordingly.*

31. Get the jitters
(a) Feeling anxious   (b) Feeling happy
(c) Stammering   (d) Feeling exposed

⊙ *(a)* The idiom 'get the jitters' means 'to feel anxious'.

32. French leave

  (a) Absent from work without asking for permission in French
  (b) Asking for permission before leaving work
  (c) Work for permission to get leave
  (d) Absent from work without asking for permission

  ⟩ *(d)* The idiom 'French leave' means 'to be absent from work without informing or asking for permission'.

33. Take a stand

  (a) To publicly express an opinion about something
  (b) To make a stand for one to sit
  (c) To be firm on your work
  (d) To be part of the work

  ⟩ *(a)* The idiom 'take a stand' means 'to publicly express opinions'.

34. Cut and run

  (a) To avoid a difficult situation by leaving suddenly
  (b) To avoid an event suddenly
  (c) To meet some danger suddenly
  (d) To ask for sudden meeting with someone

  ⟩ *(a)* The idiom 'cut and run' means 'to avoid a situation by leaving suddenly'.

35. Cut the cord

  (a) To stop needing your parents for money
  (b) To stop needing someone else to look after you and start acting independently
  (c) To be safe on your own
  (d) To be a married person

  ⟩ *(b)* The idiom 'cut the cord' means ' to stop needing or relying on someone to look after you and start acting independently'.

36. Cupboard love

  (a) Loving someone to get something from the person
  (b) Loving the cupboards
  (c) Innocent love
  (d) Loving to be free of all conditions

  ⟩ *(a)* The idiom 'Cupboard love' means 'to love someone for ones own benefit or to love someone to get something from the person'.

37. Around the corner

  (a) A thing which is at the end of the corner
  (b) An event or thing which is going to happen soon
  (c) An event that corners someone for his wrong
  (d) An event that happens in the corner of powerful place.

  ⟩ *(b)* The phrase 'around the corner' means 'an event that is going to take place soon'.

38. With Heavy Heart

  (a) With heavy weight
  (b) With joy and humour
  (c) With sense of shame
  (d) With pain and regret

  ⟩ *(d)* The idiom 'With heavy heart' means 'with pain and regret'.

39. Cost a bomb

  (a) To be very arrogant
  (b) To be with rich people
  (c) To be very expensive
  (d) To be stingy

  ⟩ *(c)* The idiom 'cost a bomb' means 'to be very expensive'.

40. Roll your sleeves up

  (a) To prepare for wrestling
  (b) To prepare for hard work
  (c) To make someone work for you
  (d) To work with others

  ⟩ *(b)* The idiom 'roll your sleeves up' means 'to prepare for hard work'.

Directions (Q.Nos. 41-50) *In this section each item consists of six sentences of a passage. The first and sixth sentences are given in the beginning as* S1 *and* S6. *The middle four sentences in each have been jumbled up and labelled as* P, Q, R *and* S. *You are required to find the proper sequence of the four sentences and mark your response accordingly on the Answer Sheet.*

41. S1: The country's economy is growing and would continue to grow at a rapid pace in the coming years.

  S6 : The market share of electrical vehicles increases with increasing availability of infrastructure.

  P : It also provides us an opportunity to grow as manufacturer of electric vehicles.

  Q : According to NITI Aayog (2019), if India reaches an electric vehicles sales penetration, emission and oil savings can be achieved.

  R : Given the commitments that India has made on the climate front as a nation and on

environmental aspects, it is likely that larger and larger share of automobile sector would be in the form of electric vehicles.

  S : This presents a great opportunity for the automobile industry as the demand for automobiles would only increase.

The correct sequence should be

  (a) S R Q P   (b) R Q S P
  (c) Q P S R   (d) Q S R P

  ⟩ *(a)* The correct and meaningful order of sentences is SRQP.

42. S1: Central government receipts can broadly be divided into non-debt and debt receipts.

  S6 : This is also evident from the composition of non-debt receipts.

  P : Debt receipts mostly consist of market borrowing and other liabilities which the government is obliged to repay in the future.

  Q : The non-debt receipts comprise of tax revenue, non-tax revenue, recovery of loans and disinvestment receipts.

  R : The outcomes as reflected in the Provisional Actual figures is lower than the budget estimate owing to reduction in the net tax revenue.

  S : The Budget 2018-19 targeted significantly high growth in non debt receipts of the Central Government, which was driven by robust growth.

The correct sequence should be

  (a) S R P Q   (b) R S Q P
  (c) P Q R S   (d) Q P R S

  ⟩ *(d)* The correct and meaningful order of sentences is QPRS.

43. S1: Palaeontology is the study of the remains of dead organisms over enormous spans of time.

  S6 : Faunal analysis gives information about the animal people hunted and domesticated, the age of animal at death, and the diseases that afflicted them.

P : Bones provide a great information.

Q : The distribution of faunal remains (animal bones) at a site can indicate which areas were used for butchering, cooking, eating, bone tool making and refuse dumping.

R : Within this discipline, molecular biology and DNA studies have been used to understand hominid evolution.

S : Hominid evolution answers the questions about what ancient people looked like, and to plot patterns of migration.

The correct sequence should be

(a) Q P R S   (b) S P Q R
(c) R S P Q   (d) P Q R S

⊙ *(c)* The correct and meaningful order of sentences is RSPQ.

44. S1 : Hormones have several functions in the body.

S6 : The two hormones together regulate the glucose level in the blood.

P : They help to maintain the balance of biological activities in the body.

Q : Insulin is released in response to the rapid rise in blood glucose level.

R : On the other hand hormone glucagon tends to increase the glucose level in the blood.

S : The role of insulin in keeping the blood glucose level within the narrow limit is an example of this function.

The correct sequence should be

(a) P S R Q   (b) R S P Q
(c) S R Q P   (d) Q R S P

⊙ *(a)* The correct and meaningful order of sentences is PSRQ.

45. S1 : All living things affect the living and non-living things around them.

S6 : This interdependability needs to be understood when we, humans, consume much morethan required and abuse nature.

P : This can also affect the population of fox, if foxes depend on rabbits for food.

Q : For example, earthworms, make burrows and worm casts.

R : This act of earthworms affects the soil, and therefore the plants growing in it.

S : Rabbit's fleas carry the virus which causes myxomatosis, so they can affect the size of the rabbit population.

The correct sequence should be

(a) R S Q P   (b) P S R Q
(c) Q R S P   (d) S Q R P

⊙ *(c)* The correct and meaningful order of sentences is QRSP.

46. S1 : The ecosystem of water is complex and many environmental factors are intricately linked.

S6 : The trees slowly transfer rainwater into the sub-soil and this is critical for sustaining water for months after the rains.

P : Thick forests make for excellent catchments.

Q : The problems we see are because we have undermined, these links over decades.

R : First, rain and snowfall are the only sources of water-about 99%.

S : In the four months of monsoon, there are about 30-35 downpours and the challenge is to hold this water in systems that can last us over 365 days.

The correct sequence should be

(a) Q R S P   (b) P S R Q
(c) S R Q P   (d) R Q S P

⊙ *(a)* The correct and meaningful order of sentences is QRSP.

47. S1: Politics is exciting because people disagree.

S6 : It is not solitary people who make politics and a good society; it is the people together which make good politics and society.

P : For Aristotle politics is an attempt to create a good society because politics is, above all, a social activity.

Q : They also disagree about how such matters should be resolved, how collective decision should be made and who should have a say.

R : They disagree about how they should live.

S : Who should get what? How should power and other resource be distributed? Should society be based on cooperation or conflict? And so on.

The correct sequence should be

(a) R S Q P   (b) P Q S R
(c) Q S R P   (d) R S P Q

⊙ *(a)* The correct and meaningful order of sentences is RSQP.

48. S1: Regular exercise makes many of the organ systems become more efficient.

S6 : Different activities require different levels of fitness.

P : It can improve your strength; make your body more flexible and less likely to suffer from sprain.

Q : It can also improve your endurance.

R : It also uses up energy and helps to prevent large amounts of fat building up in the body.

S : Exercise can increase your fitness in three ways.

The correct sequence should be

(a) Q R S P   (b) R S P Q
(c) P S Q R   (d) S Q R P

⊙ *(b)* The correct and meaningful order of sentences is RSPQ.

49. S1: On increasing the temperature of solids, the kinetic energy of the particles increases.

S6 : The temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point.

P : A stage is reached when the solid melts and is converted to a liquid.

Q : Due to the increase in kinetic energy, the particles start vibrating with greater speed.

R : The particles leave their fixed positions and start moving more freely.

S : The energy supplied by heat overcomes the forces of attraction between the particles.

The correct sequence should be

(a) Q S R P   (b) Q R S P
(c) P R S Q   (d) S P R Q

⊙ *(a)* The correct and meaningful order of sentences is QSRP.

50. S 1 : Things are often not what they seem.

S6 : This happened without you even knowing it. So imagine the changes that occur to this earth and humanity.

P : But you are really not, because the Milky Way galaxy, of which you are a part, is moving through space at 2.1 million kilometre an hour.

Q : So in roughly twenty second that it would have taken you to read this paragraph, you have already moved thousands of kilometre.

R : And that is without taking into account the effects of Earth's rotation on its own axis, its orbiting around the Sun and Sun's journey around the Milky Way.

S : As you read this sentence, perhaps sitting in a comfortable chair in your study, you would probably consider yourself at rest.

The correct sequence should be

(a) Q R P S   (b) R Q P S
(c) P Q R S   (d) S P R Q

⊘ *(d)* The correct and meaningful order of sentences is SPRQ.

Directions (Q. Nos. 51-60) *Each of the following sentences in this section has a blank space and four words or group of words are given after the sentence. Select the most appropriate word or group of words for the blank space and indicate your response on the Answer Sheet accordingly.*

51. If I .... a good match I would have got married.

(a) had found   (b) have found
(c) found   (d) have

⊘ *(a)* As the given sentence is in past perfect form, 'had found' will be the correct filler for the sentence.

52. The lady has been declared as one of top ten .... of the community.

(a) more powerful members
(b) most powerful members
(c) most powerful member
(d) more powerful member

⊘ *(b)* The correct adjectival phrase to be filled in the blank is 'most powerful members'.

53. When I visited the villages nearby the city I .... many water bodies intact.

(a) came across   (b) come across
(c) came   (d) came in

⊘ *(a)* As the given sentence is in past tense, 'came across' will be the correct filler for the sentence.

54. He has lost all his investments and he is ....

(a) broke   (b) broken
(c) discredited   (d) defunct

⊘ *(a)* Adjective broke will be the correct filler for the sentence.

55. He .... whether he could get any certificate for the course.

(a) said   (b) told
(c) thought of   (d) asked

⊘ *(d)* The tense form 'asked' will be correct filler for the sentence.

56. I .... farewell to all my course mates last year.

(a) bid   (b) bade
(c) said   (d) bad

⊘ *(b)* The word Bade is correctly used with the word 'farewell'.

57. Very few of the texts from very early Vedic period are .... now.

(a) extant   (b) exit
(c) exempt   (d) redundant

⊘ *(a)* The word 'Extant' meaning surviving will be the correct filler for the sentence.

58. A speech is a .... address, delivered to an audience that seeks to convince, persuade, inspire or inform.

(a) formal   (b) informal
(c) humorous   (d) political

⊘ *(a)* The word 'formal' is the correct filler for the sentence.

59. All that .... is not gold.

(a) glitter   (b) glitters
(c) glittering   (d) gliding

⊘ *(b)* The word 'glitters' is the correct filler for the sentence.

60. Having been in politics for about 40 years, the party now treats him like ....

(a) a have-been
(b) a had-been
(c) a has-been
(d) would have been

⊘ *(c)* The phrase 'a has-been' meaning a person who is outdated is the correct filler.

Directions (Q. Nos. 61-70) *Each item in this section consists of a sentence with an underlined word(s) followed by four words/group of words. Select the option that is nearest in meaning to the underlined word and mark your response on the Answer Sheet accordingly.*

61. Emboldened by its success, the leader now plans to go ahead with the plan and implementation.

(a) Encouraged   (b) Disgruntled
(c) Succeeded   (d) Failed

⊘ *(a)* The given word 'Emboldened' means encouraged.

62. It is encouraging to see India's indigenous cinema is going places.

(a) homogenous
(b) classical
(c) home-grown
(d) Non-native language

⊘ *(c)* The given word 'Indigenous' means originating or occurring naturally in a particular place; native. Therefore, its synonym will be home-grown.

63. The ability to imagine and conceive a common good is inconsistent with what is known as 'pleonexia' is a major struggle for a good democracy to realise.

(a) Greed to grab everything for oneself
(b) Greed to accumulate more and more wealth
(c) Dislike for others
(d) Over ambitious

⊘ *(b)* The given word 'pleonexia' means extreme greed for wealth or material possessions.

64. He tried to avoid saying something that would implicate him further.

(a) reward   (b) incriminate
(c) encourage   (d) incite

⊘ *(b)* The given word 'Implicate' means to introduce some to crime or to incriminate.

65. The statutory corporate tax which forms the major income of the government has not changed this year.

(a) legislature   (b) unlawful
(c) government   (d) legal

⊘ *(d)* The given word 'statutory' means legal.

66. He has been part of the all <u>dissident</u> activities.

(a) rebellious   (b) supportive
(c) conformist   (d) legal

⊙ **(a)** The given word 'dissident' means rebellious.

67. <u>Advocacy</u> is one major component of any new programme.

(a) promotion   (b) opposition
(c) critique   (d) liking

⊙ **(a)** The given word 'advocacy' means to promote someone.

68. People avoided him for his <u>high mindedness.</u>

(a) toughness   (b) strong principles
(c) anger   (d) whims

⊙ **(b)** The given word 'high-mindedness' refers to someone with very high and strong principles.

69. There is a <u>tendency</u> to treat social changes as mere development in terms of accumulation of wealth.

(a) position   (b) predisposition
(c) thinking   (d) idea

⊙ **(b)** The given word 'tendency' means an inclination towards a particular characteristic or type of behaviour. The word 'predisposition' means the same.

70. During the ancient period poets were <u>patronised</u> through various institutions.

(a) supported   (b) respected
(c) opposed   (d) scolded

⊙ **(a)** The given word 'patronised' means to be supported.

Directions (Q.Nos. 71-80) *Each item in this section consists of sentences with an underlined word followed by four words or group of words. Select the option that is opposite In meaning to the underlined word and mark your response on the Answer Sheet accordingly.*

71. The <u>archaic</u> thinking leads to unfounded beliefs.

(a) antiquated
(b) outmoded
(c) beyond the times
(d) modern

⊙ **(d)** The word 'archaic' means old fashioned. Its antonym is modern.

72. Police had to resort to tear gas to <u>diffuse</u> tension among the crowd.

(a) concentrate   (b) scatter
(c) disperse   (d) strew

⊙ **(a)** The word 'diffuse' means spread-out. Its antonym is concentrate.

73. <u>Unrest</u> in some pockets made the city dwellers confine themselves at home.

(a) Turbulence   (b) Unease
(c) Apprehension   (d) Calm

⊙ **(d)** The word 'unrest' means 'a feeling of disturbance'. Its antonym is calm.

74. Peace and <u>tranquility</u> are instruments which would boost the development of society.

(a) uproar   (b) calm
(c) serenity   (d) sound

⊙ **(a)** The word 'tranquility' means peace. Its antonym is uproar which means disturbance.

75. <u>Barring</u> a decision of such disputes, other matters relating to the election of President or Vice-President may be regulated by law made by Parliament.

(a) excepting   (b) without
(c) including   (d) excluding

⊙ **(c)** The word 'barring' means exceptions. Its antonym is including.

76. His speech was full of emotions and it was an <u>extempore.</u>

(a) prepared   (b) ready made
(c) unrehearsed   (d) ad lib

⊙ **(a)** The word 'extempore' means spontaneous or unprepared. Its antonym is prepared.

77. The teacher asked her students to understand the <u>ensuing</u> problems and address them suitably .

(a) subsequent   (b) consequent
(c) retrospective   (d) en suite

⊙ **(c)** The word 'ensuing' means 'as a result of'. Its antonym is retrospective which deals with past.

78. All the allegations against the actor were <u>expunged</u> by the committee of inquiry.

(a) got rid of   (b) part of
(c) accepted   (d) rejected

⊙ **(c)** The word 'expunged' means to remove. Its antonym is accepted.

79. His relatives <u>dissuaded</u> him from giving up the job.

(a) persuaded   (b) discouraged
(c) advised against   (d) deter

⊙ **(a)** The word 'dissuaded' means to discourage. Its antonym is persuaded which means to convince.

80. He is one of the <u>confidants</u> of the leader and can influence the decision of the government.

(a) opponents   (b) intimate
(c) close friend   (d) colleague

⊙ **(a)** The word 'confidants' refers to a friend or a companion. Its antonym is opponents.

Directions (Q. Nos. 81-90) *Each of the following sentences has a word or phrase underlined. Read the sentences carefully and find which part of speech the underlined word is. Indicate your response on the Answer Sheet accordingly.*

81. All the pilgrims rested for a while <u>under</u> the banyan tree.

(a) Adverb   (b) Place value
(c) Preposition   (d) Verb

⊙ **(c)** The word 'under' is a preposition.

82. The wonderful <u>statue,</u> of the leader welcomes all people to city.

(a) Object   (b) Adjective
(c) Noun phrase   (d) Noun

⊙ **(d)** The word 'statue' is a noun.

83. This is <u>his</u> pen.

(a) Possessive pronoun
(b) Possessive adjective
(c) Adverb
(d) Verb

⊙ **(b)** The word 'his' is a possessive adjective.

84. When people found that the jewel was in records of Rahim, they' gave <u>it</u> to him.

(a) Pronoun   (b) Nominative
(c) Noun   (d) Adverb

⊙ **(a)** The word 'it' is a pronoun.

85. <u>It</u> is eleven O'clock now and all of us should retire to bed.

(a) Personal pronoun
(b) Relative pronoun
(c) Impersonal pronoun
(d) Verb

⊙ **(c)** The word 'it' is an impersonal pronoun.

86. The flower is <u>very</u> beautiful.

(a) Adjective
(b) Adverb
(c) Preposition
(d) Conjunction

⊙ **(b)** The word 'very' is an adverb.

87. <u>This</u> boy is stronger than Ramesh.

(a) Pronoun   (b) Adjective
(c) Article   (d) Adverb

⊙ **(b)** The word 'this' is an adjective.

88. I hurt <u>myself.</u>

(a) Noun
(b) Pronoun

(c) Demonstrative preposition
(d) Adjective

⊙ **(b)** The word 'myself' is a pronoun.

89. The ants <u>fought</u> the wasps.

(a) Intransitive verb
(b) Transitive verb
(c) Demonstrative verb
(d) Adjective

⊙ **(c)** The word 'fought' is a transitive.

90. I can <u>hardly</u> believe it.

(a) Adjective
(b) Preposition
(c) Adverb
(d) Verb

⊙ **(c)** The word 'hardly' is an adverb.

Directions (Q.Nos. 91-110) *Each of the following sentences in this section has a blank space with four words or group of words given. Select whichever word or group of words you consider the most appropriate for the blank space and indicate your response on the Answer Sheet accordingly.*

The difficult thing about .... **91.** (a) studying   the science of habits is that most people, when they hear
(b) study
(c) studies
(d) are studying

⊙ **(a)** The correct filler is studying.

about this field of research .... **92.** (a) wanting   to know the secret formula for quickly changing any habit.
(b) wanted
(c) wants
(d) want

⊙ **(d)** The correct filler is want.

If scientists have discovered how .... **93.** (a) those   patterns work, then it stands to reason that they
(b) this
(c) these
(d) that

⊙ **(c)** The correct filler is these.

.... **94.** (a) must   have also found a recipe for rapid change, right? If only it ....
(b) will
(c) could
(d) might

⊙ **(a)** The correct filler is must.

.... **95.** (a) are   that easy. It's not .... **96.** (a) these   formulas don't
(b) were   (b) this
(c) was   (c) that
(d) will be   (d) which

⊙ **(b)** The correct filler is were.   ⊙ **(c)** The correct filler is that.

exist. The problem is that there isn't one formula for .... **97.** (a) changing
(b) changed
(c) having changed
(d) changes for

⊙ **(a)** The correct filler is changing.

habits. There are thousands. Individuals and habits are .... **98.** (a) full
(b) all
(c) complete
(d) most

⊙ **(b)** The correct filler is all.

different, and so the specifics of diagnosing and changing the patterns in our lives differ from person to ....

99. (a) people   and behaviour to behaviour. Giving up
(b) persons
(c) personnel
(d) person

⊙ **(d)** The correct filler is person.

cigarettes is different .... **100.** (a) from   curbing overeating, which is different
(b) since
(c) to
(d) into

⊙ **(a)** The correct filler is from.

from changing how you communicate with your spouse, ... **101.** (a) it
(b) this
(c) what
(d) which

⊙ *(d)* The correct filler is which.

is different from how you prioritise tasks at work. What's more, each person's habits are

.... **102.** (a) broken   by different cravings. As a result, this book does not
(b) given
(c) driven
(d) prescribed

⊙ *(c)* The correct filler is driven.

.... **103.** (a) contain   one prescription. Rather, I hoped to deliver something
(b) contains
(c) contained
(d) containing

⊙ *(a)* The correct filler is contain.

else : a framework for understanding .... **104.** (a) how   habits work and a
(b) what
(c) where
(d) whose

⊙ *(a)* The correct filler is how.

guide to experimenting with how they .... **105.** (a) might change. Some habits yield easily
(b) would
(c) will
(d) must

⊙ *(a)* The correct filler is might.

to analysis and influence. Others are .... **106.** (a) quiet   complex and obstinate, and require prolonged study. And for
(b) most
(c) better
(d) more

⊙ *(d)* The correct filler is more.

others, change is a .... **107.** (a) process   that never fully concludes. But that does not
(b) processing
(c) processed
(d) processes

⊙ *(a)* The correct filler is process.

.... **108.** (a) means   it can't occur. Each chapter in this book explains
(b) meant
(c) meaning
(d) mean

⊙ *(d)* The correct filler is mean.

a different aspect of why habits exist and how they function. The framework

.... **109.** (a) describing   in this section is an attempt to distil, in
(b) described
(c) will describe
(d) description

⊙ *(b)* The correct filler is described.

.... **110.** (a) a   very basic way, the tactics that researchers have found
(b) any
(c) the
(d) rather

⊙ *(a)* The correct filler is a .

for diagnosing and shaping habits within our own lives.

111. Which one of the following alternatives has the correct spelling?
(a) Mountaneous   (b) Mountenous
(c) Mountaineous   (d) Mountainous

⟩ *(d)* Mountainous.

112. Which one of the following alternatives has the correct spelling?
(a) Etiquette   (b) Etiquete
(c) Etiequtte   (d) Etequtte

⟩ *(a)* The correct spelling is Etiquette.

113. Which one of the following alternatives has the correct spelling?
(a) Curriculam   (b) Curiculum
(c) Curiculeum   (d) Curriculum

114. Which one of the following alternatives has the correct spelling?
(a) Magnificent   (b) Magnificant
(c) Magneficent   (d) Magenficient

⟩ *(a)* The correct spelling is Magnificent.

115. Which one of the following alternatives has the correct spelling?
(a) Felecitation   (b) Felicitation
(c) Falicitation   (d) Felicitasion

⟩ *(b)* The correct spelling is Felicitation.

116. Which one of the following alternatives has the correct spelling?
(a) Twelth   (b) Twelfth
(c) Tweluth   (d) Twelthe

⟩ *(b)* The correct spelling is Twelfth.

117. Which one of the following alternatives has the correct spelling?

⟩ *(d)* The correct spelling is Curriculum.

(a) Snobbery   (b) Snoberry
(c) Snabbery   (d) Snobbory

⟩ *(a)* The correct spelling is Snobbery.

118. Which one of the following alternatives has the correct spelling?
(a) Neurasis   (b) Nuroesis
(c) Neurosis   (d) Neuresis

⟩ *(c)* The correct spelling is Neurosis.

119. Which one of the following alternatives has the correct spelling?
(a) Dipthteria   (b) Diptheria
(c) Diphtheria   (d) Diphthria

⟩ *(c)* The correct spelling is Diphtheria.

120. Which one of the following alternatives has the correct spelling?
(a) Meagre
(b) Megare
(c) Meagr
(d) Megear

⟩ *(a)* The correct spelling is Meagre.

PAPER III General Studies

1. As per the Budget Estimates of 2019-20, the following are some of the important sources of tax receipts for the Union Government:
1. Corporation Tax
2. Taxes on Income other than Corporation Tax
3. Goods and Services Tax
4. Union Excise Duties

Which one of the following is the correct descending order of the foresaid tax receipts as a percentage of GDP?
(a) 1, 2, 3, 4   (b) 1, 3, 2, 4
(c) 3, 2, 1, 4   (d) 2, 4, 3, 1

⟩ *(b)* As per the Budget Estimates of 2019-20, the important sources of tax receipts for the Union Government are as follows-

Sources	Budgeted 2019-20 (₹ crore)
Corporation Tax	766000
Goods and Services Tax	663343
Taxes on Income	569000
Union Excise Duties	300000
Customs	155904

Hence, option (b) is correct.

2. As per the World Bank's Ease of Doing Business Ranking, India's rank has improved from 142 in 2014 to 63 in 2019. During this period, in which of the following parameters has India's rank deteriorated?
(a) Ease of starting a business
(b) Getting electricity
(c) Registering property
(d) Paying taxes

⟩ *(c)* As per the World Bank's Ease of Doing Business Report, India's rank has improved from 142 in 2014 to 63 in 2019. During this period India's rank has deteriorated in Registering Property.

S.No.	Parameters	2014	2019
1.	Starting a business	156	136
2.	Dealing with construction permits	183	27
3.	Getting electricity	134	22
4.	Registering property	115	154
5.	Getting credit	30	25
6.	Protecting investors	21	13
7.	Paying taxes	154	115
8.	Trading across borders	122	68
9.	Enforcing contracts	186	163
10.	Resolving insolvency	135	52

3. Which one of the following statements with regard to the National Food Security Act is not correct?
(a) The Act was enacted in the year 2013.
(b) The Act was rolled out in the year 2014.
(c) The Act legally entitles 67% of the population to receive highly subsidised food grains.
(d) The Act is not being implemented in all the States/Union Territories.

⟩ *(d)* The National Food Security (NFS) Act, 2013 aims to provide subsidised food grains to 67% of India's population. It was rolled out in the year 2014. It is implemented in all the State/Union Territories.

Salient Features of this Act
● Beneficiaries of the PDS are entitled to 5 kg per person per month of cereals at the following prices: Rice at ₹ 3 per kg, Wheat at ₹ 2 per kg and Coarse grains (millet) at ₹ 1 per kg.
● Pregnant women, lactating mothers and certain categories of children are eligible for daily free cereals.
● It includes the Midday Meal Scheme, Integrated Child Development Services (ICDS) scheme and the Public Distribution System (PDS).

4. Which one of the following statements about Indian economy during 2019-20 is not correct?

(a) There has been deceleration in growth rate.
(b) There has been sluggish growth in tax revenue relative to the Budget Estimates.
(c) Fiscal deficit as percentage of GDP has been as per the Budget Estimates.
(d) The non-tax revenue registered a considerably higher growth.

⊚ **(c)** There has been deceleration in growth rate in Indian Economy during 2019-20. There has been sluggish growth in tax revenue relative to the Budget Estimates. Fiscal deficit as percentage of GDP has been more than the Budget Estimates. The non-tax revenue registered a considerable growth.

5. As per the Budget Estimates of expenditure on major subsidies during 2019-20, the maximum expenditure was likely to be on

(a) urea subsidy
(b) petroleum subsidy
(c) food subsidy
(d) fertilizer subsidy

⊚ **(c)** In 2019-20, the total expenditure on subsidies is estimated to increase to ₹ 3,38,949 crore (13.3%) over the revised estimate of 2018-19. This is owing to an increase in expenditure on petroleum, fertilizer, food and other interest subsidies.

Subsidies in 2019-20 (₹ crore)

Subsidy	Budget 2019-20
Food subsidy	184220
Fertilizer subsidy	79996
Petroleum subsidy	37478
Other subsidies	37255
Total	**338949**

Hence, option (c) is correct.

6. Which one of the following Indian places receives minimum rainfall in a year?

(a) Jodhpur
(b) Leh
(c) New Delhi
(d) Bengaluru

⊚ **(b)** Leh receives minimum rainfall in a year among the given option. The average annual rainfall is only 102 mm (4.02 inches).

The annual average rainfall of the other given places are
Jodhpur – 363 mm
New Delhi – 617 mm
Bengaluru – 970 mm

7. Timber vegetation is generally not found in which of the following regions?

(a) Subtropical region
(b) Temperate region
(c) Alpine region
(d) Tundra region

⊚ **(d)** Timber vegetation is generally not found in Tundra region. The Tundra is a treeless polar desert found in the high latitudes in the polar regions. Tundra lands are covered with snow for much of the year.

The Tundra regions are-Alaska, Canada, Russia, Greenland, Iceland.
The characteristics of the Tundra Regions are:

● Extremely cold climate
● Low biotic diversity
● Limitation of drainage
● Simple vegetation structure

The Arctic Tundra's temperature is – 34° C to – 6° (c)

8. Decadal growth rate of population in percentage was highest in India in the year

(a) 1991   (b) 1981
(c) 1971   (d) 1961

⊚ **(c)** The decadal growth rate of population in India in percentage was highest in India in the year 1971 which was 24.80. The decadal growth of other given year is as follows.

● 1961-21.64%
● 1981-24.66%
● 1991-27.87%

The Decadal growth of 2011 is 17.64.

9. The Isotherm Line, which divides India North-South in almost two equal parts in the month of January, is

(a) 10 °C   (b) 25 °C
(c) 15 °C   (d) 20 °C

⊚ **(d)** The Isotherm Line, which divides India North-South in almost two equal parts in the month of January is 20°C

Isotherm is a line that connect points of equal temperature on map, so at every point along a given isotherm the temperature values are same. It is used to observe the distribution of air temperature over a vast area.

10. Which one of the following indicates the Tropical Savannah climate?

(a) Aw   (b) Dfc   (c) Cwg   (d) Am

⊚ **(a)** Aw or the tropical wet and dry climate, also known as the Savannah climate, where there is an extended dry season during the winter.

During the wet season, rainfall is less than 1000 mm, occurring mainly in the summer time.

Other Climatic Types
Aw - Monsoonal Type Climate
Dfc - Cold Humid winter with Short summer.
Cwg - Monsoon Type with Dry winters.

11. The largest geographical area of India is covered by which one of the following types of soils?

(a) Inceptisols   (b) Entisols
(c) Alfisols   (d) Vertisols

⊚ **(a)** The largest geographical area of India is covered by Inceptisols, which is 39.74%. Inceptisols are usually the weakly developed young soil though they are more developed than entisols.

Other soils cover an area of
Entisols – 28.08%
Albisols – 13.55%
Vertisols – 8.52%

12. Which one of the following cities is closest to the Equator?

(a) Mogadishu   (b) Singapore
(c) Colombo   (d) Manila

⊚ **(b)** Singapore is closest to the equator.

Other cities which are near to the equator are
Quito (Equador)
Kampala (Uganda)
Pekanbaru (Indonesia)
Padang (Indonesia)
Maccapa (Brazil)
Kisumu (Kenya)
Libreville (Gabon)

13. Who among the following gave evidence before the Joint Select Committee on the Government of India Bill, 1919 in favour of female franchise?

1. Annie Besant   2. Sarojini Naidu
3. Hirabai Tata

Select the correct answer using the codes given below.

(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) 1, 2 and 3

⊘ *(d)* Annie Besant, Sarojini Naidu and Hirabai Tata gave evidence before the Joint Select Committee on the Government of India Bill, 1919 in favour of Female Franchise.

The Government of India Act, 1919, was an Act of the Parliament of the United Kingdom. It was passed to expand participation of Indians in the Government of India. The Act embodied the reforms recommended in the report of the Secretary of State of India, Edwin Montagu, and the Viceroy Lord Chelmsford.

14. In which one of the following places was the Ahmadiyya Movement started by Mirza Ghulam Ahmad?

(a) Patna   (b) Aligarh
(c) Bhopal   (d) Gurdaspur

⊘ *(d)* The Ahmadiyya Movement was launched by Mirza Ghulam Ahmad of Qadiyan in 1889 from Gurudaspur.

He began his work as a defender of Islam against the Polemics (Religions Propoganda) of the Arya Samaj and the Christian missionaries.

15. With whom did Subhas Chandra Bose form an alliance to destroy the Holwell Monument in Calcutta during 1939-40?

(a) The Communist Party of India
(b) The Muslim League
(c) The Hindu Mahasabha
(d) The Unionist Party

⊘ *(b)* Subhas Chandra Bose with an alliance with the Muslim League destroyed the Holwell Monument in Calcutta during 1939-40.

The Holwell Monument was constructed to commemorate the victims of the 'Black Hole Tragedy 1956. It was named after John Zephaniah Holwell, one of the survivor of this incident.

16. Who among the following created the first All India Trade Union Congress in 1920?

(a) BP Wadia   (b) SA Dange
(c) NM Joshi   (d) BT Ranadive

⊘ *(c)* NM Joshi created the first All India Trade Union Congress (AITUC) in 1920.

The AITUC was founded on October 31, 1920 in Mumbai .

● It is associated with the Communist Party of India. According to provisional statistics from the Ministry of Labour, AITUC had a membership of 14.2 million in 2013.

17. Which one among the following was India's first trade union in the proper sense of the term?

(a) Bombay Labour Union
(b) Ahmedabad Labour Union
(c) Madras Labour Union
(d) Allahabad Labour Union

⊘ *(c)* Madras Union Labour was India first trade Union in the proper sense of term. Madras Labour Union was formed on April 27, 1918 by the workers of the then Buckingham and Carnatic Mills at Perambur, Chennai. The two prominent traders involved in forming the union were Selvapathi Chettiyar and Ramanujulu Naidu. BP Wadia was the founding member of the MLU. Selvapathi and Ramanujulu became the General Secretaries of the union while **Thiru Vi Ka** its Vice President.

18. Who among the following formed the Seva Samiti Boy Scouts Association in 1914?

(a) Hriday Nath Kunzru
(b) SG Vaze
(c) Annie Besant
(d) Shri Ram Bajpai

⊘ *(a)* Hriday Nath Kunzru and Madan Mohan Malviya formed the Seva Samiti Boy Scouts Association. On the line of the Worldwide Baden-Powell Organisation, which at the time refused to allow Indians to join it.

They were assisted by Shri Ram Bajpai.

19. Which one among the following is not correct about the Secretary General of the Lok Sabha?

(a) The Secretary General is the advisor of the Speaker.
(b) The Secretary General acts under the authority in the name of the Speaker.
(c) The Secretary General works under the Speaker with delegated authority.
(d) The Secretary General passes orders in the name of the Speaker.

⊘ *(d)* The Secretary General of the Lok Sabha passes orders in the name of the speaker is not correct statement.

The Secretary General of the Lok Sabha is the Administrative Head of the Lok Sabha Secretariat. He/she is appointed by the Speaker of the Lok Sabha. The post of Secretary General is of the rank of the Cabinet Secretary in the Government of India, who is the senior most civil servant to the Indian Government.
In the discharge of his constitutional

and statutory responsibilities, the Speaker of the Lok Sabha is assisted by the Secretary-General, Lok Sabha, functionaries of the level of the Additional Secretary, Joint Secretary and other officers and staff of the Secretariat at various levels.
The Secretary General remains in office till his/her retirement at the age of 60. He/she is answerable only to the Speaker, his/her action cannot be discussed or criticised in or outside the Lok Sabha. On behalf of the President of India, he/she summons members to attend session of Parliament and authenticates Bills in the absence of the Speaker.

20. Who among the following moved the motion of Secret Sitting Session of the Assembly (1942)?

(a) MS Aney   (b) GV Mavalankar
(c) CM Stephen   (d) A. Ayyangar

⊘ *(a)* Madhav Shrihari Aney (MS Aney) moved the motion of Secret Sitting Session of the Assembly in 1942. The objective of this Session was to discuss the 2nd World War situation. He was member of the Viceroy's Executive Council from 1941-1944. He is popularly referred as Loknayak Bapujj Aney. He was also Governor of Bihar from 12th January, 1948 to 14th June, 1952.

21. Which one among the following statements pertaining to the President's term of Office is not correct?

(a) The President holds Office for a term of five years.
(b) The President may be removed from the Office by way of impeachment.
(c) The President may resign before the expiration of his/her term by writing to the Speaker of the Lok Sabha.
(d) The President shall, not withstanding the expiration of his/her term, continue to hold Office until his/her successor enters upon his/her Office.

⊘ *(c)* "The President may resign before the expiration of his/her term by writing to the speaker of the Lok Sabha", is not correct. The President submits his resignation to the Vice-President.
The Indian President is the Head of the State and he is also called the First Citizen of India. He is a part of Union Executive, provisions of which are dealt with Articles 52-78 including Articles related to President (Articles 52-62).

Supreme Court shall inquire and decide regarding all doubts and disputes arising out of or in connection with the election of a President as per Article 71(1) of the Constitution. Supreme Court can remove the President for the electoral malpractices or upon being not eligible to be Lok Sabha member under the Representation of the People Act, 1951.

The President may also be removed before the expiry of the term through impeachment for violating the Constitution of India by the Parliament of India. The process may start in either of the two Houses of the Parliament.

22. Which of the following Articles in the Constitution of India are exceptions to the Fundamental Rights enumerated in Article 14 and Article-19?

(a) Article 31A and Article 31C
(b) Article 31B and Article 31D
(c) Article 12 and Article 13
(d) Article 16 and Article 17

⊙ *(a)* Article 31A and Article 31C in the Constitution of the India are exceptions to the Fundamental Rights enurmated in Article 14 and Article 19. By the 1st Constitutional Amendment of 1951, the Parliament added Article 31A to the Indian Constitution.

Article 31A of Indian Constitution was immune to Article-14 and 19 of Indian Constitution that provide for Right to Equality and the Right to Freedom, respectively.
Article 31 (C) of Indian Constitution was included through the 25th Amendment Act of 1971 through which the government gave primacy to some Directive Principles of State Policy over the Fundamental Rights.

23. Which one of the following is not the necessary condition for the issue of a Writ of Quo Warranto?

(a) The Office must be a Public Office.
(b) The Office must be created by the Statute or by the Constitution itself.
(c) The Office must not be a substantive one.
(d) There has been a contravention of the Constitution or a Statute in appropriating such person to that Office.

⊙ *(c)* "The Office must not be a substantive one" is not the necessary condition for the issue of a Writ of Quo Warranto. Orders, warrants, directions, etc. Issued under authority are examples of Writ.

There are five major types of Writ viz. Habeas Corpus, Mandamus, Prohibition, Quo Warranto and Certiorari.

Quo warranto means 'by what warrant?' This writ is issued to enquire into legality of the claim of a person or Public Office. It restrains the person or authority to act in an Office which he/she is not entitled to; and thus stops usurpation of Public Office by anyone. This Writ is applicable to the public offices only and not to Private Offices.

24. Which one of the following Commissions is related to Article 338A?

(a) The National Commission for Scheduled Castes
(b) The National Commission for Scheduled Tribes
(c) The National Commission for Backward Classes
(d) The National Commission for Women

⊙ *(b)* Article 338A of the Indian Constitution deals with the National Commission for Scheduled Tribes.

This article was added in the Constitution through the 89th Constitutional Amendment Act, 2003.

The Chairperson, Vice-Chairperson and other members of the Commission shall be appointed by the President by Warrant under his hand and seal. The Commission shall have the power to regulate its own procedure. Article 338 of the Indian Constitution deals with National Commission for Scheduled Castes.

25. August 12 is celebrated as

(a) the World Environment Day
(b) the World No-Tobacco Day
(c) the International Day against Drug Abuse and Illicit Trafficking
(d) the International Youth Day

⊙ *(d)* The August 12 is celebrated as the International Youth Day, each year to recognise efforts of the World's youth in enhancing Global Society.

It also the day aims to raise awareness about the problems faced by youth. The first International Youth Day was observed on August 12, 2000.

The theme of the International Youth Day, 2020 was 'Youth Engagement for Global Action'.

26. Which one of the following countries had chosen the name 'Nisarga' for the cyclone which devastated the coastline of

Maharashtra and Gujarat in June 2020?

(a) Maldives
(b) Bangladesh
(c) Thailand
(d) Japan

⊙ *(b)* Bangladesh had chosen the name 'Nisarga' for the cyclone which devastated the coastline of Maharashtra and Gujarat in June 2020. The Nisarga cyclone is formed because of the depression in the Arabian Sea. It is a tropical cyclone formed because of exceptional warm surface ocean temperatures.

27. Who among the following played the role of Shakuntala Devi in the biopic movie based on the life of the famous mathematician?

(a) Madhuri Dixit
(b) Rani Mukherjee
(c) Tabu
(d) Vidya Balan

⊙ *(d)* Indian bollywood actress Vidya Balan played the role of Shakuntala Devi in the biopic movie based on the life of the famous Mathematician.

Shakuntala Devi (1929 -2013) was an Indian writer and mental calculator, popularly known as the 'Human Computer'.

She strove to simplify numerical calculations for students. Her talent earned her a place in the 1982 edition of The Guinness Book of World Records.

28. GC Murmu, who was appointed as the Comptroller and Auditor General of India in August 2020, was the Lieutenant Governor/ Administrator of which one of the following Union Territories prior to this appointment?

(a) Ladakh
(b) Jammu and Kashmir
(c) Chandigarh
(d) Puducherry

⊙ *(b)* Girish Chandra Murmu is appointed as the 14th Comptroller and Auditor General of India on August 8, 2020. He was the first Lieutenant Governor of the Union Territory of Jammu and Kashmir.

He is a 1985 batch Indian Administrative Service Officer of Gujarat Cadre and was Principal Secretary of Narendra Modi during his tenure as Chief Minister of Gujarat.

29. Which one of the following States is planned to host the Khelo India Youth Games (4th Edition)?

(a) Kerala
(b) Haryana
(c) Gujarat
(d) Manipur

⊙ **(b)** On July 25, 2020, the Union Minister of Youth Affairs and Sports, Shri Kiren Rijiju announced that Haryana will host the Fourth Edition of Khelo India Youth Games. The games has been scheduled to be conducted after Tokyo Olympics.

The Khelo India Scheme was launched to improve sports culture in India. The Scheme is implemented by the Ministry of Youth Affairs and Sports. The Scheme aims to make India a good sporting nation.

30. Which one among the following is not a Coral Reef Island?

(a) Great Barrier Reef (Australia)   (b) Rainbow Reef (Fiji)
(c) Swaraj Island (India)   (d) Kyushu Island (Japan)

⊙ **(d) Kyushu Isalnd** (Japan) is not a Coral Reef Island. A coral island is a type of island formed from coral detritus and associated organic material. It occur in tropical and sub-tropical areas, typically as part of coral reefs which have grown to cover a far larger area under the sea.

The **Great Barrier Reef** is the world's largest Coral Reef System composed of over 2900 individual reefs and 900 islands stretching for over 2,300 km over an area of approximately 344,400 km^2. The reef is located in the Coral Sea, off the Coast of Queensland, Australia.

The **Rainbow Reef** is a reef in the Somosomo Strait between the Fijian islands of Taveuni and Vanua Levu. It is one of the most famous dive sites in the South Pacific.

Swaraj Island is part of Ritchie's Archipelago, in India's Andaman Islands. It's known for its dive sites and beaches, like Elephant Beach, with its coral reefs.

31. Since 2014-15, India has consistently run trade surplus with which one among the following countries?

(a) China   (b) Saudi Arabia   (c) USA   (d) Germany

⊙ **(d)** Since 2014-15, India has consistently run trade surplus with USA.

Trade Status	Country	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20 (April-Nov.)
Trade Surplus Country	USA	20.63	18.55	19.90	21.27	16.86	10.91
Trade Deficit Countires	UAE	6.89	9.67	10.87	6.41	0.34	0.25
	China PRP	−48.48	−52.70	−51.11	−63.05	−53.57	−35.32
	Saudi Arabia	−16.95	−13.94	−14.86	−16.66	−22.92	−14.32
	Iraq	−13.42	−9.83	−10.60	−16.15	−20.58	−13.98
	Germany	−5.25	−5.00	−4.40	−4.61	−6.26	−3.09
	Korea RP	−8.93	−9.52	−8.37	−11.90	−12.05	−7.80
	Indonesia	−10.96	−10.31	−9.94	−12.48	−10.57	−6.99
	Switzerland	−21.06	−18.32	−16.27	−17.84	−16.90	−11.97
	Hong Kong	8.03	6.04	5.84	4.01	−4.99	−3.88
	Singapore	2.68	0.41	2.48	2.74	−4.71	−3.15

Bilateral Trade Surplus/Deficit **(Values in US $ Billion)**

32. Arrange the following countries in descending order as per the Global Human Development Index, 2019 :

1. Germany   2. USA   3. South Africa   4. India

Select the correct answer using the codes given below.

(a) 1, 2, 3, 4   (b) 1, 3, 2, 4
(c) 3, 2, 1, 4   (d) 4, 3, 2, 1

⊙ **(a)** Countries in descending order as per the Global Human Development Index, 2019 are- Germany (4) USA (15), South Africa (113) and India (129). In HDI 2019, Norway, Switzerland, Ireland and Germany topped the HDI ranking of 189 countries and territories, while Niger, the Central African Republic, South Sudan, and Burundi have the lowest scores in the Index. The United Nations Development Programme (UNDP) ranks countries into four tiers of human development by combining measurements of life expectancy, education and per-capita income into the Human Development Index (HDI) in its annual Human Development Report.

33. As per the use-based classification of the Index of Industrial Production (IIP), the maximum weight has been assigned to

(a) primary goods
(b) intermediate goods
(c) consumer durables
(d) consumer non-durables

⊙ **(a)** The Index of Industrial Production (IIP) is an index that indicates the performance of various industrial sectors of the Indian economy. It is calculated and published by the Central Statistical Organisation (CSO), every month. The maximum weight has been assigned to primary goods.Weights of the different sectors under the used based classification (2011-12 series)

Sectors	Number of Groups	Weights
Primary Goods	15	34.05
Capital Goods	67	8.22
Intermediate Goods	110	17.22
Infrastructure/C onstruction goods	29	12.34
Consumer durables	86	12.84
Consumer Non-durables	100	15.33
Total	**407**	**100**

34. Normally, there will not be a shift in the demand curve when

(a) price of a commodity falls.
(b) consumers want to buy more at any given price.
(c) average income rises.
(d) population grows.

⊙ **(a)** The demand curve is a graphical representation of the relationship between the price of a good or service and the quantity demanded for a given period of time. If the price of a commodity falls then there will be no shift in the demand curve.

35. A market, in which there are a large number of firms, homogeneous product, infinite elasticity of demand for an individual firm and no control over price by firms, is termed as

(a) oligopoly
(b) imperfect competition
(c) monopolistic competition
(d) perfect competition

> (d) Perfect competition is a market form in which there are a large number of firms, homogenous product, infinite elasticity of demand for an individual firm and no control over price rise. Perfect competition provides both allocative efficiency and productive efficiency.

In **oligopoly**, small group of large sellers (oligopolists) dominate the market. **Monopolistic** competition occurs when an industry has many firms offering products that are similar but not identical. Imperfect competition refers to a situation where the characteristics of an economic market do not fulfil all the necessary conditions of a perfectly competitive market.

36. Which one of the following statements with regard to ozone is not correct?

(a) Ozone is found mostly at 15-55 km in the atmosphere.
(b) Ozone is produced by gaseous chemical reactions.
(c) 16th November is celebrated as the International Day for the Preservation of the Ozone Layer.
(d) Ozone is a form of oxygen in which three oxygen atoms are bounded together.

> (c) September 16 was designated by the United Nations General Assembly as the International Day for the Preservation of the Ozone Layer. This designation had been made on December 19, 2000, in commemoration of the date, in 1987, on which nations signed the Montreal Protocol on Substances that Deplete the Ozone layer. The theme for 2020 World Ozone Day was 'Ozone for Life: 35 years of Ozone Layer Protection'.

37. Sea of Azov is connected to

(a) Black Sea　　(b) Baltic Sea
(c) Mediterranean Sea
(d) North Sea

> (a) The Sea of Azov is a sea in Eastern Europe connected to the Black Sea by the narrow (about 4 km) Strait of Kerch, and is sometimes regarded as a Northern Extension of the Black Sea. The sea is bounded in the North-West by Ukraine, in the south-east by Russia. The Don River and Kuban River are the major rivers that flow into it. There is a constant outflow of water from the Sea of Azov to the Black Sea. The Sea of Azov is the shallowest sea in the world, with the depth varying between 0.9 and 14 m (2 ft 11 in and 45 ft 11 in).

38. Climax Mine, the largest producer of Molybdenum, is located in

(a) Canada　　(b) USA
(c) Australia　　(d) South Africa

> (b) The Climax mine, located in Climax, Colorado, United States, is a major Molybdenum mine. Shipments from the mine began in 1915. At its highest output, the Climax mine was the largest Molybdenum mine in the world, and for many years It supplied three-fourths of the world's supply of Molybdenum. The mine is owned by Climax Molybdenum Company, a subsidiary of Freeport-McMoRan.

Molybdenum is a chemical element with the symbol Mo and atomic number 42.

39. Which one among the following Union Territories of India is the smallest in geographical area?

(a) Chandigarh
(b) Puducherry
(c) Dadra and Nagar Haveli and Daman and Diu
(d) Lakshadweep

> (d) The Union Territory of Lakshadweep is smallest in area. It has total area of 32 km^2. It is an archipelago, situated in Arabian Sea (Indian Ocean). Its capital is Kavaratti. It is divided into two group of islands i.e. Amindivi (Northern group of islands) and Cannanore (Southern group of Islands). The Islands are made up of coral reef.

The geographical areas of other given territories are

Chandigarh	- 14 km^2
Puducherry	- 483 km^2
Dadra and Nagar Haveli and Daman and Diu	- 603 km^2

40. Buenos Aires and Montevideo are situated across the banks of

(a) River Plate　　(b) Orinoco River
(c) Purus River　　(d) Madeira River

> (a) Buenos Aires, the capital and most populous city of Argentina, located on the western bank of the River Plate. Buenos Aires is one of the safest cities to visit In South America. Montevideo is situated on the Southern coast of the country, on the North-Eastern bank of the River Plate. Montevideo is the capital and largest city of Uruguay.
The city was established in 1724 by a Spanish soldier, Bruno Mauricio de Zabala, as a strategic move amidst the Spanish-Portuguese dispute over the platine region.

41. The largest Barrier Reef System in the world is found at

(a) East Australian Coast
(b) West Australian Coast
(c) North Australian Coast
(d) South Australian Coast

> (a) The Great Barrier Reef is the world's largest coral reef. It is found off the East Australian coast. It is made up of nearly 2900 coral reefs and over 600 islands. It is 3,27,800 km^2 big and 2600 km long. It has been listed as an important World Heritage Site by UNESCO.

It is home to over 1600 species of fish, 411 species of hard coral and 150 species of soft coral, more than 30 species of whales and dolphins and six of the world's seven species of marine turtles.

The Great Barrier Reef is the largest structure made by living things. It can be seen from outer space. The biggest threat to the Great Barrier Reef today is coral bleaching caused by high sea water temperatures as a result of global warming.

42. During the 19th century, who among the following wrote *Satapatra* Series?

(a) MG Ranade
(b) BG Tilak
(c) Bankim Chandra Chatterjee
(d) GH Deshmukh

> (d) 'Lokahitavadi' Gopal Hari Deshmukh wrote Satapatra Series (1848-50) in which he called for social reforms, advocated indigenous enterprise, but also welcomed British rule. Gopal Hari Deshmukh (1823 - 1892) was an activist, thinker, social reformer and writer from Maharashtra.

43. Which one of the following was not a demand made by the Congress moderates?

(a) Universal Adult Franchise
(b) Repeal of the Arms Act
(c) Extension of Permanent Settlement
(d) Higher Jobs for Indians in the army

> (a) Universal Adult Franchise was not a demand made by the Congress moderates.

The early phase of the Congress was dominated by the 'moderates'. They believed in British rule and were loyal to them.

Prominent moderate leaders-Dadabhai Naoroji, Womesh Chandra Bonnerjee, G. Subramania Aiyer, Sir Surendranath Banerjee and Gopal Krishna Gokhale.

Major Popular Demands of the Moderates

- Decreased land revenue tax and ending peasant oppression.
- Education of the masses and organising public opinion, make people aware of their rights.
- Indian representation in the Executive Council and in the Indian Council in London.
- Separation of the Executive from the judiciary.
- Decreased land revenue tax and ending peasant oppression.
- After 1892, raised the slogan, ''No taxation without representation''.
- Abolishing salt tax and duty on sugar.
- Freedom of speech and expression.
- Freedom to form associations.
- Development of modern capitalist industries in India.
- End of economic drain of India by the British.
- Repealing the Arms Act of 1878.

44. Who among the following founded the Mohammedan Anglo-Oriental Defence Association (1893)?

(a) Auckland Colvin
(b) Badruddin Tyabji
(c) Theodore Beck
(d) Sir Syed Ahmad Khan

⊙ *(d)* Mohammedan Anglo-Oriental Defence Association was established in 1893 by Sir Syed Ahmad Khan as a part of the Aligarh Movement. He established it as he considered competence in English and Western Sciences necessary skills for maintaining Muslims' political influence, especially in Northern India. Also, the growing influence and popularity of the Congress became a cause of concern for the British. In order to counter the growing influence of the Congress, the British encouraged the formation of the Mohammedan Anglo-Oriental (M.A.O.) Defence Association.

Sir Syed Ahmed Taqvi bin Syed Muhammad Muttaqi (1817-1898), commonly known as Sir Syed Ahmed Khan, was an Islamic pragmatist, reformer, and philosopher of nineteenth century. He is considered as the pioneer of Muslim nationalism in India.

45. After the First World War, the Triveni Sangh was formed by

(a) the Jats and Gujjars
(b) the Rajputs and Yadavs

(c) the Jats and Yadavs
(d) the Ahirs and Kurmis

⊙ *(d)* The Triveni Sangh was formed in 1934 by the members of three backward castes of Bihar, namely Yadavs (Ahirs), Koer and Kurmi. It was formed to fight against the political solidarity of 'middle peasant castes' as well as to carve a space in democratic politics for the lower castes. Its nomenclature was derived from the confluence of three mighty rivers *viz.* the Ganga, Yamuna and the mythical Saraswati at Allahabad. The Sangh claimed of having atleast one million dues-paying members. Its formation was countered by the formation of Indian National Congress's Backward class Federation, which was established at the same time.

46. Who among the following was the first to accept a ministerial position in the Central Provinces in October 1925?

(a) BS Moonje   (b) MR Jayakar
(c) SB Tambe   (d) BN Sasmal

⊙ *(c)* Shripad Balwant Tambe accepted a ministerial position in the central provinces in October, 1925. He was a pledger from Amravati in Berar division of Central Provinces. He was a member of the Swaraj Party and President of the Central Provinces Legislative Council. His appointment created political interest throughout India and the Swaraj Party.

Balakrishna Shivram Moonje was a leader of the Hindu Mahasabha in India.

Makund Ramrao Jayakar was the first Vice-Chancellor of the University of Poona.

Birendra Nath Sasmal was a lawyer and political leader. He was known as Deshpran because of his work for the country and for his efforts in the Swadeshi Movement.

47. Who among the following formed the National Liberation Federation (Liberal Party)?

(a) Motilal Nehru and CR Das
(b) Muhammad Ali and CR Das
(c) TB Sapru and MR Jayakar
(d) MR Jayakar and CR Das

⊙ *(c)* The National Liberation Federation (Liberal Party) was formed by Surendra Nath Banerjee and some of its prominent leaders were Tej Bahadur Sapru, VS Srinivasa Sastri and MR Jayakar. The Liberal Party was formed in 1910, and British intellectuals and British officials were

often participating members of its committees.

Tej Bahadur Sapru emerged as the most important leader among the Liberals.

48. The National Disaster Management Authority functions under the Ministry of

(a) Environment, Forest and Climate Change
(b) Home Affairs
(c) Commerce and Industry
(d) Finance

⊙ *(b)* The National Disaster Management Authority (NDMA) functions under the Ministry of Home Affairs. It was established through the Disaster Management Act enacted by the Parliament on December 23rd 2005.

NDMA is responsible for framing policies, laying down guidelines and best practices for coordinating with the State Disaster Management Authorities (SDMAs) to ensure a holistic and distributed approach to disaster management. Prime Minister Narendra Modi is the Chairman of the NDMA. The members enjoy the rank of Secretary of the Union government.

49. The socialist idea of *Sapta Kranti* (Seven Revolutions) was proposed by

(a) Ram Manohar Lohia
(b) Jawaharlal Nehru
(c) MG Ranade
(d) Jayaprakash Narayan

⊙ *(a)* The socialist idea of Sapta Kranti (Seven Revolutions) was proposed by great socialist leader Ram Manohar Lohia.

His Seven Revolutions include

1. For equality between man and woman.
2. Against political, economic and race-based inequalities.
3. For the destruction of castes.
4. Against foreign domination.
5. For economic equality, planned production and against private property.
6. Against interference in private life.
7. Against arms and weapons and for Satyagraha.

He provided the ideological and organisational base for OBC empowerment. Much of his career was devoted to combating injustice through the development of a distinctly Indian version of socialism.

50. Which one among the following is not a character of a Secular State?

(a) It refuses theocracy.
(b) It separates religion from the State.
(c) A State in order to be secular must be democratic.
(d) It must prevent religious conflict and promote religious harmony.

⊗ *(c)* For being a Secular State, it is not necessary that State must be democratic. There are many autocratic states which are secular. *The characteristics of Secular State are as follows*

- The term 'Secular' means being 'separate' from religion, or having no religious basis.
- It refuses theocracy.
- It must prevent religious conflict and promote religious harmony.
- Religion is kept separate from the social, political, economic and cultural spheres of life.

51. A special address by the Governor refers to the address delivered by the Governor

(a) when President's Rule is called for
(b) when a national emergency necessitates dissolution of Legislative Assembly
(c) at the commencement of the first session after general election and at the first session of each year
(d) whenever he/she has concluded that such is necessary

⊗ *(c)* Article-176(1) of the Constitution of India provides that the Governor shall Address State's Assembly at the commencement of the first Session after each general election to the Assembly and at the commencement of the first session of each year and inform the Legislature of the causes of its Summons.
The aforementioned address of the Governor is referred as Special Address. The executive power of the State is vested in the Governor. He is appointed by the President by warrant under his hand and seal.

52. Which one of the following statements in relation to Panchayats is not correct?

(a) Legislature of a State may, by law, make provisions with respect to the composition of Panchayats.
(b) Panchayat area means the territorial area of a Panchayat.
(c) Gram Sabha includes all persons in the electoral rolls of village within a Panchayat.
(d) Reservation of seats for SCs and STs has nothing to do with proportion of their population.

⊗ *(d)* Seats reserved for Scheduled Castes (SCs) and Scheduled Tribes (STs) and the chairpersons of the Panchayats at all levels also shall be reserved for SCs and STs in proportion to their population. Hence, statement (d) is incorrect. The 73rd Constitutional Amendment Act of 1992 provided Constitutional status to the Panchayats. *The salient features of Panchayati Raj System are follows*

- Three-tier system of panchayats at village, intermediate block/taluk/mandal and district.
- levels except States with population below 20 lakhs (Article-243B).
- Panchayat area means the territorial area of a Panchayat.
- Gram Sabha includes all people in the electoral rolls of village within a Panchayat.
- Legislature of a state may, by law, make provision with respect to the composition of Panchayat.

53. Which one of the following statements with regard to 'protective democracy' is not correct?

(a) It propounds that citizen participation is essential in democracies.
(b) Citizens must be able to protect themselves from governmental encroachments.
(c) It is compatible with laissez-faire capitalism.
(d) Political equality is understood in formal terms as equal voting rights.

⊗ *(c)* John Locke (1631-1704) is regarded as the great apostle of protective democracy.
The basic features of protective democracy are as follows

- It propound that the citizen participation is essential in democracies.
- Both the popular sovereignty and representative form of government are legitimate.
- Citizens must be able to protect themselves from governmental encroachments.
- Political equality is understood in formal terms as equal voting rights.
- The authority is accountable to the People and in order to establish it elections are held on regular basis.
- Constitution is the source of power for all and is the guarantor of rights and liberties.

54. In August 2020, a blast has taken place at Beirut killing about one hundred people and thousand wounded. The blast was caused by

(a) dynamite
(b) ammonium nitrate
(c) RDX
(d) mercury nitride

⊗ *(b)* In August 2020, a blast had taken place at Lebanon's capital Beirut. At least 100 people were killed and nearly 4000 injured in this blast. The blast was occurred due to 2700 tonnes of ammonium nitrate stored for six years in a warehouse in the port. Ammonium nitrate (NH_4NO_3) is a white, crystalline chemical which is soluble in water. It is the main ingredient in the manufacture of commercial explosives used in mining and constructions.

55. What is 'Little Boy'?

(a) The fission bomb dropped at Hiroshima
(b) The fusion bomb dropped at Nagasaki
(c) The first nuclear bomb tested by America
(d) The first nuclear bomb tested by North Korea

⊗ *(a)* Little Boy is a codename of the fission bomb dropped at Hiroshima (a city in Japan) on August 6, 1945 by US. Uranium was used in it as a fissile material. On August 9, 1945, US dropped another bomb codenamed Fat Man, on Nagasaki. These bombing marked the end of World War II, with Japan surrendering to the Allies on August 14, 1945. Thousands more died in the following years due to the exposure to radiation from the blast and also from the black rain that fell in the aftermath of the explosions.

56. Which one of the following Indian institutes was approved by the Drugs Controller General of India for conducting human trials of the Oxford-Astra Zeneca COVID-19 vaccine candidate?

(a) Bharat Biotech
(b) AIIMS
(c) Serum Institute of India
(d) National Institute of Epidemiology

⊗ *(c)* Serum Institute of India (SII) was approved by the Drug Controller General of India for conducting trials of the Oxford-Astra Zeneca Coronavirus Vaccine. ChAdOx1 nCoV-19 or AZD1222 has been developed by the Oxford University

and drug maker Astra Zeneca (Anglo-Swedish pharma major).

SII is the world's largest vaccine manufacturer by the number of doses produced and sold globally. It has a manufacturing partnership with Astra Zeneca to produce the Oxford- Astra Zeneca vaccine.

57. The recent explosion near OIL well in Baghjan is due to

(a) removing the spool during the blowout control operations
(b) transfer of oil from its depot to a pipeline
(c) the leakage of methyl isocyanide
(d) the leakage of radiations from radioactive substance

⊙ *(a)* On May 27th, 2020, an explosion was occurred near OIL well in Baghjan (Assam) at the time of removing spool during the blowout control operation. The blowout occurred at Well No. 5 in the Oil Field, resulting in a leak of natural gas.

The leaking well subsequently caught fire and has caused environmental damage to the nearby Dibru-Saikhowa National Park.

58. Who among the following is the architect of the Ram Temple being constructed at Ayodhya?

(a) PO Sompura
(b) Chandrakant Sompura
(c) Brinda Somaya
(d) BV Doshi

⊙ *(b)* Chandrakant Sompura is the architect of the Ram Temple, being constructed at Ayodhya (UP). He is a Ahmedabad-based architect whose design was approved by Shri Ram Janmabhoomi Teerth Kshetra.The stone laying ceremony of the Ram Temple was done by the Prime Minister Narendra Modi in August 2020.

59. Which one of the following countries is not located on the Tropic of Capricorn?

(a) Chile
(b) Brazil
(c) Paraguay
(d) Uruguay

⊙ *(d)* The Tropic of Capricorn is one of the five major circles of latitude marked on maps of Earth. Its latitude is 23°26'11.7'' South of the Equator. There are 10 countries, 3 continents and 3 water bodies on it.

Continent	Country
South America	Argentina, Brazil, Chile Paraguay
Africa	Namibia, Botswana, South Africa, Mozambique, Madagascar
Australia	Australia

Uruguay is not located on Tropic of Capricorn.

60. Match List-I with List-II and select the correct answer using the codes given below the Lists.

List-I (Active Volcano)		List-II (Location)
A. Mount Merapi	1.	Hawaii
B. Sakurajima	2.	Italy
C. Mount Vesuvius	3.	Japan
D. Mauna Loa	4.	Indonesia

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	1	3	2	4
(c)	4	2	3	1
(d)	4	3	2	4

⊙ *(d)* Correct match are as follows

Active Volcano	Location
Mount Merapi	Indonesia
Sakurajima	Japan
Mount Vesuvius	Italy
Mouna Loa	Hawaii

61. Which one of the following is not a major tectonic plate?

(a) Saudi Arabian plate
(b) Antarctica and the surrounding oceanic plate
(c) India-Australia-New Zealand plate
(d) Pacific plate

⊙ *(a)* Lithosphere is divided in different tectonic plates. These plates are of two types- Major and Minor. There 7 major plates and 20 minor plates.

Major Plates are as follows

1. North American plate
2. South American plate
3. Pacific plate
4. Antarctica and the surrounding oceanic plate
5. Eurasia and the adjacent oceanic plate
6. Africa with the eastern Atlantic floor plate
7. India-Australia-New Zealand plate

Saudi Arabian plate is a minor plate. Hence, option (a) is correct.

62. Which one of the following is considered as the deepest point of the oceans?

(a) Tonga Trench
(b) Mariana Trench
(c) Philippine Trench
(d) Kermadec Trench

⊙ *(b)* The Mariana Trench is considered as deepest point of the oceans. It is located in the western Pacific Ocean, East of the Mariana Islands. The maximum known depth is 10,984 m (36,037 ft) at the southern end of a small slot-shaped valley its floor known as the Challenger Deep.

Other Important Trenches of the world

Trench	Ocean
Tonga Trench	Pacific Ocean
Philippine Trench	Pacific Ocean
Kuril-Kamchatka Trench	Pacific Ocean
Kermadec Trench	Pacific Ocean
Izu-Bonin Trench	Pacific Ocean
Japan Trench	Pacific Ocean
Puerto Rico Trench	Atlantic Ocean
South Sandwich Trench	Atlantic Ocean
Peru-Chile Trench or Atacama Trench	Pacific Ocean
Java Trench	Indian Ocean

63. The four planets closest to the Sun are called

(a) Terrestrial planets (b) Giant planets
(c) Dwarf planets   (d) Gas planets

⊙ *(a)* The four planet closest Sun are called Terrestrial planets. It includes Mercury, Venus, Earth, and Mars. Terrestrial planets are Earth-like planets made up of rocks or metals with a hard surface. Terrestrial planets also have a molten heavy-metal core, and topological features such as valleys, volcanoes and craters.

64. Which one of the following countries does not have Tundra vegetation?

(a) Belarus   (b) USA
(c) Russia   (d) Canada

⊙ *(a)* Belarus do not have Tundra vegetation. The tundra is the coldest biome. It also receives low amounts of precipitation, making the tundra similar to a desert. Scattered trees grow in some tundra regions. The tundra soil is rich in nitrogen and phosphorus. Tundra is found in the regions just below the ice caps of the Arctic, extending across North America, to Europe, and Siberia in Asia.

65. Which one of the following is not a fluvial landform?

(a) Cirque   (b) Gorge
(c) Braids   (d) Canyon

⊙ *(a)* Cirque is a glacial landform. The landform created by the glacier are known as glacial landform. Aretes, Nunatak, Esker etc. are important glacial landforms.

66. In the Gandhara School of Art, initially blue schist and green phyllite were used. When did stucco completely replace stone as main material used by Gandhara School sculptors?

(a) 1st Century CE
(b) 2nd Century CE
(c) 3rd Century CE
(d) 5th Century CE

⊙ *(c)* The Gandhara school of Art flourished in the areas of Afghanistan and present North-Western India. It flourished from 1st Century BCE to 4th Century BCE. The material used for in the sculpture making were green phyllite and gray blue schist and Stucco, which was used increasingly after the 3rd Century BCE. This school of Art is associated with the Greco-Roman style of Art. The main theme of this art were derived from the Mahayana Buddhism.

67. Which one of the following statements about Gupta coins is not correct?

(a) Gupta kings issued large number of gold coins known as Dinar.
(b) Chandragupta II, Kumaragupta I, Skandagupta and Budhagupta issued silver coins.
(c) The obverses of coins are carved with the images of the kings and on the reverse are carved deities.
(d) The largest number of coins issued by the Guptas were of copper.

⊙ *(d)* Gupta king issued large number of gold coins known as 'Dinars'. Gupta coins were usually minted in gold and silver. The obverses of coins were carved with the images of the kings in the reverse with deities. Gupta kings like Chandragupta II, Kumaragupta I, Skandagupta and Budhagupta issued silver coins. Gupta kings also depicted socio-political event such as marriage of the kings and queens, Ashvmedha Yagya etc.

Gupta dynasty reigned from 319 to 467 CE. It covered much of the Indian subcontinent.

68. Who among the following wrote The *Philosophy of the Bomb?*

(a) Sukhdev
(b) Chandrashekhar Azad
(c) Bhagwati Charan Vohra
(d) Bhagat Singh

⊙ *(c)* The Philosophy of the Bomb was written by the revolutionary freedom fighter Bhagwati Charan Vohra. He was associated with Hindustan Socialist Republican Association. He died in Lahore on May 28, 1930 while testing a bomb.

69. At which one of the following Sessions of the Indian National Congress was the resolution on Fundamental Rights and Economic Policy passed?

(a) Tripuri Session
(b) Lahore Session
(c) Lucknow Session
(d) Karachi Session

⊙ *(d)* At the Karachi Session (1931), the Indian National Congress passed to resolution on Fundamental Rights (FR) and Economic policy.

70. Which one of the following towns was not a centre of the Revolt of 1857?

(a) Ayodhya   (b) Agra
(c) Delhi   (d) Kanpur

⊙ *(b)* Agra was not a centre of the Revolt of 1857. In 1857, people of country started a revolt against the exploitative British government. The revolt began on 10th May 1857, at Meerut in the form of sepoy mutiny. The political economic and socio-religious activities of British government were responsible for the revolt.

71. Consider the following statements :

The Azamgarh Proclamation refers to

1. the declaration by the rebels of 1857.
2. the statement by the leader of the underground movement in the Revolt of 1942.

Which of the statements given above is/are not correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ *(b)* The Azamgarg proclamation was declared by the Feroz Shah, (Grandson of the Mughal Emperor) in 1857.

He fought against the British forces in the Awadh region of Uttar Pradesh. It was like a manifesto in which aims were set out for what rebels were fighting for. This proclamation appealed both Hindus and Muslims to cooperate with each other in fight against the Britishers.

72. Ibn Batuta went to China as the envoy of which one of the following Delhi Sultans?

(a) Alauddin Khilji
(b) Muhammad bin Tughluq
(c) Iltutmish
(d) Firoz Shah Tughluq

⊙ *(b)* Muhammad bin Tughlaq (AD 1324-51) had sent Ibn Batuta (Moroccan Traveller) to China as the envoy. Ibn Batuta arrived India in AD 1334. He wrote about the history of the Tughlaq dynasty.

73. Al-Biruni's Kitab-ul-Hind was written in which language?

(a) Arabic   (b) Persian
(c) Urdu   (d) Turkish

⊙ *(a)* Al-Biruni's Kitab-ul-Hind was written in Arabic language. He came to India with Mahmud Ghazni in 11th Century AD and lived here for many years. He also learnt Sanskrit language. In this book, he described the socio-economic, political, religious and economic condition of the then India.

74. Which of the following statements with regard to the privileges of the Members of the Parliament are correct?

1. Privileges would not be fettered by the Article-19(1)(a) of the Constitution of India.
2. Privileges must be read subject to the Articles-20-22 and Article-32 of the Constitution of India.
3. Immunity is available in relation to both civil and criminal prosecution.
4. Immunity is available in relation to freedom of speech even in his/her private or personal capacity.

Select the correct answer using the codes given below.

(a) 1, 2 and 4   (b) 1 and 2
(c) 2 and 3   (d) 1 and 4

⊙ *(b)* Every Member of the Parliament enjoys certain privileges so that they can carry out their duty without interference. Privileges are of two type-Collective and Individual.

Individual Privileges of Member of Parliament include.

- Immunity from assest during the session of Parliament. This privilege is available in civil case only.
- A MP may refuse to appear in court or present any evidence, during a Parliamentary session.
- No member is liable to any proceeding in any given court for anything said or any vote by him/her in the Parliament or its committees.

Privileges would not be fettered by the Article-191(a) of the Constitution. And it must be read subject to the Article 20-22 and Article-32 of the Constitution. Privileges does not cover freedom of speech in his/her private or personal capacity.

75. Which one of the following statements with regard to the appointment of the Members of the Parliamentary Committees is correct?

(a) The Members are only appointed
(b) The Members are only elected
(c) The Members are only nominated.
(d) The Members are appointed or elected on a motion made and adopted or nominated by the Speaker of the Lok Sabha or the Chairman of the Rajya Sabha

⊘ *(c)* Parliamentary Committees are constituted to perform various functions. Members are appointed or elected on a motion made and adopted or nominated by the Speaker of Lok Sabha or the Chairman of the Rajya Sabha. It has a secretariat provided by the Lok Sabha/Rajya Sabha secretariat. Indian Constitution mentions two kinds of Parliamentary Committees - Standing Committees and Ad Hoc Committees.

Standing Committees are permanent committees and are constituted for a fixed tenure. Ad hoc Committees are appointed for a specific purpose and they cease to exist when they finish the task assigned to them after submitting the report.

76. Which one of the following is not a classified category of political parties as outlined by the Election Commission of India?

(a) National Parties
(b) State Recognised Parties
(c) Regional Parties
(d) Registered Unrecognised Parties

⊘ *(b)* State Recognised Parties is not a classified category of political parties

in India as outlined the Election Commission. The Commission classifies parties into three main heads: National Parties, State Parties, and Registered (unrecognised) Parties.

Political parties in India are classified for the allocation of symbols. Currently, there are 8 National Parties. It includes the Indian National Congress (INC), the Nationalist Congress Party (NCP), the Bharatiya Janata Party (BJP), the Communist Party of India (CPI), the Communist Party of India, Marxists (CPI-M), the Bahujan Samaj Party (BSP), and the Rashtriya Janata Dal (RJD).

77. Which of the following terms were added to the Preamble of the Constitution of India by the Constitutional Amendment, 1976?

1. Socialist   2. Secular
3. Integrity   4. Fraternity

Select the correct answer using the codes given below.

(a) 1 and 2   (b) 1, 2 and 3
(c) 2 and 4   (d) 1, 3 and 4

⊘ *(b)* The 42nd Amendment Act, 1976 added words 'Socialist', 'Secular' and 'Integrity' in the Preamble of the Constitution of India. This Amendment is termed as Mini Constitution. *Other Provision of this Amendment-*

- Added Fundamental Duties by the citizens (new Part IV A).
- Made the President bound by the advice of the cabinet.
- Provided for administrative tribunals and tribunals for other matters (Added Part-XIV A).
- Frozen the seats in the Lok Sabha and State Legislative Assemblies on the basis of 1971 census till 2001-Population Controlling Measure
- Made the constitutional amendments beyond judicial scrutiny.
- Curtailed the power of judicial review and writ jurisdiction of the Supreme Court and High Courts.
- Raised the tenure of Lok Sabha and State Legislative Assemblies from 5 to 6 years.

78. Who among the following was the advisor to the Constituent Assembly?

(a) BN Rau
(b) BR Ambedkar
(c) Pattabhi Sitaramayya
(d) Alladi Krishnaswamy

⊘ *(a)* BN Rau was appointed as the Constitutional Adviser to the Constituent Assembly in 1946. He created general draft of the Constitution of India. He was also India's representative to the United Nations Security Council from 1950 to 1952.
BR Ambedkar was the President of the Drafting Committee of the Constituent Assembly.
Pattabhi Sitaramayya played instrumental role in the creation of Andhra Pradesh in 1953.
Alladi Krishnaswamy Iyer was the member of the Drafting Committee of the Constituent Assembly.

79. In the Indian judicial system, writs are issued by

(a) the Supreme Court only
(b) the High Courts only
(c) the Supreme Court and High Courts only
(d) the Supreme Court, High Courts and Lower Courts

⊘ *(c)* The Constitution of India under Article-32 and 226 empowers the Supreme Court of India High Court to issue writs respectively. Writs are a written order that commands constitutional remedies for Indian Citizens against the violation of their Fundamental Rights. Writs are of five types, namely, Habeas Corpus, Prohibition, Mandamus, Certiorari and Quo-Warranto. The High Courts can issue writs not only for the preservation of Fundamental Rights, but also for any other purpose. However, the Supreme Court can issue writs only for the preservation of Fundamental Rights.

80. The Citizenship (Amendment) Act falls under which one of the following parts of the Constitution of India?

(a) Part I   (b) Part II
(c) Part IV   (d) Part VI

⊘ *(b)* The Citizenship (Amendment) Act falls under Part II of the Constitution of India. This part contains Articles-5-11.

Article	Provision
5	Citizenship at the commencement of the Constitution
6	Citizenship of certain persons who have migrated from Pakistan
7	Citizenship of certain migrants to Pakistan
8	Citizenship of certain persons of Indian origin residing outside India
9	People voluntarily acquiring citizenship of a foreign country will not be citizens of India.

Article	Provision
10	Any person who is considered a citizen of India under any of the provisions of this Part shall continue to be citizens and will also be subject
	to any law made by the Parliament.
11	The Parliament has the right to make any provision concerning the acquisition and termination of citizenship and any other
	matter relating to citizenship.

81. Recently a rare kind of yellow turtle was discovered in India. The State in which it was seen is

(a) Uttarakhand
(b) Odisha
(c) Tamil Nadu
(d) Arunachal Pradesh

⊙ *(b)* A rare Yellow Turtle was discovered in India from Balasore district of Odisha. The colour of turtle was due to albinism. This turtle is known as the Indian flap shell turtle. This turtle is commonly found in Pakistan, Sri Lanka, India, Nepal, Bangladesh, and Myanmar. Albinism is a type of genetic disorder where it is little or no production of pigment in the skin, eyes, and hair or in other species in the fur, feathers or scales.

82. ASEEM is

(a) Aatmanirbhar Skilled Employee Employer Measurement
(b) Aatmanirbhar Skilled Employee Employer Mapping
(c) Aatmanirbhar Skilled Employee Enterprises Medium
(d) Automatic Skilled Employee Employer Mission

⊙ *(b)* ASEEM is an acronym of 'Aatamanirbhar Skilled Employee Employer Mapping' portal. It was launched by the Ministry of Skill Development and Entrepreneurship (MSDE) in July 2020 to help skilled people in fighting sustainable livelihood opportunities.

It is Managed by the National Skill Development Corporation (NSDC) in collaboration with Bengaluru-based company 'Betterplace'.

The ASEEM digital platform consists of three IT-based interfaces

Employer Portal Employer onboarding, Demand Aggregation, candidate selection

Dashboard Reports, Trends, analytics, and highlight gaps

Candidate Application Create and Track candidate profile, share job suggestion

83. The Government of India programme regarding 'Stay in India and Study in India' is initiated by

(a) the Ministry of Youth Affairs and Sports
(b) the Ministry of Culture
(c) the Ministry of Education
(d) the Ministry of Tourism

⊙ *(c)* A programme called 'Study in India - Stay in India' was initiated by the Ministry of Education in August, 2020. The objective of this plan is to prevent students from leaving the country seeking higher education abroad and also to bring back Indian students studying abroad.

For this initiative a committee has been constituted under the leadership of DK Singh to prepare guidelines and measures to strengthen both Study in India - Stay in India.

84. Which one of the following lakes in India has a large quantity of a substance found in the Moon?

(a) Lonar Lake (Maharashtra)
(b) Pangong Lake (Ladakh)
(c) Chilika Lake (Odisha)
(d) Loktak Lake (Manipur)

⊙ *(a)* Lonar Lake is in Indian State of Maharashtra and it has a large quantity of a substance found in the Moon. In March 2019, IIT-Bombay had found in research that mineral contents of Lonar lake is similar to Moon rocks. This lake was formed after a meteorite crash around 50,000 years ago.

⊙ The Lonar Crater is also a wildlife sanctuary and a notified Geo-Heritage monument. It is home to a variety of flora and fauna.

85. The Pragyan rover installed in Chandrayaan-2 mission had how many wheels?

(a) 2
(b) 3
(c) 4
(d) 6

⊙ *(d)* Indian Space Research Organisation (ISRO) launched Mission Chandrayaan-2 in July 2019 (Mission was unsuccessful). This Mission was comprised of Vikram, the lander and Pragyan, the rover. Pragyan was a six-wheeled solar-powered vehicle. It was sent to study the composition of the surface near the lunar landing site and determine the abundance of various elements.

86. If the linear momentum of a moving object gets doubled due to application of a force, then its kinetic energy will

(a) remain same
(b) increase by four times
(c) increase by two times
(d) increase by eight times

⊙ *(b)* Let m be the mass and v be the velocity of the moving object.
Kinetic energy of object,

$$K = \frac{1}{2}mv^2 = \frac{1}{2m}(m^2v^2)$$

$$K = \frac{1}{2m}(mv)^2 \qquad \dots(i)$$

Now, linear momentum,

$$p = mv \qquad \dots(ii)$$

Substituting Eq (ii) in Eq (i), we get

$$K = \frac{p^2}{2m} \implies K \propto p^2$$

If linear momentum gets doubled, then new kinetic energy will become

$$K' = \frac{(2p)^2}{2m}$$

$$= \frac{4p^2}{2m}$$

$$K' = 4K$$

Hence, if linear momentum of a moving object gets doubled, its kinetic energy will increase by four times.

87. If the distance between two objectsi s increased by two times, the gravitational force between them will

(a) remain same
(b) increase by two times
(c) decrease by two times
(d) decrease by four times

⊙ *(d)* The gravitational force between two objects of masses m_1 and m_2, separated by a distance r is given by

$$F = \frac{Gm_1m_2}{r^2} \qquad \dots(i)$$

where, G is the universal gravitational constant.

If the distance between the objects is increased by two times, the gravitational force will become,

$$F' = \frac{Gm_1m_2}{(2r)^2}$$

$$= \frac{Gm_1m_2}{4r^2}$$

$$\implies F' = \frac{F}{4} \qquad \text{[Using Eq (i)]}$$

Hence, the gravitational force will decrease by four times.

88. Which one of the following statements about the properties of neutrons is not correct?

(a) Neutron mass is almost equal to proton mass.
(b) Neutrons possess zero charge.
(c) Neutrons are located inside the atomic nuclei.
(d) Neutrons revolve around the atomic nuclei.

⊙ *(d)* Statement (d) is not correct about the properties of neutrons, whereas all other statements are correct.

Correct Statement Electrons revolve around the atomic nuclei, not neutrons.

89. Which one of the following statements with regard to the ultraviolet light is not correct?

(a) It is an electromagnetic wave
(b) It can travel through vacuum
(c) It is a longitudinal wave
(d) Its wavelength is shorter/smaller than that of visible light

⊙ *(c)* Statement in option (c) is not correct about the ultraviolet light.

The correct statement is :
Ultraviolet light is a transverse wave.

90. If the speed of light in air is represented by c and the speed in a medium is v, then the refractive index of the medium can be calculated using the formula

(a) v/c 　　　　　　(b) c/v
(c) $c/(2.v)$ 　　　　(d) $\dfrac{(c-v)}{c}$

⊙ *(b)* Refractive index of medium

$= \dfrac{\text{Speed of light in air}}{\text{Speed of light in medium}} = \dfrac{c}{v}$

91. Under the kingdom– Plantae, which of the following individuals are predominantly aquatic?

(a) Bryophytes 　　　(b) Algae
(c) Pteridophyta 　　(d) Gymnosperms

⊙ *(b)* Under the kingdom– plantae, Phyllum-Algae have individuals that are predominantly aquatic (both fresh water and marine).

These are chlorophyll bearing simple, thalloid, autotrophic organism. They occurs in a variety of habitats like standing water, moist stones, soils and woods.

92. All the individuals of a particular organism, such as rose plants, belong to a taxonomic category called

(a) Species 　　　　(b) Genus
(c) Family 　　　　(d) Order

⊙ *(a)* All the individuals of a particular organism, such as rose plants belongs to a taxonomic category called species because species is a group of individual organisms with fundamental similarities.

93. Pearls are harvested from

(a) prawn 　　　　　(b) pila
(c) tuna 　　　　　　(d) oyster

⊙ *(d)* Pearls are harvested from oyster. A pearl is an ulcer formed in the oysters when an unknown outside particle get into the shell. It is due to the stress that the oysters produce nacre that will eventually become the pearl in a couple of years. So, basically the pearl is the result of a disease in the oyster's body.

94. Wings of birds and bats are considered analogous structures because they have

(a) common origin and common function
(b) different origin and common function
(c) common origin and different function
(d) different origin and different function

⊙ *(b)* Wings of birds and bats looks alike and perform same function of flying. But anatomically they are different in origin. Birds have feathers projecting back from lightweight, fused arms and hand bones. Bats have flexible, relatively short wings with membranes stretched between elongated fingers. Thus, these are analogous.

95. Apart from hyper acid secretion, peptic ulcers are also developed due to bacterial infection. The causative agent is

(a) *Helicobacter pylori*
(b) *E. coli*
(c) *Streptococcus pneumoniae*
(d) *Salmonella typhimurium*

⊙ *(a)* *Helicobacter pylori* is the causative agent of peptic ulcer. It is a sore that develops on the living of the oesophagus, stomach or small intestine. Ulcer occurs when stomach acid damages the living of the digestive tract. Common causes of ulcer include the bacteria *H. pylori* and anti-inflammatory pain relievers including aspirin.

96. A mixture of sodium chloride (salt) and ammonium chloride can be separated by

(a) sublimation 　　(b) filtration
(c) chromatography (d) distillation

⊙ *(a)* A mixture of sodium chloride (salt) and ammonium chloride can be separated by sublimation. This technique involves the conversion of a solid direct into vapour. On heating, ammonium chloride changes from solid state to ammonia vapours. Here, ammonium chloride can be sublimed whereas sodium chloride cannot be sublimed.

97. Symbol of element was introduced by

(a) John Dalton
(b) Antoine Lavoisier
(c) Jons Jacob Berzelius
(d) Robert Boyle

⊙ *(a)* Symbol of element was introduced by John Dalton. Symbols are the representation of an element. It is simple to use the symbol of an element rather than writing a whole word.

Some symbols along with elements are as follows :

⊙ Hydrogen 　　● Carbon
⊗ Phosphorus 　⊕ Sulphur
© Copper 　　　Ⓛ Lead

98. Identify the correct pair of elements among the following which are liquid at room temperature and standard pressure.
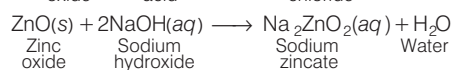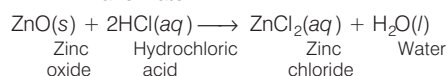
(a) Bromine and Fluorine
(b) Mercury and Rubidium
(c) Bromine and Thallium
(d) Bromine and Mercury

⊙ *(d)* Bromine and Mercury is the pair of element which are liquid at room temperature and standard pressure. Bromine is a liquid non-metal whereas mercury is a liquid metal.

99. Which one of the following oxides shows both acidic and basic behaviour?

(a) Zinc oxide 　　　(b) Copper oxide
(c) Magnesium oxide
(d) Calcium oxide

⊙ *(a)* Zinc oxide (ZnO) shows both acidic and basic behaviour. It reacts with both acids and bases to form salt and water.

$\underset{\substack{\text{Zinc}\\\text{oxide}}}{ZnO(s)} + \underset{\substack{\text{Hydrochloric}\\\text{acid}}}{2HCl(aq)} \longrightarrow \underset{\substack{\text{Zinc}\\\text{chloride}}}{ZnCl_2(aq)} + \underset{\text{Water}}{H_2O(l)}$

$\underset{\substack{\text{Zinc}\\\text{oxide}}}{ZnO(s)} + \underset{\substack{\text{Sodium}\\\text{hydroxide}}}{2NaOH(aq)} \longrightarrow \underset{\substack{\text{Sodium}\\\text{zincate}}}{Na_2ZnO_2(aq)} + \underset{\text{Water}}{H_2O}$

100. Silver articles turn black when kept in the open for longer time due to the formation of

(a) H_2S 　(b) AgS 　(c) $AgSO_4$ 　(d) Ag_2S

⊘ **(d)** Silver articles turn black when kept in the open for longer time due to the formation of silver sulphide (Ag_2S). Silver metal reacts with sulphur present in the atmosphere and forms Ag_2S. Complete reaction is as follows

$$2Ag + S \longrightarrow Ag_2S$$

101. Which of the following lenses will bend the light rays through largest angle?

(a) Lens with power + 2.0 D
(b) Lens with power + 2.5 D
(c) Lens with power − 1.5 D
(d) Lens with power − 2.0 D

⊘ **(b)** The power of a lens is defined as its ability to bend the light rays falling on it. So, the lens with more power will bend the light rays through largest angle.

∴ The lens with + 2.5 D will bend the light rays through largest angle.

102. A luminous object is placed at a distance of 40 cm from a converging lens of focal length 25 cm. The image obtained in the screen is

(a) erect and magnified
(b) erect and smaller
(c) inverted and magnified
(d) inverted and smaller

⊘ **(c)** Given,

Object distance, $u = -40$ cm
Focal length, $f = 25$ cm
Let v be the image distance.
From lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow \quad \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{25} + \frac{1}{(-40)}$$

$$\Rightarrow \quad \frac{1}{v} = \frac{1}{25} - \frac{1}{40} = \frac{8-5}{200} = \frac{3}{200}$$

$$\Rightarrow \quad v = \frac{200}{3} = 66.7 \text{ cm}$$

Now, magnification produced by lens,

$$m = \frac{v}{u} = \frac{66.7}{(-40)} = -1.66$$

Since, the magnification is negative, so the image formed will be real and inverted.

Also, the magnitude of magnification is greater than unity, so the image will be magnified.

103. When a light ray enters into glass medium from water at an angle of incidence 0°, what would be the angle of refraction?

(a) 90°   (b) 45°
(c) 0°
(d) The ray will not enter at all

⊘ **(c)** When a light ray enters into glass medium from water at angle of incidence 0°, it will fall normally on the glass medium.

```
            │ Normal
            │
Water  ─────┼─────
Glass       │
            │
            │
```
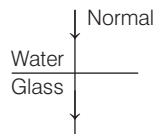
If the incident ray falls normally to the surface of glass medium, then there will be no bending of the light ray. It goes straight without any deviation.

∴ Angle of refraction = 0°

104. Which one of the following phenomena verifies the fact that light travels much faster than sound?

(a) Twinkling of stars in night sky
(b) Lighting of a matchstick
(c) Thunderstorm
(d) Mirage

⊘ **(c)** In case of a thunderstorm, the lightning is seen first and then we hear the thunder after some time.

This is because light travels with speed $3 \times 10^8 \text{ ms}^{-1}$ in air while sound travels at a speed of 340 ms^{-1} in air. This phenomenon proves the fact that light travels much faster than sound.

105. Which one of the following combinations of source and screen would produce sharpest shadow of an opaque object?

(a) A point source and an opaque screen
(b) An extended source and an opaque screen
(c) A point source and a transparent screen
(d) An extended source and a transparent screen

⊘ **(c)** To form the sharpest shadow of an opaque object, a point source and a transparent screen are required.

106. Which one among the following is a non-conventional source of energy?

(a) Petroleum
(b) Coal
(c) Radioactive elements
(d) Solar energy

⊘ **(d)** Non-conventional sources of energy are those sources of energy which are being produced continuously in nature and are inexhaustible. Amongst the given options, solar energy is a non-conventional source of energy.

107. Which one of the following statements about phloem is correct?

(a) Phloem transports water and minerals.
(b) Phloem transports photosynthetic products.
(c) Phloem is a simple tissue.
(d) Phloem gives support to the plant.

⊘ **(d)** Option (b) is correct as the phloem is the means by which the products of photosynthesis are transported to non-photosynthetic parts of the plant, such as the roots and to developing leaves, nectaries, fruits and seeds. Other statements can be corrected as

• Xylem transports water and minerals.
• Phloem is a complex tissue.
• Primary function of phloem is transport of sugars not support.

108. Mature sclerenchyma cells have

(a) cellulose wall and are living
(b) lignified wall and are living
(c) suberized wall and are dead
(d) lignified wall and are dead

⊘ **(d)** Mature Sclerenchyma consists of long, narrow cells with thick and lignified cell walls having a few or numerous pits.
They are usually dead and without protoplasts.

109. In human beings, the chromosomes that determine birth of a normal female child are

(a) one X chromosome from mother and one X chromosome from father
(b) one X chromosome from mother and one Y chromosome from father
(c) two X chromosomes from mother and one X chromosome from father
(d) one X chromosome and one Y chromosome from father and one X chromosome from mother

⊘ **(a)** The chromosome number of a normal female is 44 + XX. It has one X-chromosomes which comes from mother and one X-chromosome which comes from father.
Thus option 'A' is correct.

• Fusion of two X from mother and one X from father will lead to birth of superfemale (XXX).
• Fusion of one X-chromosome and one Y-chromosome from father and one X-chromosome from mother will lead to birth of a child with Klienfelter syndrome (XXY).

110. Antibiotic such as penicillin blocks
   (a) cell wall formation in bacteria
   (b) RNA synthesis in bacteria
   (c) DNA synthesis in bacteria
   (d) division in bacteria

   ⊙ *(a)* Antibiotics such as penicillin kills bacteria by inhibiting or blocking the proteins which cross-link pepti-doglycans in the cell wall. When these bacterium divides in the presence of penicillin, it cannot fill in the 'holes' left in its cell wall.

111. The radioactive isotope of hydrogen is
   (a) protium   (b) deuterium
   (c) tritium   (d) hydronium

   ⊙ *(c)* Tritium is the radioactive isotope of hydrogen. The nucleus of tritium contains one proton and two neutrons. It is represented as ^{3}H or T. It is used as a radioactive tracer, in radioluminescent light sources for watches and instruments.

112. Which one of the following is used for storing biological tissues?
   (a) Liquid nitrogen (b) Liquid helium
   (c) Liquid argon   (d) Liquid bromine

   ⊙ *(a)* Liquid nitrogen is used for storing biological tissues. This process is known as Cryo preservation.

   In this process, organelles, cells tissues or other biological lonsbuets susceptible to damage caused by unregulate Chemical kinetics are preserved by cooling to very low temperatures.
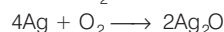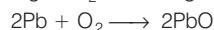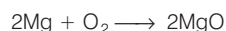
113. Which one of the following does not form oxide on reaction with oxygen?
   (a) Magnesium   (b) Lead
   (c) Tin   (d) Silver

   ⊙ *(c)* Tin (Sn) does not form oxide on reaction with oxygen. It readily form peroxide. Complete reaction is
   $$Sn + O_2 \longrightarrow \underset{\text{Tin peroxide}}{SnO_2}$$
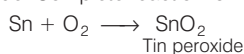
   All other options such as magnesium (Mg), lead (Pb) and Silver (Ag) forms oxide. Reactions are as follows
   $$2Mg + O_2 \longrightarrow 2MgO$$
   $$2Pb + O_2 \longrightarrow 2PbO$$
   $$4Ag + O_2 \longrightarrow 2Ag_2O$$

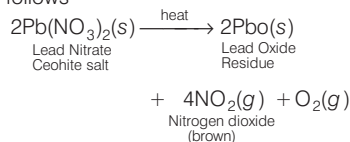**114.** The valency of phosphorus is
   (a) 2, 3   (b) 3, 4   (c) 4, 5   (d) 3, 5

   ⊙ *(d)* Valency of phosphorus is 3, 5-orbits are stable when they are fully filled or half filled. So, to attain a stable configuration it can take 3 electrons or remove 5 electrons. So, valency of 'P' is 3 and 5.

115. Lead nitrate on heating gives
   (a) PbO_2 and NO_2
   (b) PbO and NO_2
   (c) PbO and NO
   (d) PbO_2 and NO

   ⊙ *(b)* Lead nitrate on heating gives PbO (lead oxide) and NO_2 (nitrogen dioxide). Complete reaction is as follows
   $$\underset{\substack{\text{Lead Nitrate}\\\text{Ceohite salt}}}{2Pb(NO_3)_2(s)} \xrightarrow{\text{heat}} \underset{\substack{\text{Lead Oxide}\\\text{Residue}}}{2Pbo(s)}$$
   $$+ \underset{\substack{\text{Nitrogen dioxide}\\\text{(brown)}}}{4NO_2(g)} + O_2(g)$$

116. Which one of the following is a decommissioned aircraft carrier?
   (a) INS Rajput   (b) INS Chakra
   (c) INS Khanderi   (d) INS Viraat

   ⊙ *(d)* Amongst the given options, INS Viraat is a decommissioned aircraft carrier. It was a Centaur-class aircraft carrier of the Indian Navy. India acquired this aircraft carrier from England and commissioned into the Indian Navy on May 12th, 1987. Viraat was formally decommissioned on March 6th, 2017.

   INS Khanderi is a Kalvari-class submarine, built in India. **INS Rajput** is a guided-missile destroyer. **INS Chakra** is a nuclear-powered attack submarine.

117. Who among the following has won the Singles Title in Wimbledon Tennis Championship (Women) in the year 2019?
   (a) Karolina Pliskova (b) Simona Halep
   (c) Serena Williams (d) Naomi Osaka

   ⊙ *(b)* Simona Halep (Romania) won the Women's Singles title in Wimbledon Tennis Championship in the year 2019.

   Other Winners

Category	Winner
Men's Singles	N. Djokovic (Serbia)
Men's Doubles	Juan Sebastian Cabal (Colombia) and Robert Farah (Colombia)
Women's Doubles	SW. Hsieh (Taiwan) and B. Strycova (Czech Republic)
Mixed Doubles	I. Dodig (Croatia) and L. Chan (Taiwan)

118. Recently islands of Andaman and Nicobar were connected with mainland by Submarine Optical Fibre Cable.

Which one of the following islands was not connected initially?
   (a) Shaheed Island
   (b) Swaraj Island
   (c) Little Andaman
   (d) Port Blair

   ⊙ *(a)* In August 2020, submarine Optical Fibre Cable (OFC) connecting Andaman and Nicobar Islands to the mainland was inaugurated. Services began from Chennai to Port Blair, Port Blair to Little Andaman and Port Blair to Swaraj Island. Hence, Shaheed Island was not connected initially. The project of laying 2300 km optical fibre started in December, 2018.

   A submarine optical fibre communications cable is a cable laid on the seabed between land-based stations to transmit tele-communication signals across stretches of ocean and sea.

119. In August 2020, who among the following was administered the oath as the Prime Minister of Sri Lanka for the fourth time?
   (a) Gotabaya Rajapaksa
   (b) Basil Rajapaksa
   (c) Mahinda Rajapaksa
   (d) Namal Rajapaksa

   ⊙ *(c)* Mahinda Rajapaksa was administered oath as the Prime Minister of Sri Lanka for the fourth time in August 2020. He is leader of Sri Lanka People's Party (SLPP) leader. His party registered victory in 145 constituencies, bagging a total of 150 seats with its allies, a two-thirds majority in the 225-member Parliament. He has replaced Ranil Wickremesinghe.Mahinda Rajapaksa was sworn in as the Prime Minister for the first time on 6th April, 2004.

120. Which one of the following Indian Ocean island nations has recently declared a State of environmental emergency due to oil spill from a grounded ship?
   (a) Maldives   (b) Mauritius
   (c) Madagascar   (d) Sri Lanka

   ⊙ *(a)* Mauritius is an island nation in the Indian Ocean, which declared a state of emergency due to oil spill in August 2020. A japanese bulk-carrier ship MV Wakashio which was carrying fuel oil had split into two parts near Blue Bay Marine Park in South-East Mauritius. It caused leakage of over 1000 tonnes of oil. It endangers the already endangered coral reefs, seagrasses, mangroves, the fishes and other aquatic fauna.

CDS

Combined Defence Service

SOLVED PAPER 2020 (I)

> ## PAPER I Elementary Mathematics

1. The number $2 \times 3 \times 5 \times 7 \times 11 + 1$ is

(a) a prime number
(b) not a prime, but power of a prime
(c) not a power of a prime, but a composite even number
(d) not a power of a prime, but a composite odd number

⊙ **(a)** Given, number
$2 \times 3 \times 5 \times 7 \times 11 + 1$
$= 2310 + 1 = 2311$
Which is a prime number.

2. Two unequal pairs of numbers satisfy the following conditions

(i) The product of the two numbers in each pair is 2160.
(ii) The HCF of the two numbers in each pair is 12.

If x is the mean of the numbers in the first pair and y is the mean of the numbers in the second pair, then what is the mean of x and y?

(a) 60   (b) 72   (c) 75   (d) 78

⊙ **(b)** Let two unequal pairs of numbers are $(12a, 12b)$ and $(12c, 12d)$.
According to the question,
$12a \times 12b = 12c \times 12d = 2160$
$\Rightarrow \quad a \times b = c \times d = 15$
Here factors of 15 are 1, 3, 5, 15
$\therefore a = 1, b = 3, c = 5, d = 15$
Now, $x = \dfrac{12a + 12b}{2}, y = \dfrac{12c + 12d}{2}$
$\therefore$ Mean of x and $y = \dfrac{x + y}{2}$
$= \dfrac{12(a + b + c + d)}{4}$
$= 3(1 + 3 + 5 + 15)$
$= 3 \times 24 = 72$

3. How many digits are there in $(54)^{10}$?
(Given that $\log_{10} 2 = 0.301$ and $\log_{10} 3 = 0.477$)

(a) 16   (b) 18
(c) 19   (d) 27

⊙ **(b)** Let $x = (54)^{10}$
$\Rightarrow \log x = 10 \log 54$
$= 10 \log(2 \times 3^3)$
$= 10 \{\log 2 + 3 \log 3\}$
$= 10 \{0.301 + 3 \times 0.477\}$
$= 10 \{0.301 + 1.431\}$
$= 10 \times 1.732 = 17.32$
Since, the characteristic of $\log x$ is 17.
$\therefore$ Number of digits is $(54)^{10}$ is
$17 + 1 = 18$

4. Which one of the following is a set of solutions of the equation $x^{\sqrt{x}} = \sqrt[n]{x^x}$, if n is a positive integer?

(a) $\{1, n^2\}$ (b) $\{1, \sqrt{n}\}$
(c) $\{1, n\}$ (d) $\{n, n^2\}$

⊙ **(a)** Given, $x^{\sqrt{x}} = \sqrt[n]{x^x}$ ...(i)
$\Rightarrow \quad x^{x^{1/2}} = (x^x)^{1/n}$
$\Rightarrow \quad x^{x^{1/2}} = x^{x/n}$
$\Rightarrow \quad x^{1/2} = x/n$
$\Rightarrow \quad x^{1/2} = n$
$\Rightarrow \quad x = n^2$
On putting $x = 1$ in Eq. (i), we get
$(1)^{\sqrt{1}} = (1^1)^{1/n}$
$\Rightarrow \quad 1 = 1$
$\Rightarrow x = 1$ also satisfies the given equation.
So, solution set is $\{1, n^2\}$

5. In a competitive examination, 250 students have registered. Out of these, 50 students have registered for Physics, 75 students for Mathematics and 35 students for both Mathematics and Physics. What is the number of students who have registered neither for Physics nor for Mathematics?

(a) 90   (b) 100   (c) 150   (d) 160

⊙ **(d)** Total number of students have registered = 250
Students have registered for Physics = 50
Students have registered for Mathematics = 75
And students have registered for both Mathematics and Physics = 35
$\therefore$ Number of students who registered for atleast one subject
$= (50 - 35) + (75 - 35) + 35$
$= 15 + 40 + 35 = 90$
$\therefore$ The number of students who have registered neither for Physics nor for Mathematics = 250 − 90 = 160

6. If the sum of the digits of a number $10^n - 1$, where n is a natural number, is equal to 3798, then what is the value of n?

(a) 421   (b) 422   (c) 423   (d) 424

⊙ **(b)** Given, number $= 10^n - 1$
For $n = 1, 10^1 - 1 = 9$
For $n = 2, 10^2 - 1 = 99$
For $n = 3, 10^3 - 1 = 999$
$\therefore$ Sum of digits of $10^n - 1 = 9n$,
where n is a natural number.
$\therefore \quad 9n = 3798 \Rightarrow n = 422$

7. Which one of the following is the largest number among 2222^2, 222^{22}, 22^{222}, 2^{2222}?

(a) 2^{2222} (b) 22^{222} (c) 222^{22} (d) 2222^2

⊗ **(a)** Given, $2222^2, 222^{22}, 22^{222}, 2^{2222}$

Taking log
$= \log(2222)^2, \log(222)^{22}, \log(22)^{222},$
$\qquad\qquad\qquad\qquad \log(2)^{2222}$
$= 2\log(2222), 22\log(222), 222\log(22),$
$\qquad\qquad\qquad\qquad 2222\log(2)$
$= 2\log(2 \times 1111), 22\log(2 \times 111),$
$\qquad\qquad 222\log(2 \times 11), 2222\log(2)$
$= 2(\log 2 + \log 1111),$
$\qquad\qquad 22(\log 2 + \log 111),$
$\qquad\qquad 222(\log 2 + \log 11), 2222 \log 2$
$= 2(0.301 + 3), 22(0.301 + 2),$
$\qquad\qquad 222(0.301 + 1), 2222(0.301)$

Since, $\log 2 = 0.301$,
$\qquad\qquad\qquad \log 1111 = 3$ (approx.)
$\log 111 = 2$ (approx.),
$\qquad\qquad\qquad \log 11 = 1$ (approx.)
$= 2(3.301), 22(2.301), 222(1.301),$
$\qquad\qquad\qquad\qquad 2222(0.301)$
$= 6.602, 55.622, 288.822, 668.822$
Thus, 2^{2222} is the largest number.

8. If m is the number of prime numbers between 0 and 50; and n is the number of prime numbers between 50 and 100, then what is $(m - n)$ equal to?

(a) 4   (b) 5   (c) 6   (d) 7

⊗ **(b)** Prime numbers between 0 and 50 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 19, 31, 37, 41, 43, 47.
∴ Total number of prime numbers between 0 to 50.
∴ $m = 15$
And Prime numbers between 50 to 100 are
53, 59, 61, 67, 71, 73, 79, 83, 89, 97
∴ Total number of prime numbers between 50 to 100
∴ $n = 10$
∴ $m - n = 15 - 10 = 5$

9. If $\dfrac{a}{b} = \dfrac{1}{3}, \dfrac{b}{c} = 2, \dfrac{c}{d} = \dfrac{1}{2}, \dfrac{d}{e} = 3$ and $\dfrac{e}{f} = \dfrac{1}{4}$, then what is the value of $\dfrac{abc}{def}$?

(a) $\dfrac{1}{4}$ (b) $\dfrac{3}{4}$ (c) $\dfrac{3}{8}$ (d) $\dfrac{27}{4}$

⊗ **(c)** Given, $\dfrac{a}{b} = \dfrac{1}{3}$ … (i)

$\dfrac{b}{c} = 2$ … (ii)

$\dfrac{c}{d} = \dfrac{1}{2}$ … (iii)

$\dfrac{d}{e} = 3$ … (iv)

and $\dfrac{e}{f} = \dfrac{1}{4}$ … (v)

On multiplying Eqs. (i), (ii) and (iii), we get
$\dfrac{a}{b} \times \dfrac{b}{c} \times \dfrac{c}{d} = \dfrac{1}{3} \times 2 \times \dfrac{1}{2} = \dfrac{1}{3}$
⇒ $\dfrac{a}{d} = \dfrac{1}{3}$ … (vi)

On multiplying Eqs. (ii), (iii) and (iv), we get
$\dfrac{b}{c} \times \dfrac{c}{d} \times \dfrac{d}{e} = 2 \times \dfrac{1}{2} \times 3 = 3$
⇒ $\dfrac{b}{e} = 3$ … (vii)

On multiplying Eqs. (iii), (iv) and (v), we get
$\dfrac{c}{d} \times \dfrac{d}{e} \times \dfrac{e}{f} = \dfrac{1}{2} \times 3 \times \dfrac{1}{4}$
⇒ $\dfrac{c}{f} = \dfrac{3}{8}$ … (viii)

Again multiplying Eqs. (vi), (vii) and (viii), we get
$\dfrac{abc}{def} = \dfrac{1}{3} \times 3 \times \dfrac{3}{8} = \dfrac{3}{8}$

10. Which one of the following is the largest divisor of $3^x + 3^{x+1} + 3^{x+2}$, if x is any natural number ?

(a) 3   (b) 13   (c) 39   (d) 117

⊗ **(c)** Given, $3^x + 3^{x+1} + 3^{x+2}$
$= 3^x(1 + 3 + 3^2)$
$= 3^x(13)$ Where x is any natural number.
Put $x = 1$, then, $3^1(13) = 39$
Put $x = 2$, then $3^2(13) = 117$
∴ Largest divisor of $3^x + 3^{x+1} + 3^{x+2}$ is 39.

11. A two-digit number is 9 more than four times of the number obtained by interchanging its digits. If the product of digits in the two-digit number is 8, then what is the number?

(a) 81   (b) 42   (c) 24   (d) 18

⊗ **(a)** Let two digit number $= 10x + y$
According to the question,
$10x + y = 4(10y + x) + 9$
⇒ $10x + y = 40y + 4x + 9$
⇒ $6x - 39y = 9$
⇒ $2x - 13y = 3$ … (i)
Also, $xy = 8 \Rightarrow y = 8/x$ … (ii)
From Eqs. (i) and (ii), we get
$2x - 13(8/x) = 3$

⇒ $2x^2 - 3x - 104 = 0$
⇒ $x = \dfrac{3 \pm \sqrt{9 + 4 \times 2 \times 104}}{2 \times 2}$
⇒ $x = \dfrac{3 \pm \sqrt{9 + 832}}{4} = \dfrac{3 \pm \sqrt{841}}{4}$
⇒ $x = \dfrac{3 \pm 29}{4}$
⇒ $x = \dfrac{3 + 29}{4}, \dfrac{3 - 29}{4}$
⇒ $x = 8, -\dfrac{13}{2}$
From Eq. (ii), we get
$y = \dfrac{8}{8} = 1$
∴ Required number $= 10x + y$
$= 10 \times 8 + 1$
$= 81$

12. If α and β are the roots of the quadratic equation $x^2 + kx - 15 = 0$ such that $\alpha - \beta = 8$, then what is the positive value of k?

(a) 2   (b) 3
(c) 4   (d) 5

⊗ **(a)** Given quadratic equation,
$x^2 + kx - 15 = 0$
∴ $\alpha + \beta = -\dfrac{k}{1} = -k$ … (i)
and $\alpha\beta = -15$ … (ii)
and also, given $\alpha - \beta = 8$ … (iii)
Since, $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$
⇒ $(8)^2 = (-k)^2 - 4(-15)$
⇒ $64 = k^2 + 60$
⇒ $k^2 = 4$
⇒ $k = \pm 2$
∴ $k = 2 > 0$

13. What are the values of p and q respectively, if $(x - 1)$ and $(x + 2)$ divide the polynomial $x^3 + 4x^2 + px + q$?

(a) 1, −6   (b) 2, −6
(c) 1, 6   (d) 2, 6

⊗ **(a)** Given polynomial is
$x^3 + 4x^2 + px + q$.
Since, $(x - 1)$ divide the given polynomial.
∴ $(1)^3 + 4(1)^2 + p(1) + q = 0$
⇒ $1 + 4 + p + q = 0$
⇒ $p + q = -5$ … (i)
and $(x + 2)$ divide the polynomial
∴ $(-2)^3 + 4(-2)^2 + p(-2) + q = 0$
⇒ $-8 + 16 - 2p + q = 0$
⇒ $-2p + q = -8$ … (ii)
On solving Eqs. (i) and (ii), we get
$p = 1, q = -6$

14. If $(x + k)$ is the HCF of $x^2 + 5x + 6$ and $x^2 + 8x + 15$, then what is the value of k?

(a) 5   (b) 3
(c) 2   (d) 1

⊙ **(b)** Since, $(x + k)$ is the HCF of $x^2 + 5x + 6$ and $x^2 + 8x + 15$.
$\therefore (-k)^2 + 5(-k) + 6 = 0$
$\Rightarrow \quad k^2 - 5k + 6 = 0 \qquad$ … (i)
and $(-k)^2 + 8(-k) + 15 = 0$
$\Rightarrow \quad k^2 - 8k + 15 = 0 \qquad$ … (ii)
From Eqs. (i) and (ii), we get
$\quad\quad 3k - 9 = 0 \Rightarrow k = 3$

15. If $5^{x+1} - 5^{x-1} = 600$, then what is the value of 10^{2x}?

(a) 1   (b) 1000
(c) 100000   (d) 1000000

⊙ **(d)** Given, $5^{x+1} - 5^{x-1} = 600$ … (i)
$\Rightarrow 5^x \left(5 - \dfrac{1}{5} \right) = 600$
$\Rightarrow \quad 5^x \left(\dfrac{24}{5} \right) = 600$
$\Rightarrow \quad\quad 5^x = \dfrac{600 \times 5}{24} = 125 = 5^3$
$\Rightarrow \quad\quad x = 3$
$\therefore \quad\quad 10^{2x} = 10^6 = 1000000$

16. A number divides 12288, 28200 and 44333 so as to leave the same remainder in each case. What is that number?

(a) 272   (b) 232
(c) 221   (d) 120

⊙ **(c)** Let divisor is x and remainder is r. Then, according to the question,
$\quad 12288 = x \times q_1 + r \qquad$ … (i)
$\quad 28200 = x \times q_2 + r \qquad$ … (ii)
and $\quad 44333 = x \times q_3 + r \qquad$ … (iii)
From Eqs. (i) and (ii), we get
$(q_2 - q_1)x = 28200 - 12288 = 15912$
From Eqs. (ii) and (iii), we get
$(q_3 - q_2)x = 44333 - 28200 = 16133$
$\qquad\qquad\qquad$ … (v)
From Eqs. (i) and (iii), we get
$(q_3 - q_1)x = 44333 - 12288 = 32045$
$\qquad\qquad\qquad$ … (vi)
Since Eqs. (iv), (v) and (vi) are divisible by x.
$\therefore$ HCF of (15912,16133, 32045) = 221
$\therefore \qquad\qquad\qquad\qquad x = 221$

17. If $x^2 + 9y^2 = 6xy$, then what is $y : x$ equal to?

(a) 1 : 3   (b) 1 : 2
(c) 2 : 1   (d) 3 : 1

⊙ **(a)** Given, $x^2 + 9y^2 = 6xy$
$\Rightarrow x^2 + 9y^2 - 6xy = 0$
$\Rightarrow \quad\quad (x - 3y)^2 = 0$
$\Rightarrow \quad\quad\quad x - 3y = 0$
$\Rightarrow \quad\quad\quad\quad x = 3y$
$\Rightarrow \quad\quad\quad y/x = 1/3$
$\Rightarrow \quad\quad\quad y : x = 1 : 3$

18. If m and n are positive integers such that $m^n = 1331$, then what is the value of $(m - 1)^{n-1}$?

(a) 1   (b) 100   (c) 121   (d) 125

⊙ **(b)** Given, $m^n = 1331$
$\Rightarrow \quad\quad m^n = 11^3$
$\Rightarrow \quad\quad m = 11, n = 3$
$\therefore \quad (m - 1)^{n-1} = (11 - 1)^{3-1}$
$\quad\quad\quad\quad = 10^2 = 100$

19. What is $\dfrac{1}{a^{m-n} - 1} + \dfrac{1}{a^{n-m} - 1}$ equal to?

(a) 1   (b) −1
(c) 0   (d) $2a^{m-n}$

⊙ **(b)** $\dfrac{1}{a^{m-n} - 1} + \dfrac{1}{a^{n-m} - 1}$

$= \dfrac{1}{\dfrac{a^m}{a^n} - 1} + \dfrac{1}{\dfrac{a^n}{a^m} - 1}$

$= \dfrac{a^n}{a^m - a^n} + \dfrac{a^m}{a^n - a^m}$

$= \dfrac{a^n}{a^m - a^n} - \dfrac{a^m}{a^{m - a^n}}$

$= \dfrac{a^n - a^m}{a^m - a^n} = -\dfrac{a^n - a^m}{a^n - a^m} = -1$

20. If $x = \sqrt{2}$, $y = \sqrt[3]{3}$ and $z = \sqrt[6]{6}$, then which one of the following is correct?

(a) $y < x < z$ (b) $z < x < y$
(c) $z < y < x$ (d) $x < y < z$

⊙ **(b)** Given, $x = \sqrt{2}$, $y = \sqrt[3]{3}$ and $z = \sqrt[6]{6}$
$\Rightarrow x = 2^{1/2}$, $y = 3^{1/3}$ and $z = 6^{1/6}$
$\Rightarrow x = 2^{6/12}$, $y = 3^{4/12}$ and $z = 6^{2/12}$
$\Rightarrow x = (64)^{1/12}$, $y = (81)^{1/12}$
and $z = (36)^{1/12}$
Clearly, $z < x < y$.

21. If $\log x = 1.2500$ and $y = x^{\log x}$, then what is $\log y$ equal to?

(a) 4.2500   (b) 2.5625
(c) 1.5625   (d) 1.2500

⊙ **(c)** Given, $\log x = 1.2500$
and $\quad y = x^{\log x} \Rightarrow$
$\log y = (\log x)(\log x)$
$\Rightarrow \log y = (\log x)^2$
$\Rightarrow \log y = (1.25)^2 = 1.5625$

22. If $f(x)$ is divided by $(x - \alpha)(x - \beta)$, where $\alpha \neq \beta$, then what is the remainder?

(a) $\dfrac{(x - \alpha)f(\alpha) - (x - \beta)f(\beta)}{\alpha - \beta}$

(b) $\dfrac{(x - \alpha)f(\beta) - (x - \beta)f(\alpha)}{\alpha - \beta}$

(c) $\dfrac{(x - \beta)f(\alpha) - (x - \alpha)f(\beta)}{\alpha - \beta}$

(d) $\dfrac{(x - \beta)f(\beta) - (x - \alpha)f(\alpha)}{\alpha - \beta}$

⊙ **(c)** Given, $f(x)$ is divided by $(x - \alpha)(x - \beta)$.
$\therefore$ Let quotient is $q(x)$ and remainder is $(ax + b)$.
$\therefore f(x) = (x - \alpha)(x - \beta)q(x) + (ax + b)$
$\qquad\qquad\qquad$ … (i)
On putting $x = \alpha, \beta$ in Eq. (i), we get
$\quad f(\alpha) = a\alpha + b \qquad$ … (ii)
and $f(\beta) = a\beta + b \qquad$ … (iii)
From Eqs. (i) and (ii), we get
$a(\alpha - \beta) = f(\alpha) - f(\beta)$
$\Rightarrow \quad\quad a = \dfrac{f(\alpha) - f(\beta)}{\alpha - \beta} \quad$ … (iv)
From Eqs. (ii) and (iv), we get
$f(\alpha) = \left(\dfrac{f(\alpha) - f(\beta)}{\alpha - \beta} \right) \alpha + b$
$\Rightarrow b = \dfrac{\alpha f(\beta) - \beta f(\alpha)}{\alpha - \beta}$
$\therefore$ Remainder $ax + b$
$= \dfrac{f(\alpha)x - f(\beta)x}{\alpha - \beta} + \dfrac{\alpha f(\beta) - \beta f(\alpha)}{\alpha - \beta}$
$= \dfrac{(x - \beta)f(\alpha) - (x - \alpha)f(\beta)}{\alpha - \beta}$

23. If the area of a square is $2401x^4 + 196x^2 + 4$, then what is its side length?

(a) $49x^2 + 3x + 2$ (b) $49x^2 - 3x + 2$
(c) $49x^2 + 2$ (d) $59x^2 + 2$

⊙ **(c)** Given area of square
$= 2401x^4 + 196x^2 + 4$
$= (49x^2)^2 + 2 \times 49x^2 \times 2 + (2)^2$
$= (49x^2 + 2)^2$
$\therefore$ Length of side $= 49x^2 + 2$

24. If x varies as yz, then y varies inversely as

(a) xz (b) $\dfrac{x}{z}$

(c) $\dfrac{z}{x}$ (d) $\dfrac{1}{(xz)}$

⊙ **(c)** Given, x varies as yz.
$\therefore x \propto yz$
$\Rightarrow \dfrac{x}{z} \propto y \Rightarrow y \propto \dfrac{1}{(z/x)}$

25. If the points P and Q represent real numbers $0 \cdot 7\overline{3}$ and $0 \cdot 5\overline{6}$ on the number line, then what is the distance between P and Q ?

(a) $\dfrac{1}{6}$ (b) $\dfrac{1}{5}$ (c) $\dfrac{16}{45}$ (d) $\dfrac{11}{90}$

⊙ **(a)** Let $x = 0.7\overline{3} = 0.73333 ....$

$\Rightarrow 10x = 7.3333$ .... (i)

$\Rightarrow 100x = 73.333 ....$ .... (ii)

Subtracting Eq. (i) from Eq. (ii),

$90x = 66$

$\Rightarrow \quad x = \dfrac{66}{90} = \dfrac{11}{15}$

Similarly, $y = 0.5\overline{6}$

$\Rightarrow y = \dfrac{56 - 5}{90}$

$\Rightarrow y = \dfrac{51}{90} = \dfrac{17}{30}$

$\therefore$ Distance between P and Q

$= \dfrac{11}{15} - \dfrac{17}{30} = \dfrac{22 - 17}{30} = \dfrac{5}{30} = \dfrac{1}{6}$

26. What is the point on the xy-plane satisfying $5x + 2y = 7xy$ and $10x + 3y = 8xy$?

(a) $\left(-1, \dfrac{1}{6}\right)$ (b) $\left(\dfrac{1}{6}, -1\right)$

(c) $\left(1, \dfrac{1}{6}\right)$ (d) $\left(-\dfrac{1}{6}, -1\right)$

⊙ **(b)** Given, $5x + 2y = 7xy$

$\Rightarrow \qquad \dfrac{5}{y} + \dfrac{2}{x} = 7$ ... (i)

and $10x + 3y = 8xy$

$\Rightarrow \dfrac{10}{y} + \dfrac{3}{x} = 8$ ... (ii)

From $2 \times$ Eq. (i) $-$ Eq.(ii), we get

$\dfrac{4}{x} - \dfrac{3}{x} = 14 - 8$

$\Rightarrow \qquad \dfrac{1}{x} = 6 \Rightarrow x = \dfrac{1}{6}$

From Eqs. (i), we get

$\dfrac{5}{y} + 2 \times 6 = 7 \Rightarrow \dfrac{5}{y} = 7 - 12 = -5$

$\Rightarrow \qquad y = -1$

27. The price of an article X increases by 20% every year and price of article Y increases by 10% every year. In the year 2010, the price of article X was ₹ 5000 and price of article Y was ₹ 2000. In which year the difference in their prices exceeded ₹ 5000 for the first time?

(a) 2012   (b) 2013   (c) 2014   (d) 2015

⊙ **(b)** In year 2010,

Price of article X is ₹ 5000.

and price of article Y is ₹ 2000.

Difference of price of X and Y

$= 5000 - 2000 = ₹ 3000$

In 2013,

price of article

$X = 5000 \left(1 + \dfrac{20}{100}\right)^3$

$= 5000 \times \left(\dfrac{120}{100}\right)^3$

$= 5000 \times \dfrac{6}{5} \times \dfrac{6}{5} \times \dfrac{6}{5}$

$= ₹ 8640$

Price of article $Y = 2000 \left(1 + \dfrac{10}{100}\right)^3$

$= 2000 \left(\dfrac{110}{100}\right)^3$

$= 2000 \times \dfrac{11}{10} \times \dfrac{11}{10} \times \dfrac{11}{10} = ₹ 2662$

$\therefore$ Difference of price of X and Y

$= 8640 - 2662 = ₹ 5978$

28. The ratio of speeds of X and Y is $5 : 6$. If Y allows X a start of 70 m in a 1.2 km race, then who will win the race and by what distance?

(a) X wins the race by 30 m

(b) Y wins the race by 90 m

(c) Y wins the race by 130 m

(d) The race finishes in a dead heat

⊙ **(c)** Speed of $X = 5k$

and speed of $Y = 6k$

Distance travelled by

$X = 1.2 \times 1000 - 70$

$= 1200 - 70$

$= 1130 \text{ m}$

Distance travelled by $Y = 1200 \text{ m}$

$\therefore$ Time taken by $X = \dfrac{1130}{5k} = \dfrac{226}{k}$

Time taken by $Y = \dfrac{1200}{6k} = \dfrac{200}{k}$

Since, $\dfrac{226}{k} > \dfrac{200}{k}$

$\therefore$ Y wins the race.

$\therefore$ Difference of distance to win the

race $= \left(\dfrac{226}{k} - \dfrac{200}{k}\right) \times 5k$

$= 26 \times 5 = 130 \text{m}$

29. A train takes two hours less for a journey of 300 km if its speed is increased by 5 km/h from its usual speed. What is its usual speed?

(a) 50 km/h   (b) 40 km/h

(c) 35 km/h   (d) 25 km/h

⊙ **(d)** Let usual speed of train $= x$ km/h

According to the question,

$\dfrac{300}{x} - \dfrac{300}{x + 5} = 2$

$\Rightarrow \dfrac{300(x + 5 - x)}{x(x + 5)} = 2$

$\Rightarrow \qquad 300 \times 5 = 2x^2 + 10x$

$\Rightarrow \qquad 2x^2 + 10x - 1500 = 0$

$\Rightarrow \qquad x^2 + 5x - 750 = 0$

$\Rightarrow x^2 + 30x - 25x - 750 = 0$

$\Rightarrow x(x + 30) - 25(x + 30) = 0$

$\Rightarrow \qquad (x + 30)(x - 25) = 0$

$\Rightarrow \quad x + 30 = 0 \text{ or } x - 25 = 0$

$\Rightarrow x = -30 \text{ or } x = 25$

$\Rightarrow x = 25 \text{ km/h}$ $[\because x \neq -25]$

30. If 6 men and 8 women can do a piece of work in 10 days, and 13 men and 24 women can do the same work in 4 days, then what is the ratio of daily work done by a man to that of a woman?

(a) 2 : 1   (b) 1 : 2   (c) 4 : 3   (d) 3 : 4

⊙ **(a)** Let a man's one day work $= x$ unit

and a woman's one day work $= y$ unit

$\therefore$ 6 men and 8 women one day work

$\Rightarrow \qquad 8x + 8y = \dfrac{1}{10}$ ... (i)

and 13 men and 24 women one day work

$\Rightarrow \qquad 13x + 24y = \dfrac{1}{4}$ ... (ii)

On solving Eqs. (i) and (ii), we get

$x = \dfrac{1}{100}$ and $y = \dfrac{1}{200}$

$\therefore$ Ratio of x and $y = \dfrac{1}{100} : \dfrac{1}{200} = 2 : 1$

31. Students of a class are made to sit in rows of equal number of chairs. If number of students is increased by 2 in each row, then the number of rows decreases by 3. If number of students is increased by 4 in each row, then the number of rows decreases by 5. What is the number of students in the class?

(a) 100   (b) 105   (c) 110   (d) 120

⊙ **(d)** Let the numbers of row $= x$

Number of students in each row $= y$

$\therefore$ Number of students $= xy$

According to the question,

$(x - 3)(y + 2) = xy$

$\Rightarrow xy + 2x - 3y - 6 = xy$

$\Rightarrow \qquad 2x - 3y = 6$ ... (i)

and $(x - 5)(y + 4) = xy$

$\Rightarrow xy + 4x - 5y - 20 = xy$

$\Rightarrow \qquad 4x - 5y = 20$ ... (ii)

On solving Eqs. (i) and (ii), we get

$x = 15$ and $y = 8$

$\therefore$ Number of students in the class

$= xy = 15 \times 8 = 120$

32. A sum was put at simple interest at certain rate for 2 yr. Had it been put at 1% higher rate of interest, it would have fetched ₹ 24 more. What is the sum?

(a) ₹ 500   (b) ₹ 600
(c) ₹ 800   (d) ₹ 1200

⊙ *(d)* Let ₹ x was put at simple interest at rate of r% per annum for 2 yr.

According to the question,

$$SI = \frac{x \times r \times 2}{100} \qquad \dots (i)$$

and $(SI + 24) = \dfrac{x \times (r + 1) \times 2}{100} \qquad \dots (ii)$

From Eqs. (i) and (ii), we get

$$24 = \frac{2x}{100}$$

$$\Rightarrow x = \frac{24 \times 100}{2}$$

$$\Rightarrow x = 1200$$

∴ Required sum $= ₹ 1200$

33. The population of two villages is 1525 and 2600 respectively. If the ratio of male to female population in the first village is 27 : 34 and the ratio of male to female population in the second village is 6 : 7, then what is the ratio of male to female population of these two villages taken together?

(a) 33 : 41   (b) 85 : 82
(c) 71 : 90   (d) 5 : 6

⊙ *(d)* Given population of first village $= 1525$

Let male population in first village is $27x$.

And female population in first village $= 34x$

Then, $27x + 34x = 1525$

$\Rightarrow \qquad 61x = 1525 \Rightarrow x = 25$

∴ Male population in first village

$$= 27x$$
$$= 27 \times 25 = 675$$

and Female population in first village

$$= 34x$$
$$= 34 \times 25 = 850$$

Population of second village $= 2600$

Let male population in second village $= 6y$

and female population in second village $= 7y$

Then, $6y + 7y = 2600$

$\Rightarrow 13y = 2600 \Rightarrow y = 200$

∴ Male population in second village

$$= 6y = 1200$$

and Female population in second village $= 7y = 1400$

Now, total number of male in both villages $= 675 + 1200 = 1875$

Total number of female in both villages $= 850 + 1400 = 2250$

∴ Required ratio $= 1875 : 2250 = 5 : 6$

34. In a class room the ratio of number of girls to that of boys is 3 : 4. The average height of students in the class is 4.6 feet. If the average height of the boys in the class is 4.8 feet, then what is the average height of the girls in the class?

(a) Less than 4.2 feet
(b) More than 4.2 feet but less than 4.3 feet
(c) More than 4.3 feet but less than 4.4 feet
(d) More than 4.4 feet but less than 4.5 feet

⊙ *(c)* Let Number of girls $= 3x$

and number of boys $= 4x$

Total number of students

$$= 3x + 4x = 7x$$

Sum of heights of all students

$$= 4.6 \times 7x$$
$$= 32.2x$$

sum of heights of all the boys

$$= 4.8 \times 4x$$
$$= 19.2x$$

∴ Sum of heights of all the girls

$$= 32.2x - 19.2x = 13x$$

∴ Average height of the girls in the

class $= \dfrac{13x}{3x} = \dfrac{13}{3} = 4.33$

Hence, Average height of the girls in the class more than 4.3 feet but less than 4.4 feet.

35. What is the median of the data 3, 5, 9, 4, 6, 11, 18?

(a) 6   (b) 6.5   (c) 7   (d) 7.5

⊙ *(a)* Given data 3, 5, 9, 4, 6, 11, 18.

Now, arranging in ascending order

3, 4, 5, 6, 9, 11, 18

∴   Median $= 6$

36. In a pie-diagram there are three sectors. If the ratio of the angles of the sectors is 1 : 2 : 3, then what is the angle of the largest sector?

(a) 200°   (b) 180°   (c) 150°   (d) 120°

⊙ *(b)* Let angles of three sectors are x, $2x$ and $3x$.

In a pie–diagram,

$x + 2x + 3x = 360$

$\Rightarrow \qquad 6x = 360° \Rightarrow x = 60°$

∴ Largest angle

$$= 3x = 3 \times 60° = 180°$$

37. The maximum marks in a test are converted from 250 to 50 for the purpose of an Internal Assessment. The highest marks scored were 170 and lowest marks were 70. What is the difference between the maximum and minimum marks scored in the Internal Assessment?

(a) 15   (b) 17   (c) 20   (d) 24

⊙ *(c)* Since maximum marks in a test are converted from 250 to 50 for the Internal Assessment.

∴ $\dfrac{50}{250} = \dfrac{1}{5}$

$\Rightarrow$ Marks to reduced to $\dfrac{1}{5}$ th for the purpose of an Internal Assessment.

∴   Highest marks $= \dfrac{150}{5} = 34$

and Lowest marks $= \dfrac{70}{5} = 14$

∴ Required difference $= 34 - 14 = 20$

Directions (Q. Nos. 38-40) *Read the following information and answer the given questions follow.*

The following data presents count of released convicts who have served prison terms (X), those who have received some educational or technical training during their term (Y) and those who were offered Company placement (Z) respectively, from six different jails A, B, C, D, E and F, in the year 2010.

	X	Y	Z
A	86	45	25
B	1305	903	461
C	2019	940	474
D	1166	869	416
E	954	544	254
F	1198	464	174

38. Jails with highest and smallest percentage of trained convicts are respectively

(a) F and D   (b) D and F
(c) C and A   (d) D and A

⊙ *(b)* Total released convicts from point A

$$= 86 + 45 + 25 = 156$$

∴ Trained convicts from jail A

$$= \frac{45}{156} \times 100 = 28.84\%$$

Total released convicts from jail B

$$= 1305 + 903 + 461 = 2669$$

Trained convicts from jail B

$= \dfrac{903}{2669} \times 100 = 33.83\%$

Total released convicts from jail C
$= 2019 + 940 + 474 = 3433$

Trained convicts from jail C

$= \dfrac{940}{3433} \times 100 = 27.38\%$

Total released convicts from jail D
$= 1166 + 869 + 416 = 2451$

Trained convicts from jail D

$= \dfrac{869}{2451} \times 100 = 35.45\%$

Total released convicts from jail E
$= 954 + 544 + 254 = 1752$

Trained convicts from jail E

$= \dfrac{544}{1752} \times 100 = 51.05\%$

Total released convicts from jail F
$= 1198 + 464 + 174 = 1836$

Trained convicts from jail F

$= \dfrac{464}{1836} \times 100 = 25.27\%$

∴ Jails with highest and smallest percentage of trained convicts are respectively 35.45% and 25.27%.

39. Jail with highest placement rate of trained convicts is

(a) F   (b) D   (c) B   (d) A

⊙ **(d)** Placement rate of trained convicts of jail A $= \dfrac{25}{45} \times 100 = 55.55$

Placement rate of trained convicts of jail B $= \dfrac{461}{903} \times 100 = 51.05$

Placement rate of trained convicts of jail C $= \dfrac{474}{940} \times 100 = 50.43$

Placement rate of trained convicts of jail D $= \dfrac{416}{869} \times 100 = 47.87$

Placement rate of trained convicts of jail E $= \dfrac{254}{544} \times 100 = 46.69$

Placement rate of trained convicts of jail F $= \dfrac{174}{464} \times 100 = 37.5$

∴ Jail with highest placement rate of trained convicts = 55.55

40. Jails from which more than half of the trained convicts are offered jobs, are

(a) A, B and C   (b) A, B and D
(c) A, D and E   (d) A, E and F

⊙ **(a)** Trained convicts from jail A = 45

∴ Half of the trained convicts

$= \dfrac{45}{2} = 22.5$

Convicts who offered company placement from jail A = 25
Trained convicts from jail B = 903
∴ Half of the trained convicts

$= \dfrac{903}{2} = 451.5$

Convicts who offered company placement from jail B = 461
Trained convicts from jail C = 940
∴ Half of the trained convicts

$= \dfrac{940}{2} = 470$

Convicts who offered company placement from jail C = 474
Trained convicts from jail D = 869
∴ Half of the trained convicts = 434.5
Convicts who offered company placement from jail D = 416
Trained convicts of jail E = 544
∴ Half of the trained convicts = 272
Convicts who offered company placement from jail E = 254
Trained convicts from jail F = 464
∴ Half of the trained convicts = 232
Convicts who offered company placement from jail F = 174
Hence, jails from which more than half of the trained convicts are offered jobs are A, B and C.

41. The number of three digit numbers (all digits are different) which are divisible by 7 and also divisible by 7 on reversing the order of the digits, is

(a) Six   (b) Five   (c) Four   (d) Three

⊙ **(c)** Let the three digits number = xyz

and the reverse of it will be = zyx
Since, both the numbers are divisible by 7.

∴ $100x + 10y + z = 7m$ … (i)
and $100z + 10y + x = 7n$ … (ii)
From Eqs. (i) and (ii), we get
⇒ $99(x - z) = 7(m - n)$
Here, 99 is not divisible by 7 then it is must that $(x - z)$ is a factor of 7.
∴ Possible that $x = 2$, $z = 9$;
$x = 1$, $z = 8$
∴ Possible numbers are 168, 861, 259 and 952.

42. How many integral values of x and y satisfy the equation $5x + 9y = 7$, where $-500 < x < 500$ and $-500 < y < 500$?

(a) 110
(b) 111
(c) 112
(d) None of the above

⊙ **(b)** Given equation $5x + 9y = 7$,

where $-500 < x, y < 500$.
Now, $y = \dfrac{7 - 5x}{9}$

x	y
−1	12/9
−4	3
−13	8
−22	13
−31	18

Here, when
$x = -4, -13, -22, -31, \ldots$
i.e. common difference with 9, then value of y = integer value
∴ $495 = -495 + (n - 1)(9)$
$\Rightarrow n - 1 = \dfrac{495 + 495}{9}$

$= \dfrac{990}{9} = 110 \Rightarrow n = 111$

43. Let XYZ be a 3-digit number. Let $S = XYZ + YZX + ZXY$. Which of the following statements is/are correct?

1. S is always divisible by 3 and $(X + Y + Z)$.
2. S is always divisible by 9.
3. S is always divisible by 37.

Select the correct answer using the code given below:

(a) 1 only   (b) 2 only
(c) 1 and 2   (d) 1 and 3

⊙ **(d)** Given, $S = XYZ + YZX + ZXY$

$\Rightarrow S = (100X + 10Y + Z)$
$\qquad\qquad + (100Y + 10Z + X)$
$\qquad\qquad + (100Z + 10X + Y)$
$\Rightarrow S = 111(X + Y + Z)$
$\qquad = 3 \times 37 (X + Y + Z)$
$\Rightarrow S$ is always divisible by 3, 37 and $(X + Y + Z)$.

44. In covering certain distance, the average speeds of X and Y are in the ratio 4 : 5. If X takes 45 min more than Y to reach the destination, then what is the time taken by Y to reach the destination?

(a) 135 min   (b) 150 min
(c) 180 min   (d) 225 min

⊙ **(c)** When the speed is same, then speed is inversely proportional to time.

∴ $ty : tx = 4 : 5$
∴ 1 unit difference = 45 min
∴ 4 unit = $4 \times 45 = 180$ min

45. For two observations, the sum is S and product is P. What is the harmonic mean of these two observations?

(a) $\dfrac{2S}{P}$ (b) $\dfrac{S}{(2P)}$

(c) $\dfrac{2P}{S}$ (d) $\dfrac{P}{(2S)}$

⊙ **(c)** Given that, $S = x + y$

$P = xy$

∴ Harmonic Mean $= \dfrac{2xy}{x + y} = \dfrac{2P}{S}$

46. If the annual income of X is 20% more than that of Y, then the income of Y is less than that of X by p%. What is the value of p?

(a) 10 (b) $16\dfrac{2}{3}$

(c) $17\dfrac{1}{3}$ (d) 20

⊙ **(b)** Let annual income of $Y = ₹100$

Then annual income of $X = ₹120$

∴ $p\% = \dfrac{120 - 100}{120} \times 100$

$= \dfrac{20}{120} \times 100$

$= \dfrac{20 \times 5}{6} = 16\dfrac{2}{3}$

47. What is the least perfect square which is divisible by 3, 4, 5, 6 and 7?

(a) 1764 (b) 17640
(c) 44100 (d) 176400

⊙ **(c)** A number which is divisible by 3, 4, 5, 6 and 7 should be a multiple of 3, 4, 5, 6 and 7.

i.e. $2^2 \times 3 \times 5 \times 7$

For least perfect square, then it should be a perfect square i.e.

$2^2 \times 3^2 \times 5^2 \times 7^2 = 44100$

48. In a water tank there are two outlets. It takes 20 min to empty the tank if both the outlets are opened. If the first outlet is opened, the tank is emptied in 30 min. What is the time taken to empty the tank by second outlet?

(a) 30 min (b) 40 min
(c) 50 min (d) 60 min

⊙ **(d)** Let x is the time taken when both outlets are open and y is the time taken by 1st outlet then time taken by IInd outlet

$= \dfrac{xy}{y - x} = \dfrac{20 \times 30}{30 - 20} = \dfrac{600}{10}$

$= 60$ min

49. If $(x^2 - 1)$ is a factor of $ax^4 + bx^3 + cx^2 + dx + e$, then which one of the following is correct?

(a) $a + b + c = d + e$
(b) $a + b + e = c + d$
(c) $b + c + d = a + e$
(d) $a + c + e = b + d$

⊙ **(d)** Given, $(x^2 - 1)$ is a factor of

$ax^4 + bx^3 + cx^2 + dx + e$

$\Rightarrow (x - 1)(x + 1)$ is a factor of

$ax^4 + bx^3 + cx^2 + dx + e$

$\Rightarrow x = -1, 1$ roots of

$ax^4 + bx^3 + cx^2 + dx + e$

∴ $a(-1)^4 + b(-1)^3 + c(-1)^2$
$\qquad + d(-1) + e = 0$

$\Rightarrow a - b + c - d + e = 0$

$\Rightarrow \qquad a + c + e = b + d$

50. If $\left(x^8 + \dfrac{1}{x^8}\right) = 47$, what is the value of $\left(x^6 + \dfrac{1}{x^6}\right)$?

(a) 36 (b) 27 (c) 18 (d) 9

⊙ **(c)** Given, $x^8 + \dfrac{1}{x^8} = 47$

$\Rightarrow x^8 + \dfrac{1}{x^8} + 2 = 47 + 2$

$\Rightarrow \left(x^4 + \dfrac{1}{x^4}\right)^2 = 49 \Rightarrow x^4 + \dfrac{1}{x^4} = 7$

$\Rightarrow x^4 + \dfrac{1}{x^4} + 2 = 7 + 2 = 9$

$\Rightarrow \left(x^2 + \dfrac{1}{x^2}\right) = 3$

∴ $x^6 + \dfrac{1}{x^6} = (x^2)^3 + \left(\dfrac{1}{x^2}\right)^3$

$= \left(x^2 + \dfrac{1}{x^2}\right)^3$

$\qquad - 3(x^2)\left(\dfrac{1}{x^2}\right)\left(x^2 + \dfrac{1}{x^2}\right)$

$= (3)^3 - 3(3) = 27 - 9 = 18$

51. A wheel makes 360 revolutions in one minute. What is the number of radians it turns in one second?

(a) 4π (b) 6π (c) 12π (d) 16π

⊙ **(c)** 60 sec = 360 revolutions

∴ 1 sec = 6 revolutions

$= 6 \times 2\pi$ radians $= 12\pi$ radians

52. What is the least value of $(25\operatorname{cosec}^2 x + \sec^2 x)$?

(a) 40 (b) 36 (c) 26 (d) 24

⊙ **(b)** $25 \operatorname{cosec}^2 x + \sec^2 x$

∴ Minimum value of
$25 \operatorname{cosec}^2 x + \sec^2 x$
$= (\sqrt{25} + \sqrt{1})^2 = (5 + 1)^2 = 36$

53. Let $0 < \theta < 90°$ and $100\,\theta = 90°$. If $\alpha = \displaystyle\sum_{n=1}^{99} \cot n\theta$, then which one of the following is correct?

(a) $\alpha = 1$ (b) $\alpha = 0$
(c) $\alpha > 1$ (d) $0 < \alpha < 1$

⊙ **(a)** Given that,

$100\theta = 90°$ and $\alpha = \displaystyle\sum_{n-1}^{99} \cot n\theta$

$= \cot\theta.\cos 2\theta.\cot 3\theta ... \cot 99\theta$

$= \cot\theta.\cos 2\theta.\cot 3\theta .... \tan(90° - 99\theta)$

$= \cot\theta.\cot 2\theta.\cot 3\theta .... \tan(100\theta - 99\theta)$

$= \cot\theta.\cot 2\theta.\cot 3\theta .... \tan\theta$

$= \cot\theta.\tan\theta.\cot 2\theta.\tan 2\theta ....$

$\Rightarrow \alpha = 1$

54. If $\tan 6\theta = \cot 2\theta$, where $0 < 6\theta < \dfrac{\pi}{2}$, then what is the value of $\sec 4\theta$?

(a) $\sqrt{2}$ (b) 2 (c) $\dfrac{2}{\sqrt{3}}$ (d) $\dfrac{4}{3}$

⊙ **(a)** Given, $\tan 6\theta = \cot 2\theta$

$\Rightarrow \tan 6\theta = \tan(90° - 2\theta)$

$\Rightarrow \qquad 6\theta = 90° - 2\theta$

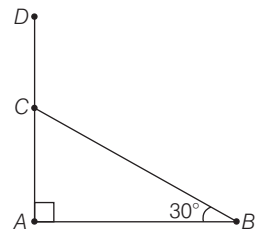$\Rightarrow 6\theta + 2\theta = 90° \Rightarrow 8\theta = 90°$

$\Rightarrow \qquad 4\theta = 45°$

∴ $\sec 4\theta = \sec 45° = \sqrt{2}$

55. A tree of height 15 m is broken by wind in such a way that its top touches the ground and makes an angle 30° with the ground. What is the height from the ground to the point where tree is broken?

(a) 10 m (b) 7 m
(c) 5 m (d) 3 m

⊙ **(c)**

Let AD be the tree such that $AD = 15$ m
And let $AC = x$
Then, $CD = BC = 15 - x$

∴ $\sin 30° = \dfrac{AC}{BC}$

$= \dfrac{x}{15 - x}$

$\Rightarrow \dfrac{1}{2} = \dfrac{x}{15 - x}$

$\Rightarrow \qquad 2x = 15 - x$

$\Rightarrow \qquad 3x = 15$

∴ $\qquad x = 5$ m

56. On a plane area there are two vertical towers separated by 100 feet apart. The shorter tower is 40 feet tall. A pole of length 6 feet stands on the line joining the base of two towers so that the tip of the towers and tip of the pole are also on the same line. If the distance of the pole from the shorter tower is 75 feet, then what is the height of the taller tower (approximately)?

(a) 85 feet　　　　(b) 110 feet
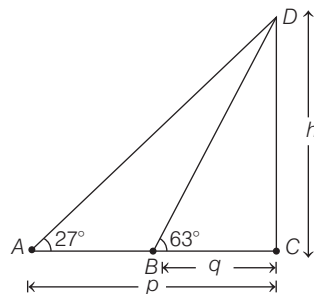(c) 125 feet　　　 (d) 140 feet

⊙ **(a)**
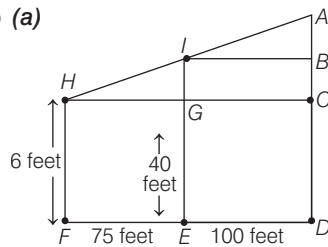
Here,

$\triangle ABI \sim \triangle IGH$

$\therefore \dfrac{IG}{AB} = \dfrac{HG}{IB} \Rightarrow \dfrac{40-6}{AB} = \dfrac{75}{100}$

$\Rightarrow AB = \dfrac{34 \times 100}{75} = 45.33$

$\therefore AD = AB + BD = AB + IE$

$\qquad = 45.33 + 40 = 85.33$ feet

$\qquad = 85$ feet (approx.)

57. The angles of elevation of the top of a tower from two points at distances p and q from the base and on the same straight line are 27° and 63° respectively. What is the height of the tower?

(a) pq　　　　　　　(b) $\sqrt{pq}$

(c) $\dfrac{pq}{2}$　　　　　　(d) $\dfrac{\sqrt{pq}}{2}$

⊙ **(b)** Let height of the tower CD be h.

$\therefore$ In $\triangle ACD$,

$\tan 27° = \dfrac{CD}{AC}$

$\Rightarrow \tan 27° = \dfrac{h}{p}$　　　　　　… (i)

and In $\triangle BCD$, $\tan 63° = \dfrac{CD}{BC}$

$\Rightarrow \tan(90° - 27°) = \dfrac{h}{q}$

$\Rightarrow \qquad \cot 27° = \dfrac{h}{q}$　　　… (ii)

From Eqs. (i) and (ii), we get

$\tan 27° \cot 27° = \dfrac{h}{p}.\dfrac{h}{q}$

$\Rightarrow \qquad h^2 = pq$

$\Rightarrow \qquad h = \sqrt{pq}$

58. What is the value of $\sin^2 6° + \sin^2 12° + \sin^2 18° + \dots + \sin^2 84° + \sin^2 90°$?

(a) 1　　(b) 2　　(c) 4　　(d) 8

⊙ **(d)** $\sin^2 6 + \sin^2 12° + \sin^2 18° + \dots + \sin^2 84° + \sin^2 90°$

$= (\sin^2 6° + \sin^2 84°) + (\sin^2 12° + \sin^2 78°) + (\sin^2 18° + \sin^2 72°) + \dots + (\sin^2 42 + \sin^2 48°) + 1$

$= (\sin^2 6° + \cos^2 6°) + (\sin^2 12° + \cos^2 12°) + (\sin^2 18° + \cos^2 18°) + \dots + (\sin^2 42° + \cos^2 42°) + 1$

$= (1 + 1 + 1 + \dots 7 \text{ times}) + 1$

$= 7 + 1 = 8$

59. What is $\dfrac{\cos \theta}{1 + \sin \theta} + \dfrac{1}{\cot \theta}$ equal to?

(a) $\operatorname{cosec} \theta$　　　　(b) $\sec \theta$
(c) $\sec \theta + \operatorname{cosec} \theta$　(d) $\operatorname{cosec} \theta - \cot \theta$

⊙ **(b)** $\dfrac{\cos \theta}{1 + \sin \theta} + \dfrac{1}{\cot \theta}$

$= \dfrac{\cos \theta}{1 + \sin \theta} + \dfrac{1}{\cos \theta / \sin \theta}$

$= \dfrac{\cos \theta}{1 + \sin \theta} + \dfrac{\sin \theta}{\cos \theta}$

$= \dfrac{\cos^2 \theta + \sin \theta + \sin^2 \theta}{\cos \theta (1 + \sin \theta)}$

$= \dfrac{(\cos^2 \theta + \sin^2 \theta) + \sin \theta}{\cos \theta (1 + \sin \theta)}$

$= \dfrac{1 + \sin \theta}{\cos \theta (1 + \sin \theta)} = \sec \theta$

60. What is $\dfrac{\sin \theta - \cos \theta + 1}{\sin \theta + \cos \theta - 1} - \dfrac{\sin \theta + 1}{\cos \theta}$ equal to?

(a) 0　　　　　　　(b) 1
(c) $2 \sin \theta$　　　　(d) $2 \cos \theta$

⊙ **(a)** $\dfrac{\sin \theta - \cos \theta + 1}{\sin \theta + \cos - 1} - \dfrac{\sin \theta + 1}{\cos \theta}$

$= \dfrac{\sin \theta / \cos \theta - \cos \theta / \cos \theta + 1/\cos \theta}{\sin \theta / \cos \theta + \cos \theta / \cos \theta - 1/\cos \theta}$

$\qquad - \dfrac{\sin \theta / \cos \theta + 1/\cos \theta}{\cos \theta / \cos \theta}$

$= \dfrac{\tan \theta - 1 + \sec \theta}{\tan \theta + 1 - \sec \theta} - \dfrac{\tan \theta + \sec \theta}{1}$

$= \dfrac{\tan \theta + \sec \theta - 1}{(\tan \theta - \sec \theta) + 1} - (\tan \theta + \sec \theta)$

$= \dfrac{(\tan \theta + \sec \theta - 1)(\tan \theta + \sec \theta)}{(\tan \theta - \sec \theta + 1)(\tan \theta + \sec \theta)}$

$\qquad\qquad - \tan \theta - \sec \theta$

$= \dfrac{(\tan \theta + \sec \theta - 1)(\tan \theta + \sec \theta)}{(\tan^2 \theta - \sec^2 \theta) + (\tan \theta + \sec \theta)}$

$\qquad\qquad - \tan \theta - \sec \theta$

$= \dfrac{(\tan \theta + \sec \theta - 1)(\tan \theta + \sec \theta)}{-1 + (\tan \theta + \sec \theta)}$

$\qquad\qquad - \tan \theta - \sec \theta$

$= \tan \theta + \sec \theta - \tan \theta - \sec \theta$

$= 0$

61. What is $(\tan x + \tan y)(1 - \cot x \cot y) + (\cot x + \cot y)(1 - \tan x \tan y)$ equal to?

(a) 0　　(b) 1　　(c) 2　　(d) 4

⊙ **(a)** $(\tan x + \tan y)(1 - \cot x \cot y) + (\cot x + \cot y)(1 - \tan x \tan y)$

$= \tan x + \tan y - \cot y - \cot x$

$\qquad + \cot x + \cot y - \tan y - \tan x = 0$

62. What is $\sqrt{\dfrac{\sec x - \tan x}{\sec x + \tan x}}$ equal to?

(a) $\dfrac{1}{\sin x + \cos x}$

(b) $\dfrac{1}{\tan x + \cot x}$

(c) $\dfrac{1}{\sec x + \tan x}$

(d) $\dfrac{1}{\operatorname{cosec} x + \cot x}$

⊙ **(c)** $\sqrt{\dfrac{\sec x - \tan x}{\sec x + \tan x}}$

$= \sqrt{\dfrac{(\sec x - \tan x)(\sec x + \tan x)}{(\sec x + \tan x)(\sec x + \tan x)}}$

$= \sqrt{\dfrac{\sec^2 x - \tan^2 x}{(\sec x + \tan x)^2}}$

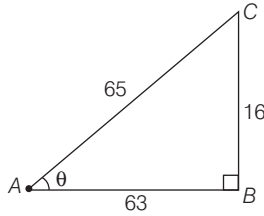$= \dfrac{\sqrt{\sec^2 x - \tan^2 x}}{\sqrt{(\sec x + \tan x)^2}}$

$= \dfrac{1}{\sec x + \tan x}$

63. If θ lies in the first quadrant and $\cot\theta = \dfrac{63}{16}$, then what is the value of $(\sin\theta + \cos\theta)$?

(a) 1   (b) $\dfrac{69}{65}$ (c) $\dfrac{79}{65}$ (d) 2

$\ominus$ **(c)** Given, $\cot\theta = \dfrac{63}{16}$

$\Rightarrow \qquad \tan\theta = \dfrac{16}{63}$

In right angled triangle ABC,
$AC^2 = 63^2 + 16^2 = 3969 + 256$
$\Rightarrow \qquad AC^2 = 4225$
$\Rightarrow \qquad AC = 65$
$\therefore \sin\theta + \cos\theta = \dfrac{16}{65} + \dfrac{63}{65} = \dfrac{79}{65}$

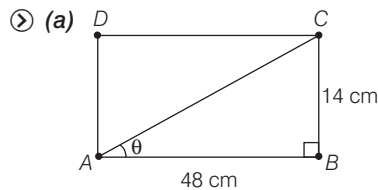**64.** What is the value of
$\dfrac{1 - 2\sin^2\theta\cos^2\theta}{\sin^4\theta + \cos^4\theta} + 4$ equal to?

(a) 0   (b) 1   (c) 2   (d) 5

$\ominus$ **(d)** $\dfrac{1 - 2\sin^2\theta\cos^2\theta}{\sin^4\theta + \cos^4\theta} + 4$

$= \dfrac{1 - 2\sin^2\theta\cos^2\theta}{(\sin^2\theta + \cos^2\theta)^2 - 2\sin^2\theta\cos^2\theta} + 4$

$= \dfrac{1 - 2\sin^2\theta\cos^2\theta}{1 - 2\sin^2\theta\cos^2\theta} + 4 = 1 + 4 = 5$

65. A rectangle is 48 cm long and 14 cm wide. If the diagonal makes an angle θ with the longer side, then what is $(\sec\theta + \csc\theta)$ equal to?

(a) $\dfrac{775}{168}$ (b) $\dfrac{725}{168}$ (c) $\dfrac{375}{84}$ (d) $\dfrac{325}{84}$

$\ominus$ **(a)**

Diagonal, $AC = \sqrt{48^2 + 14^2}$
$= \sqrt{2304 + 196}$
$= \sqrt{2500} = 50$
$\therefore \quad \sec\theta = \dfrac{AC}{AB} = \dfrac{50}{48} = \dfrac{25}{24}$
and $\csc\theta = \dfrac{AC}{BC} = \dfrac{50}{14} = \dfrac{25}{7}$

$\therefore \ \sec\theta + \csc\theta = \dfrac{25}{24} + \dfrac{25}{7}$
$= \dfrac{175 + 600}{168}$
$= \dfrac{775}{168}$

66. What is the area of the triangle having side lengths $\dfrac{y}{z} + \dfrac{z}{x}, \dfrac{z}{x} + \dfrac{x}{y}, \dfrac{x}{y} + \dfrac{y}{z}$?

(a) $\dfrac{(x + y + z)^2}{xyz}$ (b) $\dfrac{\sqrt{xyz}}{x + y + z}$

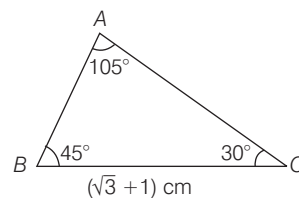(c) $\sqrt{\dfrac{x}{y} + \dfrac{y}{z} + \dfrac{z}{x}}$ (d) $\sqrt{\dfrac{xy + yz + zx}{xyz}}$

$\ominus$ **(c)** Let $a = \dfrac{y}{z} + \dfrac{z}{x}$

$b = \dfrac{z}{x} + \dfrac{x}{y}$ and $c = \dfrac{x}{y} + \dfrac{y}{z}$

$\therefore \quad s = \dfrac{a + b + c}{2} = \dfrac{2\left(\dfrac{x}{y} + \dfrac{y}{z} + \dfrac{z}{x}\right)}{2}$

$= \dfrac{x}{y} + \dfrac{y}{z} + \dfrac{z}{x}$

$\therefore$ Area of triangle
$= \sqrt{s(s - a)(s - b)(s - c)}$

$= \sqrt{\left[\left(\dfrac{x}{y} + \dfrac{y}{z} + \dfrac{z}{x}\right)\left(\dfrac{x}{y} + \dfrac{y}{z} + \dfrac{z}{x} - \dfrac{y}{z} - \dfrac{z}{x}\right)\left(\dfrac{x}{y} + \dfrac{y}{z} + \dfrac{z}{x} - \dfrac{z}{x} + \dfrac{x}{y}\right)\left(\dfrac{x}{y} + \dfrac{y}{z} + \dfrac{z}{x} - \dfrac{x}{y} - \dfrac{y}{z}\right)\right]}$

$= \sqrt{\left(\dfrac{x}{y} + \dfrac{y}{z} + \dfrac{z}{x}\right)\left(\dfrac{x}{y}\right)\left(\dfrac{y}{z}\right)\left(\dfrac{z}{x}\right)}$

$= \sqrt{\dfrac{x}{y} + \dfrac{y}{z} + \dfrac{z}{x}}$

67. If the angles of a triangle are 30° and 45° and the included side is $(\sqrt{3} + 1)$ cm, then what is the area of the triangle?

(a) $(\sqrt{3} + 1)\,\text{cm}^2$ (b) $(\sqrt{3} + 3)\,\text{cm}^2$
(c) $\dfrac{1}{2}(\sqrt{3} + 1)\,\text{cm}^2$ (d) $2(\sqrt{3} + 1)\,\text{cm}^2$

$\ominus$ **(c)** Third angle of the triangle
$= 180° - (30° + 45°)$
$= 180° - 75° = 105°$

Now, $\dfrac{\sqrt{3} + 1}{\sin 105°} = \dfrac{AB}{\sin 30°}$

$\Rightarrow \dfrac{\sqrt{3} + 1}{\left(\dfrac{\sqrt{3} + 1}{2\sqrt{2}}\right)} = \dfrac{x}{1/2}$

$\Rightarrow \qquad 2\sqrt{2} = 2x$
$\Rightarrow \qquad x = \sqrt{2}$
$\therefore$ Required area of triangle
$= \dfrac{1}{2}(AB \times BC) \times \sin 45°$
$= \dfrac{1}{2} \times \sqrt{2} \times (\sqrt{3} + 1) \times \dfrac{1}{\sqrt{2}}$
$= \dfrac{1}{2}(\sqrt{3} + 1)\,\text{cm}^2$

68. *ABCD* is a plate in the shape of a parallelogram. *EF* is the line parallel to *DA* and passing through the point of intersection *O* of the diagonals *AC* and *BD*. Further, *E* lies on *DC* and *F* lies on *AB*. The triangular portion *DOE* is cut out from the plate *ABCD*. What is the ratio of area of remaining portion of the plate to the whole?

(a) $\dfrac{5}{8}$ (b) $\dfrac{5}{7}$
(c) $\dfrac{3}{4}$ (d) $\dfrac{7}{8}$

$\ominus$ **(d)**
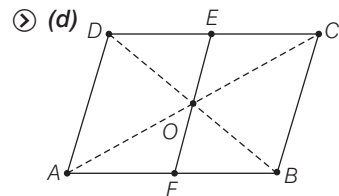
We know that, the diagonal of a parallelogram cut the parallelogram in the four equal parts.
$\therefore \text{ar}(AOB) = \text{ar}(BOC) = \text{ar}(DOC)$
$\qquad\qquad = \text{ar}(AOD)$
And $\text{ar}(DOE) = \text{ar}(EOC)$
$\qquad = \dfrac{1}{2}\text{ar}(COD)$
$\qquad = \dfrac{1}{2} \times \dfrac{1}{4}\text{ar}(ABCD)$
$\qquad = \dfrac{1}{8}\text{ar}(ABCD)$

$\therefore$ ar (Remaining portion of the plate after cutting portion *DOE*)
$\qquad = \dfrac{7}{8}\text{ar}\,(ABCD)$

$\therefore$ The ratio of area of remaining portion of the plate to the whole
$\qquad = \dfrac{7/8 \text{ ar }(ABCD)}{\text{ar }(ABCD)} = 7/8$

69. Two circles of radii 20 cm and 16 cm intersect and the length of common chord is 24 cm. If d is the distance between their centres, then which one of the following is correct?

(a) $d < 26$ cm
(b) 26 cm $< d < 27$ cm
(c) 27 cm $< d < 28$ cm
(d) $d > 28$ cm

⊚ **(b)**
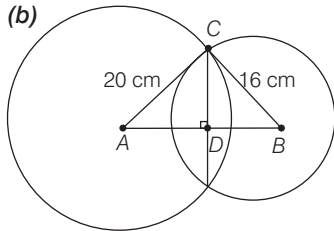
Here, $AB = d$, $CD = 12$ cm
In $\triangle ADC$, $\angle ADC = 90°$
$\therefore$ $AC^2 = AD^2 + CD^2$
$\Rightarrow$ $20^2 = AD^2 + 12^2$
$\Rightarrow$ $AD^2 = 400 - 144 = 256$
$\Rightarrow$ $AD = 16$
And in $\triangle BCD$, $\angle BDC = 90°$
$BC^2 = BD^2 + CD^2$
$\Rightarrow$ $16^2 = BD^2 + 12^2$
$\Rightarrow$ $BD^2 = 256 - 144 = 112$
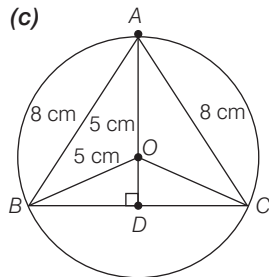$\Rightarrow$ $BD = \sqrt{112} = 10.58$
$\therefore$ $AB = AD + DB$
$\Rightarrow$ $d = 16 + 10.58 = 26.58$ cm
$\therefore 26 < d < 27$ cm

70. In a circle of radius 5 cm, AB and AC are two chords such that $AB = AC = 8$ cm. What is the length of chord BC ?

(a) 9 cm   (b) 9.2 cm
(c) 9.6 cm   (d) 9.8 cm

⊚ **(c)**

Let $OD = x$ cm
and $BD = y$ cm
In right angle triangle BOD,
$BO^2 = OD^2 + BD^2$
$\Rightarrow$ $5^2 = x^2 + y^2$ ... (i)
And in right angled triangle ABD,
$AB^2 = AD^2 + BD^2$

$\Rightarrow 8^2 = (5 + x)^2 + y^2$
$\Rightarrow 64 = (5 + x)^2 + (5^2 - x^2)$
                     [from Eq. (i)]
$\Rightarrow$ $64 = 25 + x^2 + 10x + 25 - x^2$
$\Rightarrow$ $64 = 50 + 10x$
$\Rightarrow 10x = 14 \Rightarrow x = 1.4$
Now, from Eq. (i), $25 = (1.4)^2 + y^2$
$\Rightarrow$ $25 = 1.96 + y^2$
$\Rightarrow$ $y = \sqrt{25 - 1.96}$
       $= 4.8$
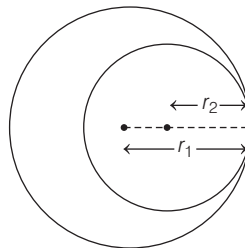$\therefore$ Length of chord $BC = 2y$
                 $= 2 \times 4.8$
                 $= 9.6$ cm

71. Two circles touch internally. The sum of their areas is 136π cm^2 and distance between their centres is 4 cm. What are the radii of the circles?

(a) 11 cm, 7 cm
(b) 10 cm, 6 cm
(c) 9 cm, 5 cm
(d) 8 cm, 4 cm

⊚ **(b)**

Let radius of larger circle be r_1 and radius of smaller circle be r_2.
$\therefore$ $r_1 - r_2 = 4$
$\Rightarrow$ $r_1 = 4 + r_2$ ... (i)
and $\pi r_1^2 + \pi r_2^2 = 136\pi$
$\Rightarrow$ $\pi(4 + r_2)^2 + \pi r_2^2 = 136\pi$
$\Rightarrow$ $16 + r_2^2 + 8r_2 + r_2^2 = 136$
$\Rightarrow$ $2r_2^2 + 8r_2 = 136 - 16 = 120$
$\Rightarrow$ $r_2^2 + 4r_2 - 60 = 0$
$\Rightarrow$ $r_2^2 + 10r_2 - 6r_2 - 60 = 0$
$\Rightarrow r_2(r_2 + 10) - 6(r_2 + 10) = 0$
$\Rightarrow$ $(r_2 + 10)(r_2 - 6) = 0$
$\Rightarrow$ $r_2 = 6$
$[\because r_2 \neq -10]$
$\therefore r_1 = 4 + 6 = 10$ cm

72. If area of a circle and a square are same, then what is the ratio of their perimeters?

(a) $2\sqrt{\pi} : 1$ (b) $\sqrt{\pi} : 1$
(c) $\sqrt{\pi} : 2$ (d) $\sqrt{\pi} : 4$

⊚ **(c)** Let radius of circle be r and side of square be x.

Then, according to the question,
$\pi r^2 = x^2$
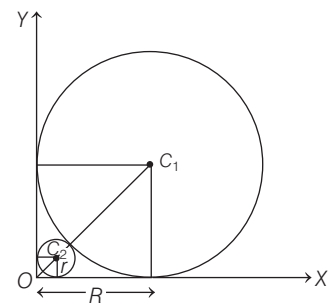$\Rightarrow$ $\sqrt{\pi} r = x \Rightarrow \dfrac{r}{x} = \dfrac{1}{\sqrt{\pi}}$
$\therefore$ Ratio of their perimeters $= \dfrac{2\pi r}{4x}$
$= \dfrac{\pi}{2} \cdot \dfrac{1}{\sqrt{\pi}} = \dfrac{\sqrt{\pi}}{2} = \sqrt{\pi} : 2$

73. A circle of diameter 8 cm is placed in such a manner that it touches two perpendicular lines. Then another smaller circle is placed in the gap such that it touches the lines and the circle. What is the diameter of the smaller circle?

(a) $4(3 - \sqrt{2})$ cm   (b) $4(3 - 2\sqrt{2})$ cm
(c) $8(3 - \sqrt{2})$ cm   (d) $8(3 - 2\sqrt{2})$ cm

⊚ **(d)**

Let the distance between the small circle and the origin O is x and radius of small circle and larger circle are r and R respectively.
$\therefore$ $OC_2 = \sqrt{r^2 + r^2} = r + x$
$\Rightarrow$ $r + x = \sqrt{2} r$
$\Rightarrow$ $x = r(\sqrt{2} - 1)$ ... (i)
And also,
$OC_2 = \sqrt{R^2 + R^2}$
$= (x + 2r + R)$
$\Rightarrow$ $x + 2r + R = \sqrt{2}R$
$\Rightarrow$ $r(\sqrt{2} - 1) + 2r + 4 = \sqrt{2}(4)$
                 $[\because 2R = 8$ cm$]$
$\Rightarrow r(\sqrt{2} - 1 + 2) = 4(\sqrt{2} - 1)$
$\Rightarrow$ $r(\sqrt{2} + 1) = 4(\sqrt{2} - 1)$
$\Rightarrow$ $r = \dfrac{4(\sqrt{2} - 1)}{\sqrt{2} + 1} \times \dfrac{\sqrt{2} - 1}{\sqrt{2} - 1}$
$\Rightarrow$ $r = \dfrac{4(\sqrt{2} - 1)^2}{2 - 1}$
$\Rightarrow$ $r = 4(2 + 1 - 2\sqrt{2})$
$\Rightarrow$ $r = 4(3 - 2\sqrt{2})$
$\therefore$ Diameter of the smaller circle $= 2r$
$= 8(3 - 2\sqrt{2})$ cm

74. The thickness of a cylinder is 1 foot, the inner radius of the cylinder is 3 feet and height is 7 feet. To paint the inner surface it requires one litre of a particular colour. How much quantity of the same colour is required to paint all the surfaces of the cylinder?

(a) $\frac{7}{3}$ L　(b) $\frac{3}{2}$ L　(c) $\frac{8}{3}$ L　(d) $\frac{10}{3}$ L

⊙ **(c)** Given, thickness of a cylinder is 1 feet and inner radius of the cylinder $(r_2) = 3$ feet
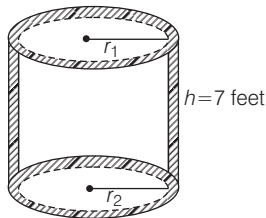
∴ Outer radius of the cylinder
$(r_1) = (3 + 1) = 4$ feet
Now, Inner surface area of cylinder
$$= 2\pi r_2 h$$
$$= 2\pi(3)(7) \text{ feet}^2$$
$$= 42\pi \text{ feet}^2$$
∴　$42\pi \text{ feet}^2 \equiv 1\,\text{L}$
$$\Rightarrow 1 \text{ feet}^2 \equiv \frac{1}{42\pi}\,\text{L}$$
Total surface area of the cylinder
$$= 2\pi r_1 h + 2\pi r_2 h + 2(\pi r_1^2 - \pi r_2^2)$$
$$= 2\pi h(r_1 + r_2) + 2\pi(r_1 - r_2)(r_1 + r_2)$$
$$= 2\pi \times 7(4 + 3) + 2\pi(4 - 3)(4 + 3)$$
$$= 2\pi(49) + 14\pi$$
$$= 112\pi \text{ feet}^2$$
∴ Required quantity of same colour to paint all the surface of cylinder
$$= 112\pi \times \frac{1}{42\pi}\,\text{L} = \frac{8}{3}\,\text{L}$$

75. A square and a rectangle have equal areas. If one side of the rectangle is of length numerically equal to the square of the length of the side of the square, then the other side of the rectangle is

(a) square root of the side of the square
(b) half the side of the square
(c) of unit length
(d) double the side of the square

⊙ **(c)** Let side of square be x, then one side of rectangle be x^2 and let other side of rectangle be y.
Then, according to the question,
$x^2 = x^2 \times y$ (area of square = area of rectangle)
$\Rightarrow y = 1$

76. The length and breadth of a rectangle are in the ratio 4 : 3. Then, what is the ratio of the area of the triangle formed by the parts of the diagonals with a long side to the area of the triangle formed by the parts of diagonals with a short side?

(a) 3 : 4　(b) 4 : 3　(c) 16 : 9　(d) 1 : 1

⊙ **(d)** Let length of rectangle be $4x$ and breadth of rectangle be $3x$.
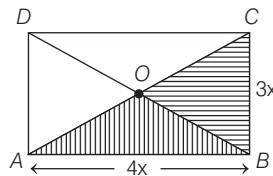
∴ Diagonal of rectangle,
$$AC = \sqrt{(4x)^2 + (3x)^2} = \sqrt{25x^2} = 5x$$
Here, side of triangle OAB formed by the parts of the diagonal with long side are $2.5x$, $2.5x$ and $4x$.
And side of triangle OBC formed by the parts of the diagonal with shord side are $2.5x$, $2.5x$ and $3x$.
$$\therefore \frac{ar(\triangle OAB)}{ar(\triangle OBC)} = \frac{\frac{1}{2} \times 4x \times \frac{3x}{2}}{\frac{1}{2} \times 3x \times \frac{4x}{2}} = \frac{4 \times 3}{3 \times 4}$$
$$\Rightarrow ar(\triangle AOB) : ar(\triangle BOC) = 1 : 1$$

77. Suppose a region is formed by removing a sector of 20° from a circular region of radius 30 feet. What is the area of this new region?
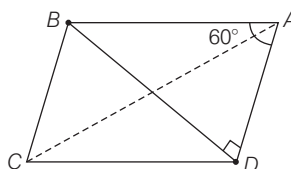
(a) 150π sq feet　(b) 550π sq feet
(c) 650π sq feet　(d) 850π sq feet

⊙ **(d)** Area of new region
$$= \pi r^2 - \left(\frac{\theta}{360°}\right)\pi r^2 = \pi r^2\left(1 - \frac{\theta}{360°}\right)$$
$$= \pi(30)^2\left(1 - \frac{20°}{360°}\right) = \pi(900)\left(\frac{17}{18}\right)$$
$$= 850\pi \text{ sq feet}$$

78. $ABCD$ is a parallelogram where AC and BD are the diagonals. If $\angle BAD = 60°$, $\angle ADB = 90°$, then what is BD^2 equal to?

(a) $\frac{3}{5}AB^2$　(b) $\frac{3}{4}AB^2$　(c) $\frac{1}{2}AB^2$　(d) $\frac{2}{3}AB^2$

⊙ **(b)** Given, $ABCD$ is a parallelogram where, AC and BD are the diagonals and $\angle BAD = 60°$, $\angle ADB = 90°$

In right angle triangle ADB
$$\sin 60° = \frac{BD}{AB}$$
$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{BD}{AB}$$
$$\Rightarrow BD^2 = \frac{3}{4}AB^2$$

79. A line through the vertex A of a parallelogram $ABCD$ meets DC in P and BC produced in Q. If P is the mid-point of DC, then which of the following is/are correct?

1. Area of $\triangle PDA$ is equal to that of $\triangle PCQ$.
2. Area of $\triangle QAB$ is equal to twice that of $\triangle PCQ$.

Select the correct answer using the code given below:

(a) Only 1　　(b) Only 2
(c) Both 1 and 2　(d) Neither 1 nor 2

⊙ **(a)** Since, $BC \parallel AD$

∴ $\angle PAD = \angle CQP$
$CP = PD$　[P is the middle point of CD]
and $\angle CPQ = \angle APD$
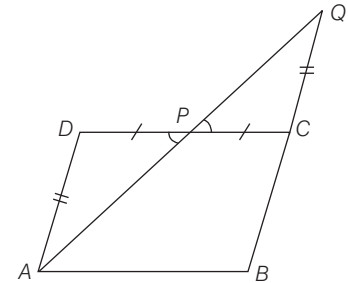
∴　　$\triangle PDA \cong \triangle PCQ$　　[by AAS]
∴ $ar(\triangle PDA) = ar(\triangle PCQ)$
Now, $\angle BQA = \angle CQP$
Since, the $\triangle PCQ$ is a part of the $\triangle BQA$.
So, there area cannot be equal.

80. How many cubic metre of earth is to be dug out to dig a well of radius 1.4 m and depth 5 m?

(a) 30.2 m^3　　(b) 30.4 m^3
(c) 30.6 m^3　　(d) 30.8 m^3

⊙ **(d)** Volume of well with radius 1.4 m and depth 5 m.
$$= \pi \times (1.4)^2 \times 5 = \frac{22}{7} \times 1.4 \times 1.4 \times 5$$
$$= 30.8 \text{ cubic metre}$$

81. If the diagonals of a rhombus are x and y, then what is its area?

(a) $\frac{xy}{2}$　　　(b) $\frac{xy}{4}$
(c) xy　　　(d) $x^2 - y^2$

▶ **(a)** Area of rhombus

$$= \frac{1}{2} \times \text{diagonal I} \times \text{diagonal II}$$

$$= \frac{1}{2} xy$$

82. The lengths of sides of a triangle are $3x$, $4\sqrt{y}$, $5\sqrt[3]{z}$, where $3x < 4\sqrt{y} < 5\sqrt[3]{z}$. If one of the angles is 90°, then what are the minimum integral values of x, y and z respectively?

(a) 1, 2, 3   (b) 2, 3, 4
(c) 1, 1, 1   (d) 3, 4, 5

▶ **(c)** Lengths of sides of a triangle are $3x$, $4\sqrt{y}$, $5\sqrt[3]{z}$, where $3x < 4\sqrt{y} < 5\sqrt[3]{z}$ and one angle is 90°.

∴ $(5\sqrt[3]{z})^2 = (3x)^2 + (4\sqrt{y})^2$

⇒ $25z^{2/3} = 9x^2 + 16y$

⇒ Value of x, y, $z = 1$ which satisfied the equation.

83. What is the maximum number of circumcircles that a triangle can have?

(a) 1   (b) 2   (c) 3   (d) Infinite

▶ **(a)** A triangle has maximum one circumcircles since it touches all the vertex of the triangle.

84. If an arc of a circle of radius 6 cm subtends a central angle measuring 30°, then which one of the following is an approximate length of the arc?
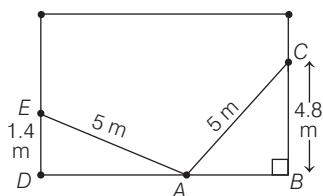
(a) 3.14 cm   (b) 2.15 cm
(c) 2.14 cm   (d) 2 cm

▶ **(a)** Length of arc $= \dfrac{\theta}{360°} \times 2\pi r$

$= \dfrac{30}{360°} \times 2 \times \pi \times 6 = \pi = 3.14$ cm

85. A ladder 5 m long is placed in a room so as to reach a point 4.8 m high on a wall and on turning the ladder over to the opposite side of the wall without moving the base, it reaches a point 1.4 m high. What is the breadth of the room?

(a) 5.8 m (b) 6 m (c) 6.2 m (d) 7.5 m

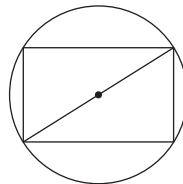▶ **(c)** Here, AC and AE are portion of ladder.

In right angled $\triangle ABC$,

$AB = \sqrt{5^2 - (4.8)^2} \Rightarrow AB = 1.4$ m

and in right angled triangle ADE

$AD = \sqrt{5^2 - (1.4)^2} = 4.8$

∴ The breadth of the room
$BD = AB + AD = 1.4 + 4.8 = 6.2$ m

86. What is the area of the largest square plate cut from a circular disk of radius one unit?

(a) 4 sq units   (b) $2\sqrt{2}$ sq units
(c) π sq units   (d) 2 sq units

▶ **(d)** For largest square plate cut from a circular disk

Diagonal of square
$\qquad$ = Diameter of circle

⇒ $\sqrt{2} \times$ side of square
$\qquad$ = 2 × 1 = 2 unit

⇒ side of square $= \dfrac{2}{\sqrt{2}} = \sqrt{2}$ unit.

∴ Area of the largest square plate
$= (\text{side})^2 = (\sqrt{2})^2 = 2$ sq. units

87. Out of 4 identical balls of radius r, 3 balls are placed on a plane such that each ball touches the other two balls. The 4th ball is placed on them such that this ball touches all the three balls. What is the distance of centre of 4th ball from the plane?

(a) $2\sqrt{\dfrac{2}{3}}\, r$ unit

(b) $\dfrac{\sqrt{3} + 2\sqrt{2}}{\sqrt{2}}\, r$ unit

(c) $\dfrac{r}{3 - 2\sqrt{2}}$ unit

(d) $\dfrac{\sqrt{3} + 2\sqrt{2}}{\sqrt{3}}\, r$ unit

▶ **(a)** Let Q be the mid-point of BC and since $\triangle ABC$ is an equilateral triangle.
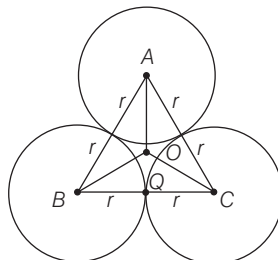
∴ $\cos 30° = \dfrac{CQ}{OC} = \dfrac{\sqrt{3}}{2} = \dfrac{r}{x}$ (let)

⇒ $x = \dfrac{2r}{\sqrt{3}}$ ... (i)
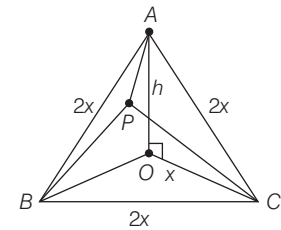
Let P be the position of 4th ball and OP is the distance of centre of 4th ball from the ground.

In $\triangle POC$, $\angle POC = 90°$
$CP^2 = OP^2 + OC^2$
⇒ $OP^2 = CP^2 - OC^2 = (2r)^2 - x^2$

$= 4r^2 - \left(\dfrac{2r}{\sqrt{3}}\right)^2$ [By using Eq. (i)]

$= 4r^2 - \dfrac{4r^2}{3} = \dfrac{8r^2}{3}$

⇒ $OP = \dfrac{2\sqrt{2}r}{\sqrt{3}} = 2\sqrt{\dfrac{2}{3}}\, r$ unit

88. A right circular cylinder just encloses a sphere. If p is the surface area of the sphere and q is the curved surface area of the cylinder, then which one of the following is correct?

(a) $p = q$
(b) $p = 2q$
(c) $2p = q$
(d) $2p = 3q$

▶ **(a)** Let radius of sphere be r.
∴ Surface area of sphere,

$\qquad p = 4\pi r^2$ ... (i)
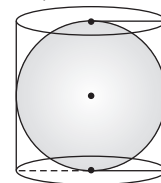
Now, height of cylinder, $h = 2r$
∴ Surface area of the cylinder
$q = 2\pi rh = 2\pi r(2r)$
$= 4\pi r^2$ ... (ii)
From Eqs. (i) and (ii), we get $p = q$

89. $ABCD$ is a quadrilateral such that $AD = DC = CA = 20$ units, $BC = 12$ units and $\angle ABC = 90°$. What is the approximate area of the quadrilateral $ABCD$?

(a) 269 sq units   (b) 300 sq units
(c) 325 sq units   (d) 349 sq units

(a) In right angled triangle $ABCD$,
$$AB^2 = AC^2 - BC^2$$
$$= (20)^2 - (12)^2 = 400 - 144$$
$$\Rightarrow AB = \sqrt{256} = 16 \text{ units}$$
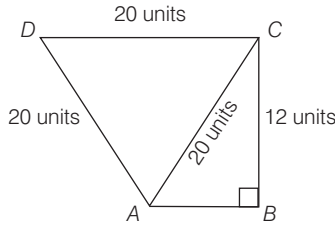
$\therefore$ Area of quadrilateral $ABCD$
$$= \text{ar}(\Delta ACD) + \text{ar}(\Delta ABC)$$
$$= \frac{\sqrt{3}}{4}(\text{side})^2 + \frac{1}{2} \times \text{Base} \times \text{height}$$
$$= \frac{\sqrt{3}}{4} \times (20)^2 + \frac{1}{2} \times 16 \times 12$$
$$= 100\sqrt{3} + 96$$
$$= 269 \text{ sq units (approx.)}$$

90. Let $PQRS$ be the diameter of a circle of radius 9 cm. The length PQ, QR and RS are equal. Semi-circle is drawn with QS as diameter (as shown in the given figure). What is the ratio of the shaded region to that of the unshaded region?

(a) 25 : 121   (b) 5 : 13
(c) 5 : 18   (d) 1 : 2

(b) We have, $PS = 2 \times 9 = 18$ cm

Since, $PQ = QR = RS$
$$\therefore PQ = QR = RS = \frac{PS}{3} = \frac{18}{3} = 6 \text{ cm}$$

$\therefore$ Area of the shaded region
$$= \frac{1}{2}(\pi \times 9^2 - \pi \times 6^2)$$
$$= \frac{\pi}{2}(81 - 36) = \frac{45}{2}\pi \text{ cm}^2$$

And area of unshaded region
$$= \frac{1}{2}(\pi \times 9^2 + \pi \times 6^2)$$
$$= \frac{\pi}{2}(81 + 36) = \frac{\pi}{2} \times 117$$

$\therefore$ Ratio of the shaded region to that of the unshaded region
$$= \frac{\frac{45}{2}\pi}{\frac{117}{2}\pi} = \frac{45}{117} = 5:13$$

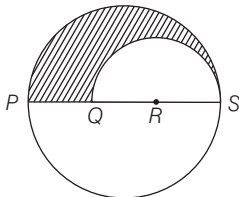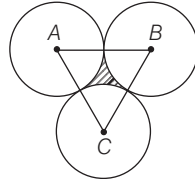**91.** What is the area of the shaded region in the given figure, if the radius of each of the circles is 2 cm?

(a) $4\sqrt{3} - 2\pi$ cm^2
(b) $\sqrt{3} - \pi$ cm^2
(c) $\sqrt{3} - \frac{\pi}{2}$ cm^2
(d) $2\pi - 2\sqrt{3}$ cm^2

(a) Side of the equilateral triangle
$ABC = 2 \times 2 = 4$ cm

$\therefore$ Area of shaded region
$=$ Area of equilateral triangle ABC
$- 3 \times$ Area of sector with angle $60°$
and radius 2 cm
$$= \frac{\sqrt{3}}{4} \times (4)^2 - 3 \times \left(\frac{60°}{360°}\right)\pi(2)^2$$
$$= \sqrt{3} \times 4 - 3 \times \frac{1}{6} \times \pi(4)$$
$$= 4\sqrt{3} - 2\pi \text{ cm}^2$$

92. In the given figure, what is the area of the shaded region?
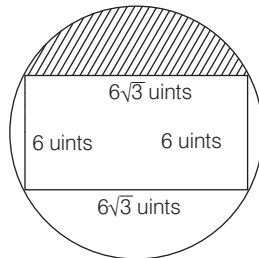
(a) $9(\pi - \sqrt{3})$ sq units
(b) $3(4\pi - 3\sqrt{3})$ sq units
(c) $3(3\pi - 4\sqrt{3})$ sq units
(d) $9(\sqrt{3} - \pi)$ sq units

(b) Diameter of circle
= diagonal of rectangular part
$$= \sqrt{(6\sqrt{3})^2 + (6)^2}$$
$$= \sqrt{108 + 36} = \sqrt{144} = 12$$
$\therefore$ Radius of circle $= \frac{12}{2} = 6$ cm

In ΔOAB,
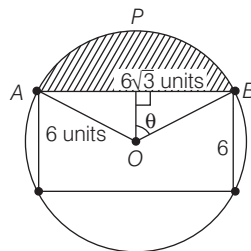
$$\sin\theta = \frac{BC}{OB} = \frac{3\sqrt{3}}{6} = \frac{\sqrt{3}}{2}$$
$$\Rightarrow \sin\theta = \sin60° \Rightarrow \theta = 60°$$
$$\therefore \angle AOB = 2\theta = 120°$$
$\therefore$ Area of shaded region $APBA$
= Area of sector
$\qquad APBOA -$ area of ΔABO
$$= \left(\frac{120°}{360°}\right)\pi(6)^2 - \frac{1}{2} \times 3 \times 6\sqrt{3}$$
$$[\because OC = 3 \text{ units}]$$
$$= \frac{1}{3} \times \pi \times 36 - 9\sqrt{3} = 12\pi - 9\sqrt{3}$$
$$= 3(4\pi - 3\sqrt{3}) \text{ sq units}$$

93. In the given figure, if $\frac{y}{x} = 6$ and $\frac{z}{x} = 5$, then what is the value of x?
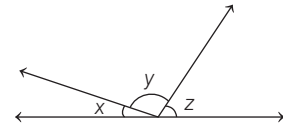
(a) 45°   (b) 30°   (c) 15°   (d) 10°

(c) Given, $\frac{y}{x} = 6$ and $\frac{z}{x} = 5$
$\Rightarrow y = 6x$ and $z = 5x$
Now, $x + y + z = 180°$ [straight angle]
$\Rightarrow x + 6x + 5x = 180°$
$\Rightarrow 12x = 180 \Rightarrow x = 15°$

94. $ABCD$ is a trapezium, where AB is parallel to DC. If $AB = 4$ cm, $BC = 3$ cm, $CD = 7$ cm and $DA = 2$ cm, then what is the area of the trapezium?

(a) $22\sqrt{\frac{2}{3}}$ cm^2 (b) $22\sqrt{\frac{3}{2}}$ cm^2
(c) $22\sqrt{3}$ cm^2 (d) $\frac{22\sqrt{2}}{3}$ cm^2

(d) Area of trapezium, when the lengths of parallel and non-parallel sides are given
$$= \frac{a+b}{k}\sqrt{s(s-k)(s-c)(s-d)}$$
Where $k = b - a = (7 - 4) = 3$ cm
and $s = \frac{k+c+d}{2} = \frac{3+2+3}{2} = 4$ cm
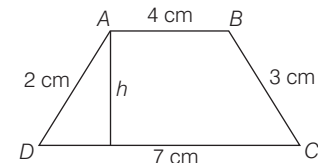
$\therefore$ Required area of trapezium
$$= \frac{(4+7)}{3}\sqrt{4(4-3)(4-2)(4-3)}$$
$$= \frac{11}{3}\sqrt{4(1)(2)(1)} = \frac{11 \times 2\sqrt{2}}{3}$$
$$= \frac{22\sqrt{2}}{3} \text{ cm}^2$$

95. Angles are shown in the given figure. What is the value of $\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 + \angle 6 + \angle 7 + \angle 8$?
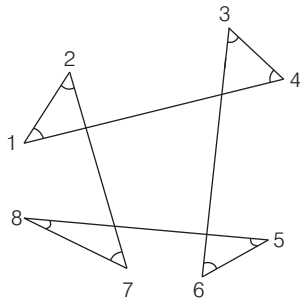
(a) 240°　　　　(b) 360°
(c) 540°　　　　(d) 720°

⊙ **(b)** Sum of angles of a quadrilateral
= 360°
$\Rightarrow (180° - (\angle 1 + \angle 2)) + (180°$
$- (\angle 3 + \angle 4) + (180° - (\angle 5 + \angle 6))$
$+ (180° - \angle 7 + \angle 8)) = 360°$
$\Rightarrow 720° - (\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5$
$+ \angle 6 + \angle 7 + \angle 8) = 360°$
$\Rightarrow \angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5$
$+ \angle 6 + \angle 7 + \angle 8 = 360°$

96. In the given figure PQ is parallel to RS, $\angle AEF = 95°$, $\angle BHS = 110°$, and $\angle ABC = x°$. Then, what is the value of x?
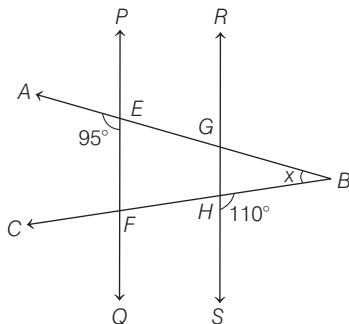
(a) 15　　　　(b) 25
(c) 30　　　　(d) 35

⊙ **(b)** $\angle BEF = 180° - 95° = 85°$

and $\angle FHG = 110°$
　　　　　　[vertically opposite angle]
∴ Since $PQ \| RS$
∴　　　$\angle EFH + \angle GHF = 180°$
$\Rightarrow$　　　$\angle EFH + 110° = 180°$
$\Rightarrow$　$\angle EFH = 180 - 110° = 70°$
In ΔBEF, $\angle B + \angle F + \angle E = 180°$
$\Rightarrow$　　$x + 70° + 85° = 180°$
$\Rightarrow$　　　　$x + 155° = 180°$
$\Rightarrow$　　　　$x = 180° - 155°$
$\Rightarrow$　　　　　$x = 25°$

97. In the given figure AB is parallel to CD and AC is parallel to BD. If $\angle EAC = 40°$, $\angle FDG = 55°$, $\angle HAB = x°$, then what is the value of x?
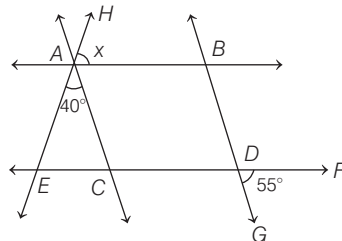
(a) 85　　　　(b) 80
(c) 75　　　　(d) 65

⊙ **(a)** Given, $AB \| CD$ and $AC \| BD$.
∴ $\angle BAC = \angle BDC = 55°$
Now,
$\angle HAB + \angle BAC + \angle CAE = 180°$
$\Rightarrow x + 55° + 40° = 180°$
$\Rightarrow$　　$x + 95° = 180°$
$\Rightarrow$　　　$x = 180° - 95°$
$\Rightarrow$　　　$x = 85°$

98. In the given figure, there are three semi-circles ABC, AEF and CDF. The distance between A and C is 28 units and F is the mid-point of AC. What is the total area of the three semi-circles?
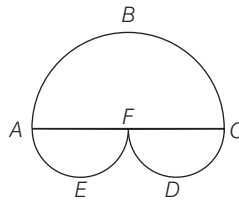
(a) 924 sq units　　(b) 824 sq units
(c) 624 sq units　　(d) 462 sq units

⊙ **(d)** Given, $AC = 28$ units
∴ $AF = \dfrac{28}{2} = 14$ units
∴ Area of three semi-circles
ABC, AEF and CDF
$= \dfrac{\pi(14)^2}{2} + \dfrac{\pi(7)^2}{2} + \dfrac{\pi(7)^2}{2}$
$= \dfrac{\pi}{2}(14^2 + 7^2 + 7^2)$
$= \dfrac{\pi}{2}(196 + 49 + 49)$
$= \dfrac{\pi}{2}(294)$
$= \dfrac{22}{7} \times \dfrac{1}{2} \times 294$
$= 462$ sq units

99. What is the approximate area of the shaded region in the figure given?
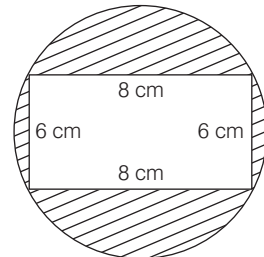
(a) 15.3 cm²　　　(b) 25.5 cm²
(c) 28.4 cm²　　　(d) 30.5 cm²

⊙ **(d)** Diameter of circle = diagonal of rectangular region = $\sqrt{8^2 + 6^2}$
$= \sqrt{64 + 36} = \sqrt{100} = 10$ cm
∴ Radius of circle = $\dfrac{10}{2} = 5$ cm
∴ Area of shaded region
= Area of circle – area of rectangular region
$= \pi(5)^2 - (8 \times 6) = 3.14 \times 25 - 48$
$= 78.5 - 48 = 30.5$ cm²

100. Consider the following statements with reference to the given figure.
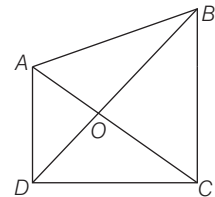
1. The sum of the areas of ΔAOD and ΔBOC is equal to the sum of the areas of ΔAOB and ΔDOC.
2. $\angle AOD = \angle BOC$
3. $AB + BC + CD + DA > AC + BD$

Which of the above statements are correct?

(a) 1 and 2　　　(b) 2 and 3
(c) 1 and 3　　　(d) 1, 2 and 3

⊙ **(b)** $\angle AOD = \angle BOC$
　　　　[vertically opposite angles]
In ΔADC, $AD + DC > AC$ 　… (i)
In ΔABC, $AB + BC > AC$ 　… (ii)
In ΔBCD, $BC + CD > BD$ 　… (iii)
and ΔBCD, $AB + AD > BD$ 　… (iv)
On adding Eqs. (i), (ii), (iii) and (iv), we get
$2(AB + BC + CD + AD)$
　　　　　　$> 2(AC + BD)$
$\Rightarrow AB + BC + CD + AD > AC + BD$
It is not necessary that
ar $(\Delta AOD) +$ ar (ΔBOC)
　　= ar $(\Delta AOB) +$ ar (ΔDOC)

PAPER II English

PASSAGE-I

Not all agricultural societies become civilisations, but no civilisation can become one without passing through the stage of agriculture. This is because at some stage in the development of agriculture, as productivity improves, not all people would need to be engaged in producing or procuring food.

A significant number of people could be freed up to pursue other activities such as building walls or monuments for new cities; making new tools, weapons and jewellery; organising long-distance trade; creating new artistic masterpieces; coming up with new inventions; keeping accounts; and perhaps constructing new public infrastructure such as irrigation canals that further improve the productivity of agriculture, thus realising even more people to do new things.

This can happen, of course, only if a society that has transitioned to high-productivity agriculture has also, at some stage in its evolution, found a way to channel the bonanza of free time into other work fruitfully.

In the ancient world, this often involved creating new ideologies and new hierarchies or power structures to coerce or otherwise convince large groups of people to devote their time to the new tasks for very little reward.

1. Which one of the following statements is true according to the author?
   (a) Agriculture has always been part of all civilisations.
   (b) Not all civilisations have undergone the processes of agriculture.
   (c) Agriculture gave birth to new civilisations.
   (d) Communities discontinued agriculture to become civilisations.

⊙ *(a)* According to the given passage, all civilisations have developed after going through a phase of agriculture. Hence, agriculture had been as part of all civilisations.

2. A significant number of people were sent to carry out other work from agriculture because
   (a) there were insufficient agricultural products.
   (b) people were needed to build monuments, weapons, jewellery, etc.
   (c) there were sufficient agricultural products.
   (d) this enabled the development of civilisations.

⊙ *(c)* The given passage states that as the agriculture production was bulk, people had to time to invest their time in other activities.

3. What kind of agriculture based societies would emerge as civilisations?
   (a) Societies which achieved high productivity in agriculture had the opportunity to find time for other work.
   (b) Societies which depended on agriculture completely moved to other fruitful work so as to move to many places.
   (c) Societies which transitioned from one stage of agriculture to another.
   (d) Societies which could not do agriculture for lack of resources moved to other work.

⊙ *(a)* According to the given passage, those agricultural societies where agricultural production was high and in bulk, those societies emerged as civilisations.

4. People as groups were convinced to do new work through
   (a) reward, force and community persuasions.
   (b) ideologies, hierarchies and power structures.
   (c) excessive agricultural products.
   (d) very high rewards.

⊙ (b) The last line of the passage states that it was 'ideologies, hierarchies and power structures' that convinced or forced people to devote their time to activities other than agriculture.

5. Which word in the passage means 'changeover'?
   (a) Transitioned
   (b) Channel
   (c) Coerce
   (d) Hierarchies

⊙ *(a)* The synonym of changeover is transitioned. Both word represent a shift to a new way.

PASSAGE-II

When we pick up a newspaper, a book or an article, we come to our task with certain preconceptions and predispositions. We expect to find a specific piece of information or be presented with an argument or an analysis of something, say, the likelihood of recession in the next six months or the reasons why children can't read. We probably know a little about the book or article we are reading even before we start. There was, after all, some reason why we chose to read one piece of writing rather than another.

Our expectations and predispositions may, however, blind us to what the article and its author is actually saying. If, for example, we are used to disagreeing with the author, we may see only what we expect to see and not what is actually there. Day after day in our routine pattern of life we expose ourselves to the same newspaper, the same magazine, even books by authors with the same perspectives. In order to reflect on our reading habits and improve our skills we need to break out of this routine, step back and look at what we are doing when we read.

6. According to the author, which one of the following statements is not true?
   (a) Reader's preconceptions influence their reading.
   (b) Readers have expectations when they read an article or a book.
   (c) Readers look for specific information in any of their readings.
   (d) Readers assume that everything they read will have new information.

> *(d)* As per the given passage, readers have certain presumptions and ideas that govern what and how they would read any literary work. In fact, it also points that readers look for some specific pieces of information in any literature. Hence, option (d) is not given in the passage.

7. Our expectations and predispositions may, however, blind us because

(a) we may not get the actual ideas of the author.
(b) we will get the actual ideas of the author.
(c) we may disagree with the author.
(d) we will agree with all the ideas of the author.

> *(a)* The passage points out that whenever we have preconceived ideas or viewpoints, it blinds us or does not let us understand what the author truly wants to say. We often assume the meaning to be something else than what the author actually wanted to say.

8. One of the ways to improve our reading habits is to

(a) break the routine by changing the time of reading.
(b) change the types of topics we read.
(c) break the routine of reading the same newspaper.
(d) stop reading for some time and then restart reading.

> *(c)* According to the given passage, the best way to improve our reading habit is to break the routine of reading the same literary work again and again.

9. Which quality does the author here advocate, to be a good reader?

(a) Being objective to the ideas of the author.
(b) Having preconceptions and predispositions.
(c) Having continuous routines.
(d) Disagreeing with the author.

> *(a)* The passage clearly states that we must be open and objective to the ideas of the author to become an effective reader.

10. Which word in the passage means 'viewpoints'?

(a) Preconceptions
(b) Predispositions
(c) Pattern
(d) Perspectives

> *(d)* The synonym of 'viewpoints' is 'perspectives', as both words means a persons opinion or point of view.

Directions (Q. Nos. 11-20) *Each item in this section has a sentence with three underlined parts labelled as (a), (b) and (c). Read each sentence to find out whether there is any error in any underlined part and indicate your response on the Answer Sheet against the corresponding letter i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d).*

11. After mysteriously expanding for decades (a) / Antarctica's sea ice cover (b) / starting melting. (c) / No error (d)

> *(c)* Replace 'starting' with 'started' to make the given sentence grammatically and contextually meaningful.

12. The auction, conducted by the bank (a) / will be price based (b) / using multiple priced method. (c) / No error (d)

> *(c)* Replace 'method' with 'methods' to make the given sentence grammatically and contextually meaningful.

13. If the scheme would have been implemented effectively (a) / all affected (b) / would have benefitted. (c) / No error (d)

> *(a)* Replace 'would have been' with 'had been' to make the given sentence grammatically and contextually meaningful.

14. Government Stock offers (a) / safety, liquidity and attractive returned (b) / for long duration. (c) / No error (d)

> *(b)* Replace 'returned' with 'returns' to make the given sentence grammatically and contextually meaningful.

15. Scrolling thorough my social media timeline, (a) / I hovered over a video (b) / of a minor road traffic accident. (c) / No error (d)

> *(a)* Replace 'thorough' with 'through' to make the given sentence grammatically and contextually meaningful. Thorough means in detail.

16. The fascination with gold at least (a) / seems to be a case were traditional belief and (b) / modern

finance would point the same way. (c) / No error (d)

> *(c)* Replace 'were' with 'where' to make the given sentence grammatically and contextually meaningful.

17. Evolutionary biology leave us (a) / distinctly pessimistic about the possibility (b) / that altruism can arise naturally among humans. (c) / No error (d)

> *(a)* Replace 'leave' with 'leaves' to make the given sentence grammatically and contextually meaningful.

18. When everything starts working for you (a) / you will find (b) / things are achieve and delivered. (c) / No error (d)

> *(c)* Replace 'achieve' with 'achieved' to make the given sentence grammatically and contextually meaningful.

19. If I were you (a) / I would not go for (b) / change of job. (c) / No error (d)

> *(c)* Add 'a' before change to make the given sentence grammatically and contextually meaningful.

20. At the beginning of the nineteenth century, (a) / female literacy was extremely lowed (b) / in comparison to male literacy. (c) / No error (d)

> *(b)* Replace 'lowed' with 'low' to make the given sentence grammatically and contextually meaningful.

Directions (Q. Nos. 21-30) *Each of the following items in this section consists of a sentence, parts of which have been jumbled. These parts have been labelled as P, Q, R and S. Given below each sentence are four sequences, namely (a), (b), (c) and (d). You are required to re-arrange the jumbled parts of the sentence and mark your response accordingly.*

21. for long and (P) / the backbone of India (Q) / will continue to be the same (R) / agriculture has been (S)

(a) SPQR
(b) SQPR
(c) QRSP
(d) QSRP

> *(b)* The correct and meaningful order of the parts of sentence is SQPR.

22. the cry of general public (P) /
agenda in any country (Q) / public
policy making (R) / is generally
driven by (S)

(a) RQSP   (b) RPSQ
(c) PSRQ   (d) QRSP

⊙ *(a)* The correct and meaningful order
of the parts of sentence is RQSP.

23. before it starts (P) / of the
government is (Q) The essential
power (R) / the power to manage
conflict (S)

(a) RSPQ   (b) SQRP
(c) RQSP   (d) QRSP

⊙ *(c)* The correct and meaningful order
of the parts of sentence is RQSP.

24. a majority of the vote (P) / the
party that received (Q) / of the
government (R) / must take
control (S)

(a) QPSR   (b) PSRQ
(c) RSPQ   (d) SQPR

⊙ *(a)* The correct and meaningful order
of the parts of sentence is QPSR.

25. can express a view on (P) / in
which the electorate (Q) / a
particular issue of public policy (R)
/ a referendum is a vote (S)

(a) SQPR   (b) RPQS
(c) QRSP   (d) PQRS

⊙ *(a)* The correct and meaningful order
of the parts of sentence is SQPR.

26. in modern societies (P) / or merely
suppressed (Q) / has class conflict
(R) / been resolved (S)

(a) RPSQ   (b) RSPQ
(c) PRSQ   (d) QRSP

⊙ *(a)* The correct and meaningful order
of the parts of sentence is RPSQ.

27. several of our food (P) / are being
extensively cultivated (Q) / and
vegetable crops (R) / hybrid
varieties of (S).

(a) QRSP   (b) SPQR
(c) QPRS   (d) SPRQ

⊙ *(d)* The correct and meaningful order
of the parts of sentence is SPRQ.

28. against the officer (P) / reason for
the accusation (Q) / there should
have been / (R) who was in-charge
at that time (S)

(a) RPSQ   (b) RQPS
(c) PQRS   (d) SPRQ

29. poetry is (P) / and ideas (Q) /
powerful feelings (R) / the
spontaneous overflow of (S)

(a) SRQP
(b) PQRS
(c) RSQP
(d) PSRQ

⊙ *(d)* The correct and meaningful order
of the parts of sentence is PSRQ.

30. historical identity and a common
descent (P) / a group of people (Q)
/ is called an ethnic group (R) /
who share a common culture (S)

(a) QSPR
(b) QRPS
(c) PSQR
(d) RQPS

⊙ *(a)* The correct and meaningful order
of the parts of sentence is QSPR.

Directions (Q. Nos. 31-40) *Given
below are some idioms/phrases
followed by four alternative meaning
to each. Choose the response (a), (b),
(c) or (d) which is the most
appropriate expression and mark your
response in the Answer Sheet
accordingly.*

31. A paper tiger

(a) Person or organisation that
appears powerful, but actually is
not.
(b) Person or organisation that acts
like a tiger.
(c) People who campaign for the
protection of tigers.
(d) A daredevil.

⊙ *(a)* The idiom 'a paper tiger' means
'a person or organisation that
appears to be powerful but actually is
not'.

32. Lily-livered

(a) Brave and courageous
(b) Not brave
(c) Comical
(d) Outrageous

⊙ *(b)* The idiom 'lily livered' means
'coward or not brave.

33. Eat like a bird

(a) Eat fast
(b) Eat very little
(c) Eat a lot
(d) Pretending to be eating

⊙ *(b)* The idiom 'Eat like a bird' means
'eat very little'.

34. The dog days

(a) Days celebrating dogs
(b) The bitter days
(c) The hottest days
(d) The coldest days

⊙ *(b)* The idiom 'the dog days' means
'The bitter days'.

35. A banana republic

(a) A small or poor country with a
weak government.
(b) A small or poor country which
produces banana.
(c) A country which has been
occupied a big country.
(d) A country without any government.

⊙ *(a)* The idiom 'a banana republic'
means 'a small or poor country with a
weak government'.

36. The pros and cons

(a) The good and bad parts of a
situation.
(b) Like and dislike of a situation.
(c) A bad experience in an event.
(d) A good moment of an event.

⊙ *(a)* The idiom 'The pros and cons'
means 'the good and bad parts of a
situation'.

37. Prime the pump

(a) To do something in order to make
something succeed.
(b) To do good things to succeed in life.
(c) To do something in order to get
bad things done.
(d) Asking people to do things to
make something succeed.

⊙ *(a)* The idiom 'prime the pump'
means 'to do something in order to
make something succeed'.

38. The green-eyed monster

(a) Feeling of being joyous
(b) Feeling of being jealous
(c) Feeling bad about happenings
(d) Feeling lucky about something

⊙ *(b)* The idiom 'the green-eyed
monster' means 'feeling of jealousy'.

39. Rise to the occasion

(a) To celebrate a success in a
difficult situation.
(b) To regret a situation which ended
in failure.
(c) To succeed in dealing with a
difficult situation.
(d) To motivate people to succeed in
a difficult situation.

⊙ *(c)* The idiom 'rise to the occasion'
means 'to succeed in dealing with a
difficult situation'.

40. Call it a day
(a) End of the day
(b) Completion of work
(c) Stop doing something
(d) A beautiful day

⊙ *(b)* The idiom 'call it a day' means 'the completion of work'.

Directions (Q. Nos. 41-50) *In this section each item consists of six sentences of a passage. The first and the sixth sentences are given in the beginning are S1 and S6. The middle four sentences in each have been jumbled up and labelled as P, Q, R and S. You are required to find out the proper sequence of the four sentences and mark your response accordingly on Answer Sheet.*

41. S1 : Chinua Achebe was born in 1930 and educated at the Government College in Umuahia, Nigeria.

S6 : Chinua Achebe has written over twenty books, including novels, stories, essays and collections of poetry, and won the Nobel Prize for literature.

P : During the Civil War in Nigeria, he worked for the Biafran government service.

Q : After the War, he was appointed Senior Research Fellow at the University of Nigeria, Nsukka.

R : He joined the Nigerian Broadcasting Company in Lagos in 1954, later becoming its Director of External Broadcasting.

S : He received a BA from London University in 1953 and in 1956 he studied broadcasting in London at the BBC.

The correct sequence should be
(a) SRPQ   (b) RPQS
(c) PQRS   (d) QRSP

⊙ *(a)* The correct and meaningful paragraph is given by SRPQ.

42. S1 : "Every person carries in his head a mental model of the world-a subjective representation of external reality," writes Alvin Toffler in Future Shock.

S6 : When we begin to think we can do so only because our mind is already filled with all sorts of ideas with which to think.

P : It organises our knowledge and gives us a place from which to argue.

Q : This mental model is, he says, like a giant filing cabinet.

R : It contains a slot for every item of information coming to us.

S : As E.F. Schumacher says, "When we think, we do not just think; we think ideas."

The correct sequence should be
(a) PSRQ   (b) SPRQ
(c) QRPS   (d) RQPS

⊙ *(c)* The correct and meaningful paragraph is given by QRPS.

43. S1 : Biology is the study of life in its entirety.

S6 : Classical descriptive and clueless biology found a theoretical framework in the evolutionary theory of Darwin.

P : In later years, the focus was physiology and internal morphology or anatomy.

Q : Darwinian ideas of evolution by natural selection changed the perception completely.

R : The growth of biology as a natural science during the last 1000 years is interesting from many points of view.

S : One feature of this growth is changing emphasis from mere description of life forms to identification and classification of all recorded living forms.

The correct sequence should be
(a) RSPQ   (b) SPRQ
(c) QRPS   (d) PQRS

⊙ *(a)* The correct and meaningful paragraph is given by RSPQ.

44. S1 : Biology is the youngest of the formalised disciplines of natural science.

S6 : Life expectancy of human beings has dramatically changed over the years.

P : However, the twentieth century and certainly the twenty-first century has demonstrated the utility of biological knowledge in furthering human welfare, be it in health sector or agriculture.

Q : The discovery of antibiotics, and synthetic plant-derived drugs, anaesthetics have changed medical practice on one hand and human health on the other hand.

R : Applications of physics and chemistry in our daily life also have a higher visibility than those of biology.

S : Progress in physics and chemistry proceeded much faster than in biology.

The correct sequence should be
(a) QPRS   (b) PRQS
(c) RPQS   (d) SRPQ

⊙ *(d)* The correct and meaningful paragraph is given by SRPQ.

45. S1 : People in society need many goods and services in their everyday life including food, clothing, shelter, transport, etc.

S6 : The teacher in the local school has the skills required to impart education to the students.

P : A weaver may have some yarn, some cotton and other instruments required for weaving cloth.

Q : A family farm may own a plot of land, some grains, farming implements, may be a pair of bullocks and also the labour services of the family members.

R : Every individual has some amount of the goods and services that one would like to use.

S : In fact, the list of goods and services that any individual needs is so large that no individual in society, to begin with, has all the things one needs.

The correct sequence should be
(a) PQRS   (b) RSPQ
(c) QPSR   (d) SRQP

⊙ *(d)* The correct and meaningful paragraph is given by SRQP.

46. S1 : Farming is the main production activity in the village.

S6 : The new ways of farming need less land, but much more capital.

P : These have allowed the farmers to produce more crops from the same amount of land.

Q : Over the years there have been many important changes in the way farming is practised.

R : But in raising production, a great deal of pressure has been put on land and other natural resources.

S : This is an important achievement, since land is fixed and scarce.

The correct sequence should be
(a) QPSR   (b) RSPQ
(c) SRPQ   (d) PRSQ

⊙ *(a)* The correct and meaningful paragraph is given by QPSR.

47. S1 : Britain was the first country to experience modern industrialisation.

S6 : This gave people a wider choice for ways to spend their earnings and expanded the market for the sale of goods.

P : This meant that the kingdom had common laws, a single currency and a market that was not fragmented by local authorities and uneven taxation.

Q : It had been politically stable since the seventeenth century, with England, Wales and Scotland unified under a monarchy.

R : By then a large section of the people received their income in the form of wages and salaries than in goods.

S : By the end of the seventeenth century, money was widely used as the medium of exchange.

The correct sequence should be

(a) QPSR   (b) PSQR
(c) RSQP   (d) SRQP

⊙ *(b)* The correct and meaningful paragraph is given by PSQR.

48. S1 : For several million years, humans lived by hunting wild animals and gathering wild plants.

S6 : As a result, conditions were favourable for the growth of grasses such as wild barley and wheat.

P : This led to the development of farming and pastoralism as a way of life.

Q : This change took place because the last ice age came to an end about 13,000 years ago and with that warmer, wetter conditions prevailed.

R : Then, between 10,000 and 4,500 years ago, people in different parts of the world learnt to domesticate certain plants and animals.

S : The shift from foraging to farming was a major turning point in the human history.

The correct sequence should be

(a) QSPR   (b) SPQR
(c) PSQR   (d) RPSQ

⊙ *(d)* The correct and meaningful paragraph is given by RPSQ.

49. S1 : All governments claim eternal consistency and success.

S6 : Diplomacy offers choices, and those choices must be negotiated with other sovereign actors.

P : Choices involved uncertainty, risk and immediacy; those who must take the choices operate in the contemporary political milieu.

Q : And yet the essence of governance is choice.

R : Nowhere is this more true than in foreign policy decision-making.

S : Some even claim omniscience.

The correct sequence should be

(a) SQPR   (b) QSRP
(c) SRPQ   (d) RSPQ

⊙ *(a)* The correct and meaningful paragraph is given by SQPR.

50. S1 : Buddhism continued to spread into many lands of Asia during the period of 5th and 6th century.

S6 : He translated several scriptural commentaries into Pali and wrote a work called the Visuddimagga, which soon attained the status of a classic work on Theravada doctrine and meditation.

P : While this can be understood as a part of larger processes of cultural interaction, especially trade, a key role was played by monks.

Q : We know a little bit about some of them, but there must have been countless men whose commitment to the Buddhist path gave them the courage and determination to persevere in the face of the long, hard journey to India and back.

R : Buddhism had made its way to Sri Lanka many centuries earlier, during the time of Ashoka, and a thriving Buddhist community soon took root.

S : In the 5th century, the monk Buddhaghosha travelled to Sri Lanka.

The correct sequence should be

(a) RQPS   (b) QRPS
(c) PQRS   (d) PSRQ

⊙ *(c)* The correct and meaningful paragraph is given by PQRS.

Directions (Q. Nos. 51-60) *Each of the following sentences in this section has a blank space and four words or group of words are given after the sentence. Select the most appropriate word or group of words for the blank space and indicate your response on the Answer Sheet accordingly.*

51. On his way to the capital, the minister .... the eminent social worker at his residence.

(a) called on   (b) called
(c) calling for   (d) call off

⊙ *(a)* The word 'called on' makes the sentence grammatically correct and contextually meaningful.

52. The fire brigade fought for four hours to .... the fire in the building.

(a) put in   (b) put out
(c) put on   (d) put off

⊙ *(b)* The word 'put out' makes the sentence grammatically correct and contextually meaningful.

53. Ravi has proved that he can .... on his promise by winning the match.

(a) carry through   (b) carry out
(c) carry   (d) carry off

⊙ *(b)* The word 'carry out' makes the sentence grammatically correct and contextually meaningful.

54. It is best to .... politics when in the classroom.

(a) keep out   (b) keep on
(c) keep off   (d) keeping

⊙ *(a)* The word 'keep out' makes the sentence grammatically correct and contextually meaningful.

55. It shows that she has .... many years of service.

(a) put in   (b) put out
(c) put   (d) put on

⊙ *(a)* The word 'put in' makes the sentence grammatically correct and contextually meaningful.

56. The chairperson said that the group was .... of time.

(a) running out   (b) running
(c) running with   (d) run out

⊙ *(a)* The word 'running out' makes the sentence grammatically correct and contextually meaningful.

57. If I .... an angel, I would solve the problems of people.

(a) am   (b) were   (c) was   (d) have

⊘ *(b)* The word 'were' makes the sentence grammatically correct and contextually meaningful.

58. Where there is a ...., there is a way.

(a) way   (b) road   (c) wing   (d) will

⊘ *(d)* The word 'will' makes the sentence grammatically correct and contextually meaningful.

59. The police could not establish how the accident ....

(a) came off   (b) came about
(c) came on   (d) came out

⊘ *(b)* The word 'came about' makes the sentence grammatically correct and contextually meaningful.

60. I .... my old friend after twenty years.

(a) ran into   (b) ran in
(c) run in   (d) run on

⊘ *(a)* The word 'ran into' makes the sentence grammatically correct and contextually meaningful.

Directions (Q. Nos. 61-70) *Each item in this section consists of a sentence with an underlined word followed by four words/group of words. Select the option that is nearest in meaning to the underlined word and mark your response on the Answer Sheet accordingly.*

61. All the developments that took place in the 20th century have had implications for the next century.

(a) consequences (b) interferences
(c) feedback   (d) planning

⊘ *(a)* The word implications means 'conclusion'. From the given options, 'Consequences' means the same and hence is the correct answer.

62. He is such a leader that his actions are contagious.

(a) complicated   (b) transmittable
(c) effective   (d) unthinkable

⊘ *(b)* The word contagious means 'capable of being transmitted'. From the given options, 'transmitted' is the correct answer.

63. The budget incorporated a number of tax reforms which included higher taxes for the very rich.

(a) excluded   (b) integrated
(c) laid down   (d) removed

⊘ *(b)* The word incorporated means 'included'. From the given options, 'integrated' means the same and hence is the correct answer.

64. His thesis makes all generic statements which have already been proved.

(a) specific   (b) crude
(c) broad   (d) non-standard

⊘ *(c)* The word generic means 'general or common'. From the given options, 'broad' means the same and hence is the correct answer.

65. The captain produced yet another stellar show to make her team enter the semi-finals.

(a) extraordinary (b) eclipse
(c) poor   (d) not a great

⊘ *(a)* The word stellar means 'extraordinary'. Hence, option (a) is the correct answer.

66. A new show is trying to change the cliched depictions of women in animation.

(a) original   (b) hackneyed
(c) crony   (d) artificial

⊘ *(b)* The word cliched means 'a lack of originality'. From the given options, 'hackneyed' means the same and hence is the correct answer.

67. Not everyone finds a vocation which suits one's aptitude.

(a) attitude   (b) approach
(c) liking   (d) occupation

⊘ *(d)* The word vocation means 'profession or occupation'. Hence, option (d) is the correct answer.

68. Uninterrupted rain had fatigued the commuters from the outskirts to the city and work suffered.

(a) excited   (b) refreshed
(c) slowed   (d) exhausted

⊘ *(d)* The word fatigued means 'exhausted'.

69. The leader said, "I am aghast with the developments so far. I will take time to understand this".

(a) satisfied   (b) sad
(c) amused   (d) horrified

⊘ *(d)* The word aghast means 'horrified'.

70. The cause of the accident is yet to be ascertained, but police officials suspect the driver of the vehicle allegedly fell asleep.

(a) determined   (b) curtained
(c) thought of   (d) being known

⊘ *(a)* The word ascertained means 'to find out or discover'. From the given options, 'determined' means the same and hence is the correct answer.

Directions (Q. Nos. 71-80) *Each item in this section consists of sentences with an underlined word followed by four words or group of words. Select the option that is opposite in meaning to the underlined word and mark your response on the Answer Sheet accordingly.*

71. Early medieval period was not a combination of urban and rural civilisation. It was not a period of urban decay as claimed by some.

(a) survival   (b) waste away
(c) decomposition   (d) spoil

⊘ *(a)* The word decay means 'to decompose or die'. From the given options, 'survival' meaning to continue to live is its antonym.

72. He speaks eloquently and can pull crowds.

(a) confusingly
(b) expressively
(c) powerfully
(d) fluently

⊘ *(a)* The word eloquently means 'fluently or persuasively'. From the given options, 'confusingly' is its antonym.

73. Everyone has to fight the inertia in the system.

(a) sluggishness   (b) indolence
(c) activity   (d) torpor

⊘ *(c)* The word inertia means 'lazy or inactive'. From the given options, 'inactivity' is its antonym.

74. There is a need to promote philanthropy in education.

(a) charity
(b) benevolence
(c) nastiness
(d) likeliness

⊘ *(c)* The word philanthropy means 'the desire to promote the welfare of others'. From the given options, 'nastiness' is its antonym.

75. What we lack in the current times is compassion.

(a) empathy   (b) carefulness
(c) indifference   (d) hardship

⊘ *(c)* The word compassion means 'kindness'. From the given options, 'indifference' is its antonym.

76. Tempestuous behaviour would not yield much in any place.
(a) relaxed   (b) passionate
(c) intense   (d) windy

⊘ *(c)* The word tempestuous means 'characterised by strong and turbulent or conflicting emotion'. From the given options, 'relaxed' is its antonym.

77. Wooing everyone over an issue for support will not serve much purpose.
(a) discouraging   (b) encouraging
(c) pursuing   (d) persuading

⊘ *(a)* The word wooing means 'seek the favour' or 'support'. From the given options, 'discouraging' its antonym.

78. The highest award was bestowed upon her for her yeoman service.
(a) conferred   (b) withdrawn
(c) imparted   (d) imbibed

⊘ *(b)* The word bestowed means 'to give'. From the given options, 'withdrawn' is its antonym.

79. One feels elated when someone praises one's work.
(a) feels good   (b) excited
(c) depressed   (d) sober

⊘ *(c)* The word elated means 'happy and joyful'. From the given options, 'depressed' meaning 'sorrowful and sad' is its antonym.

80. All business activities need not result in profit-making. There is a need to be charitable.
(a) lenient   (b) malevolent
(c) unforeseen   (d) gracious

⊘ *(b)* The word charitable means 'to assist or help someone in need'. From the given options, 'malevolent' meaning 'a wish to do something bad or evil' is its antonym.

Directions (Q. Nos. 81-100) *Each of the following sentences has a word or phrase underlined. Read the sentences carefully and find which part of speech the underlined word belongs to. Indicate your response on the Answer Sheet accordingly.*

81. He has been working in the Department of Foreign Affairs since 2002.
(a) Adverb   (b) Adjective
(c) Intensifier   (d) Noun

⊘ *(a)* The given highlighted word is an Adverb.

82. The man in dark blue is the one who made us win the match.
(a) Relative clause
(b) Interrogative pronoun
(c) Relative pronoun
(d) Affirmative

⊘ *(c)* The given highlighted word is a Relative Pronoun.

83. The most beautiful actor of the industry was awarded today.
(a) Adjective   (b) Numeral
(c) Adverb   (d) Noun

⊘ *(a)* The given highlighted word is an Adjective.

84. "What is the latest news?" asked the Captain.
(a) Relative pronoun
(b) Adjective
(c) Adverb
(d) Adjectival clause

⊘ *(b)* The given highlighted word is an Adjective.

85. Noticing the change in the behaviour of the officer, the cadets returned to their position.
(a) Participle
(b) Present continuous
(c) Noun phrase
(d) Noun

⊘ *(a)* The given highlighted word is a Participle.

86. When he reached the department, the officials had left for the meeting.
(a) Past perfect verb
(b) Past tense
(c) Dependent clause
(d) Independent clause

⊘ *(a)* The given highlighted word is a Past Perfect verb.

87. He has offered her another chance.
(a) Intransitive verb (b) Past tense
(c) Perfect tense   (d) Transitive verb

⊘ *(c)* The given highlighted word is a verb in perfect tense.

88. The building is very ancient.
(a) Transitive verb
(b) Intransitive verb
(c) Phrasal verb
(d) Auxiliary verb

⊘ *(b)* The given highlighted word is an Intransitive verb.

89. Hurrah! What a scintillating beauty the landscape is !
(a) Conjunction   (b) Adjective
(c) Adverb   (d) Interjection

⊘ *(d)* The given highlighted word is an Interjection.

90. Ravi was declared as the winner in the tie because he had hit the most number of fours and sixes.
(a) Conjunction   (b) Interjection
(c) Adverb   (d) Cause

⊘ *(a)* The given highlighted word is a Conjunction.

Directions (Q. Nos. 91-100) *In this section a word is spelt in four different ways. Identify the one which is correct. Choose the correct response (a), (b), (c) or (d) and indicate on the Answer Sheet accordingly.*

91. (a) Continuum   (b) Continuem
(c) Contuneim   (d) Continueiam

⊘ *(a)* The correctly spelt word is 'Continuum' which means 'a continuing sequence'.

92. (a) Stretegy   (b) Stretagy
(c) Stratagy   (d) Strategy

⊘ *(d)* The correctly spelt word is 'Strategy' which means 'a plan'.

93. (a) Commisionor   (b) Commisioner
(c) Commissioner (d) Comissioner

⊘ *(c)* The correctly spelt word is 'Commissioner' which refers to 'a person appointed by a commission'.

94. (a) Vacum   (b) Vacuum
(c) Vacuem   (d) Vacam

⊘ *(b)* The correctly spelt word is 'Vacuum'.

95. (a) Psephology   (b) Psefoloagy
(c) Sephology   (d) Psyphology

⊘ *(a)* The correctly spelt word is 'Psephology' which means 'the statistical study of elections and trends in voting'.

96. (a) Neuphrology   (b) Nephrology
(c) Neprology   (d) Neaprology

⊘ *(b)* The correctly spelt word is 'Nephrology' which means 'the study of a specialty of medicine and pediatric medicine that concerns with study of the kidneys'.

97. (a) Psudonym   (b) Pseudonym
(c) Pseudanym   (d) Seeudonym

⊘ *(b)* The correctly spelt word is 'Pseudonym' which means 'another name'.

98. (a) Pnumonia   (b) Neumonia
(c) Pneumonia   (d) Numania

⊘ *(c)* The correctly spelt word is 'Pneumonia' which refers to 'a disease of lungs'.

99. (a) Resilient   (b) Resilint
(c) Risilient   (d) Realisent

⊙ **(a)** The correctly spelt word is 'Resilient' which means 'strong and tough'.

100. (a) Suplementary
(b) Supplementary
(c) Supplementery
(d) Supplemantory

⊙ **(b)** The correctly spelt word is 'Supplementary' which means 'completing or enhancing something'.

Directions (Q. Nos. 101-110) *In this section two sentences are given and you are required to find the correct sentence which combines both the sentences. Choose the correct response (a), (b), (c) or (d) and indicate on the Answer Sheet accordingly.*

101. Which is the correct combination of the given two sentences? The officer will return from China on Monday. You can meet him.

(a) You can meet the officer when he returned from China on Monday.
(b) You can meet the officer when he will return from China on Monday.
(c) You can meet the officer when he returns from China on Monday.
(d) The officer will meet you when you return from China on Monday.

⊙ **(c)** The grammatically correct combination of the sentences is given in option (c).

102. Which is the correct combination of the given two sentences? He is hard-working. He is honest too.

(a) He is not only hard-working, but also honest.
(b) He is only hard-working and honest.
(c) He is hard-working but honest too.
(d) He is not hard-working but also honest.

⊙ **(a)** The grammatically correct combination of the sentences is given in option (a).

103. Which is the correct combination of the given two sentences? Parents have been waiting since morning. They want to meet the counsellor.

(a) The counsellor has been waiting to meet the parents since morning.
(b) Parents had been waiting to meet the counsellor since the morning.
(c) Parents are waiting to meet the counsellor in the morning.
(d) Parents have been waiting since morning to meet the counsellor.

⊙ **(b)** The grammatically correct combination of the sentences is given in option (b).

104. Which is the correct combination of the given two simple sentences using 'If' clause? Minchi should have worked hard. She would have cleared the test.

(a) If Minchi had worked hard, she would have cleared the test.
(b) Had not Minchi worked hard, she could not have cleared the test.
(c) If Minchi has worked hard, she would have cleared the test.
(d) If Minchi had worked hard, she will have cleared the test.

⊙ **(a)** The grammatically correct combination of the sentences is given in option (a).

105. Which one of the following is the correct statement combining the two statements using 'though'? He has been trying his level best to win. He could not succeed.

(a) Though he is trying his level best to win, he could not succeed.
(b) He is trying his level best to win, though he could not succeed.
(c) Though he has been trying his level best to win, he could not succeed.
(d) Though he had been trying his level best to win, he could not succeed.

⊙ **(d)** The grammatically correct combination of the sentences is given in option (d).

106. Which is the correct combination of the given two sentences using 'relative clause'? Gandhiji preached peace. He is an apostle of peace.

(a) Gandhiji who preached peace is an apostle of peace.
(b) Gandhiji preached peace because he is an apostle of peace.
(c) Gandhiji who preached peace is called an apostle of peace.
(d) Gandhiji is an apostle of peace because he preached peace.

⊙ **(c)** The grammatically correct combination of the sentences is given in option (c).

107. Which is the correct combination of the given two sentences? Priya reached the station. The bus left before her.

(a) When Priya reached the station, the bus had already left.
(b) When Priya had reached the station, the bus already left.
(c) Priya reached the station, when the bus already left.
(d) When Priya had reached the station, the bus had already left.

⊙ **(a)** The grammatically correct combination of the sentences is given in option (a).

108. Which is the correct combination of the given two sentences? He is too tired. He could not stand.

(a) He is so tired that he could scarcely stand.
(b) He is too tired and cannot stand.
(c) He will not stand and he is very tired.
(d) He is so tired that he could not be standing.

⊙ **(a)** The grammatically correct combination of the sentences is given in option (a).

109. Which is the correct combination of the given two sentences? The teacher entered the classroom. All students stopped talking.

(a) No sooner did the teacher enter the classroom than the students stopped talking.
(b) As soon as the teacher entered the classroom all students were asked to stop talking.
(c) All students stopped talking as the teacher enters the classroom.
(d) No sooner did the students stop talking than the teacher entered the classroom.

⊙ **(a)** The grammatically correct combination of the sentences is given in option (a).

110. Which one of the following is the correct statement of the combination of the two sentences given below using 'whereas'? Kavya is interested in reading books. Her sister shows interest in outdoor games.

(a) Kavya is interested in reading books whereas her sister's interest is outdoor games.
(b) Kavya is interested in reading books whereas her sister is not interested in it.

(c) Kavya is interested in reading whereas her sister's interest is outdoor games.

(d) Kavya is interested in reading books whereas her sister's interest is to play outside.

⊙ *(a)* The grammatically correct combination of the sentences is given in option (a).

Directions (Q. Nos. 110-120) *In this section direct speech sentences are given and you are required to find the correct indirect speech sentence of the same. Choose the correct response (a), (b), (c) or (d) and indicate on the Answer Sheet accordingly.*

111. Rahul said to his teacher, "Madam, what is the way to solve the question"?

(a) Rahul asked his teacher what the way to solve the question was.

(b) Rahul told his teacher what was the way to solve the question.

(c) Rahul asked to his teacher what the way was to solve the question.

(d) Rahul told his teacher what the way was to solve the question.

⊙ *(c)*

112. He said to his friend, "Could you please close the door?"

(a) He requested his friend to close the door.

(b) He requested his friend to please close the door.

(c) He ordered his friend to close the door.

(d) He wanted his friend to close the door for him.

⊙ *(a)*

113. Raj said to Sheela, "The Sun rises in the East."

(a) Raj told Sheela that the Sun rose in the East.

(b) Raj told Sheela that the Sun rises in the East.

(c) Raj asked Sheela that the Sun rises in the East.

(d) Raj said to Sheela that the Sun has arisen in the East.

⊙ *(b)*

114. Navanitha said to her friends, "What a scintillating beauty it is !"

(a) Navanitha told to her friends that it was a scintillating beauty.

(b) Navanitha exclaimed to her friends what a scintillating beauty it was.

(c) Navanitha asked her friends whether it was a scintillating beauty.

(d) Navanitha exclaimed to her friends that it was a scintillating beauty.

⊙ *(b)*

115. The Captain said to the soldiers, "March forward and aim at the peak of the hill today."

(a) The Captain requested the soldiers to march forward and aim at the peak of the hill that day.

(b) The Captain ordered the soldiers to march forward and aim at the peak of the hill today.

(c) The Captain ordered the soldiers to march forward and aim at the peak of the hill that day.

(d) The Captain told the soldiers that they should march forward and aim at the peak of the hill that day.

⊙ *(c)*

116. "Where were you last evening?" said the lady to her maid.

(a) The lady asked her maid where she had been the previous evening.

(b) The lady asked her maid where she had been in the last evening.

(c) The lady asked her maid where had she been the evening before.

(d) The lady told her maid where she had been to the last evening.

⊙ *(a)*

117. "Those who sowed the seeds last season will reap the harvest this season," said the leader to her followers.

(a) The leader said to her followers that those who sowed the seeds the previous season would reap the harvest that season.

(b) The leader addressed her followers that those who have sown the seeds the previous season would reap the harvest this season.

(c) The leader addressed her followers that those who had sown the seeds the previous season would reap the harvest that season.

(d) The leader advised her followers that those who sow the seeds the previous season would reap the harvest this season.

⊙ *(c)*

118. He said to his manager, "Could you please pass the bill this week?"

(a) He told his manager that bill to be passed.

(b) He requested his manager to pass the bill that week.

(c) He ordered his manager to pass the bill that week.

(d) He requested his manager to pass the bill this week.

⊙ *(b)*

119. The village chief said to the villagers, "All of us need to adopt new regulations. We will protect our Earth forever."

(a) The village chief ordered the villagers that all of them needed to adopt new regulations and they would protect their Earth forever.

(b) The village chief told the villagers that all of them need to adopt new regulations and they will protect their Earth forever.

(c) The village chief wanted the villagers needed to adopt new regulations and they would protect their Earth forever.

(d) The village chief told the villagers that all of them needed to adopt new regulations and they would protect their Earth forever.

⊙ *(d)*

120. The grandfather said to the baby, "May you live long with all good things of life".

(a) The grandfather blessed to the baby with long life and all good things of life.

(b) The grandfather asked the baby that she would live long with all good things of life.

(c) The grandfather wanted the baby to live long with all good things of life.

(d) The grandfather blessed the baby that she would live long with all good things of life.

⊙ *(a)*

PAPER III General Studies

1. Scattering of α-particles by a thin gold foil suggests the presence of

(a) electron in an atom
(b) proton in an atom
(c) positively charged nucleus at the centre of an atom
(d) isotopes of gold

⊘ **(c)** Rutherford proposed the model which was based upon the α-particle scattering experiment. In this experiment, Rutherford concluded that the atom consists of a heavy and positively charged part at its centre, called the nucleus. The entire mass of an atom resides in its nucleus and is equal to the sum of masses of protons and neutrons, since the mass of electron is negligible.

2. The elements of which of the following pairs are isobars?

(a) ^1_1H and ^3_1H (b) ^1_1H and ^2_1H
(c) $^{12}_6C$ and $^{14}_6C$ (d) $^{40}_{18}Ar$ and $^{40}_{20}Ca$

⊘ **(d)** Isobars are the atoms of different elements that have same mass number but different atomic number. Therefore, the elements of $^{40}_{18}Ar$ and $^{40}_{20}Ca$ are isobars.

3. Which one of the following chemical reaction is not feasible?

(a) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
(b) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
(c) $Cu + PbCl_2 \rightarrow CuCl_2 + Pb$
(d) $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$

⊘ **(c)** • $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$

In this reaction, iron being more reactive than Cu, displaces Cu from $CuSO_4$ solution and forms new product, iron sulphate and Cu metal. So, this reaction is feasible.

• $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

In this reaction, zinc being more reactive than Cu, displaces Cu from. $CuSO_4$ solution and forms zinc sulphate and Cu metal. So, this reaction is also feasible.

• $Cu + PbCl_2 \longrightarrow Cu \ Cl_2 + Pb$

• This reaction is not feasible because lead chloride ($PbCl_2$) is less soluble. Thus, in this reaction, Pb not displaced by $PbCl_2$.

• $Mg + CuSO_4 \longrightarrow MgSO_4 + Cu$

In this reaction, magnesium is more reactive than Cu.

It displaces Cu from $CuSO_4$ solution and form magnesium sulphate and Cu metal. Hence, this reaction is feasible.

4. A solution having pH equal to zero is known as

(a) Highly alkaline solution
(b) Highly acidic solution
(c) Weakly acidic solution
(d) Neutral solution

⊘ **(b)** pH is a number which indicates the acidic or basic nature of a solution. The solutions having pH between 0 to 2 are strongly acidic, those with pH between 2 to 4 are moderately acidic, while others having pH between 4 to 7 are weakly acidic. When the solutions having pH equal to 7 are neutral whereas others which have pH between 12 to 14 are strongly alkaline.

5. Which one of the following acids is produced in human stomach?

(a) Formic acid   (b) Sulphuric acid
(c) Nitric acid   (d) Hydrochloric acid

⊘ **(d)** Stomach acid or gastric juice, is a digestive acid i.e., formed in the stomach and is composed of hydrochloric acid (HCl), potassium chloride (KCl) and sodium chloride (NaCl). Hydrochloric acid (HCl) plays a key role in digestion of proteins and enzymes.

6. Match List-I with List-II and select the correct answer using the codes given below the Lists

List I (Compound)	List II (Use)
(A) Boric acid	1. Antiseptic
(B) Citric acid	2. Food preservative
(C) Magnesium hydroxide	3. Antacid
(D) Acetic acid	4. Pickle

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	1	3	2	4
(c)	4	3	2	1
(d)	4	2	3	1

⊘ **(a)** Boric acid is used as an antiseptic and insecticide.

• Citric acid is used as a preservative and flavouring agent in food and beverages such as soft drinks.

• Magnesium hydroxide reduces stomach acid, hence it is used as an antacid.

• Acetic acid is used in pickle as Vinegar. Thus, the correct code is given in option (a).

7. The property of the sound waves that determines the pitch of the sound is its

(a) frequency   (b) amplitude
(c) wavelength   (d) intensity

⊘ **(a)** The property of the sound waves that determines the pitch of the sound is its frequency. The pitch of a sound depends on the frequency of vibration. Greater the frequency of a sound, the higher will be its pitch.

8. Which one of the following is not a property of the X-rays?

(a) They are deflected by electric fields.
(b) They are not deflected by magnetic fields.
(c) They have high penetration length in matter.
(d) Their wavelength is much smaller than that of visible light.

⊘ **(a)** X-rays are not deflected by electric fields because X-rays do not carry any charge. These waves are electromagnetic radiations. X-rays were discovered by Roentgen in 1895. Their wavelength is of the order of 10^{-12} m to 10^{-8} m. They are mainly used in detecting the fracture of bones, hidden bullet, needle, costly material etc, inside the body and also used in the study of crystal structure.

Properties of X-rays are :

• They are not deflected by electric and magnetic fields.
• They have high penetration length in matter.
• Their wavelength is much smaller than that of visible light.

9. Which one of the following is not true about the image formed by a plane mirror?

(a) It is of the same size as the subject.
(b) It is laterally inverted.
(c) It is real image.
(d) It is formed as far behind the mirror as the object is in front.

⊘ **(c)** Image formed by a plane mirror has following properties :

• It is always virtual and erect.
• The size of image is equal to the size of the object.
• The image formed is as far behind the mirror as the object is in front of it.
• The image is laterally inverted (i.e., left seems to be right and *vice-versa*)

10. In a periscope, the two plane mirrors are kept

   (a) parallel to each other
   (b) perpendicular to each other
   (c) at an angle of 60° with each other
   (d) at an angle of 45° with each other

   ⊚ *(a)* In a periscope, the two plane mirrors are kept parallel to each other at an 45° angle with its surface, which helps to reflect the light rays from the upper end of the periscope to lower end of the periscope.

   Periscope is especially used in a submarine to see above the surface of the sea.

11. If the speed of light in air is 3×10^8 m/s, then the speed of light in a medium of refractive index $\dfrac{3}{2}$ is

   (a) 2×10^8 m/s
   (b) $\dfrac{9}{4} \times 10^8$ m/s
   (c) $\dfrac{3}{2} \times 10^8$ m/s
   (d) 3×10^8 m/s

   ⊚ *(a)* Given, speed of light in air
$$= 3 \times 10^8 \text{ m/s}$$
Refractive index, $n = \dfrac{3}{2}$

Refractive index of a medium,
$$n = \frac{c}{v}$$
where,
c = speed of light in air and
v = speed of light in medium.
Using the formula,
$$n = \frac{c}{v}$$
$$\Rightarrow \quad v = \frac{c}{n} = \frac{3 \times 10^8}{3/2}$$
$$\therefore \quad v = 2 \times 10^8 \text{ m/s}$$
Therefore, speed of light in a medium of refractive index $\dfrac{3}{2}$ is 2×10^8 m/s.

12. Which one of the following types of radiation has the shortest wavelength ?

   (a) Radio waves
   (b) Visible light
   (c) Infrared (IR)
   (d) Ultraviolet (UV)

   ⊚ *(d)* Decreasing order of wavelength of Electromagnetic waves are :
Radio waves > Infrared (IR) > Visible light > Ultraviolet (UV)

Electromagnetic Spectrum

Name	Frequency range (Hz)	Wavelength range (m)
Gamma (γ) rays	5×10^{22} to 5×10^{18}	0.6×10^{-14} to 10^{-10}
X-rays	3×10^{21} to 1×10^{16}	10^{-13} to 3×10^{-8}
Ultraviolet rays (UV)	8×10^{14} to 8×10^{16}	4×10^{-9} to 4×10^{-7}
Visible light	4×10^{14} to 8×10^{14}	4×10^{-7} to 8×10^{-7}
Thermal or Infrared rays (IR)	3×10^{11} to 4×10^{14}	8×10^{-9} to 3×10^{-3}
Microwaves	3×10^{8} to 3×10^{11}	10^{-3} to 1
Radiowaves	3×10^{3} to 3×10^{11}	10^{-3} to 10^5

13. The unit of the force constant k of a spring is

   (a) N-m
   (b) N/m
   (c) N-m^2
   (d) N/m^2

   ⊚ *(b)* The unit of force constant k of a spring is N/m. According to Hooke's law, force applied by spring,
$$F = -kx \text{ or, } k = -\frac{F}{x}$$
where, k is a constant that is a characteristic of the spring known as spring constant or force constant and x is the final elongation of the spring.

14. Which one of the following is not an epidemic disease?

   (a) Cholera
   (b) Malaria
   (c) Smallpox
   (d) Elephantiasis

   ⊚ *(c)* Smallpox is not an epidemic disease. An epidemic is the rapid spread of an infectious disease to a large number of people in a given population within a short period of time, usually two weeks or less. Malaria and elephantiasis both are vector (Mosquito) borne diseases, thus during favourable conditions like flood or heavy rain, the sudden increase in numbers of mosquito will also cause outbreak of these diseases.

   Similarly, cholera is also an epidemic disease as it is water borne disease, thus presence of bacteria *Vibrio cholerae* in local water source like pond or well will cause outbreak of cholera in every member of locality in a short period of time.

   A pandemic is an epidemic of world-wide proportions i.e. outbreaks of these diseases occur across international borders, e.g. smallpox, which throughout history, has killed between 300-500 million people in all over the world.

15. Which one of the following animals has a three-chambered heart?

   (a) *Scoliodon*
   (b) Salamander
   (c) Pigeon
   (d) Human being

   ⊚ *(b)* Amphibians and reptiles, such as salamanders, frogs, toads, lizards and snakes, have three-chambered heart, one ventricle and two atria. In three-chambered heart, blood from the ventricle travels to the lungs and skin where it is oxygenated and also to the body. In the ventricle, deoxygenated and oxygenated blood are mixed before being pumped out of the heart.

   Scoliodon has two-chambered heart, while pigeon and human beings have four-chambered heart.

16. Which one of the following is the correct sequence of events during sexual reproduction in plants?

   (a) Seedling, formation of embryo, pollination, fertilisation, division of zygote
   (b) Formation of embryo, seedling, pollination, fertilisation, division of zygote
   (c) Pollination, fertilisation, division of zygote, formation of embryo, seedling
   (d) Seedling, formation of embryo, division of zygote, pollination, fertilisation

   ⊚ *(c)* In flowering plants during sexual reproduction following events occur

   • **Formation of Flower** which is the sexual organ of plant.
   • **Gametogenesis** in which pollen grains are formed in anther, while ovules are formed in ovary.
   • **Pollination** in which pollen grains transferred to style of gynoecium/Pistil through various means like air, water, insects, etc.
   • **Fertilisation** Where a haploid male gamete fuses with another haploid egg cell of embryo sac of ovule.
   • **Embryogenesis** After fertilisation a diploid zygote is formed, which develops into a multicellular embryo through repetitive cell divisions.
   • **Formation of Seed and Seedling** After maturation the embryo develops into seed. The dormant seed after germination is known as seedling, which give rise to a new young plant.

17. When air is blown from mouth into a test-tube containing limewater, the limewater turns milky. This is due to the presence of

(a) water vapour
(b) oxygen
(c) carbon dioxide
(d) carbon monoxide

⊙ **(c)** The lime water $[Ca(OH)_2]$ is turned into milky due to formation of calcium carbonate when the lime water reacts with carbon dioxide. The products formed in this reaction is calcium carbonate $(CaCO_3)$ and water. The reaction is given below

$$\underset{\substack{\text{Calcium hydroxide}\\\text{(Lime water)}}}{Ca(OH)_2} + \underset{\substack{\text{Carbon}\\\text{dioxide}}}{CO_2} \longrightarrow$$
$$\underset{\substack{\text{Calcium}\\\text{Carbonate}}}{CaCO_3} + \underset{\text{Water}}{H_2O}$$
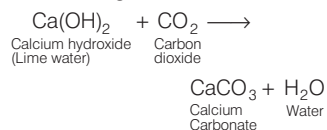
18. Which one of the following is the 'energy currency' for cellular processes?

(a) Glucose   (b) ATP
(c) ADP   (d) Pyruvic acid

⊙ **(b)** During the process of oxidation of food within a cell, all the energy contained in the respiratory substrates is not released free into the cell, or in a single step. Instead, it is released in a series of stepwise reactions controlled by enzymes and is trapped as chemical energy in the form of Adenosine Triphosphate (ATP).

Thus, it is said that ATP acts as the energy currency of the cell. The energy trapped in ATP is used in many energy requiring biological processes of the organisms such as locomotion, digestion, thinking, etc. During aerobic respiration, most of the ATPs are formed in mitochondria.

19. Which one of the following is the first enzyme to mix with food in the digestive tract?

(a) Trypsin   (b) Cellulose
(c) Pepsin   (d) Amylase

⊙ **(d)** Amylase is the first enzyme which mix with food in the digestive tract. The mastication of food in mouth is the first event of digestion in alimentary canal or digestive tract. During this process, digestion starts in the oral cavity by hydrolytic action of enzyme salivary amylase.

The saliva secreted into oral cavity contains two enzymes, i.e. amylase and lysozyme. About 30% of the starch gets hydrolysed in the oral cavity by the action of salivary amylase (at optimum pH 6.8) into a disaccharide, i.e. maltose.

Lysozyme acts as an antibacterial agent. It kills bacteria thus prevents infections.

20. Mahatma Gandhi's Dandi March, a great event in Indian freedom struggle, was associated with

(a) iron
(b) sodium chloride
(c) sulphur
(d) aluminium

⊙ **(b)** Mahatma Gandhi's Dandi March, a great event in Indian freedom struggle was associated with sodium chloride.

21. Match List I with List II and select the correct answer using the code given below the Lists.

List I (Name)		List II (Formula)
(A)	Bleaching powder	1. $NaHCO_3$
(B)	Baking soda	2. $Na_2CO_3 \cdot 10H_2O$
(C)	Washing soda	3. $Ca(OH)_2$
(D)	Slaked lime	4. $CaOCl_2$

Code

	A	B	C	D
(a)	4	1	2	3
(b)	4	2	1	3
(c)	3	2	1	4
(d)	3	1	2	4

⊙ **(a)** The chemical formula of bleaching powder is Ca(OCl)Cl. It is used for water treatment and as a bleaching agent.

• Sodium bicarbonate $(NaHCO_3)$ is commonly known as baking soda. It is widely used in baking.

• Sodium Carbonate $(Na_2CO_3 \cdot 10H_2O)$ is the inorganic compound which is used as washing soda.

• Calcium hydroxide $(Ca(OH)_2)$ is a colorless crystal i.e., known as slaked lime. Slaked lime is used as a pH–regulating agent and acid neutraliser in soil and water.

Hence, the correct codes are shown in option (a).

22. The number of water molecules associated with copper sulphate molecule to form crystals is

(a) 2
(b) 4
(c) 5
(d) 6

⊙ **(c)** Copper sulphate $(CuSO_4 \cdot 5H_2O)$ is the inorganic compound in which four water molecules are directly attached to Cu atom while one is present as water of crystallisation.

23. Silver articles become black after sometime when exposed to air because

(a) silver gets oxidised to silver oxide
(b) silver reacts with moist carbon dioxide in the air to form silver carbonate
(c) silver reacts with sulphur in the air to form a coating of silver sulphide
(d) silver reacts with nitrogen oxides in the air to form silver nitrate

⊙ **(c)** When the silver articles react with the hydrogen sulphide gas that is present in the air, a black coating of silver sulphide (Ag_2S) is formed. Silver sulphide are insoluble in all the solvents.

$$\underset{\text{Silver}}{2Ag(s)} + \underset{\substack{\text{Hydrogen}\\\text{sulphide}}}{H_2S(g)} \longrightarrow$$
$$\underset{\substack{\text{Silver}\\\text{sulphide}}}{Ag_2S\ (s)} + \underset{\substack{\text{Hydrogen}\\\text{gas}}}{H_2(g)}$$
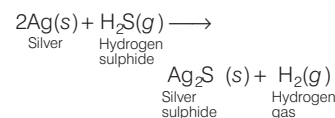
24. If x the temperature of a system in kelvin and y is the temperature of the system in °C, then the correct relation between them is

(a) $x = 273 - y$ (b) $x = 273 + y$
(c) $x = 173 + y$ (d) $x = 173 - y$

⊙ **(b)** Relation among the temperatures measured by Celsius scale and Kelvin scale.

$$K = 273 + C$$

where, K and C are the temperature of a system in kelvin and celsius (°C) respectively.

According to question, $K = x$ and $C = y$

Hence, $x = 273 + y$

25. The resistivity ρ of a material may be expressed in units of

(a) ohm   (b) ohm/cm
(c) ohm-cm   (d) ohm-cm^2

⊙ **(c)** The resistivity ρ of a material may be expressed in units of ohm-cm.

Resistivity of a conductor is defined as the resistance of a conductor of unit length and unit area of cross-section.

Resistivity, $\rho = \dfrac{RA}{l}$

where, l is the length of the conductor, A is the area of cross-section of the conductor and R is the resistance of the conductor.

26. The electromagnetic waves, which are used for satellite communication, are

(a) infrared radiations
(b) ultraviolet radiations
(c) radio waves
(d) visible lights

⊙ *(c)* The electromagnetic waves, which are used for satellite communication, are radio waves.

In the space wave propagation, the radiowaves emitted from the transmitter antenna reaches the receiving antenna through space. These radiowaves are called space waves. The space waves are the radiowaves of frequency range from 54 MHz to 4.2 GHz.

The space wave propagation is used for television broadcast microwave link and satellite communication.

27. Which one of the following is the correct sequence of organs that occur in the path of urine flow in human body?

(a) Kidney, ureter, urinary bladder, urethra
(b) Kidney, urinary bladder, ureter, urethra
(c) Kidney, ureter, urethra, urinary bladder
(d) Urinary bladder, kidney, urethra, ureter

⊙ *(a)* Urine is formed in the kidneys through the filtration of blood. The urine is then passed through the two separate tubes connected to each kidney, known as ureters which open to the urinary bladder, where urine is stored. During urination, the urine is passed from the urinary bladder through the urethra to the outside of the body.

28. Which of the following endocrine glands is not found in pair in humans?

(a) Adrenal   (b) Pituitary
(c) Testis   (d) Ovary

⊙ *(b)* Pituitary is a single gland, which is not found in pair like adrenal gland, testie and overies. It is the smallest endocrine gland but serves very important role in the human endocrine system. It directly or indirectly controls almost all other endocrine glands of the body. It is also known as master gland.

It is reddish grey in colour and is roughly oval in shape and about a size of a pea seed. It is located in a small bony cavity of the brain called sella tursica.

29. Which one of the following cell organelles contains DNA?

(a) Golgi apparatus
(b) Mitochondrion
(c) Lysosome
(d) Endoplasmic reticulum

⊙ *(b)* Mitochondrion is a semi-autonomous cell organelle. Mitochondria were first observed by Kollikar in 1850. They contain DNA as well as ribosomes and are able to synthesise proteins. According to scientific observation, the new mitochondira are originated by the growth and division of pre-existing mitochondria, which can't occur without the synthesis of proteins.

30. Who among the following scientists introduced the concept of immunisation to the medical world?

(a) Edward Jenner
(b) Robert Koch
(c) Robert Hooke
(d) Carl Linnaeus

⊙ *(a)* Edward Jenner (17th May, 1749-26th January, 1823) was an English physician who invented the smallpox vaccine. Jenner is often called a pioneer of immunisation or father of vaccination as he invented first vaccine and also proposed the concept of immunisation.

Robert Koch investigated the anthrax disease cycle in 1876 and studied the bacteria that cause tuberculosis in 1882 and cholera in 1883. He also formulated Koch's postulates.

Robert Hooke looked at a sliver of cork through a microscope lens and first time discovered cells in 1635.

Carl Linnaeus is known as the 'Father of Taxonomy'. He proposed binominal nomenclature for uniform and unique identification of organisms.

31. On 31st December, 1929 in which one of the following Congress Sessions was proclamation of Purna Swaraj made?

(a) Ahmedabad   (b) Calcutta
(c) Lahore   (d) Lucknow

⊙ *(c)* On 31st, December, 1929, in the Lahore Session of the Congress, proclamation of Purna Swaraj made. During this session, Pt. Jawaharlal Nehru was the President of the Congress. The resolution of Purna Swaraj proclaimed 26th January, 1930 as the Independence Day. This

session was historic because for the first time in the history of freedom struggle, the national leaders demanded complete independence. Later, 26th, January was selected as the Republic Day of Independent India.

32. Which one of the following acts reserved seats for women in Legislatures in accordance with the allocation of seats for different communities?

(a) The Government of India Act, 1858
(b) The Indian Councils Act, 1909
(c) The Government of India Act, 1919
(d) The Government of India Act, 1935

⊙ *(d)* The Government of India Act, 1935 reserved seats for women in Legislatures in accordance with the allocation of seats for different communities.

According to this Act, the council of states (upper house) had 156 members for British India and upto 104 members for the princely states. All members from British India were to be directly elected, except for six members who were to be nominated by the Governor-General, to secure due representation for the scheduled classes, women and minority communities.

33. Which one among the following was demanded by the All India Depressed Classes Leaders' Conference at Bombay in 1931?

(a) Universal adult suffrage
(b) Separate electorates for untouchables
(c) Reserved seats for the minorities
(d) A unitary state in India

⊙ *(b)* 'All India Depressed Classes Leaders' conference at Bombay in 1931 demanded for separate electorates for untouchables. This demand arose because their leaders were dissatisfied with the provisions of Joint electorates provided in the Simon Commission report. This report empowered Governor to authorise a non–depressed class member to contest on behalf of depressed classes.

Finally, this demand led to the issuance of MacDonald Award or Communal Award (1932). This award provided for separate electorate for Scheduled Castes.

34. Who among the following was one of the founders of the Indian Society of Oriental Art?

(a) Rabindranath Tagore
(b) Abanindranath Tagore
(c) Dwarkanath Tagore
(d) Bankim Chandra Chattopadhyaya

⊙ **(b)** Abanindranath Tagore alongwith his brother Gaganendranath Tagore founded of Indian Society of Oriental Art (ISOA) in 1907. The primary objective of ISOA was to promote the rich artistic heritage of India. This initiative went a long way in demolishing the myth of the cultural supremacy of the western world.

35. Who among the following Sultans succeeded in finally breaking and destroying the power of Turkan-i-Chihalgani?

(a) Iltutmish
(b) Balban
(c) Alauddin Khalji
(d) Muhammad bin Tughluq

⊙ **(b)** After Balban ascended the throne, he realised that the real threat to the monarchy was from Chahalgani. Thus, he broke its power.

Turkan-i-Chihalgani was a class of ruling elite of fourty powerful military leaders. This class was created by Slave dynasty ruler Iltutmish.

36. Who among the following Mongol leaders/commanders did not cross Indus to attack India?

(a) Chenghiz Khan
(b) Tair Bahadur
(c) Abdullah
(d) Qutlugh Khwaja

⊙ **(a)** Among the following leaders/commanders, Chenghiz Khan was the Mongol ruler who did not cross the Indus to attack India.

Tair Bahadur invaded Punjab in 1241. Abdullah invaded Punjab with his force in 1292.

Qutlugh Khwaja attacked Delhi in 1299. This led to Battle of Kili.

37. In the region of Eastern shore of Adriatic sea, a cold and dry wind blowing down from the mountain is known as

(a) Mistral　　　(b) Bora
(c) Bise　　　(d) Blizzard

⊙ **(b)** Bora is a cold and dry wind blowing down the mountain in the region of Eastern shore of Adriatic sea.

Mistral is a cold and dry strong wind in Southern France that blows down from the North along the lower Rhone river valley towards Mediterranean sea.

Bise is a cold, vigourous and persistent North or North-Easterly wind blowing from the alpine mountains, that affects Switzerland and Eastern France.

Blizzard is a cold, violent, powdery polar wind. They are prevalent in the North and South polar regions like Canada, the USA, Siberia, etc.

38. Nyishi tribe is found mainly in

(a) Andaman and Nicobar
(b) Arunachal Pradesh
(c) Nilgiri-Kerala
(d) Kashmir Valley

⊙ **(b)** Nyishi tribe is found mainly in Arunachal Pradesh. Nyishi tribe is the largest ethnic community in Arunachal Pradesh. Nyishi tribe people are primarily agriculturalists who practice Jhum (Shifting) cultivation.

The attire of Nyishis uses the creast of a hornbill beak. As a result, they have adversely affected the population of hornbill bird. Boori Boot Yollo is an important festival.

39. In the field of tourism, which one of the following Indian States is described as 'One State Many Worlds'?

(a) Assam　　　(b) West Bengal
(c) Karnataka　　　(d) Rajasthan

⊙ **(c)** In the field of tourism, Karnataka is described as 'One State Many Worlds'. This is because of its diverse culture and topography.

Assam is known as 'The Awesome Assam'. West Bengal is known as 'Beautiful Bengal'. Rajasthan is known as 'the Incredible State of India.'

40. The number of people per unit area of arable land is termed as

(a) agricultural density
(b) arithmetic density
(c) physiological density
(d) economic density

⊙ **(c)** The number of people per unit area of arable land is termed as **physiological density**. A higher physiological density suggests that the available agricultural land is being used by more people.

Agricultural density is defined as the number of farmers per unit area of farmland. **Arithmetic density** is same as population density (Number of people per unit area of land).

41. Which one of the following rivers joins Ganga directly?

(a) Chambal　　　(b) Son
(c) Betwa　　　(d) Ken

⊙ **(b)** Among the following rivers, Son river directly joins river Ganga.

Son river originates near Amarkantak in Anuppur district of Madhya Pradesh and joins Ganga river near Patna (Bihar).

Chambal, Betwa and Ken rivers join Yamuna river in Uttar Pradesh. Yamuna then joins Ganga at Prayagraj (Uttar Pradesh).

42. Which one of the following is not a type of commercial agriculture?

(a) Dairy farming　(b) Grain farming
(c) Livestock ranching
(d) Intensive subsistence agriculture

⊙ **(b)** Among the following, intensive subsistence agriculture is not a type of commercial agriculture.

Commercial agriculture is a cropping method in which crops and livestock are raised in order to sell the products in the market for remuneration. It is capital intensive agriculture in which crops are grown on large farms, using modern technologies like farm machinery, fertilizers, insecticides, high yeilding variety of seeds, etc. Dairy farming, grain farming, livestock ranching, plantation agriculture, etc. are few examples of this type of agriculture.

Intensive subsistence agriculture is practiced in areas where farmers have small fields. The crops are grown to be consumed by farmers themselves.

43. Which one of the following is not a land use category?

(a) Forest land
(b) Pasture land
(c) Marginal land
(d) Barren and wasteland

⊙ **(d)** Among the following Barren and wasteland is not a land use category. Barren and wastelands include mountains and hill slopes, deserts and rocky areas. These areas cannot be brought under plough except at a high input cost with possible low returns.

44. Which one of the following is not an objective of the MGNREGA?

(a) Providing up to 100 days of skilled labour in a financial year
(b) Creation of productive assets
(c) Enhancing livelihood security
(d) Ensuring empowerment to women

> *(b)* Creation of productive assets is not an objective of the MGNREGA. It is an accronym of Mahatma Gandhi National Rural Employment Guarantee Act. It was enacted in the year 2005.

The objectives of MGNREGA include

- Ensuring social protection for the most vulnerable in rural India.
- Ensuring livelihood security for poor through creation of durable assets.
- Strengthening drought proofing and flood management in rural India.
- Aiding in empowerment of the marginalised communities, especially women, SCs and STs, through the rights based legislation.
- Strengthening decentralisation etc.

45. Which one of the following statements with regard to the functioning of the Panchayats is not correct?

(a) Panchayats may levy, collect and appropriate taxes, duties, tolls, etc.

(b) A person who has attained the age of 25 years will be eligible to be a member of a Panchayat.

(c) Every Panchayat shall ordinarily continue for five years from the date of its first meeting.

(d) A Panchayat reconstituted after premature dissolution shall continue only for the remainder of the full period.

> *(b)* Among the given options, only option (b) is not correct. According to Article-243 of the Indian Constitution, a person who has attained the age of 21 years (and not 25 years) will be eligible to be a member of a Panchayat. Rest of the statements are correct.

46. Which one of the following is the earliest launched scheme of the Government of India?

(a) Deendayal Antyodaya Yojana

(b) Pradhan Mantri Gram Sadak Yojana

(c) Saansad Adarsh Gram Yojana

(d) Deendayal Upadhyaya Grameen Kaushalya Yojana

> *(b)* Among the given schemes of the Government of India, Pradhan Mantri Gram Sadak Yojana was launched

earliest. The correct order of the launch dates of the schemes is given below

- Pradhan Mantri Gram Sadak Yojana (December, 2000)
- Deendayal Antyodaya Yojana (June, 2011)
- Deendayal Upadhyaya Grameen Kaushalya Yojana (September, 2014).
- Saansad Adarsh Gram Yojana (October, 2014) Pradhan Mantri Gram Sadak Yojana was launched with an objective to provide single all–weather road connectivity to eligible unconnected habitation of designated population of 500+ in plain areas and 250+ in North–East, hill, tribal and desert areas.

47. Which of the following statements is not correct regarding the Members of Parliament Local Area Development Scheme (MPLADS)?

(a) Members of the Parliament (MPs) sanction, execute and complete works under the scheme

(b) Nominated Members of the Parliament can recommend works for implementation anywhere in the country

(c) The scheme is fully funded by the Government of India

(d) The annual entitlement per MP is ₹ 5 crore

> *(a)* Under MPLADS, the MPLAD division is responsible for the implementation of the scheme. Under the scheme, each MP has the choice to suggest to the District Collector for works to the tune of ₹ 5 crore per annum to be taken up in his/her constituency.

48. Saubhagya, a Government of India scheme, relates to which of the following areas?

(a) Achieving universal household electrification

(b) Providing clean cooking fuel to poor households

(c) Rationalising subsidies on LPG

(d) Stopping female foeticide

> *(a)* Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Also known as Saubhagya) was launched in September, 2017. Under this scheme, free electricity connections to all households (both APL and BPL) in rural areas and poor families in urban areas was provided. Rural Electrification Corporation (REC) has been designated as nodal agency for this scheme.

49. The 'Basel Convention' is aimed at protecting human health and environment against adverse effects of which of the following?

(a) Hazardous wastes

(b) Persistent Organic Pollutants

(c) Mercury

(d) Chemicals and pesticides

> *(a)* The 'Basel Convention' is aimed at protecting human health and environment against adverse effects 'hazardous waste'. The convention is a multilateral agreement on the control of transboundry movement of hazardous waste and their disposal. It was adopted in 1989 in Basel (Switzerland).

The **Stockholm Convention (2001)** is related to Persistent Organic Pollutants (POPs). 'The **Minamata convention** (2013) on mercury is related to protection of human health and environment from the adverse effects of mercury.

The **Rotterdam Convention** (2004) is related to protection of human health and environment from adverse effect of chemicals and pesticides.

50. Which one of the following is the biggest cause of incidence of migration of female persons in India?

(a) Employment   (b) Education

(c) Marriage   (d) Business

> *(c)* The biggest cause of incidence of migration of female persons in India is marriage. According to Census Data of 2011, out of total women migrants, 64.9% migrated due to marriage, 3.2% due to employment, 1.3% due to education and 0.3% due to business.

51. Which one of the following is not correct about Repo rate?

(a) It is the interest rate charged by the Central Bank on overnight loan.

(b) It is the interest rate paid by the commercial banks on overnight borrowing.

(c) It is the interest rate agreed upon in the loan contract between a commercial bank and the Central Bank.

(d) It is the cost of collateral security.

> *(d)* Among the given options, only option (d) is incorrect. Repo Rate (or repurchase rate) is the key policy rate of interest at which Central bank (or RBI) lends short-term money to banks. It helps in managing the liquidity of the economy.

52. The Cash Reserve Ratio refers to
  (a) the share of Net Demand and Time Liabilities that banks have to hold as liquid assets
  (b) the share of Net Demand and Time Liabilities that banks have to hold as balances with the RBI
  (c) the share of Net Demand and Time Liabilities that banks have to hold as part of their cash reserves
  (d) the ratio of cash holding to reserves of banks

  ⊙ *(b)* The Cash Reserve Ratio (CRR) refers to the share of Net Demand and Time Liabilities that banks have to hold as balances with the RBI. CRR is set according to guidelines of the Central Bank of a country. Currently, CRR is 4% of total deposits of banks in India.

  CRR is also an instrument used by RBI to control the liquidity in the system.

53. In economics, if a diagram has a line passing through the origin and has 45° angle with either axis and it is asserted that along the line $X = Y$ what is tacitly assumed?
  (a) Both variables are pure numbers.
  (b) Both variables are in the same unit.
  (c) Both variables are in different units.
  (d) At least one variable is a pure number.

  ⊙ *(b)* Y↑

  45°
  45°
  → X
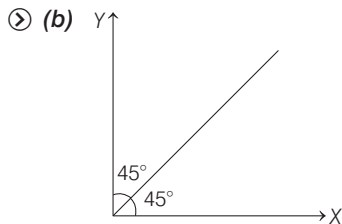
  It is assumed that along the line $X = Y$. Then, tacitly assumed that variables of X and Y are in the same units. Because an angle of 45° degree means that value of X equal the value of Y.

54. Who among the following won the Best Men's Player Award of FIFA Football Awards, 2019?
  (a) Cristiano Ronaldo
  (b) Virgil van Dijk
  (c) Lionel Messi
  (d) Xavi

  ⊙ *(c)* Lionel Messi won the best Men's player Award of FIFA Football Awards, 2019.

The Best FIFA Football Award is an association football award presented annually by the sport's governing body, FIFA. The first awarding ceremony was held on 9th January, 2017 in Zurich (Switzerland).

55. In September, 2019, which one of the following travel giants declared itself bankrupt?
  (a) Expedia   (b) Cox and Kings
  (c) SOTC   (d) Thomas Cook

  ⊙ *(d)* In September, 2019, travel giant Thomas Cook declared itself bankrupt.

  Thomas Cook is a British tour operator, one of the world's oldest travel brands. One of the main reasons for it going bankrupt was not moving its market on digital platform.

56. Greta Thunberg, a teenage environment activist who was in news recently hails from
  (a) Sweden   (b) Germany
  (c) The USA   (d) Canada

  ⊙ *(a)* Greta Thunberg, a teenage environment activist hails from Sweden. She addressed the 2018 UN Climate Change Conference and took part in 2019 UN Climate Action Summit.

  Due to her activism, she received awards like Ambassador of Conscience Award, Right Livelihood Award, International Children's Peace Prize, etc in 2019.

57. Recently the Reserve Bank of India has imposed limitations, initially for a period of six months, on the withdrawal of amount by account holders of which one of the following banks?
  (a) IndusInd Bank
  (b) Dhanlaxmi Bank
  (c) Punjab and Maharashtra Cooperative Bank
  (d) South Indian Bank

  ⊙ *(c)* In September, 2019 the RBI has imposed limitations on the withdrawal amount by the account holders of Punjab and Maharashtra Cooperative Bank (PMC), initially for a period of six months. This was done in the light of recently exposed scam in the bank.

  PMC bank was founded in 1984 and has 137 branches across seven States. Its customers include small business, housing societies and institutions.

58. Amitabh Bachchan was recently conferred with the prestigious Dada Saheb Phalke Award. Who among the following was the first recipient of the award?
  (a) Prithviraj Kapoor (b) Devika Rani
  (c) Sohrab Modi   (d) Naushad

  ⊙ *(b)* The first Dada Saheb Phalke Award was conferred to the actress Devika Rani in 1969. She is widely acknowledged as the 'First Lady of Indian Cinema'.

  The Dada Saheb Phalke Award is India's highest award in cinema presented annually at the National Film Awards Ceremony by the Directorate of Film Festivals (an organisation under the Ministry of Information and Broadcasting).

59. The famous Mughal painting, depicting Jahangir embracing the Safavid king Shah Abbas, was painted by which one of the following Mughal painters?
  (a) Abd al-Samad (b) Abul Hasan
  (c) Dasavant   (d) Bishandas

  ⊙ *(b)* The famous Mughal Painting, depicting Jahangir embracing the Safavid king Shah Abbas was painted by Abul Hasan in 1615 CE.

  Abul Hasan (1589–1630 CE) was a Mughal painter of miniatures under the reign of Jahangir. Jahangir bestowed on him the title 'Nadir–uz–Saman' (Wonder of the Age).

  Abd al–Samad is one of the founding masters of the Mughal miniature tradition. He headed the Mughal imperial workshop during reign of Akbar.

  Dasavant was also a painter in Mughal Court during Akbar.

  Bishandas was a Mughal painter during emperor Jahangir.

60. Which of the following statements about 'Mughal Mansab' system are correct?
  1. 'Zat' rank was an indicator of a Mansabdar's position in the imperial hierarchy and the salary of the Mansabdar.
  2. 'Sawar' rank indicated the number of horsemen the Mansabdar was required to maintain.
  3. In the seventeenth century, Mansabdars holding 1000 or above 'Sawar' rank were designated as nobles (Umara).
  Codes
  (a) 1 and 2   (b) 1 and 3
  (c) 2 and 3   (d) 1, 2 and 3

⟩ **(d)** According to the Mughal Mansab or Mans ab dari system 'Zat' rank was an indicator of a Mansabdar's position in the imperial hierarchy and the Salary.

'Sawar' rank indicated the number of horsemer the Mansabdar was required to maintain.

In the 17th century, Mansabdars holding 1000 or above 'Samar' rank were designated as nobels (Umara).

Hence, all the statements are correct.

The Mansabdari system was introduced by Mughal emperor Akbar as new administrative machinery and revenue system.

61. Which one of the following pairs is not correctly matched?

(a) Kuddapah-kar　Rocky wastelands
(b) Nancai　　　　Wet fields
(c) Puncai　　　　Dry fields
(d) Tottakal　　　Garden lands

⟩ **(a)** Among the following options, only option (a) is not correctly matched.

In ancient India, Kuddapah–kar was one of the two main seasons of rice cultivation (the other being Samba-peshanam). Rest all the options are correctly matched.

62. Which of the following rulers were identified through matronymics (names derived from that of the mother)?

(a) Mallas of Pava
(b) Videhas of Mithila
(c) Yaudheyas
(d) Satavahanas

⟩ **(d)** Satavahanas rulers were identified through matronymics. For example, the name of greatest ruler of Satavahanas was Gauthamiputra Satakarni, which meant Gauthami's son Satakarni.

The Satavahanas (or Andhras) were ancient Indian dynasty based in Deccan region. They reigned from late 2nd century BCE to early 3rd century CE and ruled over present day Telangana, Maharashtra, Andhra Pradesh and parts of Gujarat, Madhya Pradesh and Karnataka.

63. Which one of the following statements about the famous text of *Panchatantra* is correct?

(a) It is a philosophical text reflecting the debates of the time and refuting rival positions

(b) It is a text ushering in linguistics as a formal science
(c) It is a text discussing developments in various spheres of natural sciences
(d) It is a text showing through illustration what should and should not be done

⟩ **(d)** Panchatantra is a text showing through illustration what should and should not be done. It is a 'Niti-Shastra' (or textbook of Niti) which roughly means 'the book on wise conduct of life'.

Vishnu Sharma is considered to be the author of the text. Original text was written in Sanskrit language.

64. Geomorphic factors influencing plant and animal distributions are

(a) slope angle and relief only
(b) slope aspect and relative relief
(c) slope angle, slope aspect and relief
(d) slope angle, slope aspect and relative relief

⟩ **(d)** Geomorphic factors influencing plant and animal distribution are slope angle, slope aspect and the distribution is also influenced by climatic factors (like temperature, water, light, etc.) and Edopic factors (like salinity, soil pH, mineral nutrients, etc.)

65. Which one of the following groups of cities does not have Sclerophyll as its natural vegetation cover?

(a) Valparaiso and Cape Town
(b) Lisbon and Perth
(c) Los Angeles and Adelaide
(d) Las Vegas and Queensland

⟩ **(d)** Among the following groups of cities, Las Vegas and Queensland does not have Sclerophyll as its natural vegetation cover.

Sclerophyll is a type of vegetation that has hard leaves, short internodes and leaf orientation parallel or oblique to direct sunlight. This vegetation is mainly found in Mediterranean type of climate.

Thus, Sclerophyll vegetation is found in areas like Perth, Sydney and Adelaide region of Australia, the Mediterranean basin, Californian region, Cape province of South Africa, etc.

66. Which of the following are warm ocean currents?

(a) Kuroshio and California Current
(b) North Atlantic Drift and Brazil Current
(c) Canaries and Benguela Current
(d) West Wind Drift and Falkland Current

⟩ **(b)** North Atlantic Drift (North Atlantic Ocean) and Brazil current (South Atlantic Ocean) are warm ocean currents.

67. In India, how many States/Union Territories have more than two international boundaries?

(a) 1　　(b) 2　　(c) 3　　(d) 4

⟩ **(d)** In India, 4 States/Union Territories have more than two international boundaries. *These are*

- **Ladakh** with Pakistan, Afghanistan and China.
- **Sikkim** with Nepal, Bhutan and China.
- **West Bengal** with Nepal, Bhutan and Bangladesh.
- **Arunachal Pradesh** with Bhutan, China and Myanmar.

68. In the Hadley cell thermal circulation, air rises up and finally descends at

(a) intertropical convergence zone
(b) doldrums
(c) sub-tropical high-pressure cells
(d) equatorial troughs

⟩ **(c)** In the Hadley cell thermal circulation, air rises up (at equator) and finally descends at sub-tropical high- pressure cells.

According to tri-cellular model of atmospheric circulation, circulation takes place in three cells namely:

Hadley Cell Air rises at equator ($0°$) and decends near sub-tropical high-pressure zone ($30°$ N and S).

Ferrel Cell Air decends at sub-tropical high pressure zone ($30°$ N and S) and ascends at sub-polar low pressure zone ($60°$ N and S).

Polar Cell Air rises in sub–polar low pressure zone ($60°$ N and S) and descends at poles in both hemisphere.

69. Which one of the following soils is characterised by very high content of organic matter?

(a) Vertisol　　　(b) Histosol
(c) Gelisol　　　(d) Spodosol

⊘ *(b)* Histosol soils are characterised by very high content of organic matter. They contain at least 20-30% of organic matter by weight. Histosols are often very difficult to cultivate because of poor drainage and due to low chemical fertility.

Vertisols are rich in clay content.

Gelisols are permafrost soils in which organic content is limited to uppermost layer.

Spodosols are acidic soils rich in iron and aluminium.

70. Overseas Indians can exercise franchise in an election to the Lok Sabha under which of the following conditions?

1. They must be citizens of India.
2. Their names must figure in the electoral roll.
3. They must be present in India to vote.

Select the correct answer using the codes given below.

(a) 1, 2 and 3   (b) 2 and 3
(c) 1 and 2   (d) Only 1

⊘ *(a)* All the statements regarding franchise of overseas Indians are correct.

According to Section 20A of the Representation of People Act, 1950, overseas Indians can exercise franchise in an election to the Lok Sabha only under the conditions

● They must be citizens of India.
● Their names must figure in electoral roles.
● They must be present in India to vote.

71. Which one of the following is not a feature of the Ayushman Bharat Scheme?

(a) There is no cap on family size and age
(b) The scheme includes pre-and post hospitalisation expenses
(c) A defined transport allowance per hospitalisation will also be paid to the beneficiary
(d) The scheme provides a benefit cover of ₹ 10 lakh per family

⊘ *(d)* Among the following options, only option (d) is incorrect.

Ayushman Bharat Scheme provides a benefit cover of ₹ 5 lakh (and not ₹10 lakh) per family per year.

Ayushman Bharat Scheme is world's largest health insurance scheme fully financed by the Government of India.

Eligibility criteria for the scheme include

● No restrictions on family size, age or gender.
● All pre-existing conditions are covered from day one.
● Covers upto 3 days of pre-hospitalisation and 15 days of post-hospitalisation expenses.
● Benefits of the scheme are portable across country.
● Public hospitals are reimbursed for healthcare services at par with private hospitals.

72. Which of the following are considered to be the four pillars of human development?

(a) Equity, inclusion, productivity and empowerment
(b) Equity, productivity, empowerment and sustainability
(c) Productivity, gender, inclusion and equity
(d) Labour, productivity, inclusion and equity

⊘ *(b)* Human development is defined as the process of enlarging people's freedoms and opportunities, and improving their well-being. This concept was propounded by economist Mahbub-ul-haq in 1970s.

The four pillars of human development are

Equity It refers to creating equal access to opportunities and ensure that it is available to all.

Sustainability It means durableness in the availability of opportunities.

Productivity It means productivity in terms of human work.

Empowerment It means to have power to make choices.

73. Which one of the following was added as a Fundamental duty through the Constitution (86th Amendment) Act, 2002?

(a) To strive towards excellence in individual and collective activity
(b) To provide opportunities for education to one's child between the age of 6 and 14 years
(c) To work for the welfare of women and children
(d) To promote peace and harmony

⊘ *(b)* The Fundamental Duty "To provide opportunities for education to one's child between the age of 6 and 14 years", was added through the Constitution (86th Amendment) Act of

2002. This was done by amending the Article-51 A of the Constitution.

This amendment further added Article-21A to the Constitution.

Article-21A states that, "the State shall provide free and compulsory education to all children of the age of 6 to 14 years in such manner as the state may, by law, determine."

Moreover, 86th Constitutional Amendment Act substituted new article for Article-45. New article states that, "The state shall endeavour to provide early childhood care and education for all children until they complete the age of 6 years."

74. Which one of the following Articles of the Constitution of India protects a person against double jeopardy?

(a) Article-20   (b) Article-21
(c) Article-22   (d) Article-23

⊘ *(a)* Article-20 of the Constitution of India protects a person against double jeopardy. This means that the Constitution prohibits the prosecution and punishment for the same offence more than once.

Other provisions of the Article-20 are

● Protection against Ex-post Facto legislation, i.e. an individual cannot be convicted for actions that were committed before the enactment of the law.
● Immunity from self-incrimination, i.e. no person accused of any offence shall be compelled to be a witness against himself.

75. Consider the following statements about Stone Age in India :

1. Different periods are identified on the basis of the type and technology of stone tools.
2. There are no regional variations in the type and technology of tools in different periods.
3. Stone Age cultures of different periods evolved uniformly in a neat unilinear fashion all over the subcontinent.

Which of the statements given above is/are correct?

(a) Only 1   (b) 1 and 2
(c) Only 3   (d) 1, 2 and 3

⊘ *(a)* Among the given statements, only statement 1 is correct about Stone Age in India.

Stone Age in India was characterised by different periods that were identified on the basis of the type

and technology of store tools. For instance, during palaeolithic age, tools were made of quartzite and sharpened by chipping technique; Mesolithic age was characterised by use of 'microlith' store tools; while during neolithic age tools were more specialised (like knife, dagger, etc.) and were completely or partially polished.

There was large regional variations in the type and technology of tools in different periods. For example, in the foothills of Himalayas, tools were majorly made up of pebbles, while in central India basaltic rocks were main type of stone used in making tools.

Stone Age in India did not evolve uniformly in a unilinear fashion over the sub-continent. For instance, stone tools in Shivalik hills date back to about 2 to 1.2 million years, while in Bori (Maharashtra) they data back to 1 million years back.

76. From which one of the following factory sites were limestone and chert blades mass produced and sent to various Harappan settlements in Sindh?

(a) Sukkur and Rohri Hills
(b) Khetri in Rajasthan
(c) Chagai Hills
(d) Hills of Baluchistan

⊙ *(a)* Sukkur and Rohri hills were the factory sites from where limestone and chert blades were mass produced and sent to various Harappan settlements in Sindh.

Khetri in Rajasthan was known for exploitation of copper. Chagai hills were known for availability of Lapis Lazuli stone during the period.

77. The work *Siyar-ul- Mutakherin*, which describes the Battle of Plassey, 1757, was written by

(a) Salabat Jung   (b) Qasim Khan
(c) Ghulam Husain (d) Ram Mohan Roy

⊙ *(c)* The work Siyar-ul-Mutakherin, which describes the Battle of Plassey, 1757 was written by Ghulam Husain. This work was completed in 1781 CE and has three volumes.

78. Who believed that the Russian designs were 'an imminent peril to the security and tranquility' of the Indian Empire in 1836?

(a) Lord Auckland
(b) Lord Palmerston
(c) Lord Canning
(d) Alexander Burnes

⊙ *(b)* Lord Palmerston believed that the Russian designs were 'an imminent peril to the security and tranquility' of the Indian empire in 1836.

Lord Palmerston was foreign secretary during the Whig Cabinet of Lord Melborne. It was this belief that guided the policy of British India towards Afghanistan. This finally led to Afghan wars.

79. The 'Tattvabodhini Sabha' was established by

(a) Devendranath Tagore in 1839
(b) Keshab Chandra Sen in 1857
(c) Akshay Kumar Datta in 1850
(d) Dwarakanath Tagore in 1840

⊙ *(a)* The 'Tattvabodhini Sabha' was established by Devendranath Tagore in 1839. It was established as Tattvaranjini Sabha and later renamed as Tattvabodhini Sabha. This Sabha was a particular reform movement organisation, aimed to popularise Brahmodharma (or Brahmo faith). Its primary objective was to propagate the spirit of Hindu Scriptures, including the Vedas.

80. What was the code name given to the first ever tri-service military exercise between India and USA?

(a) Lion Triumph
(b) Elephant Triumph
(c) Tiger Triumph
(d) Bison Triumph

⊙ *(c)* Tiger Triumph was the code name given to the first ever tri-service military exercise between India and USA. This exercise was a Humanitarian Assistance and Disaster Relief (HADR) exercise. It was held in November, 2019 off the Visakhapatnam and Kakinada coasts in Andhra Pradesh.

Other joint exercises *between India and USA are*

● Military exercise : Yudh Abhyas and Vajra Prahar
● Air Forces Exercise : Cope India
● Naval Exercise (includes Japan) : Malabar.

81. 'Naropa' is an annual festival of

(a) Sikkim
(b) Ladakh
(c) Arunachal Pradesh
(d) Nagaland

⊙ *(b)* Naropa is an annual festival of Ladakh. It is one of the biggest festivals in the Himalayas that celebrates the life and legacy of the Buddhist Scholar Naropa.

In 2019, the festival was organised near Hemis Monastry of Ladakh.

The shordol dance (folk dance of Ladakh) is performed during this festival.

82. Which one of the following is India's official entry for the Best International Feature Film category in the 92nd Academy Awards?

(a) Bulbul Can Sing
(b) Super Deluxe
(c) Gully Boy
(d) And The Oscar Goes To

⊙ *(c)* *Gully Boy* was selected as India's official entry for the Best International Feature Film category in the 92nd Academy Awards.

The Academy Award for Best International Feature Film Award is one of the Academy Awards given annually by the USA based Academy of Motion Picture Arts and Sciences (AMPAS).

83. The Global Goalkeeper Award is given by

(a) the Bill and Melinda Gates Foundation
(b) the United Nations Environment Programme
(c) the Kellogg School of Management
(d) the World Meteorological Organisation

⊙ *(a)* The Global Goalkeeper Award is given by the Bill and Melinda Gates Foundation. In 2019, it was given to the Prime Minister of India for India's massive progress under the Swachh Bharat Abhiyan.

The Goalkeepers, Global Goals Awards aim to highlight the extraordinary stories of remarkable individuals who are taking action to give life to the global goals and help achieve them by 2030. In 2019, fourth edition of these awards was presented.

These awards were presented in 5 categories in 2019–Progress Award (age 16-30), Changemaker Award (age 16-30), Campaign Award (age 16-30), Goalkeepers Voice Award (any age) and the Global Goalkeeper Award (any age).

The Global Goal Keeper Award aims to recognise a political leader for his/her commitment to global goals through impactful work in their country.

84. 'Gandhi Solar Park' is located at

(a) New York   (b) Vladivostok
(c) Thimphu   (d) Houston

> *(a)* 'Gandhi Solar Park' is located at New York (UN headquarters). This park was inaugurated by PM Narendra Modi alongwith other world leaders, commemorating the 150th birth anniversary of Mahatma Gandhi.

Gandhi Solar Park is a first of its kind symbolic effort by India at the UN. It has 50 KW capacity, and a gesture by India that it is willing to go beyond the talk on climate change.

85. Who among the following was the first to arrive in Africa as traders that eventually led to European colonisation of Africa?

(a) French   (b) Spanish
(c) Portuguese   (d) Dutch

> *(c)* Portuguese were the first to arrive in Africa as traders that eventually led to European colonisation of Africa. They first reached Africa as explorers under Henry the Navigator. Initially, the Europeans colonised the areas which were un-inhabited like cape varde region.

86. The college of Military Engineering affiliated to Jawaharlal Nehru University is situated at

(a) New Delhi   (b) Dehradun
(c) Nainital   (d) Pune

> *(d)* The college of Military Engineering affiliated to Jawaharlal Nehru University is situated at Pune. It was established in 1943 as School of Military Engineering at Roorkee and later moved to Pune in 1948. This was done in view of increased responsibilities and in keeping with the higher status of the degree of Engineering courses being conducted by the school. The institute is the premier technical training institution of the Corps of Engineers of the Indian Army.

87. Which of the following statements with regard to Coal India Limited (CIL) is/are true?

1. CIL has its headquarters at Kolkata.
2. CIL operates through 82 mining area spread over twenty provincial States of India.
3. CIL is the single largest coal producing company in the world.

Select the correct answer using the codes given below.

(a) Only 1   (b) 1 and 3
(c) 2 and 3   (d) 1, 2 and 3

> *(b)* Only statements 1 and 3 regarding Coal India Limited (CIL) are correct.

CIL is a state owned coal mining corporate, which came into being in November, 1975. CIL's headquarters is at Kolkata. CIL is the single largest coal-producing company in the world. CIL operates through 82 mining areas spread over eight (and not 20) provincial states of India.

88. Which one of the following climatic types is found in Central Spain?

(a) Subarctic
(b) Mediterranean dry hot summer
(c) Subtropical Steppe
(d) Humid continental warm summer

> *(b)* Climate of Spain is mainly Mediterranean with the extremes of temperatures being found in Central Spain (due to continentality).

Mediterranean type of climate is characterised by seasonal shifting of pressure belts. In this climate, summers are hot and dry while winters are cold and wet. It is best developed in the European region bordering Mediterranean sea.

89. Which one of the following is not among the principal languages of Jammu and Kashmir?

(a) Urdu   (b) Gujari
(c) Koshur   (d) Monpa

> *(d)* Monpa is not among the principal languages of Jammu and Kashmir. Monpa language is spoken by the Monpa ethnic group of Arunachal Pradesh.

According to the department of tourism of Jammu and Kashmir, major languages of Jammu and Kashmir are Urdu, Hindi and Koshur. Further, the Gujari language spoken by Gurjar tribes which are spread across North India, including Jammu and Kashmir.

90. The major part of Central Asia is dominated by which one of the following language families?

(a) Indo-European (b) Sino-Tibetan
(c) Austric   (d) Altaic

> *(d)* The major part of Central Asia is dominated by Altaic family of languages. Altaic group of language, mainly includes Turkie, Mangolian and Tungusic family of languages.

Apart from Altaic, Indo-European is the second major family of language in this region. Central Asia is the region which stretches from Caspian sea in the West, China in the East, Iran and Afghanistan in the South and Russia in the North. It consists of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

91. Which one of the following Articles was defended by Dr. BR Ambedkar on the plea that it would be used as 'a matter of last resort'?

(a) Article-352   (b) Article-359
(c) Article-356   (d) Article 368

> *(c)* Article-356 was defended by Dr. BR Ambedkar on the plea that it would be used as a matter of last resort.
Article-356 imposes President's rule in the states, if the government of the state cannot carry on the governance according to the provisions of the Constitution.
Since, this article empowers Union Government over State Government it weakens federalism. Hence, it was opposed by various members of the Constituent Assembly. As a result, Dr. Ambedkar defended this provision by stating the above statement.

92. What is the ground on which the Supreme Court can refuse relief under Article-32?

(a) The aggrieved person can get remedy from another court.
(b) That disputed facts have to be investigated.
(c) That no Fundamental Right has been infringed.
(d) That the petitioner has not asked for the proper writ applicable to his/her case.

> *(c)* The Supreme Court can refuse relief under 32 on the ground that no Fundamental Right has been infringed.

Article-32 provides the right to constitutional remedies which means that a person has a right to move to Supreme Court for getting his/her Fundamental Rights protected. Supreme Court has the power to issue writs, homely habeas corpus, mandamus, prohibition, quo warranto and certiorari.

93. The Ministry of Heavy Industries and Public Enterprises consists of

(a) the Department of Heavy Industry and the Department for Promotion of Industry and Internal Trade
(b) the Department of Public Enterprises and the Department for Promotion of Industry and Internal Trade
(c) the Department of Scientific and Industrial Research and the Department of Heavy Industry
(d) the Department of Heavy Industry and the Department of Public Enterprises

> *(d)* The Ministry of Heavy Industries and Public Enterprises consists of the department of Heavy Industry and the department of Public Enterprises.

Department for promotion of Industry and Internal Trade is under the Ministry of Commerce and Industry. Department of Scientific and industrial research is under the Ministry of Science and Technology.

94. The First Delimitation Commission in India was constituted in

(a) 1949　(b) 1950　(c) 1951(d) 1952

> *(d)* The first Delimitation Commission in India was constituted in 1952 under the Delimitation Commission Act, 1952.

Delimitation Commission is a statutory body concerned with fixing the limits of territorial constituencies in the country. Till now, Delimitation Commission has been constituted four times in 1952, 1963, 1973 and 2002, respectively.

95. Who among the following stated in the Constituent Assembly that on 26th January, 1950, India was going to enter a life of contradictions?

(a) Dr. BR Ambedkar
(b) Jawaharlal Nehru
(c) Mahatma Gandhi
(d) SP Mukherjee

> *(a)* Dr. BR Ambedkar was the one who stated in the Constituent Assembly that on 26th January, 1950, India was going to enter a life of contradictions. This because, with the enactment of Constitution, India would have political equality (one person, one vote), but in social and economic life, India will have inequality.

96. The power of the Supreme Court to decide in the case of a dispute between two or more States is called

(a) original jurisdiction
(b) inherent jurisdiction
(c) plenary jurisdiction
(d) advisory jurisdiction

> *(a)* The power of the Supreme Court to decide in the case of a dispute between two or more states is called original jurisdiction.

Original jurisdiction of Supreme Court is under Article-131. It refers to matters for which Supreme Court can be approached directly. *Few matters covered under original jurisdiction are*

● Any dispute between Indian Government and one or more states.
● Any dispute between Indian Government and one or more states on one side and one or more states on the other side.
● Any dispute between two or more states, etc.

97. Who among the following is the Chairman of the Economic Advisory Council to the Prime Minister (EAC-PM)?

(a) Ratan P. Watal　(b) Bibek Debroy
(c) Ashima Goyal　(d) Sajjid Chinoy

> *(b)* Bibek Debroy is the Chairman of the Economic Advisory Council to the Prime Minister (EAC-PM).

EAC-PM is an independent body constituted to give advice on economic and related issues to the Government of India, specifically to the Prime Minister.

Ratan P. Watal is the Member Secretary of EAC-PM, while Ashima Goyal and Sajjid Chinoy are part-time members.

98. Hilsa is the national fish of

(a) Pakistan　　(b) India
(c) Bangladesh　(d) Nepal

> *(c)* Hilsa is the national fish of Bangladesh. Around 70% of the total Hilsa fish production in the world is from Bangladesh.

Hilsa is also the State fish of West Bengal. Masheer is the national fish of Pakistan. Dolphin is the national fish of India.

99. The Vijaynagar Advanced Landing Ground of the Indian Air Force, which was reopened recently is located in

(a) Jammu and Kashmir
(b) Arunachal Pradesh
(c) Karnataka
(d) Himachal Pradesh

> *(b)* The Vijaynagar Advanced Landing Ground of the Indian Air Force is located in Arunachal Pradesh. Earlier, it was declared unfit for fixed wing aircraft such as transport planes as the runway got damaged. It was reopened in September, 2019.

100. Rustom-2, which crashed in Karnataka recently, was a/an

(a) fighter aircraft
(b) helicopter
(c) transport aircraft
(d) unmanned aerial vehicle

> *(d)* Rustom-2, which crashed in Karnataka September, 2019, was an unmanned aerial vehicle. Aeronautical Development Establishment (ADE), a laboratory of DRDO based in Bangalore was responsible for its design and development. It is a Medium-Altitude Long Endurance Unmanned Aerial Vehicle (MALE-UAV) that flies at an altitude of 3000-9000 m for extended durations of time.

101. The maiden trilateral naval exercise involving India, Singapore and Thailand was held at

(a) Port Blair　　(b) Chennai
(c) Panaji　　　(d) Kochi

> *(a)* The maiden trilateral exercise involving the Republic of Singapore's Navy (RSN), Royal Thailand Navy (RTN) and Indian Navy was held at Port Blair, in Andaman sea in September, 2019. The name of exercise was SITMEX-19 (Singapore-India Thailand Maritime Exercise). The objective of exercise as to bolster the maritime inter-relationship among them and contribute significantly to enhance the overall security in the region.

102. The creation of a Federal Court in India was advocated by which of the following Acts/Commissions?

(a) The Government of India Act, 1919
(b) The Lee Commission, 1923
(c) The Government of India Act, 1935
(d) The Indian Councils Act, 1909

> *(c)* The Government of India Act, 1935 advocated for the creation of a Federal Court in India. This act was watershed moment in the evolution of Indian Constitutional. This act was enacted during the period of Governor-General, Lord Wellingto. *Other important provisions of this act are as follows*

● Establishment of federation of India with British India territories and Princely states.
● Elaborate safeguards and protective instruments for minorities.

103. Who founded the 'Seva Samiti' at Allahabad in 1914?

(a) Hridayanath Kunzru
(b) GK Gokhale
(c) Shri Ram Bajpai
(d) TB Sapru

⊚ *(a)* Seva Samiti was founded by the Hridayanath Kunzru at Allahabad (Prayagraj) in 1914. He had set-up this samiti to organise social service during natural disaster like flood, to promote education, sanitation, to uplift depressed class and reform criminals. He was one of the most prominent member of the servants of India society, founded by GK Gokhale in 1905.

104. The State of Hyderabad in the Deccan officially acceded to the Indian Union in the year

(a) 1948   (b) 1950
(c) 1949   (d) 1947

⊚ *(a)* After getting Independence from Britisher's in 1947, the Princely State of Hyderabad in the Deccan, declared itself as an independent province and denied to amalgamate with India. The Nizam Osman Alikhan of Hyderabad formed an irregular army known as Razakars. When talks were not resulted into any solution, then military action was taken under the code name 'Operation Polo' in 1948.

Razakar's were defeated very badly and State of Hyderabad was merged with India.

105. The Hunter Commission (1882) appointed to survey the State of education in India

(a) deprecated University education
(b) overruled the Despatch on 1854
(c) endorsed the Despatch of 1854 with greater emphasis on primary education
(d) criticised the grants-in-aid system of schooling

⊚ *(c)* The Hunter Commission was appointed by the then Governor-General of India in 1882 to survey the state of education in India. The report of Hunter Commission endorsed the Despatch of 1854 with greater emphasis on primary education. This commission gave suggestion regarding secondary education, grant-in-aid for indigenous schools, encouragement of primary education and also emphasised on the female education in the country.

Charles Wood had sent a despatch to Lord Dalhousie, the then Governor- General of India for disseminating education in India. The Woods despatch is considered as 'Magna-Carta' of English Education in India.

106. The power to legislate on all matters relating to elections to Panchayats lies with

(a) the Parliament of India
(b) the State Legislatures
(c) the State Election Commission
(d) the Election Commission of India

⊚ *(b)* According to the 73rd Constitutional Amendment Act, 1992 the power to legislate on all matters relating to election to Panchayat lies with the State Legislature. Under the Article-329, an election to a Panchayat can be called in question only by an election petition which should be presented to such authority and in such manner as may be prescribed by or under any law made by the State Legislature.

107. The 11th Schedule of the Constitution of India distributes powers between

(a) the Union and the State Legislatures
(b) the State Legislatures and the Panchayat
(c) the Municipal Corporation and the Panchayat
(d) the Gram Sabha and the Panchayat

⊚ *(b)* The 11th Schedule of the Constitution of India distribute powers between the State Legislature and Panchayat. There are overall 12 Schedules in the Constitution. *The Schedules are as follows*

Schedule	Subject
1st	List of State and Union Territories
2nd	Salary and Emolument
3rd	Form of oaths and affirmation
4th	Allocation of seats to State and UTs in the Rajya Sabha
5th	Administration and Control of Scheduled Areas
6th	Administration of Assam, Meghalaya, Tripura and Mizoram
7th	Distribution of Power between the Union and the State List
8th	List of Recognised Language
9th	Validation of Certain Act and Regulation
10th	Provision also disqualification on ground of defection
11th	It has 29 matters. This schedule was added by the 73rd Amendment Act, 1992
12th	Contains the Powers, Authority and Responsibilities of Panchayat

108. The provisions of the Constitution of India pertaining to the institution of Panchayat do not apply to which one of the following States?

(a) Meghalaya   (b) Tripura
(c) Assam   (d) Goa

⊚ *(a)* Panchayati Raj is the basic unit of administration in a system of governance. The Constitutional (73rd Amendment) Act, 1992 came into force in India on 24th April, 1993 to provide constitutional status to the Panchayati Raj institutions. This act was extended to the Panchayats in the tribal areas of eight states, namely Andhra Pradesh, Gujarat, Himachal Pradesh, Maharashtra, Madhya Pradesh, Odisha and Rajasthan from 24th December, 1996. Currently, the Panchayati Raj system exists in all States of India except Nagaland, Meghalaya, Mizoram and in all Union Territories except Delhi and Jammu and Kashmir.

109. Which one of the following rivers does not drain into Black sea?

(a) Volga   (b) Dnieper
(c) Don   (d) Danube

⊚ *(a)* Volga river does not drain into Black sea. Black sea is a body of water and marginal sea of Atlantic Ocean between Eastern Europe, the Car casus and Western Asia. Many rivers drain into it such as the Danube, Dnieper, Southern Bug, Dniester, Don and the Rioni.

The Volga river is the longest river in Europe. It is also Europe's largest river in terms of discharge and drainage basin. The Volga river flows through Central Russia and drains into Caspian sea.

110. The National Water Academy (NWA) is located at

(a) Dehradun
(b) Hyderabad
(c) Bhopal
(d) Khadakwasla

⊚ *(d)* National Water Academy (NWA) is located at Khadakwasla, Pune. NWA was formerly known as Central Training Unit. It was formed in 1988 to impart training to the in-service engineers of various Central/State organisations involved in the development and management of water resources.

111. Which one of the following is the correct sequence of formation of the Commissions starting from the earliest?

(a) Finance Commission, Planning Commission, Investment Commission, Election Commission
(b) Election Commission, Planning Commission, Finance Commission, Investment Commission
(c) Planning Commission, Election Commission, Finance Commission, Investment Commission
(d) Investment Commission, Finance Commission, Planning Commission, Election Commission

⊙ *(b)* In option (b) the commissions are arranged in the correct sequence. The Election Commission of India was formed on 25th January, 1950. The Planning Commission was formed on 15th March, 1950. The Finance Commission was first time formed on 22nd November, 1951. The Investment Commission of India (ICI) was formed in December 2004.

112. The formulation of policy in respect to Intellectual Property Rights (IPRs) is the responsibility of

(a) the Ministry of Law and Justice
(b) the Department of Science and Technology
(c) the Department for Promotion of Industry and Internal Trade
(d) the Ministry of Human Resource Development

⊙ *(c)* The Comptroller General of Patents, Designs and Trade Marks (CGPDTM) under the Department for Promotion of Industry and Internal Trade (DPIIT) under the Ministry of Commerce and Industry is entrusted with the responsibility of administering the laws relating to Patents, Designs, Trade Marks and Geographic Indications with the Territory of India. The DPIIT is also entrusted with matters concerning the UN agency (World Intellectual Property Organisation, WIPO) on Intellectual Property Rights (IPRs).

113. Which one of the following is the latest addition to the AYUSH group of healthcare system?

(a) Unani   (b) Siddha
(c) Sowa-Rigpa (d) Reiki

⊙ *(c)* Sowa-Rigpa is the latest addition to the AYUSH group of healthcare systems. The Union Cabinet in November, 2019 also approved for setting up of National Institute of Sowa-Ragpa (NISR) at Leh (Ladakh). Sowa-Rigpa is a traditional system of medicine in the Himalayan Belt of India. It originated in Tibet and popularly practised in countries namely, India, Nepal, Bhutan, Mongolia and Russia.

The other AYUSH systems are, Ayurveda, Yoga, Naturopathy, Unani, Siddha and Homeopathy. Reiki has not been included in AYUSH group of healthcare systems.

114. Which one of the following is the nodal agency in India for the United Nations Environment Programme?

(a) The Ministry of Environment, Forest and Climate Change
(b) The Ministry of Science and Technology
(c) The Ministry of Earth Sciences
(d) The Ministry of Home Affairs

⊙ *(a)* The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency in the administrative structure of the Central Government for the planning, promotion, coordination and overseeing the implementation of India's environmental and forestry policies and programmes.

The Ministry also serves as the nodal agency in the country for the United Nations Environment Programme (UNEP).
The United Nations Environment Programme (UNEP) is the leading global environmental authority that sets the global environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations system and serves as an authoritative advocate for the global environment.

115. According to the Census 2011, in India, what is the percentage of people (approximately) considered to be migrants (internal), i.e., now settled in a place different from their previous residence?

(a) 25%   (b) 35%
(c) 45%   (d) 55%

⊙ *(b)* According to census data 2011, 45.36 crore Indians (35%) in India are internal migrants, now settled in a place different from their previous residence. In 2001, the figure stood at 31.45 crore. Most of the migrants, around 70%, are females who migrate for marriage.
Migrants by place of birth are those who are enumerated at a village/town at the time of census other than their place of birth. A person is considered as migrant by place of last residence, if the place in which he is enumerated during the census is other than his place of immediate last residence.

116. Suppose an agricultural labourer earns ₹ 400 per day in her village. She gets a job to work as babysitter in a nearby town @ ₹ 700 per day. She chose to work as agricultural labourer. Which one of the following is the opportunity cost of the agricultural labourer?

(a) ₹ 1100   (b) ₹ 700
(c) ₹ 400   (d) ₹ 300

⊙ *(d)* The opportunity cost is the loss of potential gain from other alternatives when one alternative is chosen. The opportunity cost is the 'cost' incurred by not enjoying the benefit associated with the best alternative choice. Opportunity cost is a key concept in economics and has been described as expressing "the basic relationship between scarcity and choice".

Opportunity cost requires sacrifices. If there is no sacrifice involved in a decision, there will be no opportunity cost. In this regard the opportunity costs not involving cash flows are not recorded in the books of accounts, but they are important considerations in business decisions. So, when an agricultural labourer refuses to work as babysitter, she has incurred an opportunity cost of ₹ 300.

117. Match List-I with List-II and select the correct answer using the codes given below the Lists :

List-I (Market structure)		List-II (Characteristic)
A	Perfect competition	1. Only one producer selling one commodity
B	Monopoly	2. Few producers selling similar or almost similar products
C	Monopolistic Competition	3. Many producers selling differentiated products
D	Oligopoly	4. Many producers selling similar products

Codes

	A	B	C	D
(a)	4	3	1	2
(b)	4	1	3	2
(c)	2	1	3	4
(d)	2	3	1	4

⊘ *(b)* Perfect competition is the situation prevailing in a market in which buyers and sellers are so numerous and well informed that all elements of monopoly are absent and the market price of a commodity is beyond the control of individual buyers and sellers.

A monopoly is a specific type of economic market structure. A monopoly exists when a specific person or enterprise is the only supplier of a particular good. As a result, monopolies are characterised by a lack of competition within the market producing a good or service.

Monopolistic competition is a type of imperfect competition such that many producers sell products that are differentiated from one another and hence are not perfect substitutes. An oligopoly is a market form wherein a market or industry is dominated by a small number of large sellers.

118. Which one of the following was the host country for World Tourism Day, 2019?

(a) The USA
(b) India
(c) Russia
(d) Canada

⊘ *(b)* World Tourism Day is observed every year on 27th September with the objective to raise awareness about the importance of tourism among the global community and to encourage its social, cultural, political and economic values. The World Tourism Day celebrations have been led by the United Nations World Tourism Organisation (UNWTO) since 1970.

The World Tourism Day is hosted by a different country every year. World Tourism Day, 2019 was hosted by India for the very first time at New Delhi. This year the World Tourism Day theme was "Tourism and Jobs: A better future for all".

Djibouti and Addis Ababa hosted the World Tourism Day, 2020 on the theme "Tourism: Building Peace! Fostering Knowledge !"

119. BRICS Summit, 2020 will be hosted by

(a) India   (b) China
(c) Russia   (d) Brazil

⊘ *(c)* BRICS is the acronym coined for an association of five major emerging national economies: Brazil, Russia, India, China and South Africa. Since 2009, the BRICS nations have met annually at formal summits. Russia hosted the 12th BRICS Summit in July, 2020 at St Petersburg. China hosted the 9th BRICS Summit at Xiamen in September, 2017, while The 11th BRICS Summit was convened in November 2020 at Brasilia, Brazil.

The 2019 BRICS Summit was focused on the theme, 'BRICS: Economic Growth for an Innovative Future'.

120. The Government of India has recently constituted a civilian award in the name of Sardar Vallabhbhai Patel in the field of contribution to

(a) unity and integrity of India
(b) art and culture
(c) social work
(d) entrepreneurship

⊘ *(a)* On 20th September, 2019 Government of India has instituted Sardar Vallabhbhai Patel Award. It is highest civilian award in the field of contribution to the unity and integrity of India. The award seeks to recognise notable and inspiring contributions to promote the cause of national unity and integrity and to reinforce the value of a strong and United India. The award will be announced on the occasion of the National Unity Day. i.e., the birth anniversary of Sardar Patel on 31st October.

1

NUMBER SYSTEM

2019 (II)

1. Let a and b be two positive real numbers such that $a\sqrt{a} + b\sqrt{b} = 32$ and $a\sqrt{b} + b\sqrt{a} = 31$. What is the value of $\dfrac{5(a+b)}{7}$?

(a) 5   (b) 7   (c) 9
(d) Cannot be determined

⊘ **(a)** Given, $a\sqrt{a} + b\sqrt{b} = 32$ …(i)

$a\sqrt{b} + b\sqrt{a} = 31$ …(ii)

On squaring both sides Eqs. (i) and (ii), we get

$(a\sqrt{a} + b\sqrt{b})^2 = 32^2$

$[\because (a + b)^2 = a^2 + b^2 + 2ab]$

$\therefore \quad a^3 + b^3 + 2ab\sqrt{ab} = 1024$ …(iii)

$(a\sqrt{b} + b\sqrt{a})^2 = 31^2$

$a^2 b + b^2 a + 2ab\sqrt{ab} = 961$ …(iv)

On subtracting Eq. (iv) from Eq. (iii), we get

$(a^3 + b^3 + 2ab\sqrt{ab}) - (a^2 b + b^2 a + 2ab\sqrt{ab})$
$\qquad = 1024 - 961$

$a^3 + b^3 - a^2 b - b^2 a = 63$

$a^3 - a^2 b - b^2 a + b^3 = 63$

$a^2(a - b) - b^2(a - b) = 63$

$(a^2 - b^2)(a - b) = 63$

$(a + b)(a - b)(a - b) = 63$

$\{\because a^2 - b^2 = (a + b)(a - b)\}$

$(a + b)(a - b)^2 = 63$

$(a + b)$ and $(a - b)^2$ must be a co-prime number, by factorising 63 we get 7 and 9 that can satisfy the above equation.

$\because \qquad a + b = 7$

$(a - b)^2 = 9 \Rightarrow a - b = \pm 3$

If we take, $a - b = -3$, we will get b negative that can not be possible,

$\because \qquad a + b = 7$
$\qquad a - b = 3$

On solving this, we get

$\qquad a = 5$

$\Rightarrow \qquad b = 2$

Value of $\dfrac{5(a + b)}{7} = \dfrac{5(5 + 2)}{7} = 5$

2. Consider the following statements
1. Unit digit in 17^{174} is 7.
2. Difference of the squares of any two odd numbers is always divisible by 8.
3. Adding 1 to the product of two consecutive odd numbers makes it a perfect square.
Which of the above statements are correct?

(a) 1, 2 and 3   (b) Only 1 and 2
(c) Only 2 and 3   (d) Only 1 and 3

⊘ **(c)**
1. The last digit of a number depends on the unit digit, so 17 as 7 will show same characteristic.

We know, the cyclicity of 7 is 5.

While solving this problem we will take the power and divide by 5.

174 can be written as $5n + 4$, where $n = 34$

Hence, $17^{174} = 17^{(5 \times 34 + 4)}$

Hence, 7^4 and 17^{174} will have same digit in the unit place, so answer is 1.

2. Let any two odd number be 5 and 3.

According to the question,

$\Rightarrow 5^2 - 3^2 = 25 - 9 = 16$

16 which is divisible by 8.

Let check once more with non consecutive odd number be 7 and 3.

According to the question,

$\Rightarrow \qquad 7^2 - 3^2 = 49 - 9 = 40$

40 which is divisible by 8.

So, difference of the square of any two odd number is divisible by 8.

3. Let two consecutive number be x and $x + 2$.

According to the question, $x(x + 2) + 1$
$\qquad = x^2 + 2x + 1 = (x + 1)^2$

Thus, adding 1 to the product of two consecutive odd numbers makes it perfect square.

Hence, statements 2 and 3 are correct and statement 1 is incorrect.

3. When N is divided by 17, the quotient is equal to 182. The difference between the quotient and the remainder is 175. What is the value of N?

(a) 2975   (b) 3094   (c) 3101   (d) 3269

⊘ **(c)** Let the remainder be x.

According to the question,
$\qquad 182 - x = 175$

$\Rightarrow \qquad x = 7$

$\therefore$ Number = Divisor × Quotient + Remainder

$\qquad = 17 \times 182 + 7$

$\qquad = 3094 + 7 = 3101$

4. Consider the following statements :

1. If p is relatively prime to each of q and r, then p is relatively prime to the product qr.
2. If p divides the product qr and if p divides q, then p must divide r.

Which of the above statements is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ **(a)**

1. Let $p = 4, q = 3, r = 5$

Here, p is relatively prime to q and r.

The product of $qr = 3 \times 5 = 15$

In this case also p is relatively prime to product of qr.

2. Let $p = 4, q = 8$ and $r = 3$

Here, product of $qr = 8 \times 3 = 24$

p divides the product of qr but cannot divide r.

Let $p = 4, q = 8$ and $r = 12$

Product of $qr = 96$

p divides the product of qr and also divide r.

We cannot say that p will divide r.

Hence, statement 1 is correct and statement 2 is incorrect.

5. Let x be the smallest positive integer such that when 14 divides x, the remainder is 7; and when 15 divides x, the remainder is 5. Which one of the following is correct?

(a) $20 < x < 30$ (b) $30 < x < 40$
(c) $40 < x < 50$ (d) $x > 50$

⊘ **(b)** Dividend
= (Integer quotient) × divisor + remainder
$$x = 14p + 7 \implies x = 15q + 5$$
Where, p and q are quotients.
How, we can put in the values of p and q into the equation, starting with 0.
When $x = 14p + 7$
$p = 0$ $x = 14 \times 0 + 7 = 7$
$p = 1$ $x = 14 \times 1 + 7 = 21$
$p = 2$ $x = 14 \times 2 + 7 = 35$ etc.
When $x = 15q + 5$
$q = 0$ $x = 15 \times 0 + 5 = 5$
$q = 1$ $x = 15 \times 1 + 5 = 20$
$q = 2$ $x = 15 \times 2 + 5 = 35$
Here, we found the common value for x. Hece, the least possible value for x for which both statements are true, is 35.

6. Consider the following statements :
1. $\sqrt{75}$ is a rational number.
2. There exists at least a positive integer x such that $-\dfrac{4x}{5} < -\dfrac{7}{8}$.
3. $\dfrac{x-2}{x} < 1$ for all real value of x.
4. 4.232323... can be expressed in the form p/q where p and q are integers.
Which of the above statements are correct?

(a) 1 and 2   (b) 2 and 3
(c) 3 and 4   (d) 2 and 4

⊘ **(d)**
1. $\sqrt{75}$ is not a rational number.
Only root of perfect square is rational number, here 75 is not a perfect square.
2. $-\dfrac{4x}{5} < -\dfrac{7}{8} \implies -32x < -35$
$\implies 32x > 35$
It is possible, if $x \geq 2$.
3. $\dfrac{x-2}{x} < 1$ does not follow for all real values, It only follow for natural numbers,
For example, If $x = -1$
$$\dfrac{-1-2}{-1} < 1$$
$$\implies \dfrac{-3}{-1} < 1$$
$3 < 1$ (does not follow)

if $x = 3$
$$\dfrac{3-2}{3} < 1, \dfrac{1}{3} < 1 \text{ (follow)}$$
4. $x = 4.232323$ …(i)
On multiply by 100 both sides, we get
     $100x = 423.2323$ …(ii)
On subtracting Eq. (i) from Eq. (ii), we get
$100x - x = 423.2323\ldots - 4.2323\ldots\ldots$
     $99x = 419 \implies x = \dfrac{419}{99}$
$\therefore \dfrac{419}{99}$ is in $\dfrac{p}{q}$ form and both p and q are integers.
Hence, statements 2 and 4 are correct and statements 1 and 3 are incorrect.

7. What is the digit in the unit's place of the number represented by $3^{98} - 3^{89}$?

(a) 3   (b) 6   (c) 7   (d) 9

⊘ **(b)** $x = 3^{98} - 3^{89} = 3^{89}(3^9 - 1)$
We know that, the cyclicity of 3 is 4.
So, we can write above expression as
$x = 3^{4 \times 22} \times 3^1 (3^{2 \times 4} \times 3 - 1)$
It will be equal to $= 3^1(3^1 - 1) = 3 \times 2 = 6$
Unit digit of the expression is 6.

8. Which one of the following is not correct?

(a) 1 is neither prime nor composite
(b) 0 is neither positive nor negative
(c) If $p \times q$ is even, then p and q are always even
(d) $\sqrt{2}$ is an irrational number

⊘ **(c)** If $p \times q$ is even, then p and q can or cannot be even,
Let illustrate with example,
Let $p = 2$ and $q = 4$, then
    $p \times q = 2 \times 4 = 8$ (even)
Let $p = 2$ and $q = 3$, then
    $p \times q = 2 \times 3 = 6$ (even)
Let $p = 3$ and $q = 4$, then
    $p \times q = 3 \times 4 = 12$ (even)
With above example we can conclude that if any one of p and q is even we will get $p \times q$ even.

2019 (I)

9. What is the remainder when $(17^{29} + 19^{29})$ is divided by 18?

(a) 6   (b) 2   (c) 1   (d) 0

⊘ **(d)** $= \dfrac{17^{29} + 19^{29}}{18}$
$$= \dfrac{(18-1)^{29}}{18} + \dfrac{(18+1)^{29}}{18}$$

$\therefore$ Remainder $= (-1)^{29} + (1)^{29}$
     $= -1 + 1 = 0$

10. How many pairs (A, B) are possible in the number $479865AB$ if the number is divisible by 9 and it is given that the last digit of the number is odd?

(a) 5   (b) 6
(c) 9   (d) 11

⊘ **(a)** Divisible rule of 9
Sum of digit of the numbers is divisible by 9.
The number $= 479865AB$
Sum of the digit
     $= 4 + 7 + 9 + 8 + 6 + 5 + A + B$
     $= 39 + A + B$
Pairs (A, B) also the number is odd.
45 and 54 are two numbers divisible by 9.
Pairs [(1, 5), (5, 1), (3, 3), (6, 9), (8, 7)]
Option (a) is correct.

11. Consider the multiplication $999 \times abc = def\,132$ in decimal notation, where a, b, c, d, e and f are digits. What are the values of a, b, c, d, e and f, respectively?

(a) 6, 6, 8, 6, 8, 7   (b) 8, 6, 8, 6, 7, 8
(c) 6, 8, 8, 7, 8, 6   (d) 8, 6, 8, 8, 6, 7

⊘ **(d)** $999 \times abc = def\,132$

```
    9 9 9
  × a b c
  ‾‾‾‾‾‾‾
  def 132
```

In first step $9 \times c =$ unit digit 2
     $c = 8$

```
    9 9 9
  × a b 8
  ‾‾‾‾‾‾‾
  7 9 9 2
      ×
  ‾‾‾‾‾‾‾
  def 132
```

In second step $9 \times b = 9 +$ (unit digit 3)
$b = 6$

```
      9 9 9
    × a 6 8
    ‾‾‾‾‾‾‾
    7 9 9 2
  5 9 9 4 ×
      × ×
  ‾‾‾‾‾‾‾
  def 132
```

Similarly, $a = 8$

```
        9 9 9
      × 8 6 8
      ‾‾‾‾‾‾‾
      7 9 9 2
    5 9 9 4 ×
  7 9 9 2 × ×
  ‾‾‾‾‾‾‾‾‾‾‾
  8 6 7 1 3 2
```

The values of a, b, c, d, e and $f = 8, 6, 8, 8, 6, 7$
Option (d) is correct.

12. Which of the following statements is not true?

   (a) The difference of two prime numbers, both greater than 2, is divisible by 2

   (b) For two different integers m, n and a prime number p, if p divides the product $m \times n$, then p divides either m or n

   (c) If a number is of the form $6n - 1$ (n being a natural number), then it is a prime number

   (d) There is only one set of three prime numbers such that there is a gap of 2 between two adjacent prime numbers

⊙ **(c)** Every prime number is of the form $(6n - 1)$ or $(6n + 1)$ but every number which is of form $(6n - 1)$ or $(6n + 1)$ not necessarily prime.

Examples showing $(6n - 1)$

Let $n = 6$

$(6 \times 6 - 1) = 36 - 1 = 35$

          (It is not a prime number)

Let $n = 4 (6 \times 4 - 1) = 24 - 1 = 23$

          (It is a prime number)

So, option (c) is correct answer.

13. The sum of three prime numbers is 100. If one of them exceeds another by 36, then one of the number is

   (a) 17
   (b) 29
   (c) 43
   (d) None of these

⊙ **(d)** The sum of the three prime number

$$(P_1 + P_2 + P_3) = 100 \quad \ldots (i)$$

Solve by option

$$P_1 - P_2 = 36 \quad \ldots (ii)$$

Option (a)

$$P_2 = 17$$
$$P_1 - 17 = 36$$
$$P_1 = 36 + 17$$
$$P_1 = 53$$

From Eq. (i), we get

$$P_1 + P_2 + P_3 = 100$$
$$53 + 17 + P_3 = 100$$
$$P_3 = 30$$

(It is not a prime)

Option (b)

$$P_2 = 29$$
$$P_1 - 29 = 36$$
$$P_1 = 36 + 29$$
$$P_1 = 65$$

(It is not a prime)

Option (c)

$$P_2 = 43$$
$$P_1 - 43 = 36$$
$$P_1 = 36 + 43 = 79$$

On putting in Eq. (i), we get

$$P_1 + P_2 + P_3 = 100$$
$$79 + 43 + P_3 = 100$$
$$122 + P_3 = 100$$
$$P_3 = -22$$

(It is not a prime)

Then, option (d) is correct answer.

14. What is the unit place digit in the expansion of 7^{73}?

   (a) 1
   (b) 3
   (c) 7
   (d) 9

⊙ **(c)** The unit place digit $= 7$

$$\begin{bmatrix} 7^1 = 7 \\ 7^2 = 9 \\ 7^3 = 3 \\ 7^4 = 1 \\ 7^5 = 7 \end{bmatrix}$$

Then, cyclicity of 7 is 4

$$7^{73} = 7^{\frac{73}{4}} \Rightarrow \text{remainder} = \frac{73}{4} = 1 = 7^1$$

unit digit.

Option (c) is correct.

15. Consider the following statements in respect of two integers p and q (both > 1) which are relatively prime.

   1. Both p and q may be prime numbers.
   2. Both p and q may be composite numbers.
   3. One of p and q may be prime and the other composite.
   Which of the above statements are correct?

   (a) 1 and 2 only
   (b) 2 and 3 only
   (c) 1 and 3 only
   (d) 1, 2 and 3

⊙ **(d)** p and q are two integers.

p and q are also relative prime, HCF = 1

Condition 1

Both p and q may be prime numbers

   $(p, q) = (3, 5)$ HCF = 1

It is possible.

Condition 2

Both p and q may be composite numbers.

Let $(p, q) = (9, 25)$, HCF = 1

It is also possible.

Condition 3

One of p and q may be prime and the other composite.

Let $(p, q) = (5, 8)$ HCF = 1

It is also possible.

Then, condition (1), (2) and (3) are possible.

Option (d) is correct.

16. The inequality $3^N > N^3$ holds when

   (a) N is any natural number
   (b) N is a natural number greater than 2
   (c) N is a natural number greater than 3
   (d) N is a natural number except 3

⊙ **(d)** $3^N > N^3$

Let $N = 2$, $3^2 > 2^3$
          $9 > 8$ (It is correct)
Let $N = 3$, $3^3 > 3^3$ (It is not correct)
Let $N = 4$, $3^4 > 4^3$
          $81 > 64$ (It is correct)

Then, N is a natural number except 3.

Hence, option (d) is correct.

17. Which one of the following is an irrational number?

   (a) $\sqrt{59049}$
   (b) $\dfrac{231}{593}$
   (c) 0.45454545....
   (d) $0 \cdot 121122111122221111112222....$

⊙ **(d)** The number that cannot be expressed in the form of p/q are called irrational number.

For example $\sqrt{2}, \sqrt{3}, \sqrt{7}, \sqrt{11}$ etc.

Option (a)

$$\sqrt{59049} = 243$$

Option (b) $\dfrac{231}{593}$ (it is p/q form)

Option (c)   0.454545........

          $\dfrac{45}{99}$ (it is p/q form)

Option (d) 0.121122111222 .....

[it can not expressed in form of p/q]

Then, option (d) is correct answer.

18. The number 3^{521} is divided by 8. What is the remainder?

   (a) 1
   (b) 3
   (c) 7
   (d) 9

⊙ **(b)** $\dfrac{3^{521}}{8}$

Remainder $= \dfrac{3 \cdot 3^{520}}{8} = \dfrac{3 \cdot (3^2)^{260}}{8}$

$$= \dfrac{3 \cdot (8 + 1)^{260}}{8}$$

$$= \dfrac{3(1)^{260}}{8} = \dfrac{3}{8}$$

$\therefore$ 3 is remainder

Option (b) is correct.

19. A prime number contains the digit X at unit's place. How many such digits of X are possible?

   (a) 3
   (b) 4
   (c) 5
   (d) 6

⊙ **(b)** The digit x at unit's place in prime number.

Then, such digit of x are possible

$$x = [1, 3, 7, 9]$$

Option (b) is correct.

2018 (II)

20. How many five-digit numbers of the form $XXYXX$ is/are divisible by 33?

(a) 1   (b) 3   (c) 5   (d) Infinite

⊙ **(b)** For a number to be divisible by 33 it must be divisible by 3 and 11.

Now, a number is divisible by 11, if the difference of the sum of digits at odd places and the sum of digits at even places is either zero or divisible by 11.

∴ For $XXYXX$ to be divisible by 11

$2X + Y - 2X$ i.e. Y must either be 0 or divisible by 11.

Now, Y cannot be divisible by 11 because it is a single digit number.

∴ $Y = 0$

Now, for a number to be divisible by 3 the sum of digits must be divisible by 3.

i.e. $X + X + 0 + X + X$ or $4X$ must be divisible by 3.

This would happen only when X is either 3, 6 or 9.

Hence, 3 five-digit numbers of the form $XXYXX$ are divisible by 33 viz. 33033, 66066, 99099.

21. A five-digit number $XY235$ is divisible by 3 where X and Y are digits satisfying $X + Y \le 5$. What is the number of possible pairs of values of (X, Y)?

(a) 5   (b) 6   (c) 7   (d) 9

⊙ **(c)** Given, $XY235$ is divisible by 3 and $X + Y \le 5$

Now, for a number to be divisible by 3, the sum of digits must be divisible by 3.

i.e. $X + Y + 2 + 3 + 5$ or $10 + X + Y$ is divisible by 3.

Now, two cases are possible, i.e. 12 and 15.

∴ Possible values of

$(X, Y) = (1, 1), (2, 0), (1, 4), (2, 3),$
$(3, 2), (4, 1)$ and $(5, 0)$

i.e. 7 possible values are there.

22. The number of divisors of the number 38808 exclusive of the divisors 1 and itself, is

(a) 74   (b) 72   (c) 70   (d) 68

⊙ **(c)** To find the number of divisors of a number we must write it in the form of $a^m b^n c^o d^p \ldots$ where $a, b, c, d \ldots$ are prime numbers.

Now,

$38808 = 2 \times 2 \times 2 \times 3 \times 3 \times 7 \times 7 \times 11$
$\quad\quad = 2^3 \times 3^2 \times 7^2 \times 11^1$

Now, number of divisors of 38808 except 1 and 38808

$= (3 + 1)(2 + 1)(2 + 1)(1 + 1) - 2$
$= 4 \times 3 \times 3 \times 2 - 2$
$= 72 - 2 = 70$

23. If the sum of the squares of three consecutive natural numbers is 110, then the sum of their cubes is

(a) 625   (b) 654   (c) 684   (d) 725

⊙ **(c)** Let the three consecutive natural numbers be

$(x - 1), x, (x + 1)$

According to the question,

$\Rightarrow (x - 1)^2 + x^2 + (x + 1)^2 = 110$

∵ $(a - b)^2 = a^2 + b^2 - 2ab$
        $(a + b)^2 = a^2 + b^2 + 2ab$

$\Rightarrow x^2 + 1 - 2x + x^2 + x^2 + 1 + 2x = 110$
$\Rightarrow \quad\quad 3x^2 = 110 - 2$
$\Rightarrow \quad\quad x^2 = \dfrac{108}{3} = 36$
∴ $x = 6$

∴ The numbers are $(6 - 1), 6, (6 + 1)$

i.e. 5, 6 and 7

Now, sum of their cubes

$= 5^3 + 6^3 + 7^3$
$= 125 + 216 + 343 = 684$

24. Consider the following statements in respect of three 3-digit numbers XYZ, YZX and ZXY:

1. The sum of the numbers is not divisible by $(X + Y + Z)$.
2. The sum of the numbers is divisible by 111.

Which of the above statements is / are correct?

(a) 1 only   (b) 2 only
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ **(b)** We have, 3-digits numbers are XYZ, YZX, ZXY

$XYZ = 100X + 10Y + Z$
$YZX = 100Y + 10Z + X$
$ZXY = 100Z + 10X + Y$

$XYZ + YZX + ZXY$
$= 100(X + Y + Z) + 10(X + Y + Z)$
$\quad\quad\quad\quad\quad\quad + X + Y + Z$
$= (X + Y + Z)(100 + 10 + 1)$
$= (X + Y + Z)(111)$

∴ The sum of number is divisible by $X + Y + Z$ and 111.

Hence, only statement 2 is correct and statement 1 is incorrect.

25. The number of all pairs (m, n), where m and n are positive integers, such that

$\dfrac{1}{m} + \dfrac{1}{n} - \dfrac{1}{mn} = \dfrac{2}{5}$ is

(a) 6   (b) 5   (c) 4   (d) 2

⊙ **(c)** We have, $\dfrac{1}{m} + \dfrac{1}{n} - \dfrac{1}{mn} = \dfrac{2}{5}$

$\Rightarrow \quad\quad \dfrac{n + m - 1}{mn} = \dfrac{2}{5}$

$5n + 5m - 5 = 2mn$
$5n - 5 = 2mn - 5m$

Here, m and n such positive integer

∴ Possible value are

(3, 10), (4, 5), (5, 4), (10, 3)

26. If H is the harmonic mean P and Q, then the value of $\dfrac{H}{P} + \dfrac{H}{Q}$ is

(a) 1   (b) 2   (c) $\dfrac{P + Q}{PQ}$ (d) $\dfrac{PQ}{P + Q}$

⊙ **(b)** We know that, harmonic mean of a and b is

$\text{H.M} = \dfrac{2ab}{a + b}$

∴ $H = \dfrac{2PQ}{P + Q}$

$\Rightarrow \quad\quad \dfrac{2}{H} = \dfrac{P + Q}{PQ}$

$\Rightarrow \quad\quad 2 = H\left(\dfrac{1}{P} + \dfrac{1}{Q}\right)$

$\Rightarrow H\left(\dfrac{1}{P} + \dfrac{1}{Q}\right) = 2$

∴ $\dfrac{H}{P} + \dfrac{H}{Q} = 2$

2018 (I)

27. $5^{17} + 5^{18} + 5^{19} + 5^{20}$ is divisible by

(a) 7   (b) 9
(c) 11   (d) 13

⊙ **(d)** $5^{17} + 5^{18} + 5^{19} + 5^{20}$

$= 5^{17}(1 + 5^1 + 5^2 + 5^3)$
$= 5^{17}(1 + 5 + 25 + 125)$
$= 5^{17}(156)$

∵ 156 is divisible by 13

∴ $5^{17} + 5^{18} + 5^{19} + 5^{20}$ is divisible by 13.

28. Which one of the following is correct?

(a) Decimal expansion of a rational number is terminating
(b) Decimal expansion of a rational number is non-terminating
(c) Decimal expansion of an irrational number is terminating
(d) Decimal expansion of an irrational number is non-terminating and non repeating

⊙ **(d)** Decimal expansion of an irrational number is non-terminating and non repeating.

29. The smallest integer with 4-digits which is a perfect square is ?

(a) 1000   (b) 1024
(c) 1089   (d) None of these

⊙ **(b)** $\sqrt{1024} = 32$

Square of any number last digit must be, 0, 1, 4, 5, 6 or 9.
Here, 1024 is only possible square. Hence, smallest four digit number which is a perfect square is 1024.

30. The age of a woman is a two-digit integer. On reversing this integer, the new integer is the age of her husband who is elder to her. The difference between their ages is one-eleventh of their sum. What is the difference between their ages?

(a) 8 yr   (b) 9 yr
(c) 10 yr   (d) 11 yr

⊙ (**b**) Let the age of woman
$$= (10x + y) \text{ yr}$$
According to the question,
her husband age = $(10y + x)$ yr
Also, $10y + x - 10x - y$
$$= \frac{1}{11}(10x + y + 10y + x)$$
$\Rightarrow 9y - 9x = \frac{1}{11}(11x + 11y)$
$\Rightarrow 9y - 9x = x + y$
$\Rightarrow 8y = 10x$ or $\frac{x}{y} = \frac{4}{5}$
∵ x and y are digits
∴ On comparing $x = 4$ and $y = 5$
∴ Woman's age = $10 \times 4 + 5 = 45$ yr
Her husband's age = $10 \times 5 + 4 = 54$ yr
∴ Required difference = $(54 - 45)$ yr
$$= 9 \text{ yr}$$

31. All odd prime numbers upto 110 are multiplied together. What is the unit digit in this product?

(a) 0   (b) 3
(c) 5   (d) None of these

⊙ (**c**) All odd prime numbers upto 110 are 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, 101, 103, 107
Now, we know that if 5 is multiplied with any odd digit the digit at unit place will be 5.
∴ The unit digit of the product of all odd prime digits upto 110 is 5.

32. $\frac{1}{25}$ of the students who registered did not appear for the exam, $\frac{11}{20}$ of those who appeared passed. If number of registered students is 2000, the number who passed is

(a) 1920   (b) 1056   (c) 1020   (d) 864

⊙ (**b**) Number of registered students =2000

Number of students who appeared
$$= \left(1 - \frac{1}{25}\right) \times 2000$$
$$= \frac{24}{25} \times 2000 = 1920$$
Number of passed students = $\frac{11}{20} \times 1920$
$$= 1056$$

33. The arithmetic mean of two numbers is 10 and their geometric means is 8. What are the two numbers?

(a) 15, 5   (b) 12, 8   (c) 16, 4   (d) 18, 2

⊙ (**c**) Let the two numbers be x and y.
∵ Arithmetic mean = 10
∴ $\frac{x + y}{2} = 10$
and geometric mean = 8
$\sqrt{xy} = 8$
∴ $x + y = 20$ …(i)
and $xy = 64$ …(ii)
From Eq. (ii), $xy = 64$
∴ $x(20 - x) = 64$ [from Eq.(i)]
$20x - x^2 = 64$
$\Rightarrow x^2 - 20x + 64 = 0$
$\Rightarrow x^2 - 16x - 4x + 64 = 0$
$\Rightarrow x(x - 16) - 4(x - 16) = 0$
$\Rightarrow (x - 4)(x - 16) = 0$
∴ $x = 4$
or $x = 16$
And $y = 16$ or $y = 4$

34. Three numbers which are co-prime to each other, are such that the product of the first two is 286 and that of the last two is 770. What is the sum of the three numbers?

(a) 85   (b) 80   (c) 75   (d) 70

⊙ (**d**) Let the three numbers which are co-prime to each other be x, y and z.
According to the question,
$xy = 286 = 13 \times 22$
and $yz = 770 = 22 \times 35$
∴ Required numbers are 13, 22 and 35
Hence, required sum = 13 + 22 + 35
$$= 70$$

2017 (II)

35. How many numbers from 1 to 1000 are divisible by 2, 3, 4 and 5?

(a) 16   (b) 17
(c) 32   (d) None of these

⊙ (**a**) LCM of 2, 3, 4, 5 = 60
Therefore, the numbers from 1 to 1000 are divisible by 60 $= \left[\frac{1000}{60}\right] = 16$

36. a, b, c, d are non-zero integers such that (ab) divides (cd). If a and c are coprime, then which one of the following is correct?

(a) a is a factor of c
(b) a is a factor of b
(c) a is a factor of d
(d) d is a factor of a

⊙ (**c**) Since, a and c are coprime, therefore HCF $(a, c) = 1$
$\Rightarrow a$ divides $d \Rightarrow a$ is a factor of d

37. How many numbers between 500 and 1000 are divisible by 13?

(a) 36   (b) 37
(c) 38   (d) 39

⊙ (**c**) Required numbers are 507, 520, ..., 988, Which forms an A.P. with first term, $a = 507$ and common difference, $d = 13$.
Let there are n terms in the above A.P. Then, $a_n = 988$
We know that, $a_n = a + (n - 1)d$
$\Rightarrow$ $a + (n - 1)d = 988$
$\Rightarrow$ $507 + (n - 1)13 = 988$
$\Rightarrow$ $(n - 1)13 = 481$
$\Rightarrow$ $n - 1 = 37$
∴ $n = 38$
Thus, there are 38 numbers between 500 and 1000, which are divisible by 13.

38. Consider the following numbers
1. 2222   2. 11664
3. 343343   4. 220347

Which of the above are not perfect squares?

(a) 1, 2 and 3   (b) 1, 2 and 4
(c) 2, 3 and 4   (d) 1, 3 and 4

⊙ (**d**) We know that, if last digit of number is either 2 or 3 or 7 or 8, then that number cannot be a perfect square number.
∴ The number in 1, 3 and 4 are not perfect squares.

2017 (I)

39. What is the remainder when the number $(4444)^{4444}$ is divided by 9?

(a) 4   (b) 6
(c) 7   (d) 8

⊙ (**c**) According to Euler theorem
$$a^{\phi(m)} \equiv 1 \pmod{m}$$
∴ $(4444)^{4444} \equiv 4444^{6 \times 740 + 4}$
$$\equiv 4444^4$$
$$\equiv 7^4 \equiv 16$$
$$\equiv 7 \pmod 9$$
∴ Remainder is 7.

40. The number of prime numbers which are less then 100 is

(a) 24 (b) 25
(c) 26 (d) 27

⊙ **(b)** Prime numbers less than 100 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97.

∴ There are 25 prime numbers less than 100.

41. $(N^{p-1} - 1)$ is a multiple of p, if N is prime to p and p is a

(a) prime number
(b) rational number
(c) real number
(d) composite number

⊙ **(a)** According to Fermat's theorem–
If p is a prime number and n is prime to p, then $n^{p-1} - 1$ is divisible by p.

42. Consider the following statements

1. Of two consecutive integers one is even.
2. Square of an odd integer is of the form $8n + 1$

Which of the above statements is / are correct ?

(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2

⊙ **(c)** 1. Any integer number is either even or odd. Let first number be odd i.e. $2n + 1$, then next consecutive number will be $2n + 2 = 2(n + 1) = 2m =$ even.
If we take first number as even, then next number will be $2n + 1 =$ odd.
So, one number is always even.
2. $\qquad 1^2 = 1 = 8 \times 0 + 1$
$\qquad 3^2 = 9 = 8 \times 1 + 1$
$\qquad 5^2 = 25 = 8 \times 3 + 1$ and so on
∴ Square of any odd integer is always of the form $8n + 1$.
Hence, both statements are correct.

2016 (II)

43. What would be the maximum value of Q in the equation $5P9 + 3R7 + 2Q8 = 1114$?

(a) 9 (b) 8
(c) 5 (d) 4

⊙ **(a)** Given,
$5P9 + 3R7 + 2Q8 = 1114$
From above equation, we get
$\qquad P + R + Q + 2 = 11$
$\Rightarrow \qquad P + R + Q = 9$
Hence, the maximum value of Q is 9.

44. A boy saves ₹ 4.65 daily. What is the least number of days in which he will be able to save an exact number of rupees?

(a) 10 (b) 20
(c) 21 (d) 25

⊙ **(b)** From the given options, 20 is the least number of days in which he will be able to save an exact number of rupees because $4.65 \times 20 = 93$, which is an exact number of rupees.

45. What is the remainder when 2^{100} is divided by 101?

(a) 1 (b) 11
(c) 99 (d) 100

⊙ **(a)** Using Fermat's little theorem,
$\qquad a^{p-1} = 1 \pmod{p}$ for prime p.
Here, $a = 2$ and $p = 101$ given
$\Rightarrow \qquad 2^{100} = 1 \bmod (101)$
∵ 101 is prime and does not divide 2.
So, the answer is 1.

46. Which of the following is correct in respect of the number 1729?

(a) It cannot be written as the sum of the cubes of two positive integers
(b) It can be written as the sum of the cubes of two positive integers in one way only
(c) It can be written as the sum of the cubes of two positive integers in two ways only
(d) It can be written as the sum of the cubes of two positive integers in three ways only

⊙ **(c)** We have, $1729 = 1728 + 1 = (12)^3 + (1)^3$
or $\qquad 1729 = 1000 + 729 = (10)^3 + (9)^3$
∴ 1729 can be written as sum of the cubes of two positive integers in two ways only.

47. Consider the following statements in respect of positive odd integers x and y.

I. $x^2 + y^2$ is even integer.
II. $x^2 + y^2$ is divisible by 4.

Which of the above statements is/are correct?

(a) I only (b) II only
(c) Both I and II (d) Neither I nor II

⊙ **(a)** We have,
x and y both are positive odd integers.
Let $x = 2m + 1$ and $y = 2n + 1$, when $m, n \in N$
∴ $x^2 + y^2 = (2m + 1)^2 + (2n + 1)^2$
$\qquad = 4m^2 + 4m + 1 + 4n^2 + 4n + 1$
$\qquad = 4(m^2 + n^2 + m + n) + 2$

$\qquad = 2[2(m^2 + n^2 + m + n) + 1]$
$\qquad = 2k$
Hence, $x^2 + y^2$ is even integer, but $x^2 + y^2$ is not divisible by 4.

48. $2^{122} + 4^{62} + 8^{42} + 4^{64} + 2^{130}$ is divisible by which one of the following integers?

(a) 3 (b) 5
(c) 7 (d) 11

⊙ **(d)** We have,
$\qquad 2^{122} + 4^{62} + 8^{42} + 4^{64} + 2^{130}$
$\Rightarrow \quad 2^{122} + 2^{124} + 2^{126} + 2^{128} + 2^{130}$
$\Rightarrow \quad 2^{122}[1 + 2^2 + 2^4 + 2^6 + 2^8]$
$\Rightarrow \quad 2^{122}[1 + 4 + 16 + 64 + 256]$
$\Rightarrow \quad 2^{122}[341]$
∴ $\quad 2^{122} \times 31 \times 11$
which is divisible by 11.

49. Let S be a set of first ten natural numbers. What is the possible number of pairs (a, b) where $a, b \in S$ and $a \neq b$ such that the product $ab \, (> 12)$ leaves remainder 4 when divided by 12?

(a) 4 (b) 6
(c) 8 (d) 10

⊙ **(c)** The numbers (> 12) which divided by 12 leaves remainder 4, are 16, 28, 40, 52, 64, 76, 88 and 100 and so on.
As (a, b) belongs to set of first ten natural numbers and $a \neq b$.
Hence, possible product $ab \, (> 12)$ leaves remainder 4 when divided by 12 are 16, 28 and 40.
Thus, set of such pairs (a, b) are (2, 8), (8, 2), (4, 7), (7, 4), (5, 8), (8, 5), (10, 4) and (4, 10)
Hence, the possible number of such pairs are 8.

50. What is the remainder, when $13^5 + 14^5 + 15^5 + 16^5$ is divided by 29?

(a) 8 (b) 5
(c) 3 (d) 0

⊙ **(d)** $13^5 + 16^5$ is divisible by $13 + 16 = 29$
(as 5 is odd)
Also, $14^5 + 15^5$ is divisible by $14 + 15 = 29$ (as 5 is odd)
Hence, remainder of
$\left(\dfrac{13^5 + 14^5 + 15^5 + 16^5}{29} \right)$
$= $ Remainder of $\left(\dfrac{13^5 + 16^5}{29} \right)$
$\qquad + $ Remainder of $\left(\dfrac{14^5 + 15^5}{29} \right)$
$= 0 + 0 = 0$

51. What is the difference between the sum of the cubes and that of squares of first ten natural numbers?

(a) 2280   (b) 2640
(c) 3820   (d) 4130

⊙ **(b)** Sum of cubes of n natural numbers

$$= \left[\frac{n(n+1)}{2}\right]^2$$

Sum of cubes of first 10 natural

numbers $= \left\{\frac{10(10+1)}{2}\right\}^2 = 3025$

Sum of square of n natural numbers

$$= \frac{n(n+1)(2n+1)}{6}$$

Sum of squares of first 10 natural numbers

$$= \frac{10(10+1)(2\times10+1)}{6} = 385$$

∴ Required difference
  = 3025 − 385 = 2640

52. What is the unit digit of 7^{139}?

(a) 9   (b) 7
(c) 6   (d) 3

⊙ **(d)** The unit digit of $7^1 = 7$

$$7^2 = 9$$
$$7^3 = 3$$
$$7^4 = 1$$

So, cyclic period of unit digit of 7 is 4.
Remainder on dividing 139 by 4 is 3.
Hence,
unit digit of 7^{139} = unit digit of $7^3 = 3$

53. Let A and B be finite non-empty sets with the number of elements in $A = m$ and number of elements in $B = n$. Let $m > n$. If for some integer $k \geq 1$, the number of non-empty subsets of $A = 2^k + 2^n$ the number of non-empty subsets of B, then which one of the following is correct?

(a) $m = n + 2$
(b) $m = n + 1$
(c) $m = n + p$, for some odd prime number p
(d) $m = n + t$, for some composite number t

⊙ **(b)** According to the question,
$$2^m - 1 = 2^k + 2^n - 1$$
$$\Rightarrow \qquad 2^m = 2^k + 2^n$$
By taking option (b), $m = n + 1$
∴ $\qquad\qquad 2^{n+1} = 2^k + 2^n$
$$\Rightarrow \qquad 2\cdot 2^n = 2^k + 2^n$$
$$\Rightarrow \qquad 2^n(2-1) = 2^k$$
$$\Rightarrow \qquad\qquad 2^n = 2^k$$
∴ $n = k$, which is possible.

54. $7^{10} - 5^{10}$ is divisible by

(a) 5   (b) 7   (c) 10   (d) 11

⊙ **(d)** $7^{10} - 5^{10} = (7^5)^2 - (5^5)^2$
$$= (7^5 + 5^5)(7^5 - 5^5)$$
$$= (16807 + 3125)(7^5 - 5^5)$$
$$= 19932 \times (7^5 - 5^5)$$
Hence, 19932 is divisible by 11.

55. If m and n are distinct natural numbers, then which of the following is/are integer(s)?

1. $\dfrac{m}{n} + \dfrac{n}{m}$

2. $mn\left(\dfrac{m}{n} + \dfrac{n}{m}\right)(m^2 + n^2)^{-1}$

3. $\dfrac{mn}{m^2 + n^2}$

Select the correct answer using the codes given below.

(a) 1 and 2   (b) Only 2
(c) 2 and 3   (d) Only 3

⊙ **(b)**

1. If m and n are distinct natural numbers, then $\dfrac{m}{n} + \dfrac{n}{m}$ is integer if and only if $m = n$.
   Hence, statement 1 is incorrect.

2. $mn\left(\dfrac{m}{n} + \dfrac{n}{m}\right)(m^2 + n^2)^{-1}$
   $$= mn\left(\dfrac{m^2 + n^2}{mn}\right)\dfrac{1}{m^2 + n^2} = 1$$
   Hence, statement 2 is correct for all values of m and n.

3. Now, $\dfrac{mn}{m^2 + n^2}$ is fraction, if $m = n$.
   So, statement 3 is incorrect.

2016 (I)

56. What is the maximum value of m, if the number $N = 90 \times 42 \times 324 \times 55$ is divisible by 3^m?

(a) 8   (b) 7   (c) 6   (d) 5

⊙ **(b)** We have, $N = 90 \times 42 \times 324 \times 55$
$$= 3^2 \times 10 \times 3 \times 14 \times 3^4 \times 4 \times 55$$
$$= 3^7 \times 10 \times 14 \times 4 \times 55$$
Hence, N is divisible by 3^7.
So, the maximum value of m is 7 when N is divisible by 3^m.

57. Consider the following statements

1. Every natural number is a real number.
2. Every real number is an irrational number.

3. Every integer is a real number.
4. Every rational number is a real number.

Which of the above statements are correct?

(a) 1, 2 and 3   (b) 1, 3 and 4
(c) 2 and 3   (d) 3 and 4

⊙ **(b)** 1. Every natural number is a real number, which is correct.

2. Every real number is an irrational number, which is incorrect as real number can be rational or irrational.

3. Every integer is a real number, which is correct.

4. Every rational number is a real number, which is correct.

58. Consider the following statements in respect of the expression $S_n = \dfrac{n(n+1)}{2}$, where n is an integer.

1. There are exactly two values of n for which $S_n = 861$.

2. $S_n = S_{-(n+1)}$ and hence for any integer m, we have two values of n for which $S_n = m$.

Which of the above statement(s) is/are correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ **(a)** 1. $S_n = \dfrac{n(n+1)}{2} = 861$

$$\Rightarrow n^2 + n - 861 \times 2 = 0$$
$$\Rightarrow (n + 42)(n - 41) = 0$$
∴ $\qquad\qquad n = -42, 41$
Hence, statement 1 is correct.

2. Given, $S_n = S_{-(n+1)}$
   If $S_n = m$, then we have two values of n if and only if m is positive integer.
   Hence, statement 2 is incorrect.

59. Let S be a set of first fourteen natural numbers. The possible number of pairs (a, b), where $a, b \in S$ and $a \neq b$ such that ab leaves remainder 1 when divided by 15, is

(a) 3
(b) 5
(c) 6
(d) None of the above

⊙ **(d)** The possible set of pairs (a, b) such that ab leaves remainder 1 when divided by 15, are $(2, 8), (8, 2), (7, 13)$ and $(13, 7)$.
∴ Number of possible set of pairs = 4

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60. The largest natural number which divides every natural number of the form $(n^3 - n)(n - 2)$, where n is a natural number greater than 2, is

(a) 6   (b) 12
(c) 24   (d) 48

◈ (**c**) Let $x = (n^3 - n)(n - 2)$, where $n > 2$
Take $n = 3$, we get
$$x = (3^3 - 3)(3 - 2)$$
$$= (27 - 3)(1)$$
$$= 24$$
which is divisible by 6, 12 and 24.
Take $n = 4$, we get
$$x = (4^3 - 4)(4 - 2)$$
$$= (64 - 4) \times 2 = 120$$
which is again divisible by 6, 12 and 24.
Now, take $n = 5$, we get
$$x = (5^3 - 5)(5 - 2)$$
$$= (125 - 5) \times 3$$
$$= 120 \times 3$$
$$= 360$$
which is again divisible by 6, 12 and 24.
Hence, 24 is the largest natural number.

61. The digit in the unit's place of the resulting number of the expression $(234)^{100} + (234)^{101}$, is

(a) 6   (b) 4
(c) 2   (d) 0

◈ (**d**) We have,
$(234)^{100} + (234)^{101}$
$$= (234)^{100}(1 + 234)$$
$$= 235(234)^{100}$$
We know that square of any number having 4 at unit place is a number in which 6 at unit place. Any exponent of a number 6 at unit place is always 6 is at unit place.
∵ $(235)(...6) = ...30$
Resulting number have 0 at unit place.

62. The value of
$$\frac{1}{1 \times 4} + \frac{1}{4 \times 7} + \frac{1}{7 \times 10} + ... + \frac{1}{16 \times 19}, \text{ is}$$

(a) $\dfrac{5}{19}$ (b) $\dfrac{6}{19}$
(c) $\dfrac{8}{19}$ (d) $\dfrac{9}{19}$

◈ (**b**) We have,
$$\frac{1}{1 \times 4} + \frac{1}{4 \times 7} + \frac{1}{7 \times 10} + ... + \frac{1}{16 \times 19}$$
Then, nth term of 1, 4, 7,... is $(3n - 2)$ and of 4, 7, 10… is $(3n + 1)$.

Hence,
$$\frac{1}{1 \times 4} + \frac{1}{4 \times 7} + \frac{1}{7 \times 10} + ... + \frac{1}{16 \times 19}$$
$$= \sum_{n=1}^{6} \frac{1}{(3n - 2)(3n + 1)}$$
$$= \sum_{n=1}^{6} \frac{1}{3}\left(\frac{1}{3n - 2} - \frac{1}{3n + 1} \right)$$
$$= \frac{1}{3}\left[\left(\frac{1}{1} - \frac{1}{4} \right) + \left(\frac{1}{4} - \frac{1}{7} \right) + ... \right.$$
$$\left. + \left(\frac{1}{16} - \frac{1}{19} \right) \right]$$
$$= \frac{1}{3}\left(1 - \frac{1}{19} \right) = \frac{1}{3} \times \frac{18}{19} = \frac{6}{19}$$

63. A number when divided by 7 leaves a remainder 3 and the resulting quotient, when divided by 11 leaves a remainder 6. If the same number when divided by 11 leaves a remainder m and the resulting quotient when divided by 7 leaves a remainder n. What are the values of m and n, respectively?

(a) 1 and 4   (b) 4 and 1
(c) 3 and 6   (d) 6 and 3

◈ (**a**) This is an example of successive division. Let the number be N. The number and successive quotients, the successive divisors and the corresponding remainders are tabulated below.

Quotients	N	q_1	q_2
Divisors	7	11	
Remainders	3	6	

One value of N is $6 \times 7 + 3 = 45$
∴ $N = 77k + 45$
$$= 11(7k + 4) + 1$$
⇒ $m = 1$
and $q_1 = 7k + 4, q_2 = k$ and $n = 4$
∴ $(m, n) = (1, 4)$

64. The seven digit number $876p37q$ is divisible by 225. The values of p and q can be respectively

(a) 9, 0   (b) 0, 0
(c) 0, 5   (d) 9, 5

◈ (***) Seven digits number $876p37q$ is divisible by 225, then this number is also divisible by 9 and 25.
If this number is divisible by 9.
∴ Sum of its digits is divisible by 9.
Now, sum of digits
$$= 8 + 7 + 6 + p + 3 + 7 + q$$
$$= 31 + p + q$$
∴ $p + q = 5$ or $p + q = 14$, q must be 5, if $q = 5$, $p = 0$ and 9.
Options (c) and (d) both are correct.

65. Let x and y be positive integers such that $x > y$. The expressions $3x + 2y$ and $2x + 3y$, when divided by 5 leave remainders 2 and 3, respectively. What is the remainder when $(x - y)$, is divided by 5?

(a) 4   (b) 2
(c) 1   (d) 0

◈ (**a**) We have, $3x + 2y$ is divided by 5 remainder is 2.
∴ $3x + 2y = 5q + 2$ …(i)
and $2x + 3y$ is divided by 5 remainder is 3.
∴ $2x + 3y = 5m + 3$ …(ii)
On subtracting Eq. (ii) from Eq. (i), we get
$$x - y = 5(q - m) - 1$$
$$x - y = 5(q - m) - 5 + 4$$
$$x - y = 5(q - m - 1) + 4$$
∴ $x - y$ is divided by 5 remainder is 4.

66. The sum of first 47 terms of the series
$$\frac{1}{4} + \frac{1}{5} - \frac{1}{6} - \frac{1}{4} - \frac{1}{5} + \frac{1}{6} + \frac{1}{4} + \frac{1}{5} - \frac{1}{6} - ... ,$$
is

(a) 0   (b) $-\dfrac{1}{6}$
(c) $\dfrac{1}{6}$ (d) $\dfrac{9}{20}$

◈ (**b**) The sum of first 47 terms of the series
$$\frac{1}{4} + \frac{1}{5} - \frac{1}{6} - \frac{1}{4} - \frac{1}{5} + \frac{1}{6} + \frac{1}{4} + \frac{1}{5}$$
$$- \frac{1}{6} - ... 47 \text{ term}$$
It is clear that sum of first 6 term is zero.
Similarly, sum of 42 terms is zero.
Now, 43, 44, 45, 46, 47 terms are
$$\frac{1}{4} + \frac{1}{5} - \frac{1}{6} - \frac{1}{4} - \frac{1}{5} = \frac{-1}{6}$$

67. Consider all positive two-digit numbers each of which when divided by 7 leaves a remainder 3. What is their sum?

(a) 661   (b) 666
(c) 676   (d) 777

◈ (**c**) Here, required numbers are 10, 17, 24, …, 94
Let total number of such numbers be n.
∴ $94 = 10 + (n - 1)7$
           $[∵ a_n = a + (n - 1)d]$
⇒ $n = 13$
Now, total number of numbers is 13.
∴ Sum of these numbers $= \dfrac{n}{2}[a + l]$
$$= \frac{13}{2}[10 + 94]$$
$$= \frac{13}{2} \times 104 = 13 \times 52 = 676$$

68. How many right angled triangles can be formed by joining the vertices of a cuboid?

(a) 24   (b) 28
(c) 32   (d) None of these

⊙ (*d*) A cuboid has 8 vertices, 12 edges and 6 faces. By selectively choosing and 3 vertices of the cuboid, we can form 2 types of right angled triangles.

(i) Right angled triangle will all three vertices on the same face
$$= 6 \times {}^4C_3 = 24$$

(ii) Right angled triangle with 2 vertices along an edge and the third one along the diagonally opposite edge
$$= {}^{12}C_1 \times {}^2C_1 = 24.$$

∴ Total number of right angled triangles
$$= 24 + 24 = 48$$

69. Let x and y be positive integers such that x is prime and y is composite. Which of the following statements are correct?

1. $(y - x)$ can be an even integer.

2. xy can be an even integer.

3. $0.5(x + y)$ can be an even integer.

Select the correct answer using the code given below.

(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 2 and 3

⊙ (*d*) x is prime and y is composite number.

Since, x is prime number
∴ x may be {2, 3, 5, 7, 11, ...} and y may be
$$\{4, 6, 8, 9, 10, 12, 14, 15,...\}$$
Here, y may be even or odd number and x is odd number except 2.
∴ $(y - x)$ can be even number.
$(9 - 3) = 6$ be even number.
xy can be even number.
$(4 \times 3) = 12$ be even number.
$0.5(x + y) = \frac{1}{2}(x + y) = \frac{1}{2}(3 + 9) = 6$ be even number.
Hence, statements 1, 2 and 3 are correct.

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70. The last digit in the expansion of 17^{256} is

(a) 9   (b) 7   (c) 3   (d) 1

⊙ (*d*) ∵ Unit's place in $7^4 = 1$
∴ Unit's place in 17^{256} = Unit place in $(7^4)^{64}$ = Unit place in $(1)^{64} = 1$

71. What is the remainder when 4^{96} is divided by 6?

(a) 4   (b) 3
(c) 2   (d) 1

⊙ (*a*) 4 / 6 then remainder = 4
$\frac{(4)^2}{6} = \frac{16}{6}$, then remainder = 4
$\frac{(4)^3}{6} = \frac{64}{6}$, then remainder = 4
Similarly
$\frac{(4)^{96}}{6}$, then remainder = 4

72. The digit in the unit place of the product
$81 \times 82 \times 83 \times 84 \times ... \times 99$ is

(a) 0   (b) 4
(c) 6   (d) 8

⊙ (*a*) Product of unit digits
$= 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 0 \times ...$
$= 0$
∴ Required digit in the unit place is 0.

73. What is the remainder obtained when $1421 \times 1423 \times 1425$ is divided by 12?

(a) 1   (b) 2
(c) 3   (d) 4

⊙ (*c*) $\frac{1421 \times 1423 \times 1425}{12}$
$= \frac{1421 \times 1423 \times 475}{4}$
Remainder $= \frac{1 \times 3 \times 3}{4}$
$= \frac{9}{4} = \frac{1}{4} = \frac{1 \times 3}{4 \times 3} = \frac{3}{12}$
3 is remainder.

74. Consider the following statements

I. The equation $1990x - 173y = 11$ has no solution in integers for x and y.

II. The equation $3x - 12y = 7$ has no solution in integers for x and y.

Which of the above statement(s) is/are correct?

(a) Only I
(b) Only II
(c) Both I and II
(d) Neither I nor II

⊙ (*c*) I. Given, $1990x - 173y = 11$

Let x be an integer.
∴ $173y = 1990x - 11$
⇒ $y = \frac{1990x - 11}{173}$

Here, we substitute the different integer values of x, we do not get an integer value of y.

II. Given, $3x - 12y = 7$
Let x be an integer.
∴ $12y = 3x - 7$
⇒ $y = \frac{3x - 7}{12}$

Here, we substitute the different integer values of x, we do not get an integer value of y.

Hence, statements 1 and 2 both are correct.

75. What is the number of possible pairs of (P, Q), if the number $357P\ 25Q$ is divisible by both 3 and 5?

(a) 7   (b) 6
(c) 5   (d) None of these

⊙ (*a*) We know that, if the sum of the digits of a number is divisible by 3, then the number is divisible by 3 and if the digit at unit place is 5 or 0, then the number is divisible by 5.
Sum of digits
$= 3 + 5 + 7 + P + 2 + 5 + Q$
$= 22 + P + Q$
If $Q = 0$, then possible values of P are 2, 5 and 8
If $Q = 5$, then possible values of P are 0, 3, 6 and 9.
∴ The possible pairs of (P, Q) are (2, 0), (5, 0), (8, 0), (0, 5), (3, 5), (6, 5) and (9, 5) i.e. 7 pairs.

76. The difference between the squares of two consecutive odd integers is always divisible by

(a) 3   (b) 7
(c) 8   (d) 16

⊙ (*c*) Let the two consecutive odd integers be $(2x - 1)$ and $(2x + 1)$ respectively.
According to the question,
$(2x + 1)^2 - (2x - 1)^2$
$= (4x^2 + 1 + 4x) - (4x^2 + 1 - 4x)$
$= 4x^2 + 1 + 4x - 4x^2 - 1 + 4x$
$= 8x$
Hence, the difference between the squares of two consecutive odd integers is always divisible by 8.

77. What is the maximum value of m, if the number $N = 35 \times 45 \times 55 \times 60 \times 124 \times 75$ is divisible by 5^m?

(a) 4   (b) 5
(c) 6   (d) 7

⊙ (*c*) Here, 35 is divisible by 5 one time.
45 is divisible by 5 one time.
55 is divisible by 5 one time.
60 is divisible by 5 one time.
and 75 is divisible by 5 two times.
Hence, the maximum value of m is 6.

78. A light was seen regularly at an interval of 13 s. It was seen for the first time at 1 h 54 min 50 s (am) and the last time at 3 h 17 min 49 s (am). How many times was the light seen?
(a) 375   (b) 378
(c) 383   (d) 384

⊙ *(c)* Number of light seen

$$= \frac{3:17:49 - 1:54:50}{13}$$

Since, we have given the difference of light seen in seconds, so convert it into seconds.

∴ Number of light seen
$(3 \times 3600 + 17 \times 60 + 49)$

$$= \frac{-(1 \times 3600 + 54 \times 60 + 50)}{13}$$

$$= \frac{(10800 + 1020 + 49) - (3600 + 3240 + 50)}{13}$$

$$= \frac{11869 - 6890}{13}$$

$$= \frac{4979}{13} = 383$$

79. Consider the following statements for the sequence of numbers; 11, 111, 1111, 11111,… .
I. Each number can be expressed in the form $(4m + 3)$, where m is a natural number.
II. Some numbers are squares.
Which of the above statement(s) is/are correct?
(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊙ *(a)* Given numbers, 11, 111, 1111, 11111, …
I. Here, $4m + 3$ …(i)
On putting $m = 2$
⇒ $4 \times 2 + 3 = 11$
Again,   put $m = 27$
∴ $4m + 3 = 4 \times 27 + 3$
$= 108 + 3 = 111$
On putting $m = 277$
∴ $4m + 3 = 4 \times 277 + 3$
$= 1108 + 3 = 1111$
Hence, the given number is the form of $4m + 3$.
II. It is not true, as square of any number are of the form $4m$ or $4m + 1$.
Hence, statement 1 is correct and statement 2 is incorrect.

80. Consider the following statements
I. There exists only one prime number p such that $(17p + 1)$ is a square.

II. If x is the product of 10 consecutive prime numbers starting from 2, then $(x + 1)$ is also a prime number.
Which of the above statement(s) is/are correct?
(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊙ *(a)*
I. ∵ p is prime number.
∴ $p = 19$
Now, $17p + 1 = 17 \times 19 + 1$
$= 323 + 1$
$= 324 = (18)^2$
∴ $17p + 1$ is a square number.
II. Here, 10 consecutive prime numbers starting from 2
$= 2, 3, 5, 7, 11, 13, 17, 19, 23, 29$
and product of 10 consecutive prime numbers $x = 6469693230$
Now, sum of digits
$= 6 + 4 + 6 + 9 + 6 + 9 + 3 + 2 + 3 + 0$
$= 48$
∴ $x + 1 = 48 + 1 = 49$,
which is divisible by 7.
Hence, $x + 1$ is not a prime number.
Hence, statement 1 is correct and statement 2 is incorrect.

81. If A, G and H are the arithmetic, geometric and harmonic means between a and b respectively, then which one of the following relations is correct?
(a) G is the geometric mean between A and H
(b) A is the arithmetic mean between G and H
(c) H is the harmonic mean between A and G
(d) None of the above

⊙ *(a)* Given, A, G and H are the arithmetic, geometric and harmonic means between a and b, respectively.
∴ $A = \frac{a + b}{2}$ … (i)
$G = \sqrt{ab}$ … (ii)
and $H = \frac{2ab}{a + b}$ … (iii)
On multiplying Eqs. (i) and (iii), we get
∴ $AH = \frac{a + b}{2} \times \frac{2ab}{a + b}$
$= ab = (\sqrt{ab})^2$
⇒ $AH = G^2$ [from Eq. (ii)]

82. The geometric mean of three positive numbers a, b, c is 3 and the geometric mean of another three positive numbers d, e, f is 4.

Also, atleast three elements in the set $\{a, b, c, d, e, f\}$ are distinct. Which one of the following inequalities gives the best information about M, the arithmetic mean of the six numbers?
(a) $M > 2\sqrt{3}$
(b) $M > 3 \cdot 5$
(c) $M \geq 3 \cdot 5$
(d) It is not possible to set any precise lower limit for M

⊙ *(a)* ∵ $GM = \sqrt[3]{abc}$
⇒ $3 = \sqrt[3]{abc}$
⇒ $3^{\frac{1}{2}} = \sqrt[6]{abc}$
Similarly, $4 = \sqrt[3]{def}$
⇒ $4^{\frac{1}{2}} = \sqrt[6]{def}$
∵   AM> GM
∴ $M = \frac{a + b + c + d + e + f}{6} > \sqrt[6]{abcdef}$
⇒ $M > \sqrt[6]{abc}\ \sqrt[6]{def}$
⇒ $M > 3^{1/2} 4^{1/2}$
∴ $M > 2\sqrt{3}$

83. Out of 532 savings accounts held in a post office, 218 accounts have deposits over ₹ 10000 each. Further, in 302 accounts, the first or sole depositors are men, of which the deposits exceed ₹ 10000 in 102 accounts. In how many accounts the first or sole depositors are women and the deposits are upto ₹ 10000 only?
(a) 116
(b) 114
(c) 100
(d) Cannot be determined from the given data

⊙ *(b)* Total savings accounts = 532
Total accounts in which the first or sole depositors are men = 302
∴ Total accounts in which the first or sole depositors are women
$= 532 - 302 = 230$
Now, total accounts in which deposit exceeds over ₹ 10000 = 218
And the accounts of men in which deposit exceeds over ₹ 10000 = 102
Therefore, the accounts of women in which deposits exceeds over ₹ 10000
$= 218 - 102 = 116$
Hence, the accounts of women in which deposits are upto ₹ 10000
$= 230 - 116 = 114$

84. If n is a natural number and $n = p_1^{x_1} p_2^{x_2} p_3^{x_3}$, where p_1, p_2, p_3 are distinct prime factors, then the number of prime factors for n is

(a) $x_1 + x_2 + x_3$

(b) $x_1 x_2 x_3$

(c) $(x_1 + 1)(x_2 + 1)(x_3 + 1)$

(d) None of the above

⊚ **(c)** If factor of given number is the form of $p_1^{\alpha_1} p_2^{\alpha_2} \dots p_n^{\alpha_n}$, then number of prime factors are

$(\alpha_1 + 1)(\alpha_2 + 1)\dots(\alpha_n + 1)$

Hence, the prime factor of n are

$(x_1 + 1)(x_2 + 1)$ and $(x_3 + 1)$.

85. How many right angled triangles can be formed by joining the vertices of a cuboid?

(a) 24   (b) 28

(c) 32   (d) None of these

⊚ **(d)** A cuboid has 8 vertices, 12 edges and 6 faces. By selectively choosing and 3 vertices of the cuboid, we can form 2 types of right angled triangles.

(i) Right angled triangle will all three vertices on the same face

$= 6 \times {}^4 C_3 = 24$

(ii) Right angled triangle with 2 vertices along an edge and the third one along the diagonally opposite edge

$= {}^{12} C_1 \times {}^2 C_1 = 24.$

∴ Total number of right angled triangles

$= 24 + 24 = 48$

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86. $7^{10} - 5^{10}$ is divisible by

(a) 10   (b) 7

(c) 5   (d) 11

⊚ **(d)** $7^{10} - 5^{10} = (7^2)^5 - (5^2)^5$

$= 49^5 - 25^5$

Now, $49 \div 11 =$ Remainder is 5.

$25 \div 11 =$ Remainder is 3.

So, it becomes

$5^5 - 3^5 = 3125 - 243$

$= 2882$

which is divisible by 11.

Hence, $7^{10} - 5^{10}$ is divisible by 11.

87. What is the number of divisors of 360?

(a) 12

(b) 18

(c) 24

(d) None of the above

⊚ **(c)** ∵ $360 = 2^3 \times 3^2 \times 5$

∴ Number of divisors

$= (3 + 1)(2 + 1)(1 + 1)$

$= 4 \times 3 \times 2 = 24$

88. The multiplication of a three-digits number $XY5$ with digit Z yields $X215$. What is $X + Y + Z$ equal to?

(a) 13   (b) 15

(c) 17   (d) 18

⊚ **(a)** Given, three-digits number $= XY5$

$$
\begin{array}{r}
XY5 \\
\times \quad Z \\
\hline
X215
\end{array}
$$

Here, Z can take values 1, 3, 5, 7 and 9. But only 9 satisfies it, then $X = 1, Y = 3$ and $Z = 9$

$$
\begin{array}{r}
135 \\
\times 9 \\
\hline
1215
\end{array}
$$

Now, $X + Y + Z = 1 + 3 + 9 = 13$

89. If $N^2 - 33$, $N^2 - 31$ and $N^2 - 29$ are prime numbers, then what is the number of possible values of N, where N is an integer?

(a) 1   (b) 2

(c) 6   (d) None of these

⊚ **(c)** Let us consider the integer, $N = 6$

Now, $N^2 - 33 = 6^2 - 33 = 36 - 33 = 3$, which is prime.

$N^2 - 31 = 6^2 - 31 = 36 - 31 = 5$, which is prime.

and $N^2 - 29 = 6^2 - 29 = 36 - 29 = 7$, which is prime.

Hence, our assumption is true for $N = 6$ only.

90. Consider all those two-digits positive integers less than 50, which when divided by 4 yield unity as remainder. What is their sum?

(a) 310   (b) 314

(c) 218   (d) 323

⊚ **(a)** Let the two-digits numbers less than, 50 which when divided by 4 yield unity as remainder be 13, 17, ..., 49.

Here, first term, $a = 13$, common difference, $d = 4$

and $n = 10$

∴ Required sum $= \dfrac{n}{2}[2a + (n - 1)d]$

$= \dfrac{10}{2}[2 \times 13 + (10 - 1)4]$

$= \dfrac{10}{2}[26 + 36]$

$= \dfrac{10 \times 62}{2} = 310$

91. If $a_n = 3 - 4n$, then what is $a_1 + a_2 + a_3 + \dots + a_n$ equal to?

(a) $-n(4n - 3)$ (b) $-n(2n - 1)$

(c) $-n^2$ (d) $-n(2n + 1)$

⊚ **(b)** Given, $a_n = 3 - 4n$

∴ $\Sigma a_n = \Sigma(3 - 4n)$

$= \Sigma 3 - 4\Sigma n$

$= 3n - 4\dfrac{[n \times (n + 1)]}{2}$

$= 3n - 2n^2 - 2n$

$= n - 2n^2$

$= -n(2n - 1)$

92. How many pairs of X and Y are possible in the number $763X4Y2$, if the number is divisible by 9?

(a) 8   (b) 9   (c) 10   (d) 11

⊚ **(d)** We know that, any number is divisible by 9, if sum of all the digits is divisible by 9. Given number is $763X4Y2$.

Since, given number is divisible by 9.

∴ $7 + 6 + 3 + X + 4 + Y + 2 = 9k$

$\Rightarrow$ $22 + X + Y = 9k$

It is clear that LHS is divisible by 9, if $X + Y = 5, 14$.

When sum of X and Y in 5, then possible pairs are $(1, 4), (4, 1), (2, 3)$ $(3, 2), (0, 5)$ and $(5, 0)$. When sum of X and Y is 11, then possible pairs are $(5, 9), (9, 5), (6, 8), (8, 6)$ and $(7, 7)$.

Hence, possible pairs are 11.

93. What is the remainder when 4^{1012} is divided by 7?

(a) 1   (b) 2   (c) 3   (d) 4

⊚ **(d)** Given, $\dfrac{4^{1012}}{7} = \dfrac{4 \cdot 4^{1011}}{7}$

$= \dfrac{4 \cdot (4^3)^{337}}{7}$

$= \dfrac{4(63 + 1)^{337}}{7}$

$= \dfrac{4}{7} \times \dfrac{(63 + 1)^{337}}{7}$

$= \dfrac{4}{7} \times \dfrac{(1)^{337}}{7} = \dfrac{4}{7}$

Remainder is 4.

94. What is the remainder when $(1235 \times 4523 \times 2451)$ is divided by 12?

(a) 1   (b) 3   (c) 5   (d) 7

⊚ **(b)** Let $E = (1235 \times 4523 \times 2451)$

$= (12 \times 102 + 11)(12 \times 376 + 11)$

$\times (12 \times 204 + 3)$

When we divide E by 12, then remainder

$=$ Divide $11 \times 11 \times 3$ or 363 by 12

$= 3$ (remainder)

95. p, q and r are prime numbers such that $p < q < r < 13$. In how many cases would $(p + q + r)$ also be a prime number?

(a) 1
(b) 2
(c) 3
(d) None of the above

⊙ *(b)* The prime numbers less than 13 are 2, 3, 5, 7, 11.
Also, using the condition, $p < q < r < 13$ and $p + q + r$ is a prime number. Hence, only two possible pairs exist i.e. (3, 5, 11) and (5, 7, 11).

96. What is the remainder when $(17^{23} + 23^{23} + 29^{23})$ is divided by 23?

(a) 0   (b) 1   (c) 2   (d) 3

⊙ *(a)* We have, $\dfrac{17^{23} + 23^{23} + 29^{23}}{23}$

$= \dfrac{(23\times1 - 6)^{23} + (23\times1 + 0)^{23} + (23\times1 + 6)^{23}}{23}$

$\therefore$ Remainder $= (-6)^{23} + 0 + (6)^{23} = 0$

2014 (I)

97. If n is a whole number greater than 1, then $n^2 (n^2 - 1)$ is always divisible by

(a) 12   (b) 24   (c) 48   (d) 60

⊙ *(a)* If n is greater than 1, then $n^2(n^2 - 1)$ is always divisible by 12.
Illustration 1. Put $n = 2$, then
$n^2(n^2 - 1) = (2)^2(2^2 - 1)$
$= 4 \times 3 = 12$
Illustration 2. Put $n = 3$, then
$n^2(n^2 - 1) = (3)^2(3^2 - 1)$
$= 9 \times 8 = 72$

98. Consider the following statements

I. No integer of the form $4k + 3$, where k an integer, can be expressed as the sum of two squares.

II. Square of an odd integer can expressed in the form $8k + 1$, where k is an integer.

Which of the above statement(s) is/are correct?

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊙ *(a)* I. $f(k) = 4k + 3$
For $k = 1$, $f(1) = 4\times1 + 3 = 7$
For $k = 2$, $f(2) = 4\times2 + 3 = 11$
For $k = 3$, $f(3) = 4\times3 + 3 = 15$
Values of $f(k)$ for $k = 1, 2, ...$ cannot be expressed as sum of squares, since $1^2 + 2^2 = 5, 1^2 + 3^2 = 10,$ $2^2 + 3^2 = 13$.

II. $f(k) = 8k + 1$
For $k = 1$, $f(1) = (8\times1) + 1 = 9 = (3)^2$
For $k = 2$, $f(2) = (8 \times 2) + 1 = 17$
For $k = 3$, $f(3) = (8 \times 3) + 1 = 25 = (5)^2$
For $k = 4$, $f(4) = (8 \times 4) + 1 = 33$
For $k = 5$, $f(5) = (8 \times 5) + 1 = 41$
$f(k) = 8k + 1$ is square of an odd integer only for some values of k.
So, only statement I is correct.

99. The difference of two consecutive cubes

(a) is odd or even
(b) is never divisible by 2
(c) is always even
(d) None of the above

⊙ *(b)* The difference of two consecutive cubes is never divisible by 2.

Illustration 1. Let the two consecutive number be 4 and 5.
$\therefore$ $(5)^3 - (4)^3 = 125 - 64$
$= 61$
Illustration 2. Let the two consecutive numbers be 9 and 10.
$\therefore$ $(10)^3 - (9)^3 = 1000 - 729$
$= 271$

100. The product of four consecutive natural numbers plus one is

(a) a non-square
(b) always sum of two square numbers
(c) a square
(d) None of the above

⊙ *(c)* Product of four consecutive numbers plus one is always a square.

Illustration 1. Let four consecutive numbers be 3, 4, 5 and 6.
$\therefore (3 \times 4 \times 5 \times 6) + 1$
$= 361 = (19)^2$
Illustration 2. Let four consecutive numbers be 9, 10, 11 and 12.
$\therefore (9 \times 10 \times 11 \times 12) + 1 = 11881 = (109)^2$

101. What is the remainder when 4^{1000} is divided by 7?

(a) 1   (b) 2
(c) 4   (d) None of these

⊙ *(c)* We know that $\dfrac{4^1}{7}$ gives remainder 4;

$\dfrac{4^2}{7}$ gives remainder 2, $\dfrac{4^3}{7}$ gives remainder

1; $\dfrac{4^4}{7}$ gives remainder. 4.

Now, 4^4 gives us the same remainder as 4^1, so cyclicity is of 3. So, any power of 3 or multiple of 3 will give the remainder 1.
So, 44^{999} will give remainder 1 and 4^{1000} will give the next remainder in the cycle which is 4.

2

DECIMAL FRACTIONS

2019 (I)

1. What is $0.\overline{53} + 0.5\overline{3}$ equal to?

(a) $1.0\overline{68}$ (b) $1.0\overline{68}$ (c) $1.\overline{068}$ (d) 1.068

⊗ **(a)** $0.\overline{53} + 0.5\overline{3}$

In first number bar on two-digit and in second number bar on one-digit

LCM of bar digits (2, 1) = 2

Last two-digits have bar

$$
\begin{array}{r}
0.\ 5\ 3\ 5 \\
+\ 0.\ 5\ 3\ 3 \\
\hline
1.\ 0\ 6\ 8 \\
\end{array}
$$

$1.\ 0\overline{68}$

Alternative Method

$0.\overline{53} + 0.5\overline{3} = \dfrac{53}{99} + \dfrac{53 - 5}{90}$

$\Rightarrow \dfrac{53}{99} + \dfrac{48}{90} = \dfrac{53 \times 90 + 48 \times 99}{99 \times 90}$

$= \dfrac{4770 + 4752}{8910} = \dfrac{9522}{8910} = 1.0\overline{68}$

Option (a) is correct.

2018 (I)

2. What is the difference between $0.\overline{9}$ and 0.9 ?

(a) 0   (b) 0.099   (c) 0.1   (d) 0.09

⊗ **(c)** Let $x = 0.\overline{9}$ …(i)

$x = 0.999.....$

$10x = 9.999....$

$\therefore \quad 10x = 9.\overline{9}$ …(ii)

On subtracting Eq. (i) from Eq. (ii), we get

$9x = 9$ or $x = 1$

$\therefore \quad 0.\overline{9} - 0.9 = x - 0.9 = 1 - 0.9 = 0.1$

3. Which one of the following decimal numbers is a rational number with denominator 37?

(a) 0.459459459…   (b) 0. 458458458…
(c) 0.0459459459… (d) 0.00459459…

⊗ **(a)** Checking the options, we get
Option (a) 0.459459459…

$= 0.\ \overline{459} = \dfrac{459}{999} = \dfrac{17}{37}$

Here, we do not need to check other options, as in option (a) the denominator is 37.

2017 (II)

4. If the points P and Q represent the real numbers $0.8\overline{3}$ and $0.6\overline{2}$ on the number line, then the distance between P and Q is

(a) $\dfrac{21}{90}$ (b) $\dfrac{19}{90}$ (c) $\dfrac{21}{100}$ (d) $\dfrac{56}{90}$

⊗ **(b)** We have, $P = 0.8\overline{3}$ and $Q = 0.6\overline{2}$,

$P = 0.83333...$

$100P = 83.3333$ and

$10P = 8.3333,$

$\therefore \quad 100P - 10P = 83.333... - 8.333...$

$\Rightarrow \quad 90P = 75 \Rightarrow P = \dfrac{75}{90}$

Similarly, $\quad Q = \dfrac{56}{90}$

$\therefore$ Distance between P and Q is

$\dfrac{75 - 56}{90} = \dfrac{19}{90}$

2017 (I)

5. Which one among the following is the largest?

(a) $\dfrac{7}{9}$ (b) $\dfrac{11}{14}$ (c) $\dfrac{3}{4}$ (d) $\dfrac{10}{13}$

⊗ **(b)** We have, $\dfrac{7}{9}, \dfrac{11}{14}, \dfrac{3}{4}, \dfrac{10}{13}$

LCM of (9, 14, 4, 13) = 3276

Now, make the denominator of all the fractions equal to 3276. We get

$\dfrac{2548}{3276}, \dfrac{2574}{3276}, \dfrac{2457}{3276}, \dfrac{2520}{3276}$

$\therefore$ Largest number $= \dfrac{2574}{3276} = \dfrac{11}{14}$

2016 (II)

6. Which one of the following rational numbers has non-terminating and repeating decimal expansion?

(a) $\dfrac{15}{1600}$ (b) $\dfrac{23}{8}$ (c) $\dfrac{35}{50}$ (d) $\dfrac{17}{6}$

⊗ **(d)** $\because \dfrac{15}{1600} = \dfrac{15}{16 \times 4 \times 25} = \dfrac{15}{2^6 \cdot 5^2};$

$\dfrac{23}{8} = \dfrac{23}{2^3}, \dfrac{35}{50} = \dfrac{35}{5^2 \cdot 2}$ and $\dfrac{17}{6} = \dfrac{17}{2^1 \cdot 3^1}$

$\therefore \dfrac{17}{6}$ is non-terminating and repeating decimal expansion because it is not in the form of $\dfrac{N}{2^m \cdot 5^n}$.

2015 (II)

7. The value of $(0.\overline{63} + 0.\overline{37})$ is

(a) 1   (b) $\dfrac{100}{91}$ (c) $\dfrac{100}{99}$ (d) $\dfrac{1000}{999}$

⊗ **(c)** We have, $0.\overline{63} + 0.\overline{37}$

Let $\quad x = 0.\overline{63} = 0.63636363 …$

$\Rightarrow \quad 100x = 63.636363 …$

$\therefore \quad 99x = 63 \Rightarrow x = \dfrac{63}{99}$

Similarly, $y = 0.\overline{37} = 0.373737…$

$\because y = \dfrac{37}{99} \therefore x + y = \dfrac{63}{99} + \dfrac{37}{99} = \dfrac{100}{99}$

2015 (I)

8. Let p be a prime number other than 2 or 5. One would like to express the vulgar fraction 1/p in the form of a recurring decimal. Then, the decimal will be

(a) a pure recurring decimal and its period will be necessarily $(p - 1)$
(b) a mixed recurring decimal and its period will be necessarily $(p - 1)$
(c) a pure recurring decimal and its period will be some factor of $(p - 1)$
(d) a mixed recurring decimal and its period will be some factor of $(p - 1)$

⊗ **(c)** Value of p may be 3, 7, 11, 13.

$\dfrac{1}{3} = 0.\overline{3}$, Period = 1

Here, $p - 1 = 2$ and 1 is a factor of 2.

$\dfrac{1}{7} = 0.\overline{142857}$, Period = 6

Here, $p - 1 = 6$ and 6 is a factor of 6.

$\dfrac{1}{11} = 0.\overline{09}$, Period = 2

Here, $p - 1 = 10$ and 2 is a factor of 10.

3

HCF AND LCM OF NUMBERS AND POLYNOMIALS

1. HCF of two numbers is 12. Which one of the following can never be their LCM?

(a) 80   (b) 60
(c) 36   (d) 24

◉ **(a)** HCF of two numbers is 12.
LCM is common multiple for the two numbers.
So, the required answer is 80 because all other are multiple of 12.

2. X, Y and Z start at same point and same time in the same direction to run around a circular stadium. X completes a round in 252 s, Y in 308 s and Z in 198 s. After what time will they meet again at the starting point?

(a) 26 min 18 s   (b) 42 min 36 s
(c) 45 min   (d) 46 min 12 s

◉ **(d)** X completes round in 252 s.
Y completes round in 308 s.
Z completes round in 198 s.
They all meet again at starting together after, LCM of 252, 308 and 198
$\quad$ 252 = 2 × 2 × 3 × 3 × 7
$\quad$ 308 = 2 × 2 × 7 × 11
$\quad$ 198 = 2 × 3 × 3 × 11
∴ Required LCM
$\quad$ = 2 × 2 × 3 × 3 × 7 × 11
$\quad$ = 2772 s = 46 min 12 s.

3. What is the LCM of $\dfrac{1}{3}, \dfrac{5}{6}, \dfrac{2}{9}, \dfrac{4}{27}$?

(a) $\dfrac{5}{18}$ (b) $\dfrac{1}{27}$ (c) $\dfrac{10}{27}$ (d) $\dfrac{20}{3}$

◉ **(d)** LCM of $\dfrac{1}{3}, \dfrac{5}{6}, \dfrac{2}{9}$ and $\dfrac{4}{7}$

$\Rightarrow \quad \dfrac{\text{LCM of numerator}}{\text{HCF of denominator}}$

$\therefore \quad \dfrac{\text{LCM of 1, 5, 2 and 4}}{\text{HCF of 3, 6, 9, 27}} = \dfrac{20}{3}$

4. What is the LCM of the polynomials
$x^3 + 3x^2 + 3x + 1, \ x^3 + 5x^2 + 5x + 4$
and $x^2 + 5x + 4$?

(a) $(x + 1)^3(x + 4)(x^2 + x + 1)$
(b) $(x + 4)(x^2 + x + 1)$
(c) $(x + 1)(x^2 + x + 1)$
(d) $(x + 1)^2(x + 4)(x^2 + x + 1)$

◉ **(a)** Let $p = x^3 + 3x^2 + 3x + 1$
$\quad = (x + 1)^3$
$[\because (a + b)^3 = a^3 + b^3 + 3a^2b + 3b^2a]$
Let $q = x^3 + 5x^2 + 5x + 4$
$\quad = x^3 + 4x^2 + x^2 + 4x + x + 4$
$\quad = x^2(x + 4) + x(x + 4) + 1(x + 4)$
$\quad = (x + 4)(x^2 + x + 1)$
Let $r = x^2 + 5x + 4$
$\quad = x^2 + 4x + x + 4$
$\quad = x(x + 4) + 1(x + 4)$
$\quad = (x + 1)(x + 4)$
LCM of p, q and r
$\quad = (x + 1)^3(x + 4)(x^2 + x + 1)$

5. The highest four-digit number which is divisible by each of the numbers 16, 36, 45, 48 is

(a) 9180   (b) 9360
(c) 9630   (d) 9840

◉ **(b)** Number which is divisible by 16, 36, 45 and 48 = LCM of (16, 36, 45, 18)
LCM of 16, 36, 45, 48 = 720
Now, highest four digit number
$\quad$ = 9999

```
720)9999(13
    720
    2799
    2160
    639
```

∴ Highest four digit number exactly divisible by 16, 36, 45 and 48
$\quad$ = 9999 – 639 = 9360

6. HCF and LCM of two polynomials are $(x + 3)$ and $(x^3 - 9x^2 - x + 105)$ respectively. If one of the two polynomials is $x^2 - 4x - 21$, then the other is

(a) $x^2 + 2x - 21$ (b) $x^2 + 2x + 15$
(c) $x^2 - 2x - 15$ (d) $x^2 - x - 15$

◉ **(c)** Given, HCF of polynomials = $x + 3$
LCM of polynomials
$\quad = x^3 - 9x^2 - x + 105$
One polynomial = $x^2 - 4x - 21$
We know that, (HCF × LCM) of two numbers = Product of two numbers
∴ Other polynomial
$= \dfrac{(x + 3)(x^3 - 9x^2 - x + 105)}{x^2 - 4x - 21}$
$= \dfrac{(x + 3)(x^3 - 9x^2 - x + 105)}{(x - 7)(x + 3)}$
$= \dfrac{x^3 - 9x^2 - x + 105}{x - 7}$
$\Rightarrow$ Other polynomial = $x^2 - 2x - 15$

7. The product of two integers p and q, where $p > 60$ and $q > 60$, is 7168 and their HCF is 16. The sum of these two integers is

(a) 256   (b) 184   (c) 176   (d) 164

◉ **(c)** Given, HCF = 16
Product of two integers = 7168
Let first integer = 16a
Second integer = 16b
Product of two integers = 7168

$16a \times 16b = 7168$

$a \times b = 28$

Possible pair $(a, b) = (2, 14), (4, 7)$

Here, we can not use $(2, 14)$ because one integer $(16 \times 2 = 32)$ is less than 60.

∴ First integer $= 16 \times 4 = 64$

Second integer $= 16 \times 7 = 112$

∴ Sum of two integers

$$= 64 + 112 = 176$$

2018 (I)

8. There are two numbers which are greater than 21 and their LCM and HCF are 3003 and 21 respectively. What is the sum of these numbers?

(a) 504   (b) 508   (c) 514   (d) 528

⊘ (**a**) The LCM and HCF of two numbers which are greater than 21 are 3003 and 21 respectively.

Let the two numbers be $21x$ and $21y$.

∵   HCF $\times$ LCM = Product of two numbers

∴ $3003 \times 21 = 21x \times 21y$

⇒ $xy = 143 = 13 \times 11$

13 and 11 only possible numbers become, they are co-prime

Let $x = 13$ and $y = 11$

∴ The two numbers are 21×13 and 21×11

i.e. 273 and 231

Required sum $= 273 + 231 = 504$

2017 (II)

9. The product of two non-zero expressions is $(x + y + z)p^3$. If their HCF is p^2, then their LCM is

(a) $(x + y + z)$ (b) $(x + y + z)p^2$

.(c) $(x + y + z)p^5$ (d) $(x + y + z)p$

⊘ (**d**) We know that

Product of two numbers = LCM of two numbers $\times$ HCF of two numbers

∴ $(x + y + z)p^3 = p^2 \times$ LCM

LCM $= (x + y + z)p$

2017 (I)

10. Consider the following statements

1. If $a = bc$ with HCF $(b, c) = 1$, then HCF $(c, bd) =$ HCF (c, d).
2. If $a = bc$ with HCF $(b, c) = 1$, then LCM $(a, d) =$ LCM (c, bd).

Which of the above statements is / are correct?

(a) Only 1   (b) Only 2

(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ (**c**) 1. If $a = bc$ with HCF $(b, c) = 1$

⇒ b and c are co-prime numbers.

∴ HCF $(c, bd) =$ HCF (c, d)

Which is correct.

2. If $a = bc$ with HCF $(b, c) = 1$

⇒ b and c are co-prime numbers

∴   LCM $(b, c) = bc$

Now, LCM $(a, d) =$ LCM (bc, d)

∴   LCM $(a, d) =$ LCM (c, bd)

Which is correct.

Hence, both statements are correct.

11. What is the LCM of $x^3 + 8$, $x^2 + 5x + 6$ and $x^3 + 4x^2 + 4x$?

(a) $x (x + 2)^2 (x + 3)(x^2 - 2x + 4)$

(b) $x (x - 2)^2 (x - 3)(x^2 + 2x + 4)$

(c) $x (x + 2)^2 (x - 3)(x^2 - 2x + 4)$

(d) $x (x + 2)^2 (x - 3)(x^2 - 2x + 4)$

⊘ (**a**) We have,

$x^3 + 8 = (x)^3 + (2)^3$

$= (x + 2)\{(x)^2 - (x)(2) + (2)^2\}$

$\{\because a^3 + b^3 = (a + b)(a^2 - ab + b^2)\}$

$= (x + 2)(x^2 - 2x + 4)$

$x^2 + 5x + 6 = x^2 + 2x + 3x + 6$

$= x(x + 2) + 3(x + 2)$

$= (x + 2)(x + 3)$

and $x^3 + 4x^2 + 4x = x(x^2 + 4x + 4)$

$= x(x + 2)^2$

∴ LCM $= x(x + 2)^2(x + 3)(x^2 - 2x + 4)$

12. The HCF of two expressions p and q is 1. What is the reciprocal of their LCM?

(a) $p + q$ (b) $p - q$

(c) pq (d) $(pq)^{-1}$

⊘ (**d**) We have,

HCF of two expressions p and $q = 1$

Now, we know that

LCM $\times$ HCF = Product of numbers

⇒   LCM $\times 1 = p \times q$

⇒   LCM $= pq$

∴ Reciprocal of LCM $= \dfrac{1}{pq} = (pq)^{-1}$

2016 (II)

13. A is a set of those positive integers such that when these are divided by 2, 3, 4, 5 and 6 leaves the remainder 1, 2, 3, 4 and 5 respectively. How many integers between 0 and 100 belong to the set A?

(a) No integer   (b) One

(c) Two   (d) Three

⊘ (**b**) Let $p = 2, q = 3, r = 4, s = 5$ and $t = 6$ and remainders

$a = 1, b = 2, c = 3, d = 4, e = 5$

Now, $2 - 1 = 1; 3 - 2 = 1; 4 - 3 = 1;$

$5 - 4 = 1; 6 - 5 = 1,$ ∴ $k = 1$

Number that is divisible by 2, 3, 4, 5 and 6 leaves the remainder 1, 2, 3, 4 and 5

$=$ LCM of $(2, 3, 4, 5, 6) - k = 60 - 1 = 59$

Hence, there is only one integer between 0 and 100 which satisfies the given condition.

14. There are two numbers p and q such that their HCF is 1. Which of the following statements are correct?

   I. Both p and q may be prime.

   II. One number may be prime and the other composite.

   III. Both the numbers may be composite.

Select the correct answer using the code given below.

(a) I and II   (b) II and III

(c) I and III   (d) I, II and III

⊘ (**d**) Let two prime numbers 2 and 3, then their HCF = 1.

Hence, (I) statement is true.

Let $p = 5$ and $q = 6$, then their HCF is also 1.

Hence, (II) statement is also true.

Let $p = 8$ and $q = 9$,

p and q both are composite numbers and their HCF is also 1.

Hence, (III) statement is also true.

2016 (I)

15. Consider the following in respect of natural numbers a, b and c

   1. LCM $(ab, ac) = a$ LCM (b, c)

   2. HCF $(ab, ac) = a$ HCF (b, c)

   3. HCF $(a, b) <$ LCM (a, b)

   4. HCF (a, b) divides LCM (a, b).

Which of the above are correct?

(a) 1 and 2   (b) 3 and 4

(c) 1, 2 and 4   (d) 1, 2, 3 and 4

⊘ (**d**) Given, a, b and c are natural numbers.

   1. LCM of $(ab, ac) = abc$

     $a \times$ LCM of $(b, c) = abc$

     Hence, statement 1 is correct.

   2. HCF of $(ab, ac) =$ Common factor of $(ab, ac) = a$

     and $a \times$ HCF $(b, c) = a \times$ common factor of $(b, c) = a$

     Hence, statement 2 is correct.

   3. We know that HCF is always less than LCM. Hence, statement 3 is correct.

   4. HCF (a, b) divides LCM (a, b) because a common factor between a, b always divides $(a \times b)$.

     Hence, statement 4 is correct.

2015 (II)

16. What is the sum of digits of the least multiple of 13, which when divided by 6 and 12 leaves 5 and 11, respectively, as the remainders?

(a) 5   (b) 6   (c) 7   (d) 8

⊙ *(d)* Here, $6 - 5 = 1$ and $12 - 11 = 1$

Now, LCM of 6 and 12 = 12

∴   Required number $= 13(12 - 1)$
               $= 13 \times 11 = 143$

So, sum of digits $= 1 + 4 + 3 = 8$

17. If $(x + 1)$ is the HCF of $Ax^2 + Bx + C$ and $Bx^2 + Ax + C$, where $A \neq B$, then the value of C is

(a) A (b) B (c) $A - B$ (d) 0

⊙ *(d)* Since $x + 1$ is the HCF

Put $x = -1$
$$Ax^2 + Bx + C = 0$$
$$A(-1)^2 + B(-1) + C = 0$$
$$A - B + C = 0 \quad\quad \ldots(i)$$
$$Bx^2 + Ax + C = 0$$
$$B(-1)^2 + A(-1) + C = 0$$
$$B - A + C = 0 \quad\quad \ldots(ii)$$
Add Eqs. (i) and (ii)
$$A - B + C + B - A + C = 0$$
$$2C = 0$$
$$C = 0$$

18. The LCM of two numbers is 12 times their HCF. The sum of HCF and LCM is 403. If one of the numbers is 93, then the other number is

(a) 124   (b) 128   (c) 134   (d) 138

⊙ *(a)* Let other number be b and HCF be x.

∵   LCM $= 12x$

We have, $x + 12x = 403$

⇒ $13x = 403 \Rightarrow x = 31$

∵ Product of two numbers
          $=$ LCM $\times$ HCF

⇒ $93 \times b = x \times 12x$

⇒ $93 \times b = 12 \times 31 \times 31$

∴ $b = 124$

2015 (I)

19. The HCF and LCM of two polynomials are $(x + y)$ and $(3x^5 + 5x^4 y + 2x^3 y^2 - 3x^2 y^3 - 5xy^4 - 2y^5)$,

respectively. If one of the polynomials is $(x^2 - y^2)$, then the other polynomial is

(a) $3x^4 - 8x^3 y + 10x^2 y^2 + 7xy^3 - 2y^4$
(b) $3x^4 - 8x^3 y - 10x^2 y^2 + 7xy^3 + 2y^4$
(c) $3x^4 + 8x^3 y + 10x^2 y^2 + 7xy^3 + 2y^4$
(d) $3x^4 + 8x^3 y - 10x^2 y^2 + 7xy^3 + 2y^4$

⊙ *(c)* Given, HCF $= (x + y)$

and LCM
$= 3x^5 + 5x^4 y + 2x^3 y^2 - 3x^2 y^3 - 5xy^4 - 2y^5$
$= 3x^5 - 3x^2 y^3 + 5x^4 y - 5xy^4 + 2x^3 y^2 - 2y^5$
$= 3x^2(x^3 - y^3) + 5xy(x^3 - y^3) + 2y^2(x^3 - y^3)$
$= (3x^2 + 5xy + 2y^2)(x^3 - y^3)$

and first polynomial
      $= x^2 - y^2 = (x - y)(x + y)$

We know that, first polynomial × second polynomial = HCF × LCM

∴ Second polynomial

$= \dfrac{(x + y)(x^3 - y^3)(3x^2 + 5xy + 2y^2)}{(x - y)(x + y)}$

$= \dfrac{(x - y)(x^2 + y^2 + xy)(3x^2 + 5xy + 2y^2)}{(x - y)}$

    $\{\because a^3 - b^3 = (a - b)(a^2 + b^2 + ab)\}$

$= (x^2 + y^2 + xy)(3x^2 + 5xy + 2y^2)$
$= 3x^4 + 5x^3 y + 2x^2 y^2 + 3x^2 y^2 + 5xy^3 + 2y^4$
              $+ 3x^3 y + 5x^2 y^2 + 2xy^3$
$= 3x^4 + 8x^3 y + 10x^2 y^2 + 7xy^3 + 2y^4$

2014 (II)

20. What is the lowest common multiple of $ab(x^2 + 1) + x(a^2 + b^2)$ and $ab(x^2 - 1) + x(a^2 - b^2)$?

(a) $(a^2 x^2 - b^2)(a + bx)$
(b) $(a^2 x^2 - b^2)(a + bx)^2$
(c) $(a^2 x^2 - b^2)(a - bx)$
(d) $(a^2 x^2 - b^2)(a - bx)^2$

⊙ *(a)* We have,
$ab(x^2 + 1) + x(a^2 + b^2)$
    $= abx^2 + ab + a^2 x + b^2 x$
    $= ax(a + bx) + b(a + bx)$
    $= (a + bx)(ax + b)$
and $ab(x^2 - 1) + x(a^2 - b^2)$
    $= abx^2 - ab + a^2 x - b^2 x$
    $= ax(a + bx) - b(a + bx)$
    $= (a + bx)(ax - b)$
∴ Lowest common multiple
    $= (a + bx)(ax + b)(ax - b)$
    $= (a + bx)(a^2 x^2 - b^2)$

21. The LCM of two integers is 1237. What is their HCF?

(a) 37
(b) 19
(c) 1
(d) Cannot be determined

⊙ *(c)* Given, LCM of two integers is 1237, which is a prime number.
So, their HCF is 1.

22. There are 48 cricket balls, 72 hockey balls and 84 tennis balls and they have to be arranged in several rows in such a way that every row contains the same number of balls of one type. What is the minimum number of rows required for this to happen?

(a) 12   (b) 16   (c) 17   (d)19

⊙ *(c)* Given number of cricket balls
           $= 48 = 2^4 \times 3$
  Number of hockey balls
           $= 72 = 2^3 \times 3^2$
and number of tennis balls
           $= 84 = 2^2 \times 3 \times 7$
∴ HCF of 48, 72 and 84 $= 2^2 \times 3 = 12$
Now, minimum number of rows
        $= \dfrac{48}{12} + \dfrac{72}{12} + \dfrac{84}{12}$
        $= 4 + 6 + 7 = 17$

23. The HCF of two natural numbers m and n is 24 and their product is 552. How many sets of values of m and n are possible?

(a) 1   (b) 2   (c) 4
(d) No set of m and n is possible satisfying the given conditions

⊙ *(d)* Given HCF of two natural numbers m and $n = 24$
and their product, $m \times n = 552$
LCM of two natural numbers
  $= \dfrac{\text{Product of } m \text{ and } n}{\text{HCF of } m \text{ and } n} = \dfrac{552}{24} = 23$
Here, no set of m and n is possible satisfying the given conditions.

24. What is the highest common factor of $2x^3 + x^2 - x - 2$ and $3x^3 - 2x^2 + x - 2$?

(a) $x - 1$ (b) $x + 1$ (c) $2x + 1$ (d) $2x - 1$

⊙ *(a)* Let $f(x) = 2x^3 + x^2 - x - 2$
           $= (x - 1)(2x^2 + 3x + 2)$
and $g(x) = 3x^3 - 2x^2 + x - 2$
           $= (x - 1)(3x^2 + x + 2)$
Hence, the highest common factor of $f(x)$ and $g(x)$ is $(x - 1)$.

25. The LCM of two numbers is 90 times their HCF. The sum of LCM and HCF is 1456. If one of the numbers is 160, then what is the other number?

(a) 120   (b) 136
(c) 144   (d) 184

⊙ **(c)** Let the HCF of two numbers be x.
∴   LCM of two numbers be $90x$.
According to the question,
     LCM + HCF = 1456
∴ $90x + x = 1456$
⇒ $91x = 1456$
⇒ $x = 16$
∴ HCF of two numbers = 16
and LCM of two numbers = 90×16
                  = 1440
We know that,
   LCM × HCF = Product of two numbers
⇒ $1440 \times 16 = 160 \times$ Second number
∴ Second number $= \dfrac{1440 \times 16}{160} = 144$

2014 (I)

26. What is the number of integral solutions of the equations HCF $(a, b) = 5$ and $a + b = 65$?

(a) None
(b) Infinitely many
(c) Less than 65
(d) Exactly one

⊙ **(c)** ∵ HCF $(a, b) = 5$

Let $a = 5x$
and $b = 5y$
∴ $5x + 5y = 65$
⇒ $x + y = 13$
∴ Number of pairs of $(x, y) = (1, 12)$,
(2, 11), (3, 10), (4, 9), (5, 8), (6, 7)

[(12, 1), (11, 2), (10, 3), (9, 4), (8, 5), (7, 6)]

Hence, number of solutions is less than 65.

27. If a and b are positive integers, then what is HCF
$$\left(\frac{a}{\text{HCF}(a,b)} , \frac{b}{\text{HCF}(a,b)} \right) \text{equal to}$$

(a) a (b) b
(c) 1   (d) $\dfrac{a}{\text{HCF}(a, b)}$

⊙ **(c)** HCF $\left(\dfrac{a}{\text{HCF}(a,b)}, \dfrac{b}{\text{HCF}(a,b)} \right)$ is always equal to 1.

Illustration 1 Let the two positive integers be $a = 24$ and $b = 36$.
∴ HCF $\left(\dfrac{24}{\text{HCF}(24, 36)}, \dfrac{36}{\text{HCF}(24, 36)} \right)$
    = HCF $\left(\dfrac{24}{12}, \dfrac{36}{12} \right)$
    = HCF (2, 3) = 1

Illustration 2 Let the two positive integers be $a = 13$ and $b = 17$.
∴ HCF $\left(\dfrac{13}{\text{HCF}(13, 17)}, \dfrac{17}{\text{HCF}(13, 17)} \right)$
         = HCF $\left(\dfrac{13}{1}, \dfrac{17}{1} \right) = 1$

28. For any integers 'a' and 'b' with HCF$(a, b) = 1$, what is HCF
$(a + b, a - b)$ equal to?

(a) It is always 1
(b) It is always 2
(c) Either 1 or 2
(d) None of these

⊙ **(c)** HCF $(a + b, a - b)$ is either 1 or 2

Illustration 1. Let $a = 8$ and $b = 9$.
∴ HCF $(8 + 9, 9 - 8) =$ HCF $(17, 1) = 1$
Illustration 2. Let $a = 17$ and $b = 23$.
∴ HCF $(17 + 23, 23 - 17)$
            = HCF (40, 6) = 2

29. For any integer n, what is HCF $(22n + 7, 33n + 10)$ equal to?

(a) n
(b) 1
(c) 11
(d) None of the above

(b) Apply Euclidean algorithm on
$(22n + 7, 33n + 10)$,
Here, $33n + 10 > 22n + 7$
∴ $33n + 10 = (22n + 7) \times 1 + (11n + 3)$
$22n + 7 = (11n + 3) \times 2 + 1$
$11n + 3 = (11n + 3) \times 1 + 0$
∴ 1 is HCF of $(22n + 7, 33n + 10)$

30. In a fire range, 4 shooters are firing at their respective targets. The first, the second, the third and the fourth shooters hit the target once in every 5 s, 6 s, 7 s and 8 s, respectively. If all of them hit their target at 9 : 00 am, when will they hit their target together again?

(a) 9 : 04 am   (b) 9 : 08 am
(c) 9 : 14 am   (d) None of these

⊙ **(c)** Time after which they will hit the target again together
                = LCM (5, 6, 7 and 8)

   2 | 5, 6, 7, 8
      | 5, 3, 7, 4

                $= 5 \times 3 \times 7 \times 2 \times 4$
                = 840 s
They will hit target together
                $= \dfrac{840}{60} = 14$ min
So, they will hit together again at 9 : 14 am.

31. What is the HCF of $8(x^5 - x^3 + x)$ and $28 (x^6 + 1)$?

(a) $4(x^4 - x^2 + 1)$
(b) $2 (x^4 - x^2 + 1)$
(c) $(x^4 - x^2 + 1)$
(d) None of these

⊙ **(a)** Let $p(x) = 8(x^5 - x^3 + x)$
              $= 4 \times 2 \times x(x^4 - x^2 + 1)$
and $q(x) = 28(x^6 + 1)$
              $= 7 \times 4[(x^2)^3 + (1)^3]$
              $= 4 \times 7 \times (x^2 + 1)(x^4 - x^2 + 1)$
     $[∵ a^3 + b^3 = (a + b)(a^2 - ab + b^2)]$
∴ HCF of $p(x)$ and $q(x) = 4(x^4 - x^2 + 1)$

4

SQUARE ROOTS AND SURDS

1. Given y is inversely proportional to $\sqrt{x}$, and $x = 36$ when $y = 36$. What is the value of x when $y = 54$?

(a) 54   (b) 27   (c) 16   (d) 8

▶ **(c)** According to the question,

$$y \propto \frac{1}{\sqrt{x}}$$

$$y = \frac{k}{\sqrt{x}}$$

$$x = 36, \ y = 36$$

$$\Rightarrow \quad 36 = \frac{k}{\sqrt{36}} \Rightarrow k = 216$$

Now, $y = 54, \ k = 216$

$$54 = \frac{216}{\sqrt{x}}$$

$$\therefore \quad \sqrt{x} = 4 \Rightarrow x = 16$$

2. What is the square root of $16 + 6\sqrt{7}$?

(a) $4 + \sqrt{7}$ (b) $4 - \sqrt{7}$
(c) $3 + \sqrt{7}$ (d) $3 - \sqrt{7}$

▶ **(c)** Let $x = 16 + 6\sqrt{7}$

On square rooting both sides, we get

$$\sqrt{x} = \sqrt{16 + 6\sqrt{7}} = \sqrt{9 + 7 + 2 \times 3 \times \sqrt{7}}$$

$$= \sqrt{(3)^2 + (\sqrt{7})^2 + 2 \times 3 \times \sqrt{7}}$$

$$= \sqrt{(3 + \sqrt{7})^2}$$

$$[\because (a + b)^2 = a^2 + b^2 + 2ab]$$

$$\sqrt{x} = 3 + \sqrt{7}$$

3. If $a = \sqrt{7 + 4\sqrt{3}}$, then what is the value of $a + \dfrac{1}{a}$?

(a) 2   (b) 3   (c) 4   (d) 7

▶ **(c)** $a = \sqrt{7 + 4\sqrt{3}}$

$$= \sqrt{4 + 3 + 2 \times 2\sqrt{3}}$$

$$= \sqrt{2^2 + (\sqrt{3})^2 + 2 \times 2 \times \sqrt{3}}$$

$$= \sqrt{(2 + \sqrt{3})^2}$$

$$[\because (a + b)^2 = a^2 + b^2 + 2ab]$$

$$a = 2 + \sqrt{3}$$

So, $\dfrac{1}{a} = \dfrac{1}{2 + \sqrt{3}}$

$$\frac{1}{a} = \frac{1}{2 + \sqrt{3}} \times \frac{2 - \sqrt{3}}{2 - \sqrt{3}}$$

$$\frac{1}{a} = \frac{2 - \sqrt{3}}{4 - 3} = 2 - \sqrt{3}$$

Now, $a + \dfrac{1}{a} = 2 + \sqrt{3} + 2 - \sqrt{3} = 4$

4. Suppose n is a positive integer such that $(n^2 + 48)$ is a perfect square. What is the number of such n?

(a) One   (b) Two   (c) Three (d) Four

▶ **(c)** $x = \sqrt{n^2 + 48}$

On squaring both side, we get

$$x^2 = n^2 + 48$$

$$x^2 - n^2 = 48$$

$$(x - n)(x + n) = 48$$

n is an integer

$x - n$	$x + n$
2	24
4	12
6	8

Option (c) is correct.

5. For $x = \dfrac{4\sqrt{6}}{\sqrt{2} + \sqrt{3}}$, what is the value of $\dfrac{x + 2\sqrt{2}}{x - 2\sqrt{2}} + \dfrac{x + 2\sqrt{3}}{x - 2\sqrt{3}} = ?$

(a) 1   (b) $\sqrt{2}$ (c) $\sqrt{3}$ (d) 2

▶ **(d)**

$$x = \frac{4\sqrt{6}}{\sqrt{2} + \sqrt{3}}$$

$$x = 4\sqrt{6}(\sqrt{3} - \sqrt{2})$$

$$\frac{x + 2\sqrt{2}}{x - 2\sqrt{2}} + \frac{x + 2\sqrt{3}}{x - 2\sqrt{3}}$$

[divided by $\sqrt{2}$ and divided by $\sqrt{3}$]

$$= \frac{\dfrac{x}{\sqrt{2}} + 2}{\dfrac{x}{\sqrt{2}} - 2} + \frac{\dfrac{x}{\sqrt{3}} + 2}{\dfrac{x}{\sqrt{3}} - 2}$$

$$= \frac{\dfrac{4\sqrt{6}}{\sqrt{2}}(\sqrt{3} - \sqrt{2}) + 2}{\dfrac{4\sqrt{6}}{\sqrt{2}}(\sqrt{3} - \sqrt{2}) - 2} + \frac{\dfrac{4\sqrt{6}}{\sqrt{3}}(\sqrt{3} - \sqrt{2}) + 2}{\dfrac{4\sqrt{6}}{\sqrt{3}}(\sqrt{3} - \sqrt{2}) - 2}$$

$$= \frac{4\sqrt{3}(\sqrt{3} - \sqrt{2}) + 2}{4\sqrt{3}(\sqrt{3} - \sqrt{2}) - 2} + \frac{4\sqrt{2}(\sqrt{3} - \sqrt{2}) + 2}{4\sqrt{2}(\sqrt{3} - \sqrt{2}) - 2}$$

$$= \frac{4 \times 3 - 4\sqrt{6} + 2}{4 \times 3 - 4\sqrt{6} - 2} + \frac{4\sqrt{6} - 8 + 2}{4\sqrt{6} - 8 - 2}$$

$$= \frac{14 - 4\sqrt{6}}{10 - 4\sqrt{6}} + \frac{4\sqrt{6} - 6}{4\sqrt{6} - 10}$$

$$= \frac{7 - 2\sqrt{6}}{5 - 2\sqrt{6}} + \frac{3 - 2\sqrt{6}}{5 - 2\sqrt{6}}$$

[negative sign common in both]

$$= \frac{10 - 4\sqrt{6}}{5 - 2\sqrt{6}} = \frac{2(5 - 2\sqrt{6})}{5 - 2\sqrt{6}} = 2$$

Option (d) is correct.

6. For any two real numbers a and b, $\sqrt{(a - b)^2} + \sqrt{(b - a)^2}$ is

(a) always zero
(b) never zero
(c) positive only if $a \ne b$
(d) positive if and only if $a > b$

▶ **(c)** a and b are any two real numbers.

$$a = 3, \ b = 2$$

$$\sqrt{(a - b)^2} + \sqrt{(b - a)^2}$$

$$= \sqrt{(3 - 2)^2} + \sqrt{(2 - 3)^2}$$

$$= \sqrt{(1)^2} + \sqrt{(-1)^2} = 1 + 1 = 2$$

positive only if $a \ne b$

Option (c) is correct.

7. What is the value of

$$2 + \sqrt{2 + \sqrt{2 + \sqrt{\ldots\ldots}}}?$$

(a) 1   (b) 2
(c) 3   (d) 4

⟩ **(d)** $x = 2 + \sqrt{2 + \sqrt{2 + \sqrt{\ldots\ldots}}}?$

$$y = \sqrt{2 + \sqrt{2 + \sqrt{2 \ldots}}}$$

On squaring both sides, we get

$$y^2 = 2 + \sqrt{2 + \sqrt{2\ldots}}$$
$$y^2 = 2 + y$$
$$y^2 - y - 2 = 0$$
$$y^2 - 2y + y - 2 = 0$$
$$y(y - 2) + 1(y - 2) = 0$$
$$(y + 1)(y - 2) = 0$$
$$y = 2, -1$$

($y = -1$) not possible because all terms in equation are positive.

$$y = 2$$
$$x = 2 + y$$
$$x = 2 + 2 = 4$$

Option (d) is correct.

8. The expression $5^{2n} - 2^{3n}$ has a factor

(a) 3   (b) 7
(c) 17   (d) None of these

⟩ **(c)** $5^{2n} - 2^{3n}$ has a factor,

Let $n = 1$
$\Rightarrow 5^2 - 2^3 = 25 - 8 = 17$
17 is factor of $5^{2n} - 2^{3n}$

Option (c) is correct.

2018 (I)

9. What is the value of

$$\frac{\sqrt{5} - \sqrt{3}}{\sqrt{5} + \sqrt{3}} - \frac{\sqrt{5} + \sqrt{3}}{\sqrt{5} - \sqrt{3}}$$

(a) $-2\sqrt{15}$ (b) $2\sqrt{15}$
(c) $\sqrt{15}$ (d) $-\sqrt{15}$

⟩ **(a)** $\dfrac{\sqrt{5} - \sqrt{3}}{\sqrt{5} + \sqrt{3}} - \dfrac{\sqrt{5} + \sqrt{3}}{\sqrt{5} - \sqrt{3}}$

$$= \frac{(\sqrt{5} - \sqrt{3})^2 - (\sqrt{5} + \sqrt{3})^2}{(\sqrt{5})^2 - (\sqrt{3})^2}$$

$$[\because (a + b)(a - b) = a^2 - b^2]$$

$$= \frac{(5 + 3 - 2\sqrt{15}) - (5 + 3 + 2\sqrt{15})}{5 - 3}$$

$$\left[\begin{array}{l} \because \quad (a+b)^2 = a^2 + 2ab + b^2 \\ \text{and} \quad (a - b)^2 = a^2 - 2ab + b^2 \end{array} \right]$$

$$= \frac{8 - 2\sqrt{15} - 8 - 2\sqrt{15}}{2}$$

$$= \frac{-4\sqrt{15}}{2} = -2\sqrt{15}$$

2017 (II)

10. The value of $\sqrt{1 + \sqrt{1 + \sqrt{1 + \ldots}}}$

(a) equals to 1
(b) lies between 0 and 1
(c) lies between 1 and 2
(d) is greater than 2

⟩ **(c)** Let $y = \sqrt{1 + \sqrt{1 + \sqrt{1 + \ldots}}}$

Then, $y = \sqrt{1 + y}$ also, $y > 0$
On squaring both sides, we get

$$y^2 = 1 + y$$
$$\Rightarrow \quad y^2 - y - 1 = 0$$
$$\Rightarrow \quad y = \frac{1 \pm \sqrt{1 + 4}}{2}$$
$$\Rightarrow \quad y = \frac{1 \pm \sqrt{5}}{2}$$

$\because$ y cannot be negative

$$\therefore \quad y = \frac{1 + \sqrt{5}}{2}$$

$\therefore$ y lies between 1 and 2.

2017 (I)

11. What is $\sqrt{\dfrac{0.064 \times 6.25}{0.081 \times 4.84}}$ equal to?

(a) $\dfrac{10}{99}$ (b) $\dfrac{100}{99}$ (c) 9   (d) 99

⟩ **(b)** $\sqrt{\dfrac{0.064 \times 6.25}{0.081 \times 4.84}}$

$$= \sqrt{\frac{64 \times 10^{-3} \times 625 \times 10^{-2}}{81 \times 10^{-3} \times 484 \times 10^{-2}}}$$

$$= \sqrt{\frac{64 \times 625}{81 \times 484}} = \frac{8 \times 25}{9 \times 22} = \frac{100}{99}$$

12. What is the square root of
$$\frac{(0.35)^2 + 0.70 + 1}{2.25} + 0.19 ?$$

(a) 1   (b) 2   (c) 3   (d) 4

⟩ **(a)** Let $y = \dfrac{(0.35)^2 + 0.70 + 1}{2.25} + 0.19$

$$= \frac{(0.35)^2 + 2 \times 0.35 \times 1 + (1)^2}{(1.5)^2} + 0.19$$

$$= \frac{(0.35 + 1)^2}{(1.5)^2} + 0.19$$

$$\{\because (a + b)^2 = a^2 + b^2 + 2ab\}$$

$$= \left(\frac{1.35}{1.5}\right)^2 + 0.19$$

$$= (0.9)^2 + 0.19 = 0.81 + 0.19 = 1$$

$$\therefore \quad \sqrt{y} = \sqrt{1} = 1$$

13. What is the value of $\sqrt[3]{4\dfrac{12}{125}}$?

(a) $1\dfrac{3}{5}$ (b) $1\dfrac{2}{5}$ (c) $1\dfrac{4}{5}$ (d) $2\dfrac{2}{5}$

⟩ **(a)** $\sqrt[3]{4\dfrac{12}{125}} = \sqrt[3]{\dfrac{4 \times 125 + 12}{125}}$

$$= \sqrt[3]{\frac{500 + 12}{125}} = \sqrt[3]{\frac{512}{125}}$$

$$= \sqrt[3]{\left(\frac{8}{5}\right)^3} = \left[\left(\frac{8}{5}\right)^3\right]^{\frac{1}{3}}$$

$$= \left(\frac{8}{5}\right)^{3 \times \frac{1}{3}} = \frac{8}{5} = 1\frac{3}{5}$$

2016 (II)

14. What is $\dfrac{6^2 + 7^2 + 8^2 + 9^2 + 10^2}{\sqrt{7 + 4\sqrt{3}} - \sqrt{4 + 2\sqrt{3}}}$ equal to?

(a) 330   (b) 340
(c) 355   (d) 366

⟩ **(a)** Given, $\dfrac{6^2 + 7^2 + 8^2 + 9^2 + 10^2}{\sqrt{7 + 4\sqrt{3}} - \sqrt{4 + 2\sqrt{3}}}$

$$= \frac{36 + 49 + 64 + 81 + 100}{\sqrt{3 + 4 + 2 \times 2 \times \sqrt{3}} - \sqrt{1 + 3 + 2 \times 1 \times \sqrt{3}}}$$

$$= \frac{330}{\sqrt{(\sqrt{3})^2 + 2^2 + 2 \times 2 \times \sqrt{3}}} $$
$$\quad - \sqrt{1^2 + (\sqrt{3})^2 + 2 \times 1 \times \sqrt{3}}$$

$$= \frac{330}{\sqrt{(\sqrt{3} + 2)^2} - \sqrt{(1 + \sqrt{3})^2}}$$

$$= \frac{330}{\sqrt{3} + 2 - 1 - \sqrt{3}} = \frac{330}{2 - 1}$$

$$= \frac{330}{1} = 330$$

15. What is

$$\sqrt{1 + \frac{1}{1^2} + \frac{1}{2^2}} + \sqrt{1 + \frac{1}{2^2} + \frac{1}{3^2}} + \ldots +$$
$$\sqrt{1 + \frac{1}{2007^2} + \frac{1}{2008^2}} \text{ equal to?}$$

(a) $2008 - \dfrac{1}{2008}$ (b) $2007 - \dfrac{1}{2007}$

(c) $2007 - \dfrac{1}{2008}$ (d) $2008 - \dfrac{1}{2009}$

⟩ **(a)** Let
$$S = \sqrt{1 + \frac{1}{1^2} + \frac{1}{2^2}} + \sqrt{1 + \frac{1}{2^2} + \frac{1}{3^2}}$$
$$+ \ldots + \sqrt{1 + \frac{1}{(2007)^2} + \frac{1}{(2008)^2}}$$

$$\therefore a_n = \sqrt{1 + \frac{1}{n^2} + \frac{1}{(n + 1)^2}}$$

$$= \sqrt{\frac{(n + 1)^2 n^2 + (n + 1)^2 + n^2}{n^2 (n + 1)^2}}$$

$$= \sqrt{\frac{(n + 1)^2 n^2 + n^2 + 2n + 1 + n^2}{n^2 (n + 1)^2}}$$

$$= \sqrt{\frac{[n(n + 1)]^2 + 2n(n + 1) + 1}{[n(n + 1)]^2}}$$

$$= \sqrt{\frac{[n(n+1)+1]^2}{[n(n+1)]^2}}$$

$$\because a^2 + 2ab + b^2 = (a+b)^2$$

$$= \frac{n(n+1)+1}{n(n+1)}$$

$$= 1 + \frac{1}{n(n+1)} = 1 + \frac{1}{n} - \frac{1}{n+1}$$

$$\therefore S = \left(1 + 1 - \frac{1}{2}\right) + \left(1 + \frac{1}{2} - \frac{1}{3}\right) + \ldots +$$

$$\left(1 + \frac{1}{2007} - \frac{1}{2008}\right) = 2008 - \frac{1}{2008}$$

2016 (I)

16. If $x = \dfrac{\sqrt{a+2b} + \sqrt{a-2b}}{\sqrt{a+2b} - \sqrt{a-2b}}$, then $bx^2 - ax + b$ is equal to (given that, $b \neq 0$)

(a) 0　　(b) 1　　(c) ab　　(d) $2ab$

⊙ **(a)** Given, $x = \dfrac{\sqrt{a+2b} + \sqrt{a-2b}}{\sqrt{a+2b} - \sqrt{a-2b}}$

By rationalising, we get

$$x = \frac{\sqrt{a+2b} + \sqrt{a-2b}}{\sqrt{a+2b} - \sqrt{a-2b}}$$

$$\times \frac{\sqrt{a+2b} + \sqrt{a-2b}}{\sqrt{a+2b} + \sqrt{a-2b}}$$

$$\Rightarrow x = \frac{(\sqrt{a+2b} + \sqrt{a-2b})^2}{(\sqrt{a+2b})^2 - (\sqrt{a-2b})^2}$$

$$\Rightarrow \qquad (2bx - a) = \sqrt{a^2 - 4b^2}$$

$$\Rightarrow \qquad (2bx - a)^2 = (\sqrt{a^2 - 4b^2})^2$$

$$\Rightarrow 4b^2 x^2 + a^2 - 4abx = a^2 - 4b^2$$

$$\Rightarrow \quad 4b^2 x^2 - 4abx = -4b^2$$

$$\Rightarrow \qquad bx^2 - ax = -b$$

$$\therefore \qquad bx^2 - ax + b = 0$$

2015 (II)

17. If $x = \sqrt{3} + \sqrt{2}$, then the value of $x^3 + x + \dfrac{1}{x} + \dfrac{1}{x^3}$ is

(a) $10\sqrt{3}$　(b) $20\sqrt{3}$　(c) $10\sqrt{2}$　(d) $20\sqrt{2}$

⊙ **(b)** We have,

$$x = \sqrt{3} + \sqrt{2}$$

and　$\dfrac{1}{x} = \dfrac{1}{\sqrt{3}+\sqrt{2}} \times \dfrac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}}$

$$= \frac{\sqrt{3}-\sqrt{2}}{3-2} = \sqrt{3} - \sqrt{2}$$

$$\therefore \quad x + \frac{1}{x} = \sqrt{3} + \sqrt{2} + \sqrt{3} - \sqrt{2} = 2\sqrt{3}$$

…(i)

On cubing both sides, we get

$$\left(x + \frac{1}{x}\right)^3 = (2\sqrt{3})^3$$

$$x^3 + \frac{1}{x^3} + 3\left(x + \frac{1}{x}\right) = 24\sqrt{3}$$

$$\{\because (a+b)^3 = a^3 + b^3 + 3ab(a+b)\}$$

$$\therefore \quad x^3 + \frac{1}{x^3} + x + \frac{1}{x}$$

$$= 24\sqrt{3} - 2\left(x + \frac{1}{x}\right)$$

$$= 24\sqrt{3} - 2 \times 2\sqrt{3}$$

[from Eq. (i)]

$$= 24\sqrt{3} - 4\sqrt{3} = 20\sqrt{3}$$

18. Which one of the following is correct?

(a) $\sqrt{2} < \sqrt[4]{6} < \sqrt[3]{4}$
(b) $\sqrt{2} > \sqrt[4]{6} > \sqrt[3]{4}$
(c) $\sqrt[4]{6} < \sqrt{2} < \sqrt[3]{4}$
(d) $\sqrt[4]{6} > \sqrt{2} > \sqrt[3]{4}$

⊙ **(a)** We have, $2^{\frac{1}{2}}, 6^{\frac{1}{4}}, 4^{\frac{1}{3}}$

The LCM of 2, 4, 3 are 12.

$$(2)^{\frac{12}{2\times 12}}; (6)^{\frac{12}{4\times 12}}; (4)^{\frac{12}{3\times 12}}$$

$$(2^6)^{\frac{1}{12}}; (6^3)^{\frac{1}{12}}; (4^4)^{\frac{1}{12}}$$

$$(64)^{\frac{1}{12}}; (216)^{\frac{1}{12}}; (256)^{\frac{1}{12}}$$

$$2^{\frac{1}{2}} < 6^{\frac{1}{4}} < 4^{\frac{1}{3}}$$

$$\therefore \qquad \sqrt{2} < \sqrt[4]{6} < \sqrt[3]{4}$$

2015 (I)

19. What is

$$\frac{5 + \sqrt{10}}{5\sqrt{5} - 2\sqrt{20} - \sqrt{32} + \sqrt{50}}$$ equal to?

(a) 5　　　　　　(b) $5\sqrt{2}$
(c) $5\sqrt{5}$　　　　(d) $\sqrt{5}$

⊙ **(d)** $\dfrac{5+\sqrt{10}}{5\sqrt{5} - 2\sqrt{20} - \sqrt{32} + \sqrt{50}}$

$$= \frac{5+\sqrt{10}}{5\sqrt{5} - 4\sqrt{5} - 4\sqrt{2} + 5\sqrt{2}}$$

$$= \frac{(5+\sqrt{10})}{(\sqrt{5} + \sqrt{2})}$$

$$= \frac{\sqrt{5}(\sqrt{5} + \sqrt{2})}{(\sqrt{5} + \sqrt{2})}$$

$$= \sqrt{5}$$

20. The square root of

$$\frac{(0.75)^3}{1 - 0.75} + [0.75 + (0.75)^2 + 1] \text{ is}$$

(a) 1　　(b) 2　　(c) 3　　(d) 4

⊙ **(b)** $= \dfrac{(0.75)^3}{(1-0.75)} + (0.75 + (0.75)^2 + 1)$

$$= \frac{(0.75)^3 + (1-0.75)(0.75 + (0.75)^2 + 1)}{(1-0.75)}$$

$$= \frac{(0.75)^3 + [1^3 - (0.75)^3]}{1 - 0.75}$$

$$[\because (a-b)(a^2 + ab + b^2) = a^3 - b^3]$$

$$= \frac{1}{0.25} = 4$$

then, square root $= \sqrt{4} = 2$

21. When a ball bounces, it rises to $\dfrac{2}{3}$ of the height from which it fell. If the ball is dropped from a height of 36 m, then how high will it rise at the third bounce?

(a) $10\dfrac{1}{3}$ m　　　　(b) $10\dfrac{2}{3}$ m

(c) $12\dfrac{1}{3}$ m　　　　(d) $12\dfrac{2}{3}$ m

⊙ **(b)** After first bounce, height of ball

$$= \left(\frac{2}{3}\right)^1 \times 36$$

and after third bounce, height of ball

$$= \left(\frac{2}{3}\right)^3 \times 36 = \frac{8}{27} \times 36$$

$$= \frac{8 \times 4}{3} = \frac{32}{3} \text{ m} = 10\frac{2}{3} \text{ m}$$

Hence, the required height at third bounce is $10\dfrac{2}{3}$ m.

2014 (I)

22. Consider the following in respect of the numbers $\sqrt{2}, \sqrt[3]{3}$ and $\sqrt[6]{6}$

I. $\sqrt[6]{6}$ is the greatest number.
II. $\sqrt{2}$ is the smallest number.

Which of the above statement(s) is/are correct?

(a) Only I
(b) Only II
(c) Both I and II
(d) Neither I nor II

⊙ **(d)** $\sqrt{2}, \sqrt[3]{3}, \sqrt[6]{6}$

Taking LCM of 2, 3 and 6 = 12

Now, $\sqrt{2} = (2)^{1/2} = (2)^{6/12} = \sqrt[12]{2^6} = \sqrt[12]{64}$

$$\sqrt[3]{3} = (3)^{1/3} = (3)^{4/12} = \sqrt[12]{3^4} = \sqrt[12]{81}$$

$$\sqrt[6]{6} = (6)^{1/6} = (6)^{2/12} = \sqrt[12]{6^2} = \sqrt[12]{36}$$

So, neither I nor II are correct.

5

SPEED, TIME AND DISTANCE

1. It takes 11 h for a 600 km journey if 120 km is done by train and the rest by car. It takes 40 min more if 200 km are covered by train and the rest by car. What is the ratio of speed of the car to that of the train?

(a) 3 : 2 (b) 2 : 3
(c) 3 : 4 (d) 4 : 3

⊙ *(a)* Let the speed of train be x km/h and car y km/h.

According to the question,

$$\frac{120}{x} + \frac{480}{y} = 11 \qquad \ldots(i)$$

$$\frac{200}{x} + \frac{400}{y} = 11\frac{2}{3} \qquad \ldots(ii)$$

To multiply Eq. (i) by 5 and Eq. (ii) by 3, and subtracting, we get

$$\frac{600}{x} + \frac{2400}{y} - \frac{600}{x} - \frac{1200}{y} = 55 - 35$$

$$\frac{1200}{y} = 20$$

$$\Rightarrow \qquad y = 60 \text{ km/h}$$

On putting $y = 60$ in Eq. (i), we get

$$\frac{120}{x} + \frac{480}{60} = 11$$

$$\Rightarrow \qquad \frac{120}{x} = 11 - 8$$

$$x = 40 \text{ km/hr}$$

$$\therefore \quad \text{Required ratio} = \frac{y}{x} = \frac{60}{40}$$

$$= \frac{3}{2} = 3 : 2$$

2. Three cars A, B and C started from a point at 5 pm, 6 pm and 7 pm, respectively and travelled at uniform speeds of 60 km/h, 80 km/h and x km/h, respectively in the same direction. If all the three meet at another point at the same instant during their journey, then what is the value of x?

(a) 120 (b) 110 (c) 105 (d) 100

⊙ *(a)* Speed of car A = 60 km/h
    Speed of car B = 80 km/h
    Speed of car C = x km/h

```
├────────┼────────┤
M        N        Z
```
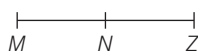
Cars A, B and C started from a point (M)
Car A started at 5 pm from point M
distance coverd by car A in 1h = speed × time = $60 \times 1 = 60$ km
Then, distance between point M and N
    = 60 km
Car B started at 6 pm from point (M)
In same direction
Relative speed of car A and car B
    = 80 − 60 = 20 km/h
Time taken by car B meet to car A

$$= \frac{60}{20} = 3\text{h}$$

$$\left[\because \text{Time} = \frac{\text{Distance}}{\text{Speed}} \right]$$

After three hour car B meet car A at point Z at 9 : 00 pm.

The distance of M to Z
    = 3 × 80 = 240 km
Car C started at 7 : 00 pm
        [from point (M)]
Car C has to travel 240 km in 2 h to meet car A and car B.

$$\text{Speed of car } C = \frac{240}{2} = 120 \text{ km/h}$$

Option (a) is correct.

$$\left[\because \text{Speed} = \frac{\text{Distance}}{\text{Time}} \right]$$

3. Radha and Hema are neighbours and study in the same school. Both of them use bicycles to go to the school. Radha's speed is 8 km/h whereas Hema's speed is 10 km/h. Hema takes 9 min less than Radha to reach the school. How far is the school from the locality of Radha and Hema?

(a) 5 km (b) 5.5 km
(c) 6 km (d) 6.5 km

⊙ *(c)* Radha's speed = 8 km/h
    Hema's speed = 10 km/h
Let the distance of the school from the locality of Radha and Hema = x km
According to the question,

$$\frac{x}{8} - \frac{x}{10} = \frac{9}{60} \quad \left[\because \text{Time} = \frac{\text{Distance}}{\text{Speed}} \right]$$

$$\frac{10x - 8x}{8 \times 10} = \frac{3}{20} \quad \left[\because 1 \text{ minute} = \frac{1}{60}\text{hour} \right]$$

$$2x = 12$$

$$x = 6 \text{ km}$$

Option (c) is correct.

4. A race has three parts. The speed and time required to complete the individual parts for a runner is displayed on the following chart

	Part I	Part II	Part III
Speed (km/h)	9	8	7.5
Time (min)	50	80	100

What is the average speed of this runner?

(a) 8.17 km/h   (b) 8 km/h
(c) 7.80 km/h   (d) 7.77 km/h

◉ **(b)**

	Part I	Part II	Part III
Speed (km/h)	9	8	7.5
Time (min)	50	80	100

Distance of Part I = $9 \times \dfrac{50}{60} = \dfrac{15}{2}$ km

[∵ Distance = Speed × Time]

Distance of part II = $8 \times \dfrac{80}{60} = \dfrac{32}{3}$ km

Distance of part III = $7.5 \times \dfrac{100}{60} = \dfrac{75}{6}$ km

Total Distance = $\dfrac{15}{2} + \dfrac{32}{3} + \dfrac{75}{6}$

$= \dfrac{45 + 64 + 75}{6} = \dfrac{184}{6}$ km

Total time = 50 + 80 + 100 = 230 min

$= \dfrac{230}{60} = \dfrac{23}{6}$ h

The average speed of this runner

$= \dfrac{\text{Total Distance}}{\text{Total Time}} = \dfrac{\dfrac{184}{6}}{\dfrac{23}{6}} = \dfrac{184 \times 6}{6 \times 23}$

$= 8$ km/h

Option (b) is correct.

2018 (II)

5. A train 100 m long passes a platform 100 m long in 10 s. The speed of the train is

(a) 36 km/h   (b) 45 km/h
(c) 54 km/h   (d) 72 km/h

◉ **(d)** Given, length of train = 100 m

Length of platform = 100 m

Time taken to pass platform = 10 s

Now, distance covered by train = 100 m +100 m = 200 m

∵   Speed = $\dfrac{\text{Distance}}{\text{Time}}$

∴   Speed = $\dfrac{200}{10} = 20$ m/s

⇒ speed of train = $20 \times \dfrac{3600}{1000}$ km/h

[∵ 1 km = 1000 m, 1 h = 3600 s]

$= 72$ km/h

6. A cyclist covers his first 20 km at an average speed of 40 km/h, another 10 km at an average speed of 10 km/h and the last 30 km at an average speed of 40 km/h. Then, the average speed of the entire journey is

(a) 20 km/h   (b) 26.67 km/h
(c) 28.24 km/h   (d) 30 km/h

◉ **(b)** We know that, Time = $\dfrac{\text{Distance}}{\text{Speed}}$

Time taken by cyclist to cover first 20 km

$= \dfrac{20}{40} = \dfrac{1}{2}$ h

Time taken by cyclist to cover 10 km

$= \dfrac{10}{10} = 1$ h

And time taken by cyclist to cover remaining 30 km $= \dfrac{30}{40} = \dfrac{3}{4}$ h

Now, total distance travelled

$= (20 + 10 + 30)$ km

$= 60$ km

Total time taken = $\left(\dfrac{1}{2} + 1 + \dfrac{3}{4}\right)$ h

$= \left(\dfrac{2 + 4 + 3}{4}\right) = \dfrac{9}{4}$ h

∴ Required average speed

$= \dfrac{60}{9} \times 4 = \dfrac{80}{3}$ km/h

$= 26.67$ km/h

7. In a race of 1000 m, A beats B by 150 m, while in another race of 3000 m, C beats D by 400 m. Speed of B is equal to that of D. (Assume that A, B, C and D run with uniform speed in all the events). If A and C participate in a race of 6000 m, then which one of the following is correct?

(a) A beats C by 250 m
(b) C beats A by 250 m
(c) A beats C by 115.38 m
(d) C beats A by 115.38 m

◉ **(c)** In a race of 1000 m, A beats B 150 m

So, if A covers 1000 m, then B covers

$= 1000 - 150 = 850$ m

Similarly, if C covers 3000 m, then D covers 3000 − 400 = 2600 m

A covers 6000 m, then B covers

$= \dfrac{6000 \times 850}{1000} = 5100$ m

If D covers 5100 m, then C covers

$= \dfrac{3000 \times 5100}{2600} = 5884.62$ m

[∵ Speed of B and D is same C]

then, A covers 6000 m and covers 5884.62 m

Hence, A beats C by

$6000 - 5884.62 = 115.38$ m

8. The minute hand of a clock overtakes the hour hand after every 72 min of correct time. How much time does the clock lose or gain in a day of normal time?

(a) Lose $130\dfrac{10}{11}$ min   (b) Lose $157\dfrac{1}{11}$ min
(c) Gain $121\dfrac{9}{11}$ min   (d) Gain $157\dfrac{1}{11}$ min

◉ **(a)** As we know that in a correct clock, the minute hand gains 55 min spaces over the hour hand in 60 min

To be together again, the minute hand must gain 60 min over the hour hand.

∵ 55 min are gained in

$\left(\dfrac{60}{55} \times 60\right) = 65\dfrac{5}{11}$ min

But they are together after 72 min

∴ Lose in 72 min = $\left(72 - 65\dfrac{5}{11}\right)$ min

$= 6\dfrac{6}{11}$ min = $\dfrac{72}{11}$ min

∴   Lose in 24 h = $\left(\dfrac{72}{11} \times \dfrac{60 \times 24}{72}\right)$ min

$= \dfrac{1440}{11}$ min = $130\dfrac{10}{11}$ min

9. A thief steals a car parked in a house and goes away with a speed of 40 km/h. The theft was discovered after half an hour and immediately the owner sets off in another car with a speed of 60 km/h. When will the owner meet the thief?

(a) 55 km from the owner's house and one hour after the theft
(b) 60 km from the owner's house and 1.5 h after the theft
(c) 60 km from the owner's house and 1.5 h after the discovery of the theft
(d) 55 km from the owner's house and 1.5 h after the theft

◉ **(b)** Speed of thief = 40 km/h

Speed of owner = 60 km/h

∵   Distance = Speed × Time

∴ Distance travelled by thief in half an hour

$= 40 \times \dfrac{1}{2} = 20$ km

Now, relative speed of owner and thief
$$= (60 - 40) \text{ km/h}$$
$$= 20 \text{ km/h}$$
∴ Time taken by owner to catch thief
$$= \frac{20}{20} = 1 \text{ h}$$
Distance covered by thief after the theft
$$= 40 \times \left(1 + \frac{1}{2}\right)$$
$$= 40 \times \frac{3}{2} = 60 \text{ km}$$
∴ The owner will meet the thief at 60 km from the owner's house and 1.5 h after the theft.

2018 (I)

10. A train moving with a speed of 60 km/h crosses an electric pole in 30 s. What is the length of the train in metres?
(a) 300   (b) 400
(c) 500   (d) 600

⊙ **(c)** Speed of train = 60 km/h

Time taken to cross pole = 30 s
∵ Distance = Speed × Time
∴ Length of train = $60 \times \frac{5}{18} \times 30$
$$= 500 \text{ m}$$

11. A passenger train and a goods train are running in the same direction on parallel railway tracks. If the passenger train now takes three times as long to pass the goods train, as when they are running in opposite directions, then what is the ratio of the speed of the passenger train to that of the goods train? (Assume that the trains run at uniform speeds)
(a) 2 : 1   (b) 3 : 2   (c) 4 : 3   (d) 1 : 1

⊙ **(a)** Let the speed of passenger train be x km/h.
and speed of goods train be y km/h.
According to the question,
$$x + y = 3(x - y)$$
$$\Rightarrow \qquad x + y = 3x - 3y$$
$$\Rightarrow \qquad -2x = -4y$$
or $\qquad\qquad x = 2y$
or $\qquad\qquad \frac{x}{y} = \frac{2}{1}$
∴ Ratio of speed of passenger train to goods train = 2 : 1

12. A man can row at a speed of x km/h in still water. If in a stream which is flowing at a speed of y km/h it takes him z h to row to a place and back, then what is the distance between the two places?
(a) $\dfrac{z(x^2 - y^2)}{2y}$ (b) $\dfrac{z(x^2 - y^2)}{2x}$
(c) $\dfrac{(x^2 - y^2)}{2zx}$ (d) $\dfrac{z(x^2 - y^2)}{x}$

⊙ **(b)** Downstream speed of man
$$= (x + y) \text{ km/h}$$
Upstream speed of man
$$= (x - y) \text{ km /h}$$
Let distance between two places be D km.
According to the question,
$$\frac{D}{x + y} + \frac{D}{x - y} = z$$
$$D\left[\frac{x - y + x + y}{x^2 - y^2}\right] = z$$
$$D \times \frac{2x}{x^2 - y^2} = z$$
∴ $\qquad\qquad D = \dfrac{z(x^2 - y^2)}{2x}$

13. A car has an average speed of 60 km/h while going from Delhi to Agra and has an average speed of y km/h while returning to Delhi from Agra (by travelling the same distance). If the average speed of the car for the whole journey is 48 km/h, then what is the value of y?
(a) 30 km/h
(b) 35 km/h
(c) 40 km/h
(d) 45 km/h

⊙ **(c)** We know that, if a car travels a distance at 'a' km/h and returns at 'b' km/h, then
Average speed $= \dfrac{2ab}{a + b}$
Here, $a = 60$ km/h, $b = y$ km/h
∴ $\qquad\qquad 48 = \dfrac{2 \times 60 \times y}{60 + y}$
$\Rightarrow 48(60 + y) = 120y$
$\Rightarrow \ \ 2(60 + y) = 5y$ $\qquad$ [Divided by 24]
$\Rightarrow \quad 120 + 2y = 5y$
$\Rightarrow \qquad\qquad 3y = 120$
∴ $\qquad\qquad y = 40$ km/h

2017 (II)

14. If a train crosses a km-stone in 12 s, how long will it take to cross 91 km-stones completely if its speed is 60 km/h?
(a) 1 h 30 min   (b) 1 h 30 min 12 s
(c) 1 h 51 min   (d) 1 h 1 min 3 s

⊙ **(b)** We have, speed of train = 60 km/h

Speed of train is m/s
$$= \frac{60 \times 5}{18} \text{ m/s} = \frac{50}{3} \text{ m/s}$$
Train crosses a km stone in 12 s.
∴ Length of train = speed × time
$$= \left(\frac{50}{3} \times 12\right) \text{ m}$$
$$= 200 \text{ m} = \frac{200}{1000} = \frac{1}{5} \text{ km}$$
Total distance travelled by train completely
91 km + length of train
$$= \left(91 + \frac{1}{5}\right) \text{ km} = \frac{456}{5} \text{ km}$$
Time taken by train $= \dfrac{\text{Distance}}{\text{Speed}}$
$$= \left(\frac{456}{5 \times 60}\right) \text{ h} = \frac{456}{300} \text{ h}$$
$= 1$ hr 30 min 12 s

15. In a 100 m race, A runs at 6 km/h. If A gives B a start of 8m and still beats him by 9 s, what is the speed of B?
(a) 4.6 km/h   (b) 4.8 km/h
(c) 5.2 km/h   (d) 5.4 km/h

⊙ **(b)** Speed of A = 6 km/h

Speed of A in m/s $= \dfrac{6 \times 5}{18} = \dfrac{5}{3}$ m/s
Time taken by A in 100 m race
$$= \frac{100}{5/3} = 60 \text{ s}$$
$$\left[\because \text{Time} = \frac{\text{Distance}}{\text{Speed}}\right]$$
Let speed of B = x m/s
Time taken by B in $(100 - 8)$ m race
$$= \frac{92}{x} \text{ second}$$
According to the question,
$$\frac{92}{x} - 60 = 9, \ \Rightarrow \frac{92}{x} = 69$$
$$x = \frac{92}{69} \text{ m/s}$$
Speed of B in km/h $= \dfrac{92}{69} \times \dfrac{18}{5}$
$$= 4.8 \text{ km/h}$$

16. A boy went to his school at a speed of 12 km/h and returned to his house at a speed of 8 km/h. If he has taken 50 min for the whole journey, what was the total distance walked?

(a) 4 km (b) 8 km (c) 16 km (d) 20 km

⊙ *(b)* Let the distance between school to house is x km.

Total time taken to cover distance is 50 min

$$\therefore \qquad \frac{x}{12} + \frac{x}{8} = \frac{50}{60}$$

$$x\left(\frac{2 + 3}{24}\right) = \frac{50}{60}$$

$$x = \frac{50 \times 24}{5 \times 60}$$

$$x = 4 \text{ km}$$

∴ Total distance walked by boy is

$$2x = 2 \times 4 = 8 \text{ km}$$

17. A man rows down a river 18 km in 4 h with the stream and returns in 10 h.

Consider the following statement

1. The speed of the man against the stream is 1.8 km/h.
2. The speed of the man in still water is 3.15 km/h.
3. The speed of the stream is 1.35 km/h.

Which of the above statements are correct?

(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

⊙ *(d)* Let the speed of man in still water
$$= x \text{ km/h}$$
speed of stream = y km/h
Distance = 18 km
Speed of man with stream = $(x + y)$ km/h
Speed of man against stream
$$= (x - y) \text{ km/h}$$
According to the question,
$$\frac{18}{x + y} = 4$$
$$\Rightarrow \qquad x + y = \frac{18}{4} \qquad \text{...(i)}$$
and $$\frac{18}{x - y} = 10$$
$$\Rightarrow \qquad x - y = \frac{18}{10} \qquad \text{...(ii)}$$
On solving Eqs. (i) and (ii), we get
Speed of man in still water = 3.15 km/h
Speed of stream = 1.35 km/h
Speed of man against stream
$$= (3.15 - 1.35) \text{ km/h} = 1.8 \text{ km}$$
∴ All the 3 statements are correct.

18. A man travelled 12 km at a speed of 4 km/h and further 10 km at a speed of 5 km/h. What was his average speed?

(a) 4.4 km/h (b) 4.5 km/h
(c) 5.0 km/h (d) 2.5 km/h

⊙ *(a)* Average speed $= \dfrac{\text{Total distance}}{\text{Total time taken}}$

$$= \frac{12 + 10}{\left(\frac{12}{4}\right) + \left(\frac{10}{5}\right)} \qquad \left[\because \text{Time} = \frac{\text{Distance}}{\text{Speed}}\right]$$

$$= \frac{22}{3 + 2} = \frac{22}{5} = 4.4 \text{ km/h}$$

2017 (I)

19. In a 100 m race A runs at a speed of $\frac{5}{3}$ m/s. If A give a start of 4 m to B and still beats him by 12 s, what is speed of B

(a) $\frac{5}{4}$ m/s (b) $\frac{7}{5}$ m/s
(c) $\frac{4}{3}$ m/s (d) $\frac{6}{5}$ m/s

⊙ *(c)* Let the speed of B be x m/s.
Then, according to the question
$$\frac{96}{x} - \frac{100}{(5/3)} = 12$$
$$\Rightarrow \qquad \frac{96}{x} - 60 = 12 \Rightarrow \frac{96}{x} = 72$$
$$\Rightarrow \qquad x = \frac{4}{3}$$
∴ Speed of B is $\frac{4}{3}$ m/s.

20. A passenger train departs from Delhi at 6 pm for Mumbai. At 9 pm an express train, whose average speed exceeds that of the passenger train by 15 km/h leaves Mumbai for Delhi. Two trains meet each other mid-route. At what time do they meet, given that the distance between the cities is 1080 km?

(a) 4 pm (b) 2 am
(c) 12 mid-night (d) 6 am

⊙ *(d)*

```
  6 PM                        9 PM
   •————————————•————————————•
   D    540 km        540 km   M
```

Let the speed of passenger train
$$= x \text{ km/h}$$
∴ Speed of express train
$$= (x + 15) \text{ km/h}$$
Then, according to the question,
$$\frac{540}{x} - \frac{540}{x + 15} = 3$$

$$\Rightarrow \qquad 540\left[\frac{1}{x} - \frac{1}{x + 15}\right] = 3$$
$$\Rightarrow \qquad 540\left[\frac{x + 15 - x}{x(x + 15)}\right] = 3$$
$$\Rightarrow \qquad 540 \times 15 = 3x(x + 15)$$
$$\Rightarrow \qquad 2700 = x^2 + 15x$$
$$\Rightarrow \qquad x^2 + 15x - 2700 = 0$$
$$\Rightarrow \qquad (x + 60)(x - 45) = 0$$
$$\Rightarrow \qquad x = 45 \qquad [\because x \neq -60]$$
∴ Time taken by passenger train to reach the meeting point
$$= \frac{540}{45} = 12 \text{ h}$$
∴ Both train will meet at (6 pm + 12 h)
$$= 6 \text{ am}$$

21. A 225 m long train is running at a speed of 30 km / hour. How much time does it take to cross a man running at 3 km / hour in the same direction?

(a) 40 s (b) 30 s
(c) 25 s (d) 15 s

⊙ *(b)* We have,
Speed of train = 30 km/h
and speed of man = 3 km/h
∴ Relative speed of train = Speed of train – Speed of man
$$= (30 - 3) \text{ km/h}$$
$$= 27 \text{ km/h}$$
$$= 27 \times \frac{5}{18} \text{ m/s}$$
$$= \frac{15}{2} \text{ m/s}$$

To cross the man, train have to cover the distance equal to its length.
$$\therefore \quad \text{Time to cross} = \frac{\text{Distance}}{\text{Speed}}$$
$$= \frac{225}{\left(\frac{15}{2}\right)} \text{ s} = 30 \text{ s}$$

22. A theif is spotted by a policeman from a distance of 100 m. When the policeman starts the chase, the theif also starts running. If the speed of the theif is 8 km / h and that of the policeman is 10 km/h, then how far will the theif have to run before he is overtaken?

(a) 200 m (b) 300 m
(c) 400 m (d) 500 m

⊙ *(c)* Given,
Speed of theif = 8 km/h
$$= 8 \times \frac{5}{18} = \frac{20}{9} \text{ m/s}$$
Speed of policeman = 10 km/h
$$= 10 \times \frac{5}{18} = \frac{25}{9} \text{ m/s}$$

Distance between policeman and thief
= 100 m
Let distance covered by theif = x m
According to the question,

$$\frac{100+x}{\frac{25}{9}} = \frac{x}{\frac{20}{9}} \quad \left\{ \because \text{Time} = \frac{\text{Distance}}{\text{Speed}} \right\}$$

$$400 + 4x = 5x$$
$$x = 400\,\text{m}$$

2016 (II)

23. Two men, A and B run a 4 km race on a course 0.25 km round. If their speeds are in the ratio 5 : 4, how often does the winner pass the another?

(a) Once   (b) Twice
(c) Thrice   (d) Four times

⊙ **(c)** When A completes 5 rounds, B completes 4 rounds.
So, A will overtake B when he completes 5 rounds.
∴ Distance travelled by A when crossing

$$B = 5 \times 0.25 \,\text{km}$$
$$= 1.25\,\text{km}$$

There are three 1.25 km in 4 km.
So, A will pass B in 3 times.

24. When the speed of a train is increased by 20%, it takes 20 min less to cover the same distance. What is the time taken to cover the same distance with the original speed?

(a) 140 min   (b) 120 min
(c) 100 min   (d) 80 min

⊙ **(b)** Let the distance = x km, original speed = y km/h, time = t h
∴ $x = yt$ …(i)
Now, increased speed

$$= y + y \text{ of } 20\%$$
$$= \frac{6}{5} y \,\text{km/h}$$

and   time $= \left(t - \frac{20}{60} \right) \text{h} = \frac{(3t-1)}{3}$

∴ Distance, $x = \left(\frac{6}{5} y \right) \left(\frac{3t-1}{3} \right)$ …(ii)

[from Eqs. (i) and (ii), we get]

$$\Rightarrow \quad yt = \frac{6}{5} y \left(\frac{3t-1}{3} \right)$$
$$\Rightarrow \quad 5t = 2(3t-1)$$
$$\Rightarrow \quad 5t = 6t - 2$$
$$\Rightarrow \quad t = 2\,\text{h}$$
$$\Rightarrow \quad t = (2 \times 60)\,\text{min}$$
$$\therefore \quad t = 120\,\text{min}$$

25. A person can row downstream 20 km in 2 h and upstream 4 km in 2 h. What is the speed of the current?

(a) 2 km/h   (b) 2.5 km/h
(c) 3 km/h   (d) 4 km/h

⊙ **(d)** Downstream speed $= \frac{20}{2} = 10\,\text{km/h}$

$$\left[\because \text{Speed} = \frac{\text{Distance}}{\text{Time}} \right]$$

Upstream speed $= \frac{4}{2} = 2\,\text{km/h}$

Speed of current

$$= \frac{\text{downstream speed} - \text{upstream speed}}{2}$$
$$= \frac{10-2}{2} = \frac{8}{2} = 4\,\text{km/h}$$

26. A motorist travels to a place 150 km away at an average speed of 50 km/h and returns at 30 km/h. What is the average speed for the whole journey?

(a) 35 km/h   (b) 37 km/h
(c) 37.5 km/h   (d) 40 km/h

⊙ **(c)** Total distance travelled by motorist
$$= 150 + 150 = 300\,\text{km}.$$
Total time taken = Time taken going to a place + time taken on returning
$$= \frac{150}{50} + \frac{150}{30} = 8\,\text{h}$$
∴ Average speed $= \frac{\text{Total distance}}{\text{Total time taken}}$
$$= \frac{300}{8}$$
$$= 37.5\,\text{km/h}$$

Alternative Method
Average speed $= \frac{2ab}{a+b}$
Here, $a = 50$ km/h, $b = 30$ km/h
∴ Average Speed $= \frac{2 \times 50 \times 30}{50 + 30}$
$$= \frac{3000}{80} = 37.5\,\text{km/h}$$

27. A train is travelling at 48 km/h completely crosses another train having half its length and travelling in opposite direction at 42 km/h in 12s. It also passes a railway platform in 45s. What is the length of the platform?

(a) 600 m   (b) 400 m
(c) 300 m   (d) 200 m

⊙ **(b)** Let the length of the train be l, then length of train travelling in opposite direction is $l/2$.
Relative speed of train $= (48 + 42)$
$$= 90\,\text{km/h}$$

Now, Distance = Speed × Time
$$\Rightarrow \quad (l + l/2) = 90 \times \frac{5}{18} \times 12$$
$$\Rightarrow \quad \frac{3}{2} l = 25 \times 12$$
$$\Rightarrow \quad l = 200\,\text{m}$$
Let x be the length of platform.
As, train crosses the platform in 45 s.
$$\therefore \quad (x + l) = 48 \times \frac{5}{18} \times 45$$
$$\Rightarrow \quad x + 200 = 600$$
$$\therefore \quad x = 400\,\text{m}$$

28. The speeds of three cars are in the ratio 2 : 3 : 4. What is the ratio between the times taken by these cars to travel the same distance?

(a) 4 : 3 : 2   (b) 2 : 3 : 4
(c) 4 : 3 : 6   (d) 6 : 4 : 3

⊙ **(d)** Let the speed of three cars be $2x$, $3x$ and $4x$ respectively.
Time taken by these cars to travel a distance of D are $\frac{D}{2x}, \frac{D}{3x}$ and $\frac{D}{4x}$, respectively.
∴ Ratio between time taken by these cars $= \frac{D}{2x} : \frac{D}{3x} : \frac{D}{4x}$

$$\left[\because \text{Time} = \frac{\text{Distance}}{\text{Speed}} \right]$$

$$= \frac{1}{2} : \frac{1}{3} : \frac{1}{4}$$
$$= 6 : 4 : 3$$

2016 (I)

29. A bike consumes 20 mL of petrol per km, if it is driven at a speed in the range of 25-50 km/h and consumes 40 mL of petrol per kilometre at any other speed. How much petrol is consumed by the bike in travelling a distance of 50 km, if the bike is driven at a speed of 40 km/h for the first 10 km, at a speed of 60 km/h for the next 30 km and at a speed of 30 km/h for the last 10 km?

(a) 1 L   (b) 1.2 L
(c) 1.4 L   (d) 1.6 L

⊙ **(d)** Petrol consumed by the bike
$$= (10 \times 20) + (30 \times 40) + (10 \times 20)\,\text{mL}$$
$$= (200 + 1200 + 200)\,\text{mL}$$
$$= 1600\,\text{mL}$$
$$= 1.6\,\text{L}$$

30. A passenger train takes 1 h less for a journey of 120 km, if its speed is increased by 10 km/h from its usual speed. What is its usual speed?

(a) 50 km/h　　　　(b) 40 km/h
(c) 35 km/h　　　　(d) 30 km/h

⊙ (d) Let the usual speed of train be x km/h.

Then, $\dfrac{120}{x} - 1 = \dfrac{120}{x + 10}$

⟹ $120 \left[\dfrac{1}{x} - \dfrac{1}{x + 10} \right] = 1$

⟹ $120 \left[\dfrac{10}{x(x + 10)} \right] = 1$

⟹ $x^2 + 10x - 1200 = 0$

⟹ $(x + 40)(x - 30) = 0$

∴ $x = 30$ km/h

Hence, the usual speed of train is 30 km/h.

31. In a race of 1000 m, A beats B by 100 m or 10 s. If they start a race of 1000 m simultaneously from the same point and if B gets injured after running 50 m less than half the race length and due to which his speed gets halved, then by how much time will A beat B?

(a) 65 s　　　　(b) 60 s
(c) 50 s　　　　(d) 45 s

⊙ (a) Since, either A beats B by 100 m or 10 s. It means that B runs 100 m in 10 s.

∴ Speed of $B = \dfrac{100}{10} = 10$ m/s

```
                    B        A
    ←——— 900 m ———→×←100 m→
    ←————— 1000 m —————→
```
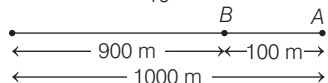
∵ B gets injured at a distance of 450 m and his speed gets halved.

So, time taken by B to cover 1000 m

$= \dfrac{450}{10} + \dfrac{550}{5} = 155$

∵ Ratio of speed of A and B is equal to ratio of distance covered by A and B.

$A : B = 1000 : 900$

$= 10 : 9$

Now, speed of $A = \dfrac{10}{9} \times 10$

$= \dfrac{100}{9}$ m/s

Time taken by A to cover

1000 m $= \dfrac{1000}{100} \times 9 = 90$ s

Hence, A beat B by length of time

$= (155 - 90) = 65$ s

32. A man walking at 5 km/h noticed that a 225 m long train coming in the opposite direction crossed him in 9 s. The speed of the train is

(a) 75 km/h　　　　(b) 80 km/h
(c) 85 km/h　　　　(d) 90 km/h

⊙ (c) Let the speed of the train $= x$ km/h

Then, relative speed of train

$= (x + 5)$ km/h

and length of the train

$= 225$ m $= 0.225$ km　　　[given]

Time taken by train to cross the man

$= \dfrac{\text{distance}}{\text{time}} = \dfrac{0.225}{x + 5}$ h

According to the question,

$\dfrac{0.225}{x + 5} = \dfrac{9}{3600}$

∴ $x + 5 = 90 \Rightarrow x = 85$ km/h

Hence, the speed of the train is 85 km/h.

33. A cyclist moves non-stop from A to B, a distance of 14 km, at a certain average speed. If his average speed reduces by 1 km/h, then he takes 20 min more to cover the same distance. The original average speed of the cyclist is

(a) 5 km/h　　　　(b) 6 km/h
(c) 7 km/h　　　　(d) None of these

⊙ (c) Let the original average speed of cyclist $= x$ km/h
Then, time taken to cover the distance by original average speed $= \dfrac{14}{x}$ h

```
    A                         B
    •—————————————————•
    ←———— 14 km ————→
```

When original average speed is decreased by 1 km/h, then time taken to cover the distance $= \dfrac{14}{(x - 1)}$ h

According to the question,

$\dfrac{14}{x} + \dfrac{20}{60} = \dfrac{14}{(x - 1)}$

⟹ $\dfrac{14}{x} + \dfrac{1}{3} = \dfrac{14}{(x - 1)}$

⟹ $\dfrac{42 + x}{3x} = \dfrac{14}{(x - 1)}$

⟹ $(42 + x)(x - 1) = 42x$

⟹ $42x - 42 + x^2 - x = 42x$

⟹ $x^2 - x - 42 = 0$

⟹ $(x - 7)(x + 6) = 0$

∴ $x = 7$ km/h

[∵ $x \neq -6$]

Hence, the original average speed of the cyclist is 7 km/h.

34. A clock strikes once at 1 O'clock, twice at 2 O'clock and thrice at 3 O'clock and so on. If it takes 8 s to strike at 5 O'clock, then time taken by it to strike at 10 O'clock is

(a) 14 s　　　　(b) 16 s
(c) 18 s　　　　(d) None of these

⊙ (b) ∵ A clock takes time to strike at 5 O'clock $= 8$ s
Then, time taken to strike at 1 O'clock

$= \dfrac{8}{5}$ s

∴ Time taken to strike at 10 O'clock

$= \dfrac{8}{5} \times 10 = 16$ s

35. A person goes to a market between 4 pm and 5 pm when he comes back, he finds that the hour hand and the minute hand of the clock have interchanged their positions. For how much time (approximately) was he out of his house?

(a) 55.38 min　　　　(b) 55.48 min
(c) 55.57 min　　　　(d) 55.67 min

⊙ (a) Since, both of the hands are interchanging their positions, minute hand is taking the place of the hour hand and the hour hand is taking the place of minute hand.

∴ Sum of the angles formed by hour and minute hand $= 360°$

Let us assume that he was out of house for t min.

So, the angle formed by minute hand
$= 6t$

and the angled formed by hour hand
$= 0.5t$

So, $0.5t + 6t = 360 \Rightarrow 6.5t = 360$

⟹ $t = \dfrac{360}{6.5} = 55.38$ min

Hence, the person was out of the house for 55.38 min.

2015 (II)

36. Two trains are moving in the same direction at 1.5 km/min and 60 km/h, respectively. A man in the faster train observes that it takes 27 s to cross the slower train. The length of the slower train is

(a) 225 m　　　　(b) 230 m
(c) 240 m　　　　(d) 250 m

⊙ (a) Let the length of the slower train $= x$
Speed of faster train $= 1.5$ km/min

$$= \frac{1.5 \times 1000}{60} = 25 \text{ m/s}$$

and speed of slower train

$$= 60 \text{ km/h} = 60 \times \frac{5}{18} = \frac{50}{3} \text{ m/s}$$

Since, these trains are moving in same direction.

So, relative speed of train

$$= \left(25 - \frac{50}{3}\right) \text{m/s} = \frac{25}{3} \text{ m/s}$$

Time taken by crossing slower train

$$= 27 \text{s}$$

∴ Distance = Speed × Time

$$\Rightarrow \qquad x = \frac{25}{3} \times 27 = 225 \text{ m}$$

37. In a race *A, B* and *C* take part. *A* beats *B* by 30 m, *B* beats *C* by 20 m and *A* beats *C* by 48 m. Which of the following is/are correct?

1. The length of the race is 300 m.
2. The speeds of *A, B* and *C* are in the ratio 50 : 45 : 42.

Select the correct answer using codes given below.

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ *(c)*

1. Let the length of race be x m.
   Then, distance covered by $A = x$ m.
   Distance covered by B when A reaches the destination $= x - 30$
   Distance covered by C when A reaches the destination $= x - 48$
   and distance covered by C when B reaches the destination $= x - 20$

   $$\Rightarrow \qquad \frac{x - 30}{x} = \frac{x - 48}{x - 20}$$

   $$\Rightarrow x^2 - 50x + 600 = x^2 - 48x$$

   $$\therefore \qquad\qquad x = 300 \text{ m}$$

2. The speeds of A, B and C are in the ratio
   $$300 : 270 : 252 = 50 : 45 : 42$$

38. A motor boat, whose speed is 15km/h in still water goes 30 km downstream and comes back in a total of 4 h and 30 min. The speed of the stream is

(a) 4 km/h   (b) 5 km/h
(c) 6 km/h   (d) 10 km/h

⊘ *(b)* Let speed of stream be x km/h.
Speed of boat in downstream
$$= (x + 15) \text{ km/h}$$
Speed of boat in upstream
$$= (15 - x) \text{ km/h}$$
Total time taken = 4 h 30 min

$$\therefore \qquad \frac{30}{x + 15} + \frac{30}{15 - x} = 4\frac{1}{2}$$

$$\Rightarrow \qquad \frac{30(15 - x + 15 + x)}{15^2 - x^2} = \frac{9}{2}$$

$$\Rightarrow \qquad \frac{30(30)}{225 - x^2} = \frac{9}{2}$$

$$\Rightarrow \qquad 200 = 225 - x^2$$

$$\Rightarrow \qquad x^2 = 25$$

$$\therefore \qquad x = 5 \text{ km/h}$$

Hence, speed of stream = 5 km/h

39. By increasing the speed of his car by 15km/h, a person covers 300 km distance by taking an hour less than before. The original speed of the car was

(a) 45 km/h   (b) 50 km/h
(c) 60 km/h   (d) 75 km/h

⊘ *(c)* Let the original speed of car be x km/h.

Time taken to cover 300 km $= \dfrac{300}{x}$ h

$$\left[\because \text{ Time} = \frac{\text{Distance}}{\text{Speed}}\right]$$

If the speed of car is increased by 15 km/h.

Then, $\dfrac{300}{x + 15} = \dfrac{300}{x} - 1$

$$\Rightarrow \qquad 1 = \frac{300}{x} - \frac{300}{x + 15}$$

$$= 300 \left[\frac{x + 15 - x}{x(x + 15)}\right]$$

$$\Rightarrow \qquad 1 = \frac{4500}{x^2 + 15x}$$

$$\Rightarrow \quad x^2 + 15x - 4500 = 0$$

$$\Rightarrow \quad (x + 75)(x - 60) = 0$$

$$\therefore \qquad x = 60 \text{ km/h}$$

40. Two trains, one is of 121 m in length at the speed of 40 km/h and the other is of 99 m in length at the speed of 32 km/h are running in opposite directions. In how much time will they be completely clear from each other from the moment they meet ?

(a) 10 s   (b) 11 s   (c) 16 s   (d) 21 s

⊘ *(b)* Total length of train = 121 + 99

$$= 220 \text{ m}$$

Relative speed of trains = (40 + 32) km/h
$$= 72 \text{ km/h}$$

i.e. $72 \times \dfrac{5}{18}$ m/s = 20 m/s

$$\because \qquad \text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$= \frac{220}{20} = 11 \text{ s}$$

41. Three athletes run a 4 km race. Their speeds are in the ratio 16 : 15 : 11. When the winner wins the race, then the distance between the athlete in the second position to the athlete in the third position is

(a) 1000 m   (b) 800 m
(c) 750 m   (d) 600 m

⊘ *(a)* Ratio of speeds are 16 : 15 : 11.

Let speed of winner athletic be 16x km/h.

Similarly, second and third position of speed of athletic is 15x and 11x, respectively.

Total distance travelled by winner is 4 km.

$$\because \text{ Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{4}{16x} \text{ h}$$

Distance travelled by second athletic in

$$\frac{4}{16x} \text{ h} = \frac{4}{16x} \times 15x = \frac{15}{4} \text{ km}$$

$$[\because \text{ Distance} = \text{Speed} \times \text{Time}]$$

Similarly, distance travelled by third athletic in

$$\frac{4}{16x} \text{ h} = \frac{4}{16x} \times 11x = \frac{11}{4} \text{ km}$$

∴ Difference between their distances

$$= \left(\frac{15}{4} - \frac{11}{4}\right) \text{km}$$

$$= 1 \text{ km} = 1000 \text{ m}$$

42. In a race of 100 m, *A* beats *B* by 4 m and *A* beats *C* by 2m. By how many metres (approximately) would *C* beat *B* in another 100 m race assuming *C* and *B* run with their respective speeds as in the earlier race?

(a) 2   (b) 2.04   (c) 2.08   (d) 3.2

⊘ *(b)* Speed of B in first race

$$= \frac{100 - 4}{t} = \frac{96}{t}$$

Speed of C in first race $= \dfrac{100 - 2}{t} = \dfrac{98}{t}$

Time taken by C to complete second race

$$= \frac{100}{\frac{98}{t}} = \frac{100t}{98} \qquad \text{...(i)}$$

As C beats B in second race.

∴ Time taken by B when C completes the race

$$= \frac{100 - x}{\frac{96}{t}} = \frac{(100 - x)t}{96} \qquad \text{...(ii)}$$

From Eqs. (i) and (ii), we get

$$\frac{100t}{98} = \frac{(100 - x)t}{96}$$

$$\Rightarrow \qquad \frac{100 - x}{100} = \frac{96}{98}$$

$$\therefore \qquad x \approx 2.04$$

2015 (I)

43. A man rows downstream 32 km and 14 km upstream and he takes 6 h to cover each distance. What is the speed of the current?

(a) 0.5 km/h   (b) 1 km/h
(c) 1.5 km/h   (d) 2 km/h

⊙ **(c)** Downstream speed $= \dfrac{\text{distance}}{\text{time}} = \dfrac{32}{6}$

Upstream speed $= \dfrac{14}{6}$

Speed of current

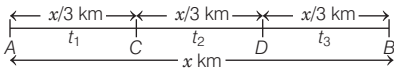$= \dfrac{\text{downstream speed} - \text{upstream speed}}{2}$

$= \dfrac{\dfrac{32}{6} - \dfrac{14}{6}}{2} = \dfrac{18}{2 \times 6} = \dfrac{3}{2} = 1.5\ \text{km/h}$

44. A car travels the first one-third of a certain distance with a speed of 10 km/h, the next one-third distance with a speed of 20 km/h and the last one-third distance with a speed of 60 km/h.
The average speed of the car for the whole journey is

(a) 18 km/h   (b) 24 km/h
(c) 30 km/h   (d) 36 km/h

⊙ **(a)** Let total distance of AB be x km.

For distance AC,

$t_1 = \dfrac{x/3}{10} = \dfrac{x}{30}\ \text{h}$

$\left[\because\ \text{Time} = \dfrac{\text{Distance}}{\text{Speed}} \right]$

For distance CD,

$t_2 = \dfrac{x/3}{20} = \dfrac{x}{60}\ \text{h}$

For distance DB,

$t_3 = \dfrac{x/3}{60} = \dfrac{x}{180}\ \text{h}$

Total time taken $= t_1 + t_2 + t_3$

$= \dfrac{x}{30} + \dfrac{x}{60} + \dfrac{x}{180}$
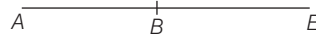
$= \dfrac{10x}{180} = \dfrac{x}{18}$

$\therefore$ Average speed $= \dfrac{\text{Total distance}}{\text{Total time taken}}$

$= \dfrac{x}{\dfrac{x}{18}} = 18\ \text{km/h}$

45. Two persons A and B start simultaneously from two places c km apart and walk in the same direction. If A travels at the rate

of p km/h and B travels at the rate of q km/h, then A has travelled before he overtakes B a distance of

(a) $\dfrac{qc}{p+q}$ km   (b) $\dfrac{pc}{p-q}$ km
(c) $\dfrac{qc}{p-q}$ km   (d) $\dfrac{pc}{p+q}$ km

⊙ **(b)** Let A and B will meet after t h at point E.

Distance travelled by $A = pt$ h

$[\because\ \text{Distance} = \text{Speed} \times \text{Time}]$

and distance travelled by $B = qt$ h

According to the question,

$pt = qt + c$

$\Rightarrow\qquad pt - qt = c$

$\Rightarrow\qquad t(p-q) = c$

$\Rightarrow\qquad t = \dfrac{c}{p-q}$ ...(i)

$\therefore$ Distance travelled by

$A = pt = \dfrac{pc}{p-q}$ km [from Eq. (i)]

46. In a flight of 600 km, an aircraft was slowed down due to bad weather. Its average speed for the trip was reduced by 200 km/h and the time of flight increased by 30 min. The duration of the flight is

(a) 1 h   (b) 2 h   (c) 3 h   (d) 4 h

⊙ **(a)** Let the original speed of an aircraft be x km/h and its reduced speed

$= (x - 200)$ km/h.

Condition I Time taken by aircraft to cover 600 km $= \dfrac{600}{x}$ h.

Condition II Time taken by aircraft to cover 600 km $= \dfrac{600}{(x - 200)}$ h

According to the question,

$\dfrac{600}{x - 200} - \dfrac{600}{x} = \dfrac{1}{2}$

$\left[\because\ 30\ \text{min} = \dfrac{1}{2}\ \text{h} \right]$

On dividing both sides by 600, we get

$\dfrac{1}{x - 200} - \dfrac{1}{x} = \dfrac{1}{600 \times 2}$

$\Rightarrow\qquad \dfrac{x - x + 200}{x(x - 200)} = \dfrac{1}{1200}$

$\Rightarrow\qquad \dfrac{200}{x(x - 200)} = \dfrac{1}{1200}$

$\Rightarrow\ x^2 - 200x - 240000 = 0$

$\Rightarrow\ (x - 600)(x + 400) = 0$

$\Rightarrow\qquad x = 600\ \text{km/h}$

$\Rightarrow\qquad x \neq -400\ \text{km/h}$

$\therefore$ Required time $= \dfrac{\text{Distance}}{\text{Speed}}$

$= \dfrac{600}{600} = 1\ \text{h}$

47. With a uniform speed, a car covers a distance in 8 h. Had the speed been increased by 4 km/h, the same distance could have been covered in 7 h and 30 min. What is the distance covered?

(a) 420 km   (b) 480 km
(c) 520 km   (d) 640 km

⊙ **(b)** Let the distance between A and B be x km.
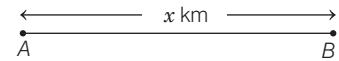
Case I   Given, distance $= x$ km, speed $= V$ km/h [let] and time $= 8$ h

$\because$ Speed $= \dfrac{\text{Distance}}{\text{Time}}$

$\therefore$ $V = \dfrac{x}{8}$ ...(i)

Case II   If speed $= (V + 4)$ km/h

and   time $= 7\dfrac{1}{2}$ h $= \dfrac{15}{2}$ h

$\therefore$ $V + 4 = \dfrac{x}{15/2}$

$\Rightarrow$ $V + 4 = \dfrac{2x}{15}$

$\Rightarrow$ $\dfrac{x}{8} + 4 = \dfrac{2x}{15}$ [from Eq. (i)]

$\Rightarrow$ $\dfrac{2x}{15} - \dfrac{x}{8} = 4$

$\Rightarrow$ $\dfrac{x}{120} = 4$

$\therefore$ $x = 480$ km

48. A runs $1\dfrac{2}{3}$ times as fast as B. If A given B a start of 80 m, then how far must the winning post from the starting point be so that A and B might reach it at the same time?

(a) 200 m   (b) 300 m
(c) 270 m   (d) 160 m

⊙ **(a)** Let the speed of B be x m/s.

$\therefore$ Speed of $A = 1\dfrac{2}{3}x = \dfrac{5x}{3}$ m/s

Ratio of speed of rates of A and B

$= \dfrac{5x}{3} : x = 5 : 3$

$\because$ 2 m are gained in a race of 5 m.

$\therefore$ 1 m are gained in a race of $\dfrac{5}{2}$ m.

So, 80 m are gained in a race of

$\dfrac{5}{2} \times 80 = 200$ m

49. A thief is noticed by a policeman from a distance of 200 m. The thief starts running and the policeman chases him. The thief and the policeman run at the speed of 10 km/h and 11 km/h, respectively. What is the distance between them after 6 min?

(a) 100 m (b) 120 m (c) 150 m (d) 160 m

⊘ (**a**) Given, speed of thief = 10 km/h

$$= \frac{10 \times 1000}{60} \text{ m/min}$$

$$= \frac{500}{3} \text{m/min}$$

and speed of policeman = 11 km/h

$$= \frac{11 \times 1000}{60} \text{ m/min}$$

$$= \frac{550}{3} \text{m/min}$$

Now, distance travelled by thief in 6 min

$$= \frac{500}{3} \times 6 = 1000 \text{ m}$$

[∵ Distance = Speed × Time]

and distance travelled by policeman in 6 min $= \frac{550}{3} \times 6 = 1100$ m

∴ Difference = (1100 − 1000)
= 100 m

Hence, the distance between them after 6 min is (200 − 100) m = 100 m.

2014 (II)

50. A train takes 10 s to cross a pole and 20 s to cross a platform of length 200 m. What is the length of the train?

(a) 50 m (b) 100 m (c) 150 m (d) 200 m

⊘ (**d**) Let length of the train be l m.

∴ Speed of train = $\frac{l}{10}$ m/s

Distance covered by train to cross the platform of length 200 m = $(l + 200)$ m
Time taken to cross the platform

$$= \frac{\text{Distance}}{\text{Speed}}$$

$$\Rightarrow 20 = \frac{l + 200}{l / 10}$$

$$\Rightarrow \frac{l}{10} \times 20 = l + 200$$

$$\Rightarrow 2l - l = 200$$

$$\therefore l = 200 \text{ m}$$

Hence, length of the train is 200 m.

51. The distance between two points (A and B) is 110 km. X starts running from point A at a speed of 60 km/h and Y starts running from point B at a speed of 40 km/h at the same time. They meet at a point C, somewhere on the line AB. What is the ratio of AC to BC?

(a) 3 : 2 (b) 2 : 3
(c) 3 : 4 (d) 4 : 3

⊘ (**a**) Distance between two points = 110 km

Their relative speed = 60 + 40
= 100 km/h

Time after which they meet

$$= \frac{\text{Total distance}}{\text{Relative speed}}$$

$$= \frac{110}{100} = 1.10 \text{ h}$$

Distance covered by A in 1.10 h
= AC = 60 × 1.10
= 66 km
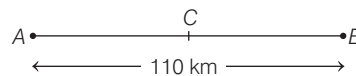
Remaining distance
= BC = 110 − 66 = 44 km

∴ Required ratio = $AC : BC$
= 66 : 44 = 3 : 2

52. A man rides one-third of the distance from A to B at the rate of x km/h and the remainder at the rate of $2y$ km/h. If he had travelled at a uniform rate of $6z$ km/h, then he could have ridden from A to B and back again in the same time. Which one of the following is correct?

(a) $z = x + y$
(b) $3z = x + y$
(c) $\frac{1}{z} = \frac{1}{x} + \frac{1}{y}$
(d) $\frac{1}{2z} = \frac{1}{x} + \frac{1}{y}$

⊘ (**c**) Let the total distance be d.
Time taken to cover $\frac{1}{3}$ rd distance,

$$t_1 = \frac{\frac{1}{3}d}{x} = \frac{d}{3x}$$

$$\left[\because \text{ Time} = \frac{\text{Distance}}{\text{Speed}} \right]$$

Remaining distance = $d - \frac{1}{3}d = \frac{2}{3}d$

Time taken to cover $\frac{2}{3}$ rd distance,

$$t_2 = \frac{\frac{2}{3}d}{2y} = \frac{2d}{6y}$$

Time taken to cover distance from A to B and B to A, $t = \frac{2d}{6z}$

According to the question, $t_1 + t_2 = t$

$$\Rightarrow \frac{d}{3x} + \frac{2d}{6y} = \frac{2d}{6z}$$

$$\Rightarrow \frac{1}{3x} + \frac{1}{3y} = \frac{1}{3z}$$

$$\therefore \frac{1}{x} + \frac{1}{y} = \frac{1}{z}$$

53. A train travels at a speed of 40 km/h and another train at a speed of 20 m/s. What is the ratio of speed of the first train to that of the second train?

(a) 2 : 1 (b) 5 : 9
(c) 5 : 3 (d) 9 : 5

⊘ (**b**) Given, speed of a train = 40 km/h

$$= 40 \times \frac{5}{18} \text{ m/s}$$

Speed of another train = 20 m/s

∴ Required ratio = $\dfrac{\text{Speed of first train}}{\text{Speed of second train}}$

$$= \frac{40 \times \frac{5}{18}}{20} = \frac{2 \times 5}{18}$$

$$= \frac{10}{18} = \frac{5}{9} \text{ or } 5 : 9$$

2014 (I)

54. A train takes 9 s to cross a pole. If the speed of the train is 48 km/h, then the length of the train is

(a) 150 m (b) 120 m
(c) 90 m (d) 80 m

⊘ (**b**) Let the length of the train be x m.
Now, speed = 48 km/h

$$= \frac{48 \times 1000}{60 \times 60} \text{ m/s}$$

Train takes 9 s to cross a pole.

∴ Length of train (x)
= Speed × Time to cross the pole

$$x = \frac{48 \times 1000}{60 \times 60} \times 9 = 120 \text{ m}$$

WORK-TIME AND UNITARY METHOD

1. A stock of food grains is enough for 240 men for 48 days. How long will the same stock last for 160 men?

(a) 72 days   (b) 64 days
(c) 60 days   (d) 54 days

⊘ *(a)* Let total stock of food grains be 1 unit.
240 men eat 1 units food grains in
$\qquad$ = 48 days
1 man eat 1 unit food grains in
$\qquad$ = 48 × 240 days
$\qquad$ (By unitary method)
∴ 160 men eat 1 unit food grains in
$\qquad = \dfrac{48 \times 240}{160} = 72$ days

2. Two taps X and Y are fixed to a water tank. If only X is opened, it drains out the full tank of water in 20 min. If both X and Y are opened, then they drain out the full tank of water in 15 min. If only Y is opened, how long does it take to drain out the full tank of water?

(a) 30 min   (b) 45 min
(c) 60 min   (d) 90 min

⊘ *(c)* X drains out full tank in 20 min.
X 1 min work $= \dfrac{1}{20}$
X and Y drain out full tank in 15 min.
X and Y 1 min work $= \dfrac{1}{15}$
Y 1 min work $= \dfrac{1}{15} - \dfrac{1}{20} = \dfrac{1}{60}$
Y will take 60 min to drain out full tank.

3. If the ratio of the work done by $(x + 2)$ workers in $(x - 3)$ days to the work done by $(x + 4)$ workers in $(x - 2)$ days is 3 : 4, then what is the value of x ?

(a) 8   (b) 10   (c) 12   (d) 15

⊘ *(b)* Number of workers $(x + 2)$ worked for $(x - 3)$ days and $(x + 4)$ workers worked for $(x - 2)$ days.
According to the question,
$$\dfrac{(x + 2)(x - 3)}{(x + 4)(x - 2)} = \dfrac{3}{4}$$
$$\dfrac{x^2 - x - 6}{x^2 + 2x - 8} = \dfrac{3}{4}$$
$$4(x^2 - x - 6) = 3(x^2 + 2x - 8)$$
$$4x^2 - 4x - 24 = 3x^2 + 6x - 24$$
$$x^2 - 10x = 0$$
$$x^2 = 10x$$
∴ $\qquad\qquad x = 10$

4. A field can be reaped by 12 men or 18 women in 14 days. In how many days can 8 men and 16 women reap it?

(a) 26 days   (b) 24 days
(c) 9 days   (d) 8 days

⊘ *(c)* A field can be reaped by 12 men or 18 women in 14 days.
$$12\,M = 18W$$
$$2M = 3W$$
$$M = 3/2W \qquad \text{…(i)}$$
Total work $= 18W \times 14$ days
Let 8 men and 16 women can reap the field $= x$ days
$(8M + 16W) \times x$ days $= 18W \times 14$ days
$\left(8 \times \dfrac{3}{2}W + 16W\right) \times x = 18W \times 14$
$\qquad\qquad\qquad$ [by Eq. (i)]
$$D = \dfrac{18W \times 14}{28W} = 9 \text{ days}$$
Then, Option (c) is correct.

5. Tushar takes 6 h to complete a piece of work, while Amar completes the same work in 10 h. If both of them work together, then what is the time required to complete the work?

(a) 3 h   (b) 3 h 15 min
(c) 3 h 30 min   (d) 3 h 45 min

⊘ *(d)* Tushar takes 6 h to complete a piece of work. While Amar complete the same work in 10 h.
Then, both complete the same work
$$= \dfrac{1}{6} + \dfrac{1}{10} = \dfrac{16}{60}$$
∴ Required time $= \dfrac{60}{16} = 3$ h 45 min
Option (d) is correct.

6. Two workers 'A' and 'B' working together completed a job in 5 days. Had 'A' worked twice as efficiently as he actually did and 'B' worked one-third as efficiently as he actually did, the work would have completed in 3 days. In how many days could 'A' alone complete the job?

(a) $3\dfrac{1}{2}$ days   (b) $4\dfrac{1}{6}$ days
(c) $5\dfrac{1}{2}$ days   (d) $6\dfrac{1}{4}$ days

⊘ *(d)* Let the efficiency of A and B be 'a' and 'b' respectively.
According to the question,
$$(a + b)5 = \left(2a + \dfrac{b}{3}\right) \times 3$$
⇒ $\qquad 5a + 5b = 6a + b$
⇒ $\qquad a = 4b$ or $\dfrac{a}{b} = \dfrac{4}{1}$
Now, efficiency $\propto \dfrac{1}{\text{Time}}$
∴ Ratio of time taken A and B = 1 : 4
Let time taken by A to finish the job be x days.
∴ Time taken by B to finish the job $= 4x$ days
Now, according to the question,
$$\dfrac{1}{x} + \dfrac{1}{4x} = \dfrac{1}{5}$$
⇒ $\qquad \dfrac{4x + x}{4x^2} = \dfrac{1}{5}$

$\Rightarrow$ $\dfrac{5x}{4x^2} = \dfrac{1}{5}$

$\Rightarrow$ $x = \dfrac{25}{4} = 6\dfrac{1}{4}$ days

$\therefore$ Number of days taken by A to complete job $6\dfrac{1}{4}$ days.

7. 'A' is thrice as good a workman as 'B' and takes 10 days less to do a piece of work than 'B' takes. The number of days taken by 'B' alone to finish the work is

(a) 12   (b) 15   (c) 20   (d) 30

$\circledS$ *(b)* Let A can finish the work = x days
B can finish the work = $3x$ days
According to the question,
$3x - x = 10 \Rightarrow 2x = 10$
$x = 5$
$\therefore$ B alone can finish the work
$= 3 \times 5 = 15$ days

8. Twelve (12) men work 8 h per day and require 10 days to build a wall. If 8 men are available, how many hours per day must they work to finish the work in 8 days?

(a) 10 h   (b) 12 h
(c) 15 h   (d) 18 h

$\circledS$ *(c)* 12 men can do a work in 10 days if they work 8 h per day.

$\therefore$ 12 men can do the work in 80 h.
1 man will do the same work in (12×80) h
$= 960$ h
And 8 men will do the same work $= \dfrac{960}{8}$ h
$= 120$ h
Now, to complete the work in 8 days, each man would have to work for $\left(\dfrac{120}{8}\right)$ h each day.

$\therefore$ Required time $= \dfrac{120}{8}$ h $= 15$ h

Alternate Method
Here $M_1 = 12, H_1 = 8 \, D_1 = 10$
$M_2 = 8, H_2 = ? \, D_2 = 8$
$\because$ $M_1 D_1 H_1 = M_2 D_2 H_2$
$\therefore 12 \times 10 \times 8 = 8 \times 8 \times H_2$
$H_2 = \dfrac{12 \times 10}{8} = 15$ h

9. X and Y together can finish a job in 6 days. X can alone do the same job in 12 days. How long will Y alone take to do the same job?

(a) 16 days   (b) 12 days
(c) 10 days   (d) 8 days

$\circledS$ *(b)* X can do the job in 12 days

$\therefore$ Work done by X in 1 day $= \dfrac{1}{12}$

Similarly, work done by X and Y in 1 day
$= \dfrac{1}{6}$

$\therefore$ 1 day work of $Y = \dfrac{1}{6} - \dfrac{1}{12}$
$= \dfrac{2-1}{12} = \dfrac{1}{12}$

$\therefore$ Y will complete the work in 12 days.

10. Twelve (12) persons can paint 10 identical rooms in 16 days. In how many days can 8 persons paint 20 such rooms?

(a) 12   (b) 24   (c) 36   (d) 48

$\circledS$ *(d)* 12 persons can paint 10 identical rooms in 16 days.
$\therefore$ Time taken by 12 persons to paint 20 such identical rooms = $16 \times 2 = 32$ days
And time taken by 1 person to paint 20 identical rooms = (32×12) days
$\therefore$ Time taken by 8 persons to paint 20 such rooms $= \left(\dfrac{32 \times 12}{8}\right)$ days $= 48$ days

Alternate Method
$m_1 = 12, \ d_1 = 16, \ w_1 = 10$ and $m_2 = 8,$
$d_2 = ?, \ w_2 = 20$
then, $\dfrac{m_1 d_1}{w_1} = \dfrac{m_2 \times d_2}{w_2}$
$\dfrac{12 \times 16}{10} = \dfrac{8 \times d_2}{20}$
$d_2 = \dfrac{2 \times 12 \times 16}{8}$
$d_2 = 48$

2018 (I)

11. A work when done by 10 women is completed in 12 days. The same work can be completed in 8 days when done by 5 men. How many days will it take to complete when 6 women and 3 men are employed to perform the same job?

(a) 12   (b) 10   (c) 8   (d) 5

$\circledS$ *(c)* One day work of 1 woman
$= \dfrac{1}{10 \times 12} = \dfrac{1}{120}$

One day work of 1 man $= \dfrac{1}{5 \times 8} = \dfrac{1}{40}$

$\therefore$ One day work of 6 women and 3 men
$= \dfrac{6}{120} + \dfrac{3}{40}$
$= \dfrac{6+9}{120} = \dfrac{15}{120} = \dfrac{1}{8}$

$\therefore$ Time taken by 6 women and 3 men to complete work = 8 days

12. A man undertakes to do a certain work in 150 days. He employs 200 men. He finds that only a quarter of the work is done in 50 days. How many additional men should he employ so that the whole work is finished in time?

(a) 75   (b) 85   (c) 100   (d) 120

$\circledS$ *(c)* Given, $M_1 = 200, D_1 = 50, W_1 = \dfrac{1}{4}$

$M_2 = 200 + x$ (here x is the number of men that must be increased)

$D_2 = 150 - 50 = 100, W_2 = \dfrac{3}{4}$

Now, $\dfrac{M_1 \times D_1}{W_1} = \dfrac{M_2 \times D_2}{W_2}$

$\therefore$ $\dfrac{200 \times 50}{\frac{1}{4}} = \dfrac{(200 + x) \times 100}{\frac{3}{4}}$

$\Rightarrow$ $200 + x = \dfrac{200 \times 50 \times 3}{100}$

$\Rightarrow$ $x = 300 - 200 = 100$

$\therefore$ Additional men required = 100

13. If 5 tractors can plough 5 hectare of land in 5 days, then what is the number of tractors required to plough 100 hectare in 50 days?

(a) 100   (b) 20   (c) 10   (d) 5

$\circledS$ *(c)* Here, $M_1 = 5, D_1 = 5, W_1 = 5$
and $M_2 = ? , D_2 = 50$ and $W_2 = 100$

$\because$ $\dfrac{M_1 D_1}{W_1} = \dfrac{M_2 D_2}{W_2}$

$\therefore$ $\dfrac{5 \times 5}{5} = \dfrac{M_2 \times 50}{100}$

$\therefore$ $M_2 = 10$
$\therefore$ Number of tractors = 10

14. A water tank has been fitted with two taps P and Q and a drain pipe R. Taps P and Q fill at the rate of 12 L/min and 10 L/min respectively. Consider the following statements $S1, S2$ and $S3$

$S1$: Pipe R drains out at the rate of 6 L/min.

$S2$: If both the taps and the drain pipe are opened simultaneously, then the tank is filled in 5 h 45 min.

$S3$: Pipe R drains out (fully) the filled tank in 15 h 20 min. To know what is the capacity of the tank, which one of the following is correct?

(a) *S2* is only sufficient
(b) *S1, S2* and *S3* are necessary
(c) Any two out of *S1, S2* and *S3* are sufficient
(d) None of the above

⊘ *(c)* Two taps *P* and *Q* fill at the rate of 12 L/min and 10 L/min respectively.
S_1 : Pipe *R* drains out at the rate of 6 L/min. Then water fill in tank
$$= (12 + 10 - 6)$$
$$= 16 \, L/min$$
S_2 : Total time taken to fill the tank
$$= 5\,h\,45\,min$$
Then, capacity of tank $= 16 \times 5\,h\,45\,min$
$$= 16 \times \frac{23}{4} \times 60 = 5520\,L$$

S_1: *R* drains cut at the rate of 6L/min
S_3 : *R* drains cut the filled tank in 1 5 hr 20 min
then, capacity of tank $= 6 \times 15\,hr\,20\,min$
$$= 6 \times \frac{46}{3} \times 60$$
$$= 5520 \text{ Liters}$$
S_2 : *P*, *Q* and *R* are opened then tank is filled in $= 5\,hr\,45\,min = \frac{23}{4}\,hr$
S_3 : *R* drains cut the filled take in
$$= 15\,hr\,20\,min = \frac{46}{3}\,h$$
P and *Q* fill thetank at the rate of
$$= \left(\frac{4}{23} + \frac{3}{46}\right) = \frac{8+3}{46} = \frac{11}{46}\,L/h$$
ATQ, $\frac{11}{46}$ L/h = 22 L/min
then, capacity of tank $= 72 \times \frac{46}{11} \times 60$
$$= 5520 \text{ cities}$$

2017 (II)

15. To maintain 8 cows for 60 days, a milkman has to spend ₹ 6400. To maintain 5 cows for *n* days, he has to spend ₹ 4800. What is the value of *n*?
(a) 46 days   (b) 50 days
(c) 58 days   (d) 72 days

⊘ *(d)* Expenditure on maintaining 1 cow for 60 days $= ₹ \frac{6400}{8} = ₹ 800$

Expenditure on maintaining 1 cow for
$$1 \text{ day} = ₹ \frac{800}{60}$$
Expenditure on maintaining 5 cows for
$$1 \text{ day} = ₹ \left(\frac{800}{60} \times 5\right)$$
Expenditure on maintaining 5 cows for *n* days $= ₹ \left(\frac{800}{60} \times 5 \times n\right)$

$$\Rightarrow \quad 4800 = \frac{800}{60} \times 5 \times n$$
$$\Rightarrow \quad 48 \times 60 = 8 \times 5 \times n$$
$$\Rightarrow \quad n = \frac{48 \times 60}{8 \times 5}$$
$$\therefore \quad n = 6 \times 12 = 72 \text{ days}$$

16. 30 men can complete a job in 40 days. However, after 24 days some men out of the assigned 30 left the job. The remaining people took another 40 days to complete the job. The number of men who left the job is
(a) 24   (b) 18   (c) 12   (d) 6

⊘ *(b)* Let number of men who left the job is *x*

Clearly, 1 day's work of 30 men $= \frac{1}{40}$

1 day's work of 1 man $= \frac{1}{30 \times 40}$

⟹ 24 day's work of 30 men
$$= \frac{24 \times 30}{30 \times 40} = \frac{24}{40}$$
and 40 days, work of $(30 - x)$ men
$$= \frac{40 \times (30 - x)}{30 \times 40}$$
∵ The work is completed in 64 days
$$\therefore \quad \frac{24}{40} + \frac{40(30 - x)}{30 \times 40} = 1$$
$$\Rightarrow \quad \frac{24}{40} + \frac{(30 - x)}{30} = 1 \Rightarrow \frac{(30-x)}{30} = \frac{16}{40}$$
$$30 - x = 12$$
$$\therefore \quad x = 18$$
Thus, 18 men left the job.

17. 4 goats or 6 sheep can graze a field in 50 days. 2 goats and 3 sheep will graze it in
(a) 200 days   (b) 150 days
(c) 100 days   (d) 50 days

⊘ *(d)* We have,
$$4 \text{ goats} = 6 \text{ sheep}$$
$$\Rightarrow \quad 2 \text{ goats} = 3 \text{ sheep}$$
2 goats + 3 sheep = 2 goats + 2 goats
$$= 4 \text{ goats}$$
2 goats + 3 sheep = 3 sheep + 3 sheep
$$= 6 \text{ sheeps}$$
Hence 2 goats and 3 sheep graze a field in same days when 4 goats or 6 sheep graze a field.
i.e. 50 days

18. A tap can fill a tub in 10 h. After opening the tap for 5 h it was found that a small outlet at the bottom of the tub was open and water was leaking through it. It was then immediately closed. It took 7 h to fill the tub after

closing the outlet. What time will be taken by the outlet to empty the full tub of water?
(a) 35 h   (b) 25 h
(c) 20 h   (d) 17 h

⊘ *(b)* Let the volume of tub is $V m^3$.
Tap can fill a tub in 10 h.
In one hour tub fill $= \frac{V}{10} m^3$
Let outlet empty the tub in *x* h.
Part of tub empty in one hour $\frac{V}{x} m^3$.

According to the question,
$$\frac{5V}{10} - \frac{5V}{x} + \frac{7V}{10} = V$$
$$\Rightarrow \quad \frac{12}{10} - 1 = \frac{5}{x}$$
$$\Rightarrow \quad x = 25$$
∴Outlet can empty the full tub of water in 25 h.

2017 (I)

19. If 15 men take 21 days of 8 h each to do a piece of work, then what is the number of days of 6 h each that 21 women would take, if 3 women would do as much as 2 men?
(a) 18   (b) 20   (c) 25   (d) 30

⊘ *(d)* We have,
$$M_1 = 15, D_1 = 21, H_1 = 8$$
$$M_2 = 14, D_2 = ?, H_2 = 6$$
$$[\because 3W = 2M \Rightarrow 21W = 14M]$$
$$\therefore \quad \frac{M_1 \times D_1 \times H_1}{W_1} = \frac{M_2 \times D_2 \times H_2}{W_2}$$
$$\Rightarrow \quad \frac{15 \times 21 \times 8}{W} = \frac{14 \times 6 \times D_2}{W}$$
$$\therefore \quad D_2 = \frac{15 \times 21 \times 8}{14 \times 6} = 30$$

20. *A* and *B* working together can finish a piece of work in 12 days while *B* alone can finish it in 30 days. In how many days can *A* alone finish the work?
(a) 18 days   (b) 20 days
(c) 24 days   (d) 25 days

⊘ *(b)* *A* and *B* do the work in 12 days.
∴One day work of *A* and $B = \frac{1}{12}$

B alone do the work in 30 days.
∴ One day work of $B = \frac{1}{30}$
∴ One day work of $A = \frac{1}{12} - \frac{1}{30}$
$$= \frac{5 - 2}{60} = \frac{3}{60} = \frac{1}{20}$$
∴ *A* can do the work alone in 20 days.

2016 (II)

21. *A* can do 50% more work than *B* in the same time. *B* alone can do a piece of work in 30 h. *B* starts working and had already worked for 12 h when *A* joins him. How many hours should *B* and *A* work together to complete the remaining work?

(a) 6 h   (b) 12 h
(c) 4.8 h   (d) 7.2 h

⊘ *(d)* We have, *A* can do 50% more work than *B* in same hour.
B alone can do a piece of work in 30 h.

In 1 h, *B* can do work = $\dfrac{1}{30}$ piece of work

and in 1 h, *A* can do work

$= \dfrac{1}{30} \times \dfrac{150}{100}$

$= \dfrac{1}{20}$ piece of work

∴ *A* alone can do a piece of work in 20 h.

∴ In 1 h *A* and *B* can do work

$= \left(\dfrac{1}{30} + \dfrac{1}{20} \right)$ piece of work

$= \dfrac{1}{12}$ piece of work

∴ *A* and *B* both can do piece of work in 12 h, but *B* has already worked for 12 h.

∴ *B* has finished $\dfrac{12}{30}$ part of work.

Now, remaining work $= 1 - \dfrac{12}{30} = \dfrac{18}{30}$

For completing the $\dfrac{18}{30}$ work by *A* and *B*

combining are $\left(\dfrac{18}{30} \times 12 \right)$ h = 7.2 h

22. A tank can be filled by pipe *X* in 2 h and pipe *Y* in 6 h. At 10 am, pipe *X* was opened. At what time will the tank be filled if pipe *Y* is opened at 11 am?

(a) 12:45 pm   (b) 5:00 pm
(c) 11:45 am   (d) 11:50 am

⊘ *(c)* Part of tank filled by *X* in 1 h = 1/2
Part of tank filled by *Y* in 1 h = 1/6
∴ Part of tank filled by (*X* + *Y*) in
       1h = 1/2 + 1/6 = 2/3
During 10 am -11am, only pipe *X* was opened
∴ Part of tank filled by pipe *X* = 1/2
∴ Remaining part to be filled
       = 1 − 1/2 = 1/2
Time taken by (*X* + *Y*) to filled 1/2 part of
tank $= \dfrac{3}{2} \times \dfrac{1}{2} = \dfrac{3}{4}$ h = 45 min

Hence, the tank will be fill 11: 45 am.

2016 (II)

23. Outside a meeting room, Madhukar was told by a person that each meeting takes place after 13/4 h. The last meeting has been over just 45 min ago and the next meeting will take place at 2 pm. At what time did Madhukar receive this information?

(a) 10 : 20 am   (b) 11 : 30 am
(c) 11 : 40 am   (d) 11 : 50 am

⊘ *(b)* Time between one meeting and
another $= \dfrac{13}{4}$ h $= \left(3 + \dfrac{1}{4} \right)$ h = 3 h 15 min

and next meeting scheduled = 2 pm
So, last meeting held at = 2 pm − 3h15 min
       = 10 h 45 min = 10 : 45 am
Madhukar receive information about meeting after 45 min last meeting held.
So, Madhukar receive information at
10 : 45 am + 45 min = 11 : 30 am.

24. Two pipes *A* and *B* can fill a tank in 60 min and 75 min, respectively. There is also an outlet *C*. If *A*, *B* and *C* are opened together, then the tank is full in 50 min. How much time will be taken by *C* to empty the full tank?

(a) 100 min   (b) 110 min
(c) 120 min   (d) 125 min

⊘ *(a)* Since, two pipes *A* and *B* fill a tank in 60 min and 75 min, respectively.
∴ Part of tank filled by pipe *A* in

     1 min $= \dfrac{1}{60}$

and part of tank filled by pipe *B* in

     1 min $= \dfrac{1}{75}$

Now, part of tank filled by *A* and *B*
together in 1 min $= \dfrac{1}{60} + \dfrac{1}{75} = \dfrac{5 + 4}{300}$

       $= \dfrac{9}{300} = \dfrac{3}{100}$

and part of tank emptied by pipe *C* in

     1 min $= \dfrac{1}{C}$

So, net part of tank filled by pipes *A*, *B*
and *C* together in 1 min $= \dfrac{3}{100} - \dfrac{1}{C}$

$\Rightarrow \dfrac{1}{50} = \dfrac{3}{100} - \dfrac{1}{C} \Rightarrow \dfrac{1}{C} = \dfrac{3}{100} - \dfrac{1}{50}$

       $= \dfrac{3}{100} - \dfrac{2}{100} = \dfrac{1}{100}$

$\Rightarrow \dfrac{1}{C} = \dfrac{1}{100}$

∴   *C* = 100
Hence, the time taken by pipe *C* to empty the tank is 100 min.

2015 (II)

25. *A* and *B* are two taps which can fill a tank individually in 10 min and 20 min, respectively. However, there is a leakage at the bottom, which can empty a filled tank in 40 min. If the tank is empty initially, then how much time will both the taps take to fill the tank with leakage?

(a) 2 min   (b) 4 min
(c) 5 min   (d) 8 min

⊘ *(d)* We have, tap *A* fill the tank in 10 min.

∴   Tap *A* fill the tank in 1 min = $\dfrac{1}{10}$ part

Similarly, *B* fill the tank in 1 min = $\dfrac{1}{20}$ part

Due to the leakage tank emptied in 40 min
∴ In one minute empty tank emptied by
$\dfrac{1}{40}$ part.

So in one minute both the taps fill the tank

with leakage $\left(\dfrac{1}{10} + \dfrac{1}{20} - \dfrac{1}{40} \right)$ part of tank

i.e. $\dfrac{1}{8}$ part of tank.

Hence, total time taken to fill the tank is 8 min.

26. If 4 men working 4 h per day for 4 days complete 4 units of work, then how many units of work will be completed by 2 men working for 2h per day in 2 days?

(a) 2   (b) 1   (c) $\dfrac{1}{2}$ (d) $\dfrac{1}{8}$

⊘ *(c)* 4 men working 4 h per day for 4 days complete 4 units of work i.e. 4 units of work completed in (4 × 4 × 4) h.
4 units of work completed in 64 h.
∴ 1 unit of work is completed

       $= \dfrac{64}{4}$ h = 16 h

Now, 2 men working for 2 h per day in 2 days.
i.e. (2 × 2 × 2) = 8 h

In 8 h $= \dfrac{8}{16}$ units of work completed

       $= \dfrac{1}{2}$ units of work completed

27. If *m* persons can paint a house in *d* days, then how many days will it take for (*m* + 2) persons to paint the same house?

(a) *md* + 2   (b) *md* − 2
(c) $\dfrac{m + 2}{md}$ (d) $\dfrac{md}{m + 2}$

⊙ *(d)* m persons paint a house in d days.
∴ 1 person paints a house in $(m \times d)$ days and $m + 2$ persons paint a house in $\left(\dfrac{md}{m + 2}\right)$ days.

Alternate method

Here, $M_1 = m, D_1 = d,$
$\quad M_2 = (m + 2), D_2 = ?$
$\quad M_1 D_1 = M_2 D_2$
$\quad\quad md = (m + 2)D_2 = \dfrac{md}{m + 2}$

In 8h $= \dfrac{8}{16}$ units of work completed

$= \dfrac{1}{2}$ units of work completed

2015 (I)

28. The efficiency of P is twice that of Q, whereas the efficiency of P and Q together is three times that of R. If P, Q and R work together on a job, then in what ratio should they share their earnings?

(a) 2 : 1 : 1   (b) 4 : 2 : 1
(c) 4 : 3 : 2   (d) 4 : 2 : 3

⊙ *(a)* Let P can finish the work $= x$ days
Q can finish the work $= 2x$ days

∴ Q's one day work $= \dfrac{1}{2x}$

and P's one day work $= \dfrac{1}{x}$

Now, $(P + Q)$'s one day's work
$= \dfrac{1}{x} + \dfrac{1}{2x} = \dfrac{3}{2x}$

∴ $(P + Q)$ will complete the whole work in $\dfrac{2x}{3}$ days.

According to the question,
R will complete this work $= \dfrac{2x}{3} \times 3$
$= 2x$ days

∴ R's one day's work $= \dfrac{1}{2x}$

∴ Required ratio $= \dfrac{1}{x} : \dfrac{1}{2x} : \dfrac{1}{2x}$
$= 1 : \dfrac{1}{2} : \dfrac{1}{2} = 2 : 1 : 1$

2014 (II)

29. Pipe A can fill a tank in 3 h but there is a leakage also, due to which it takes 3.5 h for the tank to be filled. How much time will the leakage take in emptying the tank, if the tank is filled initially?

(a) 21 h   (b) 20 h   (c) 18 h   (d) 10.5 h

⊙ *(a)* Given, pipe A can fill the tank in 3 h.

∴ Part of tank filled by pipe A in 1 h $= \dfrac{1}{3}$

and due to leakage pipe A fills the tank in 3.5 h

∴ Due to leakage part of tank filled by pipe A in 1h $= \dfrac{1}{3.5}$

Now, difference between time due to leakage $= \dfrac{1}{3} - \dfrac{1}{3.5} = \dfrac{7 - 6}{21} = \dfrac{1}{21}$

So, if the tank is full, then leakage take 21 h to empty the tank.

30. A, B and C can do a piece of work individually in 8, 12 and 15 days, respectively. A and B start working together but A quits after working for 2 days. After this, C joins and works till completion of the work. In how many days, will the work be completed?

(a) $3\dfrac{8}{9}$ days   (b) $5\dfrac{8}{9}$ days

(c) $5\dfrac{2}{3}$ days   (d) $6\dfrac{1}{18}$ days

⊙ *(b)* Work done by A in one day $= \dfrac{1}{8}$.

work done by B in one day $= \dfrac{1}{12}$

and work done by C in one day $= \dfrac{1}{15}$

Let the work will be completed in x days.

Then, $\quad \dfrac{2}{8} + \dfrac{x}{12} + \dfrac{x - 2}{15} = 1$

$\Rightarrow \quad \dfrac{1}{4} + \dfrac{x}{12} + \dfrac{x - 2}{15} = 1$

$\Rightarrow \quad \dfrac{15 + 5x + 4(x - 2)}{60} = 1$

$\Rightarrow \quad 15 + 5x + 4x - 8 = 60$

$\Rightarrow \quad 9x + 7 = 60$

$\Rightarrow \quad 9x = 53$

∴ $\quad x = \dfrac{53}{9} = 5\dfrac{8}{9}$

Hence, work will completed in $5\dfrac{8}{9}$ days.

31. A is thrice as efficient as B and hence completes a work in 40 days less than the number of days taken by B. What will be the number of days taken by both of them when working together?

(a) 22.5 days   (b) 15 days
(c) 20 days   (d) 18 days

⊙ *(b)* Let A can finish the work $= x$ days
B can finish the work $= 3x$ days
[∵ A is thrice as efficient as B]

According to the question,
$\quad 3x - x = 40$
$\quad\quad 2x = 40 \Rightarrow x = 20$

So A can finish the work = 20 days
and B can finish the work
$\quad\quad = 3 \times 20 = 60$ days

Now, A's 1 day's work $= \dfrac{1}{20}$

B's 1 day's work $= \dfrac{1}{60}$

$(A + B)$'s 1 day's work
$= \dfrac{1}{20} + \dfrac{1}{60} = \dfrac{3 + 1}{60} = \dfrac{4}{60} = \dfrac{1}{15}$

Hence, $(A + B)$ will complete the work together $= \dfrac{1}{\frac{1}{15}} = 15$ days

32. If 10 persons can dig 8 ft trench in 12 days, then how many days will 8 persons take to dig 6 ft trench?

(a) 10 days   (b) 10.25 days
(c) 11 days   (d) 11.25 days

⊙ *(d)* Let 8 persons will take x days.
Here, $M_1 = 10, D_1 = 12, W_1 = 8$
$\quad\quad M_2 = 8, D_2 = x, W_2 = 6$

∴ $\quad \dfrac{M_1 D_1}{W_1} = \dfrac{M_2 D_2}{W_2}, \dfrac{10 \times 12}{8} = \dfrac{8 \times x}{6}$

$8 \times 8 \times x = 10 \times 6 \times 12$

∴ $\quad x = \dfrac{10 \times 6 \times 12}{8 \times 8} = 11.25$

Hence, eight persons will take 11.25 days.

2014 (I)

33. 15 men complete a work in 16 days. If 24 men are employed, then the time required complete that work will be

(a) 7 days   (b) 8 days
(c) 10 days   (d) 12 days

⊙ *(c)* Let the work done be 1.
According to the formula,
$\quad M_1 D_1 W_2 = M_2 D_2 W_1$
Here, $\quad M_1 = 15, D_1 = 16, W_1 = W_2 = 1$
$\quad\quad M_2 = 24$ and $D_2 = ?$
$\Rightarrow \quad 15 \times 16 \times 1 = 24 \times D_2 \times 1$
∴ $\quad\quad D_2 = \dfrac{15 \times 16}{24} = 10$

Therefore, 10 days are required to complete the work.

34. A can do a piece of work in 4 days and B can complete the same work in 12 days. What is the number of days required to do the same work together?

(a) 2 days   (b) 3 days
(c) 4 days   (d) 5 days

(b) A's one day's work $= \dfrac{1}{4}$,

B's one day's work $= \dfrac{1}{12}$

One day's work of A and B together

$= \dfrac{1}{4} + \dfrac{1}{12} = \dfrac{3+1}{12} = \dfrac{4}{12} = \dfrac{1}{3}$

Days required by A and B together to do the work

$= \dfrac{1}{\text{One day's work of } A \text{ and } B \text{ together}}$

$= 3$ days

35. X can do a work in 16 days. In how many days will the work be completed by Y, if the efficiency of Y is 60% more than that of X?

(a) 10 days   (b) 12 days
(c) 25 days   (d) 30 days

(a) Efficiency is proportional to days

$$X \qquad\qquad Y$$
$$100 \xrightarrow{\;(+60\%)\;} 160$$

$\Rightarrow \qquad 100 \times 16 = 160 \times D$

$\therefore \qquad D = \dfrac{100 \times 16}{160} = 10$ days

Alternate Method

X's 1 day's work $= \dfrac{1}{16}$

Y's 1 day's work $= \dfrac{1}{16} + \dfrac{1}{16} \times \dfrac{60}{100}$

$= \dfrac{1}{16} \times \dfrac{160}{100} = \dfrac{1}{10}$

Hence, Y will complete the work

$= \dfrac{1}{\frac{1}{10}} = 10$ days

36. 2 men and 1 woman can complete a piece of work in 14 days, while 4 women and 2 men can do the same work in 8 days. If a man gets ₹ 90 per day, then what should be the wages per day of a woman?

(a) ₹ 48   (b) ₹ 60   (c) ₹ 72   (d) ₹ 135

(b) $\because \qquad 2\,m + 1\,w = \dfrac{1}{14}$

$\Rightarrow \qquad 14\,(2\,m + 1\,w) = 1 \qquad \text{...(i)}$

and $\qquad 4\,w + 2\,m = \dfrac{1}{8}$

$\Rightarrow \qquad 8\,(4\,w + 2\,m) = 1 \qquad \text{...(ii)}$

On equating Eqs. (i) and (ii), we get

$\qquad 14\,(2\,m + 1\,w) = 8\,(4\,w + 2\,m)$

$\Rightarrow \qquad 28\,m + 14\,w = 32\,w + 16\,m$

$\Rightarrow \qquad 28\,m - 16\,m = 32\,w - 14\,w$

$\Rightarrow \qquad 12\,m = 18\,w$

$\Rightarrow \qquad \dfrac{m}{w} = \dfrac{18}{12} = \dfrac{3}{2}$

Since, efficiency of 1 man and 1 woman is 3 : 2.
So, their wages must be in the same ratio.

$\therefore \qquad \dfrac{90}{x} = \dfrac{3}{2}$

[where, x = wages of a woman]

$\therefore \qquad x = \dfrac{90 \times 2}{3} = ₹\ 60$

37. 18 men can earn ₹ 360 in 5 days. How much money will 15 men earn in 9 days?

(a) ₹ 600   (b) ₹ 540   (c) ₹ 480   (d) ₹ 360

(b) $M_1 D_1 W_2 = M_2 D_2 W_1$

Here, $M_1 = 18$, $D_1 = 5$, $W_1 = 360$
$\qquad M_2 = 15$, $D_2 = 9$, $W_2 = x$

$\Rightarrow 18 \times 5 \times x = 15 \times 9 \times 360$

$\therefore \qquad x = \dfrac{15 \times 9 \times 360}{18 \times 5} = ₹\ 540$

38. 20 workers working for 5 h per day complete a work in 10 days. If 25 workers are employed to work 10 h per day, then what is the time required to complete the work?

(a) 4 days   (b) 5 days
(c) 6 days   (d) 8 days

(a) $M_1 D_1 T_1 = M_2 D_2 T_2$

Here, $M_1 = 20$, $D_1 = 10$,
$\qquad T_1 = 5\text{h}$, $M_2 = 25$,
$\qquad D_2 = ?$, $T_2 = 10\text{h}$

$\Rightarrow \qquad 20 \times 10 \times 5 = 25 \times D_2 \times 10$

$\therefore \qquad D_2 = \dfrac{20 \times 10 \times 5}{25 \times 10} = 4$ days

39. A can finish a work in 15 days, B in 20 days and C in 25 days. All these three worked together and earned ₹ 4700. The share of C is

(a) ₹ 1200 (b) ₹ 1500 (c) ₹ 1800 (d) ₹ 2000

(a) A's one day's work $= \dfrac{1}{15}$

B's one day's work $= \dfrac{1}{20}$

and C's one day's work $= \dfrac{1}{25}$

One day's work of A, B and C worked together $= \dfrac{1}{15} + \dfrac{1}{20} + \dfrac{1}{25}$

$= \dfrac{20 + 15 + 12}{300} = \dfrac{47}{300}$

Days taken to complete work by A, B and C working together $= \dfrac{300}{47}$

$\therefore \qquad$ Share of $C = \dfrac{1}{25} \times \dfrac{300}{47} \times 4700$

$= ₹\ 1200$

40. 4 goats or 6 sheep can graze a field in 50 days. 2 goat and 9 sheep can graze the field in

(a) 100 days   (b) 75 days
(c) 50 days   (d) 25 days

(d) Part of field grazed by 4 goats in

1 day $= \dfrac{1}{50}$

Part of field grazed by 1 goat in 1 day

$= \dfrac{1}{50 \times 4} = \dfrac{1}{200}$

Now, $4\,g = 6\,s$

[here, g = goats, s = sheep]

$\Rightarrow \qquad 1s = \dfrac{4}{6}\,g = \dfrac{2}{3}\,g$

Now, $2\,g + 9\,s = 2\,g + 9 \times \dfrac{2}{3}\,g$

$= 2\,g + 6\,g = 8\,g$

$\therefore$ 8 goats can graze the field

$= \dfrac{1}{\frac{8}{200}} = 25$ days

41. Pipe A can fill a tank in 10 min and pipe B can empty it in 15 min. If both the pipes are opened in an empty tank, then the time taken to make it full is

(a) 20 min   (b) 25 min
(c) 30 min   (d) None of these

(c) Part filled by pipe A in 1 min $= \dfrac{1}{10}$

and part empty by pipe B in 1 min $= \dfrac{1}{15}$

$\therefore$ Total tank filled in 1 minute

$= \dfrac{1}{10} - \dfrac{1}{15} = \dfrac{3-2}{30} = \dfrac{1}{30}$

Hence, the tank will be filled in 30 min.

42. X can complete a job in 12 days. If X and Y work together, they can complete the job in $6\dfrac{2}{3}$ days. Y alone can complete the job in

(a) 10 days   (b) 12 days
(c) 15 days   (d) 18 days

(c) X's one day's work $= \dfrac{1}{12}$

$(X + Y)$'s one day's work $= \dfrac{3}{20}$

$\therefore$ Y's one day's work

$= \dfrac{3}{20} - \dfrac{1}{12} = \dfrac{4}{60} = \dfrac{1}{15}$

$\therefore$ Number of days taken by Y to complete the work = 15 days

43. A mason can build a tank in 12 h. After working for 6 h, he took the help of a boy and finished the work in another 5h. The time that the boy will take alone to complete the work is

(a) 30 h   (b) 45 h
(c) 60 h   (d) 64 h

(c) Mason work for 1 h $= \dfrac{1}{12}$

Mason work for 6 h $= \dfrac{6}{12} = \dfrac{1}{2}$

Work left $= 1 - \dfrac{1}{2} = \dfrac{1}{2}$

Now, let the boy can finish the work in x h.

Then, their 1 h's work $= \dfrac{1}{12} + \dfrac{1}{x} = \dfrac{x + 12}{12x}$

$\therefore \qquad \dfrac{x + 12}{12x} \times 5 = \dfrac{1}{2}$

$\Rightarrow \quad \dfrac{5x + 60}{12x} = \dfrac{1}{2} \Rightarrow 10x + 120 = 12x$

$\Rightarrow \qquad 120 = 2x \quad \therefore \quad x = 60$ h

44. If 3 men and 4 boys can do a piece of work in 8 days, then 6 men and 8 boys can do the same work in

(a) 2 days   (b) 4 days
(c) 6 days   (d) 16 days

⊘ **(b)** 3 men + 4 boys = 8 days, 6 men + 5 boys= ?

Here, $\qquad M_1 D_1 = M_2 D_2$

$\Rightarrow \quad (3M + 4B) \times 8 = (6M + 8B) \times D_2$

$\Rightarrow \quad (3M + 4B) \times 8 = 2(3M + 4B) \times D_2$

$\therefore \qquad D_2 = \dfrac{(3M + 4B) \times 8}{2 \times (3M + 4B)}$

$\qquad\qquad = 4$ days

45. X can do a piece of work in 25 day. Y is 25% more efficient than X. The number of day taken by Y is

(a) 15 days   (b) 20 days
(c) 21 days   (d) 30 days

⊘ **(b)** X Y
    $100 \xrightarrow{(+25\%)} 125$

Efficiency is proportional to days

$\Rightarrow \qquad 100 \times 25 = 125 \times$ Days

$\therefore \quad$ Days of $Y = \dfrac{100 \times 25}{125} = 20$ days

46. 45 people take 18 day to dig a pond. If the pond would have to be dug in 15 days, then the number of people to be employed will be

(a) 50   (b) 54   (c) 60   (d) 72

⊘ **(b)** Given that, $M_1 = 45$, $D_1 = 18$
$\qquad\qquad M_2 = x$, $D_2 = 15$

By using the formula,

$M_1 D_1 = M_2 D_2$

$\therefore \qquad M_2 = \dfrac{M_1 D_1}{D_2} \Rightarrow x = \dfrac{45 \times 18}{15}$

$\qquad\qquad = 3 \times 18 = 54$

47. A and B can do a piece of work in 10 h. B and C can do it in 15 h, while A and C take 12 h to complete the work. B independently can complete the work in

(a) 12 h   (b) 16 h   (c) 20 h   (d) 24 h

⊘ **(d)** A's and B's 1 h's work $= \dfrac{1}{10}$

B's and C's 1 h's work $= \dfrac{1}{15}$

and A's and C's 1 h's work $= \dfrac{1}{12}$

$\therefore$ A's, B's and C's 1 h's work

$= \dfrac{1}{2}\left(\dfrac{1}{10} + \dfrac{1}{15} + \dfrac{1}{12} \right) = \dfrac{1}{2} \times \dfrac{1}{4} = \dfrac{1}{8}$

Hence, B's work in 1 h $= \dfrac{1}{8} - \dfrac{1}{12} = \dfrac{1}{24}$

So, B independently can complete the work in 24 h.

48. There are two taps A and B to fill up a water tank. The tank can be filled in 40 min, if both taps are on. The same tank can be filled in 60 min, if tap A alone is on. How much time will tap B alone take, to fill up the same tank?

(a) 64 min   (b) 80 min
(c) 96 min   (d) 120 min

⊘ **(d)** Work done by tap A and B together in 1 min $= \dfrac{1}{40}$ work done by A in 1 min $= \dfrac{1}{60}$

Work done by tap B in 1 min

$= \dfrac{1}{40} - \dfrac{1}{60} = \dfrac{3 - 2}{120} = \dfrac{1}{120}$

So, total time taken by the tap B to fill the tank is 120 min.

49. A stock of food is enough for 240 men for 48 days. How long will the same stock last for 160 men?

(a) 54 days   (b) 60 days
(c) 64 days   (d) 72 days

⊘ **(d)** Here, $M_1 = 240$, $D_1 = 48$

$M_2 = 160$, $D_2 = ?$

By using formula, $M_1 D_1 = M_2 D_2$

$240 \times 48 = 160 \times D_2$

$D_2 = \dfrac{240 \times 48}{160} = 72$ days

50. A can do a piece of work in 'x' day and B can do the same work $3x$ days. To finish the work together they take 12 days. What is the value of 'x'?

(a) 8   (b) 10   (c) 12   (d) 16

⊘ **(d)** 1 day's work of $A = \dfrac{1}{x}$,

1 day's work of $B = \dfrac{1}{3x}$

$\therefore$ 1 day's work of both A and B

$= \dfrac{1}{x} + \dfrac{1}{3x} = \dfrac{4}{3x}$

and given one day's work of both A and B

$= \dfrac{1}{12}$

$\Rightarrow \quad \dfrac{4}{3x} = \dfrac{1}{12} \Rightarrow 3x = 48 \quad \therefore \quad x = 16$

51. A, B and C can do a piece of work individually in 8, 10 and 15 days, respectively. A and B start working but A quits after working for 2 days. After this, C joins B till the completion of work. In how many days will the work be completed?

(a) 53/9 days   (b) 34/7 days
(c) 85/13 days   (d) 53/10 days

⊘ **(d)** Let the work will be completed in
$\qquad\qquad = x$ days

According to the question,

$\dfrac{2}{8} + \dfrac{x}{10} + \dfrac{x - 2}{15} = 1$

$\dfrac{3x + 2(x - 2)}{30} = 1 - \dfrac{1}{4}$

$\dfrac{3x + 2x - 4}{30} = \dfrac{3}{4}$

$5x = \dfrac{45}{2} + 4 = \dfrac{45 + 8}{2} \Rightarrow x = \dfrac{53}{10}$

Hence, the work will be completed in $\dfrac{53}{10}$ days.

52. 76 ladies complete a job in 33 days. Due to some reason some ladies did not join the work and therefore it was completed in 44 days. The number of ladies who did not report for the work is

(a) 17   (b) 18   (c) 19   (d) 20

⊘ **(c)** Given, number of ladies, $M_1 = 76$

The number of days to complete the work, $D_1 = 33$

Let number of ladies who did not report for the work $= x$

By given condition, $M_2 = 76 - x$

and $\qquad\qquad D_2 = 44$

$\because \qquad\qquad M_1 D_1 = M_2 D_2$

$\therefore \qquad 76 \times 33 = (76 - x) \times 44$

$\Rightarrow \qquad 76 - x = \dfrac{76 \times 3}{4} = 19 \times 3$

$\therefore \qquad\qquad x = 76 - 57 = 19$

53. How many men will be required to plough 100 acre of land in 10 days, if 10 men require 8 days to plough 20 acre of land?

(a) 30   (b) 40   (c) 50   (d) 60

⊘ **(b)** Here, $M_1 = 10$, $D_1 = 8$, $W_1 = 20$

and $\qquad M_2 = x$ (let), $D_2 = 10$, $W_2 = 100$

$\because \qquad \dfrac{M_1 D_1}{W_1} = \dfrac{M_2 D_2}{W_2}$

$\therefore \qquad \dfrac{10 \times 8}{20} = \dfrac{x \times 10}{100} \Rightarrow x = 8 \times 5 = 40$

7

PERCENTAGE

1. In a hostel the rent per room is increased by 20%. If number of rooms in the hostel is also increased by 20% and the hostel is always full, then what is the percentage change in the total collection at the cash counter?

(a) 30%   (b) 40%   (c) 44%   (d) 48%

⊙ **(c)** In a hostel the rent per room is increased by 20%.
The number of rooms in the hostel is also increased by 20%.
Then, the percentage change in the total collection at the cash counter

$$= a + b + \frac{a \times b}{100}$$

$$\therefore \quad a = b = 20\%$$

$$= 20 + 20 + \frac{20 \times 20}{100} = 44\%$$

Option (c) is correct.

Directions (Q. Nos. 2-4)

Read the given information carefully and answer the given questions below.

In a certain town of population size 100000 three types of newspapers (I, II and III) are available. The percentages of the people in the town who read these papers are as follows.

Newspaper	Proportion of readers
I	10%
II	30%
III	5%
Both I and II	8%
Both II and III	4%
Both I and III	2%
All the three (I, II and III)	1%

2. What is the number of people who read only one newspaper?

(a) 20000 (b) 25000 (c) 30000 (d) 35000

⊙ **(a)** Percentage of people who read only one newspaper.
= I + II + III − 2 [I and II + II and III + I and III] + 3 [I, II and III]
= 10 + 30 + 5 − 2[8 + 4 + 2] + 3(1)
= 45 − 28 + 3 = 20%
Population of town = 100000
Number of people who read only one newspaper = $100000 \times \frac{20}{100} = 20000$
Option (a) is correct.

3. What is the number of people who read atleast two newspapers?

(a) 12000 (b) 13000 (c) 14000 (d) 15000

⊙ **(a)** Percentage of people who read atleast two newspapers.
= I and II + II and III + I and III − 2 [I, II and III]
= 8 + 4 + 2 − 2(1) = 14 − 2 = 12%
Number of people who read atleast two newspapers = $100000 \times \frac{12}{100} = 12000$
Option (a) is correct.

4. What is the number of people who do not read any of these three newspapers?

(a) 62000 (b) 64000 (c) 66000 (d) 68000

⊙ **(d)** The percentage of people who read newspaper
I + II + III − [I and II + II and III + I and III] + [I, II and III]
= 10 + 30 + 5 − [8 + 4 + 2] + 1
= 32%
Percentage of people who do not read any of these three newspapers.
= 100% − 32% = 68%
The number of people who do not read any of these three newspapers
= $100000 \times \frac{68}{100} = 68000$
Option (d) is correct.

5. x, y and z are three numbers such that x is 30% of z and y is 40% of z. If x is $p\%$ of y, then what is the value of p?

(a) 45   (b) 55
(c) 65   (d) 75

⊙ **(d)** x, y and z are three numbers,

$$x = \frac{30}{100} \times z \implies x = \frac{3z}{10} \quad \ldots \text{(i)}$$

$$y = \frac{40}{100} \times z \implies y = \frac{4z}{10} \quad \ldots \text{(ii)}$$

$$x = \frac{p}{100} \times y$$

$$P = \frac{x \times 100}{y} = \frac{\frac{3z}{10}}{\frac{4z}{10}} \times 100$$

[from Eqs. (i) and (ii)]

$$= \frac{3 \times 100}{4} = 75\%$$
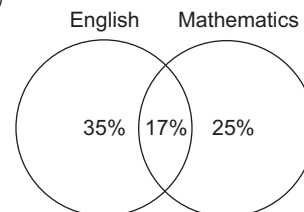
Option (d) is correct.

6. In an examination, 52% candidates failed in English and 42% failed in Mathematics. If 17% failed in both the subjects, then what per cent passed in both the subjects?

(a) 77   (b) 58
(c) 48   (d) 23

⊙ **(d)**

Total number of students fail
= 35 + 17 + 25 = 77%
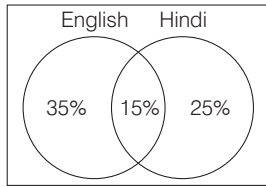Total number of students passed in both the subjects = 100 − 77 = 23%
Option (d) is correct.

2018 (II)

7. In an examination, 50% of the candidates failed in English, 40% failed in Hindi and 15% failed in both the subjects. The percentage of candidates who passed in both English and Hindi is

(a) 20%   (b) 25%
(c) 60%   (d) 75%

⊘ *(b)* Given,
50% candidates failed in English
40% candidates failed in Hindi
and 15% candidates failed in both

English   Hindi

35% 15% 25%

∴ Total percentage of candidates who failed either in one or two subjects
= (35 + 15 + 25)% = 75%
∴ Percentage of candidates who passed in both subjects = (100 − 75)% = 25%

8. Out of 85 children playing badminton or table tennis or both, the total number of girls in the group is 70% of the total number of boys in the group. The number of boys playing only badminton is 50% of the number of boys and the total number of boys playing badminton is 60% of the total number of boys. The number of children playing only table tennis is 40% of the total number of children and a total number of 12 children play badminton and table tennis both. The number of girls playing only badminton is

(a) 14   (b) 16   (c) 17   (d) 35

⊘ *(a)* Total children = 85
Let number of boys be B
∴ Number of girls = $\dfrac{70}{100}B$
Now, $B + \dfrac{70}{100}B = 85$
∴ $B = 50$
And number of girls = 85 − 50 = 35
Number of boys playing only badminton
$= 50 \times \dfrac{50}{100} = 25$

Number of boys playing badminton
$= 50 \times \dfrac{60}{100} = 30$
Number of boys playing both games
$= 30 − 25 = 5$
Number of boys playing only table tennis = 50 − 30 = 20
Number of children playing only table tennis $= 85 \times \dfrac{40}{100} = 34$
Number of children playing both games = 12
Number of girls playing both games
$= 12 − 5 = 7$
Number of girls playing only table tennis
$= 34 − 20 = 14$
Number of girls playing table tennis
$= 14 + 7 = 21$
Number of girls playing only badminton
$= 35 − 21 = 14$

Badminton   Table Tennis

Boys= 25   Boys= 20
Girls = 14   Girls = 14

Boys= 5
Girls = 7
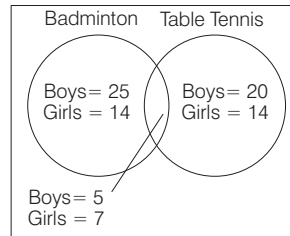
∴ Number of girls playing only badminton = 14

2018 (I)

9. If the price of wheat rises by 25%, then by how much percent must a man reduce his consumption in order to keep his budget the same as before?

(a) 15%   (b) 20%
(c) 25%   (d) 30%

⊘ *(b)* Let the price of 1kg of wheat be ₹100 and the family consumes 1 kg per month
Increased price of wheat per kg
$= \dfrac{125}{100} \times 100 = ₹125$
Reduction in consumption so, as not to increase the expenses
$= ₹(125 − 100)$
$= ₹ 25$
∴ Required percentage $= \dfrac{25}{125} \times 100$
$= 20\%$

Alternate Method

Required percentage $= \dfrac{a}{100 + a} \times 100$
Here, $a = 25\%$
$= \dfrac{25}{100 + 25} \times 100 = 20\%$

10. The annual income of a person decreases by ₹ 64 if the annual rate of interest decreases from 4% to 3.75%. What is his original annual income?

(a) ₹ 24000   (b) ₹ 25000
(c) ₹ 25600   (d) ₹ 24600

⊘ *(c)* Decrement in rate of interest
$= (4 − 3.75)\% = 0.25\%$
Let the original annual income be ₹x
According to the question,
0.25% of $x = 64$ $\left[x \times \dfrac{25}{10000} = 64 \right]$
∴ $x = \dfrac{64 \times 10000}{25}$
∴ Original annual income = ₹25600

2017 (II)

11. A fruit seller has a certain number of mangoes of which 5% are rotten. He sells 75% of the remainder and he is left with 95 mangoes.

How many mangoes did he have originally?

(a) 500   (b) 450   (c) 400   (d) 350

⊘ *(c)* Let the fruit seller has x mangoes
∴ Good mangoes = $x − 5\%$ of $x = 95\%$ of
$x = \dfrac{95}{100}x$
According to the question,
75% of $\dfrac{95x}{100} + 95 = \dfrac{95x}{100}$
$\Rightarrow \dfrac{75 \times 95x}{10000} + 95 = \dfrac{95x}{100}$
$\Rightarrow \dfrac{75x}{10000} + 1 = \dfrac{x}{100}$
$\Rightarrow \dfrac{3x}{400} + 1 = \dfrac{x}{100}$
$\Rightarrow \dfrac{x}{100} − \dfrac{3x}{400} = 1$
$\Rightarrow \qquad x = 400$
∴ Total number of mangoes = 400

12. A student has to secure 40% of marks to pass an examination. He gets only 45 marks and fails by 5 marks. The maximum marks are

(a) 120   (b) 125   (c) 130   (d) 150

⊘ *(b)* Let the maximum marks be x.
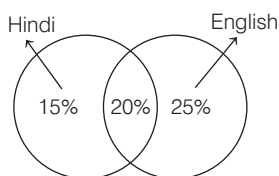Then, 40% of $x = 45 + 5$
$\dfrac{40}{100} \times x = 50$
$\Rightarrow \qquad x = \dfrac{50 \times 100}{40}$
∴ $x = 125$

13. In an examination, 35% students failed in Hindi, 45% students failed in English and 20% students failed in both the subjects. What is the percentage of students passing in both the subjects?

(a) 0   (b) 20
(c) 30   (d) 40

⊙ *(d)* Diagram for failed

Hindi   English

15%   20%   25%

Total failed students
= 15 + 20 + 25 = 60%
∴ Percentage of passed students
= 100 − 60 = 40%

14. When prices rise by 12%, if the expenditure is to be same, what is the percentage of consumption to be reduced?

(a) $16\dfrac{2}{3}\%$ (b) $10\dfrac{2}{7}\%$

(c) $16\dfrac{3}{5}\%$ (d) $10\dfrac{5}{7}\%$

⊙ *(d)* We have price rise by 12%
∴ $a = 12\%$
The percentage of consumption to be reduced

$= \dfrac{a}{100 + a} \times 100$

$= \dfrac{12}{100 + 12} \times 100$

$= \dfrac{1200}{112} = \dfrac{75}{7} = 10\dfrac{5}{7}\%$

Directions *(Q. Nos. 15-19)* In a University there are 1200 students studying four different subjects, Mathematics, Statistics, Physics and Chemistry. 20% of the total number of students are studying Mathematics, one-fourth of the total number of students are studying Physics, 320 students are studying Statistics and remaining students are studying Chemistry. Three-fifth of the total number of students studying Chemistry are girls, 150 boys are studying Mathematics. 60% of students studying Physics are boys. 250 girls are studying Statistics.

15. What is the total number of boys studying Statistics and Physics?

(a) 180   (b) 240   (c) 250   (d) 310

16. The number of girls studying Statistics is what percent (approximate) of the total number of students studying Chemistry?

(a) 58.8   (b) 73.5
(c) 78.7   (d) 80.6

17. In which subjects is the different between the number of boys and girls equal?

(a) Mathematics and Chemistry
(b) Statistics and Chemistry
(c) Mathematics and Physics
(d) Mathematics and Statistics

18. What is the difference between the number of boys studying Mathematics and the number of girls studying Physics?

(a) 20   (b) 30
(c) 60   (d) 80

19. What is the ratio of the total number of boys of the total number of girls?

(a) 67 : 83
(b) 17 : 26
(c) 27 : 19
(d) 189 : 179

⊙ **Solutions** (Q. Nos. 19-23)
Total number of students = 1200
Number of students studying Mathematics

$= \dfrac{20}{100} \times 1200 = 240$

Number of students studying statistics
= 320
Number of students studying physics

$= \dfrac{1}{4} \times 1200 = 300$

Number of students studying chemistry
= 1200 − (240 + 320 + 300)
= 340
Number of girls and boys in Mathematics are 90(240 − 150 = 90) and 70, respectively.
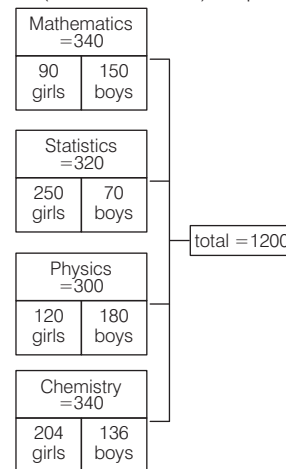Number of girls and boys in statistics are 250 and 70 (320 − 250 = 50), respectively
Number of girls and boys in Physics are

$120 \left(300 \times \dfrac{40}{100} = 120 \right)$

and 180 (300 − 120), respectively

Number of girls and boys in chemistry are 204 $\left(\dfrac{3}{5} \times 340 = 204 \right)$

and 136 (340 − 204 = 136), respectively

Mathematics
=340
90 girls | 150 boys

Statistics
=320
250 girls | 70 boys

total = 1200

Physics
=300
120 girls | 180 boys

Chemistry
=340
204 girls | 136 boys

19. *(c)* Total number of boys studying statistics and Physics = 70 + 180 = 250

20. *(b)* Required percentage

$= \dfrac{250}{340} \times 100 = 73.5\%$

21. *(c)* Difference between the number of boys and girls in Mathematics
= 150 − 90 = 60.
Difference between the number of and girls in physics = 180 − 120 = 60
∴ Differnece in Mathematics and Physics is equal.

22. *(b)* Required difference = 150 − 120 = 30

23. *(a)* Total number of boys
= 150 + 70 + 180 + 136
= 536
and total number of girls
= 1200 − 536
= 664

∴ Required ratio $= \dfrac{536}{664} = \dfrac{67}{83}$

2017 (I)

20. If a % of $a + b\%$ of $b = 2\%$ of ab, then what per cent of a is b ?

(a) 50%
(b) 75%
(c) 100%
(d) Cannot be determined

⊙ *(c)* We have,
$a\%$ of $a + b\%$ of $b = 2\%$ of ab

$\Rightarrow \dfrac{a}{100} \times a + \dfrac{b}{100} \times b = \dfrac{2}{100} \times ab$

$\Rightarrow \qquad a^2 + b^2 = 2ab$

$\Rightarrow \qquad a^2 - 2ab + b^2 = 0$

$\Rightarrow \qquad (a-b)^2 = 0$

$\Rightarrow \qquad a = b$

$\therefore$ Required percentage $= \dfrac{b}{a} \times 100$

$= \dfrac{a}{a} \times 100$

$= 100\%$

21. $\dfrac{5}{9}$th part of the population in a village are males. If 30% of the males are married, the percentage of unmarried females in the total population is

(a) $20\dfrac{2}{9}$ (b) $27\dfrac{5}{9}$

(c) $27\dfrac{7}{9}$ (d) $29\dfrac{2}{9}$

⊙ *(c)* Let the population of village $= x$

$\therefore \qquad$ Males $= \dfrac{5}{9}x$

$\therefore$ Married man $= 30\%$ of $\left(\dfrac{5}{9}x\right)$

$= \dfrac{30}{100} \times \dfrac{5}{9}x = \dfrac{x}{6}$

$\therefore$ Married female $=$ Married Males $= \dfrac{x}{6}$

Now, total females $= x - \dfrac{5x}{9} = \dfrac{4}{9}x$

$\therefore$ Unmarried females $= \dfrac{4}{9}x - \dfrac{x}{6} = \dfrac{5}{18}x$

$\therefore$ Required percentage $= \dfrac{\left(\dfrac{5x}{18}\right) \times 100}{x}$

$= \dfrac{500}{18}\%$

$= \dfrac{250}{9}\% = 27\dfrac{7}{9}\%$

2016 (II)

22. A candidate scoring $x\%$ marks in an examination and fails by a marks, while another candidate who scores $y\%$ marks gets b marks more than the minimum required pass marks.

What is the maximum marks for the examination?

(a) $\dfrac{100(a+b)}{x-y}$ (b) $\dfrac{100(a-b)}{x+y}$

(c) $\dfrac{100(a+b)}{y-x}$ (d) $\dfrac{100(a-b)}{x-y}$

⊙ *(c)* Let the maximum marks be M.

$\therefore$ Passing marks

$= x\%$ of $M + a$ and $y\%$ of $M - b$

Hence, $x\%$ of $M + a = y\%$ of $M - b$

$\Rightarrow \qquad \dfrac{xM}{100} + a = \dfrac{yM}{100} - b$

$\Rightarrow \qquad M\left(\dfrac{y}{100} - \dfrac{x}{100}\right) = a + b$

$\therefore \qquad M = \dfrac{100(a+b)}{y-x}$

2016 (I)

23. The expenditure of a household for a certain month is ₹ 20000, out of which ₹ 8000 is spent on education, ₹ 5900 on food, ₹ 2800 on shopping and the rest on personal care. What percentage of expenditure is spent on personal care?

(a) 12%   (b) 16.5%

(c) 18%   (d) 21.8%

⊙ *(b)* Given, total expenditure $= ₹ 20000$

Now, expenditure spent on personal care $= 20000 - [5900 + 8000 + 2800]$

$= ₹ 3300$

Total percentage of expenditure

$= \dfrac{3300}{20000} \times 100\%$

$= 16.5\%$

24. The salary of a person is increased by 10% of his original salary. But he received the same amount even after increment. What is the percentage of his salary he did not receive?

(a) 11%   (b) 10%

(c) $\dfrac{100}{11}\%$ (d) $\dfrac{90}{11}\%$

⊙ *(c)* Let the original salary be x.

Then, increased salary

$= \left(\dfrac{110}{100}\right)x = ₹ \dfrac{11x}{10}$

∵ He received the same salary even after increment.

Amount of salary he did not receive

$= \dfrac{11x}{10} - x = ₹\dfrac{x}{10}$

$\therefore$ Amount of salary in percentage

$= \dfrac{\left(\dfrac{x}{10}\right)}{\left(\dfrac{11x}{10}\right)} \times 100\%$

$= \dfrac{x}{11x} \times 100\%$

$= \dfrac{100}{11}\%$

2015 (II)

25. In an election, 10% of the voters on the voter list did not cast their vote and 60 voters cast their ballot papers blank. There were only two candidates. The winner was supported by 47% of total voters in the voter list and he got 308 votes more than his rival. The number of voters on the voter list is

(a) 3600   (b) 6200

(c) 6028   (d) 6400

⊙ *(b)* Let the number of voters on the voter list be x.

Total cast vote $= 90\%$ of $x - 60$

Winner was supported by 47% of total voter.

i.e. 47% of x

Hence, rival got vote

$= (90\%$ of $x - 60) - 47\%$ of x

$= 43\%$ of $x - 60$

It is given that difference between their votes is 308.

Then, 47% of $x - 43\%$ of $x + 60 = 308$

$\Rightarrow \qquad 4\%$ of $x = 308 - 60$

$\Rightarrow \qquad \dfrac{4}{100}x = 248$

$\therefore \qquad x = \dfrac{248 \times 100}{4} = 6200$

26. 20% of a number when added to 20 becomes the number itself, then the number is

(a) 20   (b) 25

(c) 50   (d) 80

⊙ *(b)* Let number be x.

Then, $\qquad 20 + \dfrac{20}{100}x = x$

$\Rightarrow \qquad x\left(1 - \dfrac{20}{100}\right) = 20$

$\Rightarrow \qquad x \times \dfrac{80}{100} = 20$

$\therefore \qquad x = 25$

27. A's salary was increased by 40% and then decreased by 20%. On the whole, A's salary is increased by

(a) 60%   (b) 40%

(c) 20%   (d) 12%

⊙ *(d)* Let A's salary be ₹ x.

We have,

$x\left(1 + \dfrac{40}{100}\right)\left(1 - \dfrac{20}{100}\right) = x\dfrac{14}{10} \times \dfrac{8}{10}$

$= \dfrac{112x}{100}$

Increase in A's salary $= \dfrac{112x}{100} - x$

$\qquad = \dfrac{12x}{100}$

$\because$ Percentage increase in A's salary

$\qquad = \left(\dfrac{\frac{12x}{100}}{x}\right) \times 100\%$

$\qquad = 12\%$

Alternate Method

Here, $x = 40$, $y = -20$

$\therefore$ Percentage increase in A's salary

$\qquad = x + y + \dfrac{xy}{100}$

$\qquad = 40 - 20 - \dfrac{40 \times 20}{100}$

$\qquad = 20 - 8 = 12\%$

2015 (I)

28. A person could save 10% of his income. But 2 yr later, when his income increased by 20%, he could save the same amount only as before. By how much percentage has his expenditure increased?

(a) $22\dfrac{2}{9}\%$ (b) $23\dfrac{1}{3}\%$ (c) $24\dfrac{2}{9}\%$ (d) $25\dfrac{2}{9}\%$

⊙ *(a)* Let the original income be ₹ x

$\therefore$ Saved income $(s_1) = x \times 10\% = ₹\dfrac{x}{10}$

Initial expenditure $= x - \dfrac{x}{10} = ₹\dfrac{9x}{10}$

2 yr later, when his income increased by 20%.

Then, new income $= x \times 120\% = ₹\dfrac{12x}{10}$

and saved income $(s_2) = ₹\dfrac{x}{10}$

$\therefore$ New expenditure

$=$ New income $-$ Saved income

$= \dfrac{12x}{10} - \dfrac{x}{10} = ₹\dfrac{11x}{10}$

$\therefore$ Required percentage

$= \dfrac{\left[\begin{matrix}\text{New expenditure}\\ -\text{Initial expenditure}\end{matrix}\right]}{\text{Initial expenditure}} \times 100\%$

$= \dfrac{\frac{11x}{10} - \frac{9x}{10}}{\frac{9x}{10}} \times 100\%$

$= \dfrac{200}{9}\% = 22\dfrac{2}{9}\%$

2014 (II)

29. If $m\%$ of $m + n\%$ of $n = 2\%$ of $(m \times n)$, then what percentage of m is n?

(a) 50%
(b) 75%
(c) 100%
(d) Cannot be determined

⊙ *(c)* $\because$ $m\%$ of $m + n\%$ of $n = 2\%$ of $(m \times n)$

$\Rightarrow \dfrac{m}{100} \times m + \dfrac{n}{100} \times n = \dfrac{2}{100} \times (mn)$

$\Rightarrow \dfrac{m^2}{100} + \dfrac{n^2}{100} = \dfrac{2mn}{100}$

$\Rightarrow \quad m^2 + n^2 = 2mn$

$\Rightarrow \quad m^2 + n^2 - 2mn = 0$

$\Rightarrow \quad (m - n)^2 = 0$

$\Rightarrow \qquad m - n = 0$

$\therefore \qquad m = n$

Since, both are equal, so 100% of m is n.

2014 (I)

30. On a 20% discount sale, an article costs ₹ 596. What was the original price of the article?

(a) ₹ 720 (b) ₹ 735 (c) ₹ 745 (d) ₹ 775

⊙ *(c)* Let the original price be ₹ x. Since, at discount of 20% article costs ₹ 596.

Then, $\quad 596 = \dfrac{80}{100} \times x$

$\Rightarrow \quad x = \dfrac{596 \times 100}{80} = 745$

$\therefore$ Original price $=$ ₹ 745

31. A water pipe is cut into two pieces. The longer piece is 70% of the length of the pipe. By how much percentage is the longer piece longer than the shorter piece?

(a) 140 %　　　　(b) $\dfrac{400}{3}\%$

(c) 40 %　　　　(d) None of these

⊙ *(b)* Let the length of the pipe $= 100$ m
Length of longer piece $= 70$ m
Length of shorter piece $= 30$ m
$\therefore$ Required percentage

$= \dfrac{70 - 30}{30} \times 100\%$

$= \dfrac{40}{30} \times 100\% = \dfrac{400}{3}\%$

8

SIMPLE AND COMPOUND INTEREST

2019 (II)

1. The rate of interest on two different schemes is the same and it is 20%. But in one of the schemes, the interest is compounded half yearly and in the other the interest is compounded annually. Equal amounts are invested in the schemes. If the difference of the returns after 2 yr is ₹ 482, then what is the principal amount in each scheme?

(a) ₹ 10000   (b) ₹ 16000
(c) ₹ 20000   (d) ₹ 24000

⊘ **(c)** Let the principal be $100x$.
In 1st scheme $P = 100x$,
Rate $(R) = \dfrac{20}{2}\% = 10\%$,

Time $(T) = 4$ half yearly.

$$CI_1 = \left[P\left(1 + \frac{r}{100}\right)^T - P\right]$$

$$= P\left[\left(1 + \frac{r}{100}\right)^T - 1\right]$$

$$= 100\,x\left[\left(1 + \frac{10}{100}\right)^4 - 1\right]$$

$$= 100x\left[\left(\frac{11}{10}\right)^4 - 1\right]$$

$$= 100x\left[\frac{14641 - 10000}{10000}\right]$$

$$= 100x \times \frac{4641}{10000}$$

$\Rightarrow \quad CI_1 = 46.41x$

In 2nd scheme
$P = 100x,\; R = 20\%, T = 2$ yr

$$CI_2 = P\left[\left(1 + \frac{r}{100}\right)^T - 1\right]$$

$$= 100x\left[\left(1 + \frac{20}{100}\right)^2 - 1\right]$$

$$= 100x\left[\left(\frac{6}{5}\right)^2 - 1\right]$$

$$= 100x\left[\frac{36 - 25}{25}\right]$$

$CI_2 = 44x$

According to the question,
$$CI_1 - CI_2 = 482$$
$$46.41x - 44x = 482$$
$$2.41x = 482$$
$$x = \frac{482}{2.41}$$
$\Rightarrow \qquad x = 200$
$\therefore \qquad$ Principal $= 100 \times 200$
$$= ₹ 20000$$

2. A lent ₹ 25000 to B and at the same time lent some amount to C at same 7% simple interest. After 4 yr A received ₹ 11200 as interest from B and C. How much did A lend to C?

(a) ₹ 20000   (b) ₹ 25000
(c) ₹ 15000   (d) ₹ 10000

⊘ **(c)** Let A lent x amount to C.
According to the question,

$$\Rightarrow \frac{25000 \times 7 \times 4}{100} + \frac{x \times 7 \times 4}{100} = 11200$$

$$\left[\because SI = \frac{P \times R \times T}{100}\right]$$

$$7000 + \frac{28x}{100} = 11200$$

$$28x = 420000$$

$\therefore \qquad\qquad x = 15000$

2019 (I)

3. What is the least number of complete years in which a sum of money put out at 40% annual compound interest will be more than tripled?

(a) 3   (b) 4   (c) 5   (d) 6

⊘ **(b)** Let $\quad P = 100, R = 40\%$

$T = ?$ [the least number of complete years in which amount will be more than tripled]
$$P = 100$$
$$A > 300$$
$$300 < P\left(1 + \frac{R}{100}\right)^n$$
$$300 < 100\left(1 + \frac{40}{100}\right)^n$$
$$3 < (7/5)^n$$
Let $n = 3,\; 3 < (1.4)^3$
$$3 < 2.744 \qquad \text{[it is not true]}$$
Let $n = 4,\; 3 < (1.4)^4$
$$3 < 3.8416 \qquad \text{[it is true]}$$
Hence, the least number of complete years in which amount will be more than tripled is 4 yr.

4. A person divided a sum of ₹ 17200 into three parts and invested at 5%, 6% and 9% per annum simple interest. At the end of two years, he got the same interest on each part of money. What is the money invested at 9%?

(a) ₹ 3200   (b) ₹ 4000
(c) ₹ 4800   (d) ₹ 5000

⊘ **(b)** A person divided a sum of ₹ 17200 into three parts.
$R_1 = 5\%, R_2 = 6\%, R_3 = 9\%$, Time $= 2$yr

Let the money invested at 5%, 6% and 9% be x_1, x_2 and x_3 respectively.
We got the same interest

$$\frac{x_1 \times 5 \times 2}{100} = \frac{x_2 \times 6 \times 2}{100}$$

$$= \frac{x_3 \times 9 \times 2}{100} \qquad \left[\because SI = \frac{P \times R \times T}{100} \right]$$

$$x_1 \times \frac{10}{100} = x_2 \times \frac{12}{100} = x_3 \times \frac{18}{100}$$

Ratio of sum

$$x_1 \times \frac{10}{100} = x_2 \times \frac{12}{100}$$

$$\frac{x_1}{x_2} = \frac{6}{5}$$

$$\Rightarrow \qquad x_1 : x_2 = 6 : 5$$

$$x_2 \times \frac{12}{100} = x_3 \times \frac{18}{100}$$

$$\frac{x_2}{x_3} = \frac{3}{2}$$

$$\Rightarrow \qquad x_2 : x_3 = 3 : 2$$

$x_1 : x_2 : x_3$
$$= 6 \times 3 : 5 \times 3 : 2 \times 5 = 18 : 15 : 10$$

∴ The money invested at

$$9\% = x_3 = \frac{17200 \times 10}{(18 + 15 + 10)}$$

$$= \frac{172000}{43} = ₹4000$$

2018 (II)

5. What is the principal amount which earns ₹ 210 as compound interest for the second year at 5% per annum?

(a) ₹ 2000   (b) ₹ 3200
(c) ₹ 4000   (d) ₹ 4800

⟩ **(c)** Let principal be ₹ P

$\because$ Amount $= \text{Principal} \left(1 + \dfrac{\text{Rate}}{100} \right)^{\text{Time}}$

∴ Amount after one year

$$= P \left(1 + \frac{5}{100} \right)^1 = \frac{21P}{20}$$

CI after one year $= \dfrac{21P}{20} - P = \dfrac{P}{20}$

Similarly, amount after two years

$$= P \left(1 + \frac{5}{100} \right)^2 = \frac{441}{400} P$$

and CI after two years $= \dfrac{441P}{400} - P$

$$= \frac{41P}{400}$$

According to the question,

$$\frac{41P}{400} - \frac{P}{20} = 210$$

$$\Rightarrow \qquad \frac{41P - 20P}{400} = 210$$

$$\therefore \qquad 21P = 210 \times 400$$

or   Principal = ₹ 4000

Alternate Method
Let principal be ₹ P, $R = 5\%$
CI for first year $= \dfrac{P \times 5 \times 1}{100} = \dfrac{P}{20}$

[$\because$ CI for first year is equal to the SI for first year]

Amount after first year $= P + \dfrac{P}{20} = \dfrac{21P}{20}$

CI for second year
$$= \frac{21P}{20} \times \frac{5 \times 1}{100} = \frac{21P}{20 \times 20}$$

$$210 = \frac{21P}{400}$$

$$P = ₹ 4000$$

6. Two equal amounts were borrowed at 5% and 4% simple interest. The total interest after 4 yr amounts to ₹ 405. What was the total amount borrowed?

(a) ₹ 1075   (b) ₹ 1100
(c) ₹ 1125   (d) ₹ 1150

⟩ **(*)** Let the amount borrowed be ₹ P each for both the rates.

$\because$ Simple interest
$$= \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}$$

∴ According to the question,

$$\frac{P \times 5 \times 4}{100} + \frac{P \times 4 \times 4}{100} = 405$$

$$\Rightarrow \qquad 20P + 16P = 40500$$

$$\therefore \qquad P = \frac{40500}{36} = 1125$$

$\therefore$ Amount borrowed = ₹ 1125
∴ Total amount borrowed $= 2 \times 1125$
$$= ₹ 2250$$

2018 (I)

7. A person borrowed ₹ 5,000 at 5% rate of interest per annum and immediately lent it at 5.5%. After two years he collected the amount and settled his loan. What is the amount gained by him in this transaction?

(a) ₹ 25   (b) ₹ 50
(c) ₹ 100   (d) ₹ 200

⟩ **(b)** Principal = ₹ 5000
and time period = 2 yr
$\because$ Simple interest
$$= \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}$$

∴ Required profit
$$= \frac{5000 \times 5.5 \times 2}{100} - \frac{5000 \times 5 \times 2}{100}$$

$$= \frac{5000 \times 2}{100} (5.5 - 5) = 100 \times 0.5$$

$$= ₹ 50$$

8. A merchant commences with a certain capital and gains annually at the rate of 25%. At the end of 3 yr he has ₹10000. What is the original amount that the merchant invested?

(a) ₹ 5120   (b) ₹ 5210
(c) ₹ 5350   (d) ₹ 5500

⟩ **(a)** Let the original amount be ₹ x.
Annual gain = 25 %,
Time period = 3 yr
And final amount = ₹10000

$$\text{Amount} = P \left[1 + \frac{R}{100} \right]^n$$

$$10000 = x \left[1 + \frac{25}{100} \right]^3 = x \left[\frac{125}{100} \right]^3$$

$$\therefore 10,000 = x \times \frac{125}{100} \times \frac{125}{100} \times \frac{125}{100}$$

$$\therefore \qquad x = 10000 \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5}$$

$\therefore$ Original amount $x = ₹5120$

2017 (II)

9. The difference between the compound interest (compounded annually) and simple interest on a sum of money deposited for 2 yr at 5% per annum is ₹ 15. What is the sum of money deposited?

(a) ₹ 6000   (b) ₹ 4800
(c) ₹ 3600   (d) ₹ 2400

⟩ **(a)** Let the sum of money deposited by ₹ P. Then, according to given condition
CI − SI = 15

$$\therefore \left[P \left(1 + \frac{5}{100} \right)^2 - P \right] - \left[\frac{P \times 5 \times 2}{100} \right] = 15$$

$$\Rightarrow \qquad P \left[\left(\frac{21}{20} \right)^2 - 1 - \frac{1}{10} \right] = 15$$

$$\Rightarrow \qquad P \left[\frac{441}{400} - \frac{1}{10} - 1 \right] = 15$$

$$\Rightarrow \qquad P \left[\frac{1}{400} \right] = 15$$

$$\therefore \qquad P = 6000$$

Thus, the sum of money deposited is ₹ 6000

Alternate Method
Here, $D = 15$, $R = 5\%$
Difference between CI and SI for 2 yr,

$$D = P \left(\frac{R}{100} \right)^2 \Rightarrow 15 = P \left(\frac{5}{100} \right)^2$$

$$\Rightarrow \qquad 15 = \frac{P \times 25}{10000}$$

$$P = \frac{15 \times 10000}{25} = ₹ 6000$$

2017 (I)

10. A sum of ₹ 8400 was taken as a loan. This is to be paid in two equal instalments. If the rate of interest is 10% per annum, compounded annually, then the value of each instalment is

(a) ₹ 4200
(b) ₹ 4480
(c) ₹ 4840
(d) None of the above

⊘ *(c)* We have,
loan amount = ₹ 8400
and rate of interest = 10%
Let the instalment money be ₹ x.
We know that,

$$\text{Amount} = \text{Principal}\left(1 + \frac{\text{Rate}}{100}\right)^{\text{Time}}$$

$$\Rightarrow \quad x = p\left(1 + \frac{10}{100}\right)^n$$

$$\Rightarrow \quad x = p\left(\frac{11}{10}\right)^n$$

$$\Rightarrow \quad p = ₹\, x\left(\frac{10}{11}\right)^n$$

Now, put $n = 1$,

First year instalment $= x\left(\frac{10}{11}\right)$ ...(i)

and again put $n = 2$,

Second year instalment $= x\left(\frac{10}{11}\right)^2$ ...(ii)

∵ Loan amount = ₹ 8400
∴ First year instalment + Second year instalment = 8400

$$\Rightarrow \quad x\left(\frac{10}{11}\right) + x\left(\frac{10}{11}\right)^2 = 8400$$

$$\Rightarrow \quad x\left(\frac{10}{11}\right)\left(1 + \frac{10}{11}\right) = 8400$$

$$\Rightarrow \quad x \times \frac{10}{11} \times \frac{21}{11} = 8400$$

$$\therefore \qquad\qquad x = ₹\,4840$$

11. The difference between the simple and the compound interest on a certain sum of money at 4% per annum for 2 yr is ₹ 10. What is the sum?

(a) ₹ 5000
(b) ₹ 6000
(c) ₹ 6250
(d) ₹ 7500

⊘ *(c)* We have,
$R = 4\%$ and $T = 2$ yr
Now, difference between compound interest and simple interest of 2 yr

$$= P\left(\frac{R}{100}\right)^2$$

Where P is sum.

$$\therefore \quad 10 = P\left(\frac{4}{100}\right)^2$$

$$\Rightarrow \qquad 10 = P\left(\frac{1}{25}\right)^2$$

$$\Rightarrow \qquad P = 10(25)^2$$

$$\therefore \qquad P = ₹\,6250$$

2016 (I)

12. If a sum of money at a certain rate of simple interest per year doubles in 5 yr and at a different rate of simple interest per year becomes three times in 12 yr, then the difference in the two rates of simple interest per year is

(a) 2%   (b) 3%   (c) $3\frac{1}{3}\%$ (d) $4\frac{1}{3}\%$

⊘ *(c)* Let principal = ₹ P, then amount of money = ₹$2P$, $T = 5$ yr

∴ $\qquad$ SI $= 2P - P = ₹P$

Now, $\qquad P = \dfrac{P \times r \times 5}{100}$

$\Rightarrow \qquad r = 20\%$

Amount of money after 12 yr = ₹ $3P$

∴ $\qquad$ SI $= 3P - P = 2P$

Now, $\qquad 2P = \dfrac{P \times R \times 12}{100}$

$\Rightarrow \qquad R = \dfrac{50}{3}\%$

∴ Difference between two interest rates

$$= \left(20 - \frac{50}{3}\right)\%$$

$$= \frac{10}{3}\% = 3\frac{1}{3}\%$$

2015 (II)

13. A sum of ₹ 10000 is deposited for 1 yr at the rate of interest 10% compounded half yearly. What will be the interest at the end of one year?

(a) ₹ 1000
(b) ₹ 1025
(c) ₹ 1050
(d) ₹ 1100

⊘ *(b)* Given, $P = ₹\,10000$, $r = 10\%$ and $n = 1$yr, since interest compounded half yearly, then $r = \dfrac{10}{2} = 5\%$

$n = 2$ half year

$$\therefore \quad A = 10000\left(1 + \frac{5}{100}\right)^2$$

$$\left[\because A = P\left(1 + \frac{r}{100}\right)^n\right]$$

$$= 10000 \times \frac{21}{20} \times \frac{21}{20}$$

$$= ₹\,11025$$

∴ $\quad$ Interest $= A - P$
$$= 11025 - 10000 = ₹\,1025$$

2015 (I)

14. The difference between compound interest and simple interest at the same rate of interest $R\%$ per annum on an amount of ₹ 15000 for 2 yr is ₹ 96. What is the value of R?

(a) 8%
(b) 10%
(c) 12%
(d) Cannot be determined

⊘ *(a)* Given, principal $(P) = ₹\,15000$, Time $(n) = 2$ yr and rate $= R\%$ per annum

∴ Simple interest (SI)

$$= \frac{\text{Principal} \times \text{Time} \times \text{Rate}}{100}$$

$$= \frac{15000 \times 2 \times R}{100} = 300\,R \qquad ...(i)$$

Now, compound interest (CI)

$$= \text{Principal}\left[\left(1 + \frac{R}{100}\right)^n - 1\right]$$

$$= 15000\left[\left(1 + \frac{R}{100}\right)^2 - 1\right] \qquad ...(ii)$$

According to the question,

$$\text{CI} - \text{SI} = 96$$

$$\Rightarrow 15000\left[\left(1 + \frac{R}{100}\right)^2 - 1\right] - 300R = 96$$

$$\Rightarrow 15000\left[\left(\frac{100 + R}{100}\right)^2 - 1\right] - 300R = 96$$

$$\Rightarrow 15000\left[\frac{(100 + R)^2 - (100)^2}{(100)^2}\right] - 300R = 96$$

$$\Rightarrow \frac{15000}{10000}\,[(100 + R + 100)$$

$$(100 + R - 100)] - 300R = 96$$

$$\Rightarrow \qquad 1.5\,[(200 + R)\,R] - 300R = 96$$

$$\Rightarrow \qquad 1.5\,(200R + R^2) - 300R = 96$$

$$\Rightarrow \qquad 300R + 1.5\,R^2 - 300R = 96$$

$$\Rightarrow \qquad R^2 = \frac{96}{1.5} = \frac{960}{15} = 64$$

$$\Rightarrow \qquad R = 8$$

Hence, the value of R is 8%.

Alternate Method
Given, Principal, $P = ₹\,15000$,
Rate, $R = ?$, Difference, $D = ₹\,96$
For 2 yr difference,

$$D = \frac{PR^2}{(100)^2}$$

$$\Rightarrow \qquad 96 = \frac{15000 \times R^2}{100 \times 100}$$

$$\Rightarrow \qquad R^2 = 64$$

$$\therefore \qquad R = 8\%$$

15. An automobile financer claims to be lending money at simple interest, but he includes the interest every six months for calculating the principal. If he is charging an interest at the rate of 10%, the effective rate of interest become

(a) 10.25% (b) 10.5%
(c) 10.75% (d) 11%

⊙ **(a)** Let the principal be ₹ 100.
Given, rate = 10% and time = 6 months

∴ $SI = \dfrac{100 \times 10 \times 6}{100 \times 12} = ₹\,5$

Now, after six months new principal
= ₹ 100 + ₹ 5 = ₹ 105

$SI = \dfrac{105 \times 10 \times 6}{100 \times 12} = ₹\,5.25$

∵ Total amount = ₹ 105 + ₹ 5.25
= ₹ 110.25

∴ Required rate = 110.25 − 100
= 10.25%

16. There is 60% increase in an amount in 6 yr at simple interest. What will be the compound interest on ₹ 12000 after 3 yr at the same rate of interest?

(a) ₹ 2160 (b) ₹ 3120
(c) ₹ 3972 (d) ₹ 6240

⊙ **(c)** Let the principal be ₹x.
Then, SI = ₹ $\dfrac{60x}{100}$

∵ $SI = \dfrac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}$

⇒ $\dfrac{60x}{100} = \dfrac{x \times \text{Rate} \times 6}{100}$ [∵ time = 6 yr]

∴ Rate = 10%

Again, principal = ₹ 12000, time = 3 yr

Amount = Principal $\left(1 + \dfrac{\text{Rate}}{100}\right)^{\text{Time}}$

= $12000 \left(1 + \dfrac{10}{100}\right)^3$

= $12000 \left(\dfrac{11}{10}\right)^3$

= $12000 \times \dfrac{11 \times 11 \times 11}{1000}$

= $12 \times 121 \times 11 = ₹\,15972$

∴ CI = Amount − Principal
= 15972 − 12000
= ₹ 3972

17. In how much time would the simple interest on a principal amount be 0.125 times the principal amount at 10% per annum?

(a) $1\dfrac{1}{4}$ yr (b) $1\dfrac{3}{4}$ yr
(c) $2\dfrac{1}{4}$ yr (d) $2\dfrac{3}{4}$ yr

⊙ **(a)** Let the principal be ₹ P and the time be T yr.

Rate = 10%

∵ Simple interest = $\dfrac{P \times R \times T}{100}$

According to the question,
0.125 × Principal = Simple interest

∴ $0.125\,P = \dfrac{P \times 10 \times T}{100}$

⇒ $0.125P = \dfrac{10PT}{100}$

⇒ $\dfrac{125P}{1000} = \dfrac{10PT}{100}$

⇒ $\dfrac{125}{100} = T$

∴ $T = \dfrac{5}{4} = 1\dfrac{1}{4}$ yr

Hence, the required time is $1\dfrac{1}{4}$ yr.

2014 (II)

18. The difference between compound interest and simple interest for 2 yr at the rate of 10% over principal amount of ₹ X is ₹ 10. What is the value of X?

(a) ₹ 100 (b) ₹ 1000
(c) ₹ 500 (d) ₹ 5000

⊙ **(b)** Given, principal amount (P) = ₹ X
Rate (R) = 10% and time (T) = 2 yr [given]

∴ Simple interest,

$SI = \dfrac{PRT}{100} = \dfrac{X \times 10 \times 2}{100} = \dfrac{X}{5}$

and compound interest, CI = $A − P$

= $P\left(1 + \dfrac{R}{100}\right)^T − P$

= $P\left[\left(1 + \dfrac{10}{100}\right)^2 − 1\right]$

= $X\left[\left(\dfrac{11}{10}\right)^2 − 1\right] = X\left[\dfrac{21}{100}\right]$

Now, difference between CI and SI = 10

⇒ $\dfrac{21}{100}X − \dfrac{X}{5} = 10$

⇒ $\dfrac{21X − 20X}{100} = 10$

∴ $X = 10 \times 100$
= ₹ 1000

Alternate Method
Here, $D = 10, P = X, R = 10\%$
Difference between CI and SI for 2 yr

$D = P\left(\dfrac{R}{100}\right)^2$

$10 = X\left(\dfrac{10}{100}\right)^2$

$X = 10 \times 100$
$X = ₹\,1000$

19. A sum of money becomes 3 times in 5 yr at simple interest. In how many years, will the same sum become 6 times at the same rate of simple interest?

(a) 10 yr (b) 12 yr
(c) 12.5 yr (d) 10.5 yr

⊙ **(c)** Let principal amount P be ₹ x.
Then, amount, $A = 3x, T = 5$ yr

∴ SI = $3x − x = 2x$
Let rate of interest be R.

Then, $SI = \dfrac{PRT}{100}$

⇒ $2x = \dfrac{x \times R \times 5}{100}$

⇒ $2x \times 100 = 5Rx$

⇒ $R = \dfrac{2x \times 100}{5x}$

∴ $R = 40\%$
Now, required amount = $6x$
Then, SI = $6x − x = 5x$

∴ Required time = $\dfrac{100 \times SI}{P \times R}$

= $\dfrac{100 \times 5x}{x \times 40} = 12.5$ yr

Alternative Method
$T_1 = 5, T_2 = ?, N = 3, N_2 = 6$

∴ $\dfrac{T_1}{T_2} = \dfrac{N_1 − 1}{N_2 − 1}$

$\dfrac{5}{T_2} = \dfrac{3 − 1}{6 − 1} = \dfrac{2}{5}$

$T_2 = \dfrac{25}{2} = 12.5$ yr

9

PROFIT AND LOSS

1. A trader sells two computers at the same price, making a profit of 30% on one and a loss of 30% on the other. What is the net loss or profit percentage on the transaction?

(a) 6% loss   (b) 6% gain

(c) 9% loss   (d) 9% gain

⊙ *(c)* Let the selling price of each computers be $100x$.

Cost price of computer 1

$= \text{selling price} \times \left(\dfrac{100}{100 + \text{profit \%}} \right)$

$= 100x \times \dfrac{100}{130} = \dfrac{1000x}{13}$

Cost price of computer 2

$= \text{selling price} \times \left(\dfrac{100}{100 - \text{loss \%}} \right)$

$= 100x \times \dfrac{100}{70} = \dfrac{1000x}{7}$

Total cost price of computers 1 and 2

$= \dfrac{1000x}{13} + \dfrac{1000x}{7}$

$= \dfrac{20000x}{91}$

Total selling price of both computers

$= 100x + 100x = 200x$

Net loss = Total CP − Total SP

$= \dfrac{20000x}{91} - 200x$

$= \dfrac{20000x - 18200x}{91}$

$= \dfrac{1800}{91} x$

Net loss% $= \dfrac{\dfrac{1800}{91}x}{\dfrac{20000x}{91}} \times 100 = 9\%$

Alternate Method

When two article sell at same selling price, one at a profit of $a\%$ another at a loss of $a\%$, then there is always a loss of $\left(\dfrac{a}{10} \right)^2 \%$.

Here, $a = 30\%$

Required loss percentage

$= \left(\dfrac{a}{10} \right)^2 = \left(\dfrac{30}{10} \right)^2 = 9\%$

2. A person sells two items each at Rs. 990, one at a profit of 10% and another at a loss of 10%. What is the combined percentage of profit or loss for the two items?

(a) 1% loss

(b) 1% profit

(c) No profit no loss

(d) 0.5% profit

⊙ *(a)* Let CP of 1st and 2nd items are $100x$ and $100y$ respectively.

According to the question,

SP_1 of 1st item

$= CP \times \left(\dfrac{100 + \text{profit \%}}{100} \right)$

$= 100x \times \dfrac{110}{100} = 110x$

SP_2 of 2nd item

$= CP \times \left(\dfrac{100 - \text{Loss\%}}{100} \right)$

$= 100y \times \dfrac{90}{100} = 90y$

Selling price of both items is 990

∴ $110x = 990$

⇒ $x = 9$

     $90y = 990$

⇒ $y = 11$

CP_1 of 1st item $= 100 \times 9 = 900$

CP_2 of 2nd item $= 100 \times 11 = 1100$

Total cost price $= CP_1 + CP_2$

$= 900 + 1100$

$= 2000$

∴ Required loss % $= \dfrac{2000 - 1980}{2000} \times 100$

$= 1\%$ loss

Alternate Method

Here, $a = 10\%$

∴ Required loss percentage

$= \left(\dfrac{a}{10} \right)^2 = \left(\dfrac{10}{10} \right)^2 = 1\%$

3. If an article is sold at a gain of 6% instead of a loss of 6%, the seller gets ₹ 6 more. What is the cost price of the article?

(a) ₹ 18   (b) ₹ 36

(c) ₹ 42   (d) ₹ 50

⊙ *(d)* Let cost price of an article = ₹ x

If an article sold at a gain of 6%, then selling price of an article

$= \text{Cost price} \times \left(\dfrac{100 + \text{gain\%}}{100} \right)$

$= \dfrac{106}{100} \times x$

$= ₹ \dfrac{106x}{100}$

If an article sold at a loss of 6%, then selling price = Cost price

$\times \left(\dfrac{100 - \text{Loss\%}}{100} \right)$

$= \dfrac{94}{100} \times x = ₹ \dfrac{94x}{100}$

Then, $\dfrac{106x}{100} - \dfrac{94x}{100} = 6$

⇒ $12x = 600$

∴ $x = ₹ 50$

2018 (II)

4. A milk vendor bought 28 L of milk at the rate of ₹ 8.50 /L. After adding some water he sold the mixture at the same price. If his gain is 12.5%, how much water did he add?

(a) 4.5 L   (b) 4 L   (c) 3.5 L   (d) 3 L

⊙ *(c)* Cost price of 28L of milk = 8.50 × 28
            = ₹ 238

Let the quantity of added water = x L
∴ Selling price of whole mixture
       = $(x + 28) \times 8.50$

Cost price = Selling price × $\left(\dfrac{100}{100 + \text{gain\%}}\right)$

$238 = (x + 28) \times 8.50 \times \left(\dfrac{100}{100 + 12.5}\right)$

$238 = (x + 28) \times \dfrac{850}{112.5}$

$238 \times 112.5 = (x + 28) \times 850$

$26775 = 850x + 23800$

$850x = 26775 - 23800$

$850x = 2975$

$x = 3.5\,L$

∴ Quantity of water be added in milk = 3.5L

2018 (I)

5. An article is sold at a profit of 32%. If the cost price is increased by 20% and the sale price remains the same, then the profit percentage becomes

(a) 10%   (b) 12%
(c) 15%   (d) 20%

⊙ *(a)* Let the cost price of article be ₹x.
Profit percentage = 32%

∴ Selling price = Cost price

         $\times \left(\dfrac{100 + \text{profit\%}}{100}\right)$

     $= \dfrac{132}{100} \times x = ₹\dfrac{132x}{100}$

New cost price $= \dfrac{120}{100} \times x = \dfrac{₹120}{100}x$

New profit = Selling price − Cost price

     $= ₹\left(\dfrac{132}{100}x - \dfrac{120}{100}x\right)$

     $= ₹\dfrac{12}{100}x$

Required profit percentage

$= \dfrac{\text{Profit}}{\text{Cost price}} \times 100 = \dfrac{\dfrac{12x}{100}}{\dfrac{120x}{100}} \times 100 = 10\%$

2017 (II)

6. Sudhir purchased a chair with three consecutive discounts of 20%, 12.5% and 5%.

The actual deduction will be

(a) 33.5%   (b) 30%
(c) 32%   (d) 35%

⊙ *(a)* We have given three consecutive discount 20%, 12.5% and 5%.
The actual deduction is

$= \left[1 - \left(1 - \dfrac{r_1}{100}\right)\left(1 - \dfrac{r_2}{100}\right)\left(1 - \dfrac{r_3}{100}\right)\right]$
                    $\times 100\%$

$= \left[1 - \left(1 - \dfrac{20}{100}\right)\left(1 - \dfrac{12.5}{100}\right)\right.$

            $\left.\left(1 - \dfrac{5}{100}\right)\right] \times 100\%$

$= \left[1 - \left(\dfrac{80}{100}\right)\left(\dfrac{87.5}{100}\right)\left(\dfrac{95}{100}\right)\right] \times 100\%$

$= \left[1 - \dfrac{665000}{1000000}\right] \times 100\%$

$= \left[1 - \dfrac{665}{1000}\right] \times 100\%$

$= \dfrac{335}{1000} \times 100\%$

$= 33.5\%$

7. Ram buys 4 chairs and 9 stools for ₹ 1340. If he sells chairs at 10% profit and stools at 20% profit, he earns a total profit of ₹ 188. How much money did he have to pay for the chairs?

(a) ₹ 200   (b) ₹ 400
(c) ₹ 800   (d) ₹ 1600

⊙ *(c)* Let the cost price of one chair be ₹ x.
And the cost price of one stool be ₹ y
Then, according to given conditions,

     $4x + 9y = 1340$ …(i)

Also, 4(10% of x) + 9(20% of y) = 188

⇒ $\dfrac{4}{10}x + \dfrac{18}{10}y = 188$

⇒ $4x + 18y = 1880$ …(ii)

On subtracting Eq. (i) from Eq. (ii), we get

       $9y = 540$

⇒ $y = 60$

On substituting $y = 60$ in Eq. (i), we get

     $4x = 1340 - 540$

     $4x = 800$

Thus, Ram have to pay ₹ 800 for the chairs.

2017 (I)

8. Rajendra bought a mobile with 25% discount on the selling price. If the mobile cost him ₹ 4875, what is the original selling price of the mobile?

(a) ₹ 6300   (b) ₹ 6400
(c) ₹ 6500   (d) ₹ 6600

⊙ *(c)* Let the original selling price of mobile is ₹ x.

According to question,

     $x - \dfrac{25}{100}x = 4875$

⇒ $x - \dfrac{x}{4} = 4875$

⇒ $\dfrac{3x}{4} = 4875$

⇒ $x = \dfrac{4875 \times 4}{3} = 6500$

∴ Original selling price of mobile is ₹ 6500.

2016 (II)

9. A shopkeeper increases the cost price of an item by 20% and offers a discount of 10% on this marked price. What is his gain percentage?

(a) 15%   (b) 12%
(c) 10%   (d) 8%

⊙ *(d)* Let the cost price of an item = ₹ 100
Cost price of an item after increased
       20% = ₹ 120

Selling price after 10% discount on ₹ 120

     $= 120 - \dfrac{120 \times 10}{100}$

     = ₹(120 − 12) = ₹ 108

∴ Percentage gain $= \dfrac{\text{SP} - \text{CP}}{\text{CP}} \times 100$

     $= \dfrac{108 - 100}{100} \times 100 = 8\%$

2016 (I)

10. A cloth merchant buys cloth from a weaver and cheats him by using a scale which is 10 cm longer than a normal metre scale. He claims to sell cloth at the cost price to his customers, but while selling uses a scale which is 10 cm shorter than a normal metre scale. What is his gain?

(a) 20%   (b) 21%
(c) $22\dfrac{2}{9}\%$ (d) $23\dfrac{1}{3}\%$

⊙ *(c)* Let the length of cloth = 100 cm

Then, the length of cloth purchased

= 110 cm

[∵ Merchant uses a scale which is 10 cm longer than a normal metre scale]

Let the price of cloth = ₹ 1 per cm

Cost price of cloth = 1 × 100 = ₹ 100

[∵ Merchant uses a scale which is 10 cm shorter than a normal scale]

Selling price of cloth = ₹ 1 per cm

Selling price of cloth = $1 \times \dfrac{1100}{9}$

$= ₹ \dfrac{1100}{9}$

Required gain %

$= \dfrac{\text{Selling price} - \text{Cost price}}{\text{Cost price}} \times 100$

$= \dfrac{\dfrac{1100}{9} - 100}{100} \times 100$

$= \dfrac{1100 - 900}{9} = \dfrac{200}{9} = 22\dfrac{2}{9}\%$

2015 (II)

11. The value of a single discount on some amount which is equivalent to a series of discounts of 10%, 20% and 40% on the same amount, is equal to

(a) 43.2%   (b) 50%
(c) 56.8%   (d) 70%

⊙ *(c)* Let the amount be x and single discount of same amount be r%.

Then, $x\left(1 - \dfrac{10}{100}\right)\left(1 - \dfrac{20}{100}\right)\left(1 - \dfrac{40}{100}\right)$

$= x\left(1 - \dfrac{r}{100}\right)$

⇒ $\dfrac{90}{100} \times \dfrac{80}{100} \times \dfrac{60}{100} = 1 - \dfrac{r}{100}$

∴ $r = 56.8\%$

2015 (I)

12. A milkman claims to sell milk at its cost price only but he is making a profit of 20%, since he has mixed some amount of water in the milk. What is the percentage of milk in the mixture?

(a) 80%   (b) $\dfrac{250}{3}\%$

(c) 75%   (d) $\dfrac{200}{3}\%$

⊙ *(b)* Let CP of 1 L of milk be ₹ x.

∴ SP of 1 L of milk = $x \times 120\%$

$= ₹ 1.2x$

Now, as in ₹ 1.2 x, the quantity of milk sold = 1 L

∴ In ₹ x, quantity of milk sold

$= \dfrac{1}{1.2x} \times x$

$= \dfrac{5}{6}$L

According to the question, CP of milk and SP of mixture are same, therefore in mixture, quantity of milk must be $\dfrac{5}{6}$ L.

Hence, the required percentage

$= \dfrac{5}{6} \times 100\%$

$= \dfrac{250}{3}\%$

2014 (II)

13. A person selling an article for ₹ 96 finds that his loss per cent is one-fourth of the amount of rupees that he paid for the article. What can be the cost price?

(a) Only ₹ 160   (b) Only ₹ 240
(c) Either ₹ 160 or ₹ 240
(d) Neither ₹ 160 nor ₹ 240

⊙ *(c)* Let the cost price of an article be ₹ x and selling price of an article = ₹ 96 [given]

According to the question,

$\dfrac{x - 96}{x} \times 100 = \dfrac{1}{4}x$

$\left[\because \text{Loss}\% = \dfrac{CP - SP}{CP} \times 100\right]$

⇒ $400x - 96 \times 400 = x^2$

⇒ $x^2 - 400x + 38400 = 0$

⇒ $x^2 - 160x - 240x + 38400 = 0$

⇒ $x(x - 160) - 240(x - 160) = 0$

⇒ $(x - 160)(x - 240) = 0$

∴ $x = 160$ or 240

Hence, the cost price of an article is either ₹ 160 or ₹ 240.

14. When an article is sold at 20% discount, the selling price is ₹ 24. What will be the selling price when the discount is 30%?

(a) ₹ 25   (b) ₹ 23
(c) ₹ 21   (d) ₹ 20

⊙ *(c)* Let the marked price of an article = ₹ x

Selling price = Marked price

$\times \left(\dfrac{100 - \text{Discount}\%}{100}\right)$

$24 = x \times \left(\dfrac{100 - 20}{100}\right)$

$x = \dfrac{2400}{80} = ₹ 30$

Now, selling price after 30% discount

$= 30 \times \left(\dfrac{100 - 30}{100}\right) = \dfrac{30 \times 70}{100}$

$= ₹ 21$

15. A shopkeeper sells his articles at their cost price but uses a faulty balance which reads 1000 g for 800 g. What is his actual profit percentage?

(a) 25%   (b) 20%
(c) 40%   (d) 30%

⊙ *(a)* Actual profit percentage

$= \left(\dfrac{\text{Fair weight} - \text{Unfair weight}}{\text{Unfair weight}} \times 100\right)\%$

$= \left(\dfrac{1000 - 800}{800} \times 100\right)\%$

$= \left(\dfrac{200}{800} \times 100\right)\%$

$= 25\%$

16. A man buys 200 oranges for ₹ 1000. How many oranges for ₹ 100 can be sold, so that his profit percentage is 25%?

(a) 10   (b) 14
(c) 16   (d) 20

⊙ *(c)* Cost price of 200 oranges

= ₹ 1000

∴ Cost price of 1 orange

$= \dfrac{1000}{200} = ₹ 5$

Selling price of 1 orange

$= \text{Cost price} \times \left(\dfrac{100 + \text{profit}\%}{100}\right)$

$= 5\left(\dfrac{100 + 25}{100}\right) = 5 \times \dfrac{125}{100}$

$= ₹ 6.25$

Now, in ₹ 6.25, number of oranges can be sold = 1

In ₹ 100, number of oranges can be sold

$= \dfrac{100}{6.25} = 16$

Hence, 16 oranges can be sold in ₹ 100 for profit 25%.

RATIO-PROPORTION
AND VARIATION

2019 (II)

1. The monthly incomes of A and B are in the ratio 4 : 3. Each save ₹ 600. If their expenditures are in the ratio 3 : 2, then what is the monthly income of A?

(a) ₹ 1800 (b) ₹ 2000
(c) ₹ 2400 (d) ₹ 3600

⊙ **(c)** Let monthly income of A and B be $4x$ and $3x$.

According to the question,

$\dfrac{A\text{'s expenditure}}{B\text{'s expenditure}} = \dfrac{3}{2}$

[∵ Expenditure = Income – Saving]

$\dfrac{4x - 600}{3x - 600} = \dfrac{3}{2}$

$8x - 1200 = 9x - 1800$

$x = 600$

A's monthly income $= 4 \times 600 = ₹ 2400$

2. The train fare and bus fare between two stations is in the ratio 3 : 4. If the train fare increases by 20% and bus fare increases by 30%, then what is the ratio between revised train fare and revised bus fare?

(a) $\dfrac{9}{13}$ (b) $\dfrac{17}{12}$
(c) $\dfrac{32}{43}$ (d) $\dfrac{19}{21}$

⊙ **(a)** Let the fare of train and bus be $3x$ and $4x$.

According to the question,

New fare of train $= 3x \times \dfrac{120}{100} = 3.6\,x$

New fare of bus $= 4x \times \dfrac{130}{100} = 5.2\,x$

∴ Required ratio $= \dfrac{3.6\,x}{5.2\,x} = \dfrac{36}{52} = \dfrac{9}{13}$

2019 (I)

3. If $a : b = c : d = 1 : 6$, then what is the value of $\dfrac{a^2 + c^2}{b^2 + d^2} = ?$

(a) $\dfrac{1}{600}$ (b) $\dfrac{1}{60}$ (c) $\dfrac{1}{36}$ (d) $\dfrac{1}{6}$

⊙ **(c)** $a : b = c : d = 1 : 6$

$\dfrac{a}{b} = \dfrac{c}{d} = \dfrac{1}{6}$

Let $a = x$, $c = x$, $b = 6x$, $d = 6x$

Now,

$\dfrac{a^2 + c^2}{b^2 + d^2} = \dfrac{(x)^2 + (x)^2}{(6x)^2 + (6x)^2} = \dfrac{x^2 + x^2}{36x^2 + 36x^2}$

$= \dfrac{2x^2}{72x^2} = \dfrac{1}{36}$

Option (c) is correct.

4. A man who recently died left a sum of ₹ 390000 to be divided among his wife, five sons and four daughters. He directed that each son should receive 3 times as much as each daughter receives and that each daughter should receive twice as much as their mother receives. What was the wife's share?

(a) ₹ 14000 (b) ₹ 12000
(c) ₹ 10000 (d) ₹ 9000

⊙ **(c)** Let wife's of man receives $= ₹ x$

Each daughter receives $= ₹ 2x$
and each son receives $= ₹ 6x$
According to the question,
$x + 4(2x) + 5(6x) = 390000$
$39x = 390000$
∴ $x = 10000$
Option (c) is correct.

2018 (II)

5. Ten (10) years before, the ages of a mother and her daughter were in the ratio 3 : 1. In another 10 yr from now, the ratio of their ages will be 13 : 7. What are their present ages?

(a) 39 yr, 21 yr (b) 55 yr, 25 yr
(c) 75 yr, 25 yr (d) 49 yr, 31 yr

⊙ **(b)** Let the age of mother 10 yr ago be $3x$ yr.

∴ Age of daughter 10 yr ago $= x$ yr
Present age of mother $= (3x + 10)$ yr
and present age of daughter

$= (x + 10)$ yr

According to the question,

$\dfrac{3x + 10 + 10}{x + 10 + 10} = \dfrac{13}{7}$

⇒ $21x + 140 = 13x + 260$

⇒ $8x = 120$

or $x = \dfrac{120}{8} = 15$

∴ Present age of mother $= 3x + 10$

$= 3 \times 15 + 10$

$= 55$ yr

And present age of daughter

$= x + 10 = 25$ yr

6. The ratio of the sum and difference of the ages of the father and the son is 11 : 3. Consider the following statements

1. The ratio of their ages is 8 : 5.
2. The ratio of their ages after the son attains twice the present age will be 11 : 8.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ **(b)** From statement 1

Ratio of ages of father and son = 8 : 5

Let father's age = $8x$

and son's age = $5x$

∴ According to the question, the ratio of the sum and difference of the ages of father and son is 11 : 3.

∴ $\dfrac{8x + 5x}{8x - 5x} = \dfrac{11}{3}$

⇒ $\dfrac{13x}{3x} = \dfrac{11}{3}$

But it is not equal to $\dfrac{11}{3}$ as $\dfrac{13}{3} \neq \dfrac{11}{3}$

∴ Statement 1 is not true.

From statement 2

Ratio of the age of father and son after the son attains twice the present age will be 11 : 8

Let father's age be F and son's age be S

∴ $\dfrac{F + S}{S + S} = \dfrac{11}{8}$

⇒ $8F + 8S = 22S$

⇒ $8F = 14S$

or $\dfrac{F}{S} = \dfrac{7}{4}$

Let father's age be $7x$ and son's age be $4x$

∴ According to the question,

$\dfrac{7x + 4x}{7x - 4x} = \dfrac{11x}{3x} = \dfrac{11}{3}$

∴ Statement 2 is correct.

2018 (I)

7. If $A : B = 1 : 2, B : C = 3 : 4$, $C : D = 2 : 3$ and $D : E = 3 : 4$, then what is $B : E$ equal to?

(a) 3 : 2   (b) 1 : 8   (c) 3 : 8   (d) 4 : 1

⊙ **(c)** $A{:}B,\ B{:}C,\ C{:}D,\ D{:}E$
    1:2 , 3:4,   2:3,   3:4
⇒   3:6, 6:8,   8:12, 12:16

∴ $A : B : C : D : E = 3{:}6{:}8{:}12{:}16$

∴ $B : E = 6 : 16 = 3 : 8$

8. In the following table of inverse variation, what are the values of A, B and C respectively?

M	15	−6	2	C
N	−4	A	B	60

(a) 10, −30, −1
(b) 10, −1, 30
(c) −30, 10, −1
(d) −1, −30, 10

⊙ **(a)** According to the question,

$$M \propto \dfrac{1}{N}$$

∴ $M = \dfrac{x}{N}$

or $MN = x$

Now, if $M = 15$ and $N = -4$

Then, $MN = 15(-4) = -60 = x$

Similarly, $-6 \times A = -60$

∴ $A = 10$

and $2 \times B = -60$

∴ $B = -30$

and $C \times 60 = -60$

∴ $C = -1$

Hence, A, B and C are 10, −30 and −1, respectively.

9. An alloy A contains two elements, copper and tin in the ratio of $2 : 3$, whereas an alloy B contains the same elements in the ratio of $3 : 4$. If 20 kg of alloy A, 28 kg of alloy B and some more pure copper are mixed to form a third alloy C which now contains copper and tin in the ratio of $6 : 7$, then what is the quantity of pure copper mixed in the alloy C?

(a) 3 kg
(b) 4 kg
(c) 5 kg
(d) 7 kg

⊙ **(b)** The ratio of copper and tin in alloy $A = 2 : 3$

The quantity of copper in 20 kg of alloy $A = 20 \times \dfrac{2}{(2 + 3)} = 8$ kg

The quantity of tin in 20 kg of alloy $A = 20 - 8 = 12$ kg

The ratio of copper and tin in alloy $B = 3 : 4$

The quantity of copper in 28 kg of alloy $B = 28 \times \dfrac{3}{(3 + 4)} = 12$ kg

The quantity of tin 28 kg of alloy $B = 28 - 12 = 16$ kg

Let the quantity of pure copper mixed in alloy C be x kg.

According to the question,

$$\dfrac{8 + 12 + x}{12 + 16} = \dfrac{6}{7}$$

⇒ $\dfrac{20 + x}{28} = \dfrac{6}{7}$

∴ $x = 24 - 20$
       $= 4$ kg

10. A, B, C, D and E start a partnership firm. Capital contributed by A is three times that contributed by D. E contributes half of A's contribution, B contributes one third of E's contribution and C contributes two-third of A's contribution. If the difference between the combined shares of A, D and E and the combined shares of B and C in the total profit of the firm is ₹ 13500, what is the combined share of B, C and E? (the shares are supposed to be proportional to the contributions)

(a) ₹ 13500
(b) ₹ 18000
(c) ₹ 19750
(d) ₹ 20250

⊙ **(b)** Let the capital contributed by A, B, C, D and E be ₹ A, ₹ B, ₹ C, ₹ D and ₹ E.

According to the question,

      $A = 3D$

⇒ $D = \dfrac{A}{3}$

      $E = \dfrac{1}{2}A$

      $B = \dfrac{1}{3}E$

      $= \dfrac{1}{3} \times \dfrac{1}{2}A = \dfrac{A}{6}$

and $C = \dfrac{2}{3}A$

$A : B : C : D = A : \dfrac{A}{6} : \dfrac{2A}{3} : \dfrac{A}{3} : \dfrac{A}{2}$

∴ $A : B : C : D : E = 6 : 1 : 4 : 2 : 3$

Let $A = 6x, B = x, C = 4x, D = 2x$ and $E = 3x$

∴ $(A + D + E)'$ share $-(B + C)'$ share
       $= 13500$

$(6x + 2x + 3x) - (x + 4x) = 13500$

$11x - 5x = 13500$

$6x = 13500$

$x = 2250$

Now, combined share of B, C and E

      $= x + 4x + 3x = 8x$

      $= 8 \times 2250 = ₹\ 18000$

2017 (II)

11. There are 350 boys in the first three standards. The ratio of the number of boys in first and second standards is 2 : 3, while that of boys in second and third standards is 4 : 5. What is the total number of boys in first and third standards?

(a) 302   (b) 280
(c) 242   (d) 230

◉ **(d)** Let the number of boys in first and second standards be $2x$ and $3x$. Then, number of boys is third standard

$= \dfrac{5}{4} \times$ number of boys in IInd standards

$= \dfrac{5}{4} \times 3x = \dfrac{15x}{4}$

$\left[\because \dfrac{\text{Number of boys in IInd standard}}{\text{Number of boys in IIIrd standard}} = \dfrac{4}{5} \right]$

Since, total number of boys = 350

$\therefore \quad 2x + 3x + \dfrac{15x}{4} = 350$

$\Rightarrow \quad 20x + 15x = 1400$

$\Rightarrow \quad\quad 35x = 1400$

$\Rightarrow \quad\quad x = \dfrac{1400}{35} = 40$

Thus, total number of boys in first and third standard $= 2x + \dfrac{15x}{4} = 80 + 150 = 230$

2017 (I)

12. If $A : B = 3 : 4$, then what is the value of the expression $\left(\dfrac{3A^2 + 4B}{3A - 4B^2} \right)$?

(a) $\dfrac{43}{55}$

(b) $-\dfrac{43}{55}$

(c) $\dfrac{47}{55}$

(d) cannot be determined

◉ **(d)** We have, $A : B = 3 : 4$

$\Rightarrow \quad\quad \dfrac{A}{B} = \dfrac{3}{4}$

$\Rightarrow \quad\quad A = \dfrac{3}{4}B$

Now, $\dfrac{3A^2 + 4B}{3A - 4B^2} = \dfrac{3\left(\dfrac{3}{4}B\right)^2 + 4B}{3\left(\dfrac{3}{4}B\right) - 4B^2}$

$= \dfrac{\dfrac{27}{16}B^2 + 4B}{\dfrac{9}{4}B - 4B^2} = \dfrac{\left[\dfrac{27B^2 + 64B}{16}\right]}{\left[\dfrac{9B - 16B^2}{4}\right]}$

$= \dfrac{27B^2 + 64B}{4(9B - 16B^2)} = \dfrac{27B + 64}{4(9 - 16B)}$

But we don't have the value of B

∴ The value of given expression cannot be determined.

13. The cost of a diamond varies directly as the square of its weight. A diamond broke into four pieces with their weights in the ratio of $1:2:3:4$. If the loss in total value of the diamond was ₹ 70000 what was the price of the original diamond?

(a) ₹ 100000   (b) ₹ 140000
(c) ₹ 150000   (d) ₹ 175000

◉ **(a)** Let the weights of the pieces of diamond are $x, 2x, 3x, 4x$.

∴ Total weight $= 10x$

∴ Total cost $= (10x)^2 = 100x^2$ …(i)

Cost of each piece $= x^2, 4x^2, 9x^2, 16x^2$

∴ Total cost of pieces $= 30x^2$

∴ Total loss $= 100x^2 - 30x^2 = 70x^2$

But total loss = 70000

$\therefore \quad\quad 70x^2 = 70000$

$\Rightarrow \quad\quad x^2 = 1000$

∴ Total cost of original diamond $= 100x^2$

$= 100 \times 1000 \; [\because x^2 = 1000]$

$= ₹100000$

14. In a class of 49 students, the ratio of girls to boys is 4 : 3. If 4 girls leave the class, the ratio of girls to boys would be

(a) 11 : 7   (b) 8 : 7
(c) 6 : 5   (d) 9 : 8

◉ **(b)** Number of boys $= \dfrac{3}{4+3} \times 49 = 21$

Number of girls $= \dfrac{4}{4+3} \times 49 = 28$

If 4 girls leave the class, then remaining girls $= 28 - 4 = 24$

∴ Required ratio $= 24 : 21 = 8 : 7$

15. The ratio of two numbers is $1:5$ and their product is 320. What is the difference between the square of these two numbers?

(a) 1024   (b) 1256   (c) 1536   (d) 1640

◉ **(c)** Since the number are in the ratio 1 : 5.

∴ Numbers are x and $5x$.

Now, $(x)(5x) = 320$

$\Rightarrow \quad\quad 5x^2 = 320$

$\Rightarrow \quad\quad x^2 = 64$

$\Rightarrow \quad\quad x = 8$

∴ Numbers are 8 and 40.

∴ Difference between their squares

$= (40)^2 - (8)^2$

$= 1600 - 64$

$= 1536$

16. 25 kg of alloy X is mixed with 125 kg of alloy Y. If the amount of lead and tin in the alloy X is the ratio 1 : 2 and the amount of lead and tin in the alloy Y is in the ratio 2 : 3, then what is the ratio of lead to tin in the mixture?

(a) 1 : 2   (b) 2 : 3
(c) 3 : 5   (d) 7 : 11

◉ **(d)** Amount of lead in

$X = \dfrac{1}{1+2} \times 25 = \dfrac{25}{3}$ kg

Amount of tin in $X = \dfrac{2}{1+2} \times 25 = \dfrac{50}{3}$ kg

Amount of lead in $Y = \dfrac{2}{2+3} \times 125$

$= \dfrac{2 \times 125}{5} = 50$ kg

Amount of tin in $Y = \dfrac{3}{2+3} \times 125$

$= \dfrac{3}{5} \times 125 = 75$ kg

When X and Y are mixed, then

Amount of lead $= \dfrac{25}{3} + 50 = \dfrac{175}{3}$ kg

Amount of tin $= \dfrac{50}{3} + 75 = \dfrac{275}{3}$ kg

∴ Ratio of lead to tin in the mixture

$= \dfrac{175}{3} : \dfrac{275}{3}$

$= 175 : 275 = 7 : 11$

2016 (II)

17. In an office, one-third of the workers are women, half of the women are married and one-third of the married women have children. If three-fourth of the men are married and one-third of the married men have children, then what is the ratio of married women to married men?

(a) 1 : 2   (b) 2 : 1
(c) 3 : 1   (d) 1 : 3

⊙ (**d**) We have, $\frac{1}{3}$ of workers are women

and $\frac{2}{3}$ of workers are men.

$\frac{1}{2}$ of the women are married $= \frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$

and $\frac{3}{4}$ of the men are married

$$= \frac{3}{4} \times \frac{2}{3} = \frac{1}{2}$$

∴ Ratio of married women to married

men are $\frac{1}{6} : \frac{1}{2} \Rightarrow 1 : 3$

18. There are twelve friends $A, B, C, D, E, F, G, H, I, J, K$ and L who invested money in some business in the ratio of $1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12$ and the duration for which they invested the money is in the ratio of $12 : 11 : 10 : 9 : 8 : 7 : 6 : 5 : 4 : 3 : 2 : 1$, respectively. Who will get the maximum profit at the end of the year?

(a) *F* only
(b) *G* only
(c) Both *F* and *G*
(d) Neither *F* nor *G*

⊙ (**c**) We have, *A, B, C, D, E, F, G, H, I J, K, L* invested in

$1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12$

Ratio of duration in an year,

$12 : 11 : 10 : 9 : 8 : 7 : 6 : 5 : 4 : 3 : 2 : 1$

Ratio of total money invested in duration in an year

$= 1 \times 12 : 2 \times 11 : 3 \times 10 : 4 \times 9 : 5 \times 8$
$\qquad : 6 \times 7 : 7 \times 6 : 8 \times 5 :$
$\qquad 9 \times 4 : 10 \times 3 : 11 \times 2 : 12 \times 1$

$12 : 22 : 30 : 36 : 40 : 42 : 42 : 40 : 36 : 30 : 22 : 12$

Thus, *F* and *G* get the maximum profit at the end of year.

19. Incomes of Mahesh and Kamal are in the ratio $1 : 2$ and their expenses are in the ratio $1 : 3$. Which one of the following statements is correct?

(a) Mahesh saves more than what Kamal saves
(b) Savings of both of them are equal
(c) Kamal saves more than what Mahesh saves
(d) It is not possible to determine who saves more

⊙ (**d**) Let the income of Mahesh and Kamal be ₹ x and ₹ $2x$, respectively.

Also, let the expenses of Mahesh and Kamal be ₹ y and ₹ $3y$ respectively.

∴ Savings of Mahesh $=$ ₹ $(x - y)$

Savings of Kamal $=$ ₹ $(2x - 3y)$

As data is inadequate, therefore it is not possible to determine who saves more.

20. X and Y entered into partnership with ₹ 700 and ₹ 600 respectively. After 3 months, X withdrew 2/7 of his stock but after 3 months, he puts back 3/5 of what he had withdrawn. The profit at the end of the year is ₹ 726. How much of this should X receive?

(a) ₹ 336   (b) ₹ 366
(c) ₹ 633   (d) ₹ 663

⊙ (**b**) Investment by *X* : Investment by *Y*

X invested for 3 months
$= 700 \times 3 =$ ₹ 2100

X withdrew amount $= 700 \times \frac{2}{7} =$ ₹ 200

X invested for next 3 months
$= (700 - 200) \times 3$
$= 500 \times 3 =$ ₹ 1500

X invested for next 6 months

$= \left(500 + 200 \times \frac{3}{5}\right) \times 6 = (500 + 120) \times 6$

$= 620 \times 6 =$ ₹ 3720

X invested for 1 year or 12 months
$= 2100 + 1500 + 3720 =$ ₹ 7320

Y invested for 1 year or 12 months
$= 600 \times 12 =$ ₹ 7200

$= 7320 : 7200 = 61 : 60$

∵ *X*'s profit : *Y*'s profit $= 61 : 60$

∴ Profit of *X* $=$ ₹ $\frac{61}{121} \times 726 =$ ₹ 366

AVERAGE

Directions (Q. Nos. 1-4) *Read the following information and answer the given question in below*

The data shows that Indian roads are turning deadlier over the years.

Year	2014	2015	2016	2017
Number of bikers killed	40957	46070	52750	48746
Number of pedestrians killed	12330	13894	15746	20457
Number of cyclists killed	4037	3125	2585	3559

1. What was the average number of pedestrians killed per day in the year 2017?

(a) 51   (b) 53   (c) 54   (d) 56

⊘ *(d)* Since, 2017 is not a leap year, total number of days in 2017 = 365 days.

∴ Required average $= \dfrac{20457}{365} = 56.05$

≈ 56 pedestrians.

2. What is the average number of bikers killed daily in road accidents in the year 2017?

(a) 163   (b) 152   (c) 147   (d) 134

⊘ *(d)* Since, 2017 is not a leap year, total number of days in 2017 = 365 days

∴ Required average $= \dfrac{48746}{365} = 133.55$

≈ 134 bikers.

3. What is the average number of cyclists killed daily in road accidents in 2017?

(a) 10   (b) 12   (c) 19   (d) 21

⊘ *(a)* Since, 2017 is not a leap year, total number of days in 2017 = 365 days

∴ Required average $= \dfrac{3559}{365} = 9.75$

≈ 10 cyclists.

4. A library has an average number of 510 visitors on Sunday and 240 on other days. What is the average number of visitors per day in a month of 30 days beginning with Saturday?

(a) 276   (b) 282   (c) 285   (d) 375

⊘ *(c)* Since, the months begin with Saturday, there will be five Sunday,
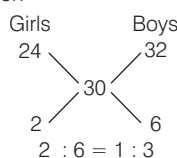Required average

$= \dfrac{\text{Total number of visitors}}{\text{Number of days}}$

$= \dfrac{510 \times 5 + 240 \times 25}{30}$

$= \dfrac{8550}{30} = 285$

5. In a class of 100 students, the average weight is 30 kg. If the average weight of the girls is 24 kg and that of the boys is 32 kg, then what is the number of girls in the class?

(a) 25   (b) 26   (c) 27   (d) 28

⊘ *(a)* Let the number of girls $= x$
The number of boys $= 100 - x$
Total weight of girls = average weight × number of girls $= 24 \times x = 24x$
Total weight of boys $= 32 \times (100 - x)$
Total weight of students
$\qquad = 30 \times 100 = 3000$
∴ $24x + 32(100 - x) = 3000$
$24x + 3200 - 32x = 3000$
$8x = 200$
$x = 25$
Hence, the number of girls in the class is 25.

Alternate method
A class of 100 students.
The average weight of the class = 30 kg.
The average weight of the girls = 24 kg.
The average weight of the boys = 32 kg.
By Alligation

```
     Girls        Boys
      24           32
        \         /
          \  30  /
          /      \
        /          \
      2              6
      2  :  6  =  1 : 3
```

Ratio of girls and boys = 1 : 3
The number of girls $= 100 \times \dfrac{1}{(1 + 3)}$

$\qquad = \dfrac{100}{4} = 25$

Option (a) is correct.

6. The average of 50 consecutive natural numbers is x. What will be the new average when the next four natural numbers are also included?

(a) $x + 1$ (b) $x + 2$
(c) $x + 4$ (d) $x + (x / 54)$

⊘ *(b)* The average of 50 consecutive natural numbers is x.
New average

$= \text{Old average} + \dfrac{\text{Number of next terms}}{2}$

$= x + \dfrac{4}{2} = x + 2$

7. Consider two-digit numbers which remain the same when the digits interchange their positions. What is the average of such two-digit numbers?

(a) 33   (b) 44
(c) 55   (d) 66

⊘ *(c)* Two-digit numbers which remain the same when the digits interchange their positions.

11, 22, 33, 44, 55, 66, 77, 88, 99

$\text{Average} = \dfrac{\text{Sum of numbers}}{\text{Number of terms}}$

$= \dfrac{\begin{bmatrix} 11 + 22 + 33 + 44 + 55 + 66 \\ + 77 + 88 + 99 \end{bmatrix}}{9}$

$= \dfrac{495}{9} = 55$

Alternative method

$\text{Average} = \dfrac{\text{First term} + \text{Last term}}{2}$

$= \dfrac{11 + 99}{2} = 55$

Option (c) is correct.

2018 (II)

8. The sum of ages of a father, a mother, a son Sonu and daughters Savita and Sonia is 96 yr. Sonu is the youngest member of the family. The year Sonu was born, the sum of the ages of all the members of the family was 66 yr. If the father's age now is 6 times that of Sonu's present age, then 12 yr. Hence, the father's age will be

(a) 44 yr   (b) 45 yr
(c) 46 yr   (d) 48 yr

⊘ *(d)* Sum of ages of father, mother, Sonu, Savita and Sonia is 96 yr and when Sonu was born the sum was 66 yr.

∵ There are 5 members in the family.

∴ Present age of Sonu
$$= \frac{96 - 66}{5} = 6 \text{ yr}$$

∴ Present age of father
$$= 6 \times 6 = 36 \text{ yr}$$
and father's age after 12 yr
$$= 36 + 12 = 48 \text{ yr}$$

9. The average marks of section A are 65 and that of section B are 70. If the average marks of both the sections combined are 67, then the ratio of number of students of section A to that of section B is

(a) 3 : 2   (b) 1 : 3
(c) 3 : 1   (d) 2 : 3

⊘ *(a)* Let the number of students in section
$$A = x$$
Total marks of students in section
A = average marks × number of students
$$= 65 \times x = 65x$$
and the number of students in section B = y
Total marks of students in section
$$B = 70 \times x = 70x$$
∴ Total number of students = $x + y$
Total marks of both sections combined
$$= 67(x + y)$$
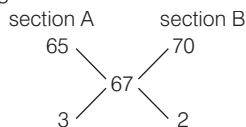∴ $65x + 70y = 67(x + y)$
⇒ $2x = 3y$
⇒ $x : y :: 3 : 2$

Alternate method
By alligation
     section A   section B
       65   70

            67

    3   2

∴ Required ratio = 3 : 2.

2018 (I)

10. If the average of 9 consecutive positive integers is 55, then what is the largest integer?

(a) 57   (b) 58   (c) 59   (d) 60

⊘ *(c)* Let the consecutive integers be
$x - 4, x - 3, x - 2, x - 1, x, x + 1,$
$x + 2, x + 3, x + 4$
Their average = 55   [given]
Sum of these consecutive integers = $9x$

∵   Average = $\dfrac{\text{Sum of integers}}{\text{Number of integers}}$

∴ $\dfrac{9x}{9} = 55$ or $x = 55$

∴ Largest integer = $x + 4 = 55 + 4 = 59$

11. The average of the ages of 15 students in a class is 19 yr. When 5 new students are admitted to the class, the average age of the class becomes 18.5 yr. What is the average age of the 5 newly admitted students?

(a) 17 yr   (b) 17.5 yr
(c) 18 yr   (d) 18.5 yr

⊘ *(a)* Average age of 15 students = 19 yr
∴ Sum of age of 15 students = average age × number of students = 15 × 19
$$= 285 \text{ yr}$$
Similarly, sum of age of 20 students
$$= 18.5 \times 20 = 370 \text{ yr}$$
∴ Sum of age of 5 new students
$$= 370 - 285 = 85 \text{ yr}$$
∴ Average age of 5 newly admitted
students = $\dfrac{85}{5} = 17 \text{ yr}$

2017 (II)

12. A small company pays each of its 5 category 'C' workers ₹ 20,000, each of its 3 category 'B' workers ₹ 25,000 and a category 'A' worker ₹ 65,000. The number of workers earning less than the mean salary is

(a) 8   (b) 5   (c) 4   (d) 3

⊘ *(a)* Mean salary = $\dfrac{\text{Sum of earnings}}{\text{Number of workers}}$

$$= \frac{5 \times 20000 + 3 \times 25000 + 1 \times 65000}{5 + 3 + 1}$$

$$= \frac{100000 + 75000 + 65000}{9}$$

$$= \frac{2,40,000}{9} = 26,667 \quad \text{[approx]}$$

Clearly, the number of workers earning less than the mean salary is 5 + 3 = 8

13. The average height of 22 students of a class is 140 cm and the average height of 28 students of another class is 152 cm. What is the average height of students of both the classes?

(a) 144.32 cm   (b) 145.52 cm
(c) 146.72 cm   (d) 147.92 cm

⊘ *(c)* Total height of class first = average height × number of students
$$= 140 \times 22 = 3080$$
Total height of class second
$$= 152 \times 28 = 4256$$
∴ Required average
$$= \frac{\text{Total height of both classes}}{\text{Total number of students}}$$
$$= \frac{3080 + 4256}{50}$$
$$= \frac{7336}{50} = 146.72 \text{ cm}$$

2017 (I)

14. Let *a, b, c, d, e, f, g* be consecutive even numbers and *j, k, l, m, n* be consecutive odd numbers. What is the average of all the numbers ?

(a) $\dfrac{3(a + n)}{2}$ (b) $\dfrac{(5l + 7d)}{4}$

(c) $\dfrac{(a + b + m + n)}{4}$ (d) None of these

⊘ *(d)* Let $a = x$ (even)
$b = x + 2, c = x + 4, d = x + 6$
$e = x + 8, f = x + 10, g = x + 12$
$a + b + c + d + e + f + g = 7x + 42$
$$= 7(x + 6)$$
$$= 7d$$
And $j = y$ (odd), $k = y + 2$,
$l = y + 4, m = y + 6, n = y + 8$
$j + k + l + m + n = 5y + 20$
$$= 5(y + 4) = 5l$$
∴ Average of all the numbers = $\dfrac{7d + 5l}{12}$

15. An individual purchases three qualities of pencils. The relevant data is given below

Quality	Price per pencil (in ₹)	Money spent INR (in ₹)
A	1.00	50
B	1.50	x
C	2.00	20

It is known, the average price per pencil is ₹ 1.25. What is the value of *x*?

(a) ₹ 10   (b) ₹ 30   (c) ₹ 40   (d) ₹ 60

⊙ **(b)** Number of pencils of quality

$$A = \frac{50}{1} = 50$$

Number of pencils of quality

$$B = \frac{x}{1.5} = \frac{2}{3}x$$

Number of pencils of quality

$$C = \frac{20}{2} = 10$$

∴ Total number of pencils

$$= 50 + \frac{2}{3}x + 10$$

$$= 60 + \frac{2}{3}x$$

Total money spent $= 50 + x + 20$
$$= 70 + x$$

Now, average price

$$= \frac{\text{Total money spent}}{\text{Total number of pencils}}$$

$$\Rightarrow \quad 1.25 = \frac{70 + x}{60 + \frac{2}{3}x}$$

$$\Rightarrow \quad 1.25\left(60 + \frac{2}{3}x\right) = 70 + x$$

$$\Rightarrow \quad 75 + \frac{2.5}{3}x = 70 + x$$

$$\Rightarrow \quad 5 = \frac{0.5}{3}x \Rightarrow x = ₹\ 30$$

2016 (II)

16. The average score of class X is 83. The average score of class Y is 76. The average score of class Z is 85. The average score of class X and Y is 79 and average score of class Y and Z is 81.

What is the average score of X, Y and Z?

(a) 81.5   (b) 80.5   (c) 79.0   (d) 78.0

⊙ **(a)** We have,
average score of class $X = 83$
average score of class $Y = 76$
average score of class $Z = 85$
Let n_1, n_2 and n_3 students are in class X, Y and Z, respectively.
∴ Total scores of class $X = 83n_1$
Total scores of class $Y = 76n_2$
Total scores of class $Z = 85n_3$
Average score of class X and Y is

$$\frac{83n_1 + 76n_2}{n_1 + n_2} = 79$$

$$\Rightarrow \quad 4n_1 = 3n_2 \qquad \ldots(i)$$

Similarly, average score of class Y and Z is

$$\frac{76n_2 + 85n_3}{n_2 + n_3} = 81$$

$$\Rightarrow \quad 5n_2 = 4n_3 \qquad \ldots(ii)$$

From Eqs. (i) and (ii)

$$n_1 : n_2 : n_3 = 3 : 4 : 5$$

Let $n_1 = 3k, n_2 = 4k, n_3 = 5k$

∴ Average score of X, Y, Z

$$= \frac{83n_1 + 76n_2 + 85n_3}{n_1 + n_2 + n_3}$$

$$= \frac{83 \times 3k + 76 \times 4k + 85 \times 5k}{3k + 4k + 5k}$$

$$= \frac{978k}{12k} = 81.5$$

17. A cricketer has a certain average of 10 innings. In the eleventh inning he scored 108 runs, there by increasing his average by 6 runs. What is his new average?

(a) 42   (b) 47
(c) 48   (d) 60

⊙ **(c)** Let the average run of cricketer in 10 innings be x.
∴ Total runs in 10 innings $= 10x$
Total runs in 11 innings
$$= 10x + 108$$
Average runs in 11 innings is

$$\frac{10x + 108}{11} = x + 6$$

$$\Rightarrow \quad 10x + 108 = 11x + 66$$
$$\therefore \quad x = 42$$
Hence, new average
$$= 42 + 6 = 48.$$

2015 (II)

18. The average of m numbers is n^4 and the average of n numbers is m^4. The average of $(m + n)$ numbers is

(a) mn
(b) $m^2 + n^2$
(c) $mn(m^2 + n^2)$
(d) $mn\,(m^2 + n^2 - mn)$

⊙ **(d)** Sum of m numbers = average × total numbers $= n^4 \times m = mn^4$
Sum of n numbers $= m^4 \times n = m^4 n$
Now, average of $(m + n)$ numbers

$$= \frac{mn^4 + nm^4}{m + n} = \frac{mn(m^3 + n^3)}{m + n}$$

$$= mn\frac{(m + n)(m^2 + n^2 - mn)}{m + n}$$

$$= mn(m^2 + n^2 - mn)$$

19. The average weight of students in a class is 43 kg. Four new students are admitted to the class whose weights are 42 kg, 36.5 kg, 39 kg and 42.5 kg, respectively.

Now, the average weight of the students of the class is 42.5 kg. The number of students in the beginning was

(a) 10   (b) 15
(c) 20   (d) 25

⊙ **(c)** Let the number of students be n.

Total weight of n students = average weight × number of students
$= 43 \times n = 43n$

$$\Rightarrow \frac{43n + 42 + 36.5 + 39 + 42.5}{n + 4} = 42.5$$

$$\left[\begin{array}{l} \because \text{Average weight} \\ \quad = \dfrac{\text{Total weight}}{\text{Number of students}} \end{array}\right]$$

$$\Rightarrow \quad 43n + 160 = 42.5n + 170$$
$$\Rightarrow \quad 0.5n = 10$$
$$\therefore \quad n = 20$$

20. 4 yr ago, the average age of A and B was 18 yr. Now, the average age of A, B and C is 24 yr. After 8 yr, the age of C will be

(a) 32 yr   (b) 28 yr
(c) 36 yr   (d) 40 yr

⊙ **(c)** Let present ages of A, B and C be x, y and z, respectively.

Then, $\dfrac{x + y + z}{3} = 24$

$$\Rightarrow \quad x + y + z = 72 \qquad \ldots \text{(i)}$$
4 yr ago,   A's age $= x - 4$
and   B's age $= y - 4$

$$\Rightarrow \quad \frac{x - 4 + y - 4}{2} = 18$$

$$\Rightarrow \quad x + y - 8 = 36$$
$$\Rightarrow \quad x + y = 44 \qquad \ldots \text{(ii)}$$
$$\Rightarrow \quad z = 72 - 44$$
$$= 28 \text{ yr}$$
∴ After 8 yr,
age of $C = 28 + 8$
$$= 36 \text{ yr}$$

2014 (II)

21. The price of a commodity increased by 5% from 2010 to 2011, 8% from 2011 to 2012 and 77% from 2012 to 2013. What is the average price increase (approximate) from 2010 to 2013?

(a) 26%   (b) 32%   (c) 24%   (d) 30%

⊚ **(d)** Let the price of commodity in 2010
$$= ₹ 100$$
The price of commodity in 2011
$$= 100 + 100 \times \frac{5}{100}$$
$$= 100 + 5 = ₹ 105$$
The price of commodity in 2012
$$= 105 + 105 \times \frac{8}{100}$$
$$= 105 + 8.4 = ₹ 113.4$$
The price of commodity in 2013
$$= 113.4 + 113.4 \times \frac{77}{100}$$
$$= 113.4 + 87.318 = 200.718$$
Total price increase from 2010 to 2013
$$= 200.718 - 100$$
$$= ₹ 100.78$$
Average price increase from 2010 to 2013
$$= \frac{100.78}{3} = 33.57 \approx 32\%$$

2014 (I)

22. If the average of *A* and *B* is 30, the average of *C* and *D* is 20, then which of the following is/are correct?

I. The average of *B* and *C* must be greater than 25.
II. The average of *A* and *D* must be less than 25.
   Select the correct answer using the codes given below
(a) Only I
(b) Only II
(c) Either I or II
(d) Neither I nor II

⊚ **(d)** Average of *A* and *B* = 30
$$\Rightarrow \qquad \frac{A + B}{2} = 30$$
$$\Rightarrow A + B = 60 \text{ and average of}$$
C and *D* = 20
$$\Rightarrow \qquad \frac{C + D}{2} = 20$$
$$\Rightarrow \qquad C + D = 40$$
Since, the individual values of *A*, *B*, *C* and *D* are not specified.
Hence, average of *B* and *C* can be greater or less than 25 and average of *A* and *D* can be greater or less than 25.

23. The average age of male employees is 52 yr and that of female employees is 42 yr. The percentage of male and female employees are respectively.

(a) 80% and 20%
(b) 20% and 80%
(c) 50% and 50%
(d) 52% and 48%

⊚ **(a)** Let the number of male employees be *x* and female employees be *y*.
Now, total age of male employees
= average age × number of employees
$$= 52x$$
Total age of female employees = 42*y*
Now, mean age of all employees
$$= \frac{52x + 42y}{x + y}$$
According to the question,
$$\frac{52x + 42y}{x + y} = 50$$
$$\Rightarrow \qquad 52x + 42y = 50x + 50y$$
$$\Rightarrow \qquad 2x = 8y$$
$$\Rightarrow \qquad \frac{x}{y} = \frac{4}{1}$$
i.e. $\qquad x : y = 4 : 1$
So, 80% of population is male and 20% of population is female.

LOGARITHM

1. What is the value of
$\log_{10}(\cos\theta) + \log_{10}(\sin\theta)$
$+ \log_{10}(\tan\theta) + \log_{10}(\cot\theta)$
$+ \log_{10}(\sec\theta) + \log_{10}(\csc\theta)$?

(a) −1   (b) 0   (c) 0.5   (d) 1

⊙ **(b)** $\log_{10}(\cos\theta) + \log_{10}(\sin\theta) + \log_{10}(\tan\theta)$
$+ \log_{10}(\cot\theta) + \log_{10}(\sec\theta)$
$+ \log_{10}(\csc\theta)$
$\Rightarrow \log_{10}(\cos\theta\cdot\sin\theta) + \log_{10}(\tan\theta\cdot\cot\theta)$
$+ \log_{10}(\sec\theta\cdot\csc\theta)$
$[\because \log_a b + \log_a c = \log_a b\cdot c]$
$\Rightarrow \log_{10}(\cos\theta\cdot\sin\theta)$
$+ \log_{10}(\sec\theta\cdot\csc\theta) + \log_{10}(1)$
$\Rightarrow \log_{10}(\cos\theta\cdot\sin\theta\cdot\sec\theta\cdot\csc\theta) + 0$
$[\because \log_{10}1 = 0]$
$\Rightarrow \log_{10}(1) \Rightarrow 0$

2. The sides of a triangle are 30 cm, 28 cm and 16 cm, respectively. In order to determine its area, the logarithm of which of the quantities are required?

(a) 37, 11, 28, 16   (b) 21, 30, 28, 7
(c) 37, 21, 11, 9   (d) 37, 21, 9, 7

⊙ **(d)** Sides of triangle are 30, 28 and 16 cm

Semi perimeter $= \dfrac{30 + 28 + 16}{2} = 37$

Area
$(A) = \sqrt{37(37 - 30)(37 - 28)(37 - 16)}$
$A = \sqrt{37 \times 7 \times 9 \times 21}\,\text{cm}^2$
On taking log both sides, we get
$\log A = \log(37 \times 7 \times 9 \times 21)^{1/2}$
$= \dfrac{1}{2}\log(37 \times 7 \times 9 \times 21)$
$[\because \log a^b = b\log a]$
$= \dfrac{1}{2}[\log 37 + \log 7 + \log 9 + \log 21]$
$[\because \log(a \times b) = \log a + \log b]$
Logarithmic of 37, 7, 9 and 21 is required.

3. If $\log_{10}1995 = 3.3000,$ then what is the value of $(0.001995)^{\frac{1}{8}}$?

(a) $\dfrac{1}{10^{0.3475}}$ (b) $\dfrac{1}{10^{0.3375}}$
(c) $\dfrac{1}{10^{0.3275}}$ (d) $\dfrac{1}{10^{0.3735}}$

⊙ **(b)** Let $x = (0.001995)^{1/8}$
On taking $\log_{10}$ both sides, we get
$\log_{10}x = \log_{10}(0.001995)^{1/8}$
$= \dfrac{1}{8}\log_{10}(0.001995)$
$[\because \log a^b = b\log a]$
$= \dfrac{1}{8}\log_{10}\left[\dfrac{1995}{1000000}\right]$
$= \dfrac{1}{8}[\log_{10}1995 - \log_{10}10^6]$
$= \dfrac{1}{8}[\log_{10}1995 - 6\log_{10}10]$
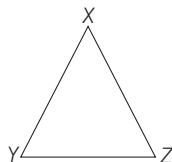$= \dfrac{1}{8}[3\cdot3 - 6] = \dfrac{1}{8}[-2.7] = -\dfrac{1}{8}[2.7]$
$= -0.3375$
On taking antilog both sides, we get
$x = \dfrac{1}{10^{0.3375}}$

4. Let XYZ be an equilateral triangle in which $XY = 7$ cm. If A denotes the area of the triangle, then what is the value of $\log_{10}A^4$? (given that $\log_{10}1050 = 3.0212$ and $\log_{10}35 = 1.5441$)

(a) 5.3070   (b) 5.3700
(c) 5.5635   (d) 5.6535

⊙ **(a)** Given, XYZ is an equilateral triangle and $XY = 7$ cm

Area (A) of equilateral triangle $= \dfrac{\sqrt{3}}{4}(XY)^2$

$A = \dfrac{\sqrt{3}}{4}(7)^2 = \dfrac{\sqrt{3}}{4} \times 49\,\text{cm}^2$ ...(i)

$= \log_{10}A^4 = \log_{10}(A^2)^2 = 2\log_{10}A^2$

$= 2\log_{10}\left(\dfrac{49\sqrt{3}}{4}\right)^2$ by Eq. (i)

$= 2\log_{10}\left[\dfrac{49 \times 49 \times 3}{4 \times 4}\right]$

$= 2[\log_{10}(49 \times 49 \times 3) - \log_{10}16]$

$\left[\because \log\dfrac{a}{b} = \log a - \log b\right]$

$= 2[\log_{10}(7^4 \times 3) - \log_{10}2^4]$

$= 2[\log_{10}7^4 + \log_{10}3 - 4\log_{10}2]$
$[\because \log(a \times b) = \log a + \log b]$

$= 2\left[4\log_{10}7 + \log_{10}3 - 4\log_{10}\dfrac{2 \times 5}{5}\right]$
$[\because \log a^b = b\log a]$
[5 divided and multiply in last number]

$= 2[4\log_{10}7 + \log_{10}3 - 4(\log_{10}10 - \log_{10}5)]$

$= 2[4\log_{10}7 + 4\log_{10}5 + \log_{10}3 - 4\log_{10}10]$

$= 2[4\log_{10}35 + \log_{10}3 - 4\log_{10}10]$

$= 2[4 \times \log_{10}35 + \log_{10}3 - 4]$ ...(ii)
$[\because \log_{10}10 = 1]$

$\Rightarrow \qquad \log_{10}1050 = 3.0212$
$\log_{10}(105 \times 10) = 3.0212$
$\log_{10}10 + \log_{10}(35 \times 3) = 3.0212$
$\log_{10}10 + \log_{10}35 + \log_{10}3 = 3.0212$
$\log_{10}3 = 3.0212 - \log_{10}35 - \log_{10}10$
$= 3.0212 - 1.5441 - 1 = 0.4771$ ...(iii)
On putting the value of $\log_{10}3$ in Eq. (ii), we get

$= 2[4 \times 1.5441 + 0.4771 - 4]$
$[\because \log_{10}35 = 1.5441]$
$= 2 \times [(6.1764 + 0.4771) - 4]$
$= 2 \times (6.6535 - 4)$
$= 2 \times (2.6535) = 5.3070$
Option (a) is correct.

5. What is the number of digits in $7^{25}, 8^{23}$ and 9^{20}, respectively?

[given, $\log_{10} 2 = 0.301$, $\log_{10} 3 = 0.477$, $\log_{10} 7 = 0.845$]

(a) 21, 20, 19   (b) 20, 19, 18
(c) 22, 21, 20   (d) 22, 20, 21

⊙ **(c)** Let $x = 7^{25}$

On taking log both sides, we get
$\log_{10} x = \log_{10} 7^{25}$
$= 25\log_{10} 7$ $[\because \log a^b = b\log a]$
$= 25 \times 0.845 \Rightarrow = 21.125$
$\therefore$ Number of digits $= 21 + 1 = 22$
Let $y = 8^{23}$
On taking log both sides, we get
$\log_{10} y = \log_{10} 8^{23}$
$= \log_{10}(2^3)^{23} = \log_{10} 2^{69}$
$= 69\log_{10} 2$ $[\because \log a^b = b\log a]$
$= 69 \times 0.301 = 20.769$
$\therefore$ Number of digits $= 20 + 1 = 21$
Let $z = 9^{20}$
On taking log both sides, we get
$\log_{10} z = \log_{10} 9^{20}$
$= \log_{10}(3^2)^{20}$
$= \log_{10} 3^{40} = 40\log_{10} 3$
           $[\because \log a^b = b\log a]$
$= 40 \times 0.477$
$= 19.08$
Number of digits $= 19 + 1 = 20$

2019 (I)

6. It is given that $\log_{10} 2 = 0.301$ and $\log_{10} 3 = 0.477$. How many digits are there in $(108)^{10}$?

(a) 19   (b) 20
(c) 21   (d) 22

⊙ **(c)** Given, $\log_{10} 2 = 0.301$
$\log_{10} 3 = 0.477$
$x = (108)^{10}$
On taking log both sides, we get
$\log x = \log 108^{10}$
$\log x = 10\log 108$
$\log x = 10[\log(2^2 \times 3^3)]$
         $[\because 108 = 2^2 \times 3^3]$
$\log x = 10[\log 2^2 + \log 3^3]$
     $[\because \log(a \times b) = \log a + \log b]$
$\log x = 10[2\log 2 + 3\log 3]$
         $[\because \log a^b = b\log a]$
$\log x = 10[2 \times 0.301 + 3 \times 0.477]$
$\log x = 10 \times 2.033 = 20.33$
On taking antilog both sides, we get
$x = e^{20.33}$
Number of digit are there is $= 20.33 \approx 21$
Option (c) is correct.

2018 (II)

7. If $\log_{10} 2 = 0.3010$ and $\log_{10} 3 = 0.4771$, then the value of $\log_{100}(0.72)$ is equal to

(a) 0.9286   (b) 1.9286
(c) 1.8572   (d) 1.9572

⊙ **(b)** We have, $\log_{10} 2 = 0.3010$
and $\log_{10} 3 = 0.4771$
$\log_{100}(0.72) = \log_{100} 2(0.72)$
$= \frac{1}{2}\log_{10}(0.72)$
$= \frac{1}{2}\log_{10} \frac{72}{100}$
$= \frac{1}{2}[\log_{10} 72 - \log_{10} 100]$
     $\left[\because \log \frac{a}{b} = \log a - \log b\right]$
$= \frac{1}{2}[\log_{10} 9 \times 8 - \log_{10} 10^2]$
$= \frac{1}{2}[\log_{10} 9 + \log_{10} 8 - 2\log_{10} 10]$
     $[\because \log(a \times b) = \log a + \log b]$
$= \frac{1}{2}[\log_{10} 3^2 + \log_{10} 2^3 - 2]$
$= \frac{1}{2}[2\log_{10} 3 + 3\log_{10} 2 - 2]$
$= \frac{1}{2}[2 \times 0.4771 + 3 \times 0.3010 - 2]$
$= \frac{1}{2}[0.9542 + 0.9030 - 2]$
$= \frac{1}{2}[1.8572 - 2]$
$= 0.9286 - 1 = \overline{1}.9286$

8. There are n zeros appearing immediately after the decimal point in the value of $(0.2)^{25}$. It is given that the value of $\log_{10} 2 = 0.30103$. The value of n is

(a) 25   (b) 19   (c) 18   (d) 17

⊙ **(c)** Let $x = (0.2)^{25}$
On taking log both sides, we get
$\log x = \log(0.2)^{25}$
$\Rightarrow$ $\log x = 25\log\left(\frac{2}{10}\right)$
         $[\because \log a^b = b\log a]$
$\Rightarrow$ $\log x = 25(\log_{10} 2 - \log_{10} 10)$
     $\left[\because \log \frac{a}{b} = \log a - \log b\right]$
$\Rightarrow$ $\log x = 25(0.3010 - 1)$
$\Rightarrow$ $\log x = 7.525 - 25$
$\Rightarrow$ $\log x = 0.525 - 18$
$\Rightarrow$ $x = $ antilog$(0.525) \times 10^{-18}$
$\therefore$ 18 zero appearing immediately after the decimal point.

2018 (I)

9. For $0 < m < 1$, which one of the following is correct?

(a) $\log_{10} m < m^2 < m < m^{-1}$
(b) $m < m^{-1} < m^2 < \log_{10} m$
(c) $\log_{10} m < m < m^{-1} < m^2$
(d) $\log_{10} m < m^{-1} < m < m^2$

⊙ **(a)** For every value of m which is less than 1 and greater than 0.

m will always be greater than m^2 all options except (a) violates this condition.
$\therefore$ for $0 < m < 1$
     $\log_{10} m < m^2 < m < m^{-1}$

2017 (II)

10. If $\log_{10} 6 = 0.7782$ and $\log_{10} 8 = 0.9031$, then what is the value of $\log_{10} 8000 + \log_{10} 600$?

(a) 4.6813   (b) 5.5813
(c) 1.5813   (d) 6.6813

⊙ **(d)** We have, $\log_{10} 6 = 0.7782$ ...(i)
and $\log_{10} 8 = 0.9031$ ...(ii)
Now consider, $\log_{10} 8000 + \log_{10} 600$
$= \log_{10}(8000 \times 600)$
         $[\because \log a + \log b = \log(a \times b)]$
$= \log_{10}(8 \times 6 \times 10^5)$
$= \log_{10} 8 + \log_{10} 6 + \log_{10} 10^5$
     $[\because \log(a \times b) = \log a + \log b]$
$= (0.9031) + (0.7782) + 5\log_{10} 10$
         $[\because \log a^b = b\log a]$
$= 1.6813 + 5 = 6.6813$ $[\because \log_{10} 10 = 1]$

2017 (I)

11. What is the number of digits in 2^{40}?

(Given that $\log_{10} 2 = 0.301$)

(a) 14   (b) 13   (c) 12   (d) 11

⊙ **(b)** Let $y = 2^{40}$
On taking log both sides, we get
$\log y = \log 2^{40} \Rightarrow \log y = 40\log 2$
$\Rightarrow$ $\log y = 40 \times 0.3010$
         $[\because \log 2 = 0.3010]$
$\Rightarrow$ $\log y = 12.040$
$\therefore$ $y = $ antilog (12.040)
$\therefore$ Number of digits $= (12 + 1) = 13$

13. What is the solution of the equation $x \log_{10}\left(\frac{10}{3}\right) + \log_{10} 3$
$= \log_{10}(2 + 3^x) + x$?

(a) 10   (b) 3   (c) 1   (d) 0

⊙ **(d)** We have,

$$x\log_{10}\left(\frac{10}{3}\right) + \log_{10}3$$

$$= \log_{10}(2 + 3^x) + x$$

$$\Rightarrow \quad \log_{10}\left(\frac{10}{3}\right)^x + \log_{10}3$$

$$= \log_{10}(2 + 3^x) + \log_{10}10^x$$

$$[\because \log_a a = 1, \log a^m = m\log a]$$

$$\Rightarrow \quad \log_{10}\left(\frac{10}{3}\right)^x \cdot 3 = \log_{10}(2 + 3)^x \cdot 10^x$$

$$[\because \log_c a + \log_c b = \log_c ab]$$

$$\Rightarrow \quad 3\left(\frac{10}{3}\right)^x = 10^x(2 + 3^x)$$

$$\Rightarrow \quad \frac{3 \cdot 10^x}{3^x} = 10^x(2 + 3^x)$$

$$\Rightarrow \quad 3 \cdot 10^x = 3^x \cdot 10^x(2 + 3^x)$$

$$\Rightarrow \quad 3 = 3^x(2 + 3^x)$$

Let $3^x = y$

$\therefore \qquad 3 = y(2 + y)$

$\Rightarrow \qquad 3 = 2y + y^2$

$\Rightarrow \quad y^2 + 2y - 3 = 0$

$\Rightarrow \quad (y + 3)(y - 1) = 0$

$\Rightarrow \qquad y = -3, 1$

$\therefore \qquad 3^x = -3, 1$

$\Rightarrow \qquad 3^x = 1 \qquad [\because 3^x \neq -3]$

$\Rightarrow \qquad x = 0$

2016 (II)

14. What is the solution of

$$\log_{10}\left[1 - \{1 - (1 - x^2)^{-1}\}^{-1}\right]^{-\frac{1}{2}} = 1?$$

(a) $x = 100$ (b) $x = 10$
(c) $x = 1$ (d) $x = 0$

⊙ **(b)** Given,

$$\log_{10}[1 - \{1 - (1 - x^2)^{-1}\}^{-1}]^{-1/2} = 1$$

$$\Rightarrow \quad \log_{10}\left[1 - \left\{1 - \frac{1}{1 - x^2}\right\}^{-1}\right]^{-1/2} = 1$$

$$\left[\because a^{-n} = \frac{1}{a^n}\right]$$

$$\Rightarrow \quad \log_{10}\left[1 - \left\{\frac{1 - x^2 - 1}{1 - x^2}\right\}^{-1}\right]^{-1/2} = 1$$

$$\Rightarrow \quad \log_{10}\left[1 - \left(\frac{-x^2}{1 - x^2}\right)^{-1}\right]^{-1/2} = 1$$

$$\Rightarrow \quad \log_{10}\left[1 + \frac{1 - x^2}{x^2}\right]^{-1/2} = 1$$

$$\Rightarrow \quad \log_{10}\left[\frac{x^2 + 1 - x^2}{x^2}\right]^{-1/2} = 1$$

$$\Rightarrow \quad \log_{10}\left[\frac{1}{x^2}\right]^{-1/2} = 1$$

$$\Rightarrow \quad \log_{10}(x^2)^{1/2} = 1$$

$$\Rightarrow \quad \log_{10}x = 1$$

$$\therefore \qquad x = (10)^1 = 10$$

15. What are the roots of the

equation $2^{x+2} \cdot 27^{\frac{x}{x-1}} = 9$?

(a) $2, 1 - \log\left(\frac{3}{2}\right)$

(b) $2, 1 - \log\left(\frac{2}{3}\right)$

(c) $-2, 1 - \left(\frac{\log 3}{\log 2}\right)$

(d) $-2, 1 - \left(\frac{\log 2}{\log 3}\right)$

⊙ **(c)** We have, $2^{x+2} \cdot 27^{\frac{x}{x-1}} = 9$

On taking log both sides, we get

$$(x + 2)\log 2 + \frac{x}{x - 1}\log 27 = \log 9$$

$$\Rightarrow (x + 2)\log 2 + \frac{3x}{x - 1}\log 3 = 2\log 3$$

$$\Rightarrow (x + 2)\log 2 + \left(\frac{3x}{x - 1} - 2\right)\log 3 = 0$$

$$\Rightarrow (x + 2)\log 2 + \left(\frac{x + 2}{x - 1}\right)\log 3 = 0$$

$$\Rightarrow (x + 2)\left[\log 2 + \frac{1}{x - 1}\log 3\right] = 0$$

$$\Rightarrow \qquad x + 2 = 0$$

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or $\log 2 + \dfrac{1}{x - 1}\log 3 = 0$

$\Rightarrow \qquad x = -2$

or $(x - 1) = -\dfrac{\log 3}{\log 2}$

$\therefore \qquad x = -2$

or $x = 1 - \left(\dfrac{\log 3}{\log 2}\right)$

16. The number of digits in 3^{30} is n and it is given that $\log_{10} 3 = 0 \cdot 4771$. What is the value of n?

(a) 13   (b) 14
(c) 15   (d) 16

⊙ **(c)** Let $x = 3^{30}$

$\log x = \log 3^{30}$

$\Rightarrow \log x = 30\log_{10} 3 \quad [\because \log a^b = b\log a]$

$\qquad = 30 \times 0.4771 \quad [\because \log_{10} 3 = 0.4771]$

$\qquad = 14.3130$

Since, the characteristic in the resultant value of $\log_{10}(3^{30})$ is 14.

$\therefore$ The number of digits in 3^{30} is $(14 + 1) = 15$.

2016 (I)

17. The value of

$$\frac{1}{5}\log_{10} 3125 - 4\log_{10} 2 + \log_{10} 32$$

is

(a) 0   (b) 1   (c) 2   (d) 3

⊙ **(b)** $\dfrac{1}{5}\log_{10} 3125 - 4\log_{10}2 + \log_{10} 32$

$\qquad = \log_{10}[(5)^5]^{1/5} - \log_{10}(2)^4 + \log_{10} 32$

$\qquad\qquad [\because b\log a = \log a^b]$

$\qquad = \log_{10}5 - \log_{10} 16 + \log_{10} 32$

$\qquad = \log_{10}\left(\dfrac{5 \times 32}{16}\right)$

$$\left[\because \log a - \log b + \log c = \log \frac{(a \times c)}{b}\right]$$

$\qquad = \log_{10} 10 = 1$

13

BASIC OPERATION AND FACTORISATION

1. If $\dfrac{36}{11} = 3 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$, where

x, y and z are natural numbers, then what is $(x + y + z)$ equal to

(a) 6   (b) 7   (c) 8   (d) 9

⊙ **(a)** Given, $\dfrac{36}{11} = 3 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

$\Rightarrow 3 + \dfrac{3}{11} = 3 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

By comparing, we get

$\dfrac{3}{11} = \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

$x + \dfrac{1}{y + \dfrac{1}{z}} = \dfrac{11}{3} \Rightarrow x + \dfrac{1}{y + \dfrac{1}{z}} = 3 + \dfrac{2}{3}$

By comparing, we get

$x = 3, \ y + \dfrac{1}{z} = \dfrac{3}{2}$

$y + \dfrac{1}{z} = 1 + \dfrac{1}{2}$

By comparing, we get $y = 1, z = 2$

Then, $(x + y + z) = 3 + 2 + 1 = 6$

2. What is the value of

$$\dfrac{(x - y)^3 + (y - z)^3 + (z - x)^3}{9(x - y)(y - z)(z - x)}$$

(a) 0   (b) $\dfrac{1}{3}$ (c) $\dfrac{1}{9}$ (d) 1

⊙ **(b)** Let $p = \dfrac{(x - y)^3 + (y - z)^3 + (z - x)^3}{9(x - y)(y - z)(z - x)}$

Let $a = x - y, b = y - z, c = z - x$

$a + b + c = x - y + y - z + z - x = 0$

If $a + b + c = 0$,

then $a^3 + b^3 + c^3 = 3abc$

$\therefore p = \dfrac{3(x - y)(y - z)(z - x)}{9(x - y)(y - z)(z - x)} = \dfrac{1}{3}$

3. If $x = \dfrac{1 + \sqrt{3}}{2}$ and $y = x^3$, then y satisfies which one of the following equations?

(a) $8y^2 - 20y - 1 = 0$
(b) $8y^2 + 20y - 1 = 0$
(c) $8y^2 + 20y + 1 = 0$
(d) $8y^2 - 20y + 1 = 0$

⊙ **(a)** Given, $y = x^3$ ...(i)

and $x = \dfrac{1 + \sqrt{3}}{2}$ ...(ii)

On putting $x = \dfrac{1 + \sqrt{3}}{2}$ in Eq. (i), we get

$y = \left[\dfrac{1 + \sqrt{3}}{2} \right]^3$

$y = \dfrac{(1 + \sqrt{3})^3}{2^3}$

$= \dfrac{1 + 3\sqrt{3} + 3\sqrt{3}(1 + \sqrt{3})}{8}$

$[\because (a + b)^3 = a^3 + b^3 + 3ab(a + b)]$

$y = \dfrac{1 + 3\sqrt{3} + 3\sqrt{3} + 9}{8}$

$y = \dfrac{5 + 3\sqrt{3}}{4}$

$4y = 5 + 3\sqrt{3}$ ...(iii)

On squaring both sides in Eq. (iii), we get

$(4y)^2 = (5 + 3\sqrt{3})^2$

$16y^2 = 25 + 27 + 30\sqrt{3}$

$[\because (a + b)^2 = a^2 + b^2 + 2ab]$

$16y^2 = 52 + 30\sqrt{3}$

$8y^2 = 26 + 15\sqrt{3}$ ...(iv)

On multiplying Eq. (iii) by 5, we get

$20y = 25 + 15\sqrt{3}$ ...(v)

Eq. (v) substract from Eq. (iv),

$\Rightarrow 8y^2 - 20y = 1$

$\Rightarrow 8y^2 - 20y - 1 = 0$

Option (a) will satisfy 'y'.

4. For what value of k can the expression $x^3 + kx^2 - 7x + 6$ be resolved into three linear factors?

(a) 0   (b) 1   (c) 2   (d) 3

⊙ **(a)** For a particular value of k we must get 3 different value of x.

We can satisfy the option in this type of question, and by solving we will get that only option (a) will satisfy the equation.

$\Rightarrow x^3 + kx^2 - 7x + 6 = 0$

On putting $k = 0$,

$\Rightarrow x^3 + x^2 - x^2 - 7x + 6 = 0$

$\Rightarrow x^3 - x^2 + x^2 - x - 6x + 6 = 0$

$\Rightarrow x^2(x - 1) + x(x - 1) - 6(x - 1) = 0$

$\Rightarrow (x - 1)(x^2 + x - 6) = 0$

$\Rightarrow (x - 1)(x^2 + 3x - 2x - 6) = 0$

$\Rightarrow (x - 1)(x(x + 3) - 2(x + 3)) = 0$

$\Rightarrow (x - 1)(x - 2)(x + 3) = 0$

We will get, $x = 1, 2,$ and -3.

5. The quotient when $x^4 - x^2 + 7x + 5$ is divided by $(x + 2)$ is $ax^3 + bx^2 + cx + d$. What are the values of a, b, c and d, respectively?

(a) 1, -2, 3, 1
(b) -1, 2, 3, 1
(c) 1, -2, -3, -1
(d) -1, 2, -3, -1

(a) Lets divide $x^4 - x^2 + 7x + 5$ with long division method,

$$x + 2 \overline{) x^4 - x^2 + 7x + 5} (x^3 - 2x^2 + 3x + 1$$
$$\underline{x^4 + 2x^3}$$
$$\underline{ - -}$$
$$\underline{-2x^3 - x^2}$$
$$\underline{+ -2x^3 + 4x^2}$$
$$\underline{+ +}$$
$$3x^2 + 7x$$
$$\underline{3x^2 + 6x -}$$
$$\underline{ - }$$
$$x + 5$$
$$\underline{x + 2}$$
$$\underline{ -}$$
$$3$$

According to the question,
$$ax^3 + bx^2 + cx + d$$
$$= x^3 - 2x^2 + 3x + 1$$
By comparing it, we will get
$$a = 1, b = -2, c = 3 \text{ and } d = 1$$

6. What is $(x - a)(x - b)(x - c)$ equal to ?

(a) $x^3 - (a + b + c)x^2 + (bc + ca + ab)x - abc$
(b) $x^3 + (a + b + c)x^2 + (bc + ca + ab)x + abc$
(c) $x^3 - (bc + ca + ab)x^2 + (a + b + c)x - abc$
(d) $x^3 + (bc + ca + ab)x^2 - (a + b + c)x - abc$

(a) Let $y = (x - a)(x - b)(x - c)$

$= (x^2 - ax - bx + ab)(x - c)$
$= x^3 - ax^2 - bx^2 + abx - cx^2 + acx + bcx - abc$
$= x^3 - x^2(a + b + c) + x(ab + bc + ac) - abc$

After solving this we get option (a) is correct.

7. A real number x is such that $(x - x^2)$ is maximum. What is x equal to ?

(a) -1.5 (b) -0.5 (c) 0.5 (d) 1.5

(c) x is a real number such that $(x - x^2)$ is maximum.

Let $\quad y = x - x^2$

On differential both sides w.r.t. x, we get

$$\frac{dy}{dx} = \frac{d}{dx}(x) - \frac{d}{dx}(x^2)$$
$$= x^{1-1} - 2x^{2-1}$$
$$\frac{dy}{dx} = 1 - 2x$$

To be the function maximum $\frac{dy}{dx} = 0$

$$1 - 2x = 0 \Rightarrow 2x = 1$$
$$\therefore \quad x = \frac{1}{2} \Rightarrow x = 0.5$$

Alternate method : On solving the given question with respect of option :
From option (a),

$(x - x^2) =$
$-1.5 - (-1.5)^2 = -1.5 - 2.25 = -3.75$
From option (b),
$(x - x^2) = -0.5 - (-0.5)^2$
$\quad = 0.5 - 0.25 = -0.75$
From option (c),
$(x - x^2) = 0.5 - (0.5)^2 = 0.5 - 0.25 = 0.25$
From option (d),
$(x - x^2) = 1.5 - (-1.5)^2 = 1.5 - 2.25 = -0.75$
Hence, $x = 0.5$

8. What is the sum of all integer values of n for which $n^2 + 19n + 92$ is a perfect square?

(a) 21   (b) 19
(c) 0   (d) −19

(d) Let $k^2 = n^2 + 19n + 92$

On multiplying both sides by 4, we get
$$4n^2 + 76n + 368 = 4k^2$$
$$\Rightarrow (2n)^2 + 2 \times 19 \times 2n + 361 + 7 = 4k^2$$
$$\Rightarrow (2n + 19)^2 = (4k^2 - 7) \qquad \ldots(i)$$
Let $\quad (2n + 19) = m$
Then, $\quad 4k^2 - 7 = m^2$
$$4k^2 - m^2 = 7$$
$$(2k - m)(2k + m) = 7$$
$$[\because a^2 - b^2 = (a + b)(a - b)]$$
Factor of 7 are 7 and 1
So, $\quad 2k + m = 7$
$$2k - m = 1$$
By solving this, we get
$$k = 2$$
Now, putting $k = 2$ in Eq. (i), we get
$$(2n + 19)^2 = (4(2)^2 - 7) = 16 - 7$$
$$\Rightarrow (2n + 19)^2 = 9$$
$$\Rightarrow 2n + 19 = \pm 3$$
$$\Rightarrow 2n + 19 = +3 \Rightarrow n = -8$$
$$\Rightarrow 2n + 19 = -3 \Rightarrow n = -11$$
Sum of integer value of $n = -8 + (-11)$
$$= -19$$

2019 (I)

9. For $x = \dfrac{4\sqrt{6}}{\sqrt{2} + \sqrt{3}}$, what is the value of

$$\frac{x + 2\sqrt{2}}{x - 2\sqrt{2}} + \frac{x + 2\sqrt{3}}{x - 2\sqrt{3}} = ?$$

(a) 1   (b) $\sqrt{2}$
(c) $\sqrt{3}$ (d) 2

(d) Given, $x = \dfrac{4\sqrt{6}}{\sqrt{2} + \sqrt{3}}$

$x = 4\sqrt{6}(\sqrt{3} - \sqrt{2})$ [$\because$ By relionlisation]

$$\frac{x + 2\sqrt{2}}{x - 2\sqrt{2}} + \frac{x + 2\sqrt{3}}{x - 2\sqrt{3}}$$

(divided by $\sqrt{2}$)

$$\frac{\dfrac{x}{\sqrt{2}} + 2}{\dfrac{x}{\sqrt{2}} - 2} + \frac{\dfrac{x}{\sqrt{3}} + 2}{\dfrac{x}{\sqrt{3}} - 2}$$

$$= \frac{\dfrac{4\sqrt{6}}{\sqrt{2}}(\sqrt{3} - \sqrt{2}) + 2}{\dfrac{4\sqrt{6}}{\sqrt{2}}(\sqrt{3} - \sqrt{2}) - 2} + \frac{\dfrac{4\sqrt{6}}{\sqrt{3}}(\sqrt{3} - \sqrt{2}) + 2}{\dfrac{4\sqrt{6}}{\sqrt{3}}(\sqrt{3} - \sqrt{2}) - 2}$$

$$= \frac{4\sqrt{3}(\sqrt{3} - \sqrt{2}) + 2}{4\sqrt{3}(\sqrt{3} - \sqrt{2}) - 2} + \frac{4\sqrt{2}(\sqrt{3} - \sqrt{2}) + 2}{4\sqrt{2}(\sqrt{3} - \sqrt{2}) - 2}$$

$$= \frac{4 \times 3 - 4\sqrt{6} + 2}{4 \times 3 - 4\sqrt{6} - 2} + \frac{4\sqrt{6} - 8 + 2}{4\sqrt{6} - 8 - 2}$$

$$= \frac{14 - 4\sqrt{6}}{10 - 4\sqrt{6}} + \frac{4\sqrt{6} - 6}{4\sqrt{6} - 10}$$

$$= \frac{7 - 2\sqrt{6}}{5 - 2\sqrt{6}} + \frac{3 - 2\sqrt{6}}{5 - 2\sqrt{6}}$$

[negative sign common in both]

$$= \frac{10 - 4\sqrt{6}}{5 - 2\sqrt{6}} = \frac{2(5 - 2\sqrt{6})}{5 - 2\sqrt{6}}$$

Option(d) is correct.

10. For $x > 0$, what is the minimum value of $x + \dfrac{x + 2}{2x}$?

(a) 1
(b) 2
(c) $2\dfrac{1}{2}$
(d) Cannot be determined

(c) $x + \dfrac{x + 2}{2x}, x > 0 \qquad \ldots(i)$

$$= x + \frac{x}{2x} + \frac{2}{2x} = x + \frac{1}{2} + \frac{1}{x}$$

Differentiation of the Eq. (i), we get

$$0 = 1 + 0 - \frac{1}{x^2}$$
$$\frac{1}{x^2} = 1 \Rightarrow x^2 = 1$$
$$x = \pm 1$$
$$x = 1 \quad (x > 0)$$
On putting $x = 1$ in Eq. (i), we get

$$= (1) + \frac{(1) + 2}{2(1)}$$
$$= 1 + \frac{3}{2} = \frac{5}{2} = 2\frac{1}{2}$$

Option (c) is correct.

11. If $\dfrac{1 + px}{1 - px} \sqrt{\dfrac{1 - qx}{1 + qx}} = 1$, then what are the non-zero solutions of x?

(a) $\pm \dfrac{1}{p} \sqrt{\dfrac{2p - q}{q}}, 2p \neq q$

(b) $\pm \dfrac{1}{pq} \sqrt{p - q}, p \neq q$

(c) $\pm \dfrac{p}{q} \sqrt{p - q}, p \neq q$

(d) $\pm \dfrac{q}{p} \sqrt{2p - q}, 2p \neq q$

(a) $\dfrac{1+px}{1-px}\sqrt{\dfrac{1-qx}{1+qx}}=1$

$$\dfrac{1+px}{1-px}=\sqrt{\dfrac{1+qx}{1-qx}}$$

On squaring both sides, we get

$$\dfrac{(1+px)^2}{(1-px)^2}=\dfrac{1+qx}{1-qx}$$

Use Componendo and Dividendo rule,

$$\dfrac{(1+px)^2+(1-px)^2}{(1+px)^2-(1-px)^2}=\dfrac{1+qx+1-qx}{1+qx-1+qx}$$

$$\Rightarrow \dfrac{(1+p^2x^2+2px)+(1+p^2x^2-2px)}{(1+p^2x^2+2px)-(1+p^2x^2-2px)}$$

$$=\dfrac{1+qx+1-qx}{1+qx-1+qx}$$

$$[\because (a+b)^2=a^2+b^2+2ab,$$
$$(a-b)^2=a^2+b^2-2ab]$$

$$\Rightarrow \dfrac{2+2p^2x^2}{4px}=\dfrac{2}{2qx}$$

$$\Rightarrow \dfrac{1+p^2x^2}{2px}=\dfrac{1}{qx}$$

$$\Rightarrow 1+p^2x^2=\dfrac{2p}{q}$$

$$\Rightarrow p^2x^2=\dfrac{2p}{q}-1$$

$$\therefore px=\pm\sqrt{\dfrac{2p-q}{q}}$$

$$x=\pm\dfrac{1}{p}\sqrt{\dfrac{2p-q}{q}}$$

Option (a) is correct.

12. If a, b and c are positive integers such that $\dfrac{1}{a+\dfrac{1}{b+\dfrac{1}{c+\dfrac{1}{2}}}}=\dfrac{16}{23}$, then what is the mean of a, b and c?

(a) 1   (b) 2   (c) 1.33   (d) 2.33

(b) $\dfrac{1}{a+\dfrac{1}{b+\dfrac{1}{c+\dfrac{1}{2}}}}=\dfrac{16}{23}\Rightarrow\dfrac{16}{23}$

$$=\dfrac{1}{23/16}=\dfrac{1}{1+\dfrac{7}{16}}$$

$$=\dfrac{1}{1+\dfrac{1}{16/7}}=\dfrac{1}{1+\dfrac{1}{2+\dfrac{2}{7}}}$$

$$=\dfrac{1}{1+\dfrac{1}{2+\dfrac{1}{7/2}}}=\dfrac{1}{1+\dfrac{1}{2+\dfrac{1}{3+\dfrac{1}{2}}}}$$

Then, $a=1, b=2, c=3$

Mean of a, b and $c=\dfrac{a+b+c}{3}$

$$=\dfrac{1+2+3}{3}=2$$

Option (b) is correct.

13. If $\dfrac{a}{b+c}=\dfrac{b}{c+a}=\dfrac{c}{a+b}$, then which one of the following statements is correct?

(a) Each fraction is equal to 1 or −1

(b) Each fraction is equal to $\dfrac{1}{2}$ or 1

(c) Each fraction is equal to $\dfrac{1}{2}$ or −1

(d) Each fraction is equal to $\dfrac{1}{2}$ only

(d) $\dfrac{a}{b+c}=\dfrac{b}{c+a}=\dfrac{c}{a+b}=k$ (let)

$$\dfrac{a}{b+c}=k$$
$$a=k(b+c) \qquad \dots(i)$$
$$\dfrac{b}{c+a}=k$$
$$b=k(c+a) \qquad \dots(ii)$$
$$\dfrac{c}{a+b}=k$$
$$c=k(a+b) \qquad \dots(iii)$$

On adding Eqs. (i), (ii) and (iii), we get

$$a+b+c=2k(a+b+c)$$
$$k=1/2$$

Option (d) is correct.

14. If $(4a+7b)(4c-7d)$
$=(4a-7b)(4c+7d)$, then which one of the following is correct?

(a) $\dfrac{a}{b}=\dfrac{c}{d}$ (b) $\dfrac{a}{d}=\dfrac{c}{b}$

(c) $\dfrac{a}{b}=\dfrac{d}{c}$ (d) $\dfrac{4a}{7b}=\dfrac{c}{d}$

(a) $(4a+7b)(4c-7d)$

$$=(4a-7b)(4c+7d)$$
$$\Rightarrow \dfrac{4a+7b}{4a-7b}=\dfrac{4c+7d}{4c-7d}$$

Use componendo and dividendo rule,

$$\dfrac{(4a+7b)+(4a-7b)}{(4a+7b)-(4a-7b)}$$
$$=\dfrac{(4c+7d)+(4c-7d)}{(4c+7d)-(4c-7d)}$$

$$\dfrac{8a}{14b}=\dfrac{8c}{14d}$$

$$\dfrac{a}{b}=\dfrac{c}{d}$$

Option (a) is correct.

15. What is $\dfrac{(x-y)^3+(y-z)^3+(z-x)^3}{3(x-y)(y-z)(z-x)}$ equal to?

(a) 1   (b) 0   (c) $\dfrac{1}{3}$ (d) 3

(a) $\dfrac{(x-y)^3+(y-z)^3+(z-x)^3}{3(x-y)(y-z)(z-x)}$

If $\qquad a+b+c=0$
$$a^3+b^3+c^3=3abc$$
$$x-y+y-z+z-x=0$$

Then,

$$=\dfrac{3(x-y)(y-z)(z-x)}{3(x-y)(y-z)(z-x)}=1$$

Option (a) is correct answer.

16. If $a^x=b^y=c^z$ and $b^2=ac$, then what is $\dfrac{1}{x}+\dfrac{1}{z}$ equal to?

(a) $\dfrac{1}{y}$ (b) $-\dfrac{1}{y}$ (c) $\dfrac{2}{y}$ (d) $-\dfrac{2}{y}$

(c) Given, $a^x=b^y=c^z$ and $b^2=ac$

$$a^x=b^y=c^z=k \text{ (let)}$$
$$a=k^{1/x}$$
$$b=k^{1/y}$$
$$c=k^{1/z}$$
$$\because \qquad b^2=ac$$
$$(k^{1/y})^2=k^{1/x}\times k^{1/z}$$
$$k^{\frac{2}{y}}=k^{\left(\frac{1}{x}+\frac{1}{z}\right)}$$
$$\dfrac{2}{y}=\dfrac{1}{x}+\dfrac{1}{z}$$

Option (c) is correct.

2018 (II)

17. If $x=2+2^{2/3}+2^{1/3}$, then the value of the expression x^3-6x^2+6x will be

(a) 2   (b) 1   (c) 0   (d) −2

(a) Given, $x=2+2^{2/3}+2^{1/3}$

$$\Rightarrow \qquad x-2=2^{2/3}+2^{1/3}$$

On cubing both sides, we get

$$(x-2)^3=(2^{2/3}+2^{1/3})^3$$
$$\Rightarrow x^3-2^3-3(x)(2)(x-2)$$
$$=(2^{2/3})^3+(2^{1/3})^3+3(2)^{2/3}$$
$$(2)^{1/3}(2^{2/3}+2^{1/3})$$
$$[\because (a-b)^3=a^3-b^3-3ab\,(a-b),$$
$$(a+b)^3=a^3+b^3+3ab\,(a+b)]$$
$$\Rightarrow x^3-8-6x^2+12x$$
$$=2^2+2+6(x-2)$$
$$\Rightarrow x^3-6x^2+12x=6+8+6x-12$$
$$\Rightarrow x^3-6x^2+6x=2$$

18. If $x^6 + \dfrac{1}{x^6} = k\left(x^2 + \dfrac{1}{x^2}\right)$, then k is

equal to

(a) $\left(x^2 - 1 + \dfrac{1}{x^2}\right)$ (b) $\left(x^4 - 1 + \dfrac{1}{x^4}\right)$

(c) $\left(x^4 + 1 + \dfrac{1}{x^4}\right)$ (d) $\left(x^4 - 1 - \dfrac{1}{x^4}\right)$

⊘ *(b)* We know that,

$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

∴ $x^6 + \dfrac{1}{x^6} = (x^2)^3 + \left(\dfrac{1}{x^2}\right)^3$

$= \left(x^2 + \dfrac{1}{x^2}\right)\left(x^4 - 1 + \dfrac{1}{x^4}\right)$

∴ $k = x^4 - 1 + \dfrac{1}{x^4}$

19. The sum of all possible products taken two at a time out of the numbers $\pm 1, \pm 2, \pm 3, \pm 4$ is

(a) 0   (b) –30   (c) 30   (d) 55

⊘ *(b)* Let $\pm 1, \pm 2, \pm 3, \pm 4$ are the roots of the polynomials

∴$(x + 1)(x - 1)(x + 2)(x - 2)(x + 3)$
$(x - 3)(x + 4)(x - 4) = 0$
$\Rightarrow (x^2 - 1)(x^2 - 4)(x^2 - 9)$
$(x^2 - 16) = 0$
$\Rightarrow (x^4 - 5x^2 + 4)$
$(x^4 - 25x^2 + 144) = 0$
$\Rightarrow x^8 - 30x^6 + 148x^4$
$-820x^2 + 576 = 0$

The sum of the roots taken two at a time is coefficient of x^6 is –30

20. The remainder when
$3x^3 - 2x^2 y - 13xy^2 + 10 y^3$
is divided by $(x - 2 y)$ is equal to

(a) 0   (b) y
(c) $y - 5$ (d) $y + 3$

⊘ *(a)* Let $f(x)$

$= 3x^3 - 2x^2 y - 13xy^2 + 10y^3$
And $g(x) = x - 2y$
When $f(x)$ is divided by $g(x)$
∴ $f(2 y) = 3(2 y)^3 - 2(2 y)^2 y$
$-13(2 y)y^2 + 10y^3$
$f(2 y) = 24y^3 - 8y^3 - 26y^3 + 10y^3$
$f(2 y) = 0$
Hence, remainder $= 0$

21. If $ab + bc + ca = 0$, then the value of

$$\dfrac{\begin{bmatrix}(b^2 - ca)(c^2 - ab) + (a^2 - bc)\\(c^2 - ab) + (a^2 - bc)(b^2 - ca)\end{bmatrix}}{(a^2 - bc)(b^2 - ca)(c^2 - ab)}$$

is

(a) –1   (b) 0
(c) 1   (d) 2

⊘ *(b)* We have, $ab + bc + ca = 0$

Now, $\dfrac{\begin{matrix}(b^2 - ca)(c^2 - ab) + (a^2 - bc)\\(c^2 - ab) + (a^2 - bc)(b^2 - ca)\end{matrix}}{(a^2 - bc)(b^2 - ca)(c^2 - ab)}$

$= \dfrac{1}{a^2 - bc} + \dfrac{1}{b^2 - ca} + \dfrac{1}{c^2 - ab}$

$= \dfrac{1}{a^2 + ab + ac} + \dfrac{1}{b^2 + ab + bc}$

$+ \dfrac{1}{c^2 + bc + ca}$

$= \dfrac{1}{a(a + b + c)} + \dfrac{1}{b(a + b + c)}$

$+ \dfrac{1}{c(a + b + c)}$

$= \dfrac{1}{(a + b + c)}\left[\dfrac{1}{a} + \dfrac{1}{b} + \dfrac{1}{c}\right]$

$= \dfrac{1}{(a + b + c)}\left(\dfrac{ab + bc + ca}{abc}\right) = 0$

2018 (I)

22. If $a + b = 2c$, then what is the value of $\dfrac{a}{a - c} + \dfrac{c}{b - c}$?

(a) –1   (b) 0   (c) 1   (d) 2

⊘ *(c)* Given, $a + b = 2c$
or $a + b = c + c$
or $a - c = c - b$ ...(i)
Now, $\dfrac{a}{a - c} + \dfrac{c}{b - c}$

$= \dfrac{a}{c - b} - \dfrac{c}{c - b}$ [from Eq. (i)]

$= \dfrac{a - c}{c - b} = \dfrac{c - b}{c - b}$ [from Eq. (i)]

$= 1$

23. If $\dfrac{b}{y} + \dfrac{z}{c} = 1$ and $\dfrac{c}{z} + \dfrac{x}{a} = 1$, then

what is $\dfrac{ab + xy}{bx}$ equal to ?

(a) 1   (b) 2   (c) 0   (d) –1

⊘ *(a)* Let $\dfrac{z}{c} = p$

∴ $\dfrac{b}{y} + p = 1$ and $\dfrac{1}{p} + \dfrac{x}{a} = 1$

$\Rightarrow \dfrac{b}{y} = 1 - p$ and $\dfrac{x}{a} = 1 - \dfrac{1}{p} = \dfrac{p - 1}{p}$

$\Rightarrow$ $\dfrac{y}{b} = \dfrac{1}{1 - p}$ ...(i)

and $\dfrac{a}{x} = \dfrac{p}{p - 1}$ ...(ii)

Now, adding Eqs. (i) and (ii), we get

$\dfrac{y}{b} + \dfrac{a}{x} = \dfrac{1}{1 - p} + \dfrac{p}{p - 1}$

$\Rightarrow \dfrac{xy + ab}{bx} = \dfrac{1}{1 - p} - \dfrac{p}{1 - p}$

$\Rightarrow \dfrac{ab + xy}{bx} = \dfrac{1 - p}{1 - p} = 1$

24. If $x + y + z = 0$, then what is $(y + z - x)^3 + (z + x - y)^3$
$+ (x + y - z)^3$ equal to ?

(a) $(x + y + z)^3$
(b) $3(x + y)(y + z)(z + x)$
(c) $24xyz$
(d) $-24xyz$

⊘ *(d)* Given, $x + y + z = 0$ ...(i)
We have to find the value of
$(y + z - x)^3 + (z + x - y)^3$
$+ (x + y - z)^3$
Let $y + z - x = a, z + x - y = b$
and $x + y - z = c$
∴ $a + b + c = y + z - x + z$
$+ x - y + x + y - z$
$= x + y + z$
$= 0$ [from Eq. (i)]
If $a + b + c = 0$,
then $a^3 + b^3 + c^3 = 3abc$
∴ $(y + z - x)^3 + (z + x - y)^3 + (x + y - z)^3$
$= 3(y + z - x)(z + x - y)(x + y - z)$
$= 3(y + z + x - 2x)(z + x + y - 2y)$
$(x + y + z - 2z)$
$= 3(-2x)(-2y)(-2z)$ [∵$x + y + z = 0$]
$= -24xyz$

25. If $(x + 3)$ is a factor of $x^3 + 3x^2 + 4x + k$, then what is the value of k?

(a) 12   (b) 24
(c) 36   (d) 72

⊘ *(a)* As, $(x + 3)$ is a factor of given equation
∴ $x = -3$
Now, $p(x) = x^3 + 3x^2 + 4x + k$
∴ $p(-3) = 0$
$\Rightarrow (-3)^3 + 3(-3)^2 + 4(-3) + k = 0$
$\Rightarrow$ $-27 + 27 - 12 + k = 0$
$\Rightarrow$ $k = 12$

26. Which one of the following is a zero of the polynomial $3x^3 + 4x^2 - 7$?

(a) 0   (b) 1
(c) 2   (d) –1

⊘ *(b)* Given, $p(x) = 3x^3 + 4x^2 - 7$
Putting $x = 1$
$\Rightarrow$ $p(1) = 3(1)^3 + 4(1)^2 - 7$
$\Rightarrow$ $p(1) = 3 + 4 - 7 = 0$
Hence, $x = 1$ is a zero for polynomial
$3x^3 + 4x^2 - 7$

27. The remainder when $3x^3 + kx^2 + 5x - 6$ is divided by $(x + 1)$ is -7. What is the value of k?

(a) -14 (b) 14 (c) -7 (d) 7

⊗ **(d)** $p(x) = 3x^3 + kx^2 + 5x - 6$

$x + 1 = 0$

∴ $x = -1$

$p(-1) = 3(-1)^3 + k(-1)^2 + 5(-1) - 6$

$= -3 + k - 5 - 6$

$= k - 14$

∴ Remainder $= k - 14$

But, remainder $= -7$ [given]

∴ $k - 14 = -7$

∴ $k = -7 + 14 = 7$

28. If $f(x)$ and $g(x)$ are polynomials of degree p and q respectively, then the degree of $\{f(x) \pm g(x)\}$ (if it is non-zero) is

(a) greater than min (p, q)
(b) greater than max (p, q)
(c) less than or equal to max (p, q)
(d) equal to min (p, q)

⊗ **(c)** We have, degree of $f(x) = p$

degree of $g(x) = q$

degree $(f(x) + g(x)) = $ max

$(p, q), p \neq q$

degree $(f(x) - g(x)) = $ max(p, q),

$p \neq q$

degree $(f(x) + g(x)) = p$ or q, $p = q$

degree $(f(x) - g(x)) = $ less than or equal to max (p, q) $p = q$

∴ Degree $(f(x) \pm g(x)) = $ less than or equal to max (p, q)

29. If $\dfrac{a^2 - 1}{a} = 5$, then what is the value of $\dfrac{a^6 - 1}{a^3}$?

(a) 125 (b) -125 (c) 140 (d) -140

⊗ **(c)** $\dfrac{a^2 - 1}{a} = 5$ [given]

∴ $a - \dfrac{1}{a} = 5$ ...(i)

On cubing both sides, we get

$\left(a - \dfrac{1}{a}\right)^3 = 5^3$

$\Rightarrow a^3 - \dfrac{1}{a^3} - 3\left(a - \dfrac{1}{a}\right) \times a \times \dfrac{1}{a} = 125$

$[\because (a - b)^3 = a^3 - b^3 - 3ab(a - b)]$

$a^3 - \dfrac{1}{a^3} - 3 \times 5 = 125$ [from Eq.(i)]

$\Rightarrow a^3 - \dfrac{1}{a^3} = 125 + 15$

∴ $\dfrac{a^6 - 1}{a^3} = 140$

2017 (II)

30. If $x = 111 \dots 1$ (20 digits), $y = 333 \dots 3$ (10 digits) and $z = 222 \dots 2$ (10 digits), then what is $\dfrac{x - y^2}{z}$ equal to?

(a) $\dfrac{1}{2}$ (b) 1

(c) 2 (d) 3

⊗ **(b)** We have, $x = 111 \dots 1$ (20 digit)

$y = 333 \dots 3$ (10 digit)

$z = 222 \dots 2$ (10 digits)

∴ $x = 10^0 + 10^1 + 10^2 + \dots + 10^{20}$

$= \dfrac{10^{20} - 1}{9}$

$y = 3(10^0 + 10^1 + 10^2 \dots 10^{10})$

$= \dfrac{3(10^{10} - 1)}{9}$

$z = 2(10^0 + 10^1 + 10^2 + \dots + 10^{10})$

$= \dfrac{2(10^{10} - 1)}{9}$

$\dfrac{x - y^2}{z} = \dfrac{\left(\dfrac{10^{20} - 1}{9}\right) - 9\left(\dfrac{10^{10} - 1}{9}\right)^2}{\dfrac{2(10^{10} - 1)}{9}}$

$= \dfrac{(10^{10} + 1)(10^{10} - 1) - (10^{10} - 1)(10^{10} - 1)}{2(10^{10} - 1)}$

$= \dfrac{(10^{10} - 1)(10^{10} + 1 - 10^{10} + 1)}{2(10^{10} - 1)} = 1$

31. Let $f(x)$ and $g(x)$ be two polynomials (with real coefficients) having degrees 3 and 4 respectively. What is the degree of $f(x)\,g(x)$?

(a) 12 (b) 7 (c) 4 (d) 3

⊗ **(b)** We have, degree of $f(x) = 3$

degree of $g(x) = 4$

New degree of $f(x)\,g(x) = $ degree of $f(x)$

$+$ degree of $g(x) = 3 + 4 = 7$

32. Let $f(x) = a_0 x^n + a_1 x^{n-1} + a_2 x^{n-2} + \dots + a_{n-1} x + a_n$, where $a_0, a_1, a_2, \dots, a_n$ are real numbers. If $f(x)$ is divided by $(ax - b)$, then the remainder is

(a) $f\left(\dfrac{b}{a}\right)$ (b) $f\left(-\dfrac{b}{a}\right)$

(c) $f\left(\dfrac{a}{b}\right)$ (d) $f\left(-\dfrac{a}{b}\right)$

⊗ **(a)** Consider, $ax - b = 0 \Rightarrow x = \dfrac{b}{a}$

Since, $f(x)$ is divided by $ax - b$, therefore by remainder theorem, remainder is given by $f\left(\dfrac{b}{a}\right)$.

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33. The non-zero solution of the equation $\dfrac{a - x^2}{bx} - \dfrac{b - x}{c} = \dfrac{c - x}{b} - \dfrac{b - x^2}{cx}$, where $b \neq 0$, $c \neq 0$ is

(a) $\dfrac{b^2 + ac}{b^2 + c^2}$ (b) $\dfrac{b^2 - ac}{b^2 - c^2}$

(c) $\dfrac{b^2 - ac}{b^2 + c^2}$ (d) $\dfrac{b^2 + ac}{b^2 - c^2}$

⊗ **(a)** Given equation is

$\dfrac{a - x^2}{bx} - \dfrac{b - x}{c} = \dfrac{c - x}{b} - \dfrac{b - x^2}{cx}$

$\Rightarrow \dfrac{a - x^2}{bx} + \dfrac{b - x^2}{cx} = \dfrac{c - x}{b} + \dfrac{b - x}{c}$

$\Rightarrow \dfrac{ac - cx^2 + b^2 - bx^2}{bcx}$

$= \dfrac{c^2 - cx + b^2 - bx}{bc}$

$\Rightarrow \dfrac{(b^2 + ac) - x^2(b + c)}{bcx}$

$= \dfrac{(b^2 + c^2) - x(b + c)}{bc}$

$\Rightarrow (b^2 + ac) - x^2(b + c) = x(b^2 + c^2) - x^2(b + c)$

$\Rightarrow b^2 + ac = x(b^2 + c^2)$

$\Rightarrow x = \dfrac{b^2 + ac}{b^2 + c^2}$

34. If $ab + bc + ca = 0$, then what is the value of $\dfrac{a^2}{a^2 - bc} + \dfrac{b^2}{b^2 - ca} + \dfrac{c^2}{c^2 - ab}$?

(a) 3 (b) 0 (c) 1 (d) -1

⊗ **(c)** We have, $ab + bc + ca = 0$

$\Rightarrow ab + ca = -bc$

$\Rightarrow a = \dfrac{-bc}{b + c}$

$\Rightarrow a^2 = \dfrac{b^2 c^2}{(b + c)^2}$

Now, consider

$\dfrac{a^2}{a^2 - bc} + \dfrac{b^2}{b^2 - ca} + \dfrac{c^2}{c^2 - ab}$

$= \dfrac{\dfrac{b^2 c^2}{(b + c)^2}}{\dfrac{b^2 c^2}{(b + c)^2} - bc} + \dfrac{b^2}{b^2 - c\left(\dfrac{-bc}{b + c}\right)}$

$+ \dfrac{c^2}{c^2 - b\left(\dfrac{-bc}{b + c}\right)}$

$= \dfrac{b^2 c^2}{b^2 c^2 - (b + c)^2 bc} + \dfrac{b^2(b + c)}{b^2(b + c) + bc^2}$

$+ \dfrac{c^2(b + c)}{c^2(b + c) + b^2 c}$

$$= \frac{bc}{bc - (b+c)^2} + \frac{b(b+c)}{b(b+c) + c^2}$$

$$+ \frac{c(b+c)}{c(b+c) + b^2}$$

$$= \frac{bc}{-(b^2 + c^2 + bc)} + \frac{b(b+c)}{b^2 + bc + c^2}$$

$$+ \frac{c(b+c)}{b^2 + c^2 + bc}$$

$$= \frac{-bc + b^2 + bc + c^2 + bc}{b^2 + c^2 + bc}$$

$$= \frac{b^2 + bc + c^2}{b^2 + c^2 + bc} = 1$$

35. What is $\dfrac{(x-y)(y-z)(z-x)}{(x-y)^3 + (y-z)^3 + (z-x)^3}$

equal to?

(a) $-\dfrac{1}{3}$ (b) $\dfrac{1}{3}$

(c) 3   (d) -3

⟩ **(b)** We know that if, $a + b + c = 0$, then
$a^3 + b^3 + c^3 = 3abc$

Here, $(x-y) + (y-z) + (z-x)$
$= x - y + y - z + z - x = 0$

∴ $(x-y)^3 + (y-z)^3 + (z-x)^3$
$= 3(x-y)(y-z)(z-x)$ ...(i)

Now consider,
$$\frac{(x-y)(y-z)(z-x)}{(x-y)^3 + (y-z)^3 + (z-x)^3}$$

$$= \frac{(x-y)(y-z)(z-x)}{3(x-y)(y-z)(z-x)}$$ [using Eq. (i)]

$$= \frac{1}{3}$$

36. If $5x^3 + 5x^2 - 6x + 9$ is divided by $(x + 3)$, then the remainder is

(a) 135   (b) -135
(c) 63   (d) -63

⟩ **(d)** We have,
$f(x) = 5x^3 + 5x^2 - 6x + 9$
$g(x) = x + 3 = 0 \Rightarrow x = -3$
$f(-3) = 5(-3)^3 + 5(-3)^2 - 6(-3) + 9$
$= -135 + 45 + 18 + 9 = -63$
Hence $5x^3 + 5x^2 - 6x + 9$, is divided by $(x + 3)$ the remainder is -63.

37. The quotient of $8x^3 - y^3$ when divided by $2xy + 4x^2 + y^2$ is

(a) $2x + y$ (b) $x + 2y$
(c) $2x - y$ (d) $4x - y$

⟩ **(c)** We have,
$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
∴ $8x^3 - y^3 = (2x)^3 - (y)^3$
$= (2x - y)(4x^2 + 2xy + y^2)$
$8x^3 - y^3$ is divided by $2xy + 4x^2 + y^2$,
then quotient $= 2x - y$

38. If $(x + 2)$ is a common factor of $x^2 + ax + b$ and $x^2 + bx + a$, then the ratio $a : b$ is equal to

(a) 1   (b) 2
(c) 3   (d) 4

⟩ **(a)** We have, $x + 2$ is factor of
$x^2 + ax + b$
∴ $(-2)^2 + (-2)a + b = 0$
⟹ $b - 2a = -4$ ...(i)
also, $(x + 2)$ is factor of $x^2 + bx + a$
∴ $(-2)^2 - 2b + a = 0$
⟹ $a - 2b = -4$ ...(ii)
On solving Eqs. (i) and (ii) we get
∴ $a = b = 4$
∴ $a : b = 1$

39. The product of the polynomials $(x + 2), (x - 2), (x^3 - 2x^2 + 4x - 8)$ and $(x^3 + 2x^2 + 4x + 8)$ is

(a) $x^8 - 256$
(b) $(x^4 - 16)^2$
(c) $(x^4 + 16)^2$
(d) $(x^2 - 4)^4$

⟩ **(b)** Let $f(x)$ be the product of given polynomials. Then,
$f(x) = (x + 2)(x - 2)$
      $(x^3 - 2x^2 + 4x - 8)$
      $(x^3 + 2x^2 + 4x + 8)$
$= (x^2 - 2^2)(x^2(x - 2) + 4(x - 2))$
      $(x^2(x + 2) + 4(x + 2))$
$= (x^2 - 4)((x - 2)(x^2 + 4))$
          $((x + 2)(x^2 + 4))$
$= (x^2 - 4)(x^2 + 4)^2(x^2 - 2^2)$
    $[\because (a + b)(a - b) = (a^2 - b^2)]$
$= (x^2 - 4)(x^2 + 4)^2(x^2 - 4)$
$= [(x^2 - 4)(x^2 + 4)]^2$
$= (x^4 - 4^2)^2 = (x^4 - 16)^2$

40. The factors of $x(x + 2)(x + 3)(x + 5) - 72$ are

(a) $x, (x + 3), (x + 4)$ and $(x - 6)$
(b) $(x - 1), (x + 6)$ and $(x^2 - 2x - 12)$
(c) $(x - 1), (x + 6)$ and $(x^2 + 5x + 12)$
(d) $(x + 1), (x - 6)$ and $(x^2 - 5x - 12)$

⟩ **(c)** Let
$f(x) = x(x + 2)(x + 3)(x + 5) - 72$
$= x(x + 2)[x^2 + 8x + 15] - 72$
$= x[x^3 + 8x^2 + 15x + 2x^2 + 16x + 30] - 72$
$= x(x^3 + 10x^2 + 31x + 30) - 72$
$= x^4 + 10x^3 + 31x^2 + 30x - 72$
Clearly, $f(1) = 0$
∴ $x - 1$ is a factor of $f(x)$
Also, $f(-6) = 0$
∴ $(x + 6)$ is a factor of $f(x)$

Now, to find other factors, let us divide $f(x)$ by $(x - 1)(x + 6)$, i.e., by

$$\begin{array}{r} x^2 + 5x + 12 \\ x^2 + 5x - 6 \overline{)x^4 + 10x^3 + 31x^2 + 30x - 72} \\ \underline{x^4 + 5x^3 - 6x^2} \\ (-) \quad (-) \quad (+) \\ 5x^3 + 37x^2 + 30x - 72 \\ \underline{5x^3 + 25x^2 - 30x} \\ (-) \quad (-) \quad (+) \\ 12x^2 + 60x - 72 \\ \underline{12x^2 + 60x - 72} \\ (-) \quad (-) \quad (+) \\ 0 \end{array}$$

The other factor is $x^2 + 5x + 12$
∴ all factors of
$x(x + 2)(x + 3)(x + 5) - 72$ are
$(x - 1), (x + 6)$ and $(x^2 + 5x + 12)$.

41. If the HCF of polynomials $f(x) = (x - 1)(x^2 + 3x + a)$ and $g(x) = (x + 2)(x^2 + 2x + b)$ is $(x^2 + x - 2)$, then what are the values of a and b respectively?

(a) 2, 2   (b) 2, -3
(c) $-1, -3$ (d) $-2, -1$

⟩ **(b)** Let $h(x) = x^2 + x - 2$
$= x^2 + 2x - x - 2$
$= x(x + 2) - 1(x + 2) = (x + 2)(x - 1)$
Since, $h(x)$ is the H.C.F of $f(x)$ and $g(x)$
∴ $h(x)$ completely divides both $f(x)$ and $g(x)$
⟹ $(x + 2)$ is also a factor of $f(x)$ and $(x - 1)$ is a factor of $g(x)$
⟹ $f(-2) = 0$ and $g(1) = 0$
⟹ $(-3)(4 - 6 + a) = 0$
and $3(1 + 2 + b) = 0$
⟹ $(a - 2) = 0$ and $b + 3 = 0$
⟹ $a = 2$ and $b = -3$

2017 (I)

42. If $x = \dfrac{\sqrt{a + b} - \sqrt{a - b}}{\sqrt{a + b} + \sqrt{a - b}}$, then what is $bx^2 - 2ax + b$ equal to $(b \neq a)$?

(a) 0   (b) 1   (c) ab (d) $2ab$

⟩ **(a)** We have, $x = \dfrac{\sqrt{a + b} - \sqrt{a - b}}{\sqrt{a + b} + \sqrt{a - b}}$

⟹ $x = \dfrac{\sqrt{a + b} - \sqrt{a - b}}{\sqrt{a + b} + \sqrt{a - b}}$

        $\times \dfrac{\sqrt{a + b} - \sqrt{a - b}}{\sqrt{a + b} - \sqrt{a - b}}$

⟹ $x = \dfrac{(\sqrt{a + b} - \sqrt{a - b})^2}{(a + b) - (a - b)}$

⟹ $x = \dfrac{a + b + a - b - 2\sqrt{a^2 - b^2}}{2b}$

$\Rightarrow \quad x = \dfrac{2a - 2\sqrt{a^2 - b^2}}{2b}$

$\Rightarrow \quad x = \dfrac{a - \sqrt{a^2 - b^2}}{b}$

$\Rightarrow \quad bx = a - \sqrt{a^2 - b^2}$

$\Rightarrow \quad a - bx = \sqrt{a^2 - b^2}$

On squaring both the sides, we get

$\Rightarrow \quad (a - bx)^2 = a^2 - b^2$

$\Rightarrow \quad a^2 + b^2x^2 - 2abx = a^2 - b^2$

$\Rightarrow \quad b^2x^2 - 2abx + b^2 = 0$

$\Rightarrow \quad bx^2 - 2ax + b = 0$

43. What is the value of $\dfrac{(443 + 547)^2 + (443 - 547)^2}{443 \times 443 + 547 \times 547}$?

(a) 0   (b) 1
(c) 2   (d) 3

⊙ *(c)* $\dfrac{(443 + 547)^2 + (443 - 547)^2}{443 \times 443 + 547 \times 547}$

$= \dfrac{\left[\begin{array}{l}(443)^2 + (547)^2 + 2 \times 443 \times 547 \\ +(443)^2 + (547)^2 - 2 \times 443 \times 547\end{array}\right]}{(443)^2 + (547)^2}$

$[\because (a + b)^2 = a^2 + b^2 + 2ab]$

$= \dfrac{2[(443)^2 + (547)^2]}{[(443)^2 + (547)^2]} = 2$

44. If $a^3 = 335 + b^3$ and $a = 5 + b$, then what is the value of $a + b$ (given that $a > 0$ and $b > 0$)?

(a) 7   (b) 9
(c) 16   (d) 49

⊙ *(b)* We have, $a^3 = 335 + b^3$

$\Rightarrow \quad a^3 - b^3 = 335 \quad \quad \text{...(i)}$

and $\quad \quad a = 5 + b$

$\Rightarrow \quad a - b = 5 \quad \quad \text{...(ii)}$

Now, $\quad (a - b)^3 = a^3 - b^3 - 3ab(a - b)$

$\Rightarrow \quad (5)^3 = 335 - 3ab(5)$

$\quad \quad \quad$ [∵ from Eqs. (i) and (ii)]

$\Rightarrow \quad 125 = 335 - 15ab$

$\Rightarrow \quad ab = 14$

Again,

$\quad (a + b)^2 = (a - b)^2 + 4ab$

$\quad \quad \quad = (5)^2 + 4(14) = 25 + 56$

$\quad (a + b)^2 = 81$

$\therefore \quad \quad a + b = 9$

45. If $a + b = 5$ and $ab = 6$, then what is the value of $a^3 + b^3$?

(a) 35   (b) 40
(c) 90   (d) 125

⊙ *(a)* We know that,

$a^3 + b^3 = (a + b)^3 - 3ab(a + b)$

$\quad \quad = (5)^3 - 3 \times 6 \times 5$

$\quad \quad = 125 - 90 = 35$

46. $(x + 4)$ is a factor of which one of the following expressions?

(a) $x^2 - 7x + 44$ (b) $x^2 + 7x - 44$
(c) $x^2 - 7x - 44$ (d) $x^2 + 7x + 44$

⊙ *(c)* We have, $(x + 4)$ as a factor

∴ Put $x = -4$ in all the options.

(a) $(-4)^2 - 7(-4) + 44$

$\quad = 16 + 28 + 44 = 88 \neq 0$

(b) $(-4)^2 + 7(-4) - 44$

$\quad = 16 - 28 - 44 = -56 \neq 0$

(c) $(-4)^2 - 7(-4) - 44$

$\quad = 16 + 28 - 44 = 0$

(d) $(-4)^2 + 7(-4) + 44$

$\quad = 16 - 28 + 44 = 32 \neq 0$

∴ $(x + 4)$ is a factor of $x^2 - 7x - 44$.

47. If $x = 2 + 2^{2/3} + 2^{1/3}$, then what is the value of $x^3 - 6x^2 + 6x$?

(a) 3   (b) 2
(c) 1   (d) 0

⊙ *(b)* We have,

$\quad \quad x = 2 + 2^{2/3} + 2^{1/3} \quad \quad \text{...(i)}$

$\Rightarrow \quad x - 2 = 2^{1/3}(2^{1/3} + 1)$

On cubing both the sides, we get

$\quad (x - 2)^3 = 2(2^{1/3} + 1)^3$

$\Rightarrow \quad x^3 - 3(x^2)(2) + 3(x)(2)^2 - 8$

$\quad \quad = 2((2^{1/3})^3 + 3(2^{1/3})^2(1)$

$\quad \quad \quad + 3(2^{1/3})(1)^2 + (1)^3)$

$[\because (a - b)^3 = a^3 - b^3 - 3a^2b + 3ab^2]$

$\Rightarrow \quad x^3 - 6x^2 + 12x - 8 =$

$\quad \quad 2[2 + 3 \times 2^{2/3} + 3 \times 2^{1/3} + 1]$

$\Rightarrow \quad x^3 - 6x^2 + 12x - 8 =$

$\quad \quad 2[3 + 3 \times 2^{2/3} + 3 \times 2^{1/3}]$

$\Rightarrow x^3 - 6x^2 + 12x - 8 = 6[1 + 2^{2/3} + 2^{1/3}]$

$\Rightarrow x^3 - 6x^2 + 12x - 8 = 6[1 + x - 2]$

$\quad \quad \quad \quad \quad \text{[from Eq. (i)]}$

$\Rightarrow \quad x^3 - 6x^2 + 12x - 8 = 6(x - 1)$

$\Rightarrow \quad x^3 - 6x^2 + 12x - 8 = 6x - 6$

$\therefore \quad \quad x^3 - 6x^2 + 6x = 2$

2016 (II)

48. If $x^2 = y + z$, $y^2 = z + x$ and $z^2 = x + y$, then what is the value of $\dfrac{1}{x + 1} + \dfrac{1}{y + 1} + \dfrac{1}{z + 1}$?

(a) -1 (b) 1   (c) 2   (d) 4

⊙ *(b)* Given,

$\quad x^2 = y + z \Rightarrow x = \dfrac{y + z}{x} \quad \text{...(i)}$

$\quad y^2 = z + x \Rightarrow y = \dfrac{z + x}{y} \quad \text{...(ii)}$

and $z^2 = x + y \Rightarrow z = \dfrac{x + y}{z} \quad \text{...(iii)}$

Now, $\dfrac{1}{x + 1} + \dfrac{1}{y + 1} + \dfrac{1}{z + 1}$

$= \dfrac{1}{\dfrac{y + z}{x} + 1} + \dfrac{1}{\dfrac{z + x}{y} + 1} + \dfrac{1}{\dfrac{x + y}{z} + 1}$

$= \dfrac{x}{x + y + z} + \dfrac{y}{x + y + z} + \dfrac{z}{x + y + z}$

$= \dfrac{x + y + z}{x + y + z} = 1$

49. If $x + \dfrac{1}{1 + \dfrac{1}{2 + \dfrac{1}{3}}} = 2$, then what is x equal to?

(a) $\dfrac{7}{10}$ (b) $\dfrac{13}{10}$ (c) $\dfrac{11}{10}$ (d) $\dfrac{17}{10}$

⊙ *(b)* Given, $x + \dfrac{1}{1 + \dfrac{1}{2 + \dfrac{1}{3}}} = 2$

$\Rightarrow \quad x + \dfrac{1}{1 + \dfrac{3}{7}} = 2$

$\Rightarrow \quad x + \dfrac{7}{10} = 2$

$\therefore \quad \quad x = 2 - \dfrac{7}{10} = \dfrac{13}{10}$

50. If $4x + 3a = 0$, then what is the value of $\dfrac{x^2 + ax + a^2}{x^3 - a^3} - \dfrac{x^2 - ax + a^2}{x^3 + a^3}$?

(a) $-\dfrac{4}{7a}$ (b) $\dfrac{7}{a}$
(c) $-\dfrac{32}{7a}$ (d) $\dfrac{24}{7a}$

⊙ *(c)* Given, $4x + 3a = 0$

$\Rightarrow \quad x = \dfrac{-3a}{4}$

Now, $\dfrac{x^2 + ax + a^2}{x^3 - a^3} - \dfrac{x^2 - ax + a^2}{x^3 + a^3}$

$= \dfrac{x^2 + ax + a^2}{(x - a)(x^2 + ax + a^2)}$

$\quad \quad - \dfrac{x^2 - ax + a^2}{(x + a)(x^2 + a^2 - ax)}$

$\left[\begin{array}{l}\because a^3 - b^3 = (a - b)(a^2 + ab + b^2) \\ a^3 + b^3 = (a + b)(a^2 - ab + b^2)\end{array}\right]$

$= \dfrac{1}{x - a} - \dfrac{1}{x + a} = \dfrac{2a}{x^2 - a^2}$

$= \dfrac{2a}{\left(\dfrac{-3a}{4}\right)^2 - a^2} = -\dfrac{32}{7a}$

2016 (I)

51. For what value of k is $(x + 1)$ a factor of $x^3 + kx^2 - x + 2$?

(a) 4   (b) 3
(c) 1   (d) –2

▷ **(d)** Let $f(x) = x^3 + kx^2 - x + 2$.
If $(x + 1)$ is a factor of $f(x)$.

Then, $f(-1) = 0$
$\Rightarrow$ $(-1)^3 + k(-1)^2 - (-1) + 2 = 0$
$\Rightarrow$ $-1 + k + 1 + 2 = 0$
$\Rightarrow$ $k = -2$

52. If $\dfrac{61}{19} = 3 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$, where x, y and z are natural numbers, then z is equal to

(a) 1   (b) 2
(c) 3   (d) 4

▷ **(c)** Given, $\dfrac{61}{19} = 3 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

$\Rightarrow$ $\dfrac{61}{19} - 3 = \dfrac{1}{x + \dfrac{1}{\frac{yz + 1}{z}}}$

$\Rightarrow$ $\dfrac{4}{19} = \dfrac{1}{x + \dfrac{z}{yz + 1}}$

$\Rightarrow$ $\dfrac{4}{19} = \dfrac{yz + 1}{xyz + x + z}$

$\Rightarrow 4xyz + 4x + 4z = 19yz + 19$
$\Rightarrow (4xy + 4 - 19y)z = 19 - 4x$
$\Rightarrow$ $z = \dfrac{19 - 4x}{4xy + 4 - 19y}$

As x, y and z are natural numbers.
Again, let $x = 4$ and $y = 1$
Then,
$z = \dfrac{19 - 4 \times 4}{4 \times 4 \times 1 + 4 - 19 \times 1} = \dfrac{19 - 16}{20 - 19} = 3$
which is a natural number.

53. If $(s - a) + (s - b) + (s - c) = s$, then the value of

$$\dfrac{(s - a)^2 + (s - b)^2 + (s - c)^2 + s^2}{a^2 + b^2 + c^2}$$

will be

(a) 3   (b) 1
(c) 0   (d) – 1

▷ **(b)** Given, $(s - a) + (s - b) + (s - c) = s$
$\Rightarrow$ $2s = (a + b + c)$

$\therefore$ $\dfrac{(s-a)^2 + (s-b)^2 + (s-c)^2 + s^2}{a^2 + b^2 + c^2}$

$= \dfrac{\begin{bmatrix} 3s^2 + a^2 + b^2 + c^2 \\ -2s(a + b + c) + s^2 \end{bmatrix}}{a^2 + b^2 + c^2}$

$= \dfrac{4s^2 + a^2 + b^2 + c^2 - 2s(2s)}{a^2 + b^2 + c^2}$

$= \dfrac{a^2 + b^2 + c^2}{a^2 + b^2 + c^2} = 1$

54. Let p and q be non-zero integers. Consider the polynomial $A(x) = x^2 + px + q$. It is given that $(x - m)$ and $(x - km)$ are simple factors of $A(x)$, where m is a non-zero integer and k is a positive integer, $k \geq 2$. Which one of the following is correct?

(a) $(k + 1)^2 p^2 = kq$
(b) $(k + 1)^2 q = kp^2$
(c) $k^2 q = (k + 1)p^2$
(d) $k^2 p^2 = (k + 1)^2 q$

▷ **(b)** We have, $A(x) = x^2 + px + q$
$\because (x - m)$ and $(x - km)$ are factors of $A(x)$, then m and km are roots of $A(x)$.
$\therefore$ $m + km = -p$
$\Rightarrow$ $m(k + 1) = -p$
$\Rightarrow$ $m = \dfrac{-p}{(k + 1)}$ ...(i)
and $m \cdot km = q$
$\Rightarrow$ $m^2 k = q$
$\Rightarrow$ $\dfrac{p^2}{(k + 1)^2} \cdot k = q$ [from Eq. (i)]
$\Rightarrow$ $(k + 1)^2 q = kp^2$

55. If the linear factors of $ax^2 - (a^2 + 1)x + a$ are p and q, then $p + q$ is equal to

(a) $(x - 1)(a + 1)$ (b) $(x + 1)(a + 1)$
(c) $(x - 1)(a - 1)$ (d) $(x + 1)(a - 1)$

▷ **(a)** Let $f(x) = ax^2 - (a^2 + 1)x + a$
$= ax^2 - x - a^2x + a$
$= x(ax - 1) - a(ax - 1) = (x - a)(ax - 1)$
If p and q are linear factors of $f(x)$, then
$p = (x - a)$ and $q = (ax - 1)$
$\therefore$ $p + q = (x - a) + (ax - 1)$
$= (x - 1)(a + 1)$

56. The value of the expression $\dfrac{(243 + 647)^2 + (243 - 647)^2}{243 \times 243 + 647 \times 647}$ is equal to

(a) 0   (b) 1   (c) 2   (d) 3

▷ **(c)** $\dfrac{(243 + 647)^2 + (243 - 647)^2}{243 \times 243 + 647 \times 647}$

$= \dfrac{\begin{array}{l}(243)^2 + (647)^2 + 2 \times 243 \times 647 \\ + (243)^2 + (647)^2 - 2 \times 243 \times 64\end{array}}{(243)^2 + (647)^2}$

$[\because (a + b)^2 = a^2 + b^2 + 2ab]$

$= \dfrac{2[(243)^2 + (647)^2]}{(243)^2 + (647)^2} = 2$

57. If the polynomial $x^6 + px^5 + qx^4 - x^2 - x - 3$ is divisible by $(x^4 - 1)$, then the value of $p^2 + q^2$ is

(a) 1   (b) 9   (c) 10   (d) 13

▷ **(c)** Let $f(x) = x^6 + px^5 + qx^4$
$- x^2 - x - 3$
$\because f(x)$ is divisible by $(x^4 - 1)$.
$\therefore$ $f(1) = f(-1) = 0$
Now, $f(1) = 1 + p + q - 1 - 1 - 3 = 0$
$\Rightarrow$ $p + q = 4$ ...(i)
and $f(-1) = 1 - p + q - 1 + 1 - 3 = 0$
$\Rightarrow$ $q - p = 2$ ...(ii)
On solving Eqs. (i) and (ii), we get
     $q = 3$ and $p = 1$
$\therefore$ $p^2 + q^2 = 3^2 + 1^2 = 10$

58. If $\dfrac{a}{b} = \dfrac{b}{c} = \dfrac{c}{d}$, then which of the following is/are correct?

1. $\dfrac{b^3 + c^3 + d^3}{a^3 + b^3 + c^3} = \dfrac{d}{a}$

2. $\dfrac{a^2 + b^2 + c^2}{b^2 + c^2 + d^2} = \dfrac{a}{d}$

Select the correct answer using the codes given below.

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

▷ **(a)** $\dfrac{a}{b} = \dfrac{b}{c} = \dfrac{c}{d} = k$ [say]

$\Rightarrow$ $a = bk, b = ck, c = dk$
$\therefore$ $a = dk^3, b = dk^2, c = dk$

1. $\dfrac{b^3 + c^3 + d^3}{a^3 + b^3 + c^3} = \dfrac{(dk^2)^3 + (dk)^3 + d^3}{(dk^3)^3 + (dk^2)^3 + (dk)^3}$

$= \dfrac{d^3(k^6 + k^3 + 1)}{d^3(k^9 + k^6 + k^3)} = \dfrac{k^6 + k^3 + 1}{k^3(k^6 + k^3 + 1)}$

$= \dfrac{1}{k^3} = \dfrac{d}{a}$

Hence, statement 1 is correct.

2. $\dfrac{a^2 + b^2 + c^2}{b^2 + c^2 + d^2} = \dfrac{(dk^3)^2 + (dk^2)^2 + (dk)^2}{(dk^2)^2 + (dk)^2 + d^2}$

$= \dfrac{d^2(k^6 + k^4 + k^2)}{d^2(k^4 + k^2 + 1)}$

$= \dfrac{k^2(k^4 + k^2 + 1)}{k^4 + k^2 + 1}$

$= k^2 = \dfrac{b}{d}$

Hence, statement 2 is incorrect.

59. If $x = 2^{1/3} + 2^{-1/3}$, then the value of $2x^3 - 6x - 5$ is equal to

  (a) 0   (b) 1
  (c) 2   (d) 3

⊘ *(a)* Given, $x = 2^{1/3} + 2^{-1/3}$

∴ $2x^3 - 6x - 5 = 2(2^{1/3} + 2^{-1/3})^3$
$$- 6(2^{1/3} + 2^{-1/3}) - 5$$
$$= 2[2 + 2^{-1} + 3(2^{1/3} + 2^{-1/3})]$$
$$- 6(2^{1/3} + 2^{-1/3}) - 5$$

$[\because (a + b)^3 = a^3 + b^3 + 3ab(a + b)]$
$$= 4 + 2 \times \frac{1}{2} + 6(2^{1/3} + 2^{-1/3})$$
$$- 6(2^{1/3} + 2^{-1/3}) - 5$$
$$= 4 + 1 - 5 = 0$$

Alternate method

$x = 2^{\frac{1}{3}} + 2^{\frac{-1}{3}}$

On cube both sides
$(x)^3 = (2^{1/3} + 2^{-1/3})^3$

       $[\because (a + b)^3 = a^3 + b^3 + 3ab(a + b)]$

$x^3 = \left(2^{\frac{1}{3}}\right)^3 + \left(2^{-\frac{1}{3}}\right)^3 + 3\left(2^{\frac{1}{3}}\right)\left(2^{-\frac{1}{3}}\right)$
$$\left(2^{\frac{1}{3}} + 2^{-\frac{1}{3}}\right)$$

$x^3 = 2^1 + 2^{-1} + 3x$ $[\because 2^{1/3} + 2^{-1/3} = x]$

$x^3 - 3x = 2 + \frac{1}{2}$

$2(x^3 - 3x) = 5$
$2x^3 - 6x - 5 = 0$

60. If $a^3 = 117 + b^3$ and $a = 3 + b$, then the value of $a + b$ is (given that $a > 0$ and $b > 0$)

  (a) 7   (b) 9
  (c) 11   (d) 13

⊘ *(a)* We have,
$$a^3 - b^3 = 117 \qquad \text{...(i)}$$
and $\qquad (a - b) = 3 \qquad \text{...(ii)}$

On cubing both sides of Eq. (ii), we get
$$(a - b)^3 = (3)^3$$
$\Rightarrow a^3 - b^3 - 3ab(a - b) = 27$
$\Rightarrow \qquad 117 - 3ab(3) = 27$
$\Rightarrow \qquad 117 - 9ab = 27$
$\Rightarrow \qquad 9ab = 90$
$\Rightarrow \qquad ab = 10$
Now, $(a + b)^2 = (a - b)^2 + 4ab$
$\Rightarrow (a + b)^2 = (3)^2 + 4(10)$
$\Rightarrow (a + b)^2 = 9 + 40 = 49$
∴ $\qquad (a + b) = 7$
$$[\because a > 0 \text{ and } b > 0]$$

2015 (II)

61. Which one of the following is correct?

  (a) $(x + 2)$ is a factor of
$$x^4 - 6x^3 + 12x^2 - 24x + 32$$
  (b) $(x + 2)$ is a factor of
$$x^4 + 6x^3 - 12x^2 + 24x - 32$$
  (c) $(x - 2)$ is a factor of
$$x^4 - 6x^3 + 12x^2 - 24x + 32$$
  (d) $(x - 2)$ is a factor of
$$x^4 + 6x^3 - 12x^2 + 24x - 32$$

⊘ *(c)* (a) Let
$p(x) = x^4 - 6x^3 + 12x^2 - 24x + 32$
Now, $p(-2) = (-2)^4 - 6(-2)^3 + 12(-2)^2$
$$- 24(-2) + 32$$
$= 16 - 6(-8) + 12(4) + 48 + 32$
$= 16 + 48 + 48 + 48 + 32 \neq 0$
Hence, it is not a factor.

(b) Let
$p(x) = x^4 + 6x^3 - 12x^2 + 24x - 32$
Then, $p(-2) = (-2)^4 + 6(-2)^3 - 12(-2)^2$
$$+ 24(-2) - 32$$
$= 16 - 48 - 48 - 48 - 32 \neq 0$
Hence, it is not a factor.

(c) Let
$p(x) = x^4 - 6x^3 + 12x^2 - 24x + 32$
Then, $p(2) = 2^4 - 6(2)^3 + 12(2)^2$
$$- 24(2) + 32$$
$= 16 - 48 + 48 - 48 + 32$
$= 48 - 48 = 0$
It is a factor.

(d) Let
$p(x) = x^4 + 6x^3 - 12x^2 + 24x - 32$
Then,
$p(2) = (2)^4 + 6(2)^3 - 12(2)^2 + 24 \times 2 - 32$
$= 16 + 48 - 48 + 48 - 32 \neq 0$
Hence, it is not a factor.

62. If $x = \dfrac{91}{216}$, then the value of

$3 - \dfrac{1}{(1 - x)^{1/3}}$ is

  (a) $\dfrac{9}{5}$ (b) $\dfrac{5}{9}$ (c) $\dfrac{4}{9}$ (d) $\dfrac{4}{5}$

⊘ *(a)* We have, $x = \dfrac{91}{216}$

$\Rightarrow \quad 1 - x = 1 - \dfrac{91}{216} = \dfrac{125}{216} = \left(\dfrac{5}{6}\right)^3$

$\Rightarrow \quad (1 - x)^{\frac{1}{3}} = \dfrac{5}{6} \Rightarrow \dfrac{1}{(1 - x)^{\frac{1}{3}}} = \dfrac{6}{5}$

∴ $\quad 3 - \dfrac{1}{(1 - x)^{\frac{1}{3}}} = 3 - \dfrac{6}{5} = \dfrac{9}{5}$

2015 (I)

63. If $\dfrac{37}{13} = 2 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$, where

x, y, z are natural numbers, then what is z equal to?

  (a) 1   (b) 2
  (c) 3
  (d) Cannot be determined due to insufficient data

⊘ *(b)* $\dfrac{37}{13} = 2 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

$\Rightarrow \dfrac{37}{13} = 2 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

$\Rightarrow 2 + \dfrac{11}{13} = 2 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

$\Rightarrow 2 + \dfrac{1}{\dfrac{13}{11}} = 2 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

$\Rightarrow 2 + \dfrac{1}{1 + \dfrac{2}{11}} = 2 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

$\Rightarrow 2 + \dfrac{1}{1 + \dfrac{1}{\dfrac{11}{2}}} = 2 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

$\Rightarrow 2 + \dfrac{1}{1 + \dfrac{1}{5 + \dfrac{1}{2}}} = 2 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$

Then,
$x = 1, y = 5, z = 2$ [∵ on comparing]

64. For what value of k is $(x - 5)$ a factor of $x^3 - 3x^2 + kx - 10$?

  (a) −8   (b) 4
  (c) 2   (d) 1

⊘ *(a)* Let $p(x) = x^3 - 3x^2 + kx - 10$
Then, $(x - 5)$ is a factor of $p(x)$.
∴ $\qquad\qquad\qquad p(5) = 0$
$\Rightarrow \quad 5^3 - 3(5)^2 + k \times 5 - 10 = 0$
$\Rightarrow \qquad 125 - 75 + 5k - 10 = 0$
$\Rightarrow \qquad\qquad\qquad 40 + 5k = 0$
$\Rightarrow \qquad\qquad\qquad\qquad k = -8$
Hence, the value of k is −8.

65. The expression $x^3q^2 - x^3pt +$
$4x^2pt - 4x^2q^2 + 3xq^2 - 3xpt$
is divisible by

(a) Only $(x-1)$
(b) Only $(x-3)$
(c) Both $(x-1)$ and $(x-3)$
(d) Neither $(x-1)$ nor $(x-3)$

⊘ *(c)* $x^3q^2 - x^3pt + 4x^2pt - 4x^2q^2$
$\qquad + 3xq^2 - 3xpt$
$= x^3q^2 - x^3pt - 4x^2q^2 + 4x^2pt$
$\qquad +3xq^2 - 3xpt$
$= x^3(q^2 - pt) - 4x^2(q^2 - pt)$
$\qquad +3x(q^2 - pt)$
$= (x^3 - 4x^2 + 3x)(q^2 - pt)$
$= x(x^2 - 4x + 3)(q^2 - pt)$
$= x(x^2 - 3x - x + 3)(q^2 - pt)$
$= x[x(x-3) - 1(x-3)](q^2 - pt)$
$= x(x-3)(x-1)(q^2 - pt)$

Hence, the given expression is divisible by $(x-1)$ and $(x-3)$.

66. If $x + y + z = 0$, then
$x^3 + y^3 + z^3 - 3xyz$ is equal to

(a) 0 (b) $6xyz$ (c) $12xyz$ (d) xyz

⊘ *(a)* $\because$ $x^3 + y^3 + z^3 - 3xyz = (x + y + z)$
$(x^2 + y^2 + z^2 - xy - yz - zx)$
Given, $\qquad x + y + z = 0$
$\therefore$ $x^3 + y^3 + z^3 - 3xyz = 0$
Hence, the value of $x^3 + y^3 + z^3 - 3xyz$ is zero.

67. If $a - b = 4$ and $a^2 + b^2 = 40$, where a and b are positive integers, then $a^3 + b^6$ is equal to

(a) 264 (b) 280
(c) 300 (d) 324

⊘ *(b)* Given, $\qquad a - b = 4$ $\qquad$ …(i)
On squaring both sides, we get
$(a - b)^2 = (4)^2$
$\Rightarrow$ $a^2 + b^2 - 2ab = 16$
$\Rightarrow$ $\qquad 40 - 2ab = 16$
$\qquad\qquad [\because a^2 + b^2 = 40]$
$\Rightarrow$ $\qquad 2ab = 40 - 16$
$\Rightarrow$ $\qquad 2ab = 24$
$\Rightarrow$ $\qquad ab = 12$
$\because$ $\qquad a + b = \sqrt{a^2 + b^2 + 2ab}$
$\qquad = \sqrt{40 + 2 \times 12}$
$\qquad = \sqrt{40 + 24} = \sqrt{64} = 8$
$\therefore$ $\qquad a + b = 8$ $\qquad$ …(ii)
On adding Eqs. (i) and (ii), we get
$\qquad\qquad 2a = 12$
$\Rightarrow$ $\qquad\qquad a = 6$
On putting the value of a in Eq. (i), we get
$\qquad 6 - b = 4 \Rightarrow b = 2$

Now, $a^3 + b^6 = 6^3 + 2^6 = 2^3 \times 3^3 + 2^6$
$\qquad = 2^3(3^3 + 2^3)$
$\qquad = 8(27 + 8) = 8 \times 35 = 280$
Hence, the value of $a^3 + b^6$ is 280.

2014 (II)

68. If $(x + k)$ is the common factor of $x^2 + ax + b$ and $x^2 + cx + d$, then what is k equal to?

(a) $(d - b)/(c - a)$ (b) $(d - b)/(a - c)$
(c) $(d + b)/(c + a)$ (d) $(d - b)/(c + a)$

⊘ *(a)* Given, $x + k$ is the common factor of $x^2 + ax + b$ and $x^2 + cx + d$.
$\therefore$ $\qquad k^2 - ka + b = 0$
and $\qquad k^2 - kc + d = 0$
Then, $\qquad k^2 - ka + b = k^2 - kc + d$
$\Rightarrow$ $\qquad k(c - a) = d - b$
$\therefore$ $\qquad k = \dfrac{d - b}{c - a}$

69. What is the remainder when $x^5 - 5x^2 + 125$ is divided by $(x + 5)$?

(a) 0 (b) 125
(c) – 3125 (d) 3125

⊘ *(c)* Let $f(x) = x^5 - 5x^2 + 125$
$\therefore$ Required remainder $= f(-5)$
$\qquad = (-5)^5 - 5(-5^2) + 125$
$\qquad = -3125 - 125 + 125 = -3125$

70. What is $\dfrac{1}{a - b} - \dfrac{1}{a + b}$
$- \dfrac{2b}{a^2 + b^2} - \dfrac{4b^3}{a^4 + b^4} - \dfrac{8b^7}{a^8 - b^8}$
equal to?

(a) $a + b$ (b) $a - b$ (c) 1 (d) 0

⊘ *(d)* $\dfrac{1}{a - b} - \dfrac{1}{a + b} - \dfrac{2b}{a^2 + b^2}$
$\qquad - \dfrac{4b^3}{a^4 + b^4} - \dfrac{8b^7}{a^8 - b^8}$
$= \dfrac{(a + b) - (a - b)}{(a - b)(a + b)} - \dfrac{2b}{a^2 + b^2}$
$\qquad - \dfrac{4b^3}{a^4 + b^4} - \dfrac{8b^7}{a^8 - b^8}$
$= \dfrac{2b}{a^2 - b^2} - \dfrac{2b}{a^2 + b^2}$
$\qquad - \dfrac{4b^3}{a^4 + b^4} - \dfrac{8b^7}{a^8 - b^8}$
$= \dfrac{2b(a^2 + b^2) - 2b(a^2 - b^2)}{(a^2 - b^2)(a^2 + b^2)}$
$\qquad - \dfrac{4b^3}{a^4 + b^4} - \dfrac{8b^7}{a^8 - b^8}$

$= \dfrac{2a^2b + 2b^3 - 2a^2b + 2b^3}{(a^4 - b^4)}$
$\qquad - \dfrac{4b^3}{a^4 + b^4} - \dfrac{8b^7}{a^8 - b^8}$
$= \dfrac{4b^3(a^4 + b^4) - 4b^3(a^4 - b^4)}{(a^4 - b^4)(a^4 + b^4)}$
$\qquad - \dfrac{8b^7}{a^8 - b^8}$
$= \dfrac{4a^4b^3 + 4b^7 - 4a^4b^3 + 4b^7}{a^8 - b^8}$
$\qquad - \dfrac{8b^7}{a^8 - b^8}$
$= \dfrac{8b^7}{a^8 - b^8} - \dfrac{8b^7}{a^8 - b^8} = 0$

71. If $ax + by - 2 = 0$ and $axby = 1$, where $a \neq 0, b \neq 0$, then what is $(a^2x + b^2y)$ equal to?

(a) $a + b$ (b) $2ab$
(c) $a^3 + b^3$ (d) $a^4 + b^4$

⊘ *(a)* Given, $ax + by - 2 = 0 \Rightarrow ax + by = 2$
On squaring both sides, we get
$\qquad (ax + by)^2 = (2)^2$
$\Rightarrow$ $a^2x^2 + b^2y^2 + 2axby = 4$
$\Rightarrow$ $a^2x^2 + b^2y^2 + 2 = 4$ $\quad [\because axby = 1]$
$\Rightarrow$ $\qquad a^2x^2 + b^2y^2 = 2$
$\Rightarrow$ $\qquad a^2x^2 = 1$ and $b^2y^2 = 1$
$\Rightarrow$ $\qquad ax = 1$ and $by = 1$
$\Rightarrow$ $\qquad x = \dfrac{1}{a}$ and $y = \dfrac{1}{b}$
$\therefore$ $a^2x + b^2y = a^2 \cdot \dfrac{1}{a} + b^2 \cdot \dfrac{1}{b} = a + b$

72. Consider the following statements
1. $(a - b - c)$ is one of the factors of $3abc + b^3 + c^3 - a^3$.
2. $(b + c - 1)$ is one of the factors of $3bc + b^3 + c^3 - 1$.

Which of the above statement(s) is/are correct?

(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2

⊘ *(c)* 1. We have, $3abc + b^3 + c^3 - a^3$
$= -(a^3 - b^3 - c^3 - 3abc)$
$= -[a^3 + (-b)^3 + (-c)^3 - 3(a)(-b)(-c)]$
$= -(a - b - c)(a^2 + b^2 + c^2 + ab$
$\qquad\qquad\qquad -bc + ac)$
So, $(a - b - c)$ is a factor of
$\qquad 3abc + b^3 + c^3 - a^3$.
Hence, Statement 1 is correct.
2. Now, $3bc + b^3 + c^3 - 1$
$= b^3 + c^3 - (1)^3 - 3bc(-1)$
$= (b + c - 1)[b^2 + c^2 + 1^2 - bc + c + b]$
So, $(b + c - 1)$ is a factor of
$3bc + b^3 + c^3 - 1$.
Hence, Statement 2 is also correct.

2014 (I)

73. $x^3 + 6x^2 + 11x + 6$ is divisible by

(a) Only $(x + 1)$
(b) Only $(x + 2)$
(c) Only $(x + 3)$
(d) All of the above

⊘ **(d)** Let $f(x) = x^3 + 6x^2 + 11x + 6$

Now, by hit and trial, put $x = -1$

∴ $f(x) = 0$

So, $x = -1$ is a factor.

$$x + 1 \overline{)\, x^3 + 6x^2 + 11x + 6\,} \left(x^2 + 5x + 6 \right.$$
$$\underline{x^3 + x^2}$$
$$\underline{-\quad -}$$
$$5x^2 + 11x + 6$$
$$\underline{5x^2 + 5x}$$
$$\underline{-\quad -}$$
$$6x + 6$$
$$\underline{6x + 6}$$
$$\underline{-\quad -}$$
$$\times$$

∴ $f(x) = (x + 1)(x^2 + 5x + 6)$
$= (x + 1)(x^2 + 3x + 2x + 6)$
$= (x + 1)(x + 2)(x + 3)$

Hence, $(x + 1)$, $(x + 2)$ and $(x + 3)$ are the factors of $f(x)$.

74. What should be added to $x(x + a)(x + 2a)$ $(x + 3a)$, so that the sum must be a perfect square?

(a) $9a^2$
(b) $4a^2$
(c) a^4
(d) None of the above

⊘ **(c)** $x(x + a)(x + 2a)(x + 3a)$

$= (x^2 + ax)(x^2 + 5ax + 6a^2)$

$= x^4 + ax^3 + 5ax^3 + 5a^2x^2$
$\qquad\qquad\qquad + 6a^2x^2 + 6a^3x$

$= x^4 + ax(x^2 + 5x^2 + 5ax$
$\qquad\qquad\qquad + 6ax + 6a^2)$

$= x^4 + ax(6x^2 + 11ax + 6a^2) \quad \ldots\text{(i)}$

Now, for terms to be perfect square,

$(x + y)^2 (x + y)^2$

$= (x^2 + 2xy + y^2)(x^2 + y^2 + 2xy)$

$= x^4 + 2x^3y + x^2y^2 + x^2y^2$
$\qquad\qquad\qquad + 2xy^3 + y^4$
$\qquad\qquad + 2x^3y + 4x^2y^2 + 2xy^3$

$= x^4 + xy(4x^2 + 6xy + 4y^2) + y^4 \quad \ldots\text{(ii)}$

On comparing Eqs. (i) and (ii), as $y = a$

So, a^4 must be added to make it a perfect square.

75. If $3x^4 - 2x^3 + 3x^2 - 2x + 3$ is divided by $(3x + 2)$, then the remainder is

(a) 0   (b) $\dfrac{185}{27}$ (c) $\dfrac{181}{25}$ (d) $\dfrac{3}{4}$

⊘ **(b)**
$$3x + 2 \overline{)\, 3x^4 - 2x^3 + 3x^2 - 2x + 3\,} \left(x^3 - \tfrac{4}{3}x^2 + \tfrac{17}{9}x - \tfrac{52}{27} \right.$$
$$\underline{3x^4 + 2x^3}$$
$$\underline{-\quad -}$$
$$-4x^3 + 3x^2 - 2x + 3$$
$$\underline{-4x^3 - \tfrac{8}{3}x^2}$$
$$\underline{+\quad +}$$
$$\tfrac{17}{3}x^2 - 2x + 3$$
$$\underline{\tfrac{17}{3}x^2 + \tfrac{34}{9}x}$$
$$\underline{-\quad -}$$
$$-\tfrac{52x}{9} + 3$$
$$\underline{-\tfrac{52x}{9} - \tfrac{104}{27}}$$
$$\underline{+\quad +}$$
$$\tfrac{185}{27}$$

∴ Required remainder $= \dfrac{185}{27}$

76. The expression $2x^3 + x^2 - 2x - 1$ is divisible by

(a) $x + 2$ (b) $2x + 1$
(c) $x - 2$ (d) $2x - 1$

⊘ **(b)** Let $f(x) = 2x^3 + x^2 - 2x - 1$

$= x^2(2x + 1) - 1(2x + 1)$

$= (2x + 1)(x^2 - 1)$

$= (2x + 1)(x + 1)(x - 1)$

So, expression is divisible by $(2x + 1)$.

77. If $\left(x^2 + \dfrac{1}{x^2}\right) = \dfrac{17}{4}$, then what is $\left(x^3 - \dfrac{1}{x^3}\right)$ equal to?

(a) $\dfrac{75}{16}$ (b) $\dfrac{63}{8}$

(c) $\dfrac{95}{8}$ (d) None of these

⊘ **(b)** Given, $\left(x^2 + \dfrac{1}{x^2}\right) = \dfrac{17}{4}$

$\Rightarrow \quad x^2 + \dfrac{1}{x^2} + 2 - 2 = \dfrac{17}{4}$

$\Rightarrow \quad \left(x - \dfrac{1}{x}\right)^2 + 2 = \dfrac{17}{4}$

$\Rightarrow \quad \left(x - \dfrac{1}{x}\right)^2 = \dfrac{17}{4} - 2$

$\Rightarrow \quad \left(x - \dfrac{1}{x}\right)^2 = \dfrac{9}{4}$

$\Rightarrow \quad \left(x - \dfrac{1}{x}\right) = \dfrac{3}{2}$

[∵ taking square root of both sides]

On cubing both sides, we get

$$\left(x - \dfrac{1}{x}\right)^3 = \left(\dfrac{3}{2}\right)^3$$

$\Rightarrow x^3 - \dfrac{1}{x^3} - 3 \times \dfrac{1}{x} \cdot x\left(x - \dfrac{1}{x}\right) = \dfrac{27}{8}$

$\Rightarrow \quad x^3 - \dfrac{1}{x^3} = \dfrac{27}{8} + 3 \times \dfrac{3}{2}$

$\Rightarrow \quad x^3 - \dfrac{1}{x^3} = \dfrac{27}{8} + \dfrac{9}{2}$

∴ $\quad x^3 - \dfrac{1}{x^3} = \dfrac{63}{8}$

14

LINEAR EQUATIONS IN ONE AND TWO VARIABLES

1. If the sum of a real number and its reciprocal is $\dfrac{26}{5}$, then how many such numbers are possible?

(a) None   (b) One

(c) Two   (d) Four

⊘ **(b)** Let the number be x.

Reciprocal of number $= \dfrac{1}{x}$

According to the question,

$$x + \dfrac{1}{x} = \dfrac{26}{5}$$

$\Rightarrow \quad \dfrac{x^2 + 1}{x} = \dfrac{26}{5}$

$\Rightarrow \quad 5(x^2 + 1) = 26x$

$\Rightarrow \quad 5x^2 + 5 - 26x = 0$

$\Rightarrow \quad 5x^2 - 25x - x + 5 = 0$

$\Rightarrow \quad 5x(x - 5) - 1(x - 5) = 0$

$\Rightarrow \quad (5x - 1)(x - 5) = 0$

$\therefore \quad\quad\quad x = 5, x = \dfrac{1}{5}$

2. Radha and Rani are sisters. Five years back, the age of Radha was three times that of Rani, but one year back the age of Radha was two times that of Rani. What is the age difference between them?

(a) 8   (b) 9   (c) 10   (d) 11

⊘ **(a)** Let the present age of Radha be x and Rani be y.

Five years ago,

Age of Radha $= x - 5$

Age of Rani $= y - 5$

According to the question,

$x - 5 = 3(y - 5) \Rightarrow x - 5 = 3y - 15$

$3y - x = 10$ …(i)

One year ago,

Age of Radha $= x - 1$

Age of Rani $= y - 1$

According to the question,

$\quad\quad x - 1 = 2(y - 1)$

$\Rightarrow \quad\quad x - 1 = 2y - 2$

$\Rightarrow \quad\quad 2y - x = 1$ …(ii)

On solving Eqs. (i) and (ii), we get

$$y = 9, x = 17$$

$\therefore$ Required difference $= 17 - 9 = 8$ yr

3. A person carries ₹ 500 and wants to buy apples and oranges out of it. If the cost of one apple is ₹ 5 and the cost of one orange is ₹ 7, then what is the number of ways in which a person can buy both apples and oranges using total amount?

(a) 10   (b) 14   (c) 15   (d) 17

⊘ **(b)** Let there are x number of apples and y number of oranges

So, $5x + 7y = 500$

Now, we have to check for $x = 1, 2, …$

When, $x = 2$

$\quad\quad 10 + 7 \times y = 500$

$\quad\quad\quad\quad\quad\quad y = 70$

When, $x = 9$

$\quad\quad 45 + 7y = 500$

$\quad\quad\quad\quad y = 65$

Similarly, we can go ahead and find all the ways or we can check at which value of y oranges will be minimum.

For $y = 5, x$ (s) will be minimum

$\quad\quad 5x + 35 = 900$

$\quad\quad\quad\quad x = 93$

This forms an arithmetic series, where $a = 2, d = 9 - 2 = 7$ and $a_n = 93$

$a_n = a + (n - 1)d$

$93 = 2 + (n - 1)7$

$\quad n - 1 = 13$

$\quad\quad\quad n = 14$

There are 14 number of ways by which a person can by apples and oranges.

4. Priya's age was cube of an integral number (different from 1) four years ago and square of an integral number after four years. How long should she wait so that her age becomes square of a number in the previous year and cube of a number in the next year?

(a) 7 yr   (b) 12 yr   (c) 14 yr   (d) 21 yr

⊘ **(c)** Let say Priya age 4 yr ago $= x$ yr

Current age $= x + 4$ yr

Age after 4 yr $= x + 4 + 4 = x + 8$

x is cube and $x + 8$ is an square

8 and 16 are possible solution.

Cube $(x)^3$: 8, 27, 64, 125

$(x^3 + 8)$: 16, 35, 72, 133

Square : 4, 9, 16, 25, 36, 49, 64, 81, 100 is square

So, $x = 8$ and $x + 8 = 16$

So, present age $= 12$ yr

Her age becomes square of the number in the previous year and cube or the number in next year.

$\Rightarrow$ Cube $=$ square $+2$

Cube $= 27$

Square $= 25$

Age $= 26$ yr

$26 - 12 = 14$ yr

Then, she has to wait for 14 yr

Option (c) is correct.

2018 (II)

5. A person bought two articles X and Y from a departmental store. The sum of prices before sales tax was ₹ 130. There was no sales tax on the article X and 9% sales tax on the article Y. The total amount the person paid, including the sales tax was ₹ 136.75. What was the price of the article Y before sales tax ?

(a) ₹ 75   (b) ₹ 85   (c) ₹ 122   (d) ₹ 125

⊙ *(a)* Let the cost of article X and Y before sales tax be ₹ x and ₹ y, respectively.

According to the question,
$$x + y = 130 \qquad \ldots(i)$$

Now, after 9% sales tax on item Y
$$x + \frac{109}{100} y = 136.75$$
$$100x + 109y = 13675 \qquad \ldots(ii)$$

On solving Eqs. (i) and (ii), we get
$$x = 55$$
$$y = 75$$

∴ Cost of item Y before sales tax ₹ 75.

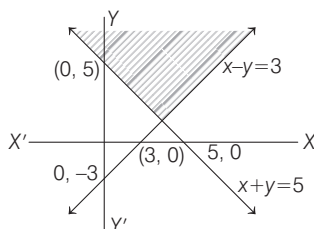**6.** The solution of linear inequalities $x + y \geq 5$ and $x - y \leq 3$ lies

(a) Only in the first quadrant
(b) In the first and second quadrants
(c) In the second and third quadrants
(d) In the third and fourth quadrants

⊙ *(b)* We have,
$$x + y \geq 5$$
and $$x - y \leq 3$$

The graph of linear equalities are below

Clearly, from graph solution lies in first and second quadrants.

7. According to Mr. Sharma's will, half of his property goes to his wife and the rest in equally divided between his two sons, Ravi and Raj. Some years later, Ravi dies and leaves half of his property to his brother Raj.

When Raj dies has leaves half of his property to his widow and remaining to his mother, who is still alive. The mother now owns ₹ 88000 worth of the property. The total worth of the property of Mr. Sharma was

(a) ₹ 100000   (b) ₹ 124000
(c) ₹ 128000   (d) ₹ 132000

⊙ *(c)* Let total property of Mr. Sharma be ₹ $16x$

After Mr. Sharma's death
Property of Mrs. Sharma = $8x$
Property of Ravi and Raj = $4x$ and $4x$

After Ravi's death
Property of Raj = $4x + 2x = 6x$

After Raj's death
Property of Mrs. Sharma = $8x + 3x = 11x$

Now, according to the question,
$$11x = 88000$$
or $$x = 8000$$

∴ Property of Mr. Sharma
$$= 16 \times 8000$$
$$= ₹ 128000$$

8. X bought 4 bottles of lemon juice and Y bought one bottle of orange juice. Orange juice per bottle costs twice the cost of lemon juice per bottle. Z bought nothing but contributed ₹ 50 for his share of the drink which they mixed together and shared the cost equally. If Z's ₹ 50 is covered from his share, then what is the cost of one bottle of orange juice?

(a) ₹ 75   (b) ₹ 50   (c) ₹ 46   (d) ₹ 30

⊙ *(b)* Let the cost of 1 bottle of lemon juice be ₹ x

∴ Cost of 1 bottle of orange juice = ₹ $2x$

Total share = ₹ 50×3 = ₹ 150
∴ $$4x + 2x = 150$$
or $$x = \frac{150}{6} = 25$$

∴ Cost of 1 bottle of orange juice
$$= 25 \times 2 = ₹ 50$$

2018 (I)

9. If $65x - 33y = 97$ and $33x - 65y = 1$, then what is xy equal to?

(a) 2   (b) 3   (c) −2   (d) −3

⊙ *(a)*
$$65x - 33y = 97 \qquad \ldots(i)$$
$$33x - 65y = 1 \qquad \ldots(ii)$$

On adding Eqs. (i) and (ii), we get
$$x - y = 1 \qquad \ldots(iii)$$

On subtracting Eqs. (ii) from (i), we get,
$$x + y = 3 \qquad \ldots(iv)$$
On solving Eqs. (iii) and (iv), we get
$$x = 2, y = 1$$
∴ $$x y = 2 \times 1 = 2$$

10. At present the average of the ages of father and a son is 25 yr. After 7 yr the son will be 17 yr old. What will be the age of the father after 10 yr?

(a) 44 yr   (b) 45 yr   (c) 50 yr   (d) 52 yr

⊙ *(c)* Given, age of son after 7 yr = 17 yr
Present age of son = $(17 - 7)$ yr = 10 yr
Let present age of father be x yr
∴ According to the question
$$\frac{10 + x}{2} = 25$$
⇒ $$x = 50 - 10 = 40 \text{ yr}$$
Hence, age of father after 10 yr
$$= (40 + 10) \text{ yr}$$
$$= 50 \text{ yr}$$

11. ₹ 120 is distributed among A, B and C so that A's share is ₹ 20 more than B's and ₹ 20 less than C's. What is B's share?

(a) ₹ 10   (b) ₹ 15   (c) ₹ 20   (d) ₹ 25

⊙ *(c)* Let B's share be ₹ x

∴ A's share = ₹ $(x + 20)$
and C's share $(120 - x - x - 20)$
$$= ₹ (100 - 2x)$$
But, A's share is ₹ 20 less than C's share
∴ $$x + 20 = 100 - 2x - 20$$
⇒ $$x + 20 = 80 - 2x$$
⇒ $$3x = 60$$
or $$x = 20$$
∴ $$B\text{'s share} = ₹ 20$$

12. At present the average of the ages of a father and a son is 25 yr. After 7 yr the son will be 17 yr old. What will be the age of the father after 10 yr?

(a) 44 yr   (b) 45 yr   (c) 50 yr   (d) 52 yr

⊙ *(c)* Given,
Age of son after 7 yr = 17 yr
Present age of son $= (17 - 7)$ yr
$$= 10 \text{ yr}$$
Let present age of father be x yr
∴ According to the question,
$$\frac{10 + x}{2} = 25$$
⇒ $$x = 50 - 10 = 40 \text{ yr}.$$
Hence, age of father after 10 yr
$$= (40 + 10) \text{ yr} = 50 \text{ yr}.$$

13. A gentleman left a sum of ₹ 39,000 to be distributed after his death among his widow, five sons and four daughters. If each son receives 3 times as much as a daughter receives and each daughter receives twice as much as their mother receives, then what is the widow's share?

(a) ₹ 1,000   (b) ₹ 1,200
(c) ₹ 1,500   (d) None of these

⊘ *(a)* Let the share which mother receives be ₹ x

∴ Share of each daughter = ₹ $2x$

and share of each son = ₹ $6x$

According to the question,

$x + 5 \times 6x + 4 \times 2x = 39000$

⇒ $x + 30x + 8x = 39000$

⇒ $39x = 39000$

∴ $x = \dfrac{39000}{39} = 1000$

∴ Mother's (widow's) share = ₹1000

2017 (II)

14. Five years ago, Ram was three times as old as Shyam. Four years from now, Ram will be only twice as old as Shyam.

What is the present age of Ram?

(a) 30 yr   (b) 32 yr   (c) 36 yr   (d) 40 yr

⊘ *(b)* Let the present age of Shyam be x yr and age of Ram be y yr. Then according to question,

$(y - 5) = 3(x - 5)$

$y - 5 = 3x - 15$

⇒ $3x - y = 10$ …(i)

and $(y + 4) = 2(x + 4)$

⇒ $y + 4 = 2x + 8$

and $2x - y = -4$ …(ii)

On subtracting Eq. (i) from Eq. (ii), we get

$x = 14$

On substituting $x = 14$ in Eq. (ii), we get

$2 \times 14 - y = -4$

⇒ $28 - y = -4$

Thus, present age of Ram is 32 yr.

15. If 78 is divided into 3 parts which are proportional to $1, \dfrac{1}{3}, \dfrac{1}{6}$,

then the middle part is

(a) $\dfrac{28}{3}$ (b) 13   (c) $\dfrac{52}{3}$ (d) $\dfrac{55}{3}$

⊘ *(c)* Let the three parts are x, $\dfrac{x}{3}$ and $\dfrac{x}{6}$

∴ $x + \dfrac{x}{3} + \dfrac{x}{6} = 78$

⇒ $\dfrac{6x + 2x + x}{6} = 78$

⇒ $9x = 78 \times 6$

            $x = \dfrac{78 \times 6}{9} = 52$

∴   Middle part = $\dfrac{x}{3} = \dfrac{52}{3}$

2017 (I)

16. If $\sqrt{\dfrac{x}{y}} = \dfrac{24}{5} + \sqrt{\dfrac{y}{x}}$ and $x + y = 26$,

then what is the value of xy?

(a) 5   (b) 15   (c) 25   (d) 30

⊘ *(c)* We have, $\sqrt{\dfrac{x}{y}} = \dfrac{24}{5} + \sqrt{\dfrac{y}{x}}$

Let $\sqrt{\dfrac{x}{y}} = z$

∴ $z = \dfrac{24}{5} + \dfrac{1}{z}$

⇒ $z = \dfrac{24z + 5}{5z}$

⇒ $5z^2 - 24z - 5 = 0$

⇒ $5z^2 - 25z + z - 5 = 0$

⇒ $5z(z - 5) + 1(z - 5) = 0$

⇒ $(z - 5)(5z + 1) = 0$

⇒ $z = 5$ or $-\dfrac{1}{5}$

⇒ $\sqrt{\dfrac{x}{y}} = 5$ or $-\dfrac{1}{5}$

⇒ $\sqrt{\dfrac{x}{y}} = 5$ $\left[\because \sqrt{\dfrac{x}{y}} \neq -\dfrac{1}{5} \right]$

⇒ $x = 25y$ …(i)

Again, we have $x + y = 26$

⇒ $25y + y = 26$ [from Eq. (i)]

⇒ $26y = 26$

⇒ $y = 1$

∴ $x = 25$

∴ $xy = 25 \times 1 = 25$

17. The pair of linear equations $kx + 3y + 1 = 0$ and $2x + y + 3 = 0$ intersect each other, if

(a) $k = 6$ (b) $k \neq 6$ (c) $k = 0$ (d) $k \neq 0$

⊘ *(b)* For the system of linear equations

$a_1 x + b_1 y + c_1 = 0$

and $a_2 x + b_2 y + c_2 = 0$

Has unique solution

$\dfrac{a_1}{a_2} \neq \dfrac{b_1}{b_2}$

We have, $kx + 3y + 1 = 0$

            $2x + y + 3 = 0$

For unique solution, $\dfrac{k}{2} \neq \dfrac{3}{1} \Rightarrow k \neq 6$

18. Sunil wants to spend ₹ 200 on two types of sweets, costing ₹ 7 and ₹ 10 repectively. What is the maximum number of sweets he can get so that no money is left over?

(a) 25   (b) 26   (c) 27   (d) 28

⊘ *(b)* Let the number of sweets purchased at the rate ₹ 7 and ₹ 10 be x and y respectively.

∴ According to the question,

$7x + 10y = 200 \Rightarrow y = 20 - \dfrac{7}{10}x$

For maximum value of number of sweets, the number of sweets of lower cost must be greater than number of sweets at higher cost. i.e. $x > y$

For $x > y$, x must be multiple of 10 i.e. 10, 20, 30, 40, …

For $x \geq 30$, y is negative

∴ $x = 20$

∴ $y = 20 - \dfrac{7}{10} \times 20 = 6$

∴ Maximum number of sweets = 20 + 6 = 26

19. The system of equations $2x + 4y = 6$ and $4x + 8y = 8$ is

(a) consistent with a unique solution
(b) consistent with infinitely many solutions
(c) inconsistent
(d) None of the above

⊘ *(c)* We have, $2x + 4y = 6$

and $4x + 8y = 8$

∴ $a_1 = 2, b_1 = 4, c_1 = (-6)$

and $a_2 = 4, b_2 = 8, c_2 = -8$

Now, $\dfrac{a_1}{a_2} = \dfrac{2}{4} = \dfrac{1}{2}, \dfrac{b_1}{b_2} = \dfrac{4}{8} = \dfrac{1}{2}$

$\dfrac{c_1}{c_2} = \dfrac{-6}{-8} = \dfrac{3}{4}$

Since $\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} \neq \dfrac{c_1}{c_2}$

∴ System of equation is inconsistent.

20. Leela got married 6 yr ago.

Today her age is $1\dfrac{1}{4}$ times her age at the time of her marriage.

Her son's age is $\dfrac{1}{10}$ times her age. What is the present age of her son?

(a) 1 yr   (b) 2 yr   (c) 3 yr   (d) 4 yr

⊙ *(c)* Let the age of Leela at her marriage was x yr.

∴ Present age of Leela = $(x + 6)$ yr

According to the question,

$$x + 6 = \frac{5}{4}x$$

$$\Rightarrow \quad \frac{1}{4}x = 6$$

$$\Rightarrow \quad x = 24$$

∴ Present age of Leela = $(24 + 6) = 30$ yr

∴ Leela's son age = $\frac{1}{10}$ Age of Leela

$$= \frac{1}{10} \times 30 = 3 \text{ yr}$$

2016 (II)

21. The cost of 2.5 kg rice is ₹ 125. The cost of 9 kg rice is equal to that of 4 kg pulses. The cost of 14 kg pulses is equal to that of 1.5 kg tea. The cost of 2 kg tea is equal to that of 5 kg nuts.

What is the cost of 11 kg nuts?

(a) ₹ 2310 (b) ₹ 3190 (c) ₹ 4070 (d) ₹ 4620

⊙ *(d)* We have, cost of 2.5 kg rice = ₹ 125

∴ Cost of 1 kg rice = $\frac{125}{2.5}$ = ₹ 50 ...(i)

Let r, p, t, n be the cost of rice, pulse, tea and nuts respectively.

Given, $\quad 9r = 4p$ ...(ii)

$\quad 14p = 1.5t$ ...(iii)

and $\quad 2t = 5n$ ...(iv)

From Eqs. (ii), (iii) and (iv), we get

$$2\left(\frac{14}{1.5} \times \frac{9}{4}\right)r = 5n \Rightarrow n = \frac{42}{5}r$$

∴ Cost of 1 kg nuts

$$= \text{Cost of } \frac{42}{5} \text{ kg of rice}$$

$$= \frac{42}{5} \times 50 = ₹ 420$$

[From eq. (i)]

So, the cost of 11 kg nuts = ₹ 420 × 11

= ₹ 4620

22. In an examination, a student was asked to divide a certain number by 8. By mistake he multiplied it by 8 and got the answer 2016 more than the correct answer. What was the number?

(a) 252 (b) 256
(c) 258 (d) 260

⊙ *(b)* Let x be the number, then

$$8x = \frac{x}{8} + 2016$$

$$\Rightarrow \quad 8x - \frac{x}{8} = 2016$$

$$\Rightarrow \quad \frac{63x}{8} = 2016$$

$$\therefore \quad x = \frac{2016 \times 8}{63} = 256$$

2016 (I)

23. The value of k, for which the system of equations $3x - ky - 20 = 0$ and $6x - 10y + 40 = 0$ has no solution, is

(a) 10 (b) 6
(c) 5 (d) 3

⊙ *(c)* For no solution, $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

Here, $a_1 = 3$, $b_1 = -k$, $c_1 = -20$

$a_2 = 6$, $b_2 = -10$, $c_2 = 40$

$$\therefore \quad \frac{3}{6} = \frac{-k}{-10} \neq \frac{-20}{40}$$

$$\Rightarrow \quad k = \frac{3 \times 10}{6} = 5$$

24. There are three brothers. The sums of ages of two of them at a time are 4 yr, 6 yr and 8 yr. The age difference between the eldest and the youngest is

(a) 3 yr (b) 4 yr
(c) 5 yr (d) 6 yr

⊙ *(b)* Let the ages of three brothers be a, b and c.

Then, $a + b = 4$, $b + c = 6$

and $c + a = 8$

On solving these three equations, we get

$a = 3, b = 1$

and $c = 5$

∴ Age difference between eldest and youngest

$= 5 - 1 = 4$ yr

25. Let a two digits number be k times the sum of its digits. If the number formed by interchanging the digits is m times the sum of the digits, then the value of m is

(a) $9 - k$ (b) $10 - k$
(c) $11 - k$ (d) $k - 1$

⊙ *(c)* Let the unit's place digit be y and ten's place digit be x.

Then, number = $10x + y$

Now, after interchanging the digits,

New number = $10y + x$ and sum of digits = $x + y$

According to the question,

$10x + y = k(x + y)$ ...(i)

and $10y + x = m(x + y)$ ...(ii)

On adding Eqs. (i) and (ii), we get

$11(x + y) = (k + m)(x + y)$

$\Rightarrow \quad k + m = 11 \Rightarrow m = 11 - k$

26. The annual incomes of two persons are in the ratio $9 : 7$ and their expenses are in the ratio $4 : 3$. If each of them saves ₹ 2000 per year, then what is the difference in their annual incomes?

(a) ₹ 4000 (b) ₹ 4500
(c) ₹ 5000 (d) ₹ 5500

⊙ *(a)* Let annual incomes of two persons be $9x$ and $7x$ and expenses be $4y$ and $3y$, respectively.

Then, according to the question,

$9x - 4y = 2000$ ...(i)

and $7x - 3y = 2000$ ...(ii)

From Eqs. (i) and (ii), we get

$9x - 4y = 7x - 3y$

$\Rightarrow \quad y = 2x$

On putting the value of y in Eq. (i), we get

$9x - 8x = 2000 \Rightarrow x = ₹ 2000$

∴ Difference between their annual incomes

$= 9x - 7x = 2x = ₹ 4000$

27. If $\frac{p}{x} + \frac{q}{y} = m$ and $\frac{q}{x} + \frac{p}{y} = n$, then what is $\frac{x}{y}$ equal to?

(a) $\frac{np + mq}{mp + nq}$ (b) $\frac{np + mq}{mp - nq}$

(c) $\frac{np - mq}{mp - nq}$ (d) $\frac{np - mq}{mp + nq}$

⊙ *(c)* Given, $\frac{p}{x} + \frac{q}{y} = m$ and $\frac{q}{x} + \frac{p}{y} = n$

Let $\frac{1}{x} = u$ and $\frac{1}{y} = v$

Then, $pu + qv = m$ ...(i)

and $qu + pv = n$ ...(ii)

On solving Eqs. (i) and (ii), we get

$$u = \frac{mp - nq}{p^2 - q^2}$$

and $$v = \frac{mq - np}{q^2 - p^2}$$

$$\therefore \quad \frac{x}{y} = \frac{1/u}{1/v}$$

$$= \frac{v}{u} = \frac{-(mq - np)}{mp - nq} = \frac{np - mq}{mp - nq}$$

28. If $\sqrt{\dfrac{x}{y}} = \dfrac{10}{3} - \sqrt{\dfrac{y}{x}}$ and $x - y = 8$,

then the value of xy is equal to

(a) 36   (b) 24   (c) 16   (d) 9

⊙ (**d**) We have, $x - y = 8$ ...(i)

and $\sqrt{\dfrac{x}{y}} = \dfrac{10}{3} - \sqrt{\dfrac{y}{x}}$

$\Rightarrow \quad \sqrt{\dfrac{x}{y}} + \sqrt{\dfrac{y}{x}} = \dfrac{10}{3}$

$\Rightarrow \quad \dfrac{(\sqrt{x})^2 + (\sqrt{y})^2}{\sqrt{xy}} = \dfrac{10}{3}$

$\Rightarrow \quad x + y = \dfrac{10}{3}\sqrt{xy}$

On squaring both sides, we get

$$(x + y)^2 = \dfrac{100}{9}xy$$

$\Rightarrow \quad (x - y)^2 + 4xy = \dfrac{100}{9}xy$

$$[\because (x + y)^2 = (x - y)^2 + 4xy]$$

$\Rightarrow \quad (8)^2 = \left(\dfrac{100}{9} - 4\right)xy \quad \text{[from Eq. (i)]}$

$\therefore \quad 64 = \dfrac{64}{9}xy \Rightarrow xy = 9$

2015 (II)

29. A tin of oil was $\dfrac{4}{5}$ full. When

6 bottles of oil were taken out from this tin and 4 bottles of oil were poured into it, it was $\dfrac{3}{4}$ full.

Oil of how many bottles can the tin contain? (All bottles are of equal volume)

(a) 35   (b) 40   (c) 45   (d) 50

⊙ (**b**) Let a tin of oil contain x bottles of oil.

According to the question,

$$\dfrac{4}{5} - \dfrac{6}{x} + \dfrac{4}{x} = \dfrac{3}{4}$$

$\Rightarrow \quad \dfrac{4}{5} - \dfrac{3}{4} = \dfrac{6}{x} - \dfrac{4}{x}$

$\Rightarrow \quad \dfrac{1}{20} = \dfrac{2}{x} \Rightarrow x = 40$

$\therefore$ A tin contains 40 bottles.

30. The number of pairs (x, y), where x, y are integers satisfying the equation $21x + 48y = 5$, is

(a) Zero   (b) One   (c) Two   (d) Infinity

⊙ (**a**) $21x + 48y = 5 \Rightarrow 3(7x + 16y) = 5$

If x, y are integer, then LHS of the above equation is multiple of 3, but the RHS of above equation is not multiple of 3.

$\therefore$ There is no any integral values of x and y exist.

31. A number consists of two digits, whose sum is 7. If the digits are reversed, the number is increased by 27. The product of digits of the number is

(a) 6   (b) 8   (c) 10   (d) 12

⊙ (**c**) Let the number be $10x + y$.

We have, $x + y = 7$ ...(i)

and $10y + x = 10x + y + 27$

$\Rightarrow \quad 9y - 9x = 27$

$y - x = 3$ ...(ii)

On solving Eqs. (i) and (ii), we get $y = 5$ and $x = 2$

$\therefore$ Number $= 10 \times 2 + 5 = 20 + 5 = 25$

$\therefore$ Product of digits of number

$$= 2 \times 5 = 10$$

2015 (I)

32. A student was asked to multiply a number by 25. He instead multiplied the number by 52 and got the answer 324 more than the correct answer. The number to be multiplied was

(a) 12   (b) 15   (c) 25   (d) 32

⊙ (**a**) Let x be the required number.

$\therefore \quad 52x - 25x = 324$

$\Rightarrow \quad 27x = 324 \Rightarrow x = \dfrac{324}{27} = 12$

Hence, the required number is 12.

33. Consider the following statements

I. The equation $1990x - 173y = 11$ has no solution in integers for x and y.

II. The equation $3x - 12y = 7$ has no solution in integers for x and y.

Which of the above statement(s) is/are correct?

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊙ (**c**) I. Given, $1990x - 173y = 11$

Let x be an integer.

$\therefore \quad 173y = 1990x - 11$

$\Rightarrow \quad y = \dfrac{1990x - 11}{173}$

Here, we substitute the different integer values of x, we do not get an integer value of y.

II. Given, $3x - 12y = 7$

Let x be an integer.

$\therefore \quad 12y = 3x - 7$

$\Rightarrow \quad y = \dfrac{3x - 7}{12}$

Here, we substitute the different integer values of x, we do not get an integer value of y.

2014 (II)

34. A certain number of two digits is three times the sum of its digits. If 45 is added to the number, then the digits will be reversed. What is the sum of the squares of the two digits of the number?

(a) 41   (b) 45   (c) 53   (d) 64

⊙ (**c**) Let the two digits number be $10x + y$.

According to the question,

$$10x + y = 3(x + y)$$

$\Rightarrow \quad 10x + y - 3x - 3y = 0$

$\Rightarrow \quad 7x - 2y = 0$ ...(i)

and $(10x + y) + 45 = 10y + x$

$\Rightarrow \quad 10x + y + 45 - 10y - x = 0$

$\Rightarrow \quad 9x - 9y + 45 = 0$

$\Rightarrow \quad x - y = -5$ ...(ii)

On solving Eqs. (i) and (ii), we get

$$x = 2 \text{ and } y = 7$$

$\therefore$ Sum of the squares of digits

$$= (2)^2 + (7)^2$$
$$= 4 + 49 = 53$$

35. How many pairs of positive integers m and n satisfy the equation $\dfrac{1}{m} + \dfrac{4}{n} = \dfrac{1}{12}$, where n is an odd integer less than 60?

(a) 7   (b) 5   (c) 4   (d) 3

⊙ (**d**) Given equation,

$$\dfrac{1}{m} + \dfrac{4}{n} = \dfrac{1}{12}$$

$\Rightarrow \quad 12(n + 4m) = mn$

$\Rightarrow \quad 12n + 48m = mn$

$\Rightarrow \quad m(48 - n) = -12n$

$\Rightarrow \quad m(n - 48) = 12n$

$\therefore \quad m = \dfrac{12n}{n - 48}$ ...(i)

Now, as m and n are positive integers, therefore $n > 48$.

But n is an odd integer less than 60, therefore possible values of $n = 49$, 51, 53, 55, 57 and 59.

But on putting $n = 53$, 55 and 59 in Eq. (i), we get the non-integer values of m.

On putting $n = 49$, 51 and 57, we get the value of $m = 588$, 204 and 76, respectively.

Hence, there are three possible pairs of m and n that satisfy the equation.

2014 (I)

36. Two chairs and one table cost ₹ 700 and 1 chair and 2 tables cost ₹ 800. If the cost m tables and m chairs is ₹ 30000, then what is m equal to?

(a) 60 (b) 55 (c) 50 (d) 45

⊙ *(a)* Let the cost of chair be x and the cost of table be y, then

$$2x + y = 700 \qquad ...(i)$$
and $\qquad x + 2y = 800 \qquad ...(ii)$

On multiplying Eq. (ii) by 2 and subtracting it from Eq. (i), we get

$$2x + y = 700$$
$$\underline{2x + 4y = 1600}$$
$$- 3y = - 900 \Rightarrow y = 300$$
$$\therefore \qquad x = 800 - 600 = 200$$

Since, the number of chairs and tables are m to be purchased for ₹ 30000.

$$\therefore \quad 200m + 300m = 30000$$
$$\Rightarrow \quad m = \frac{30000}{500} \Rightarrow m = 60$$

37. Ravi's brother is 3 yr elder to him. His father was 28 yr of age when his sister was born while his mother was 26 yr of age when he was born. If his sister was 4 yr of age when his brother was born, the ages of Ravi's father and mother, respectively when his brother was born, were

(a) 32 yr and 23 yr
(b) 32 yr and 29 yr
(c) 35 yr and 29 yr
(d) 35 yr and 33 yr

⊙ *(a)* When Ravi was born his mother's age is 26 yr and his elder brother is 3 yr elder to him.

∴ Mother's age when, brother was born

$$= 26 - 3 = 23 \text{ yr}$$

Ravi's father was 28 yr of age when his sister was born and his sister was 4 yr of age when his brother was born.

∴ Age of father when brother was born

$$= 28 + 4 = 32 \text{ yr}$$

38. The sum of two positive numbers x and y is 2.5 times their difference. If the product of numbers is 84, then what is the sum of those two numbers?

(a) 26 (b) 24 (c) 22 (d) 20

⊙ *(d)* According to the question,

$$(x + y) = 2.5(x - y)$$
$$\Rightarrow \quad x + y = 2.5x - 2.5y$$
$$\Rightarrow \quad 3.5y = 1.5x$$
$$\Rightarrow \quad \frac{x}{y} = \frac{7}{3} \qquad ...(i)$$

Now, $x\,y = 84$

$$\Rightarrow \quad \frac{7}{3}y \times y = 84 \Rightarrow y^2 = \frac{84 \times 3}{7}$$
$$\Rightarrow \quad y^2 = 12 \times 3 = 36$$
$$\therefore \qquad y = 6 \Rightarrow x = \frac{7}{3} \times 6 = 14$$

[From Eq. (i)]

∴ Sum of numbers

$$= x + y = 14 + 6 = 20$$

39. A positive number, when increased by 10 equals 200 times its reciprocal. What is number?

(a) 100 (b) 10
(c) 20 (d) 200

⊙ *(b)* Let the positive number be x.

Then, according to the question,

$$x + 10 = \frac{200}{x} \Rightarrow x^2 + 10x = 200$$
$$\Rightarrow \quad x^2 + 10x - 200 = 0$$
$$\Rightarrow \quad (x - 10)(x + 20) = 0$$
$$\therefore \qquad x = 10, - 20$$

But $x \neq - 20$, since x is a positive number.

So, the required number is 10.

40. The present age of Ravi's father is 4 times Ravi's present age. 5 yr back, Ravi's father was seven times as old as Ravi was at that time. What is the present age of Ravi's father?

(a) 84 yr (b) 70 yr (c) 40 yr (d) 35 yr

⊙ *(c)* Let present age of Ravi be x.

∴ Present age of Ravi's father = $4x$

Now, 5 yr ago
Ravi's father age = 7 × Ravi's age
$$\Rightarrow \qquad 4x - 5 = 7(x - 5)$$
$$\Rightarrow \qquad 4x - 5 = 7x - 35$$
$$\Rightarrow \qquad 3x = 30$$
$$\therefore \qquad x = 10$$

∴ Ravi's present age = x = 10 yr
Ravi's father's present age

$$= 4x = 4 \times 10 = 40 \text{ yr}$$

41. A bus starts with some passengers. At the first stop, one-fifth of the passengers gets down and 40 passengers get in. At the second stop half of the passengers gets down and 30 get in. The number of passengers now is 70. The number of passengers with which the bus started was.

(a) 40 (b) 50
(c) 60 (d) 70

⊙ *(b)* Let bus starts with x number of passengers.

After 1st stoppage, number of passengers

$$= x - \frac{x}{5} + 40 = \frac{5x - x + 200}{5}$$
$$= \frac{4x + 200}{5}$$

After 2nd stoppage, number of passengers

$$= \frac{4x + 200}{5} - \frac{4x + 200}{5 \times 2} + 30$$
$$\Rightarrow \frac{4x + 200}{5} - \frac{4x + 200}{10} + 30 = 70$$
$$\Rightarrow \quad \frac{4x + 200}{5}\left(1 - \frac{1}{2}\right) + 30 = 70$$
$$\Rightarrow \quad \frac{4x + 200}{5}\left(\frac{2 - 1}{2}\right) = 40$$
$$\Rightarrow \quad \frac{4x + 200}{5} \times \frac{1}{2} = 40$$
$$\Rightarrow \quad \frac{4x + 200}{10} = 40$$
$$\Rightarrow \quad 4x + 200 = 400$$
$$\Rightarrow \quad 4x = 200$$
$$\therefore \qquad x = \frac{200}{4} = 50$$

QUADRATIC EQUATIONS AND INEQUATIONS

2019 (II)

1. If the equations $x^2 + 5x + 6 = 0$ and $x^2 + kx + 1 = 0$ have a common root, then what is the value of k?

(a) $-\dfrac{5}{2}$ or $-\dfrac{10}{3}$ (b) $\dfrac{5}{2}$ or $\dfrac{10}{3}$

(c) $\dfrac{5}{2}$ or $-\dfrac{10}{3}$ (d) $-\dfrac{5}{2}$ or $\dfrac{10}{3}$

⟩ **(b)** Given, equations

$x^2 + 5x + 6 = 0$ ...(i)

$x^2 + kx + 1 = 0$ ...(ii)

If both equations have common roots then,

$\Rightarrow \qquad x^2 + 5x + 6 = 0$

$\Rightarrow \qquad x^2 + 3x + 2x + 6 = 0$

$\Rightarrow \qquad x(x + 3) + 2(x + 3) = 0$

$\Rightarrow \qquad (x + 2)(x + 3) = 0$

$\Rightarrow \qquad x = -2, -3$

The value of x must satisfy the Eq. (ii)

On putting $\quad x = -2$

$\Rightarrow \qquad x^2 + kx + 1 = 0$

$\Rightarrow \quad (-2)^2 + k(-2) + 1 = 0$

$\Rightarrow \quad 4 - 2k + 1 = 0 \Rightarrow 2k = 5$

$k = \dfrac{5}{2}$

On putting $x = -3$

$\Rightarrow \qquad x^2 + kx + 1 = 0$

$\Rightarrow \quad (-3)^2 + k(-3) + 1 = 0$

$9 - 3k + 1 = 0 \Rightarrow 3k = 10$

$\therefore \qquad\qquad k = \dfrac{10}{3}$

2. The sum of the squares of four consecutive natural numbers is 294. What is the sum of the numbers?

(a) 38   (b) 34   (c) 30   (d) 26

⟩ **(b)** Let the four consecutive natural numbers are $x - 1, x, x + 1, x + 2$

According to the question,

$(x - 1)^2 + x^2 + (x + 1)^2 + (x + 2)^2$
$\qquad\qquad\qquad\qquad = 294$

$x^2 + 1 - 2x + x^2 + x^2 + 1 + 2x + x^2$
$\qquad\qquad\qquad\qquad + 4x + 4 = 294$

$4x^2 + 4x - 288 = 0$

$\Rightarrow \qquad x^2 + x - 72 = 0$

$x^2 + 9x - 8x - 72 = 0$

$\Rightarrow \quad x(x + 9) - 8(x + 9) = 0$

$(x - 8)(x + 9) = 0$

$x = 8$ and $-9 \qquad (x = -9)$[ignore]

The numbers are, 7, 8, 9, 10

Sum of numbers $= 7 + 8 + 9 + 10 = 34$

3. The equation $x^2 + px + q = 0$ has roots equal to p and q where $q \neq 0$. What are the values of p and q, respectively?

(a) 1, −2   (b) 1, 2

(c) −1, 2   (d) −1, −2

⟩ **(a)** $x^2 + px + q = 0$

So, $\qquad p + q = -p$

$q = -2p$ ...(i)

$pq = q \Rightarrow p = 1$

Now, on putting $p = 1$ in Eq. (i), we get

$q = -2 \times 1$

$q = -2$

$p = 1$ and $q = -2$

4. How many pairs of natural numbers are there such that the difference of their squares is 35?

(a) 1   (b) 2   (c) 3   (d) 4

⟩ **(b)** Let the number be x and y.

$x^2 - y^2 = 35$

$(x - y)(x + y) = 35$

Thus, the factor of 35 possibles are 7, 5, 35, 1

If $\qquad\qquad x - y = 5$

$x + y = 7$

$x = 6$ and $y = 1$ [1st pair]

If $\qquad\qquad x + y = 35$

$x - y = 1$

$x = 18$ and $y = 17$ [2nd pair]

Only 2 pair are possible.

5. If $(b - 6)$ is one root of the quadratic equation $x^2 - 6x + b = 0$, where b is an integer, then what is the maximum value of b^2?

(a) 36   (b) 49

(c) 64   (d) 81

⟩ **(d)** $(b - 6)$ is one root of expression

$x^2 - 6x + b = 0$

So, $x = b - 6$ should satisfy the equation.

$(b - 6)^2 - 6(b - 6) + b = 0$

$b^2 + 36 - 12b - 6b + 36 + b = 0$

$b^2 - 17b + 72 = 0$

$b^2 - 8b - 9b + 72 = 0$

$b(b - 8) - 9(b - 8) = 0$

$(b - 9)(b - 8) = 0$

$b = 8$ and 9

To get maximum value of b^2

$b = 9$

$\Rightarrow \qquad b^2 = 81$

6. What is the maximum value of the expression $\dfrac{1}{x^2 + 5x + 10}$?

(a) $\dfrac{15}{4}$ (b) $\dfrac{15}{2}$ (c) 1   (d) $\dfrac{4}{15}$

⟩ **(d)** $\dfrac{1}{x^2 + 5x + 10}$

Take denominator $x^2 + 5x + 10$.

$y = x^2 + 5x + 10$

$= x^2 + 2 \times \dfrac{5}{2}x + \dfrac{25}{4} - \dfrac{25}{4} + 10$

$= \left(x + \dfrac{5}{2}\right)^2 + \dfrac{15}{4}$

To make the expression $\dfrac{1}{x^2 + 5x + 10}$ maximum, then we must minimize the value of denominator.

To minimize denominator of expression $\dfrac{1}{\left(x + \dfrac{5}{2}\right)^2 + \dfrac{15}{4}}$, we can take $x = -\dfrac{5}{2}$

The maximum value of expression will be $\dfrac{1}{\left(-\dfrac{5}{2} + \dfrac{5}{2}\right)^2 + \dfrac{15}{4}} = \dfrac{4}{15}$

7. Two numbers p and q are such that the quadratic equation $px^2 + 3x + 2q = 0$ has -6 as the sum and the product of the roots. What is the value of $(p - q)$?

  (a) -1 (b) 1   (c) 2   (d) 3

⊙ **(c)** $px^2 + 3x + 2q = 0$

Sum of roots $(\alpha + \beta) = -\dfrac{3}{p}$

Product of root $(\alpha \cdot \beta) = \dfrac{2q}{p}$

According to the question, $\dfrac{-3}{p} = -6$

$$p = \dfrac{1}{2}$$

$\Rightarrow \quad \dfrac{2q}{p} = -6 \Rightarrow q = \dfrac{-6 \times p}{2}$

$$q = \dfrac{-3}{2}$$

Then, $p - q = \dfrac{1}{2} - \left(-\dfrac{3}{2}\right)$

$$= \dfrac{1}{2} + \dfrac{3}{2} = \dfrac{4}{2} = 2$$

2019 (I)

8. Given that the polynomial $(x^2 + ax + b)$ leaves the same remainder when divided by $(x - 1)$ or $(x + 1)$. What are the values of a and b, respectively?

  (a) 4 and 0
  (b) 0 and 3
  (c) 3 and 0
  (d) 0 and any integer

⊙ **(d)** The polynomial $(x^2 + ax + b)$ leaves the same remainder when divided by $(x - 1)$ or $(x + 1)$.

$$(x - 1) = 0$$
$$x = 1 \qquad \ldots\text{(i)}$$
$$(x + 1) = 0$$
$$x = -1 \qquad \ldots\text{(ii)}$$

On putting these value in polynomial
$$(1)^2 + a(1) + b = R \qquad \text{[remainder]}$$
$$a + b + 1 = R \qquad \ldots\text{(iii)}$$
$$(-1)^2 + a(-1) + b = R$$
$$b - a + 1 = R \qquad \ldots\text{(iv)}$$

Eq. (iii) is equal to Eq. (iv), we get
$$a + b + 1 = b - a + 1$$
$$2a = 0$$
$$a = 0$$

b any integer.
Hence, option (d) is correct.

9. If p and q are the roots of the equation $x^2 - 15x + r = 0$ and $p - q = 1$, then what is the value of r?

  (a) 55   (b) 56   (c) 60   (d) 64

⊙ **(b)** p and q are the roots of the equation.
$$x^2 - 15x + r = 0 \quad p - q = 1 \quad \ldots\text{(i)}$$

$$\begin{bmatrix} ax^2 + bx + c = 0 \\ x^2 - \left(-\dfrac{b}{a}\right)x + \dfrac{c}{a} = 0 \\ \alpha + \beta = -\dfrac{b}{a}, \alpha\beta = \dfrac{c}{a} \end{bmatrix}$$

$[\alpha$ and β are the root of Eq. (i)$]$
Then, $\quad x^2 - 15x + r = 0$
$$p + q = 15 \qquad \ldots\text{(ii)}$$
$$r = pq \qquad \ldots\text{(iii)}$$
$$p - q = 1 \qquad \ldots\text{(iv)}$$
On solving Eqs. (ii) and (iv)
$$p = 8$$
$$q = 7$$
$$r = 8 \times 7 = 56$$
Hence, option (b) is correct.

10. For the inequation $x^2 - 7x + 12 > 0$, which one of the following is correct?

  (a) $3 < x < 4$
  (b) $-\infty < x < 3$ only
  (c) $4 < x < \infty$ only
  (d) $-\infty < x < 3$ or $4 < x < \infty$

⊙ **(d)** $\qquad x^2 - 7x + 12 > 0$
$$x^2 - 4x - 3x + 12 > 0$$
$$x(x - 4) - 3(x - 4) > 0$$
$$(x - 4)(x - 3) > 0$$
$$\therefore \qquad x > 4 \text{ or } x < 3$$
$$-\infty < x < 3$$
or $\qquad\qquad 4 < x < \infty$
Hence, option (d) is correct.

11. Which of the following pair of numbers is the solution of the equation $3^{x+2} + 3^{-x} = 10$?

  (a) 0, 2   (b) 0, -2 (c) 1, -1 (d) 1, 2

⊙ **(b)** $\qquad 3^{x+2} + 3^{-x} = 10$
$$\Rightarrow \qquad 3^x \cdot 3^2 + \dfrac{1}{3^x} = 10$$

Let $3^x = y$, then
$$\Rightarrow \qquad 9y + \dfrac{1}{y} = 10$$
$$\Rightarrow \qquad 9y^2 + 1 = 10y$$
$$\Rightarrow \quad 9y^2 - 10y + 1 = 0$$
$$\Rightarrow 9y^2 - 9y - y + 1 = 0$$
$$\Rightarrow 9y(y - 1) - 1(y - 1) = 0$$
$$\Rightarrow \quad (y - 1)(9y - 1) = 0$$
$$\therefore \qquad y = 1, \dfrac{1}{9}$$

when $3^x = 1 \Rightarrow 3^x = 3^0 \Rightarrow x = 0$
when $3^x = \dfrac{1}{9} \Rightarrow 3^x = 3^{-2} \Rightarrow x = -2$

So, $\quad x = 0, -2$

2018 (II)

12. If $x^2 - 6x - 27 > 0$, then which one of the following is correct?

  (a) $-3 < x < 9$ (b) $x < 9$ or $x > -3$
  (c) $x > 9$ or $x < -3$ (d) $x < -3$ only

⊙ **(c)** Given, $x^2 - 6x - 27 > 0$
or $\quad x^2 - 9x + 3x - 27 > 0$
$$x(x - 9) + 3(x - 9) > 0$$
$$(x + 3)(x - 9) > 0$$
Now, for $(x + 3)(x - 9)$ to be greater than 0.
Either $(x + 3)$ and $(x - 9)$ must be greater than 0.
or both $(x + 3)$ and $(x - 9)$ must be less than 0.
$$\therefore \quad x > 9 \text{ and } x < -3$$

13. If α and β are two real numbers such that $\alpha + \beta = -\dfrac{q}{p}$ and $\alpha\beta = \dfrac{r}{p}$, where $1 < p < q < r$, then which one of the following is the greatest?

  (a) $\dfrac{1}{\alpha + \beta}$ (b) $\dfrac{1}{\alpha} + \dfrac{1}{\beta}$
  (c) $-\dfrac{1}{\alpha\beta}$ (d) $\dfrac{\alpha\beta}{\alpha + \beta}$

⊙ **(c)** Given, $\alpha + \beta = \dfrac{-q}{p}, \alpha\beta = \dfrac{r}{p}$

and $\qquad 1 < p < q < r$
From option(a), $\dfrac{1}{\alpha + \beta} = \dfrac{-p}{q}$

From option (b),
$$\dfrac{1}{\alpha} + \dfrac{1}{\beta} = \dfrac{\alpha + \beta}{\alpha\beta} = \dfrac{-q}{p} \times \dfrac{p}{r} = \dfrac{-q}{r}$$

From option (c), $\quad \dfrac{-1}{\alpha\beta} = \dfrac{-p}{r}$

From option (d), $\dfrac{\alpha\beta}{\alpha + \beta} = \dfrac{r}{p} \times \left(\dfrac{-p}{q}\right) = \dfrac{-r}{q}$

Now, except (d) in all other options the numerator is smaller than denominator.

$\therefore$ Option (b) is smallest.

Now, from option (a) and (c), i.e. $\dfrac{-p}{q}$ and

$\dfrac{-p}{r}, \dfrac{-p}{r}$ is greater as $r > q$

Now, from option (c) and (b), i.e. $\dfrac{-p}{r}$ and

$\dfrac{-q}{r}$

$\dfrac{-p}{r}$ is greater as $q > p$

$\therefore \ -\dfrac{1}{\alpha\beta}$ is greatest.

14. If α and β are the roots of the equation $ax^2 + bx + c = 0$, then the value of $\dfrac{1}{a\alpha + b} + \dfrac{1}{a\beta + b}$ is

(a) $\dfrac{a}{bc}$　(b) $\dfrac{b}{ac}$　(c) $\dfrac{c}{ab}$　(d) $\dfrac{1}{abc}$

⟩ **(b)** We have, α, β are the roots of the equation

$ax^2 + bx + c = 0$

$\therefore \ \alpha + \beta = \dfrac{-b}{a}, \alpha\beta = \dfrac{c}{a}$

Now, $\dfrac{1}{a\alpha + b} + \dfrac{1}{a\beta + b}$

$= \dfrac{a\beta + b + a\alpha + b}{(a\alpha + b)(a\beta + b)}$

$= \dfrac{a(\alpha + \beta) + 2b}{a^2(\alpha\beta) + ab(\alpha + \beta) + b^2}$

$= \dfrac{a\left(\dfrac{-b}{a}\right) + 2b}{a^2\left(\dfrac{c}{a}\right) + ab\left(\dfrac{-b}{a}\right) + b^2} = \dfrac{b}{ac}$

15. The minimum value of the expression $2x^2 + 5x + 5$ is

(a) 5　　　　(b) 15/8
(c) −15/8　　(d) 0

⟩ **(b)** Let $y = 2x^2 + 5x + 5$

$y = 2\left(x^2 + \dfrac{5}{2}x + \dfrac{5}{2}\right)$

$y = 2\left(x^2 + \dfrac{5}{2}x + \dfrac{25}{16}\right) + 5 - \dfrac{25}{8}$

$y = 2\left(x + \dfrac{5}{4}\right)^2 + \dfrac{15}{8}$

$\therefore$ Minimum value of y is $\dfrac{15}{8}$

Alternate method

$y = 2x^2 + 5x + 5$
$a = 2, b = 5, c = 5$

Minimum value $= \dfrac{4ac - b^2}{4a}$

$= \dfrac{4 \times 2 \times 5 - (5)^2}{4 \times 2} = \dfrac{40 - 25}{8} = \dfrac{15}{8}$

16. It is given that equations $x^2 - y^2 = 0$ and $(x - a)^2 + y^2 = 1$ have single positive solution. For this, the value of 'a' is

(a) $\sqrt{2}$　(b) 2　(c) $-\sqrt{2}$　(d) 1

⟩ **(a)** We have, $x^2 - y^2 = 0$ ...(i)

and $(x - a)^2 + y^2 = 1$ ...(ii)

From Eq. (i), $x^2 - y^2 = 0 \Rightarrow x^2 = y^2$

Put the value of y^2 in Eq. (ii), we get

$\Rightarrow \quad (x - a)^2 + x^2 = 1$

$\Rightarrow \quad 2x^2 - 2ax + a^2 - 1 = 0$

Equation have single positive solution

$\therefore \quad\quad\quad D = 0$

$\Rightarrow 4a^2 - 4(a^2 - 1)(2) = 0$

$b^2 - 4ac = 0$

$(-2a)^2 - 4 \times 2 \times (a^2 - 1) = 0$

(here, $a = 2, b = -2a, c = a^2 - 1$)

$\Rightarrow \quad 4a^2 - 8a^2 + 8 = 0$

$\Rightarrow \quad\quad a^2 = 2 \Rightarrow a = \sqrt{2}$

17. If α, β and γ are the zeroes of the polynomial $f(x) = ax^3 + bx^2 + cx + d$, then $\alpha^2 + \beta^2 + \gamma^2$ is equal to

(a) $\dfrac{b^2 - ac}{a^2}$　　(b) $\dfrac{b^2 - 2ac}{a}$

(c) $\dfrac{b^2 + 2ac}{b^2}$　　(d) $\dfrac{b^2 - 2ac}{a^2}$

⟩ **(d)** We have, $f(x) = ax^3 + bx^2 + cx + d$

α, β, γ are the zero of the given polynomials

$\therefore \quad \alpha + \beta + \gamma = -\dfrac{b}{a}$

$\alpha\beta + \beta\gamma + \gamma\alpha = \dfrac{c}{a}$

$\alpha\beta\gamma = -\dfrac{d}{a}$

$(\alpha + \beta + \gamma)^2 = \alpha^2 + \beta^2 + \gamma^2$
$+ 2(\alpha\beta + \beta\gamma + \gamma\alpha)$

$\Rightarrow \quad \left(-\dfrac{b}{a}\right)^2 = \alpha^2 + \beta^2 + \gamma^2 + \dfrac{2c}{a}$

$\Rightarrow \alpha^2 + \beta^2 + \gamma^2 = \dfrac{b^2}{a^2} - \dfrac{2c}{a} = \dfrac{b^2 - 2ac}{a^2}$

2018 (I)

18. If the roots of the equation $px^2 + x + r = 0$ are reciprocal to each other, then which one of the following is correct?

(a) $p = 2r$ (b) $p = r$ (c) $2p = r$ (d) $p = 4r$

⟩ **(b)** Let the roots of the equation be 'α' and 'β'.

According to the question,

$\alpha = \dfrac{1}{\beta}$ ...(i)

From the equation,

$px^2 + x + r = 0$

$\alpha \times \beta = \dfrac{r}{p}$ $\left[\because \text{products of roots} = \dfrac{c}{a}\right]$

or $\quad\quad \beta \times \dfrac{1}{\beta} = \dfrac{r}{p}$ [from Eq. (i)]

or $\quad\quad\quad r = p$

19. If α and β are the roots of the equation $ax^2 + bx + c = 0$, then what is the value of the expression $(\alpha + 1)(\beta + 1)$?

(a) $\dfrac{a + b + c}{a}$　　(b) $\dfrac{b + c - a}{a}$

(c) $\dfrac{a - b + c}{a}$　　(d) $\dfrac{a + b - c}{a}$

⟩ **(c)** α and β are the roots of the equation

$ax^2 + bx + c = 0$

$\therefore$ Sum of roots $= \alpha + \beta = \dfrac{-b}{a}$

And product of roots $= \alpha \cdot \beta = \dfrac{c}{a}$

$\therefore (\alpha + 1)(\beta + 1) = \alpha\beta + \alpha + \beta + 1$

$= (\alpha\beta) + (\alpha + \beta) + 1$

$= \dfrac{-b}{a} + \dfrac{c}{a} + 1 = \dfrac{-b + c + a}{a}$

$= \dfrac{a - b + c}{a}$

20. The sum of a number and its square is 20. Then, the number is

(a) −5 or 4　　(b) 2 or 3
(c) −5 only　　(d) 5 or −4

⟩ **(a)** Let the number be x

According to the question,

$x + x^2 = 20$

$\Rightarrow \quad\quad x^2 + x - 20 = 0$

$\Rightarrow \quad x^2 + 5x - 4x - 20 = 0$

$\Rightarrow \quad x(x + 5) - 4(x + 5) = 0$

$\Rightarrow \quad\quad (x + 5)(x - 4) = 0$

$\therefore \quad\quad\quad\quad x = -5, 4$

21. A quadratic polynomial $ax^2 + bx + c$ is such that when it is divided by $x, (x - 1)$ and $(x + 1)$, the remainders are 3, 6 and 4 respectively. What is the value of $(a + b)$?

(a) 3　　(b) 2　　(c) 1　　(d) −1

⟩ **(a)** $p(x) = ax^2 + bx + c$

for $x = 0$
$p(0) = 3$
$p(0) = a(0)^2 + b(0) + c \Rightarrow c = 3$

for $x - 1 = 0$ i.e. $x = 1$
$p(1) = 6$

$\therefore \quad a(1)^2 + b(1) + c = 6$

$a + b + 3 = 6$

$\Rightarrow \quad\quad\quad a + b = 3$

2017 (II)

22. What is the value of $\alpha(\alpha \neq 0)$ for which $x^2 - 5x + \alpha$ and $x^2 - 7x + 2\alpha$ have a common factor?

(a) 6   (b) 4   (c) 3   (d) 2

⊚ **(a)** We have,

$x^2 - 5x + \alpha$ and $x^2 - 7x + 2\alpha$ have a common factor

Let $x^2 - 5x + \alpha = (x - a)(x - b)$
$= x^2 - (a + b)x + ab$

and $x^2 - 7x + 2\alpha = (x - a)(x - c)$
$= x^2 - (a + c)x + ac$

On comparing, we get
$a + b = 5, ab = \alpha$
$a + c = 7, ac = 2\alpha$

∴ $ac = 2(ab) \Rightarrow c = 2b$
$a + b = 5$ and $a + c = 7$

⇒ $a + 2b = 7$

Solving these equations, we get
$a = 3, b = 2$

∴ $\alpha = ab = 3 \times 2 = 6$

23. What is the positive value of m for which the roots of the equation $12x^2 + mx + 5 = 0$ are in the ratio $3 : 2$?

(a) $5\sqrt{10}$ (b) $\dfrac{5\sqrt{10}}{12}$ (c) $\dfrac{5}{12}$ (d) $\dfrac{12}{5}$

⊚ **(a)** We have, $12x^2 + mx + 5 = 0$

Let α, β are the roots of equation

∴ $\alpha + \beta = -\dfrac{m}{12}$ and $\alpha\beta = \dfrac{5}{12}$

Given, $\dfrac{\alpha}{\beta} = \dfrac{3}{2} \Rightarrow \alpha = \dfrac{3\beta}{2}$

∴ $\left(\dfrac{3\beta}{2}\right)(\beta) = \dfrac{5}{12} \Rightarrow \beta^2 = \dfrac{10}{36}$

⇒ $\beta = \dfrac{\sqrt{10}}{6} \Rightarrow \alpha = \dfrac{3\sqrt{10}}{12}$

Hence, $m = 12\left(\dfrac{3\sqrt{10}}{12} + \dfrac{\sqrt{10}}{6}\right)$

$= 12\left(\dfrac{5\sqrt{10}}{12}\right)$

⇒ $m = 5\sqrt{10}$

24. If the roots of the equation $a(b - c)x^2 + b(c - a)$ $x + c(a - b) = 0$ are equal, then which one of the following is correct?

(a) $2b = a + c$ (b) $b^2 = ac$
(c) $\dfrac{2}{b} = \dfrac{1}{a} + \dfrac{1}{c}$ (d) $\dfrac{1}{b} = \dfrac{1}{a} + \dfrac{1}{c}$

⊚ **(c)** Given equation is

$a(b - c)x^2 + b(c - a)x + c(a - b) = 0$

Since, it has equal roots, therefore $D = 0$

⇒ $B^2 - 4AC = 0$

⇒ $(b(c - a))^2 - 4a(b - c)c(a - b) = 0$

⇒ $b^2(c - a)^2 - 4ac(b - c)(a - b) = 0$

⇒ $b^2(c^2 + a^2 - 2ac) -$
$\qquad 4ac(ab - b^2 - ac + bc) = 0$

$\Rightarrow b^2c^2 + b^2a^2 - 2acb^2 - 4a^2bc$
$\qquad + 4acb^2 + 4a^2c^2 - 4abc^2 = 0$

$\Rightarrow (bc)^2 + (ab)^2 + (2ac)^2 + 2acb^2$
$\qquad\qquad - 4a^2bc - 4\,abc^2 = 0$

$\Rightarrow (bc)^2 + (ab)^2 + (-2ac)^2 + 2acb^2$
$\qquad\qquad - 4a^2bc - 4\,abc^2 = 0$

⇒ $(bc + ab - 2ac)^2 = 0$

⇒ $bc + ab = 2ac$

⇒ $b(a + c) = 2ac \Rightarrow \dfrac{1}{a} + \dfrac{1}{c} = \dfrac{2}{b}$

25. If k is an integer, then $x^2 + 7x - 14\left(k^2 - \dfrac{7}{8}\right) = 0$ has

(a) both integral roots
(b) at least one integral root
(c) no integral root
(d) both positive integral roots

⊚ **(c)** Given equation is

$x^2 + 7x - 14\left(k^2 - \dfrac{7}{8}\right) = 0$

⇒ $x = \dfrac{-7 \pm \sqrt{49 + 4(14)\left(k^2 - \dfrac{7}{8}\right)}}{2}$

⇒ $x = \dfrac{-7 \pm \sqrt{49 + 56k^2 - 49}}{2}$

⇒ $x = \dfrac{-7 \pm \sqrt{56k^2}}{2}$

⇒ $x = \dfrac{-7 \pm 2\sqrt{14}k}{2}$

Clearly x can't take any integral value, for any integer k.

∴ The given equation has no integral root.

2017 (I)

26. If α and β are the roots of the quadratic equation $2x^2 + 6x + k = 0$, where $k < 0$, then what is the maximum value of $\dfrac{\alpha}{\beta} + \dfrac{\beta}{\alpha}$?

(a) 2   (b) – 2   (c) 9   (d) – 9

⊚ **(d)** We have, $2x^2 + 6x + k = 0$

∴ $\alpha + \beta = -\dfrac{6}{2} = -3$ and $\alpha\beta = \dfrac{k}{2}$

Now, $\dfrac{\alpha}{\beta} + \dfrac{\beta}{\alpha} = \dfrac{\alpha^2 + \beta^2}{\alpha\beta}$

Since, numerator is always positive and denominator will be always negative $(k < 0)$

∴ $\dfrac{\alpha^2 + \beta^2}{\alpha\beta}$ will be a negative value.

So, option (a) and (c) are wrong.

Now, $\dfrac{\alpha^2 + \beta^2}{\alpha\beta} = \dfrac{(\alpha + \beta)^2 - 2\alpha\beta}{\alpha\beta}$

$\qquad = \dfrac{9 - k}{k/2} = \dfrac{2(9 - k)}{K}$

Put $\dfrac{2(9 - k)}{k} = -2 \Rightarrow 9 - k = -k$

$\Rightarrow 9 = 0$ which is not possible

Put $\dfrac{2(9 - k)}{k} = -9 \Rightarrow k = -\dfrac{18}{7}$ which is true.

∴ Maximum value is –9.

27. If one root of $(a^2 - 5a + 3)\,x^2 + (3a - 1)\,x + 2 = 0$ is twice the other, then what is the value of 'a'?

(a) $\dfrac{2}{3}$ (b) $-\dfrac{2}{3}$ (c) $\dfrac{1}{3}$ (d) $-\dfrac{1}{3}$

⊚ **(a)** Let $\alpha, 2\alpha$ be the roots of the given equation.

∴ $\alpha + 2\alpha = \dfrac{-(3a - 1)}{a^2 - 5a + 3}$

⇒ $3\alpha = \dfrac{-(3a - 1)}{a^2 - 5a + 3}$

⇒ $\alpha = \dfrac{-(3a - 1)}{3(a^2 - 5a + 3)}$ …(i)

Also, $(\alpha)(2\alpha) = \dfrac{2}{a^2 - 5a + 3}$

⇒ $\alpha^2 = \dfrac{1}{a^2 - 5a + 3}$ …(ii)

From Eqs. (i) and (ii), we get

∴ $\left[\dfrac{-(3a - 1)}{3(a^2 - 5a + 3)}\right]^2 = \dfrac{1}{a^2 - 5a + 3}$

⇒ $\dfrac{(3a - 1)^2}{9(a^2 - 5a + 3)^2} = \dfrac{1}{a^2 - 5a + 3}$

⇒ $(3a - 1)^2 = 9(a^2 - 5a + 3)$

⇒ $9a^2 - 6a + 1 = 9a^2 - 45a + 27$

∴ $39a = 26 \Rightarrow a = \dfrac{26}{39} = \dfrac{2}{3}$

28. If α and β are the roots of the equation $x^2 + px + q = 0$, then what is $\alpha^2 + \beta^2$ equal to?

(a) $p^2 - 2q$ (b) $q^2 - 2p$
(c) $p^2 + 2q$ (d) $q^2 - q$

⊚ **(a)** We have, α and β are the roots of the equation $x^2 + px + q = 0$

∴ $\alpha + \beta = -p$ and $\alpha\beta = q$

Now, $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$
$\qquad\qquad = (-p)^2 - 2(q) = p^2 - 2q$

29. The values of x which satisfy the equation $5^{1+x} + 5^{1-x} = 26$ are

(a) –1, 1   (b) 0, 1   (c) 1, 2   (d) –1, 0

⊚ **(a)** We have, $5^{1+x} + 5^{1-x} = 26$

$\Rightarrow \qquad 5.5^x + 5.5^{-x} = 26$

$\Rightarrow \qquad 5.5^x + \dfrac{5}{5^x} = 26$

Let $5^x = y$

$\therefore \qquad 5y + \dfrac{5}{y} = 26$

$\Rightarrow \qquad 5y^2 - 26y + 5 = 0$

$\Rightarrow \qquad 5y^2 - 25y - y + 5 = 0$

$\Rightarrow \qquad 5y(y - 5) - 1(y - 5) = 0$

$\Rightarrow (y - 5)(5y - 1) = 0$

$\Rightarrow \qquad y = 5, \dfrac{1}{5}$

$\Rightarrow \qquad 5^x = 5 \text{ or } 5^{-1}$

$\Rightarrow \qquad x = 1 \text{ or } -1$

30. Aman and Alok attempted to solve a quadratic equation. Aman made a mistake in writing down the constant term and ended up in roots (4, 3). Alok made a mistake in writing down the coefficient of x to get roots (3, 2). The correct roots of the equation are

(a) $-4, -3$ (b) 6, 1
(c) 4, 3   (d) $-6, -1$

⊘ **(b)** Let quadratic equation be
$$ax^2 + bx + c = 0$$
If α and β are roots, then
$$\alpha + \beta = \dfrac{-b}{a}$$
and $\qquad \alpha\beta = \dfrac{c}{a}$

Since, Aman made a mistake in writing down the constant term.

$\therefore \quad \alpha + \beta = 4 + 3 = 7$
and Alok made a mistake in writing down the coefficient of x.

$\therefore \qquad \alpha\beta = 3 \times 2 = 6$
So, equation will be
$$x^2 - (\alpha + b)x + \alpha\beta = 0$$
$\Rightarrow \quad x^2 - 7x + 6 = 0$
$\Rightarrow \quad (x - 6)(x - 1) = 0$
$\therefore \qquad\qquad x = 6, 1$

2016 (II)

31. If λ is an integer and α, β are the roots of $4x^2 - 16x + \dfrac{\lambda}{4} = 0$, such that $1 < \alpha < 2$ and $2 < \beta < 3$, then how many values can λ take?

(a) 3   (b) 9
(c) 14   (d) 15

⊘ **(d)** Given, $4x^2 - 16x + \dfrac{\lambda}{4} = 0$

$\Rightarrow \qquad 16x^2 - 64x + \lambda = 0 \qquad \dots(i)$

It is given that α and β are the roots of Eq. (i).

$\therefore \ \beta = \dfrac{-(-64) + \sqrt{(-64)^2 - 4 \times 16 \times \lambda}}{2 \times 16}$

and

$\alpha = \dfrac{-(-64) - \sqrt{(-64)^2 - 4 \times 16 \times \lambda}}{2 \times 16}$

$\Rightarrow \quad \beta = \dfrac{64 + 8\sqrt{64 - \lambda}}{32}$

and $\quad \alpha = \dfrac{64 - 8\sqrt{64 - \lambda}}{32}$

$\Rightarrow \quad \beta = \dfrac{8(8 + \sqrt{64 - \lambda})}{32}$

and $\quad \alpha = \dfrac{8(8 - \sqrt{64 - \lambda})}{32}$

$\Rightarrow \quad \beta = \dfrac{8 + \sqrt{64 - \lambda}}{4}$

and $\quad \alpha = \dfrac{8 - \sqrt{64 - \lambda}}{4}$

$1 < \alpha < 2$ and $2 < \beta < 3$

then, $1 < \dfrac{8 - \sqrt{64 - \lambda}}{4} < 2$

and $2 < \dfrac{8 + \sqrt{64 - \lambda}}{4} < 3$

$4 < 8 - \sqrt{64 - \lambda} < 8$
and $8 < 8 + \sqrt{64 - \lambda} < 12$
and $\qquad 8 < 8 + \sqrt{64 - \lambda} < 12$
$\qquad 4 - 8 < -\sqrt{64 - \lambda} < 8 - 8$
and $\quad 8 - 8 < \sqrt{64 - \lambda} < 12 - 8$
$\qquad -4 < -\sqrt{64 - \lambda} < 0$
and $\qquad 0 < \sqrt{64 - \lambda} < 4$
$\qquad 4 > \sqrt{64 - \lambda} > 0$
and $\qquad 0 < \sqrt{64 - \lambda} < 4$
On solving each term, we get
$\qquad 16 > 64 - \lambda > 0$
$\qquad 16 - 64 > -\lambda > 0 - 64$
$\qquad -48 > -\lambda < -64$
$\qquad 48 < \lambda < 64$
Hence, λ can take 15 values.

32. In the quadratic equation $x^2 + ax + b = 0$, a and b can take any value from the set $\{1, 2, 3, 4\}$. How many pairs of values of a and b are possible in order that the quadratic equation has real roots?

(a) 6   (b) 7   (c) 8   (d) 16

(b) For real roots, $B^2 - 4AC \geq 0$
So, by equation, $\quad a^2 - 4b \geq 0$
$\Rightarrow \qquad\qquad a^2 \geq 4b$
When, $b = 1$
$\Rightarrow \qquad\qquad a^2 \geq 4$
$\Rightarrow \qquad\qquad a^2 - 4 \geq 0$
$\Rightarrow \quad (a - 2)(a + 2) \geq 0$

$\Rightarrow \qquad a \in (-\infty, -2] \cup [2, \infty)$
$\therefore \qquad b = 1 \text{ and } a = 2, 3, 4$
When $b = 2$, then $a^2 - 8 \geq 0$
$\therefore \qquad b = 2 \text{ and } a = 3, 4$
When $b = 3$, then $a^2 - 12 \geq 0$
$\therefore \qquad b = 3 \text{ and } a = 4$
When $b = 4$, then $a^2 - 16 \geq 0$
$\therefore \qquad a = 4 \text{ and } b = 4$
Hence, 7 pairs of values of a and b are possible.

33. The sum of the squares of two positive integers is 208. If the square of the larger number is 18 times the smaller number, then what is the difference of the larger and smaller numbers?

(a) 2   (b) 3   (c) 4   (d) 6

⊘ **(c)** Let two positive integers be x and y.
According to the question,
$\qquad\qquad x^2 + y^2 = 208 \qquad \dots(i)$
and $\qquad\qquad y^2 = 18x \qquad \dots(ii)$
On putting $y^2 = 18x$ in Eq. (i), we get
$\qquad\qquad x^2 + 18x = 208$
$\Rightarrow \qquad x^2 + 18x - 208 = 0$
$\Rightarrow \quad x^2 + 26x - 8x - 208 = 0$
$\Rightarrow \quad x(x + 26) - 8(x + 26) = 0$
$\Rightarrow \qquad (x + 26)(x - 8) = 0$
$\Rightarrow \qquad x + 26 = 0 \text{ or } x - 8 = 0$
$\Rightarrow \qquad x = -26 \text{ or } x = 8$
But x is positive.
$\therefore \qquad\qquad x = 8$
On putting $x = 8$ in Eq. (ii), we get
$\qquad\qquad y^2 = 18x$
$\Rightarrow \qquad y^2 = 18 \times 8$
$\Rightarrow \qquad y = \pm \sqrt{16 \times 9}$
$\Rightarrow \qquad y = 4 \times 3 \qquad [\because y > 0]$
$\Rightarrow \qquad y = 12$
$\therefore$ Difference between larger and smaller is $12 - 8 = 4$.

34. If α and β are the two zeroes of the polynomial $25x^2 - 15x + 2$, then what is a quadratic polynomial whose zeroes are $(2\alpha)^{-1}$ and $(2\beta)^{-1}$?

(a) $x^2 + 30x + 2$ (b) $8x^2 - 30x + 25$
(c) $8x^2 - 30x$ (d) $x^2 + 30x$

⊘ **(b)** Let $\quad 25x^2 - 15x + 2 = 0$
$\Rightarrow 25x^2 - 10x - 5x + 2 = 0$
$\qquad\qquad\qquad$ [by factorisation]
$\Rightarrow 5x(5x - 2) - 1(5x - 2) = 0$
$\Rightarrow \qquad (5x - 1)(5x - 2) = 0$
$\Rightarrow \qquad\qquad 5x = 1 \text{ or } 5x = 2$
$\Rightarrow \qquad\qquad x = \dfrac{1}{5} \text{ or } x = \dfrac{2}{5}$

It is given that α and β are zeroes of $25x^2 - 15x + 2 = 0$.

$\therefore \qquad \alpha = \dfrac{1}{5} \text{ and } \beta = \dfrac{2}{5} \qquad \ldots\text{(i)}$

Now, a quadratic equation whose roots are $(2\alpha)^{-1}$ and $(2\beta)^{-1}$, is given by

$x^2 - [(2\alpha)^{-1} + (2\beta)^{-1}]x + (2\alpha)^{-1} \cdot (2\beta)^{-1} = 0$

$\Rightarrow x^2 - \left[\dfrac{1}{2\alpha} + \dfrac{1}{2\beta}\right]x + \left(\dfrac{1}{2\alpha}\right)\left(\dfrac{1}{2\beta}\right) = 0$

$\Rightarrow x^2 - \left[\dfrac{1}{2 \times \dfrac{1}{5}} + \dfrac{1}{2 \times \dfrac{2}{5}}\right]x$

$\qquad + \left(\dfrac{1}{2 \times \dfrac{1}{5}}\right)\left(\dfrac{1}{2 \times \dfrac{2}{5}}\right) = 0 \ \text{[from Eq. (i)]}$

$\Rightarrow \quad x^2 - \left[\dfrac{5}{2} + \dfrac{5}{4}\right]x + \left(\dfrac{5}{2}\right)\left(\dfrac{5}{4}\right) = 0$

$\Rightarrow \quad x^2 - \dfrac{15}{4}x + \dfrac{25}{8} = 0$

$\Rightarrow \quad \dfrac{8x^2 - 30x + 25}{8} = 0$

$\therefore \quad 8x^2 - 30x + 25 = 0$

Hence, the required quadratic polynomial is $8x^2 - 30x + 25$.

35. If p and q are the roots of $x^2 + px + q = 0$, then which one of the following is correct?

(a) $p = 0$ or 1 (b) $p = 1$ only
(c) $p = -2$ or 0 (d) $p = -2$ only

⊘ **(b)** We have, p and q are the roots of equation

$\qquad x^2 + px + q = 0,$
$\therefore \qquad p + q = -p \text{ and } pq = q$

On solving above equations, we get

$\qquad p = 1, q = -2$

36. If $2p + 3q = 12$ and $4p^2 + 4pq - 3q^2 = 126$, then what is the value of $p + 2q$?

(a) 5 (b) $\dfrac{21}{4}$

(c) $\dfrac{25}{4}$ (d) $\dfrac{99}{16}$

⊘ **(d)** Given, $\qquad 2p + 3q = 12 \quad \ldots \text{(i)}$

and $\qquad 4p^2 + 4pq - 3q^2 = 126$
$\Rightarrow \quad 4p^2 + 6pq - 2pq - 3q^2 = 126$
$\Rightarrow \quad (2p + 3q)(2p - q) = 126$
$\Rightarrow \quad 12(2p - q) = 126 \qquad \text{[from Eq. (i)]}$
$\Rightarrow \qquad 2p - q = \dfrac{21}{2} \qquad \ldots \text{(ii)}$

On solving Eqs. (i) and (ii), we get

$\qquad p = \dfrac{87}{16} \text{ and } q = \dfrac{3}{8}$

$\therefore \quad p + 2q = \dfrac{87}{16} + 2 \times \dfrac{3}{8} = \dfrac{99}{16}$

2016 (I)

37. If a and b are negative real numbers and c is a positive real number, then which of the following is/are correct?

1. $a - b < a - c$

2. If $a < b$, then $\dfrac{a}{c} < \dfrac{b}{c}$.

3. $\dfrac{1}{b} < \dfrac{1}{c}$

Select the correct answer using the codes given below.

(a) Only 1   (b) Only 2
(c) Only 3   (d) 2 and 3

⊘ **(d)** 1. $a - b < a - c$

$\Rightarrow \quad b - c > 0 \qquad \ldots \text{(i)}$
As, b is negative real number and c is positive real number, then Eq. (i) is not true.

2. If $a < b$, when a and b are negative real numbers and c is a positive real number, then $\dfrac{a}{c} < \dfrac{b}{c}$
is always true for $b > a$.

3. $\dfrac{1}{b} < \dfrac{1}{c}$ is always true, as c is a positive real number and b is a negative real number.

38. Under what condition on p and q, one of the roots of the equation $x^2 + px + q = 0$ is the square of the other?

(a) $1 + q + q^2 = 3pq$
(b) $1 + p + p^2 = 3pq$
(c) $p^3 + q + q^2 = 3pq$
(d) $q^3 + p + p^2 = 3pq$

⊘ **(c)** Let α and α^2 be the roots of equation $x^2 + px + q = 0$.
Then, $\qquad \alpha \cdot \alpha^2 = q$

$\qquad \left[\because \text{product of roots} = \dfrac{c}{a}\right]$

$\therefore \qquad \alpha = (q)^{1/3} \qquad \ldots \text{(i)}$
and $\qquad \alpha + \alpha^2 = -p$

$\qquad \left[\because \text{sum of roots} = \dfrac{-b}{a}\right]$

$\therefore \qquad (q)^{1/3} + (q)^{2/3} = -p \qquad \ldots \text{(ii)}$
On cubing both sides, we get
$q + q^2 + 3q(q^{1/3} + q^{2/3}) = -p^3$
$\Rightarrow \qquad q + q^2 + 3q(-p) = -p^3$

$\qquad \text{[from Eq. (ii)]}$

$\Rightarrow \qquad q + q^2 + p^3 = 3pq$

39. The solution of the inequation $1 + \dfrac{1}{x} - \dfrac{1}{x^2} \geq 0$ is
(given that, $x \neq 0$)

(a) $x > 0$

(b) $x < 0$

(c) $\dfrac{-1 - \sqrt{5}}{5} \leq x \leq \dfrac{-1 + \sqrt{5}}{2}$

(d) $x \leq \dfrac{-1 - \sqrt{5}}{2}$ or $x \geq \dfrac{-1 + \sqrt{5}}{2}$

⊘ **(d)** We have, $\quad 1 + \dfrac{1}{x} - \dfrac{1}{x^2} \geq 0$

$\Rightarrow \qquad \dfrac{x^2 + x - 1}{x^2} \geq 0$

$\qquad x^2 + x - 1 \geq 0$

If $x^2 + x - 1 = 0$, then $x = \dfrac{-1 \pm \sqrt{5}}{2}$

$\therefore \left[x - \left(\dfrac{-1 + \sqrt{5}}{2}\right)\right]\left[x - \left(\dfrac{-1 - \sqrt{5}}{2}\right)\right] \geq 0$

$\Rightarrow \quad x \leq \dfrac{-1 - \sqrt{5}}{2}$

or $\quad x \geq \dfrac{-1 + \sqrt{5}}{2}$

40. Which of the points $P(5, -1), Q(3, -2)$ and $R(1, 1)$ lie in the solution of the system of inequations $x + y \leq 4$ and $x - y \geq 2$?

(a) Q and R
(b) P and R
(c) P and Q
(d) P, Q and R

⊘ **(c)** Given points are $P(5, -1), Q(3, -2)$ and $R(1, 1)$.
If points P, Q and R lie in the solution of inequations $x + y \leq 4$ and $x - y \geq 2$, then points P, Q and R satisfy these inequations.

For point $P(5, -1)$, $5 - 1 \leq 4$ [true]
$\qquad\qquad\qquad 5 + 1 \geq 2$ [true]
For point $Q(3, -2)$, $3 - 2 \leq 4$ [true]
$\qquad\qquad\qquad 3 + 2 \geq 2$ [true]
and for point $R(1, 1)$, $1 + 1 \leq 4$ [true]
$\qquad\qquad\qquad 1 - 1 \geq 2$ [false]
So, the point $R(1, 1)$ does not satisfy the inequations.
Hence, points P and Q lie in the solution of inequations.

41.
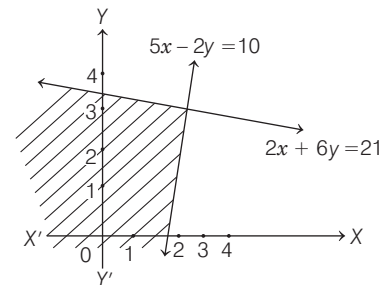
The linear inequations, for which the shaded area in the

figure given above is the solution set, are

(a) $2x + 6y \le 21$, $5x - 2y \le 10$
(b) $2x + 6y \le 21$, $5x - 2y \ge 10$
(c) $2x + 6y \ge 21$, $5x - 2y \le 10$
(d) $2x + 6y \ge 21$, $5x - 2y \ge 10$

⊙ **(a)** Consider the line, $2x + 6y = 21$ ...(i)
The point (0, 0) does not satisfy Eq. (i) but the point (0,0) satisfy the inequation $2x + 6y \le 21$.
So, the shaded portion will be the area contain (0,0).
Now, consider the line,

$$5x - 2y = 10 \quad \text{... (ii)}$$

The point (0, 0) does not satisfy the Eq. (ii) but the point (0,0) satisfies the inequation $5x - 2y \le 10$. So, the shaded portion will be the area contain (0,0).
Thus, the linear inequations corresponding to the given set are $2x + 6y \le 21$ and $5x - 2y \le 10$.

42. If the sum of the roots of $ax^2 + bx + c = 0$ is equal to the sum of the squares of their reciprocals, then which one of the following relations is correct?

(a) $ab^2 + bc^2 = 2a^2c$
(b) $ac^2 + bc^2 = 2b^2a$
(c) $ab^2 + bc^2 = a^2c$
(d) $a^2 + b^2 + c^2 = 1$

⊙ **(a)** Let α and β be the roots of equation $ax^2 + bx + c = 0$.

Then, $\alpha + \beta = \dfrac{-b}{a}$

and $\alpha\beta = \dfrac{c}{a}$

Now, $\alpha + \beta = \left(\dfrac{1}{\alpha}\right)^2 + \left(\dfrac{1}{\beta}\right)^2$

$\Rightarrow \quad \alpha + \beta = \dfrac{\beta^2 + \alpha^2}{(\alpha\beta)^2}$

$= \dfrac{(\alpha + \beta)^2 - 2\alpha\beta}{(\alpha\beta)^2}$

$\Rightarrow \quad \dfrac{-b}{a} = \dfrac{b^2/a^2 - 2c/a}{c^2/a^2}$

$\Rightarrow \quad ab^2 - 2a^2c = -bc^2$

$\Rightarrow \quad ab^2 + bc^2 = 2a^2c$

43. Consider the following statements in respect of two different non-zero integers p and q.
  1. For $(p + q)$ to be less than $(p - q)$, q must be negative.
  2. For $(p + q)$ to be greater than $(p - q)$, both p and q must be positive.

Which of the above statement(s) is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ **(a)** Given, p and q are non-zero integers.
1. ∵ $p + q < p - q$
$\Rightarrow q + q < 0 \Rightarrow 2q < 0 \Rightarrow q < 0$
∴ q must be negative.
Hence, statement 1 is correct.
2. ∵ $p + q > p - q \Rightarrow q + q > 0$
∴ $2q > 0$
∴ q must be positive irrespective of p.
Hence, statement 2 is incorrect.

44. If the roots of the equation $lx^2 + mx + m = 0$ are in the ratio $p:q$, then $\sqrt{\dfrac{p}{q}} + \sqrt{\dfrac{q}{p}} + \sqrt{\dfrac{m}{l}}$ is equal to

(a) 0   (b) 1   (c) 2   (d) 3

⊙ **(a)** Since, the roots of equation $lx^2 + mx + m = 0$ are in the ratio $p:q$.
Then, we can take roots as pk and qk.
∴ Sum of roots $= pk + qk = -\dfrac{m}{l}$

$\Rightarrow \quad (p+q)k = -\dfrac{m}{l} \quad \text{...(i)}$

and product of roots

$= (pq)k^2 = \dfrac{m}{l} \quad \text{...(ii)}$

On dividing Eq. (i) by Eq. (ii), we get

$\dfrac{(p+q)k}{(pq)k^2} = -1$

$\Rightarrow \quad \left(\dfrac{p+q}{pq}\right) = -k = \dfrac{m/l}{(p+q)}$

[from Eq. (i)]

$\Rightarrow \quad \dfrac{(p+q)^2}{pq} = \dfrac{m}{l}$

$\Rightarrow \quad \dfrac{p+q}{\sqrt{pq}} = \pm\sqrt{\dfrac{m}{l}}$

$\Rightarrow \quad \dfrac{p+q}{\sqrt{pq}} = -\sqrt{\dfrac{m}{l}}$

∴ $\sqrt{\dfrac{p}{q}} + \sqrt{\dfrac{q}{p}} + \sqrt{\dfrac{m}{l}} = 0$

45. If $\sqrt{3x^2 - 7x - 30} - \sqrt{2x^2 - 7x - 5}$ $= x - 5$ has α and β as its roots, then the value of $\alpha\beta$ is

(a) − 15   (b) − 5   (c) 0   (d) 5

⊙ **(a)** Given, $\sqrt{3x^2 - 7x - 30} = (x - 5)$
$+ \sqrt{2x^2 - 7x - 5}$
On squaring both sides, we get
$3x^2 - 7x - 30 = (x - 5)^2 +$
$(2x^2 - 7x - 5)$
$+ 2(x - 5)\sqrt{2x^2 - 7x - 5}$
$[\because (a - b)^2 = a^2 + b^2 - 2ab]$

$\Rightarrow 3x^2 - 7x - 30 = x^2 + 25 - 10x$
$+ 2x^2 - 7x - 5$
$+ (2x - 10)\sqrt{2x^2 - 7x - 5}$

$\Rightarrow \quad 3x^2 - 7x - 30 - x^2 + 10x$
$+ 7x - 2x^2 - 20$
$= (2x - 10)\sqrt{2x^2 - 7x - 5}$

$\Rightarrow (10x - 50) = (2x - 10)\sqrt{2x^2 - 7x - 5}$

$\Rightarrow 10(x - 5) = 2(x - 5)\sqrt{2x^2 - 7x - 5}$

$\Rightarrow \quad \sqrt{2x^2 - 7x - 5} = 5 \quad \text{...(i)}$

Again, on squaring both sides of Eq. (i), we get

$2x^2 - 7x - 5 = 25$

$\Rightarrow \quad 2x^2 - 7x - 30 = 0 \quad \text{...(ii)}$

If α and β are roots of Eq. (ii), then

$\alpha\beta = \dfrac{-30}{2} = -15$

46. If $a^2 - by - cz = 0$, $ax - b^2 + cz = 0$ and $ax + by - c^2 = 0$, then the value of $\dfrac{x}{a + x} + \dfrac{y}{b + y} + \dfrac{z}{c + z}$ will be

(a) $a + b + c$
(b) 3
(c) 1
(d) 0

⊙ **(c)** Given, $a^2 - by - cz = 0$ ...(i)
$ax - b^2 + cz = 0$ ...(ii)
and $ax + by - c^2 = 0$ ...(iii)
On adding Eqs. (i), (ii) and (iii), we get

$x = \dfrac{b^2 - a^2 + c^2}{2a}$

$\Rightarrow \quad \dfrac{x}{a + x} = \dfrac{\dfrac{b^2 - a^2 + c^2}{2a}}{a + \dfrac{b^2 - a^2 + c^2}{2a}}$

$= \dfrac{\dfrac{b^2 - a^2 + c^2}{2a}}{\dfrac{2a^2 + b^2 - a^2 + c^2}{2a}} = \dfrac{b^2 - a^2 + c^2}{a^2 + b^2 + c^2}$

Similarly, $\dfrac{y}{b + y} = \dfrac{a^2 - b^2 + c^2}{a^2 + b^2 + c^2}$

and $\dfrac{z}{c + z} = \dfrac{a^2 + b^2 - c^2}{a^2 + b^2 + c^2}$

∴ $\dfrac{x}{a + x} + \dfrac{y}{y + b} + \dfrac{z}{c + z}$

$= \dfrac{\left[(b^2 - a^2 + c^2) + (a^2 - b^2 + c^2) + (a^2 + b^2 - c^2)\right]}{a^2 + b^2 + c^2}$

$= \dfrac{a^2 + b^2 + c^2}{a^2 + b^2 + c^2} = 1$

47. If the equations $x^2 - px + q = 0$ and $x^2 + qx - p = 0$ have a common root, then which one of the following is correct?

(a) $p - q = 0$
(b) $p + q - 2 = 0$
(c) $p + q - 1 = 0$
(d) $p - q - 1 = 0$

⊛ **(d)** Given, $x^2 - px + q = 0$ …(i)
$x^2 + qx - p = 0$ …(ii)
Let α is a common root of both equations, then put $x = \alpha$ in both equations, $\alpha^2 - p\alpha + q = 0$
$\alpha^2 = p\alpha - q$ …(iii)
$\alpha^2 + q\alpha - p = 0$
$p\alpha - q + q\alpha - p = 0$ [from Eq. (iii)]
$\alpha(p + q) = p + q$
$\alpha = 1$
From Eq. (iii)
$1 = p \times 1 - q$
$p - q - 1 = 0$

48. The sum and difference of two expressions are $5x^2 - x - 4$ and $x^2 + 9x - 10$, respectively. The HCF of the two expressions will be

(a) $(x + 1)$　(b) $(x - 1)$
(c) $(3x + 7)$　(d) $(2x - 3)$

⊛ **(b)** Let $f(x) + g(x) = 5x^2 - x - 4$ …(i)
and $f(x) - g(x) = x^2 + 9x - 10$ …(ii)
On solving Eqs. (i) and (ii), we get
$f(x) = 3x^2 + 4x - 7 = (x - 1)(3x + 7)$
and $g(x) = 2x^2 - 5x + 3$
$= (x - 1)(2x - 3)$
Hence, the required HCF is $(x - 1)$.

2015 (II)

49. The number of values of x satisfying $x + \dfrac{100}{x} > 50$, where x is a natural number less than or equal to 100, is

(a) 51　(b) 53
(c) 55　(d) 57

⊛ **(c)** We have, $x + \dfrac{100}{x} > 50$
and $1 \le x \le 100$
$\Rightarrow x^2 - 50x + 100 > 0$
$\Rightarrow x = \dfrac{50 \pm \sqrt{2500 - 400}}{2}$
$= \dfrac{50 \pm 10\sqrt{21}}{2}$
$x < 25 - 5\sqrt{21}$
or $x > 25 + 5\sqrt{21}$

$\Rightarrow x < 2.087$
or $x > 47.91$
$\Rightarrow x = 1$ and 2 or $x = 48, 49,...,100$
∴ Number of total values of $x = 2 + 53$
$= 55$

50. Consider the following in respect of the equation

$$y = \dfrac{\sqrt{(x - 1)^2}}{x - 1}$$

1. $y = 1$, if $x > 1$
2. $y = -1$, if $x < 1$
3. y exists for all values of x

Which of the above statement(s) is/are correct?

(a) Only 1　(b) Only 2
(c) 1 and 2　(d) 1, 2 and 3

⊛ **(c)** Given, $y = \dfrac{\sqrt{(x - 1)^2}}{x - 1}$ …(i)

1. If $x > 1$
then put $x = 2$ in Eq. (i)
$y = \dfrac{\sqrt{(2 - 1)^2}}{2 - 1} = \dfrac{\sqrt{(1)^2}}{1} = 1$
put $x = 3$
$y = \dfrac{\sqrt{(3 - 1)^2}}{3 - 1} = \dfrac{\sqrt{4}}{2} = \dfrac{2}{2} = 1$
Hence, statement 1 ($y = 1$, if $x > 1$) is correct

2. If $x < 1$
then put $x = -1$ in Eq. (i)
$y = \dfrac{\sqrt{(-1 - 1)^2}}{-1 - 1} = \dfrac{\sqrt{4}}{-2} = \dfrac{2}{-2} = -1$
put $x = -2$
$y = \dfrac{\sqrt{(-2 - 1)^2}}{-2 - 1} = \dfrac{\sqrt{9}}{-3} = \dfrac{3}{-3} = -1$
Hence, statement 2 ($y = -1$ if $x < 1$) is correct.

3. Put $x = 1$ in Eq. (i)
$y = \dfrac{\sqrt{(1 - 1)}}{1 - 1} = 0$
Hence, statement 3 is not correct.

51. If a, b and c satisfy the equation $x^3 - 3x^2 + 2x + 1 = 0$, then what is the value of $\dfrac{1}{a} + \dfrac{1}{b} + \dfrac{1}{c}$?

(a) $-\dfrac{1}{2}$　(b) 2
(c) -2　(d) $\dfrac{1}{2}$

⊛ **(c)** We have, $x^3 - 3x^2 + 2x + 1 = 0$
If roots are a, b and c.
∴ $a + b + c = 3$, $ab + bc + ca = 2$
and $abc = -1$
∴ $\dfrac{1}{a} + \dfrac{1}{b} + \dfrac{1}{c} = \dfrac{bc + ca + ab}{abc} = \dfrac{2}{-1} = -2$

52. If $k = x - y + 2z$, where $-2 \le x \le 1$ and $-1 \le y \le 2$ and $3 \le z \le 6$, then which one of the following is correct?

(a) $0 \le k \le 9$
(b) $5 \le k \le 11$
(c) $2 \le k \le 14$
(d) $2 \le k \le 11$

⊛ **(c)** We have, $-2 \le x \le 1$ …(i)
$-1 \le y \le 2$
∴ $-2 \le -y \le 1$ …(ii)
and $3 \le z \le 6$
$6 \le 2z \le 12$ …(iii)
On adding Eqs. (i), (ii) and (iii), we get
$-2 - 2 + 6 \le x - y + 2z \le 1 + 1 + 12$
$2 \le k \le 14$

53. If the roots of the quadratic equation $x^2 - 4x - \log_{10} N = 0$ are all real, then the minimum value of N is

(a) $\dfrac{1}{100}$　(b) $\dfrac{1}{1000}$
(c) $\dfrac{1}{10000}$　(d) 10000

⊛ **(c)** We have,
$x^2 - 4x - \log_{10} N = 0$
We know that, roots are real, if $D \ge 0$
$\Rightarrow B^2 - 4AC \ge 0$
$\Rightarrow (4)^2 - 4 \times 1 \times (-\log_{10} N) \ge 0$
$\Rightarrow 16 - 4(-\log_{10} N) \ge 0$
$\Rightarrow 16 + 4\log_{10} N \ge 0$
$\Rightarrow \log_{10} N \ge -4$
$\Rightarrow N \ge 10^{-4}$
$\Rightarrow N \ge \dfrac{1}{10000}$
Minimum value of $N = \dfrac{1}{10000}$

54. The difference of maximum values of the expressions $(6 + 5x - x^2)$ and $(y - 6 - y^2)$ for any real values of x and y, is

(a) 16　(b) 17
(c) 18　(d) 19

⊛ **(c)** $6 + 5x - x^2 = 6 + \dfrac{25}{4} - \dfrac{25}{4} + 5x - x^2$
$= \dfrac{49}{4} - \left(x - \dfrac{5}{2}\right)^2$ and
$y - 6 - y^2 = -6 + \dfrac{1}{4} - \dfrac{1}{4} + y - y^2$
$= \dfrac{-23}{4} - \left(y - \dfrac{1}{2}\right)^2$
The expressions $(6 + 5x - x^2)$ and $(y - 6 - y^2)$ can be written as
$\dfrac{49}{4} - \left(x - \dfrac{5}{2}\right)^2$ and $-\dfrac{23}{4} - \left(y - \dfrac{1}{2}\right)^2$.

Therefore, the maximum value of
$$-x^2 + 5x + 6 \text{ is } \frac{49}{4}$$
and that of $-y^2 + y - 6$ is $-\frac{23}{4}$.

∴ Their difference $= \frac{49}{4} - \left(-\frac{23}{4}\right)$
$$= \frac{49}{4} + \frac{23}{4}$$
$$= \frac{72}{4} = 18$$

2015 (I)

55. The sign of the quadratic polynomial $ax^2 + bx + c$ is always positive, if

(a) a is positive and $b^2 - 4ac \le 0$
(b) a is positive and $b^2 - 4ac \ge 0$
(c) a can be any real number and $b^2 - 4ac \le 0$
(d) a can be any real number and $b^2 - 4ac \ge 0$

(a) If a is positive and $b^2 - 4ac \le 0$, then the sign of quadratic polynomial $ax^2 + bx + c$ is always positive.

56. For which value of k does the pair of equations $x^2 - y^2 = 0$ and $(x - k)^2 + y^2 = 1$ yield a unique positive solution of x?

(a) 2 (b) 0
(c) $\sqrt{2}$ (d) $-\sqrt{2}$

(c) Given, $x^2 - y^2 = 0$
$$\Rightarrow \qquad y^2 = x^2 \qquad \qquad ...(i)$$
Now, $(x - k)^2 + y^2 = 1$
From Eq. (i), we get
$$x^2 + k^2 - 2kx + x^2 = 1$$
$$[\because (a - b)^2 = a^2 + b^2 - 2ab]$$
$$\Rightarrow \qquad 2x^2 - 2kx + k^2 - 1 = 0$$
∵ The equation has unique solution, if
$$D = 0 \Rightarrow b^2 - 4ac = 0$$
$$\Rightarrow (-2k)^2 - 4 \times 2 \times (k^2 - 1) = 0$$
$$\Rightarrow 4k^2 - 8k^2 + 8 = 0$$
$$\Rightarrow -4k^2 + 8 = 0$$
$$\Rightarrow -4k^2 = -8$$
$$\Rightarrow k = \pm \sqrt{2}$$
For positive roots,
$$-\frac{b}{a} > 0 \quad \text{and} \quad \frac{c}{a} > 0$$
$$\Rightarrow -\left(\frac{-2k}{2} > 0\right) \text{and} \frac{k^2 - 1}{2} > 0$$
$$\Rightarrow k > 0 \text{ and } k^2 \ge 1$$
$$\therefore \qquad k = \sqrt{2}$$

2014 (II)

57. If one of the roots of the equation $px^2 + qx + r = 0$ is three times the other, then which one of the following relations is correct?

(a) $3q^2 = 16\, pr$ (b) $q^2 = 24\, pr$
(c) $p = q + r$ (d) $p + q + r = 1$

(a) Given equation is $px^2 + qx + r = 0$.
Let one root of the equation be α.
Then, other root $= 3\alpha$
∴ Sum of roots $= \alpha + 3\alpha = -\dfrac{q}{p}$
$$\Rightarrow \qquad 4\alpha = \frac{-q}{p} \Rightarrow \alpha = \frac{-q}{4p} \qquad ...(i)$$
and product of roots $= (\alpha) \cdot (3\alpha) = \dfrac{r}{p}$
$$\Rightarrow \qquad 3\alpha^2 = \frac{r}{p}$$
$$\Rightarrow \qquad 3\left(\frac{-q}{4p}\right)^2 = \frac{r}{p} \qquad [\text{from Eq. (i)}]$$
$$\Rightarrow \qquad \frac{3q^2}{16p^2} = \frac{r}{p}$$
$$\Rightarrow \qquad 3q^2 p = 16p^2 r$$
$$\therefore \qquad 3q^2 = 16pr$$

58. If the equation $x^2 + 2(1 + k)x + k^2 = 0$ has equal roots, then what is the value of k?

(a) $\dfrac{1}{2}$ (b) $-\dfrac{1}{2}$ (c) 1 (d) -1

(b) Given equation is
$$x^2 + 2(1 + k)x + k^2 = 0.$$
If it has equal roots, then $D = 0$
$$\Rightarrow B^2 - 4AC = 0$$
$$\Rightarrow \{2(1 + k)\}^2 - 4k^2 = 0$$
$$\Rightarrow 4(1 + k^2 + 2k) - 4k^2 = 0$$
$$\Rightarrow 4 + 4k^2 + 8k - 4k^2 = 0$$
$$\Rightarrow 4 + 8k = 0$$
$$\therefore \qquad k = -\frac{4}{8}$$
$$\Rightarrow \qquad k = -\frac{1}{2}$$

59. If m and n are the roots of the equation $x^2 + ax + b = 0$ and m^2, n^2 are the roots of the equation $x^2 - cx + d = 0$, then which of the following is/are correct?

1. $2b - a^2 = c$ 2. $b^2 = d$

Select the correct answer using the codes given below.

(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2

(b) 1. Given, m and n are the roots of the equation $x^2 + ax + b = 0$.
$$\therefore \qquad m + n = -a \qquad \qquad ...(i)$$
$$\text{and} \qquad mn = b \qquad \qquad ...(ii)$$
Also, given m^2 and n^2 are the roots of the equation $x^2 - cx + d = 0$.
$$\therefore \qquad m^2 + n^2 = c \qquad ...(iii)$$
$$\text{and} \qquad m^2 n^2 = d \qquad ...(iv)$$
On squaring Eq. (i) both sides, we get
$$m^2 + n^2 + 2mn = a^2$$
$$\text{[from Eqs. (i) and (ii)]}$$
$$\Rightarrow \qquad c + 2b = a^2$$
$$\Rightarrow \qquad c = a^2 - 2b$$
$$\Rightarrow \qquad 2b - a^2 = -c$$
Hence, statement 1 is incorrect.
2. From Eq. (ii),
$$m^2 n^2 = b^2 \Rightarrow b^2 = d$$
Hence, statement 2 is correct.

60. If m and n $(m > n)$ are the roots of the equation
$$7(x + 2a)^2 + 3a^2 = 5a(7x + 23a),$$
where $a > 0$, then what is $3m - n$ equal to?

(a) $12a$ (b) $14a$ (c) $15a$ (d) $18a$

(c) Given equation is
$$7(x + 2a)^2 + 3a^2 = 5a(7x + 23a)$$
$$[\because (a + b)^2 = a^2 + b^2 + 2ab]$$
$$\Rightarrow \quad 7(x^2 + 4a^2 + 4ax) + 3a^2$$
$$= 35ax + 115a^2$$
$$\Rightarrow \quad 7x^2 - 7ax - 84a^2 = 0$$
$$\Rightarrow \quad x^2 - ax - 12a^2 = 0$$
$$\Rightarrow \quad (x + 3a)(x - 4a) = 0$$
$$\Rightarrow \quad x = -3a \text{ and } x = 4a$$
Since, m and n are the roots of the given equation.
Let $m = 4a$ and $n = -3a$
$$\therefore \quad 3m - n = 3(4a) - (-3a)$$
$$= 12a + 3a = 15a$$

2014 (I)

61. In solving a problem, one student makes a mistake in the coefficient of the first degree term and obtains -9 and -1 for the roots. Another student makes a mistake in the constant term of the equation and obtains 8 and 2 for the roots. The correct equation was

(a) $x^2 + 10x + 9 = 0$
(b) $x^2 - 10x + 16 = 0$
(c) $x^2 - 10x + 9 = 0$
(d) None of the above

⊙ *(c)* When mistake is done in first degree term, then the roots of the equation are -9 and -1.

$\therefore \qquad \alpha\beta = (-9) \times (-1)$

$\qquad \alpha\beta = 9$

When mistake is done in constant term, then the roots of equation are 8 and 2.

$\therefore \qquad \alpha + \beta = 8 + 2 = 10$

Now, equation will be

$\qquad x^2 - (\alpha + \beta)x + \alpha\beta = 0$

$\therefore \qquad x^2 - 10x + 9x = 0$

62. If m and n are the roots of the equation $27ax^2 + bx + c = 0$, then the equation whose roots are $(m^2 + 1)/m$ and $(n^2 + 1)/n$ is

(a) $acx^2 + (ab + bc)x + b^2$
$\qquad\qquad + (a - c)^2 = 0$

(b) $acx^2 + (ab - bc)x + b^2$
$\qquad\qquad + (a - c)^2 = 0$

(c) $acx^2 + (ab - bc)x + b^2$
$\qquad\qquad - (a - c)^2 = 0$

(d) $acx^2 + (ab + bc)x + b^2$
$\qquad\qquad - (a - c)^2 = 0$

⊙ *(a)* For the given equation $ax^2 + bx + c = 0$, m and n are the roots.

$\therefore$ Sum of roots $= m + n = -b/a$

and product of roots $= mn = \dfrac{c}{a}$

Sum of roots for $\dfrac{m^2 + 1}{m}$ and $\dfrac{n^2 + 1}{n}$

$= \dfrac{m^2 + 1}{m} + \dfrac{n^2 + 1}{n}$

$= \dfrac{m^2 n + n + mn^2 + m}{mn}$

$= \dfrac{mn(m + n) + 1(m + n)}{mn}$

$= \dfrac{(m + n)(mn + 1)}{mn}$

$= \dfrac{-\dfrac{b}{a}\left(\dfrac{c}{a} + 1\right)}{\dfrac{c}{a}} = \dfrac{-b(a + c)}{ac}$

$\left[\text{put } m + n = -\dfrac{b}{a} \text{ and } mn = \dfrac{c}{a}\right]$

$\therefore$ Product of roots $= \dfrac{m^2 + 1}{m} \times \dfrac{n^2 + 1}{n}$

$= \dfrac{(m^2 + 1)(n^2 + 1)}{mn}$

$= \dfrac{m^2 n^2 + n^2 + m^2 + 1}{mn}$

$= \dfrac{(mn)^2 + (m + n)^2 - 2mn + 1}{mn}$

$[\because a^2 + b^2 = (a + b)^2 - 2ab]$

$= \dfrac{\left(\dfrac{c}{a}\right)^2 + \left(\dfrac{-b}{a}\right)^2 - 2\left(\dfrac{c}{a}\right) + 1}{\dfrac{c}{a}}$

$= \dfrac{c^2 + b^2 - 2ac + a^2}{ac}$

$= \dfrac{b^2 + (a - c)^2}{ac}$

We know that, quadratic equation is of the form

$x^2 -$ (Sum of roots) $x +$ Product of roots $= 0$

$\Rightarrow \quad x^2 - \left(\dfrac{-b(a + c)}{ac}\right)x$

$\qquad\qquad + \left(\dfrac{b^2 + (a - c)^2}{ac}\right) = 0$

$\Rightarrow acx^2 + b(a + c)x + b^2 + (a - c)^2 = 0$

$\Rightarrow \quad acx^2 + (ab + bc)x + b^2$
$\qquad\qquad + (a - c)^2 = 0$

63. The value of $x^2 - 4x + 11$ can never be less than

(a) 7 　(b) 8 　(c) 11 　(d) 22

⊙ *(a)* Let $f(x) = x^2 - 4x + 11$

Minimum value of $x = \dfrac{4ac - b^2}{4a}$

Here, $a = 1, b = -4, c = 11$

$\therefore$ Minimum value of $x = \dfrac{4 \times 1 \times 11 - (-4)^2}{4 \times 1}$

$= \dfrac{44 - 16}{4} = \dfrac{28}{4} = 7$

So, the value of expression can never be less than 7.

64. The expression $2x^3 + x^2 - 2x - 1$ is divisible by

(a) $x + 2$　(b) $2x + 1$ (c) $x - 2$　(d) $2x - 1$

⊙ *(b)* Let $f(x) = 2x^3 + x^2 - 2x - 1$

$\qquad = x^2(2x + 1) - 1(2x + 1)$

$\qquad = (2x + 1)(x^2 - 1)$

$\qquad = (2x + 1)(x + 1)(x - 1)$

So, expression is divisible by $(2x + 1)$.

65. If $x + y = 5$, $y + z = 10$ and $z + x = 15$, then which one of the following is correct?

(a) $z > x > y$ 　　(b) $z > y > x$
(c) $x > y > z$ 　　(d) $x > z > y$

⊙ *(a)* Given equations

$\qquad\qquad x + y = 5 \qquad\qquad$ …(i)
$\qquad\qquad y + z = 10 \qquad\quad$ …(ii)

and $\qquad\qquad z + x = 15 \qquad\quad$ …(iii)

On solving Eqs. (i), (ii) and (iii), we get

$\qquad\qquad x = 5, y = 0 \text{ and } z = 10$

$\therefore \qquad\qquad z > x > y$

66. If the roots of the equation
$(a^2 - bc)\, x^2 + 2\,(b^2 - ac)\, x$
$+ (c^2 - ab) = 0$ are equal, where
$b \neq 0$, then which one of the following is correct?

(a) $a + b + c = abc$
(b) $a^2 + b^2 + c^2 = 0$
(c) $a^3 + b^3 + c^3 = 0$
(d) $a^3 + b^3 + c^3 = 3abc$

⊙ *(d)* Given equation is
$\qquad (a^2 - bc)x^2 + 2(b^2 - ac)x$
$\qquad\qquad\qquad\qquad + (c^2 - ab) = 0$

Since, the given roots are equal.

$\therefore \quad D = 0$

$\Rightarrow B^2 - 4AC = 0$

i.e. $\quad [2(b^2 - ac)]^2 - 4(a^2 - bc)$
$\qquad\qquad\qquad\qquad (c^2 - ab) = 0$

$\qquad [\because (a - b)^2 = a^2 + b^2 - 2ab]$

$\Rightarrow \quad 4(b^4 + a^2 c^2 - 2ab^2 c)$
$\qquad -4(a^2 c^2 - bc^3 - a^3 b + ab^2 c) = 0$

$\Rightarrow \quad 4b^4 + 4a^2 c^2 - 8ab^2 c - 4a^2 c^2$
$\qquad\qquad + 4bc^3 + 4a^3 b - 4ab^2 c = 0$

$\Rightarrow \quad 4b^4 - 12ab^2 c + 4bc^3 + 4a^3 b = 0$

$\Rightarrow \quad b^3 + c^3 + a^3 - 3abc = 0$

$\therefore \qquad\qquad a^3 + b^3 + c^3 = 3abc$

67. If the roots of the equation
$Ax^2 + Bx + C = 0$ are -1 and 1,
then which one of the following is correct?

(a) A and C are both zero
(b) A and B are both positive
(c) A and C are both negative
(d) A and C are of opposite signs

⊙ *(d)* Given equation is
$\qquad\qquad Ax^2 + Bx + C = 0 \qquad$ …(i)

Since, the given roots are -1 and 1.

$\therefore$ Sum of roots $= -1 + 1 = 0$

and product of roots $= 1 \times (-1) = -1$

Standard equation is

$x^2 -$ (Sum of roots)$x +$ Product of roots $= 0$

On comparing with above equation from Eq. (i), we get

$\qquad\qquad x^2 + \dfrac{B}{A}x + \dfrac{C}{A} = 0$

$\therefore \qquad\qquad \dfrac{C}{A} =$ Product of roots

$\Rightarrow \qquad\qquad C = -A$

So, A and C are of opposite signs.

SET THEORY

1. If $X = \{a, \{b\}, c\}$

$Y = \{\{a\}, b, c\}$ and

$Z = \{a, b, \{c\}\}$,

then $(X \cap Y) \cap Z$ equals to

(a) $\{a, b, c\}$ (b) $\{\{a\}, \{b\}, \{c\}\}$

(c) $\{\phi\}$ (d) ϕ

⊙ **(d)** Given, $X = \{a, \{b\}, c\}$

$Y = \{\{a\}, b, c\}$

$Z = \{a, b, \{c\}\}$

Then, $X \cap Y = \{c\}$

$(X \cap Y) \cap Z = \{c\} \cap \{a, b, \{c\}\} = \phi$

Directions (Q. Nos. 2-5) *Consider the following for the next 04 (four) items that follow :*

In an examination of class XII, 55% students passed in Biology, 62% passed in Physics, 60% passed in Chemistry, 25% passed in Physics and Biology, 30% passed in Physics and Chemistry, 28% passed in Biology and Chemistry. Only 2% failed in all the subjects.

2. What percentage of students passed in all the three subjects?

(a) 6 (b) 5

(c) 4 (d) 3

⊙ **(c)** Given, $n(B) = 55\%$

$n(P) = 62\%$

$n(C) = 60\%$

Here, B = Biology, P = Physics and C = Chemistry

$n(P \cap B) = 25\%$

$n(P \cap C) = 30\%$

$n(B \cap C) = 28\%$

$n(P \cup B \cup C)' = 2\%$

$\therefore n(P \cup B \cup C) = 100\% - n(P \cup B \cup C)'$

$= 100\% - 2\% = 98\%$

$n(P \cup B \cup C) = n(B) + n(P)$
$+ n(C) - n(P \cap B)$
$- n(P \cap C) - n(B \cap C) - n(P \cap B \cap C)$

$\Rightarrow 98 = 55 + 62 + 60 - 25 - 28 - 30$
$+ n(P \cap B \cap C)$

$\Rightarrow n(P \cap B \cap C) = 4\%$

∵ Percentage of student passed in all three subjects is 4%

3. What percentage of students passed in exactly one subject?

(a) 21 (b) 23 (c) 25 (d) 27

⊙ **(b)** Percentage of students passed in exactly one subject

$= n(B) + n(P) + n(C) - 2\{n(P \cap B)$
$+ n(B \cap C) + n(P \cap C)\}$
$+ 3\{n(P \cap B \cap C)\}$

$= 55 + 62 + 60 - 2(25 + 28 + 30) + 3(4)$

$= 177 - 166 + 12 = 23\%$

4. If the number of students in 360, then how many students passed in atleast two subjects?

(a) 270 (b) 263 (c) 265 (d) 260

⊙ **(a)** Percentage of students passed in exactly two subject

$= n(P \cup B) + n(P \cap C) + n(B \cap C)$
$- 3\{n(P \cap B \cap C)\}$

$= 25 + 28 + 30 - 12 = 71\%$

Percentage of passed atleast two subjects = 71% + 4% = 75%

∴ Number of students passed

$= \dfrac{75}{100} \times 360 = 270$

5. What is the ratio of number of students who passed in both Physics and Chemistry to number of students who passed in both Biology and Physics but not Chemistry?

(a) 7 : 10 (b) 10 : 7 (c) 9 : 7 (d) 7 : 9

⊙ **(b)** Percentage of students passed in both Physics and Chemistry = 30%

Percentage of students passed in both Biology and Physics but not Chemistry

$= (25 - 4)\%$

$= 21\%$

∴ Ratio $= \dfrac{30\%}{21\%} = 10 : 7$

6. Which one of the following is a correct statement?

(a) $\{x : x + 5 = 5\} = \phi$

(b) $\{x : x + 5 = 5\} = \{0\}$

(c) $\{x : x + 5 = 5\} = 0$

(d) $\{x : x + 5 = 5\} = \{\phi\}$

⊙ **(b)** Clearly, $x + 5 = 5$

$\Rightarrow x = 5 - 5 = 0$

$\{x : x + 5 = 5\} = \{0\}$

7. If $A = \{x : x$ is a multiple of 7$\}$

$B = \{x : x$ is a multiple of 5$\}$ and

$C = \{x : x$ is a multiple of 35$\}$ then which one of the following is a null set?

(a) $(A - B) \cup C$

(b) $(A - B) - C$

(c) $(A \cap B) \cap C$

(d) $(A \cap B) - C$

⊙ **(d)** We have,

$A = \{x : x$ is a multiple of 7$\}$

$B = \{x : x$ is a multiple of 5$\}$

$C = \{x : x$ is a multiple of 35$\}$

$\therefore A \cap B = \{x : x$ is a multiple of 7 and 5$\}$
$= \{x : x$ is a multiple of 35$\} = C$

$\therefore (A \cap B) - C = C - C = \phi$

2016 (II)

8. Let $A = \{7, 8, 9, 10, 11, 12\}$ and $B = \{7, 10, 14, 15\}$. What is the number of elements in $(A - B)$ and $(B - A)$, respectively?

(a) 2 and 4   (b) 4 and 2
(c) 2 and 2   (d) 4 and 4

⊘ *(b)* Given, $A = \{7, 8, 9, 10, 11, 12\}$

and $\qquad B = \{7, 10, 14, 15\}$

$\qquad A - B = \{8, 9, 11, 12\}$

∴ $\quad n(A - B) = 4$

$\qquad B - A = \{14, 15\}$

∴ $\quad n(B - A) = 2$

2016 (I)

9. In a gathering of 100 people, 70 of them can speak Hindi, 60 can speak English and 30 can speak French. Further, 30 of them can speak both Hindi and English, 20 can speak both Hindi and French. If x is the number of people who can speak both English and French, then which one of the following is correct? (Assume that everyone can speak atleast one of the three languages)

(a) $9 < x \leq 30$
(b) $0 \leq x < 8$
(c) $x = 9$
(d) $x = 8$

⊘ *(b)* Let A, B and C be the number of people who can speak Hindi, English and French respectively.

Then, $\quad n(A) = 70, n(B) = 60, n(C) = 30,$

$\qquad n(A \cap B) = 30, n(A \cap C) = 20$

and $n(B \cap C) = x$

Venn diagram of the above data is as follows
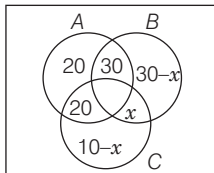
It is clear from the above Venn diagram that $(10 - x)$ can speak French only and $(30 - x)$ can speak English only. We know that the value of x is always positive.

Hence, from the options, the possible value of x is $0 \leq x < 8$.

2015 (II)

10. Let A denotes the set of quadrilaterals having two diagonals equal and bisecting each other. Let B denotes the set of quadrilaterals having diagonals bisecting each other at $90°$. Then, $A \cap B$ denotes

(a) the set of parallelograms
(b) the set of rhombuses
(c) the set of squares
(d) the set of rectangles

⊘ *(c)* A = diagonals equal and bisecting each other.

B = diagonals bisecting each other at $90°$.

A is square or rectangle. and B diagonal bisecting each other at rightangle.

So, $A \cap B$ = the set of squares.

2015 (I)

11. Out of 105 students taking an examination English and Mathematics, 80 students pass in English, 75 students pass in Mathematics 10 students fail in both the subjects. How many students pass in only one subject?

(a) 26   (b) 30
(c) 35   (d) 45

⊘ *(d)* Number of students failing in Mathematics

$\qquad = 105 - 75 = 30$

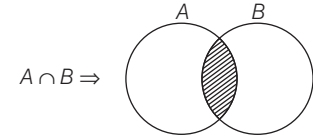Number of students failing in English

$\qquad = 105 - 80 = 25$

∴ Number of students failing in 1 subject

$\qquad = (25 + 30) - 10 = 45$

12. If A and B are any two non-empty subsets of a set E, then what is $A \cup (A \cap B)$ equal to?

(a) $A \cap B$ (b) $A \cup B$
(c) A (d) B

⊘ *(c)* Since, A and B are non-empty subsets of E.

∴ $A \cup (A \cap B) = A \cup$ (Shaded portion)
$\qquad\qquad\qquad = A$

13. If A is a non-empty subset of a set E, then what is $E \cup (A \cap \phi) - (A - \phi)$ equal to?

(a) A
(b) Complement of A
(c) ϕ
(d) E

⊘ *(d)* $E \cup [(A \cap \phi) - (A - \phi)]$

$\qquad E \cup A = E$

$\qquad\qquad [∵ (A \cap \phi) = \phi$ and $(A - \phi) = A]$

14. Let A and B be finite non-empty sets with the number of elements in $A = m$ and number of elements in $B = n$. Let $m > n$. If for some integer $k \geq 1$, the number of non-empty subsets of $A = 2^k$ + the number of non-empty subsets of B_1 then which one of the following is correct?

(a) $m = n + 2$
(b) $m = n + 1$
(c) $m = n + p$, for some odd prime number p
(d) $m = n + t$, for some composite number t

⊘ *(b)* According to the question,

$\qquad 2^m - 1 = 2^k + 2^n - 1$

$\Rightarrow \qquad 2^m = 2^k + 2^n$

By taking option (b), $m = n + 1$

∴ $\qquad 2^{n+1} = 2^k + 2^n$

$\Rightarrow \quad 2 \cdot 2^n = 2^k + 2^n$ $[∵ a^{m+n} = a^m \times a^n]$

$\Rightarrow 2^n(2 - 1) = 2^k \Rightarrow 2^n = 2^k$

∴ $n = k$, which is possible.

17

LAW OF INDICES

2019 (II)

1. If 10^n divides $6^{23} \times 75^9 \times 105^2$, then what is the largest value of n?

  (a) 20   (b) 22
  (c) 23   (d) 28

⊙ **(a)** Let $x = 6^{23} \times 75^9 \times 105^2$

We can also write this expression as
$x = 2^{23} \times 3^{23} \times 5^{18} \times 3^9 \times 5^2 \times 3^2 \times 7^2$
$ = 2^{23} \times 3^{34} \times 7^2 \times 5^{20}$

If 10^n divides this expression, then n must be equal to the number of zero in the expression, from above expression we can conclude that there will be 20 number of zero ($5^{20} \times 2^{20}$) because only 5 and 2 make zero.

So, $n = 20$

2019 (I)

2. What is the largest value of n such that 10^n divides the product
$2^5 \times 3^3 \times 4^8 \times 5^3 \times 6^7 \times 7^6 \times 8^{12}$
$ \times 9^9 \times 10^6 \times 15^{12} \times 20^{14}$
$ \times 22^{11} \times 25^{15}$?

  (a) 65   (b) 55
  (c) 50   (d) 45

⊙ **(a)** $2^5 \times 3^3 \times 4^8 \times 5^3 \times 6^7 \times 7^6 \times 8^{12} \times 9^9$
$ \times 10^6 \times 15^{12} \times 20^{14} \times 22^{11} \times 25^{15}$

10 makes by $= (2 \times 5)$

Find the number of five (5) in the product
$ 5^3 \times 10^6 \times 15^{12} \times 20^{14} \times 25^{15}$

Number of 5
$ 3 + 6 + 12 + 14 + 30 = 65$

[∵ $(10)^6 = (2 \times 5)^6$ 6 five in this product]
10^{65} will divide the product $n = 65$

2018 (II) — left column

3. If $3^x = 4^y = 12^z$, then z is equal to

  (a) $x\,y$ (b) $x + y$
  (c) $\dfrac{x\,y}{x + y}$ (d) $4x + 3y$

⊙ **(c)** $3^x = 4^y = 12^z = k$ (let)

$ 3 = k^{\frac{1}{x}}$ …(i)
$ 4 = k^{1/y}$ …(ii)
$ 12 = k^{1/z}$ …(iii)

∵ $ 3 \times 4 = 12$
$ k^{1/x} \times k^{1/y} = k^{1/z}$
$ k^{\frac{1}{x} + \frac{1}{y}} = k^{\frac{1}{z}}$

[by Eqs. (i), (ii) and (iii)]

⇒ $ \dfrac{1}{x} + \dfrac{1}{y} = \dfrac{1}{z}$

∴ $ z = \dfrac{x\,y}{x + y}$

Option (c) is correct.

2018 (II)

4. If $x = y^a$, $y = z^b$ and $z = x^c$, then the value of abc is

  (a) 1   (b) 2
  (c) −1   (d) 0

⊙ **(a)** Given, $x = y^a$
Or, $x = (z^b)^a$ (as $y = z^b$)
Or, $x = ((x^c)^b)^a$ (as $z = x^c$)
Or, $x = x^{abc}$
Or, $abc = 1$ [∵ on compairing]

5. If $a^x = b^y = c^z$ and $abc = 1$, then the value of $\dfrac{1}{x} + \dfrac{1}{y} + \dfrac{1}{z}$ will be equal to

  (a) −1   (b) 0
  (c) 1   (d) 3

⊙ **(b)** Given, $a^x = b^y = c^z = k$ [let]
and $abc = 1$
Now, $a^x = k$ or $a = k^{1/x}$
Similarly, $b = k^{1/y}$ and $c = k^{1/z}$
Now, $abc = 1$ or $k^{1/x} . k^{1/y} . k^{1/z} = 1$

or $k^{\left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z}\right)} = 1$

[∵ $a^m \times a^n \times a^0 = a$]

or $k^{\left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z}\right)} = k^0$

[∵ $a^0 = 1^{m+n}$]

or $\dfrac{1}{x} + \dfrac{1}{y} + \dfrac{1}{z} = 0$

6. If $a = xy^{p-1}$, $b = yz^{q-1}$, $c = zx^{r-1}$, then $a^{q-r} \cdot b^{r-p} c^{\,p-q}$ is equal to

  (a) abc (b) xyz
  (c) 0   (d) None of these

⊙ **(d)** We have,
$ a = xy^{p-1}, b = yz^{q-1}, c = zx^{r-1}$
Now, $a^{q-r} b^{r-p} c^{p-q}$
$ = (xy^{p-1})^{q-r} \ (yz^{q-1})^{r-p} (zx^{r-1})^{p-q}$
$= x^{q-r} y^{(p-1)(q-r)} \cdot y^{r-p} z^{(q-1)(r-p)}$
$ \cdot z^{p-q} x^{(r-1)(p-q)}$
$= x^{(q-r)+(r-1)(p-q)} \cdot y^{(p-1)(q-r)+r-p}$
$ \cdot z^{(q-1)(r-p)+p-q}$
$= x^{q-r+pr-qr-p+q} \cdot y^{pq-pr-q+r-p}$
$ \cdot z^{q\,r-pq-r+p+p-q}$
$= x^{2q-p+r(p-q-1)} \cdot y^{2r-q+p(q-r-1)}$
$ \cdot z^{2p-r+q(r-p-1)}$

2018 (I)

7. What is the largest power of 10 that divides the product
$1 \times 2 \times 3 \times 4 \times \ldots \times 23 \times 24 \times 25$?

  (a) 2   (b) 4
  (c) 5   (d) None of these

⊙ **(d)** Product of
$1 \times 2 \times 3 \times 4 \times \ldots \times 23 \times 24 \times 25$

Maximum power of 10 that divides the product = $(2 \times 5), (10), (12 \times 15), (20),$

$$(4 \times 25)$$

Hence, maximum power of 10 that divides the product is 6.

8. If $x = y^{\frac{1}{a}}$, $y = z^{\frac{1}{b}}$ and $z = x^{\frac{1}{c}}$ where $x \neq 1$, $y \neq 1, z \neq 1,$ then what is the value of abc?

(a) -1 (b) 1
(c) 0   (d) 3

⊘ **(b)** Given, $x = y^{1/a}$ …(i)
                $y = z^{1/b}$ … (ii)
and $z = x^{1/c}$ …(iii)
Now, $x = y^{1/a}$ [from Eq.(i)]
$\Rightarrow$ $x = (z^{1/b})^{1/a}$ [from Eq.(ii)]
$\Rightarrow$ $x = ((x^{1/c})^{1/b})^{1/a}$ [from Eq. (iii)]

$\Rightarrow$ $x = x^{\frac{1}{abc}}$

$\Rightarrow$ $\dfrac{1}{abc} = 1$ [∵ on compairing]

or $abc = 1$

9. If $2b = a + c$ and $y^2 = xz,$ then what is $x^{b-c} y^{c-a} z^{a-b}$ equal to?

(a) 3   (b) 2
(c) 1   (d) -1

⊘ **(c)** Given, $2b = a + c$ …(i)

Now, $x^{b-c} y^{c-a} z^{a-b}$

$= x^{b-c} \times ((x z)^{1/2})^{c-a} \times z^{a-b}$

$$[\because y = (x z)^{1/2}]$$

$= x^{b-c} \times (x z)^{\left(\frac{c-a}{2}\right)} \times z^{a-b}$

$= x^{b-c} \times (x)^{\left(\frac{c-a}{2}\right)} \times z^{\left(\frac{c-a}{2}\right)} \times z^{a-b}$

$= x^{\left(\frac{2b-2c+c-a}{2}\right)} \times z^{\left(\frac{c-a+2a-2b}{2}\right)}$

$= x^{\frac{2b-a-c}{2}} \times z^{\left(\frac{-2b+a+c}{2}\right)}$

$= x^{\frac{2b-(a+c)}{2}} \times z^{\frac{(a+c)-2b}{2}}$

$= x^{\frac{2b-2b}{2}} \times z^{\frac{2b-2b}{2}}$ [∵ $a + c = 2b$]

$= x° \times y° = 1 \times 1 = 1$ [∵ $a^0 = 1$]

2017 (I)

10. If $x = t^{\frac{1}{t-1}}$ and $y = t^{\frac{t}{t-1}}, t > 0, t \neq 1$ then what is the relation between x and y ?

(a) $y^x = x^{1/y}$ (b) $x^{1/y} = y^{1/x}$
(c) $x^y = y^x$ (d) $x^y = y^{1/x}$

⊘ **(c)** We have,
     $x = t^{\frac{1}{t-1}}$ and $y = t^{\frac{t}{t-1}}, t > 0, t \neq 1$

Now, $y = \left[t^{\left(\frac{1}{t-1}\right)}\right]^t = x^t$ …(i)

Again $\dfrac{y}{x} = \dfrac{t^{\frac{t}{t-1}}}{t^{\frac{1}{t-1}}} = t^{\frac{t}{t-1} - \frac{1}{t-1}} = t^{\frac{t-1}{t-1}} = t$

$\Rightarrow$ $\dfrac{y}{x} = t$ …(ii)

From Eqs. (i) and (ii), we get
           $y = x^{y/x}$
$\therefore$ $y^x = x^y$

11. If $9^x 3^y = 2187$ and $2^{3x} 2^{2y} - 4^{xy} = 0$, then what can be the value of $(x + y)$?

(a) 1   (b) 3   (c) 5   (d) 7

⊘ **(c)** We have, $9^x . 3^y = 2187$

$\Rightarrow$ $(3^2)^x . 3^y = 2187$
$\Rightarrow$ $3^{2x+y} = 3^7$
$\Rightarrow$ $2x + y = 7$ …(i)
Again,
      $2^{3x} . 2^{2y} - 4^{xy} = 0$
$\Rightarrow$ $2^{3x} . 2^{2y} = 4^{xy}$
$\Rightarrow$ $2^{3x+2y} = (2^2)^{xy}$
$\Rightarrow$ $3x + 2y = 2xy$ …(ii)
From Eqs. (i) and (ii)
     $3x + 2(7 - 2x) = 2x(7 - 2x)$
$\Rightarrow$ $3x + 14 - 4x = 14x - 4x^2$
$\Rightarrow$ $4x^2 - 15x + 14 = 0$
$\Rightarrow$ $(x - 2)(4x - 7) = 0$
$\Rightarrow$ $x = 2, \dfrac{7}{4}$

$\therefore$ $y = 3, \dfrac{7}{2}$

$\therefore$ $x + y = 5$ or $\dfrac{21}{4}$

2016 (I)

12. If $4^x 2^y = 128$ and $3^{3x} 3^{2y} - 9^{xy} = 0,$ then the value of $x + y$ can be equal to

(a) 7   (b) 5   (c) 3   (d) 1

⊘ **(b)** Given, $4^x 2^y = 128 \Rightarrow 2^{2x+y} = 2^7$

$\Rightarrow$ $2x + y = 7$ …(i)
and $3^{3x} 3^{2y} - 9^{xy} = 0$
$\Rightarrow$ $3^{3x+2y} = 3^{2xy}$
$\Rightarrow$ $3x + 2y = 2xy$ …(ii)
On solving Eqs. (i) and (ii), we get
      $x = 2$ and $y = 3$
$\therefore$ $x + y = 2 + 3 = 5$

2015 (I)

13. What are the possible solutions for x of the equation $x^{\sqrt{x}} = \sqrt[n]{x^x},$ where x and n are positive integers?

(a) $0, n^2$ (b) $1, n$ (c) n, n^2 (d) $1, n^2$

⊘ **(a)** Given, $x^{\sqrt{x}} = \sqrt[n]{x^x},$ where x and r are positive integers.
On taking log both sides, we get
      $\log x^{\sqrt{x}} = \log[\sqrt[n]{x^x}]$
$\Rightarrow$ $\sqrt{x}\log x = \log(x^x)^{1/n} = \log x^{x/n}$
$\Rightarrow$ $\sqrt{x}\log x = \dfrac{x}{n}\log x$

$\Rightarrow$ $\sqrt{x}\log x - \dfrac{x}{n}\log x = 0$

$\Rightarrow$ $\log x\left[\sqrt{x} - \dfrac{x}{n}\right] = 0$

$\because$ $\log x \neq 0$

$\therefore$ $\sqrt{x} - \dfrac{x}{n} = 0$

$\Rightarrow$ $\sqrt{x} = \dfrac{x}{n} \Rightarrow \dfrac{x}{\sqrt{x}} = n$

On squaring both sides, we get
        $\dfrac{x^2}{x} = n^2$
$\Rightarrow$ $x^2 - n^2 x = 0$
$\Rightarrow$ $x(x - n^2) = 0$
$\therefore$ $x = 0, x = n^2$
Hence, the possible solution of x is $(0, n^2)$.

TRIGONOMETRIC RATIOS AND TRIGONOMETRIC IDENTITIES

1. If $\cos^2 x + \cos x = 1$, then what is the value of $\sin^{12} x + 3\sin^{10} x + 3\sin^8 x + \sin^6 x$?

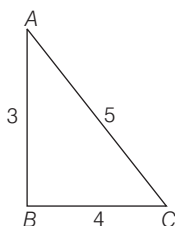(a) 1   (b) 2   (c) 4   (d) 8

⊘ **(a)** Given, $\cos^2 x + \cos x = 1$

$$\cos x = 1 - \cos^2 x$$
$$\cos x = \sin^2 x$$

$\Rightarrow \sin^{12} x + 3\sin^{10} x + 3\sin^8 x + \sin^6 x$

$\Rightarrow (\sin^4 x)^3 + 3(\sin^4)^2 \sin^2 x + 3(\sin^2 x)^2 \cdot \sin^4 x + (\sin^2 x)^3$

$[\because (a + b)^3 = a^3 + b^3 + 3a^2b + 3b^2a)]$

$\Rightarrow (\sin^4 x + \sin^2 x)^3$

$[\because \sin^2 x = \cos x, \sin^4 x = \cos^2 x]$

$\Rightarrow (\cos^2 x + \cos x)^3$

$[\text{given}, \cos^2 x + \cos x = 1]$

$\Rightarrow (1)^3 = 1$

Option (a) is correct.

2. If $0 < \theta < 90°$, $\sin \theta = 3/5$ and $x = \cot \theta$, then what is the value of $1 + 3x + 9x^2 + 27x^3 + 81x^4 + 243x^5$?

(a) 941   (b) 1000   (c) 1220   (d) 1365

⊘ **(d)** Given, $\sin \theta = \dfrac{3}{5}$

A

3   5

B   4   C

In a right angle triangle,

$$\sin \theta = \frac{\text{Perpendicular}}{\text{Hypotenuse}}$$

$$\frac{P}{H} = \frac{3}{5}$$

Using Pythagoras theorem,

$$AC^2 = AB^2 + BC^2$$
$$5^2 = 3^2 + BC^2$$
$$\Rightarrow BC^2 = 5^2 - 3^2 \Rightarrow BC = 4$$

$$\cot \theta = \frac{\text{Base}}{\text{Perpendicular}} = \frac{BC}{AB}$$

$$\cot \theta = \frac{4}{3} \Rightarrow x = \frac{4}{3} \text{ [given, } \cot \theta = x]$$

$\Rightarrow 1 + 3x + 9x^2 + 27x^3 + 81x^4 + 243x^5$

$\Rightarrow 1 + 3x + 9x^2 + 27x^3(1 + 3x + 9x^2)$

$\Rightarrow (1 + 3x + 9x^2)(1 + 27x^3)$

Now, on putting $x = \dfrac{4}{3}$

$$\left[1 + 3 \times \frac{4}{3} + 9 \times \left(\frac{4}{3}\right)^2\right]\left[1 + 27 \times \left(\frac{4}{3}\right)^3\right]$$

$$\Rightarrow \left(1 + 3 \times \frac{4}{3} + 9 \times \frac{16}{9}\right)\left(1 + 27 \times \frac{64}{27}\right)$$

$\Rightarrow (1 + 4 + 16)(1 + 64) = 21 \times 65 = 1365$

Option (d) is correct.

3. What is the value of $\dfrac{\sin 19°}{\cos 71°} + \dfrac{\cos 73°}{\sin 17°}$?

(a) 0   (b) 1   (c) 2   (d) 4

⊘ **(c)** Given, $\dfrac{\sin 19°}{\cos 71°} + \dfrac{\cos 73°}{\sin 17°}$

$$= \frac{\sin 19°}{\cos(90 - 19°)} + \frac{\cos 73°}{\sin(90 - 73°)}$$

$$= \frac{\sin 19°}{\sin 19°} + \frac{\cos 73°}{\cos 73°} = 1 + 1 = 2$$

$$\begin{bmatrix}\because \sin(90° - \theta) = \cos\theta, \\ \cos(90° - \theta) = \sin\theta\end{bmatrix}$$

Option (c) is correct.

4. If $\tan x = 1, 0 < x < 90°$, then what is the value of $2\sin x \cos x$?

(a) $\dfrac{1}{2}$ (b) 1

(c) $\dfrac{\sqrt{3}}{2}$ (d) $\sqrt{3}$

⊘ **(b)** Given, $\tan x = 1, 0 < x < 90°$

$$x = \tan^{-1}(1)$$
$$x = \tan^{-1}(\tan 45°)$$
$$\therefore \qquad x = 45°$$

$$= 2\sin x \cos x$$
$$= 2\sin 45° \cos 45°$$
$$= 2 \times \frac{1}{\sqrt{2}} \times \frac{1}{\sqrt{2}} = 1$$

Option (b) is correct.

5. What is the value of $\sin 46° \cos 44° + \cos 46° \sin 44°$?

(a) $\sin 2°$ (b) 0   (c) 1   (d) 2

⊘ **(c)** Given, $\sin 46° \cos 44° + \cos 46° \sin 44°$

$$= \sin 46° \cos(90° - 46°) + \cos 46° \sin(90° - 46°)$$

$[\because \sin(90°-\theta) = \cos\theta, \cos(90°-\theta) = \sin\theta]$

$$= \sin 46° \sin 46° + \cos 46° \cos 46°$$
$$= \sin^2 46° + \cos^2 46° = 1$$

$[\because \sin^2\theta + \cos^2\theta = 1]$

Option (c) is correct.

Alternate Method

$\sin 46° \cos 44° + \cos 46° \sin 44°$

$= \sin(46° + 44°)$

$[\because \sin A \cos B + \cos A \sin B = \sin(A + B)]$

$= \sin 90°$

$= 1$

6. Suppose $0 < \theta < 90°$, then for every θ, $4\sin^2\theta + 1$ is greater than or equal to

(a) 2   (b) $4\sin\theta$
(c) $4\cos\theta$ (d) $4\tan\theta$

⟩ *(a)* $4\sin^2\theta + 1$ $0 < \theta < 90°$

Let $\theta = 30°$ $\theta = 45°$
$= 4\sin^2 30° + 1$ $= 4\sin^2 45° + 1$
$= 4 \times \dfrac{1}{4} + 1 = 2$ $= 4 \times \dfrac{1}{2} + 1 = 3$
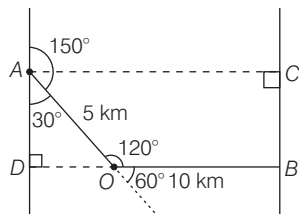
Then, this equation greater than or equal to 2.

Option (a) is correct.

7. What is the value of $\tan 1° \tan 2° \tan 3° \ldots \tan 89°$?

(a) 0   (b) 1
(c) 2   (d) ∞

⟩ *(b)* Given, $\tan 1° \tan 2° \tan 3° \ldots \tan 89°$

$= (\tan 1° \tan 89°)(\tan 2° \tan 88°)\ldots$
         $\ldots(\tan 44° \tan 45°)\tan 45°$
$= 1 \times 1 \ldots 1 \times 1$ [$\because \tan\theta\tan(90° - \theta) = 1$]
$= 1$ [$\because \tan 45° = 1$]

Option (b) is correct.

8. There are two parallel streets each directed North to South. A person in the first street travelling from South to North wishes to take the second street which is on his right side. At some place, he makes a 150° turn to the right and he travels for 15 min at the speed of 20 km/h. After that he takes a left turn of 60° and travels for 20 min at the speed of 30 km/h in order to meet the second street. What is the distance between the two streets?

(a) 7.5 km   (b) 10.5 km
(c) 12.5 km   (d) 15 km

⟩ *(c)* There are two parallel streets.

AO = travells for 15 min at the speed of 20 km/h

Distance = speed $\times$ time
      $= \dfrac{15}{60} \times 20 = 5$ km

OB = travells for 20 min at the speed of 30 km/h
      $= \dfrac{20}{60} \times 30 = 10$ km

$\triangle ADO$, $\angle DAO = 180° - 150° = 30°$

$\sin 30° = \dfrac{OD}{OA} = \dfrac{OD}{5}$

$\dfrac{1}{2} = \dfrac{OD}{5}$

$OD = 2.5$ km

The distance between the two streets.
    $DB = DO + OB$
        $= 2.5 + 10 = 12.5$ km

Option (c) is correct.

9. If $3\tan\theta = \cot\theta$ where $0 \le \theta < \dfrac{\pi}{2}$, then what is the value of θ?

(a) $\dfrac{\pi}{6}$ (b) $\dfrac{\pi}{4}$ (c) $\dfrac{\pi}{3}$ (d) $\dfrac{\pi}{2}$

⟩ *(a)* Given, $3\tan\theta = \cot\theta$ $0 \le \theta < \dfrac{\pi}{2}$

$3\tan\theta = \dfrac{1}{\tan\theta}$ $\left[\because \cot\theta = \dfrac{1}{\tan\theta}\right]$

$\tan^2\theta = \dfrac{1}{3}$

$\tan\theta = \dfrac{1}{\sqrt{3}}$

[$\tan\theta$, value positive in first quadrant]

$\theta = \tan^{-1}\left(\dfrac{1}{\sqrt{3}}\right) = \tan^{-1}(\tan 30°)$

$\theta = 30° \Rightarrow \theta = \dfrac{\pi}{6}$

Option (a) is correct.

10. What is the value of $\sin^2 25° + \sin^2 65°$?

(a) 0   (b) 1   (c) 2   (d) 4

(b) Given, $\sin^2 25° + \sin^2 65°$
     $= \sin^2 25° + \sin^2(90° - 25°)$
     $= \sin^2 25° + \cos^2 25°$
            [$\because \sin(90° - \theta) = \cos\theta$]
     $= 1$ [$\because \sin^2\theta + \cos^2\theta = 1$]

Option (b) is correct.

11. What is the value of $\sin^6\theta + \cos^6\theta + 3\sin^2\theta\cos^2\theta - 1$?

(a) 0   (b) 1   (c) 2   (d) 4

⟩ *(a)* Given,

$\sin^6\theta + \cos^6\theta + 3\sin^2\theta\cos^2\theta - 1$

$= (\sin^2\theta)^3 + (\cos^2\theta)^3 + 3\sin^2\theta\cos^2\theta$
                  $(\sin^2\theta + \cos^2\theta) - 1$

   [$\because (a + b)^3 = a^3 + b^3 + 3ab(a + b)$]

$= (\sin^2\theta + \cos^2\theta)^3 - 1$

            [$\because \sin^2\theta + \cos^2\theta = 1$]

$= (1)^3 - 1 = 0$

Option (a) is correct.

12. Consider the following for real numbers α, β, γ and δ

1. $\sec\alpha = 1/4$ 2. $\tan\beta = 20$
3. $\operatorname{cosec}\gamma = 1/2$ 4. $\cos\delta = 2$

How many of the above statements are not possible?

(a) One   (b) Two
(c) Three   (d) Four

⟩ *(c)* α, β, γ and δ are real numbers

1. $\sec\alpha = 1/4$ [$\because$ Value of $\sec\alpha$ lies between $(-\infty, -1] \cup [1, \infty)$]
It is not possible.
2. $\tan\beta = 20$ [$\because$ value of $\tan\beta$ lies between $[-\infty, \infty]$]
It is possible.
3. $\operatorname{cosec}\gamma = 1/2$ [$\because$ value of $\operatorname{cosec}\gamma$ lies between $(-\infty, -1] \cup [1, \infty)$]
It is not possible.
4. $\cos\delta = 2$ [$\because$ value of $\cos\delta$ lies between $[-1, 1]$]
It is not possible.
Three statements are not correct.
Then,
Option (c) is correct.

2018 (II)

13. If $\cos\theta = \dfrac{1}{\sqrt{5}}$, where $0 < \theta < \dfrac{\pi}{2}$, then $\dfrac{2\tan\theta}{1 - \tan^2\theta}$ is equal to

(a) $4/3$ (b) $-4/3$
(c) $1/3$ (d) $-2/3$

⟩ *(b)* We have,

$\cos\theta = \dfrac{1}{\sqrt{5}}$

$\Rightarrow$ $\sec\theta = \sqrt{5}$

$\Rightarrow$ $\tan\theta = \sqrt{\sec^2\theta - 1} = \sqrt{5 - 1} = 2$

            $\left[\because \sec\theta = \dfrac{1}{\cos\theta}\right]$

$\therefore$ $\dfrac{2\tan\theta}{1 - \tan^2\theta} = \dfrac{2(2)}{1 - (2)^2}$

        $= \dfrac{4}{1 - 4} = \dfrac{-4}{3}$

Option (b) is correct.

14. If $0 < \theta < 90°$, $0 < \phi < 90°$ and $\cos\theta < \cos\phi$, then which one of the following is correct ?

(a) $\theta < \phi$
(b) $\theta > \phi$
(c) $\theta + \phi = 90°$
(d) No conclusion can be drawn

⊘ *(b)* $0 < \theta < 90°$, $0 < \phi < 90°$

and $\cos\theta < \cos\phi$

$\theta > \phi$

[$\cos x$ is decreasing function in $\left[0, \dfrac{\pi}{2}\right]$]

Option (b) is correct.

15. Let $\sin(A + B) = \dfrac{\sqrt{3}}{2}$ and

$\cos B = \dfrac{\sqrt{3}}{2}$, where A, B are acute

angles. What is $\tan(2A - B)$ equal to ?

(a) $1/2$ (b) $\sqrt{3}$

(c) $\dfrac{1}{\sqrt{3}}$ (d) 1

⊘ *(c)* We have,

$$\sin(A + B) = \frac{\sqrt{3}}{2}$$

$\Rightarrow \qquad A + B = 60° \qquad \ldots(i)$

and $\qquad \cos B = \dfrac{\sqrt{3}}{2}$

$\Rightarrow \qquad B = 30° \qquad \ldots(ii)$

On solving Eqs. (i) and (ii), we get

$A = 30°$

$\therefore \tan(2A - B) = \tan(60 - 30°)$

$= \tan 30° = \dfrac{1}{\sqrt{3}}$

Option (c) is correct.

16. Consider the following statements

1. If $\dfrac{\cos\theta}{1 - \sin\theta} + \dfrac{\cos\theta}{1 + \sin\theta} = 4$, where

$0 < \theta < 90°$, then $\theta = 60°$.

2. If $3\tan\theta + \cot\theta = 5\,\mathrm{cosec}\,\theta$, where $0 < \theta < 90°$, then $\theta = 60°$.

Which of the statements given above is/are correct?

(a) 1 only   (b) 2 only

(c) Both 1 and 2   (d) Neither 1 nor 2

(c) We have,

1. $\dfrac{\cos\theta}{1 - \sin\theta} + \dfrac{\cos\theta}{1 + \sin\theta} = 4$

$\Rightarrow \dfrac{\cos\theta (1 + \sin\theta + 1 - \sin\theta)}{1 - \sin^2\theta} = 4$

$\Rightarrow \dfrac{2\cos\theta}{\cos^2\theta} = 4 \qquad [\because 1 - \sin^2\theta = \cos^2\theta]$

$\Rightarrow \cos\theta = \dfrac{1}{2} = \cos 60°$

$\Rightarrow \qquad \theta = 60°$

$\therefore$ Statement 1 is correct.

2. $3\tan\theta + \cot\theta = 5\cos ec\,\theta$

put $\qquad \theta = 60°$

$\because \; 3\tan 60° + \cot 60° = 5\,\mathrm{cosec}\;60°$

$3\sqrt{3} + \dfrac{1}{\sqrt{3}} = 5 \times \dfrac{2}{\sqrt{3}}$

$\Rightarrow \qquad \dfrac{9 + 1}{\sqrt{3}} = \dfrac{10}{\sqrt{3}}$

$\Rightarrow \qquad \dfrac{10}{\sqrt{3}} = \dfrac{10}{\sqrt{3}}$

$\therefore$ Statement 2 is also correct.

Option (c) is correct.

17. Consider the following statements

1. $\cos^2\theta = 1 - \dfrac{p^2 + q^2}{2pq}$, where p, q

are non-zero real numbers, is possible only when $p = q$.

2. $\tan^2\theta = \dfrac{4pq}{(p + q)^2} - 1$, where p, q

are non-zero real numbers, is possible only when $p = q$.

Which of the statements given above is/are correct ?

(a) 1 only   (b) 2 only

(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ *(c)* $\cos^2\theta = 1 - \dfrac{p^2 + q^2}{2pq}$

$0 \le \cos^2\theta \le 1$

$0 \le 1 - \dfrac{p^2 + q^2}{2pq} \le 1$

$0 \le 2pq - (p^2 + q^2) \le 2pq$

$p^2 + q^2 - 2pq \le 0$

$\Rightarrow \qquad (p - q)^2 \le 0$

It is possible only when $p = q$

$\therefore$ Statement 1 is correct.

$\tan^2\theta = \dfrac{4pq}{(p + q)^2} - 1$

$\Rightarrow \qquad \tan^2\theta \ge 0$

$\Rightarrow \qquad \dfrac{4pq}{(p + q)^2} - 1 \ge 0$

$\Rightarrow \qquad 4pq - (p + q)^2 \ge 0$

$\Rightarrow \qquad (p + q)^2 - 4pq \le 0$

$\Rightarrow p^2 + q^2 + 2pq - 4pq \le 0$

$\Rightarrow \qquad (p - q)^2 \le 0$

It is possible only $p = q$

$\therefore$ Statement 2 is correct

Option (c) is correct.

18. Consider the following statements

1. $\cos\theta + \sec\theta$ can never be equal to 1.5

2. $\sec^2\theta + \cos ec^2\theta$ can never be less than 4.

Which of the statements given above is / are correct?

(a) 1 only   (b) 2 only

(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ *(c)* 1. $\cos\theta + \sec\theta$

Let $\cos\theta + \sec\theta = \dfrac{3}{2}$ is possible

$\Rightarrow \cos\theta + \dfrac{1}{\cos\theta} = \dfrac{3}{2}$

$\Rightarrow \dfrac{\cos^2\theta + 1}{\cos\theta} = \dfrac{3}{2}$

$\Rightarrow 2\cos^2\theta + 2 = 3\cos\theta$

$\Rightarrow 2\cos^2\theta - 3\cos\theta + 2 = 0$

The above equation has no real roots for $\cos\theta$.

Since, discriminant of the quadratic equation is

$$D = b^2 - 4ac$$
$$= (-3)^2 - 4(2)\,(2)$$
$$= 9 - 16$$
$$= -7 < 0$$

$\therefore \cos\theta + \sec\theta \ne 1.5$ or $\dfrac{3}{2}$

$\therefore$ Statement 1 is correct.

2. $\sec^2\theta + \cos ec^2\theta = \dfrac{1}{\cos^2\theta} + \dfrac{1}{\sin^2\theta}$

$= \dfrac{\sin^2\theta + \cos^2\theta}{\sin^2\theta\cos^2\theta} = \dfrac{1}{\sin^2\theta \cdot \cos^2\theta}$

$[\because \sin^2\theta + \cos^2\theta = 1]$

$= \dfrac{4}{(2\sin\theta\cos\theta)^2} = \dfrac{4}{\sin^2 2\theta}$

$\therefore \quad \dfrac{4}{\sin^2 2\theta} \ge 4$

$[\because$ value of $\sin^2\theta$ lies between (0, 1)]

Statement 2 is also correct.

Option (c) is correct.

19. If $\sin^2 x + \sin x = 1$, then what is the value of $\cos^{12} x + 3\cos^{10} x + 3\cos^8 x + \cos^6 x$?

(a) -1 (b) 0 (c) 1 (d) 8

⊘ *(c)* We have,

$\sin^2 x + \sin x = 1$

$\Rightarrow \sin x = 1 - \sin^2 x = \cos^2 x$

$\Rightarrow \qquad \sin^2 x = \cos^4 x$

$\Rightarrow \qquad 1 - \cos^2 x = \cos^4 x$

$\Rightarrow \cos^4 x + \cos^2 x = 1$

On cubing both sides,

$(\cos^4 x + \cos^2 x)^3 = (1)^3$

$[\because (a + b)^3 = a^3 + b^3 + 3a^2 b + 3ab^2]$

$\Rightarrow \quad \cos^{12} x + 3\cos^{10} x$

$+ 3\cos^8 x + \cos^6 x = 1$

Option (c) is correct.

20. If $3\sin\theta + 5\cos\theta = 4$, then what is the value of $(3\cos\theta - 5\sin\theta)^2$?

(a) 9 (b) 12 (c) 16 (d) 18

⊘ *(d)* We have, $3\sin\theta + 5\cos\theta = 4$

On squaring both sides,

$9\sin^2\theta + 25\cos^2\theta + 30\sin\theta\cos\theta = 16$

$9(1 - \cos^2\theta) + 25(1 - \sin^2\theta)$
$\qquad + 30\sin\theta\cos\theta = 16$
$\qquad\qquad [\because \sin^2\theta = 1 - \cos^2\theta]$
$\Rightarrow 9 - 9\cos^2\theta + 25 - 25\sin^2\theta$
$\qquad\qquad + 30\sin\theta\cos\theta = 16$
$\Rightarrow 9\cos^2\theta + 25\sin^2\theta - 30\sin\theta\cos\theta$
$\qquad\qquad = 9 + 25 - 16$
$\Rightarrow (3\cos\theta - 5\sin\theta)^2 = 18$
$\qquad\qquad [\because a^2 + b^2 - 2ab = (a-b)^2]$
Option (d) is correct.

21. If $\cot\theta(1 + \sin\theta) = 4m$ and $\cot\theta(1 - \sin\theta) = 4n$, then which one of the following is correct?
(a) $(m^2 + n^2)^2 = mn$
(b) $(m^2 - n^2)^2 = mn$
(c) $(m^2 - n^2)^2 = m^2n^2$
(d) $(m^2 + n^2)^2 = m^2n^2$

⊙ **(b)** We have,
$\qquad \cot\theta(1 + \sin\theta) = 4m \qquad \ldots\text{(i)}$
$\qquad \cot\theta(1 - \sin\theta) = 4n \qquad \ldots\text{(ii)}$
Multiplying both the equations
$\qquad 16mn = \cot^2\theta(1 - \sin^2\theta)$
$\qquad 16mn = \cot^2\theta\cos^2\theta$
$\qquad\qquad [\because 1 - \sin^2\theta = \cos^2\theta]\ldots\text{(iii)}$
Now, add Eqs. (i) and (ii), we get
$\qquad \cot\theta = 2(m + n)$
On subtracting Eqs. (ii) from (i), we get
$\qquad \cot\theta\sin\theta = 2(m - n)$
$\qquad \dfrac{\cos\theta}{\sin\theta} \times \sin\theta = 2(m - n)$
$\Rightarrow \qquad \cos\theta = 2(m - n)$
Putting the value of $\cot\theta$ and $\cos\theta$ in Eq. (iii), we get
$\qquad 16mn = [2^2(m - n)^2][2^2(m + n)^2]$
$\qquad\qquad = 16(m^2 - n^2)^2$
$\Rightarrow \quad mn^2(m^2 - n^2)^2$
$\qquad mn = (m^2 - n^2)^2$
Option (b) is correct.

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22. What is $\sin^4\theta - \cos^4\theta$ equal to for any real number θ ?
(a) 1   (b) $1 - 2\sin^2\theta$
(c) $2\cos^2\theta + 1$ (d) $1 - 2\cos^2\theta$

⊙ **(d)** $\sin^4\theta - \cos^4\theta$
$(\sin^2\theta)^2 - (\cos^2\theta)^2$
$\qquad = (\sin^2\theta + \cos^2\theta)(\sin^2\theta - \cos^2\theta)$
$\qquad\qquad [\because a^2 - b^2 = (a+b)(a-b)]$
$\qquad = 1 \times (\sin^2\theta - \cos^2\theta)$
$\qquad\qquad [\because \sin^2\theta + \cos^2\theta = 1]$
$\qquad = 1 - \cos^2\theta - \cos^2\theta$
$\qquad\qquad [\because \sin^2\theta = 1 - \cos^2\theta]$
$\qquad = 1 - 2\cos^2\theta$

23. What is $\cot 1° \cot 23° \cot 45°$ $\cot 67° \cot 89°$ equal to ?
(a) 0   (b) 1
(c) $\dfrac{1}{2}$ (d) $\dfrac{1}{3}$

⊙ **(b)** $\cot 1°\cdot \cot 23°\cdot \cot 45°\cdot$
$\qquad \cot 67°\cdot \cot 89°$
$\qquad = \cot 1°\cdot \tan(90° - 23°)\cdot$
$\qquad\qquad \cot 45°\cdot\cot 67°\cdot\tan(90° - 89°)$
$\qquad\qquad [\because \tan(90° - \theta) = \cot\theta]$
$\qquad = \cot 1°\cdot\tan 67°\cdot\cot 45°\cdot\cot 67°\cdot\tan 1°$
$\qquad = \cot 45° \qquad [\because \tan\theta\cdot\cot\theta = 1]$
$\qquad = 1 \qquad\qquad [\because \cot 45° = 1]$

24. Consider the following statements:
1. $(\sec^2\theta - 1)(1 - \csc^2\theta) = 1$
2. $\sin\theta(1 + \cos\theta)^{-1}$ $+ (1 + \cos\theta)(\sin\theta)^{-1} = 2\csc\theta$
Which of the above is/are correct?
(a) 1 only   (b) 2 only
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ **(b)** Statement 1.
LHS $= (\sec^2\theta - 1)(1 - \csc^2\theta)$
$\qquad = (\tan^2\theta)\times(-\cot^2\theta)$
$\qquad\qquad [\because 1 + \tan^2\theta = \sec^2\theta$ and $1 + \cot^2\theta = \csc^2\theta]$
$\qquad = -1 \qquad [\because \tan\theta\cdot\cot\theta = 1]$
Statement 1 is incorrect.
Statement 2.
LHS
$= \sin\theta(1 + \cos\theta)^{-1} + (1 + \cos\theta)(\sin\theta)^{-1}$
$= \dfrac{\sin\theta}{1 + \cos\theta} + \dfrac{1 + \cos\theta}{\sin\theta}$
$= \dfrac{\sin^2\theta + (1 + \cos\theta)^2}{\sin\theta(1 + \cos\theta)}$
$= \dfrac{\sin^2\theta + \cos^2\theta + 1 + 2\cos\theta}{\sin\theta(1 + \cos\theta)}$
$\qquad\qquad [\because (a + b)^2 = a^2 + 2ab + b^2]$
$= \dfrac{2 + 2\cos\theta}{\sin\theta(1 + \cos\theta)} \quad [\because \sin^2\theta + \cos^2\theta = 1]$
$= \dfrac{2(1 + \cos\theta)}{\sin\theta(1 + \cos\theta)} \quad \left[\because \csc\theta = \dfrac{1}{\sin\theta}\right]$
$= 2\csc\theta = $ RHS
Statement 2 is correct.

25. If $\sec x \csc x = 2$, then what is $\tan^n x + \cot^n x$ equal to?
(a) 2   (b) 2^{n+1}
(c) 2^n (d) 2^{n-1}

⊙ **(a)** We have.
$\qquad \sec x \csc x = 2$
$\qquad \dfrac{1}{\sin x \cos x} = 2$

$\Rightarrow \quad 2\sin x\cos x = 1$
$\Rightarrow \qquad \sin 2x = 1$
$\qquad\qquad 2x = \dfrac{\pi}{2}$
$\Rightarrow \qquad x = \dfrac{\pi}{4}$
$\tan^n x + \cot^n x = \left(\tan\dfrac{\pi}{4}\right)^n + \left(\cot\dfrac{\pi}{4}\right)^n$
$\qquad = 1 + 1 = 2$
$\qquad \left[\because \tan\dfrac{\pi}{4} = 1, \cot\dfrac{\pi}{4} = 1\right]$

26. If $\cos x + \cos^2 x = 1$, then what is $\sin^2 x + \sin^4 x$ equal to ?
(a) 1   (b) 1.5
(c) 2   (d) 3

⊙ **(a)** $\cos x + \cos^2 x = 1 \qquad$ [given]
$\qquad 1 - \cos^2 x = \cos x \qquad \ldots\text{(i)}$
Now, $\sin^2 x + \sin^4 x$
$\qquad = (1 - \cos^2 x) + (1 - \cos^2 x)^2$
$\qquad\qquad [(\because \sin^2\theta + \cos^2\theta = 1]$
$\qquad = \cos x + \cos^2 x$ [from Eq. (i)]
But, $\cos x + \cos^2 x = 1$
$\therefore \quad \sin^2 x + \sin^4 x = 1$
Option (a) is correct.

27. If $\sin A + \cos A = p$ and $\sin^3 A + \cos^3 A = q$, then which one of the following is correct?
(a) $p^3 - 3p + q = 0$
(b) $q^3 - 3q + 2p = 0$
(c) $p^3 - 3p + 2q = 0$
(d) $p^3 + 3p + 2q = 0$

⊙ **(c)** Given, $\sin A + \cos A = p \qquad \ldots\text{(i)}$
$\sin^3 A + \cos^3 A = q \qquad\qquad \ldots\text{(ii)}$
On squaring Eq. (i), we get
$\qquad (\sin A + \cos A)^2 = p^2$
$\Rightarrow \sin^2 A + \cos^2 A + 2\sin A\cos A = p^2$
or $\quad 2\sin A\cos A = p^2 - 1$
$\qquad\qquad [\because \sin^2 A + \cos^2 A = 1]$
$\Rightarrow \quad \sin A\cos A = \dfrac{p^2 - 1}{2} \qquad \ldots\text{(iii)}$
Now, cubing both sides of Eq. (i), we get
$\qquad (\sin A + \cos A)^3 = p^3$
$\sin^3 A + \cos^3 A$
$\qquad + 3\sin A\cos A(\sin A + \cos A) = p^3$
$\qquad [\because (a + b)^3 = a^3 + b^3 + 3ab(a + b)]$
$\Rightarrow \quad q + 3\left(\dfrac{p^2 - 1}{2}\right)p = p^3$ [from Eq. (iii)]
$\Rightarrow \quad 2q + 3p^3 - 3p = 2p^3$
$\Rightarrow \quad p^3 - 3p + 2q = 0$
Hence, option (c) is correct.

28. If $x = \dfrac{\sec^2\theta - \tan\theta}{\sec^2\theta + \tan\theta}$, then which

one of the following is correct?

(a) $\dfrac{1}{3} < x < 3$ (b) $x \notin \left[\dfrac{1}{3}, 3\right]$

(c) $-3 < x < -\dfrac{1}{3}$ (d) $\dfrac{1}{3} \le x \le 3$

⊘ **(d)** $x = \dfrac{\sec^2\theta - \tan\theta}{\sec^2\theta + \tan\theta} = \dfrac{\dfrac{1}{\cos^2\theta} - \dfrac{\sin\theta}{\cos\theta}}{\dfrac{1}{\cos^2\theta} + \dfrac{\sin\theta}{\cos\theta}}$

$= \dfrac{1 - \sin\theta\cos\theta}{1 + \sin\theta\cos\theta}$

$= \dfrac{2 - 2\sin\theta\cos\theta}{2 + 2\sin\theta\cos\theta} = \dfrac{2 - \sin 2\theta}{2 + \sin 2\theta}$

$[\because 2\sin\theta\cos\theta = \sin 2\theta]$

We know that, minimum and maximum value of $\sin 2\theta$ are -1 and 1.

$\therefore \quad x = \dfrac{2 - (-1)}{2 + (-1)} = 3 \qquad [\sin 2\theta = -1]$

and $\quad x = \dfrac{2 - 1}{2 + 1} = \dfrac{1}{3} \qquad [\sin 2\theta = 1]$

Hence, $\dfrac{1}{3} \le x \le 3$

29. What angle does the hour hand of a clock describe in 10 min of time?

(a) 1° (b) 5° (c) 6° (d) 10°

⊘ **(b)** The hour hand of the clock covers 360° in 12 h.

∴ Angle covered by hour hand in 1 h

or 60 min $= \dfrac{360}{12} = 30°$

And angle covered by hour hand in

10 min $= \dfrac{30}{60} \times 10 = 5°$

30. *ABC* is a right angled triangle with base $\overline{BC}$ and height $\overline{AB}$. The hypotenuse $\overline{AC}$ is four times the length of the perpendicular drawn to it from the opposite vertex. What is $\tan C$ equal to

(a) $2 - \sqrt{3}$ (b) $\sqrt{3} - 1$

(c) $2 + \sqrt{3}$ (d) $\sqrt{3} + 1$

⊘ **(a)** According to the question,
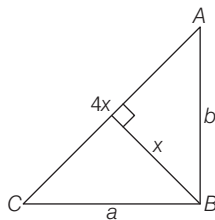
Let $BC = a$ and $AB = b$

Area of triangle $ABC = \dfrac{1}{2}ab = \dfrac{1}{2}4x \times x$

$\Rightarrow \qquad x^2 = \dfrac{ab}{4}$

$\Rightarrow \qquad ab = 4x^2$

Using Pythagoras theorem in $\triangle ABC$

$a^2 + b^2 = (4x)^2 = 16x^2$

$(a+b)^2 - 2ab = 16x^2$

$(a+b)^2 = 16x^2 + 2 \times 4x^2 = 24x^2$

$\Rightarrow \qquad a + b = 2\sqrt{6}x \qquad \ldots(i)$

Now, $(a-b)^2 = a^2 + b^2 - 2ab$

$= 16x^2 - 2 \times 4x^2 = 8x^2$

$\Rightarrow \qquad a - b = 2\sqrt{2}x \qquad \ldots(ii)$

On adding Eqs. (i) and (ii), we get

$2a = 2\sqrt{6}x + 2\sqrt{2}x$

$a = (\sqrt{6} + \sqrt{2})x$

On subtracting Eqs. (i) and (ii), we get

$2b = 2\sqrt{6}x - 2\sqrt{2}x$

$b = (\sqrt{6} - \sqrt{2})x$

Now in $\triangle ABC$

$\tan C = \dfrac{b}{a} = \dfrac{(\sqrt{6} - \sqrt{2})x}{(\sqrt{6} + \sqrt{2})x}$

$= \dfrac{\sqrt{6} - \sqrt{2}}{\sqrt{6} + \sqrt{2}} \times \dfrac{\sqrt{6} - \sqrt{2}}{\sqrt{6} - \sqrt{2}}$

$\dfrac{(\sqrt{6} - \sqrt{2})^2}{(\sqrt{6})^2 - (\sqrt{2})^2} = \dfrac{6 + 2 - 4\sqrt{3}}{6 - 2} = \dfrac{8 - 4\sqrt{3}}{4}$

$\therefore \qquad \tan C = 2 - \sqrt{3}$

2017 (II)

31. If $0 < x < \dfrac{\pi}{2}$, then $(\sin x + \operatorname{cosec} x)$ is

(a) > 2 (b) < 2

(c) ≥ 2 (d) ≤ 2

⊘ **(a)** We have

$\sin x + \operatorname{cosec} x$ and $x \in \left(0, \dfrac{\pi}{2}\right)$

$\therefore \dfrac{\sin x + \operatorname{cosec} x}{2} \ge \sqrt{\sin x \, \operatorname{cosec} x}$

$[\because AM \ge GM]$

$\dfrac{\sin x + \operatorname{cosec} x}{2} \ge 1$

$\left[\because \operatorname{cosec} x = \dfrac{1}{\sin x}\right]$

$\Rightarrow \sin x + \operatorname{cosec} x \ge 2$

Since $x \in \left(0, \dfrac{\pi}{2}\right)$

$\therefore \quad \sin x + \operatorname{cosec} x > 2$

32. If $\sin\theta = \dfrac{m^2 - n^2}{m^2 + n^2}$ and $0 < \theta < \dfrac{\pi}{2}$,

then what is the value of $\cos\theta$?

(a) $\dfrac{2mn}{m^2 + n^2}$ (b) $\dfrac{2mn}{m^2 - n^2}$

(c) $\dfrac{m^2 + n^2}{2mn}$ (d) $\dfrac{m^2 - n^2}{2mn}$

⊘ **(a)** We have, $\sin\theta = \dfrac{m^2 - n^2}{m^2 + n^2}$

$\cos\theta = \sqrt{1 - \sin^2\theta}$

$\cos\theta = \sqrt{1 - \dfrac{(m^2 - n^2)^2}{(m^2 + n^2)^2}}$

$\cos\theta = \sqrt{\dfrac{(m^2 + n^2)^2 - (m^2 - n^2)^2}{(m^2 + n^2)^2}}$

$\cos\theta = \sqrt{\dfrac{4m^2n^2}{(m^2 + n^2)^2}}$

$\cos\theta = \dfrac{2mn}{m^2 + n^2}$

33. If $A = \dfrac{\sin 45° - \sin 30}{\cos 45° + \cos 60°}$ and

$B = \dfrac{\sec 45° - \tan 45°}{\operatorname{cosec} 45° + \cot 45°}$, then

which one of the following is correct?

(a) $A = B$ (b) $A > B > 0$

(c) $A < B$ (d) $B < A < 0$

⊘ **(a)** We have,

$A = \dfrac{\sin 45° - \sin 30°}{\cos 45° + \cos 60°}$

$A = \dfrac{\dfrac{1}{\sqrt{2}} - \dfrac{1}{2}}{\dfrac{1}{\sqrt{2}} + \dfrac{1}{2}}$

$= \dfrac{\sqrt{2} - 1}{\sqrt{2} + 1}$

$B = \dfrac{\sec 45° - \tan 45°}{\operatorname{cosec} 45° + \cot 45°}$

$B = \dfrac{\sqrt{2} - 1}{\sqrt{2} + 1}$

Hence, $A = B$

34. If θ measured in radians is the angle between the hour and the minute hand of a clock when the time is 4 : 36 pm, then which one of the following is correct?

(a) $\dfrac{3\pi}{5} < \theta < \dfrac{4\pi}{5}$ (b) $\dfrac{2\pi}{5} < \theta < \dfrac{3\pi}{5}$

(c) $\dfrac{\pi}{5} \le \theta \le \dfrac{2\pi}{5}$ (d) $\dfrac{7\pi}{15} \le \theta \le \dfrac{8\pi}{15}$

⟫ *(b)* We know that hour completes are rotation in 12 hours while hand completes are rotation in 60 minutes.

∴ Angle traced by hour hand in 12 hours $= 2\pi$

⇒ Angle traced by the hour hand in 4 hrs 36 min i.e. $\left(4 + \dfrac{36}{60}\right)$ hr

or $\dfrac{23}{5}$ hrs $= \dfrac{2\pi}{12} \times \dfrac{23}{5} = \dfrac{23\pi}{30}$

Also, angle traced by the minute hand in 60 min $= 2\pi$

⇒ The angle traced by the minute hand in

$$36 \text{ min} = \dfrac{2\pi}{60} \times 36 = \dfrac{6\pi}{5}$$

Hence, the required angle between two hands

$$= \dfrac{6\pi}{5} - \dfrac{23\pi}{30} = \dfrac{36\pi - 23\pi}{30} = \dfrac{13\pi}{30}$$

Which lies between $\dfrac{2\pi}{5}$ and $\dfrac{3\pi}{5}$

$$\left[\because \dfrac{2\pi}{5} = \dfrac{12\pi}{30} \text{ and } \dfrac{3\pi}{5} = \dfrac{18\pi}{30}\right]$$

Option (b) is correct.

35. Consider the following statements

   1. If $45° < \theta < 60°$, then $\sec^2\theta + \csc^2\theta = \alpha^2$ for some real number $\alpha > 1$

   2. If $0° < \theta < 45°$, then $\dfrac{1 + \cos\theta}{1 - \cos\theta} = x^2$ for some real number $x > 2$.

   3. If $0° < \theta < 45°$, then $\dfrac{\cos\theta}{1 - \tan\theta} + \dfrac{\sin\theta}{1 - \cot\theta} \geq 2$

What is the number of true statements?

(a) Zero   (b) One
(c) Two   (d) Three

⟫ *(c)* We have,

1. $45° < \theta < 60°$

$$\sec^2\theta + \csc^2\theta = \alpha^2$$
$$\theta = 45° \quad \sec^2 45° + \csc^2 45°$$
$$= 2 + 2 = 4$$
$$[\because \sec 45° = \sqrt{2}, \csc 45° = \sqrt{2})$$

when $\theta = 60°$

$$\therefore \sec^2 60° + \csc^2 60° = 4 + \dfrac{4}{3} = \dfrac{16}{3}$$

$$4 < \alpha^2 < \dfrac{16}{3} \quad \text{True}$$

2. $0° < \theta < 45°$

$$\dfrac{1 + \cos\theta}{1 - \cos\theta} = x^2$$

put $\theta = 30° \Rightarrow \dfrac{1 + \cos 30°}{1 - \cos 30}$

$$x^2 = \dfrac{2 + \sqrt{3}}{2 - \sqrt{3}}$$
$$x^2 = \dfrac{2 + \sqrt{3}}{2 - \sqrt{3}} \times \dfrac{2 + \sqrt{3}}{2 + \sqrt{3}}$$
$$x^2 = (2 + \sqrt{3})^2$$
$$x = 2 + \sqrt{3}$$
$$x > 2$$

It is true

3. $0° < \theta < 45°$, $\dfrac{\cos\theta}{1 - \tan\theta} + \dfrac{\sin\theta}{1 - \cot\theta}$

$$= \dfrac{\cos^2\theta}{\cos\theta - \sin\theta} - \dfrac{\sin^2\theta}{\cos\theta - \sin\theta}$$

$$\Rightarrow \dfrac{\cos^2\theta - \sin^2\theta}{\cos\theta - \sin\theta} = \cos\theta + \sin\theta$$

Maximum value of $\cos\theta + \sin\theta$ is $\sqrt{2}$

$$[\because \text{ Maximum value of}$$
$$a\cos\theta + b\sin\theta = \sqrt{a^2 + b^2}]$$

False

∴ Statements 1 and 2 are true.

36. The value of $\dfrac{\sin 1°}{\sin 1^c}$, where 1^c represents 1 radian is

(a) equal to 1
(b) less than 1
(c) greater than 1 but less than 2
(d) greater than 2

⟫ *(b)* We know that

     1 radian $= 57°$ [approx]

$$\therefore \quad \sin 1° < \sin 57°$$

$$\Rightarrow \quad \dfrac{\sin 1°}{\sin 57°} < 1 \quad [\because \sin 57° > \sin 1°]$$

$$\Rightarrow \quad \dfrac{\sin 1°}{\sin 1^c} < 1$$

2017 (I)

37. If D is the number of degrees and R is the number of radians in an angle θ, then which one of the following is correct?

(a) $\pi D = 180R$ (b) $\pi D = 90R$
(c) $\pi R = 180D$ (d) $\pi R = 90D$

⟫ *(c)* We know that,

$$\pi \text{ Radian} = 180°$$

$$\therefore \quad 1 \text{ Radian} = \dfrac{180°}{\pi}$$

$$\Rightarrow \quad R \text{ Radian} = \dfrac{180°}{\pi}$$

$$\Rightarrow \quad \pi R = 180°D$$

38. What is the minimum value of $9\tan^2\theta + 4\cot^2\theta$?

(a) 6   (b) 9
(c) 12   (d) 13

⟫ *(c)* We know that, AM ≥ GM

$$\therefore \quad \dfrac{9\tan^2\theta + 4\cot^2\theta}{2} \geq$$
$$[(9\tan^2\theta)(4\cot^2\theta)]^{1/2}$$

$$\Rightarrow \quad \dfrac{9\tan^2\theta + 4\cot^2\theta}{2} \geq 6$$

$$[\because \tan\theta \cdot \cot\theta = 1]$$

$$\Rightarrow \quad 9\tan^2\theta + 4\cot^2\theta \geq 12$$

∴ Minimum value of $9\tan^2\theta + 4\cot^2\theta$ is 12.

39. If $x\sin\theta = y\cos\theta = \dfrac{2z\tan\theta}{1 - \tan^2\theta}$, then what is $4z^2(x^2 + y^2)$ equal to?

(a) $(x^2 + y^2)^3$ (b) $(x^2 - y^2)^2$
(c) $(x^2 - y^2)^3$ (d) $(x^2 + y^2)^2$

⟫ *(b)* Let $x\sin\theta = y\cos\theta = \dfrac{2z\tan\theta}{1 - \tan^2\theta} = k$

Taking $x\sin\theta = y\cos\theta$

$$\Rightarrow \quad \dfrac{y}{x} = \tan\theta \quad\quad \text{…(i)}$$

Now, $x = k\csc\theta \quad\quad \text{…(ii)}$
          $y = k\sec\theta \quad\quad \text{…(iii)}$

and $z = k\left(\dfrac{1 - \tan^2\theta}{2\tan\theta}\right) = k\left(\dfrac{1 - \dfrac{y^2}{x^2}}{2 \cdot \dfrac{y}{x}}\right)$

$$= k\left(\dfrac{x^2 - y^2}{x^2} \times \dfrac{x}{2y}\right) = k\left(\dfrac{x^2 - y^2}{2xy}\right) \quad \text{…(iv)}$$

From Eqs. (ii) and (iii), we get
$$x^2 + y^2 = k^2(\csc^2\theta + \sec^2\theta)$$
$$= k^2(\tan^2\theta + \cot^2\theta + 2)$$
$$[\because \sec^2\theta = 1 + \tan^2\theta, \csc^2\theta = 1 + \cot^2\theta]$$

$$= k^2(\tan\theta + \cot\theta)^2$$

$$\Rightarrow x^2 + y^2 = k^2\left(\dfrac{y}{x} + \dfrac{x}{y}\right)^2$$

$$= k^2\left(\dfrac{x^2 + y^2}{xy}\right)^2$$

$$\Rightarrow k^2 = \dfrac{x^2 + y^2}{\left(\dfrac{x^2 + y^2}{xy}\right)^2}$$

$$= (x^2 + y^2) \times \dfrac{x^2y^2}{(x^2 + y^2)^2} = \dfrac{x^2y^2}{x^2 + y^2}$$

From Eq. (iv), we get

$$z^2 = \left(\dfrac{x^2y^2}{x^2 + y^2}\right)\left(\dfrac{x^2 - y^2}{2xy}\right)^2$$

$$\therefore \quad 4z^2(x^2 + y^2) =$$

$$4\left(\dfrac{x^2y^2}{x^2 + y^2}\right)\left(\dfrac{x^2 - y^2}{2xy}\right)^2(x^2 + y^2)$$

$$\Rightarrow \quad (x^2 - y^2)^2$$

Option (b) is correct.

40. If $\cos\theta_1 + \cos\theta_2 + \cos\theta_3 = 3$ then what is $\sin\theta_1 + \sin\theta_2 + \sin\theta_3$ equal to?

(a) 0   (b) 1
(c) 2   (d) 3

⊘ *(a)* We have,
$$\cos\theta_1 + \cos\theta_2 + \cos\theta_3 = 3 \qquad \ldots(i)$$
Since $\quad 0 \le \cos\theta \le 1$
∴ From Eqs. (i) to be true
$$\cos\theta_1 = \cos\theta_2 = \cos\theta_3 = 1$$
∴ $\qquad \theta_1 = \theta_2 = \theta_3 = 2n\pi$
Now, $\quad \sin\theta_1 + \sin\theta_2 + \sin\theta_3$
$$= \sin 2n\pi + \sin 2n\pi + \sin 2n\pi$$
$$= 0 + 0 + 0 \qquad [\because \sin 2n\pi = 0]$$
$$= 0$$

41. What is the value of θ which satisfies the equation $\cos\theta + \tan\theta = 1$?

(a) 0°   (b) 30°
(c) 45°   (d) 60°

⊘ *(a)* We have,
$$\cos\theta + \tan\theta = 1$$
When $\theta = 0°$
$$\cos 0° + \tan 0° = 1 + 0 = 1$$
When $\theta = 30°$
$$\cos 30° + \tan 30° = \frac{\sqrt{3}}{2} + \frac{1}{\sqrt{3}} = \frac{5}{2\sqrt{3}}$$
When $\theta = 45°$
$$\cos 45° + \tan 45° = \frac{1}{\sqrt{2}} + 1 = \frac{1 + \sqrt{2}}{\sqrt{2}}$$
When $\theta = 60°$
$$\cos 60° + \tan 60° = \frac{1}{2} + \sqrt{3}$$
$$= \frac{1 + 2\sqrt{3}}{2}$$
∴ It is clear that, $\cos\theta + \tan\theta = 1$ is valid only when $\theta = 0°$.

42. What is the value of
$$\sin x \sqrt{\frac{1}{1 + \cos x} + \frac{1}{1 - \cos x}} \ ?$$

(a) $\sqrt{2}$ (b) $2\sqrt{2}$
(c) $\sqrt{2}\tan x$ (d) 0

⊘ *(a)* We have,
$$\sin x \sqrt{\frac{1}{1 + \cos x} + \frac{1}{1 - \cos x}}$$
$$= \sin x \sqrt{\frac{1 - \cos x + 1 + \cos x}{(1 + \cos x)(1 - \cos x)}}$$
$$\qquad [1 - \cos^2\theta = \sin^2\theta]$$
$$= \sin x \sqrt{\frac{2}{1 - \cos^2 x}} = \sin x \sqrt{\frac{2}{\sin^2 x}}$$
$$= \sin x \cdot \frac{\sqrt{2}}{\sin x} = \sqrt{2}$$

43. What is $\dfrac{\cos^4 A - \sin^4 A}{\cos^2 A - \sin^2 A}$ equal to?

(a) $\cos^2 A - \sin^2 A$ (b) $\cos A - \sin A$
(c) 1   (d) 2

⊘ *(c)* We have, $\dfrac{\cos^4 A - \sin^4 A}{\cos^2 A - \sin^2 A}$
$$= \frac{(\cos^2 A)^2 - (\sin^2 A)^2}{\cos^2 A - \sin^2 A}$$
$$= \frac{(\cos^2 A + \sin^2 A)(\cos^2 A - \sin^2 A)}{(\cos^2 A - \sin^2 A)}$$
$$\qquad [\because a^2 - b^2 = (a + b)(a - b)]$$
$$= \cos^2 A + \sin^2 A = 1$$

44. If $7\sin^2 x + 3\cos^2 x = 4,0 < x < 90°$, then what is the value of $\tan x$?

(a) $\sqrt{2}$ (b) 1   (c) $\dfrac{\sqrt{3}}{2}$ (d) $\dfrac{1}{\sqrt{3}}$

⊘ *(d)* We have,
$$7\sin^2 x + 3\cos^2 x = 4$$
Dividing both sides by $\cos^2 x$
$$\Rightarrow \quad 7\frac{\sin^2 x}{\cos^2 x} + 3\frac{\cos^2 x}{\cos^2 x} = \frac{4}{\cos^2 x}$$
$$\Rightarrow \quad 7\tan^2 x + 3 = 4\sec^2 x$$
$$\Rightarrow \quad 7\tan^2 x + 3 = 4(1 + \tan^2 x)$$
$$\qquad [\because 1 + \tan^2 x = \sec^2 x]$$
$$\Rightarrow \quad 7\tan^2 x + 3 = 4 + 4\tan^2 x$$
$$\Rightarrow \quad 3\tan^2 x = 1$$
$$\Rightarrow \quad \tan^2 x = \frac{1}{3} \qquad [\because 0 < x < 90°]$$
$$\Rightarrow \quad \tan x = \frac{1}{\sqrt{3}}$$

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45. If $\sin\theta + \cos\theta = \dfrac{\sqrt{7}}{2}$, then what is $\sin\theta - \cos\theta$ equal to?

(a) 0   (b) $\dfrac{1}{2}$ (c) 1   (d) $\sqrt{2}$

⊘ *(b)* Given, $\sin\theta + \cos\theta = \dfrac{\sqrt{7}}{2}$
On squaring both sides, we get
$$(\sin\theta + \cos\theta)^2 = \left(\frac{\sqrt{7}}{2}\right)^2$$
$$\Rightarrow \quad \sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta = \frac{7}{4}$$
$$\qquad [\because (a + b)^2 = a^2 + b^2 + 2ab]$$
$$\Rightarrow \quad 1 + 2\sin\theta\cos\theta = \frac{7}{4}$$
$$\Rightarrow \quad 2\sin\theta\cos\theta = \frac{7}{4} - 1$$
$$\Rightarrow \quad 2\sin\theta\cos\theta = \frac{3}{4}$$

Now, $(\sin\theta - \cos\theta)^2 = \sin^2\theta + \cos^2\theta - 2\sin\theta\cos\theta$
$$= 1 - \frac{3}{4} \Rightarrow \frac{4 - 3}{4}$$
$$\Rightarrow \quad (\sin\theta - \cos\theta)^2 = \frac{1}{4}$$
$$\therefore \quad \sin\theta - \cos\theta = \frac{1}{2}$$

46. If $\sin x + \sin^2 x = 1$, then what is the value of $\cos^8 x + 2\cos^6 x + \cos^4 x$?

(a) 0   (b) 1   (c) 2   (d) 4

⊘ *(b)* Given, $\sin x + \sin^2 x = 1$
$$\Rightarrow \quad \sin x = 1 - \sin^2 x$$
$$\Rightarrow \quad \sin x = \cos^2 x \qquad \ldots(i)$$
Now, $\cos^8 x + \cos^6 x + \cos^4 x$
$$= (\cos^2 x)^4 + 2(\cos^2 x)^3 + (\cos^2 x)^2$$
$$= \sin^4 x + 2\sin^3 x + \sin^2 x$$
$$\qquad \text{[from Eq. (i)]}$$
$$= \sin^2 x(\sin^2 x + 2\sin x + 1)$$
$$= \sin^2 x(\sin x + 1)^2$$
$$= [(\sin x)(\sin x + 1)]^2$$
$$= (\sin^2 x + \sin x)^2$$
$$= (1)^2 \qquad [\because \sin^2 x + \sin x = 1]$$
$$= 1$$

47. What is the value of $\operatorname{cosec}^2 68° + \sec^2 56° - \cot^2 34° - \tan^2 22°$?

(a) 0   (b) $\dfrac{1}{2}$ (c) 1   (d) 2

⊘ *(d)* We have, $\operatorname{cosec}^2 68° + \sec^2 56°$
$$\qquad\qquad - \cot^2 34° - \tan^2 22°$$
$$= \operatorname{cosec}^2 68° - \tan^2 22°$$
$$\qquad\qquad + \sec^2 56° - \cot^2 34°$$
$$= \operatorname{cosec}^2 68° - \tan^2(90° - 68°)$$
$$\qquad\qquad + \sec^2 56° - \cot^2(90° - 56°)$$
$$= \operatorname{cosec}^2 68° - \cot^2 68° + \sec^2 56°$$
$$\qquad\qquad - \tan^2 56°$$
$$[\because \tan(90° - \theta) = \cot\theta\cot, (90° - \theta) = \tan\theta]$$
$$= 1 + 1 = 2$$
$$[\because \operatorname{cosec}^2\theta - \cot^2\theta = 1, \sec^2\theta - \tan^2 = 1]$$

48. If $2y\cos\theta = x\sin\theta$ and $2x\sec\theta - y\operatorname{cosec}\theta = 3$, then what is $x^2 + 4y^2$ equal to?

(a) 1   (b) 2   (c) 4   (d) 8

⊘ *(c)* Given, $2y\cos\theta = x\sin\theta$
$$\Rightarrow \quad x\sin\theta - 2y\cos\theta = 0 \qquad \ldots(i)$$
and $\quad 2x\sec\theta - y\operatorname{cosec}\theta = 3$
$$\Rightarrow \quad \frac{2x}{\cos\theta} - \frac{y}{\sin\theta} = 3$$
$$\left[\because \sec\theta = \frac{1}{\cos\theta} \text{ and } \operatorname{cosec}\theta = \frac{1}{\sin\theta}\right]$$
$$\Rightarrow 2x\sin\theta - y\cos\theta = 3\sin\theta\cos\theta \quad \ldots(ii)$$

On multiplying both sides of Eq. (ii) by 2, then subtract the result from Eq. (i), we get

$x \sin\theta - 2y\cos\theta - 4x\sin\theta + 2y\cos\theta$
$\qquad = 0 - 6\sin\theta\cos\theta$

$\Rightarrow \quad -3x\sin\theta = -6\sin\theta\cos\theta$

$\Rightarrow \qquad x = \dfrac{-6\sin\theta\cos\theta}{-3\sin\theta}$

$\Rightarrow \qquad x = 2\cos\theta \qquad \ldots\text{(iii)}$

On putting $x = 2\cos\theta$ in Eq. (i), we get

$2\cos\theta\sin\theta - 2y\cos\theta = 0$

$\Rightarrow \qquad y = \dfrac{2\cos\theta\sin\theta}{2\cos\theta}$

$\Rightarrow \qquad y = \sin\theta \qquad \ldots\text{(iv)}$

$\therefore x^2 + 4y^2 = (2\cos\theta)^2 + 4(\sin\theta)^2$
$\qquad\qquad$ [from Eqs. (iii) and (iv)]
$\qquad = 4\cos^2\theta + 4\sin^2\theta$
$\qquad = 4(\cos^2\theta + \sin^2\theta)$
$\qquad = 4 \qquad [\because \cos^2\theta + \sin^2\theta = 1]$

49. If $\sin\theta + \cos\theta = \dfrac{1+\sqrt{3}}{2}$, where $0 < \theta < \dfrac{\pi}{2}$, then what is $\tan\theta + \cot\theta$ equal to?

(a) $\dfrac{\sqrt{3}}{4}$ (b) $\dfrac{1}{\sqrt{3}}$ (c) $\sqrt{3}$ (d) $\dfrac{4}{\sqrt{3}}$

⟩ **(d)** Given, $\sin\theta + \cos\theta = \dfrac{1+\sqrt{3}}{2}$

On squaring both sides, we get

$(\sin\theta + \cos\theta)^2 = \left(\dfrac{1+\sqrt{3}}{2}\right)^2$

$\Rightarrow \sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta$

$\qquad = \dfrac{1^2 + (\sqrt{3})^2 + 2\times 1\times\sqrt{3}}{4}$
$\qquad\qquad [\because (a+b)^2 = a^2 + b^2 + 2ab]$

$\Rightarrow 1 + 2\sin\theta\cos\theta = \dfrac{1+3+2\sqrt{3}}{4}$
$\qquad\qquad [\because \sin^2\theta + \cos^2\theta = 1]$

$\Rightarrow \quad 2\sin\theta\cos\theta = \dfrac{4+2\sqrt{3}}{4} - 1$

$\qquad = \dfrac{4+2\sqrt{3}-4}{4} = \dfrac{2\sqrt{3}}{4}$

$\Rightarrow \qquad 2\sin\theta\cos\theta = \dfrac{\sqrt{3}}{2}$

$\therefore \qquad \sin\theta\cos\theta = \dfrac{\sqrt{3}}{4} \qquad \ldots\text{(i)}$

Now, $\tan\theta + \cot\theta = \dfrac{\sin\theta}{\cos\theta} + \dfrac{\cos\theta}{\sin\theta}$

$\qquad = \dfrac{\sin^2\theta + \cos^2\theta}{\cos\theta\sin\theta} = \dfrac{1}{\sin\theta\cos\theta}$

$\qquad = \dfrac{1}{\left(\dfrac{\sqrt{3}}{4}\right)} \qquad$ [from Eq. (i)]

$\qquad = \dfrac{4}{\sqrt{3}}$

---

50. If $A = \sin^2\theta + \cos^4\theta$, where $0 \le \theta < \dfrac{\pi}{2}$, then which one of the following is correct?

(a) $1 \le A \le 2$ (b) $\dfrac{3}{4} \le A \le 1$

(c) $\dfrac{13}{16} \le A \le 2$ (d) $\dfrac{3}{4} \le A \le \dfrac{13}{16}$

⟩ **(b)** The value of A, when $\theta = 0°$,

$\sin^2\theta + \cos^4\theta = 1$

When $\theta = 45°$,

$\sin^2\theta + \cos^4\theta = \dfrac{1}{2} + \dfrac{1}{4} = \dfrac{3}{4}$

When $\theta = 30°$,

$\sin^2\theta + \cos^4\theta = \dfrac{1}{4} + \dfrac{9}{16} = \dfrac{13}{16}$

$\therefore$ Value of A, $\dfrac{3}{4} \le A \le 1$

51. What is $\dfrac{\cot A + \operatorname{cosec} A - 1}{\cot A - \operatorname{cosec} A + 1}$ equal to?

(a) $\dfrac{1+\cos A}{\sin A}$ (b) $\dfrac{1-\cos A}{\sin A}$

(c) $\dfrac{1+\sin A}{\cos A}$ (d) $\dfrac{1-\sin A}{\cos A}$

⟩ **(a)** Let $y = \dfrac{\cot A + \operatorname{cosec} A - 1}{\cot A - \operatorname{cosec} A + 1}$

$\qquad = \dfrac{\dfrac{\cos A}{\sin A} + \dfrac{1}{\sin A} - 1}{\dfrac{\cos A}{\sin A} - \dfrac{1}{\sin A} + 1}$

$\qquad \left[\because \cot\theta = \dfrac{\cos\theta}{\sin\theta} \text{ and } \operatorname{cosec}\theta = \dfrac{1}{\sin\theta}\right]$

$\qquad = \dfrac{\cos A + 1 - \sin A}{\cos A - 1 + \sin A}$

$\qquad = \dfrac{\cos A + (1 - \sin A)}{\cos A - (1 - \sin A)}$

$\qquad\qquad \times \dfrac{\cos A + (1 - \sin A)}{\cos A + (1 - \sin A)}$
$\qquad\qquad\qquad$ [by rationalisation]

$\qquad = \dfrac{[\cos A + (1 - \sin A)]^2}{\cos^2 A - (1 - \sin A)^2}$
$\qquad\qquad [\because (a-b)(a+b) = a^2 - b^2]$

$\qquad = \dfrac{\begin{bmatrix}\cos^2 A + (1-\sin A)^2 \\ + 2\cos A(1-\sin A)\end{bmatrix}}{\cos^2 A - (1-\sin A)^2}$
$\qquad\qquad [\because (a+b)^2 = a^2 + b^2 + 2ab]$

$\qquad = \dfrac{\begin{bmatrix}(1-\sin^2 A) + (1-\sin A)^2 \\ + 2\cos A(1-\sin A)\end{bmatrix}}{(1-\sin^2 A) - (1-\sin A)^2}$
$\qquad\qquad [\because \cos^2\theta = 1 - \sin^2\theta]$

$\qquad = \dfrac{\begin{bmatrix}(1-\sin A)(1+\sin A) + (1-\sin A)^2 \\ + 2\cos A(1-\sin A)\end{bmatrix}}{(1-\sin A)(1+\sin A) - (1-\sin A)^2}$
$\qquad\qquad [\because a^2 - b^2 = (a-b)(a+b)]$

$\qquad = \dfrac{(1-\sin A)[(1+\sin A) + (1-\sin A) + 2\cos A]}{(1-\sin A)[(1+\sin A) - (1-\sin A)]}$

$\qquad = \dfrac{2 + 2\cos A}{2\sin A} = \dfrac{1+\cos A}{\sin A}$

Option (a) is correct.

52. Consider the following

   I. $\sin 1° > \sin 1^c$
   II. $\cos 1° < \cos 1^c$
   III. $\tan 1° > \tan 1^c$

Which of the above are not correct?

(a) I and II
(b) II and III
(c) I and III
(d) I, II and III

⟩ **(d)** We know that,

$\qquad \text{radian} = \dfrac{180}{\pi} \text{ degree}$

$\qquad\qquad = 57° 17' 45''$

Now,

I. $\sin 1° > \sin 1^c$

$\Rightarrow \sin 1° > \sin \dfrac{180°}{\pi}$

False, since $\sin\theta$ is an increasing function for

$\qquad \theta \in \left[0, \dfrac{\pi}{2}\right].$

II. $\cos 1° < \cos \dfrac{180°}{\pi}$

False, since $\cos\theta$ is an decreasing function for

$\qquad \theta \in \left[0, \dfrac{\pi}{2}\right].$

III. $\tan 1° > \tan \dfrac{180°}{\pi}$

False, since $\tan\theta$ is an increasing function for

$\qquad \theta \in \left[0, \dfrac{\pi}{2}\right].$

53. If $\tan^2 x + \dfrac{1}{\tan^2 x} = 2$ and $0° < x < 90°$, then what is the value of x?

(a) 15°   (b) 30°
(c) 45°   (d) 60°

⟩ **(c)** Given,

$\qquad\qquad \tan^2 x + \dfrac{1}{\tan^2 x} = 2$

$\Rightarrow \qquad \tan^4 x + 1 - 2\tan^2 x = 0$

$\Rightarrow \qquad (\tan^2 x - 1)^2 = 0$

$\Rightarrow$ $\tan^2 x - 1 = 0$

$[\because a^2 + b^2 - 2ab = (a-b)^2]$

$\Rightarrow$ $\tan^2 x = 1$

$\Rightarrow$ $\tan x = \pm 1$

$\Rightarrow$ $\tan x = 1 \quad [\because 0° < x < 90°]$

$\Rightarrow$ $\tan x = \tan 45°$

$\therefore$ $x = 45°$

54. Consider the following

I. $\dfrac{\cos 75°}{\sin 15°} + \dfrac{\sin 12°}{\cos 78°} - \dfrac{\cos 18°}{\sin 72°} = 1$

II. $\dfrac{\cos 35°}{\sin 55°} - \dfrac{\sin 11°}{\cos 79°} +$
$\cos 28° \operatorname{cosec} 62° = 1$

III. $\dfrac{\sin 80°}{\cos 10°} - \sin 59° \sec 31° = 0$

Which of the above are correct?

(a) I and II
(b) II and III
(c) I and III
(d) I, II and III

$\odot$ **(d)** I. LHS $\dfrac{\cos 75°}{\sin 15°} + \dfrac{\sin 12°}{\cos 78°} - \dfrac{\cos 18°}{\sin 72°}$

$= \dfrac{\cos (90° - 15°)}{\sin 15°} + \dfrac{\sin (90° - 78°)}{\cos 78°}$

$\qquad - \dfrac{\cos (90° - 72°)}{\sin 72°}$

$[\because \sin(90° - \theta) = \cos\theta, \cos(90° - \theta) = \sin\theta]$

$= \dfrac{\sin 15°}{\sin 15°} + \dfrac{\cos 78°}{\cos 78°} - \dfrac{\sin 72°}{\sin 72°}$

$= 1 + 1 - 1 = 1 = \text{RHS}$

II. LHS $= \dfrac{\cos 35°}{\sin 55°} - \dfrac{\sin 11°}{\cos 79°} + \cos 28°$

$\qquad\qquad\qquad\qquad \operatorname{cosec} 62°$

$= \dfrac{\cos (90° - 55°)}{\sin 55°} - \dfrac{\sin (90° - 79°)}{\cos 79°}$

$+ \cos 28° \cdot \dfrac{1}{\sin 62°} \left[\because \sin\theta = \dfrac{1}{\operatorname{cosec}\theta}\right]$

$= \dfrac{\sin 55°}{\sin 55°} - \dfrac{\cos 79°}{\cos 79°} + \dfrac{\cos (90° - 62°)}{\sin 62°}$

$= 1 - 1 + 1 \qquad [\because \cos(90 - \theta) = \sin\theta]$

$= 1 = \text{RHS}$

III. LHS $= \dfrac{\sin 80°}{\cos 10°} - \sin 59° \sec 31°$

$= \dfrac{\sin 80°}{\cos (90° - 80°)} - \sin 59° \sec (90° - 59°)$

$= \dfrac{\sin 80°}{\sin 80°} - \sin 59° \operatorname{cosec} 59°$

$= 1 - \sin 59° \cdot \dfrac{1}{\sin 59°}$

$= 1 - 1 = 0 = \text{RHS}$

55. What is the value of $\tan 1° \tan 2°$ $\tan 3° \tan 4° \ldots \tan 89°$?

(a) 0   (b) 1   (c) 2   (d) $\sqrt{3}$

$\odot$ **(b)** We have, $\tan 1° \tan 2° \tan 3° \ldots$
$\tan 89°$

$= \tan 1° \tan 2° \tan 3° \ldots \tan 45° \tan 46°$
$\qquad\qquad\qquad\qquad \tan 47° \ldots \tan 89°$

$= (\tan 1° \tan 89°) \cdot (\tan 2° \tan 88°) \ldots$
$\qquad\qquad (\tan 44° \tan 46°) \cdot \tan 45°$

$= 1 \cdot 1 \ldots 1 = 1 \quad [\because \tan\theta \tan(90° - \theta) = 1]$

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56. If $\tan\theta + \cot\theta = \dfrac{4}{\sqrt{3}}$, where

$0 < \theta < \dfrac{\pi}{2}$, then $\sin\theta + \cos\theta$ is

equal to

(a) 1   (b) $\dfrac{\sqrt{3} - 1}{2}$

(c) $\dfrac{\sqrt{3} + 1}{2}$ (d) $\sqrt{2}$

$\odot$ **(c)** We have, $\tan\theta + \cot\theta = \dfrac{4}{\sqrt{3}}$

$\Rightarrow$ $\dfrac{\sin\theta}{\cos\theta} + \dfrac{\cos\theta}{\sin\theta} = \dfrac{4}{\sqrt{3}}$

$\Rightarrow$ $\dfrac{\sin^2\theta + \cos^2\theta}{\cos\theta \cdot \sin\theta} = \dfrac{4}{\sqrt{3}}$

$\Rightarrow$ $\dfrac{1}{\dfrac{\sin 2\theta}{2}} = \dfrac{4}{\sqrt{3}} \Rightarrow \sin 2\theta = \dfrac{\sqrt{3}}{2}$

$\Rightarrow$ $2\theta = \dfrac{\pi}{3} \Rightarrow \theta = \dfrac{\pi}{6}$

$\therefore$ $\sin\theta + \cos\theta = \sin\dfrac{\pi}{6} + \cos\dfrac{\pi}{6}$

$= \dfrac{1}{2} + \dfrac{\sqrt{3}}{2} = \dfrac{\sqrt{3} + 1}{2}$

57. Consider the following statements

1. There exists a positive real number m such that $\cos x = 2^{m+1}$.

2. $mn \geq m + n$, for all m, n belonging to set of natural numbers.

Which of the above statement(s) is/are correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

$\odot$ **(d)** 1. As $\cos x$ lies between -1 and 1, then $\cos x = 2^{m+1}$ does not exist for positive value of m.

2. $\because$ AM $\geq$ GM

$\therefore \dfrac{m + n}{2} \geq \sqrt{mn}$, so $mn \geq (m + n)$

does not hold true for m, n belonging to natural numbers.

Let's take an example.

If $m = 1$, then $n \geq 1 + n$ this cannot be true.

Hence, neither 1 nor 2 is correct.

58. If $\dfrac{x}{a} - \dfrac{y}{b} \tan\theta = 1$ and

$\dfrac{x}{a} \tan\theta + \dfrac{y}{b} = 1$, then the value of

$\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2}$ is

(a) $2\sec^2\theta$ (b) $\sec^2\theta$
(c) $\cos^2\theta$ (d) $2\cos^2\theta$

$\odot$ **(d)** Given, $\dfrac{x}{a} - \dfrac{y}{b}\tan\theta = 1$ ...(i)

and $\dfrac{x}{a}\tan\theta + \dfrac{y}{b} = 1$ ...(ii)

On solving Eqs. (i) and (ii), we get

$\dfrac{-y}{b} = \dfrac{1 - \dfrac{x}{a}}{\tan\theta}$

[by solving Eq. (i)]

$\dfrac{y}{b} = -\dfrac{(1 - x/a)}{\tan\theta}$ ...(iii)

$\dfrac{y}{b} = 1 - \dfrac{x}{a}\tan\theta$ ...(iv)

[by solving Eq. (iii)]

From Eqs. (iii) and (iv)

$\left(\dfrac{1 - \dfrac{x}{a}}{\tan\theta}\right) = 1 - \dfrac{x}{a}\tan\theta$

$1 - \dfrac{x}{a} = \tan\theta\left(\dfrac{x}{a}\tan\theta - 1\right)$

$1 - \dfrac{x}{a} = \dfrac{x}{a}\tan^2\theta - \tan\theta$

$1 + \tan\theta = \dfrac{x}{a}(\tan^2\theta - 1)$

$\dfrac{x}{a} = \dfrac{1 + \tan\theta}{\sec^2\theta}$ ...(v)

Eq. (v) put in Eq. (iii)

$\dfrac{-y}{b} = \dfrac{1 - 1 + \tan\theta}{\dfrac{\sec^2\theta}{\tan\theta}}$

$\dfrac{-y}{b} = \dfrac{\sec^2\theta - 1 - \tan\theta}{\tan\theta\sec^2\theta}$

$\dfrac{-y}{b} = \dfrac{\tan^2\theta - \tan\theta}{\tan\theta\sec^2\theta}$

$[\because 1 + \tan^2\theta = \sec^2\theta]$

$\dfrac{y}{b} = \dfrac{\tan\theta(1 - \tan\theta)}{\tan\theta\sec^2\theta}$

$$\frac{y}{b} = \frac{1 - \tan\theta}{\sec^2\theta} \qquad \ldots(iv)$$

$$\frac{x}{a} = \frac{1 + \tan\theta}{\sec^2\theta} \text{ and } \frac{y}{b} = \frac{1 - \tan\theta}{\sec^2\theta}$$

$$\therefore \frac{x^2}{a^2} + \frac{y^2}{b^2} = \frac{(1 + \tan\theta)^2 + (1 - \tan\theta)^2}{\sec^4\theta}$$

$$= \frac{2 + 2\tan^2\theta}{\sec^4\theta}$$

$$= \frac{2(1 + \tan^2\theta)}{\sec^4\theta}$$

$$= \frac{2\sec^2\theta}{\sec^4\theta} = 2\cos^2\theta$$

$$[\because 1 + \tan^2\theta = \sec^2\theta]$$

59. Consider the following

1. $\sqrt{\dfrac{1 - \cos\theta}{1 + \cos\theta}} = \cosec\theta - \cot\ \theta$

2. $\sqrt{\dfrac{1 + \cos\theta}{1 - \cos\theta}} = \cosec\theta + \cot\theta$

Which of the above is/are identity/ identities are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊛ **(c)** 1.

$$\sqrt{\frac{1 - \cos\theta}{1 + \cos\theta}} = \sqrt{\frac{1 - \cos\theta}{1 + \cos\theta} \times \frac{1 - \cos\theta}{1 - \cos\theta}}$$

$$= \sqrt{\frac{(1 - \cos\theta)^2}{1 - \cos^2\theta}}$$

$$= \sqrt{\frac{(1 - \cos\theta)^2}{\sin^2\theta}} = \frac{1 - \cos\theta}{\sin\theta}$$

$$[\because 1 - \cos^2\theta = \sin^2\theta]$$

$$= \cosec\ \theta - \cot\theta$$
Hence, statement 1 is true.

2. $\sqrt{\dfrac{1 + \cos\theta}{1 - \cos\theta}} = \sqrt{\dfrac{1 + \cos\theta}{1 - \cos\theta} \times \dfrac{1 + \cos\theta}{1 + \cos\theta}}$

$$= \sqrt{\frac{(1 + \cos\theta)^2}{1 - \cos^2\theta}}$$

$$= \sqrt{\frac{(1 + \cos\theta)^2}{\sin^2\theta}}$$

$$= \frac{1 + \cos\theta}{\sin\theta}$$

$$= \cosec\ \theta + \cot\theta$$
Hence, statement 2 is true.

60. If $p = \cot\theta + \tan\theta$ and $q = \sec\theta - \cos\theta$, then $(p^2q)^{2/3} - (q^2p)^{2/3}$ is equal to
(a) 0　　　　(b) 1
(c) 2　　　　(d) 3

⊛ **(b)** We have, $p = \cot\theta + \tan\theta$

$$P = \frac{\cos\theta}{\sin\theta} + \frac{\sin\theta}{\cos\theta} = \frac{\cos^2\theta + \sin^2\theta}{\sin\theta\cos\theta}$$

$$= \frac{1}{\sin\theta\cos\theta}$$

$$q = \sec\theta - \cos\theta$$

$$q = \frac{1}{\cos\theta} - \cos\theta = \frac{1 - \cos^2\theta}{\cos\theta}$$

$$= \sin^2\theta\sec\theta$$

$$\therefore (p^2q)^{2/3} - (q^2p)^{2/3}$$

$$= (\cosec^2\theta \cdot \sec^2\theta \cdot \sin^2\theta \cdot \sec\theta)^{2/3}$$

$$\quad - (\sin^4\theta \cdot \sec^2\theta \cdot \cosec\ \theta \cdot \sec\theta)^{2/3}$$

$$= (\sec^3\theta)^{2/3} - (\sin^3\theta \cdot \sec^3\theta)^{2/3}$$

$$= \sec^2\theta - \sin^2\theta \cdot \sec^2\theta$$

$$= \sec^2\theta\ (1 - \sin^2\theta) = 1$$

61. If $\dfrac{\cos^2\theta - 3\cos\theta + 2}{\sin^2\theta} = 1$, where $0 < \theta < \dfrac{\pi}{2}$, then which of the following statement(s) is/are correct?

1. There are two values of θ satisfying the above equation.

2. $\theta = 60°$ is satisfied by the above equation.

Select the correct answer using the codes given below.
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊛ **(b)** $\because \dfrac{\cos^2\theta - 3\cos\theta + 2}{\sin^2\theta} = 1$

$$\Rightarrow \cos^2\theta - 3\cos\theta + 1 + 1 - \sin^2\theta = 0$$

$$\Rightarrow \cos^2\theta - 3\cos\theta + 1 + \cos^2\theta = 0$$

$$\Rightarrow 2\cos^2\theta - 3\cos\theta + 1 = 0$$

$$\Rightarrow (2\cos\theta - 1)(\cos\theta - 1) = 0$$

$$\Rightarrow \cos\theta = \frac{1}{2} \text{ or } \cos\theta = 1$$

$$\therefore \theta = 60° \text{ or } \theta = 0°$$

But, $0 < \theta < \dfrac{\pi}{2}$　　　　(given)

Then,
Only $\theta = 60°$ is correct
Hence, only statement 2nd is correct.

62. Which of the following is correct in respect of the equation $3 - \tan^2\theta = \alpha(1 - 3\tan^2\theta)$? (given that α is a real number.)

(a) $\alpha \in \left[\dfrac{1}{3}, 3\right]$

(b) $\alpha \in \left(-\infty, \dfrac{1}{3}\right] \cup [3, \infty)$

(c) $\alpha \in \left(-\infty, \dfrac{1}{3}\right) \cup [3, \infty)$

(d) None of the above

⊛ **(b)** $\because 3 - \tan^2\theta = \alpha\ (1 - 3\tan^2\theta)$

$$\Rightarrow (3\alpha - 1)\tan^2\theta = \alpha - 3$$

$$\Rightarrow \tan^2\theta = \frac{\alpha - 3}{3\alpha - 1}$$

As, $\tan^2\theta \geq 0$, then

$$\frac{\alpha - 3}{3\alpha - 1} \geq 0$$

$$\Rightarrow \alpha \geq 3 \text{ or } \alpha \leq \frac{1}{3}$$

$$\therefore \alpha \in \left(-\infty, \frac{1}{3}\right] \cup [3, \infty)$$

63. $\left(\dfrac{\sin 35°}{\cos 55°}\right)^2 - \left(\dfrac{\cos 55°}{\sin 35°}\right)^2$
$+ 2\sin 30°$ is equal to
(a) -1　　　　(b) 0
(c) 1　　　　(d) 2

⊛ **(c)** $\left(\dfrac{\sin 35°}{\cos 55°}\right)^2 - \left(\dfrac{\cos 55°}{\sin 35°}\right)^2 + 2\sin 30°$

$$= \left[\frac{\sin (90° - 55°)}{\cos 55°}\right]^2$$

$$\quad - \left[\frac{\cos (90° - 35°)}{\sin 35°}\right]^2 + 2 \times \frac{1}{2}$$

$$\begin{bmatrix}\because \sin(90° - \theta) = \cos\theta, \\ \cos(90° - \theta) = \sin\theta\end{bmatrix}$$

$$= \left(\frac{\cos 55°}{\cos 55°}\right)^2 - \left(\frac{\sin 35°}{\sin 35°}\right)^2 + 1$$

$$= 1^2 - 1^2 + 1 = 1$$

2015 (II)

64. Consider the following statements

1. $\dfrac{1 + \tan^2\theta}{1 + \cot^2\theta} = \left(\dfrac{1 - \tan\theta}{1 - \cot\theta}\right)^2$ is true for all $0 < \theta < \dfrac{\pi}{2}, \theta \neq \dfrac{\pi}{4}$

2. $\cot\theta = \dfrac{1}{\tan\theta}$ is true for $\theta = 45°$ only.

Which of the above statement(s) is/are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊛ **(a)** 1. LHS

$$= \frac{1 + \tan^2\theta}{1 + \cot^2\theta} = \frac{\sec^2\theta}{\cosec^2\theta} = \tan^2\theta$$

$$\text{RHS} = \left(\frac{1 - \tan\theta}{1 - \cot\theta}\right)^2 = \left(\frac{1 - \tan\theta}{1 - \dfrac{1}{\tan\theta}}\right)^2$$

$$= \left(\frac{(1-\tan\theta)\tan\theta}{\tan\theta - 1}\right)^2$$

$$= \tan^2\theta$$

At $\theta = \frac{\pi}{4}$, RHS $= \frac{0}{0}$ form, which is indeterminante form.

∴ Statement 1 is correct.

2. $\cot\theta = \frac{1}{\tan\theta} \Rightarrow \tan\theta \cdot \cot\theta = 1$

Which is true for all values of θ.
Hence, Statement 2 is incorrect but Statement 1 is correct.

65. If $x = a\cos\theta$ and $y = b\cot\theta$, then $(ax^{-1} - by^{-1})(ax^{-1} + by^{-1})$ is equal to

(a) 0   (b) 1
(c) $\tan^2\theta$ (d) $\sin^2\theta$

⊘ **(b)** We have, $x = a\cos\theta$ and $y = b\cot\theta$

∴ $\left(\frac{a}{x} - \frac{b}{y}\right)\left(\frac{a}{x} + \frac{b}{y}\right) = \frac{a^2}{x^2} - \frac{b^2}{y^2}$

$\frac{a^2}{a^2\cos^2\theta} - \frac{b^2}{b^2\cot^2\theta} = \frac{1}{\cos^2\theta} - \frac{1}{\cot^2\theta}$

$= \sec^2\theta - \tan^2\theta = 1$

66. $\frac{\cos\theta}{1-\sin\theta}$ is equal to $\left(\text{where}, \theta \neq \frac{\pi}{2}\right)$

(a) $\frac{\tan\theta - 1}{\tan\theta + 1}$ (b) $\frac{1 + \sin\theta}{\cos\theta}$
(c) $\frac{\tan\theta + 1}{\tan\theta - 1}$ (d) $\frac{1 + \cos\theta}{\sin\theta}$

⊘ **(b)** We have,
$\frac{\cos\theta}{1 - \sin\theta} \times \frac{1 + \sin\theta}{1 + \sin\theta}$

$= \frac{\cos\theta(1 + \sin\theta)}{1 - \sin^2\theta}$

$= \frac{\cos\theta(1 + \sin\theta)}{\cos^2\theta}$

$[\because 1 - \sin^2\theta = \cos^2\theta]$

$= \frac{1 + \sin\theta}{\cos\theta}$

67. If
$\tan(x + 40)° \tan(x + 20)° \tan(3x)°$
$\tan(70 - x)° \tan(50 - x)° = 1,$
then the value of x is

(a) 30   (b) 20
(c) 15   (d) 10

⊘ **(c)** We have,
$\tan(x + 40)° \tan(x + 20)° \tan(3x)°$
$\tan(70 - x)° \tan(50 - x)° = 1$

$[\because \cot(90° - \theta) = \tan\theta]$

$\Rightarrow \tan(x + 40)° \tan(x + 20)° \tan(3x)°$

$\cot(90° - 70° + x)°$
$\cot(90 - 50 + x)° = 1$
$\Rightarrow \tan(x + 40)° \tan(x + 20)° \tan(3x)°$
$\cot(20 + x)° \cot(40 + x)° = 1$
$\Rightarrow \tan(3x)° = 1$ $[\because \tan\theta\cot\theta = 1]$
$\Rightarrow \tan(3x)° = \tan 45°$
$\Rightarrow 3x = 45$
∴ $x = 15$

68. If θ is an acute angle and
$\sin\theta\cos\theta = 2\cos^3\theta - 1.5\cos\theta,$
then what is $\sin\theta$ equal to?

(a) $\frac{\sqrt{5} - 1}{4}$ (b) $\frac{1 - \sqrt{5}}{4}$
(c) $\frac{\sqrt{5} + 1}{4}$ (d) $-\frac{\sqrt{5} + 1}{4}$

⊘ **(a)** We have,
$\sin\theta\cos\theta = 2\cos^3\theta - \frac{3}{2}\cos\theta$
$\Rightarrow 2\sin\theta\cos\theta = 4\cos^3\theta - 3\cos\theta$
$\cos\theta \neq 0; 2\sin\theta = 4\cos^2\theta - 3$
$\Rightarrow \qquad 2\sin\theta = 4 - 4\sin^2\theta - 3$
$[\because \cos^2\theta = 1 - \sin^2\theta]$
$\Rightarrow 4\sin^2\theta + 2\sin\theta - 1 = 0$
∴ $\sin\theta = \frac{-2 \pm \sqrt{4 + 16}}{8}$
$= \frac{-2 \pm 2\sqrt{5}}{8}$
$\Rightarrow \qquad \sin\theta = \frac{-1 \pm \sqrt{5}}{4}$

Since, θ is an acute angle.
$\sin\theta > 0$
∴ $\sin\theta = \frac{\sqrt{5} - 1}{4}$

69. Consider the following statements

1. $\sin 66°$ is less than $\cos 66°$.
2. $\sin 26°$ is less than $\cos 26°$.

Which of the above statement(s) is/are correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊘ **(b)** 1. If $45° < \theta < 90°$
Then, $\sin\theta > \cos\theta$
∴ $\sin 66° > \cos 66°$ incorrect.

2. When $0° < \theta < 45°$, $\cos\theta > \sin\theta$,
$\cos 26° > \sin 26°$
or $\sin 26° < \cos 26°$. It is correct
Hence, only 2 is correct.

70. If a and b are positive, then the relation $\sin\theta = \frac{2a + 3b}{3b}$ is

(a) not possible
(b) possible only if $a = b$
(c) possible, if $a > b$
(d) possible, if $a < b$

⊘ **(a)** We have,
$\sin\theta = \frac{2a + 3b}{3b} = 1 + \frac{2a}{3b}$
Since, $\sin\theta$ is always smaller or equal to 1 but $1 + \frac{2a}{3} > 1$. $[\because a > 0]$
Hence, it is not possible.

71. If $\tan\theta + \sec\theta = 2$, then $\tan\theta$ is equal to

(a) $\frac{3}{4}$ (b) $\frac{5}{4}$
(c) $\frac{3}{2}$ (d) $\frac{5}{2}$

⊘ **(a)** We have, $\tan\theta + \sec\theta = 2$
$\Rightarrow \sec\theta = 2 - \tan\theta$
On squaring both sides, we get
$\sec^2\theta = 4 + \tan^2\theta - 4\tan\theta$
$[\because (a - b)^2 = a^2 + b^2 - 2ab]$
$\Rightarrow \qquad 1 + \tan^2\theta = 4 + \tan^2\theta - 4\tan\theta$
$\Rightarrow \qquad 4\tan\theta = 3 \Rightarrow \tan\theta = \frac{3}{4}$

72. The minimum value of
$\cos^2 x + \cos^2 y - \cos^2 z$ is

(a) -1 (b) 0
(c) 2   (d) 2

⊘ **(a)** Since, $0 \leq \cos^2 x \leq 1$
$\because -1 \leq \cos^2 x + \cos^2 y - \cos^2 z \leq 2$
∴ Minimum value of the given expression is -1.

73. The value of
$32\cot^2\left(\frac{\pi}{4}\right) - 8\sec^2\left(\frac{\pi}{3}\right)$
$+ 8\cos^3\left(\frac{\pi}{6}\right)$ is

(a) $\sqrt{3}$ (b) $2\sqrt{3}$ (c) 3   (d) $3\sqrt{3}$

⊘ **(d)** We have,
$32\cot^2\frac{\pi}{4} - 8\sec^2\left(\frac{\pi}{3}\right) + 8\cos^3\left(\frac{\pi}{6}\right)$

$= 32 \cdot (1) - 8 \cdot (2)^2 + 8 \cdot \left(\frac{\sqrt{3}}{2}\right)^3$

$= 32 - 8 \cdot (4) + 8 \cdot \frac{3\sqrt{3}}{8}$

$= 32 - 32 + 3\sqrt{3}$

$= 3\sqrt{3}$

2015 (I)

74. If $\tan(A + B) = \sqrt{3}$ and $\tan A = 1$, then $\tan(A - B)$ is equal to
(a) 0   (b) 1
(c) $\dfrac{1}{\sqrt{3}}$ (d) $\sqrt{2}$

⊙ **(c)** Given, $\tan(A + B) = \sqrt{3}$
$\Rightarrow \quad \tan(A + B) = \tan 60°$
$\therefore \qquad A + B = 60° \qquad$ ...(i)
and $\qquad \tan A = 1$
$\Rightarrow \qquad \tan A = \tan 45°$
$\therefore \qquad A = 45°$
From Eq. (i), $\quad A + B = 60°$
$\Rightarrow \qquad 45°+ B = 60° \Rightarrow \quad B = 15°$
Now, $\quad \tan(A - B) = \tan(45° - 15°)$
$$= \tan 30° = \frac{1}{\sqrt{3}}$$
Hence, the value of $\tan(A - B)$ is $\dfrac{1}{\sqrt{3}}$.

75. If $\cos A = \tan B, \cos B = \tan C$ and $\cos C = \tan A$, then $\sin A$ is equal to
(a) $\dfrac{\sqrt{5} - 1}{4}$ (b) $\dfrac{\sqrt{5} - 1}{2}$
(c) $\dfrac{\sqrt{3} - 1}{4}$ (d) $\dfrac{\sqrt{3} - 1}{2}$

⊙ **(b)** Let $\qquad \sin A = x \qquad$ ...(i)
Then, $\cos A = \tan B$
$\Rightarrow \quad \sqrt{1 - \sin^2 A} = \tan B$
$\Rightarrow \qquad \sqrt{1 - x^2} = \tan B \qquad$ ...(ii)
Now, $\qquad \cos B = \tan C$
$\Rightarrow \qquad \dfrac{1}{\sec B} = \tan C$
$\Rightarrow \qquad \dfrac{1}{\sqrt{1 + \tan^2 B}} = \tan C$
From Eq. (ii), we get
$$\frac{1}{\sqrt{1 + 1 - x^2}} = \tan C$$
$\Rightarrow \qquad \dfrac{1}{\sqrt{2 - x^2}} = \tan C \qquad$ ...(iii)
Now, $\cos C = \dfrac{1}{\sqrt{\sec^2 C}} = \dfrac{1}{\sqrt{1 + \tan^2 C}}$
$$= \frac{1}{\sqrt{1 + \dfrac{1}{2 - x^2}}} \text{ [from Eq. (iii)]}$$
$\Rightarrow \quad \cos C = \dfrac{\sqrt{2 - x^2}}{\sqrt{3 - x^2}} \qquad$ ...(iv)
$\because \qquad \cos C = \tan A$
$\Rightarrow \quad \cos C = \dfrac{\sin A}{\cos A}$

$\Rightarrow \quad \cos C = \dfrac{\sin A}{\sqrt{1 - \sin^2 A}}$
From Eqs. (i) and (iv), we get
$$\frac{\sqrt{2 - x^2}}{\sqrt{3 - x^2}} = \frac{x}{\sqrt{1 - x^2}}$$
$\Rightarrow \qquad x = \dfrac{\sqrt{2 - x^2} \times \sqrt{1 - x^2}}{\sqrt{3 - x^2}}$
On squaring both sides, we get
$(3 - x^2)x^2 = (2 - x^2)(1 - x^2)$
$\Rightarrow \quad 3x^2 - x^4 = 2 - 2x^2 - x^2 + x^4$
$\Rightarrow \qquad 3x^2 - x^4 = 2 - 3x^2 + x^4$
$\Rightarrow \quad x^4 - 3x^2 + 2 - 3x^2 + x^4 = 0$
$\Rightarrow \quad 2x^4 - 6x^2 + 2 = 0$
$\Rightarrow \qquad x^4 - 3x^2 + 1 = 0$
Let $\qquad\qquad x^2 = t$
$\therefore \qquad\qquad t^2 - 3t + 1 = 0$
Now, comparing $\quad at^2 + bt + c = 0$,
we get
$\qquad a = 1, b = -3$ and $c = 1$
$\therefore \quad t = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
$$= \frac{3 \pm \sqrt{9 - 4 \times 1 \times 1}}{2 \times 1}$$
$\Rightarrow \quad t = 3 \pm \dfrac{\sqrt{5}}{2}$
Now, put $\ t = x^2$
$\therefore \quad x^2 = \dfrac{3 \pm \sqrt{5}}{2} = \dfrac{2}{2} \times \left(\dfrac{3 \pm \sqrt{5}}{2} \right)$
$$= \frac{6 \pm 2\sqrt{5}}{4}$$
$$= \frac{1 + 5 \pm 2\sqrt{5}}{4} = \frac{(1 \pm \sqrt{5})^2}{4}$$
$\therefore \quad x = \dfrac{\sqrt{5} - 1}{2} \Rightarrow \sin A = \dfrac{\sqrt{5} - 1}{2}$

76. If $\dfrac{3 - \tan^2 A}{1 - 3 \tan^2 A} = k$, where k is a real number, then $\csc A (3 \sin A - 4 \sin^3 A)$ is equal to
(a) $\dfrac{2k}{k - 1}$
(b) $\dfrac{2k}{k - 1}$, where $\dfrac{1}{3} \le k \le 3$
(c) $\dfrac{2k}{k - 1}$, where $k < \dfrac{1}{3}$ or $k > 3$
(d) $\dfrac{2k}{k + 1}$

⊙ **(a)** Given, $\dfrac{3 - \tan^2 A}{1 - 3 \tan^2 A} = k$
$\Rightarrow \qquad 3 - \tan^2 A = k(1 - 3 \tan^2 A)$
$\Rightarrow \qquad 3 - \tan^2 A = k - 3k \tan^2 A$
$\Rightarrow \quad 3K \tan^2 A - \tan^2 A = k - 3$

$\Rightarrow \ \tan^2 A(3k - 1) = k - 3$
$\Rightarrow \qquad \tan^2 A = \dfrac{k - 3}{3k - 1}$
$\Rightarrow \qquad \tan A = \sqrt{\dfrac{k - 3}{3k - 1}} = \dfrac{\sqrt{k - 3}}{\sqrt{3k - 1}}$
In right angled ΔABC,
$\qquad AC^2 = BC^2 + AB^2$
$\Rightarrow \quad AC^2 = (\sqrt{k - 3})^2 + (\sqrt{3k - 1})^2$
$\Rightarrow \quad AC^2 = k - 3 + 3k - 1$
$\Rightarrow \quad AC^2 = 4k - 4$
$\Rightarrow \quad AC^2 = 4(k - 1)$
$\therefore \qquad AC = 2\sqrt{k - 1}$
From the figure,
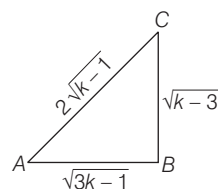
$\sin A = \dfrac{BC}{AC} = \dfrac{\sqrt{k - 3}}{2\sqrt{k - 1}}$
Now, $\csc A (3 \sin A - 4 \sin^3 A)$
$= \csc A \times \sin A (3 - 4 \sin^2 A)$
$= \dfrac{1}{\sin A} \times \sin A (3 - 4 \sin^2 A)$
$$\left[\because \csc A = \frac{1}{\sin A} \right]$$
$= 3 - 4 \sin^2 A = 3 - 4 \left(\dfrac{\sqrt{k - 3}}{2\sqrt{k - 1}} \right)^2$
$= 3 - 4 \left[\dfrac{k - 3}{4(k - 1)} \right] = 3 - \dfrac{(k - 3)}{(k - 1)}$
$= \dfrac{3(k - 1) - (k - 3)}{k - 1}$
$= \dfrac{3k - 3 - k + 3}{k - 1}$
$= \dfrac{2k}{k - 1}$

77. If $\tan A + \cot A = 4$, then $\tan^4 A + \cot^4 A$ is equal to
(a) 110   (b) 191
(c) 80   (d) 194

⊙ **(d)** Given, $\tan A + \cot A = 4$
On squaring both sides, we get
$(\tan A + \cot A)^2 = (4)^2$
$\Rightarrow \tan^2 A + \cot^2 A + 2 \tan A \cot A = 16$
$\Rightarrow \quad \tan^2 A + \cot^2 A + 2 = 16$
$$[\because \tan A \cot A = 1]$$
$\Rightarrow \qquad \tan^2 A + \cot^2 A = 14$
Again, squaring both sides, we get
$(\tan^2 A + \cot^2 A)^2 = (14)^2$
$\Rightarrow \tan^4 A + \cot^4 A + 2 \tan^2 A \cot^2 A = 196$
$\Rightarrow \qquad\qquad \tan^4 A + \cot^4 A + 2 = 196$
$\Rightarrow \qquad\qquad\qquad \tan^4 A + \cot^4 A = 194$

78. If $p = \sqrt{\dfrac{1 - \sin x}{1 + \sin x}}$, $q = \dfrac{1 - \sin x}{\cos x}$ and
$r = \dfrac{\cos x}{1 + \sin x}$, then which of the
following is/are correct?

   I. $p = q = r$ II. $p^2 = qr$

Select the correct answer using
the codes given below.
(a) Only I
(b) Only II
(c) Both I and II
(d) Neither I nor II

⊘ **(c)** Given, $p = \sqrt{\dfrac{1 - \sin x}{1 + \sin x}}$

$p = \sqrt{\dfrac{(1 - \sin x)(1 - \sin x)}{(1 + \sin x)(1 - \sin x)}}$

$\quad = \dfrac{1 - \sin x}{\sqrt{1 - \sin^2 x}} = \dfrac{1 - \sin x}{\cos x}$

$r = \dfrac{\cos x}{1 + \sin x} \times \dfrac{(1 - \sin x)}{(1 - \sin x)} = \dfrac{\cos x (1 - \sin x)}{1 - \sin^2 x}$

$\quad = \dfrac{\cos x (1 - \sin x)}{\cos^2 x} = \dfrac{1 - \sin x}{\cos x}$

$\therefore \quad p = q = r$

Now,

$p^2 = \left(\dfrac{1 - \sin x}{\cos x}\right)^2 = \dfrac{(1 - \sin x)}{\cos x} \times \dfrac{(1 - \sin x)}{\cos x}$

$\Rightarrow p^2 = q \times r$

79. Consider the following identity

   I. $\dfrac{\cos A}{1 - \tan A} + \dfrac{\sin A}{1 - \cot A}$
$\quad = \sin A + \cos A$

   II. $(1 - \sin A - \cos A)^2$
$\quad = 2(1 - \sin A)(1 + \cos A)$

Which of the above is/are
identity/identities?
(a) Only I
(b) Only II
(c) Both I and II
(d) Neither I nor II

⊘ **(a)**   I. LHS $= \dfrac{\cos A}{1 - \tan A} + \dfrac{\sin A}{1 - \cot A}$

$\quad = \dfrac{\cos A}{1 - \dfrac{\sin A}{\cos A}} + \dfrac{\sin A}{1 - \dfrac{\cos A}{\sin A}}$

$\quad = \dfrac{\cos^2 A}{\cos A - \sin A} + \dfrac{\sin^2 A}{\sin A - \cos A}$

$\quad = \dfrac{\cos^2 A}{\cos A - \sin A} - \dfrac{\sin^2 A}{\cos A - \sin A}$

$\quad = \dfrac{\cos^2 A - \sin^2 A}{(\cos A - \sin A)}$

$\quad = \dfrac{(\cos A - \sin A)(\cos A + \sin A)}{(\cos A - \sin A)}$

$\quad = (\cos A + \sin A) = $ RHS

   II.   LHS $= [(1 - \sin A) - \cos A]^2$

$\quad = (1 - \sin A)^2 + \cos^2 A$
$\quad\quad - 2\cos A(1 - \sin A)$
$\quad [\because (a - b)^2 = a^2 + b^2 - 2ab]$

$\quad = 1 + \sin^2 A - 2\sin A + \cos^2 A$
$\quad\quad - 2\cos A(1 - \sin A)$

$\quad = 1 + \sin^2 A + \cos^2 A - 2\sin A$
$\quad\quad - 2\cos A(1 - \sin A)$

$\quad = 2 - 2\sin A - 2\cos A(1 - \sin A)$

$\quad = 2(1 - \sin A) - 2\cos A(1 - \sin A)$

$\quad = 2(1 - \sin A)(1 - \cos A) \neq $ RHS

$\therefore$ Option (a) is correct.

80. ABC is a right angled triangle at
B and $AB:BC = 3:4$. What is
$\sin A + \sin B + \sin C$ equal to?

(a) 2
(b) $\dfrac{11}{5}$
(c) $\dfrac{12}{5}$
(d) 3

⊘ **(c)** In right angled $\triangle ABC$,
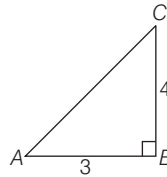
$\quad\quad AB : BC = 3 : 4$
or $\quad\quad \dfrac{AB}{BC} = \dfrac{3}{4}$

Now, in $\triangle ABC$,

$\quad\quad AC^2 = AB^2 + BC^2$
$\quad\quad\quad = 3^2 + 4^2 = 9 + 16 = 25$

$\Rightarrow \quad\quad AC = 5$

$\Rightarrow \quad\quad \sin A = \dfrac{BC}{AC} = \dfrac{4}{5}$

$\quad\quad \sin B = \sin 90° = 1$

and $\quad \sin C = \dfrac{AB}{AC} = \dfrac{3}{5}$

Now, $\sin A + \sin B + \sin C = \dfrac{4}{5} + 1 + \dfrac{3}{5}$

$\quad = \dfrac{4 + 5 + 3}{5} = \dfrac{12}{5}$

81. The value of $\operatorname{cosec}^2 67° + \sec^2 57°$
$- \cot^2 33° - \tan^2 23°$ is
(a) $2\sqrt{2}$ (b) 2   (c) $\sqrt{2}$ (d) 0

⊘ **(b)** $\operatorname{cosec}^2 67° + \sec^2 57°$
$\quad\quad\quad\quad - \cot^2 33° - \tan^2 23°$
$= \operatorname{cosec}^2(90° - 23°) + \sec^2(90° - 33°)$
$\quad\quad\quad\quad - \cot^2 33° - \tan^2 23°$
$\quad \begin{bmatrix} \because \operatorname{cosec}(90° - \theta) = \sec\theta, \\ \sec(90° - \theta) = \operatorname{cosec}\theta \end{bmatrix}$
$= \sec^2 23° + \operatorname{cosec}^2 33°$
$\quad\quad\quad\quad - \cot^2 33° - \tan^2 23°$
$= 1 + \tan^2 23° + 1 + \cot^2 33°$
$\quad\quad\quad\quad - \cot^2 33° - \tan^2 23°$
$\quad [\because 1 + \tan^2\theta = \sec^2\theta \text{ and } 1$
$\quad\quad\quad + \cot^2\theta = \operatorname{cosec}^2\theta]$
$= 2$

82. Consider the following
statements
  I. There exists atleast one value
    of x between 0 and $\dfrac{\pi}{2}$ which
    satisfies the equation
    $\sin^4 x - 2\sin^2 x - 1 = 0$.
  II. sin 1.5 is greater than cos 1.5.
Which of the above statement(s)
is/are correct?
(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊘ **(b)** I. $\sin^4 x - 2\sin^2 x - 1 = 0$

$\Rightarrow \sin^2 x = \dfrac{2 \pm \sqrt{4 + 4}}{2} = \dfrac{2 \pm \sqrt{8}}{2}$

$\Rightarrow \sin^2 x = \dfrac{2 \pm 2\sqrt{2}}{2} = 1 \pm \sqrt{2}$

$\Rightarrow \quad \sin^2 x = 1 + \sqrt{2} > 1$
$\quad\quad\quad\quad\quad\quad [\because 0 \le \sin^2 x \le 1]$
or $\quad \sin^2 x = 1 - \sqrt{2} < 0$
Hence, both are not possible.

  II. Since, 1.5 radian is in IInd
    quadrant.
    Therefore, sin 1.5 > 0 and
    cos 1.5 < 0
   $\therefore \quad$ sin 1.5 > cos 1.5

83. If $\sin x + \cos x = c$, then
$\sin^6 x + \cos^6 x$ is equal to
(a) $\dfrac{1 + 6c^2 - 3c^4}{16}$ (b) $\dfrac{1 + 6c^2 - 3c^4}{4}$
(c) $\dfrac{1 + 6c^2 + 3c^4}{16}$ (d) $\dfrac{1 + 6c^2 + 3c^4}{4}$

⊘ **(b)** Given, $\sin x + \cos x = c$
On squaring both sides, we get
$\quad\quad (\sin x + \cos x)^2 = c^2$
$\Rightarrow \quad \sin^2 x + \cos^2 x + 2\sin x \cos x = c^2$
$\quad\quad\quad [\because (a + b)^2 = a^2 + b^2 + 2ab]$
$\Rightarrow \quad 1 + 2\sin x \cos x = c^2$
$\quad\quad\quad\quad [\because \sin^2 x + \cos^2 x = 1]$
$\Rightarrow \quad\quad \sin x \cos x = \dfrac{c^2 - 1}{2} \quad\quad ...(i)$
Now, $\sin^6 x + \cos^6 x$
$\quad\quad = (\sin^2 x)^3 + (\cos^2 x)^3$
$= (\sin^2 x + \cos^2 x)[\sin^4 x + \cos^4 x$
$\quad\quad\quad\quad\quad\quad - \sin^2 x \cos^2 x]$
$\quad [\because a^3 + b^3 = (a + b)(a^2 + b^2 - ab)]$
$= 1[(\sin^2 x + \cos^2 x)^2 - 3\sin^2 x \cos^2 x]$
$= (1 - 3\sin^2 x \cos^2 x)$
$\therefore \quad \sin^6 x + \cos^6 x = 1 - 3\sin^2 x \cos^2 x$
$= 1 - 3\left(\dfrac{c^2 - 1}{2}\right)^2 \quad\quad$ [from Eq. (i)]
$= 1 - 3\left(\dfrac{c^4 + 1 - 2c^2}{4}\right)$
$= \dfrac{4 - 3c^4 - 3 + 6c^2}{4} = \dfrac{1 + 6c^2 - 3c^4}{4}$

84. Consider the following statements

I. There exists no value of x such that
$$\frac{1}{1-\sin x} = 4 + 2\sqrt{3}, \quad 0 < x < \frac{\pi}{2}$$

II. $\sin x = 3^{\sin^2 x}$ does not hold good for any real x.

Which of the above statement(s) is/are correct?

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊘ **(d)** I. ∵ $1 - \sin x \neq 0 \Rightarrow \sin x \neq 0$

$\Rightarrow x \neq 0$, which does not belong to be given interval.

So, there is no value of x.

II. $\sin x = 3^{\sin^2 x} \Rightarrow 1 = \sin x \cdot 3^{-\sin^2 x}$

On multiplying 3 both sides, we get

$$3 = \sin x \cdot 3^{-\sin^2 x} \cdot 3$$

$\Rightarrow \quad 3 = \sin x \cdot 3^{1 - \sin^2 x}$

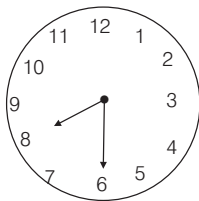$\Rightarrow \quad 3 = \sin x \cdot 3^{\cos^2 x}$

RHS is less than 3 while LHS is 3. Thus, the equation does not hold for any x.

85. At 8 : 30, the hour hand and the minute hand of a clock form an angle of

(a) 80°   (b) 75°   (c) 70°   (d) 60°

⊘ **(b)** Here, $n = 8$, $x = 30$

So, the required angle
$$= \left\{30\left(n - \frac{x}{5}\right) + \frac{x}{2}\right\}^{\circ}$$
$$= \left\{30\left(8 - \frac{30}{5}\right) + \frac{30}{2}\right\}^{\circ}$$
$$= \{30(8 - 6) + 15\}^{\circ}$$
$$= \{60 + 15\}^{\circ} = 75^{\circ}$$

2014 (II)

86. If $0 < \theta < \dfrac{\pi}{4}$, then what is $\sqrt{1 - 2\sin\theta\cos\theta}$ equal to?

(a) $\cos\theta - \sin\theta$ (b) $\sin\theta - \cos\theta$
(c) $\pm (\cos\theta - \sin\theta)$ (d) $\cos\theta\sin\theta$

⊘ **(a)** Given, $0 < \theta < \dfrac{\pi}{4}$,

then $\sqrt{1 - 2\sin\theta\cos\theta}$

$$= \sqrt{\sin^2\theta + \cos^2\theta - 2\sin\theta\cos\theta}$$

$[\because \sin^2\theta + \cos^2\theta = 1] = \sqrt{(\cos\theta - \sin\theta)^2}$

$$\left[\begin{array}{l}\because 0 < \theta < \dfrac{\pi}{4}, \cos\theta > \sin\theta, \\ \text{so we take }(\cos\theta - \sin\theta)^2\end{array}\right]$$

$$= \cos\theta - \sin\theta$$

87. If $\tan\theta + \cot\theta = 2$, then what is $\sin\theta + \cos\theta$ equal to?

(a) $\dfrac{1}{2}$ (b) $\dfrac{1}{\sqrt{3}}$

(c) $\sqrt{2}$ (d) 1

⊘ **(c)** Given, $\tan\theta + \cot\theta = 2$

$\Rightarrow \quad \dfrac{\sin\theta}{\cos\theta} + \dfrac{\cos\theta}{\sin\theta} = 2$

$\Rightarrow \quad \dfrac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta} = 2$

$\Rightarrow \quad \dfrac{1}{\sin\theta\cos\theta} = 2$

$ [\because \sin^2\theta + \cos^2\theta = 1]$

$\Rightarrow \quad \sin\theta\cos\theta = \dfrac{1}{2} \quad \text{...(i)}$

Now, $(\sin\theta + \cos\theta)^2 = \sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta$

$$= 1 + 2 \times \dfrac{1}{2} = 1 + 1 \quad \text{[from Eq. (i)]}$$

$\Rightarrow \quad (\sin\theta + \cos\theta)^2 = 2$

$\therefore \quad \sin\theta + \cos\theta = \sqrt{2}$

88. What is $\dfrac{\sec x}{\cot x + \tan x}$ equal to?

(a) $\sin x$ (b) $\cos x$
(c) $\tan x$ (d) $\cot x$

⊘ **(a)** $\dfrac{\sec x}{\cot x + \tan x} = \dfrac{1/\cos x}{\dfrac{\cos x}{\sin x} + \dfrac{\sin x}{\cos x}}$

$$= \dfrac{1/\cos x}{\dfrac{\cos^2 x + \sin^2 x}{\sin x \cos x}}$$

$$\left[\because \sec x = \dfrac{1}{\cos x}\right]$$

$$= \dfrac{1}{\cos x} \times \dfrac{\sin x \cos x}{1} = \sin x$$

89. What is $\dfrac{\sin x - \cos x + 1}{\sin x + \cos x - 1}$ equal to?

(a) $\dfrac{\sin x - 1}{\cos x}$ (b) $\dfrac{\sin x + 1}{\cos x}$

(c) $\dfrac{\sin x - 1}{\cos x + 1}$ (d) $\dfrac{\sin x + 1}{\cos x + 1}$

⊘ **(b)** $\dfrac{\sin x - \cos x + 1}{\sin x + \cos x - 1} = \dfrac{(\sin x - \cos x) + 1}{(\sin x + \cos x) - 1}$

$$\times \dfrac{(\sin x + \cos x) + 1}{(\sin x + \cos x) + 1}$$

$$= \dfrac{(\sin x - \cos x + 1)(\sin x + \cos x + 1)}{(\sin x + \cos x)^2 - 1}$$

$$= \dfrac{\left[\begin{array}{l}\sin^2 x + \sin x \cos x + \sin x \\ -\cos x \sin x - \cos^2 x - \cos x \\ + \sin x + \cos x + 1\end{array}\right]}{\sin^2 x + \cos^2 x + 2\sin x \cos x - 1}$$

$$= \dfrac{\sin^2 x + 2\sin x - \cos^2 x + 1}{1 + 2\sin x \cos x - 1}$$

$$[\because \sin^2 x + \cos^2 x = 1]$$

$$= \dfrac{\sin^2 x + 2\sin x - (1 - \sin^2 x) + 1}{2\sin x \cos x}$$

$$= \dfrac{\sin^2 x + 2\sin x - 1 + \sin^2 x + 1}{2\sin x \cos x}$$

$$= \dfrac{2\sin^2 x + 2\sin x}{2\sin x \cos x}$$

$$= \dfrac{2\sin x (\sin x + 1)}{2\sin x \cos x} = \dfrac{\sin x + 1}{\cos x}$$

90. What is $(\sin^2 x - \cos^2 x)$ $(1 - \sin^2 x \cos^2 x)$ equal to?

(a) $\sin^4 x - \cos^4 x$ (b) $\sin^6 x - \cos^6 x$
(c) $\cos^8 x - \sin^8 x$ (d) $\sin^8 x - \cos^8 x$

⊘ **(b)** $(\sin^2 x - \cos^2 x)(1 - \sin^2 x \cos^2 x)$

$= (\sin^2 x - \cos^2 x)[(\sin^2 x + \cos^2 x)^2 - \sin^2 x \cos^2 x]\ [\because \sin^2 x + \cos^2 x = 1]$

$= (\sin^2 x - \cos^2 x)$
$ [(\sin^4 x + \cos^4 x + 2\sin^2 x \cos^2 x) - \sin^2 x \cos^2 x]$

$= (\sin^2 x - \cos^2 x)(\sin^4 x + \cos^4 x + \sin^2 x \cos^2 x)$

$= \sin^6 x + \sin^2 x \cos^4 x + \sin^4 x \cos^2 x - \cos^2 x \sin^4 x - \cos^6 x - \sin^2 x \cos^4 x$

$= \sin^6 x - \cos^6 x$

91. What is $(\sin x \cos y + \cos x \sin y)$ $(\sin x \cos y - \cos x \sin y)$ equal to?

(a) $\cos^2 x - \cos^2 y$ (b) $\cos^2 x - \sin^2 y$
(c) $\sin^2 x - \cos^2 y$ (d) $\sin^2 x - \sin^2 y$

⊘ **(d)** $(\sin x \cos y + \cos x \sin y)$
$(\sin x \cos y - \cos x \sin y)$

$= \sin(x + y) \cdot \sin(x - y)$

$= \sin^2 x - \sin^2 y$

$[\because \sin^2 A - \sin^2 B = \sin(A + B)\sin(A - B)]$

92. What is $(1 + \cot x - \csc x)$ $(1 + \tan x + \sec x)$ equal to?

(a) 1   (b) 2   (c) $\sin x$ (d) $\cos x$

⊘ **(b)** $(1 + \cot x - \csc x)$
$(1 + \tan x + \sec x)$

$= (1 + \cot x - \csc x)$
$$\left(1 + \frac{1}{\cot x} + \sec x\right)$$
$= \dfrac{(1 + \cot x - \csc x)(1 + \cot x + \csc x)}{\cot x}$

$$\left[\because \tan x = \frac{1}{\cot x}\right]$$

$= \dfrac{(1 + \cot x)^2 - (\csc x)^2}{\cot x}$

$$[\because (a+b)(a-b) = a^2 - b^2]$$

$= \dfrac{1^2 + \cot^2 x + 2\cot x - \csc^2 x}{\cot x}$

$$[\because (a+b)^2 = a^2 + b^2 + 2ab]$$

$= \dfrac{1 + 2\cot x - (\csc^2 x - \cot^2 x)}{\cot x}$

$= \dfrac{1 + 2\cot x - 1}{\cot x} = 2$

93. What is $(\csc x - \sin x)$
$(\sec x - \cos x)(\tan x + \cot x)$ equal to?
(a) $\sin x + \cos x$ (b) $\sin x - \cos x$
(c) 2   (d) 1

⊘ **(d)** $(\csc x - \sin x)(\sec x - \cos x)$
$$(\tan x + \cot x)$$
$= \left(\dfrac{1}{\sin x} - \sin x\right)\left(\dfrac{1}{\cos x} - \cos x\right)$
$$\left(\dfrac{\sin x}{\cos x} + \dfrac{\cos x}{\sin x}\right)$$
$= \dfrac{(1 - \sin^2 x)(1 - \cos^2 x)(\sin^2 x + \cos^2 x)}{\sin x \cos x \cdot \sin x \cos x}$
$= \dfrac{\cos^2 x \sin^2 x \times 1}{\sin^2 x \cos^2 x} = 1$

$$\left[\begin{array}{l}\because 1 - \sin^2 x = \cos^2 x, \\ 1 - \cos^2 x = \sin^2 x\end{array}\right]$$

94. Consider the following statements
1. $\sin 1° > \sin 1$ 2. $\cos 1° < \cos 1$

Which of the above statement(s) is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ **(d)** We know that, $\sin 1° < \sin 1$ and
$\cos 1 < \cos 1°$
Hence, neither Statement 1 nor 2 is correct.

95. If $\sin x + \csc x = 2$, then what is $\sin^9 x + \csc^9 x$ equal to?

(a) 2   (b) 18
(c) 512   (d) 1024

⊘ **(a)** Given, $\sin x + \csc x = 2$ ...(i)
On cubing Eq. (i) both sides, we get

$(\sin x + \csc x)^3 = 8$
$(\sin^3 x + \csc^3 x)$
   $+ 3\sin x \csc x(\sin x + \csc x) = 8$
     $[\because (a+b)^3 = a^3 + b^3 + 3ab(a+b)]$
$\Rightarrow$ $\sin^3 x + \csc^3 x + 3(2) = 8$
$\Rightarrow$ $\sin^3 x + \csc^3 x = 8 - 6$
$\Rightarrow$ $\sin^3 x + \csc^3 x = 2$ ...(ii)

On cubing Eq. (ii) both sides, we get
$(\sin^3 x)^3 + (\csc^3 x)^3 + 3\sin^3 x \csc^3 x$
$(\sin^3 x + \csc^3 x) = (2)^3$
$\Rightarrow$ $\sin^9 x + \csc^9 x + 3(2) = 8$
$\Rightarrow$ $\sin^9 x + \csc^9 x = 8 - 6 = 2$

96. If $\sin x + \cos x = p$ and
$\sin^3 x + \cos^3 x = q$, then what is $p^3 - 3p$ equal to?

(a) 0   (b) $-2q$
(c) $2q$ (d) $4q$

⊘ **(b)** Given, $\sin x + \cos x = p$ ...(i)
and $\sin^3 x + \cos^3 x = q$ ...(ii)
On cubing Eq. (i) both sides, we get
$\sin^3 x + \cos^3 x$
   $+ 3\sin x \cos x(\sin x + \cos x) = p^3$
$\Rightarrow$ $q + 3\sin x \cos x(p) = p^3$ ...(iii)
     [from Eqs. (i) and (ii)]

On squaring Eq. (i) both sides, we get
$\sin^2 x + \cos^2 x + 2\sin x \cos x = p^2$
$\Rightarrow$ $\sin x \cos x = \dfrac{p^2 - 1}{2}$
     $[\because \sin^2 x + \cos^2 x = 1]$

From Eq. (iii),
$q + \dfrac{3(p^2 - 1)p}{2} = p^3$
$\Rightarrow$ $2q + 3p^3 - 3p = 2p^3$
$\Rightarrow$ $p^3 - 3p = -2q$

2014 (I)

97. The value of $\cos 25° - \sin 25°$ is
(a) positive but less than 1
(b) positive but greater than 1
(c) negative
(d) 0

⊘ **(a)** Since, value of $\cos\theta$ decreases, from
0° to 90° and at 45° it is equal to the value of $\sin\theta$.

Similarly, value of $\sin\theta$ increases from 0 to 90° and at 45° it is equal to the value of $\cos\theta$.

For $0° < \theta < 45°$, $\cos\theta > \sin\theta$

So, value of $\cos 25° - \sin 25°$ is always positive but less than 1.

98. In a right angled ΔABC, right angle at B, if $\cos A = \dfrac{4}{5}$, then what is $\sin C$ is equal to?

(a) $\dfrac{3}{5}$ (b) $\dfrac{4}{5}$ (c) $\dfrac{3}{4}$ (d) $\dfrac{2}{5}$

⊘ **(b)** In ΔABC, $\cos A = \dfrac{4}{5}$

i.e. $AB = 4$ and $AC = 5$
$$\sin C = \dfrac{AB}{AC} = \dfrac{4}{5}$$
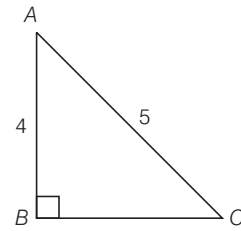
99. If α and β are complementary angles, then what is
$\sqrt{\cos\alpha \csc\beta - \cos\alpha \sin\beta}$ equal to?

(a) $\sec\beta$ (b) $\cos\alpha$
(c) $\sin\alpha$ (d) $-\tan\beta$

⊘ **(c)** Since, α and β are complementary angles.
$\therefore$ $\alpha = 90° - \beta$
Now, $\sqrt{\cos\alpha \csc\beta - \cos\alpha \sin\beta}$
$= \sqrt{\dfrac{\cos\alpha}{\sin\beta} - \cos\alpha \sin\beta}$
$= \sqrt{\dfrac{\cos\alpha}{\cos(90 - \beta)} - \cos\alpha \cos(90 - \beta)}$
$= \sqrt{\dfrac{\cos\alpha}{\cos\alpha} - \cos\alpha \cdot \cos\alpha}$
$= \sqrt{1 - \cos^2\alpha} = \sqrt{\sin^2\alpha} = \sin\alpha$

100. If $2\cot\theta = 3$, then what is
$\dfrac{2\cos\theta - \sin\theta}{2\cos\theta + \sin\theta}$ equal to?

(a) $\dfrac{2}{3}$ (b) $\dfrac{1}{3}$ (c) $\dfrac{1}{2}$ (d) $\dfrac{3}{4}$

⊘ **(c)** $\because$ $2\cot\theta = 3$
$\Rightarrow$ $\cot\theta = \dfrac{3}{2}$

$\therefore$ $\dfrac{2\cos\theta - \sin\theta}{2\cos\theta + \sin\theta}$

     [Divide numerator and denominator
                      by $\sin\theta$]

$= \dfrac{2\cot\theta - 1}{2\cot\theta + 1}$

$= \dfrac{2 \times \dfrac{3}{2} - 1}{2 \times \dfrac{3}{2} + 1} = \dfrac{3 - 1}{3 + 1} = \dfrac{2}{4} = \dfrac{1}{2}$

101. If $\sin\theta\cos\theta = \dfrac{1}{2}$, then what is $\sin^6\theta + \cos^6\theta$ equal to?

(a) 1　　　　　　(b) 2
(c) 3　　　　　　(d) $\dfrac{1}{4}$

▷ **(d)** $\sin^6\theta + \cos^6\theta = (\sin^2\theta)^3 + (\cos^2\theta)^3$

$= (\sin^2\theta + \cos^2\theta)(\sin^4\theta + \cos^4\theta$
$\qquad\qquad - \sin^2\theta\cos^2\theta)$
$[\because a^3 + b^3 = (a + b)(a^2 - ab + b^2)]$
$= (\sin^2\theta + \cos^2\theta)^2 - 2\sin^2\theta\cos^2\theta$
$\qquad\qquad - \sin^2\theta\cos^2\theta$
$= (1 - 3\sin^2\theta\cos^2\theta) = 1 - 3 \times \dfrac{1}{4}$
$= 1 - \dfrac{3}{4} = \dfrac{1}{4}$

Alternate Method

$\sin\theta\cos\theta = \dfrac{1}{2}$

$2\sin\theta\cos\theta = 1$

$\sin2\theta = 1 \qquad [\because 2\sin\theta\cos\theta = \sin2\theta]$
$\sin2\theta = \sin90°$
$2\theta = 90°$
$\theta = 45°$

$\therefore \sin^6\theta + \cos^6\theta = \sin^6 45° + \cos^6 45°$

$= \left(\dfrac{1}{\sqrt{2}}\right)^6 + \left(\dfrac{1}{\sqrt{2}}\right)^6$

$= 2 \times \left(\dfrac{1}{\sqrt{2}}\right)^6 = \dfrac{1}{4}$

102. If $\sec\theta + \tan\theta = 2$, then what is the value of $\sec\theta$?

(a) $\dfrac{3}{2}$　　　　　　(b) $\sqrt{2}$
(c) $\dfrac{5}{2}$　　　　　　(d) $\dfrac{5}{4}$

▷ **(d)** By trigonometric identity,
$\sec^2\theta - \tan^2\theta = 1$
$\Rightarrow (\sec\theta + \tan\theta)(\sec\theta - \tan\theta) = 1$
$\Rightarrow \sec\theta - \tan\theta = \dfrac{1}{2} \qquad ...(i)$

and given, $\sec\theta + \tan\theta = 2 \qquad ...(ii)$
On adding Eqs. (i) and (ii), we get
$2\sec\theta = \dfrac{1}{2} + 2$
$\therefore \sec\theta = \dfrac{5}{4}$

103. What is
$\operatorname{cosec}(75° + \theta) - \sec(15° - \theta)$
$- \tan(55° + \theta) + \cot(35° - \theta)$
equal to?

(a) –1　(b) 0　(c) 1　(d) $\dfrac{3}{2}$

▷ **(b)** $\operatorname{cosec}(75° + \theta) - \sec(15° - \theta)$
$\qquad - \tan(55° + \theta) + \cot(35° - \theta)$
$= \operatorname{cosec}(75° + \theta)$
$\qquad - \operatorname{cosec}[90° - (15° - \theta)]$
$- \tan(55° + \theta) + \tan[90° - (35° - \theta)]$
$\begin{bmatrix}\because \sec\theta = \operatorname{cosec}(90° - \theta), \\ \cot\theta = \tan(90° - \theta)\end{bmatrix}$
$= \operatorname{cosec}(75° + \theta) - \operatorname{cosec}(75° + \theta)$
$\qquad - \tan(55° + \theta) + \tan(55° + \theta) = 0$

104. If $\sin\theta + 2\cos\theta = 1$, where
$0 < \theta < \pi/2$, then what is
$2\sin\theta - \cos\theta$ equal to?

(a) – 1　(b) 1/2　(c) 2　(d) 1

▷ **(c)** $\sin\theta + 2\cos\theta = 1$
On squaring both sides, we get
$(\sin\theta + 2\cos\theta)^2 = 1$
$\Rightarrow \sin^2\theta + 4\cos^2\theta + 4\sin\theta\cos\theta = 1$
$\Rightarrow (1 - \cos^2\theta) + 4(1 - \sin^2\theta)$
$\qquad\qquad + 4\sin\theta\cos\theta = 1$
$\Rightarrow -(\cos^2\theta + 4\sin^2\theta) + 4\sin\theta\cos\theta$
$\qquad\qquad = 1 - 5$
$\Rightarrow \cos^2\theta + 4\sin^2\theta - 4\sin\theta\cos\theta = 4$
$\Rightarrow (2\sin\theta - \cos\theta)^2 = 4$
$\Rightarrow 2\sin\theta - \cos\theta = 2$

105. If $\cos x + \sec x = 2$, then what
$\cos^n x + \sec^n x$ equal to, where n
is a positive integer?

(a) 2　(b) 2^{n-2}　(c) 2^{n-1}　(d) 2^n

▷ **(a)** $\cos x + \sec x = 2 \qquad ...(i)$
On squaring both sides, we get
$\cos^2 x + \sec^2 x + 2 = 4$
$\Rightarrow \cos^2 x + \sec^2 x = 2 \qquad ...(ii)$
On cubing Eq. (i), we get
$\cos^3 x + \sec^3 x + 3(\cos x + \sec x) = 8$
$\Rightarrow \cos^3 x + \sec^3 x + (3 \times 2) = 8$
$\Rightarrow \cos^3 x + \sec^3 x = 2 \qquad ...(iii)$
From Eqs. (i), (ii) and (iii),
$\cos^n x + \sec^n x = 2$

106. What is $\sin25° \sin35° \sec65°$
$\sec55°$ equal to?

(a) –1　　　　　　(b) 0
(c) $\dfrac{1}{2}$　　　　　　(d) 1

▷ **(d)** $\sin25°\sin35°\sec65°\sec55°$

$= \sin25° \cdot \sin35° \cdot \dfrac{1}{\cos65°} \cdot \dfrac{1}{\cos55°}$

$= \sin25° \cdot \sin35° \cdot \dfrac{1}{\cos(90 - 25°)}$

$\qquad\qquad \cdot \dfrac{1}{\cos(90 - 35°)}$

$[\because \cos(90° - \theta) = \sin\theta]$

$= \sin25° \cdot \sin35° \cdot \dfrac{1}{\sin25°} \cdot \dfrac{1}{\sin35°}$

$= 1$

107. If $\tan8\theta = \cot2\theta$, where
$0 < 8\theta < \dfrac{\pi}{2}$, then what is the
value of $\tan5\theta$?

(a) $\dfrac{1}{\sqrt{3}}$　　　　　　(b) 1
(c) $\sqrt{3}$　　　　　　(d) 0

▷ **(b)** Given, $\tan8\theta = \cot2\theta$
$\Rightarrow \tan8\theta = \tan(90° - 2\theta)$
$\qquad\qquad [\because \cot\theta = \tan(90° - \theta)]$
$\Rightarrow 8\theta = 90° - 2\theta$
$\Rightarrow \theta = 9°$
$\therefore \tan5\theta = \tan45° = 1$

108. If $\sin(A + B) = 1$, where $0 < B <$
$45°$, then what is $\cos(A - B)$
equal to?

(a) $\sin 2B$　　　　　(b) $\sin B$
(c) $\cos 2B$　　　　　(d) $\cos B$

▷ **(a)** $\because \sin(A + B) = 1$
$\Rightarrow A + B = \sin^{-1} 1$
$\Rightarrow (A + B) = 90°$
$\therefore B = 90° - A$
$\Rightarrow A = 90° - B$
Now, $\cos(A - B) = \cos A \cos B$
$\qquad\qquad + \sin A \sin B$
$= \cos(90° - B)\cos B$
$\qquad\qquad + \sin(90° - B)\sin B$
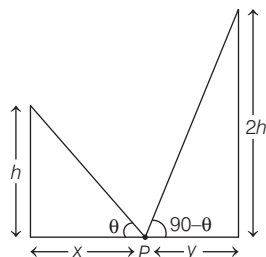$= \sin B \cos B + \cos B \sin B$
$= 2\sin B \cos B = \sin 2B$

19

HEIGHT AND DISTANCE

1. The angles of elevation of the tops of two pillars of heights h and $2h$ from a point P on the line joining the feet of the two pillars are complementary. If the distances of the foot of the pillars from the point P are x and y respectively, then which one of the following is correct?

(a) $2h^2 = x^2 y$ (b) $2h^2 = x y^2$
(c) $2h^2 = x y$ (d) $2h^2 = x^2 y^2$

⊘ *(c)*

According to the question,

$$\tan\theta = \frac{h}{x} \qquad \dots(i)$$

$$\tan(90 - \theta) = \frac{2h}{y}$$

$$\cot\theta = \frac{2h}{y} \qquad \dots(ii)$$

$$[\because \tan(90° - \theta) = \cot\theta]$$

On multiplying Eqs. (i) and (ii), we get

$$\tan\theta \cdot \cot\theta = \frac{h}{x} \times \frac{2h}{y}$$
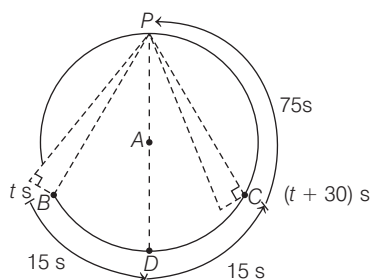
$$1 = \frac{2h^2}{xy}$$

$$[\tan\theta.\cot\theta = 1]$$

$$\therefore \qquad 2h^2 = x y$$

2. A plane is going in circles around an airport. The plane takes 3 min to complete one round. The angle of elevation of the plane from a point P on the ground at time t is equal to that at time $(t + 30)$ s. At time $(t + x)$ s, the plane flies vertically above the point P. What is x equal to?

(a) 75 s   (b) 90 s   (c) 105 s   (d) 135 s

⊘ *(c)* "A" is airport and a plane is going in circles around it.

The plane takes 3 min to complete one round.

$$\text{In s} = 3 \times 60 = 180 \text{ s}$$

Plane reaches at B in t s   ...(i)
Plane reaches at C in $(t + 30)$ S   ...(ii)

The angle of elevation of the plane from a point P on the ground at time t s is equal to that at time $(t + 30)$ s.

Plane is going to D from point B distance increases respect to P.

[because PD is longest chord of circle or diameter of circle]

After point D the distance of the plane decreases with respect to point P and at point C the distance is equal to arc PC and PB.

Then, it take equal time from B to D and from D to C.

i.e. plane takes total 30 s

15 s from B to D, 15 s from D to C.

The plane takes total time to complete a round = 180 sec

$PB + BD + DC + CP = 180$ sec

$CP + 15 + 15 + CP = 180$ sec

$2CP = 180 - 30 = 150$

$CP = 75$ sec

Then, total time is $(t + x)$ s, when plane is at point P.

Major arc from B to P.

Total time = $(t + 75 + 15 + 15)$

Total time = $(t + 105)$ s

3. Consider a regular hexagon *ABCDEF*. Two towers are situated at B and C. The angle of elevation from A to the top of the tower at B is 30°, and the angle of elevation to the top of the tower at C is 45°. What is the ratio of the height of towers at B and C?

(a) $1 : \sqrt{3}$ (b) $1 : 3$
(c) $1 : 2$ (d) $1 : 2\sqrt{3}$

⊘ *(b)* A regular hexagon *ABCDEF*.

Two towers are situated at B and C.
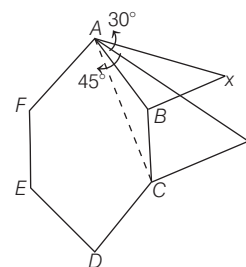
Let side of hexagon = a

BX tower at B and CY tower at C

ΔABX

$$AB = a$$

$$\tan 30° = \frac{BX}{BA}$$

$$\frac{1}{\sqrt{3}} = \frac{BX}{a}$$

$$BX = \frac{a}{\sqrt{3}} \qquad \dots(i)$$

ΔABC
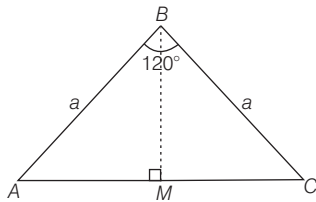
[$\angle B = 120°$ each internal angle of hexagon 120°]

$BM \perp AC$ Similarly,

ΔABM $MC = \frac{\sqrt{3}}{2} a$

$\angle ABM = 60°$

$\angle AMB = 90°$ $AC = AM + MC$

$\sin 60° = \frac{AM}{AB}$ $= \frac{\sqrt{3}}{2}a + \frac{\sqrt{3}}{2}a$

$\frac{\sqrt{3}}{2} = \frac{AM}{a}$ $= \sqrt{3}a$

$AM = \frac{\sqrt{3}a}{2}$

$\Delta AYC, \quad \tan 45° = \frac{CY}{AC}$

$$1 = \frac{CY}{\sqrt{3}a}$$

$$\sqrt{3}a = CY$$

Ratio of tower B and C

$$BX : CY$$

$$\frac{a}{\sqrt{3}} : \sqrt{3}a$$

$$1 : 3$$

Option (b) is correct.

2018 (II)

4. On the top of a hemispherical dome of radius r, there stands a flag of height h. From a point on the ground, the elevation of the top of the flag is 30°. After moving a distance d towards the dome, when the flag is just visible, the elevation is 45°. The ratio of h to r is equal to

(a) $\sqrt{2} - 1$ (b) $\frac{\sqrt{3}+1}{2\sqrt{2}}$

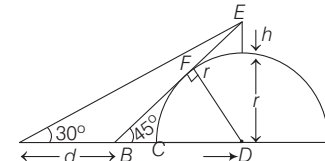(c) $\frac{\sqrt{3}+1}{2\sqrt{2}}d$ (d) $\frac{(\sqrt{3}+1)(\sqrt{2}-1)}{2\sqrt{2}}d$

⊘ **(a)** According to given information, we have the following figure.

In ΔBDE, we have $\tan 45° = \frac{DE}{BD}$

$\Rightarrow$ $BD = DE = h + r$

$\Rightarrow$ $BC + r = h + r$

$\Rightarrow$ $BC = h$

Now, as $\angle EBD = 45°$, therefore $\angle BED = 45°$

Also, In ΔBFD

$$\tan 45° = \frac{FD}{FB}$$

$\Rightarrow$ $FB = FD = r$

Similarly, $EF = r$

Now, consider ΔBDE, then we have

Using pythagoras theorm

$$(BE)^2 = (BD)^2 + (DE)^2$$

$\Rightarrow$ $(2r)^2 = (h + r)^2 + (h + r)^2$

$\Rightarrow$ $4r^2 = 2(h + r)^2$

$\Rightarrow$ $2r^2 = (h + r)^2$

$\Rightarrow$ $h + r = \sqrt{2}r$

$\Rightarrow$ $h = (\sqrt{2} - 1)r$

$\therefore$ $\frac{h}{r} = \sqrt{2} - 1$

2018 (I)

5. Each corner of a square subtends an angle of 60° at the tip of a tower of height h m standing at the centre of the square. If l is the length of each side of the square, then what is h^2 equal to ?

(a) $2l^2$ (b) $\frac{l^2}{2}$ (c) $\frac{3l^2}{2}$ (d) $\frac{2l^2}{3}$

⊘ **(c)** Let $ABCD$ be a square
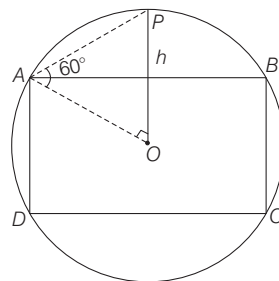
Side of square = l [given]

Let O be its centre

Height of tower OP from centre

           $= h$ [given]

$\because$ Diagonal of square $= \sqrt{2} \times$ Side of square $= \sqrt{2}l$

$\therefore$ $AO = \frac{l\sqrt{2}}{2} = \frac{l}{\sqrt{2}}$

Now, in ΔOAP

$$\tan 60° = \frac{h}{\frac{l}{\sqrt{2}}}$$

$\Rightarrow$ $\sqrt{3} = \frac{\sqrt{2}h}{l}$

On squaring both sides

or $3 = \frac{2h^2}{l^2}$

$\Rightarrow$ $h^2 = \frac{3l^2}{2}$

6. From a height of h units, a man observes the angle of elevation as α and angle of depression as β of the top and the bottom respectively of a tower of height $H(> 4h)$. To what further height should he climb so that the values of angle of elevation and angle of depression get interchanged for the top and bottom of the tower?

(a) $H - h$ units   (b) $H - 2h$ units
(c) $H - 3h$ units   (d) $H - 4h$ units

⊘ **(b)** Let the distance between two towers be 'a' units.
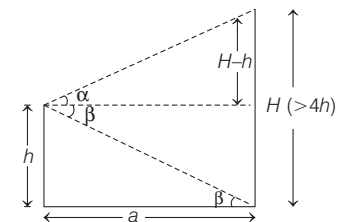
Fig-I
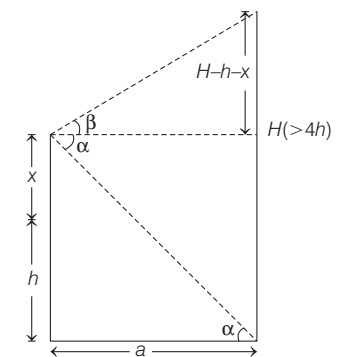
And the man climbs 'x' units further

From fig. I. $\tan \alpha = \frac{H - h}{a}$ $\dots$ (i)

$\tan\beta = \dfrac{h}{a}$ ... (ii)

From fig. II, $\tan\alpha = \dfrac{h+x}{a}$ ... (iii)

$\tan\beta = \dfrac{H-h-x}{a}$ ... (iv)

From Eqs. (i) and (iii)

$\dfrac{H-h}{a} = \dfrac{h+x}{a}$

$\Rightarrow \qquad x = H-2h$

Hence, the man climbs $H-2h$ further.

2017 (II)

7. Let AB represents a building of height h metre with A being is top, B being its bottom. Let $A'B'$ represents a tower of height $(h+x)$ metre $(x>0)$ with A' being its top and B' being its bottom. Let $BB' = d$ metre. Let the angle of elevation of A' as seen from A be 45°.

Consider the following statements.

Statement I : $h + x > d$

Statement II : The angle of depression of B as seen from A' is less than 45°.

Which one of the following is correct in respect of the above statements?

(a) Both Statement I and Statement II are true and Statement II is the correct explanation of Statement I
(b) Both Statement I and Statement II are true but Statement II is not the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statements II is true

⊘ *(c)* We have, $AB = h$

$A'B' = h + x$

$BB' = d$

$\angle A'AC = 45°$
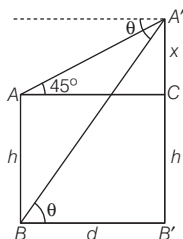
In $\Delta A'AC$

$\tan 45° = \dfrac{A'C}{AC}$

$1 = \dfrac{x}{AC}$

$AC = x$

$AC = d$ [∵ $AC = BB' = d$]

Hence, $h + x > d$

In $\Delta A'BB'$

$\tan\theta = \dfrac{A'B'}{BB'}$, $\tan\theta = \dfrac{h+x}{d}$

$\tan\theta > 1$ [∵ $h + x > d$]

∴ $\theta > 45°$

Hence, angle of depression of B as seen form $A'B$ greater than 45°.

∴ Statement I is true but statement II is false.

8. A man, standing at a point X on the bank XY of a river that cannot be crossed, observes a tower to be N $\alpha°$ E on the opposite parallel bank. He than walks 200 m along the bank to the point Y towards East, and finds the tower to be N $\beta°$ W. From these observations, the breadth of the river will be (Given that $\tan\alpha° = 2$ and $\tan\beta° = 0.5$) From

(a) 60 m   (b) 70 m   (c) 80 m   (d) 90 m

⊘ *(c)* Let
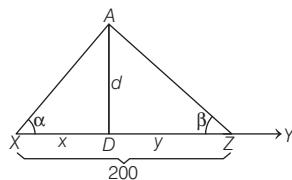
AD = breadth of river

In ΔAXD

$\tan\alpha = \dfrac{AD}{XD}$, $2 = \dfrac{d}{x}$ $\Rightarrow$ $x = \dfrac{d}{2}$

In ΔADZ

$\tan\beta = \dfrac{AD}{DZ}$

$0.5 = \dfrac{d}{y}$ $\Rightarrow$ $y = 2d$

We have, $x + y = 200$ m

$\dfrac{d}{2} + 2d = 200$ m

$d = 80$ m

2017 (I)

9. An aeroplane flying at a height of 300 m above the ground passes vertically above another plane at an instant when the angles of elevation of the two planes from the same point on the ground are 60° and 45°

respectively. What is the height of the lower plane from the ground?

(a) $100\sqrt{3}$ m   (b) $\dfrac{100}{\sqrt{3}}$ m

(c) $50\sqrt{3}$ m   (d) $150(\sqrt{3}+1)$ m

⊘ *(a)* Let the height of the lower plane from the ground be h m and $PA = x$
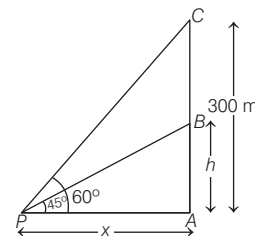
Now, in ΔBAP,

$\tan 45° = \dfrac{AB}{AP}$

$1 = \dfrac{h}{x}$

$h = x$ ...(i)

Now, in ΔAPC

$\tan 60° = \dfrac{AC}{AP} = \dfrac{300}{x}$

$\Rightarrow \qquad x = \dfrac{300}{\sqrt{3}}$ ...(ii)

From Eqs. (i) and (ii), we get

$h = x = \dfrac{300}{\sqrt{3}}$

$\Rightarrow \qquad h = \dfrac{300}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}}$

$= \dfrac{300\sqrt{3}}{3}$

$= 100\sqrt{3}$ m

10. From the top of a building 90 m high, the angles of depression of the top and the bottom of a tree are 30° and 45° respectively. What is the height of the tree?

(a) $30\sqrt{3}$ m
(b) $90 - 30\sqrt{3}$ m
(c) $90 + 30\sqrt{3}$ m
(d) $60 + 30\sqrt{3}$ m

⊘ *(b)*
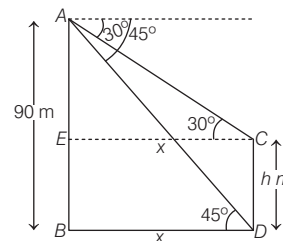
Let AB and CD be the building and tree respectively.

Now, in ΔABD

$\tan 45° = \dfrac{AB}{BD}$

$\Rightarrow \qquad 1 = \dfrac{90}{BD}$

$\Rightarrow \qquad BD = 90 \, m \qquad\qquad ...(i)$

Again, in $\triangle AEC$

$\qquad \tan 30° = \dfrac{AE}{EC} \quad [\because EC = BD = 90 \, m]$

$\Rightarrow \qquad \dfrac{1}{\sqrt{3}} = \dfrac{AE}{90}$

$\Rightarrow \qquad AE = \dfrac{90}{\sqrt{3}} = 30\sqrt{3} \, m$

$\therefore$ Height of tree $= CD = BE = AB - AE$

$\qquad\qquad = (90 - 30\sqrt{3}) \, m$

11. From an aeroplane vertically over a straight horizontal road, the angles of depression of two consecutive kilometre-stones on the opposite sides of the aeroplane are observed to be α and β. The height of the aeroplane above the road is

(a) $\dfrac{\tan\alpha + \tan\beta}{\tan\alpha \tan\beta}$ (b) $\dfrac{\tan\alpha \tan\beta}{\tan\alpha + \tan\beta}$

(c) $\dfrac{\cot\alpha \cot\beta}{\cot\alpha + \cot\beta}$ (d) $\dfrac{\cot\alpha + \cot\beta}{\cot\alpha \cot\beta}$

⊙ **(b)**

Let the height of aeroplane be h km.

Now, in $\triangle ABC$

$\qquad \tan\alpha = \dfrac{AC}{BC}$

$\Rightarrow \quad \tan\alpha = \dfrac{h}{d_1}$

$\Rightarrow \quad d_1 = h \cot\alpha \qquad\qquad ...(i)$

Again, in $\triangle ACD$

$\qquad \tan\beta = \dfrac{AC}{CD}$

$\qquad \tan\beta = \dfrac{h}{d_2}$

$\Rightarrow \qquad d_2 = h \cot\beta \qquad\qquad ...(ii)$

On adding Eqs. (i) and (ii), we get

$\qquad d_1 + d_2 = h \cot\alpha + h \cot\beta$

$\Rightarrow \qquad 1 = h(\cot\alpha + \cot\beta)$

$\Rightarrow \qquad h = \dfrac{1}{\cot\alpha + \cot\beta}$
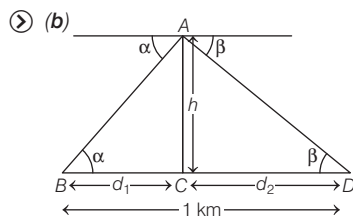
$\qquad = \dfrac{1}{\dfrac{1}{\tan\alpha} + \dfrac{1}{\tan\beta}}$

$\qquad = \dfrac{\tan\alpha \, \tan\beta}{\tan\alpha + \tan\beta}$

2016 (II)

12. A man from the top of a 100 m high tower seen a car moving towards the tower at an angle of depression 30°. After some time, the angle of depression becomes 60°. What is the distance travelled by the car during this time?

(a) $100\sqrt{3}$ m   (b) $\dfrac{200\sqrt{3}}{3}$ m

(c) $\dfrac{100\sqrt{3}}{3}$ m   (d) $200\sqrt{3}$ m

⊙ **(b)** Let AB be the tower of height is 100 m.
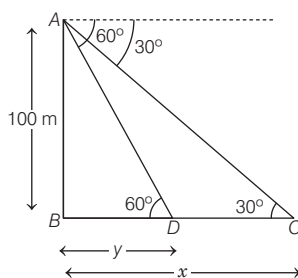
Now, in $\triangle ABC$,

$\qquad \tan 30° = \dfrac{AB}{BC} = \dfrac{100}{x}$

$\Rightarrow \qquad x = 100\sqrt{3} \, m$

Again, in $\triangle ABD$

$\qquad \tan 60° = \dfrac{AB}{BD} = \dfrac{100}{y}$

$\Rightarrow \qquad y = \dfrac{100}{\sqrt{3}} \, m$

$\therefore$ Required distance travelled by car

$\qquad = CD = x - y$

$\qquad = \left(100\sqrt{3} - \dfrac{100}{\sqrt{3}}\right)$

$\qquad = \dfrac{300 - 100}{\sqrt{3}} = \dfrac{200}{\sqrt{3}} = \dfrac{200}{3}\sqrt{3} \, m$

13. Two men on either side of a tower 75 m high observed that the angle of elevation of the top of the tower to be 30° and 60°. What is the distance between the two men?

(a) $100\sqrt{3}$ m   (b) $75\sqrt{3}$ m

(c) $\dfrac{100\sqrt{3}}{3}$ m   (d) $60\sqrt{3}$ m

⊙ **(a)** Let AB be the tower of height 75 m, C and D denotes the positions of two men on either side of a tower.

Now, in $\triangle ABC$

$\qquad \tan 60° = \dfrac{AB}{BC} = \dfrac{75}{x}$

$\Rightarrow \qquad \sqrt{3} = \dfrac{75}{x} \;\Rightarrow x = \dfrac{75}{\sqrt{3}} \, m$
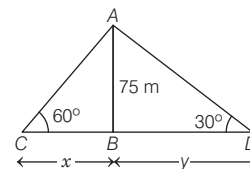
Again $\triangle ABD$,

$\qquad \tan 30° = \dfrac{AB}{BD} = \dfrac{75}{y}$

$\Rightarrow \qquad \dfrac{1}{\sqrt{3}} = \dfrac{75}{y} \;\Rightarrow y = 75\sqrt{3} \, m$

Hence, distance between the two men

$\qquad = x + y$

$\qquad = \dfrac{75}{\sqrt{3}} + 75\sqrt{3} = \dfrac{75 + 225}{\sqrt{3}}$

$\qquad = \dfrac{300}{\sqrt{3}} = 100\sqrt{3} \, m$

14. If the length of the shadow of a tower is equal to its height, then what is the Sun's altitude at that time?

(a) 15°   (b) 30°   (c) 45°   (d) 60°

⊙ **(c)** Let AB and BC be the height of tower and length of the shadow of a tower.
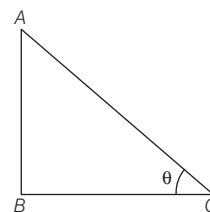
According to question,

$\qquad\qquad AB = BC \qquad\qquad ...(i)$

Now, in $\triangle ABC$,

$\qquad \tan\theta = \dfrac{AB}{BC} = \dfrac{AB}{AB} \qquad$ [from Eq. (i)]

$\Rightarrow \qquad \tan\theta = 1$

$\therefore \qquad \tan\theta = \tan 45°$

$\Rightarrow \qquad \theta = 45°$

Hence, the Sun's altitude is 45°.

2016 (I)

15. Two observers are stationed due North of a tower (of height x m) at a distance y m from each other. The angles of elevation of the tower observed by them are 30° and 45°, respectively. Then, x / y is equal to

(a) $\dfrac{\sqrt{2} - 1}{2}$ (b) $\dfrac{\sqrt{3} - 1}{2}$ (c) $\dfrac{\sqrt{3} + 1}{2}$ (d) 1

⊙ (c) In right angled $\triangle ADC$, $\tan 45° = \dfrac{AC}{CD}$

$\Rightarrow \qquad CD = \dfrac{AC}{\tan 45°} = x \qquad \dots(i)$

Now, in right angled $\triangle ABC$,

$\tan 30° = \dfrac{AC}{BC}$

$\tan 30° = \dfrac{x}{y + CD}$

$\Rightarrow \qquad \dfrac{1}{\sqrt{3}} = \dfrac{x}{x + y} \qquad$ [from Eq. (i)]

$\therefore \qquad \dfrac{x + y}{x} = \dfrac{\sqrt{3}}{1}$

$\Rightarrow \quad \dfrac{x}{y} = \dfrac{1}{\sqrt{3} - 1} \times \dfrac{\sqrt{3} + 1}{\sqrt{3} + 1} = \dfrac{\sqrt{3} + 1}{2}$

2015 (II)

16. An aeroplane flying at a height of 3000 m passes vertically above another aeroplane at an instant, when the angles of elevation of the two planes from some point on the ground are 60° and 45°, respectively. Then, the vertical distance between the two planes is

(a) $1000(\sqrt{3} - 1)$ m
(b) $1000\sqrt{3}$ m
(c) $1000(3 - \sqrt{3})$ m
(d) $3000\sqrt{3}$ m

⊙ (c) Let A and B be the position of two planes and D be a point.
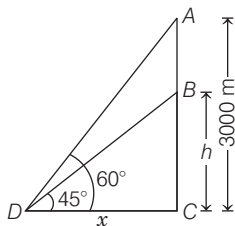
In $\triangle BCD$, $\tan 45° = \dfrac{h}{x}$

$\Rightarrow \qquad h = x \qquad \dots(i)$

In $\triangle ACD$, $\tan 60° = \sqrt{3} = \dfrac{3000}{x}$

$\therefore \quad x = \dfrac{3000}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}} = 1000\sqrt{3}$ m

$\therefore \quad AB = 3000 - h = 3000 - 1000\sqrt{3}$

$= 1000(3 - \sqrt{3})$ m

17. A pole is standing erect on the ground which is horizontal. The tip of the pole is tied tight with a rope of length $\sqrt{12}$ m to a point on the ground. If the rope is making 30° with the horizontal, then the height of the pole is

(a) $2\sqrt{3}$ m (b) $3\sqrt{2}$ m (c) 3 m (d) $\sqrt{3}$ m

⊙ (d) AB is a pole and AC is rope.

Let height of the pole $= AB = h$

In $\triangle ABC$, $\sin 30° = \dfrac{AB}{AC} = \dfrac{h}{\sqrt{12}}$

$\Rightarrow \qquad \dfrac{h}{\sqrt{12}} = \dfrac{1}{2}$

$\therefore \qquad h = \dfrac{\sqrt{12}}{2} = \dfrac{2\sqrt{3}}{2} = \sqrt{3}$ m
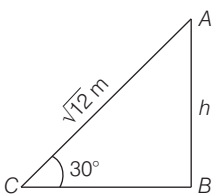
2015 (I)

18. The angles of elevation of the top of a tower from two points P and Q at distance m^2 and n^2 respectively, from the base and in the same straight line with it are complementary. The height of the tower is

(a) $(mn)^{1/2}$ (b) $mn^{1/2}$ (c) $m^{1/2}n$ (d) mn

⊙ (d) Let the height of the tower be h.

$PB = m^2$ and $QB = n^2$

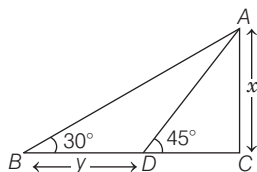In right angled $\triangle AQB$,

$\tan\theta = \dfrac{AB}{QB} \Rightarrow \tan\theta = \dfrac{h}{n^2} \qquad \dots(i)$
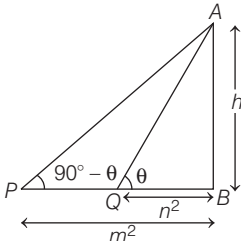
In right angled $\triangle APB$,

$\tan(90°-\theta) = \dfrac{AB}{PB}$

$\Rightarrow \qquad \cot\theta = \dfrac{h}{m^2} \qquad \dots(ii)$

On multiplying Eqs. (i) and (ii), we get

$\tan\theta \cdot \cot\theta = \dfrac{h}{n^2} \times \dfrac{h}{m^2}$

$\Rightarrow \qquad 1 = \dfrac{h^2}{m^2 n^2} \qquad$ [∵ $\tan\theta\cot\theta = 1$]

$\therefore \qquad h^2 = m^2 n^2$

$\Rightarrow \qquad h = mn$

Hence, the height of the tower is mn.

19. The angle of elevation of a cloud from a point 200 m above a lake is 30° and the angle of depression of its reflection in the lake is 60°. The height of the cloud is

(a) 200 m (b) 300 m
(c) 400 m (d) 600 m

⊙ (c) Let P be the cloud at height H above the level of the water in the lake and Q its image in the water.
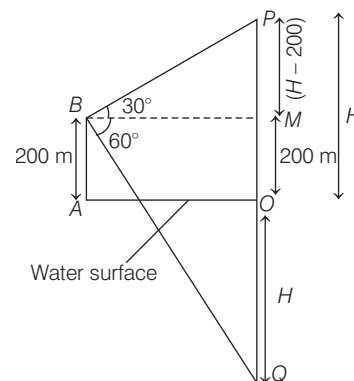
$\therefore \qquad OQ = OP = H$

Given, $\angle PBM = 30°$

and $\angle MBQ = 60°$

In right angled $\triangle PBM$,

$\tan 30° = \dfrac{PM}{BM} = \dfrac{H - 200}{BM}$

$\Rightarrow \qquad \dfrac{1}{\sqrt{3}} = \dfrac{H - 200}{BM}$

$\Rightarrow \qquad BM = \sqrt{3}(H - 200) \qquad \dots(i)$

In right angled $\triangle QBM$,

$\tan 60° = \dfrac{MQ}{BM} = \dfrac{H + 200}{BM}$

$\Rightarrow \qquad \sqrt{3} = \dfrac{H + 200}{\sqrt{3}(H - 200)} \quad$ [from Eq. (i)]

$\Rightarrow \qquad H + 200 = 3(H - 200)$

$\Rightarrow \qquad H + 200 = 3H - 600$

$\therefore \qquad 2H = 800 \Rightarrow H = 400$ m

Hence, the height of the cloud is 400 m.

20. From the top of a tower, the angles of depression of two objects P and Q (situated on the ground on the same side of the tower) separated at a distance of $100(3 - \sqrt{3})$ m are 45° and 60°, respectively. The height of the tower is

(a) 200 m (b) 250 m
(c) 300 m (d) None of these

⊙ *(c)* Let $BC = h$ be height of tower and P and Q be the points, where the angle subtended are 45° and 60°.

In right angled ΔBQC,
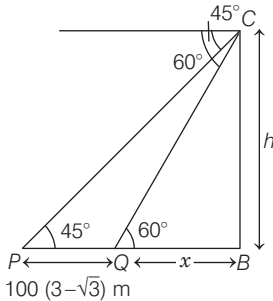
100 $(3-\sqrt{3})$ m

$$\tan 60° = \frac{BC}{BQ} \Rightarrow \sqrt{3} = \frac{h}{x}$$

$$\Rightarrow \qquad x = \frac{h}{\sqrt{3}} \qquad \qquad ...(i)$$

In right angled ΔBPC,

$$\tan 45° = \frac{BC}{PB} = \frac{BC}{PQ + QB}$$

$$\Rightarrow \qquad 1 = \frac{h}{100(3-\sqrt{3}) + x}$$

$$\Rightarrow \qquad 100(3-\sqrt{3}) + x = h$$

$$\Rightarrow \qquad 100(3-\sqrt{3}) + \frac{h}{\sqrt{3}} = h \qquad \text{[from Eq. (i)]}$$

$$\Rightarrow \qquad h - \frac{h}{\sqrt{3}} = 100(3-\sqrt{3})$$

$$\Rightarrow \qquad h\left(1 - \frac{1}{\sqrt{3}}\right) = 100(3-\sqrt{3})$$

$$\Rightarrow \qquad \frac{h(\sqrt{3}-1)}{\sqrt{3}} = 100(3-\sqrt{3})$$

$$\Rightarrow \qquad h = \frac{100\sqrt{3}(3-\sqrt{3})}{(\sqrt{3}-1)}$$

$$\Rightarrow \qquad h = \frac{100\sqrt{3} \times \sqrt{3}(\sqrt{3}-1)}{(\sqrt{3}-1)} = 300 \text{ m}$$

2014 (II)

21. If from the top of a post a string twice the length of the post is stretched tight to a point on the ground, then what angle will the string make with the post?

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$ (c) $\frac{5\pi}{12}$ (d) $\frac{\pi}{3}$

⊙ *(d)* Let AB be the height, AC be the string and the angle made by string with the post be θ.
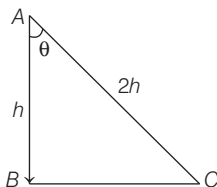
Now, $\cos\theta = \frac{AB}{AC} = \frac{h}{2h} = \frac{1}{2} = \cos\frac{\pi}{3}$

$$\therefore \qquad \theta = \frac{\pi}{3}$$

22. From a certain point on a straight road a person observe a tower in the West direction at a distance of 200 m. He walks some distance along the road and finds that the same tower is 300 m South of him. What is the shortest distance of the tower from the road?

(a) $\frac{300}{\sqrt{13}}$ m   (b) $\frac{500}{\sqrt{3}}$ m

(c) $\frac{600}{\sqrt{13}}$ m   (d) $\frac{900}{\sqrt{3}}$ m

⊙ *(c)* Let person be at point C and observes a tower in West direction at B.
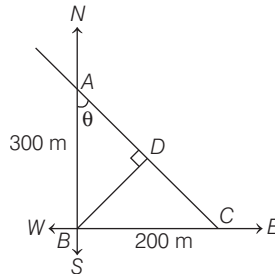
$\therefore BC = 200$ m

He walks some distance and reach at A.

Now, he observes tower in South direction at B.

$\therefore \qquad AB = 300$ m

Let BD be the shortest distance of tower from the road. which is a perpendicular distance.

If $\angle ABC = \theta$, then $\angle CBD = 90° - \theta$

[∵ angle between S and W = 90°]

In ΔADB, $\cos\theta = \frac{BD}{AB} \Rightarrow \cos\theta = \frac{BD}{300}$ ...(i)

In ΔCDB, $\cos(90° - \theta) = \frac{BD}{BC}$

$$\Rightarrow \qquad \sin\theta = \frac{BD}{200} \qquad \qquad ...(ii)$$

We know that, $\cos^2\theta + \sin^2\theta = 1$

$$\Rightarrow \left(\frac{BD}{300}\right)^2 + \left(\frac{BD}{200}\right)^2 = 1$$

[from Eqs. (i) and (ii)]

$$\Rightarrow BD^2\left[\frac{40000 + 90000}{90000 \times 40000}\right] = 1$$

$$\Rightarrow BD^2\left[\frac{130000}{3600000000}\right] = 1$$

$$\Rightarrow BD^2 = \frac{360000}{13}$$

$$\therefore \quad BD = \sqrt{\frac{360000}{13}} = \frac{600}{\sqrt{13}} \text{ m}$$

2014 (I)

23. The shadow of a tower standing on a level plane is found to be 50 m longer when the Sun's elevation is 30°, then when it is 60°. What is the height of the tower?

(a) 25 m   (b) $25\sqrt{3}$ m

(c) $\frac{25}{\sqrt{3}}$ m   (d) 30 m

⊙ *(b)* Let h be the height of the tower and BC be x m.
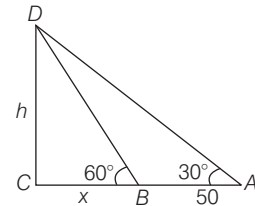
In ΔBCD, $\tan 60° = \frac{h}{x}$

$$\Rightarrow \sqrt{3} = \frac{h}{x} \Rightarrow h = x\sqrt{3} \qquad ...(i)$$

Now, in ΔACD, $\tan 30° = \frac{h}{50 + x}$

$$\Rightarrow \qquad \frac{1}{\sqrt{3}} = \frac{x\sqrt{3}}{50 + x}$$

$$\Rightarrow 50 + x = 3x \Rightarrow x = 25 \text{ m}$$

$$\therefore \qquad h = 25\sqrt{3} \text{ m} \qquad \text{[from Eq. (i)]}$$

24. The angle of elevation of the top of a tower 30 m high from the foot of another tower in the same plane is 60° and the angle of elevation of the top of the second tower from the foot of the first tower is 30°. The distance between the two towers is m times the height of the shorter tower. What is m equal to?

(a) $\sqrt{2}$ (b) $\sqrt{3}$ (c) $\frac{1}{2}$ (d) $\frac{1}{3}$

⊙ *(b)* Let h be the height of shorter tower, then the distance between the two towers is mh m.
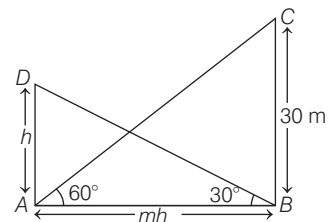
In ΔABD, $\tan 30° = \frac{h}{mh} \Rightarrow \frac{1}{\sqrt{3}} = \frac{1}{m}$

$$\therefore \qquad m = \sqrt{3}$$

AREA AND PERIMETER

1. The area of a sector of a circle of radius 4 cm is 25.6 cm². What is the radian measure of the arc of the sector?

(a) 2.3   (b) 3.2   (c) 3.3   (d) 3.4

(b) Area of a sector = 25.6 cm²

Length of arc $(l) = \dfrac{A \times 2}{r}$

$$l = \dfrac{25.6 \times 2}{4} \Rightarrow l = 12.8$$

$$\theta = \dfrac{l}{r}$$

θ = angle in radian

$\therefore \qquad \theta = \dfrac{12.8}{4} = \dfrac{128}{40} = \dfrac{16}{5} = 3.2$

2. The perimeter of a triangle is 22 cm. Through each vertex of the triangle, a straight line parallel to the opposite side is drawn. What is the perimeter of triangle formed by these lines?

(a) 33 cm (b) 44 cm (c) 66 cm (d) 88 cm

(b)
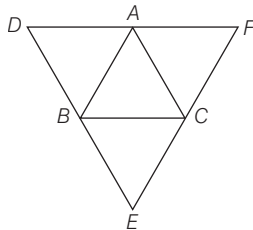
As, $AC \parallel BE$ and $AB \parallel CE$, $ABEC$ forms a parallelogram.

where, $AC = BE$ and $AB = CE$

Similarly,

As, $AC \parallel DB$ and $BC \parallel AD$, $ADBC$ forms a second parallelogram.

where, $AC = BD$ and $AD = BC$

With this we can conclude that B is mid-point of DE and AC is half of DE.

Similarly, it will be true for FD and EF also.

The ratio of the perimeter of new triangle to that original triangle is 2 : 1.

$\therefore$ Required perimeter $= 22 \times \dfrac{2}{1} = 44$ cm

3. If l is the length of the median of an equilateral triangle, then what is its area?

(a) $\dfrac{\sqrt{3}\, l^2}{3}$ (b) $\dfrac{\sqrt{3}\, l^2}{2}$ (c) $\sqrt{3}\, l^2$ (d) $2l^2$

(a) Median of a equilateral triangle $= \dfrac{\sqrt{3}}{2}a$

$$l = \dfrac{\sqrt{3}}{2}a \Rightarrow a = \dfrac{2l}{\sqrt{3}}$$

Area of equilateral triangle $= \dfrac{\sqrt{3}}{4}a^2$

$$= \dfrac{\sqrt{3}}{4} \times \left(\dfrac{2l}{\sqrt{3}}\right)^2 = \dfrac{\sqrt{3}}{4} \times \dfrac{4l^2}{3} = \dfrac{\sqrt{3}\, l^2}{3}$$

4. A piece of wire is in the form of a sector of a circle of radius 20 cm, subtending an angle 150° at the centre. If it is bent in the form of a circle, then what will be its radius?

(a) $\dfrac{19}{3}$ cm   (b) 7 cm

(c) 8 cm   (d) None of these

(d) Radius = 20 cm

Length of arc $(l) = \dfrac{\theta}{360°} \times 2\pi r$

$$= \dfrac{150°}{360°} \times 2 \times \pi \times 20$$

$$= \dfrac{50}{3}\pi$$

Perimeter of sector = Length of arc + $2r$

$$= \dfrac{50}{3}\pi + 40$$

According to the question,

$$2\pi r = \dfrac{50}{3}\pi + 40$$

$\Rightarrow \quad r = \dfrac{25}{3} + \dfrac{20}{\pi} \Rightarrow r = \dfrac{25}{3} + \dfrac{70}{11}$

$\therefore \qquad r = \dfrac{485}{33} = 14.7$ [approx.]

5. An equilateral triangle and a square are constructed using metallic wires of equal length. What is the ratio of area of triangle to that of square?

(a) 3 : 4   (b) 2 : 3

(c) $4\sqrt{3}$: 9   (d) $2\sqrt{3}$: 9

(c) Let side of triangle be 'x' unit.

Let the side of square be 'a' unit.

Perimeter of square $= 4 \times a = 4a$ unit

According to the question,

Perimeter of triangle = Perimeter of square

$$3x = 4a$$

$$x = \dfrac{4a}{3}$$

Required ratio $= \dfrac{\text{Area of triangle}}{\text{Area of square}}$

$$= \dfrac{\dfrac{\sqrt{3}}{4}x^2}{a^2} = \dfrac{\dfrac{\sqrt{3}}{4} \times \dfrac{4a}{3} \times \dfrac{4a}{3}}{a^2}$$

$$= \dfrac{4\sqrt{3}}{9}$$

$\therefore \ 4\sqrt{3}$: 9

6. All the four sides of a parallelogram are of equal length. The diagonals are in the ratio 1 : 2. If the sum of the lengths of the diagonals is 12 cm, then what is the area of the parallelogram?

(a) 9 cm²   (b) 12 cm²

(c) 16 cm²   (d) 25 cm²

(c) If all the sides of a parallelogram is equal that mean its a rhombus.

Let diagonal of rhombus are x and $2x$.

According to the question,

$$x + 2x = 12$$

$$3x = 12$$

$$x = 4$$

$\therefore$ Area of rhombus $= \dfrac{1}{2} \times d_1 \times d_2$

$$= \dfrac{1}{2} \times 4 \times 8 = 16 \text{ cm}^2$$

7. *ABC* is a triangle right angled at *B*. If *AB* = 5 cm and *BC* = 10 cm, then what is the length of the perpendicular drawn from the vertex *B* to the hypotenuse?

(a) 4 cm   (b) $2\sqrt{5}$ cm
(c) $\dfrac{4}{\sqrt{5}}$ cm   (d) 8 cm

⊘ *(b)*
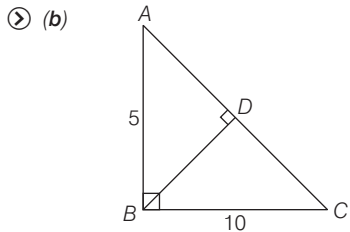
In ΔABC, $AB = 5$ cm, $BC = 10$ cm
Using Pythagoras theorem, we get
$$AB^2 + BC^2 = AC^2$$
$$5^2 + 10^2 = AC^2$$
$$AC = 5\sqrt{5}$$
$$BD = \frac{AB \times BC}{AC} = \frac{5 \times 10}{5\sqrt{5}}$$
$$BD = \frac{10}{\sqrt{5}} = \frac{10}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$$
$$\therefore \quad BD = 2\sqrt{5} \text{ cm}$$

8. The length and breadth of a rectangle are increased by 20% and 10%, respectively. What is the percentage increase in the area of the rectangle?

(a) 32%   (b) 30%   (c) 25%   (d) 15%

⊘ *(a)* Let length and breadth of rectangle be *x* and *y*.
According to the question,
New length $= \dfrac{120}{100} \times x = 1.2x$
New breadth $= \dfrac{110}{100} \times y = 1.1\,y$
Area of rectangle $= x \times y$
Area of new rectangle $= 1.2\,x \times 1.1y$
$$= 1.32\ xy$$
∴ Required percentage
$$= \frac{1.32\,xy - xy}{xy} \times 100$$
$$= \frac{0.32\,x\,y}{x\,y} \times 100 = 32\%$$

Alternate method

Here, $a = 20\%$, $b = 10\%$
Required percentage increase in the area of rectangle
$$= \left(a + b + \frac{a \times b}{100}\right)\%$$
$$= \left(20 + 10 + \frac{20 \times 10}{100}\right)\%$$
$$= (30 + 2)\% = 32\%$$

9. If the length of the hypotenuse of a right angled triangle is 10 cm, then what is the maximum area of such a right angled triangle?

(a) 100 cm^2 (b) 50 cm^2
(c) 25 cm^2 (d) 10 cm^2

⊘ *(c)* $(10)^2 = x^2 = y^2$
For maximum value, $x = y$,
Then, $(10)^2 = x^2 + x^2$
$$\Rightarrow \quad 2x^2 = 100$$
$$x = 5\sqrt{2} \text{ cm}$$
∴ Maximum area possible $= \dfrac{1}{2} \times x \times y$
$$= \frac{5\sqrt{2} \times 5\sqrt{2}}{2} = 25 \text{ cm}^2$$

10. A square is drawn such that its vertices are lying on a circle of radius 201 mm. What is the ratio of area of circle to that of square?

(a) 11 : 7   (b) 7 : 11
(c) 20 : 19   (d) 19 : 20

⊘ *(a)*
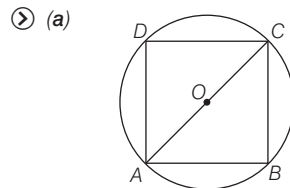
Let side fo square be *x* cm.
Diagonal of square
$$= 201 \times 2 = 402 \text{ cm}$$
Using Pythagoras theorem,
$$x^2 + x^2 = (402)^2$$
$$\Rightarrow \quad 2x^2 = 402 \times 402$$
$$x^2 = 201 \times 402$$
$$\Rightarrow \quad x = 201\sqrt{2}$$
∴ Required ratio $= \dfrac{\pi r^2}{x^2} = \dfrac{\frac{22}{7} \times 201 \times 201}{201\sqrt{2} \times 201\sqrt{2}}$
$$= \frac{11}{7} = 11 : 7$$

11. A piece of wire of length 33 cm is bent into an arc of a circle of radius 14 cm. What is the angle subtended by the arc at the centre of the circle?

(a) 75°   (b) 90°   (c) 135°   (d) 150°

⊘ *(c)* Length of arc (l) = 33 cm
Radius (r) = 14 cm
$$l = \frac{\theta}{360°} \times 2\pi r$$
$$33 = \frac{\theta}{360°} \times 2 \times \frac{22}{7} \times 14$$
$$\therefore \quad \theta = 135°$$

12. What is the ratio of the area of a square inscribed in a semicircle of radius *r* to the area of square inscribed in a circle of radius *r* ?

(a) 1 : 2   (b) 2 : 5
(c) 2 : 3   (d) 3 : 5

⊘ *(b)*

(i)

(ii)
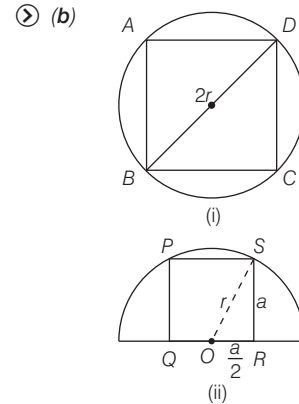
Let *r* be the radius of circle and side of square '*a*'. In fig. (i),
Diagonal of square = 2*r*
Using Pythagoras theorem in ΔBCD,
$$BC^2 + CD^2 = BD^2$$
$$a^2 + a^2 = (2r)^2 \Rightarrow 2a^2 = 4r^2$$
$$a = r\sqrt{2}$$
In fig. (ii),
Using Pythagoras theorem in ΔORS,
$$(OS)^2 = (OR)^2 + (RS)^2$$
$$r^2 = a^2 + \frac{a^2}{4} \Rightarrow r^2 = \frac{5a^2}{4}$$
$$a^2 = \frac{4r^2}{5} \Rightarrow a = \frac{2r}{\sqrt{5}}$$
∴ Required Ratio $= \dfrac{\left(\dfrac{2r}{\sqrt{5}}\right)^2}{(r\sqrt{2})^2}$

[∵ area of square = (side)^2]
$$= \frac{\dfrac{4r^2}{5}}{r^2 \times 2}$$
$$= \frac{2}{5} \Rightarrow 2 : 5$$

13. If one side of a right-angled triangle (with all sides integers) is 15 cm, then what is the maximum perimeter of the triangle?

(a) 240 cm   (b) 225 cm
(c) 113 cm   (d) 112 cm

⊘ *(a)* Let 2 other sides be *x* and *y*.
So, $x^2 = y^2 + 15^2$
[for maximum perimeter]
$$x^2 - y^2 = 15^2$$
$$(x - y)(x + y) = 225$$
To make perimeter maximum we need to minimize the difference between sides.

So, on comparing

$$x + y = 225 \quad \ldots(i)$$
$$x - y = 1 \quad \ldots(ii)$$

By solving Eqs. (i) and (ii), we get

$$x = 113, \ y = 112$$

$\therefore$ Maximum perimeter $= x + y + 15$

$$= 113 + 112 + 15$$
$$= 240 \text{ cm}$$

2019 (I)

14. In a rectangle, length is three times its breadth. If the length and the breadth of the rectangle are increased by 30% and 10% respectively, then its perimeter increases by

(a) $\dfrac{40}{3}$%   (b) 20%   (c) 25%   (d) 27%

⊗ *(c)* Breadth of the rectangle $= x$

Length of the rectangle $= 3x$

Perimeter of rectangle $= 2(x + 3x)$

$$= 8x \quad \ldots(i)$$
$$[\because P = 2 \ (l + b)]$$

Increases length 30%, then

Length $= \dfrac{130}{100} \times 3x = \dfrac{39x}{10}$

Increases breadth 10%, then

Breadth $= \dfrac{110}{100} \times x = \dfrac{11x}{10}$

New perimeter of rectangle

$$= 2\left(\dfrac{39x}{10} + \dfrac{11x}{10} \right) = 10x \ \ldots(ii)$$

Increases in perimeter Eqs. (i) and (ii), we get

$$10x - 8x = 2x$$

Percentage of change in perimeter

$$= \dfrac{2x}{8x} \times 100 = 25\%$$

Option (c) is correct.

15. What is the percentage decrease in the area of a triangle if its each side is halved?

(a) 75%   (b) 50%
(c) 25%   (d) No change

⊗ *(a)* Let we have an equilateral triangle and side of triangle $= x$

Area of triangle $= \dfrac{\sqrt{3}}{4} x^2$

Now, Triangle each side is halved $= x / 2$

New area of triangle $= \dfrac{\sqrt{3}}{4} \left(\dfrac{x}{2} \right)^2 = \dfrac{\sqrt{3}}{4} \dfrac{x^2}{4}$

Change in area $= \dfrac{\sqrt{3}}{4} x^2 - \dfrac{\sqrt{3}}{4} \dfrac{x^2}{4}$

$$= \dfrac{\sqrt{3}}{4} \dfrac{3x^2}{4}$$

Change in percentage of area

$$= \dfrac{\dfrac{\sqrt{3}}{4} \times \dfrac{3x^2}{4}}{\dfrac{\sqrt{3}}{4} x^2} \times 100 = 75\%$$

Option (a) is correct.

Alternate method

Here, $a = 50\%$

Required percentage decrease in area of equilateral triangle $= \left(2a - \dfrac{a^2}{100} \right)\%$

$$= 2 \times 50 - \dfrac{(50)^2}{100} = 100 - \dfrac{2500}{100}$$
$$= 100 - 25 = 75\%$$

16. Considering two opposite vertices of a square of side '*a*' as centres, two circular arcs are drawn within the square joining the other two vertices, thus forming two sectors. What is the common area in these two sectors?

(a) $a^2 \left(\pi + \dfrac{1}{2} \right)$ (b) $a^2 \left(\pi - \dfrac{1}{2} \right)$

(c) $a^2 \left(\dfrac{\pi}{2} - 1 \right)$ (d) $a^2 \left(\dfrac{\pi}{2} + 1 \right)$

⊗ *(c)* *ABCD* is a square and Side of a square $= a$
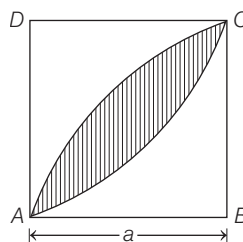
Shaded region is the common area of the sectors.

Area of shaded region

$= 2 \times$ Area of sector $-$ Area of square

$= 2 \times \pi a^2 \times \dfrac{90°}{360°} - a^2$

$$\left[\because \text{area of sector } \pi r^2 \dfrac{\theta}{360°} \right]$$

$= 2 \times \dfrac{\pi a^2}{4} - a^2 = a^2 \left(\dfrac{\pi}{2} - 1 \right)$

Option (c) is correct.

17. Two circles are drawn with the same centre. The circumference of the smaller circle is 44 cm and that of the bigger circle is double the smaller one. What is the area between these two circles?

(a) 154 cm²   (b) 308 cm²
(c) 462 cm²   (d) 616 cm²

⊗ *(c)* Two circle are drawn with the same centre (*O*).
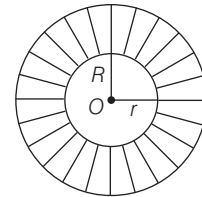
Circumference of smaller circle $= 44$ cm and Radius of smaller circle $= r$

Circumference of circle $= 2\pi r$

$$\Rightarrow \qquad 2\pi r = 44$$
$$r = 7 \qquad \ldots(i)$$

Circumference of big circle

$$= 2 \times \text{smaller circle}$$
$$= 2 \times 44 = 88$$
$$2\pi R = 88$$
$$R = 14$$

Area between two circles

$$A = \pi R^2 - \pi r^2$$
$$A = \pi (R^2 - r^2)$$
$$= \dfrac{22}{7} \times [14^2 - 7^2] = \dfrac{22}{7} \times 21 \times 7$$
$$= 462 \text{ cm}^2$$

18. A rectangular red carpet of size 6 ft × 12 ft has a dark red border 6 inches wide. What is the area of the dark red border?

(a) 9 sq feet   (b) 15 sq feet
(c) 17 sq feet   (d) 18 sq feet

⊗ *(c)* Given
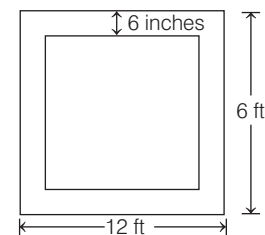
Width of red border = 6 inches

$$= \dfrac{6}{12} = 0.5 \text{ feet } \{\because 1 \text{ ft} = 12 \text{ inches}\}$$

Length of outer rectangle = 12 feet

Breadth of outer rectangle = 6 feet

Area of outer rectangle

$$= l \times b = 12 \times 6 = 72 \text{ sq feet}$$

Length of inner rectangle

$$= 12 - 0.5 - 0.5 = 11 \text{ feet}$$

Breadth of inner rectangle

$$= 6 - 0.5 - 0.5 = 5 \text{ feet}$$

Area of inner rectangle

$$= 11 \times 5 = 55 \text{ sq feet}$$

Area of darkred border

$$= (\text{area of outer rectangle})$$
$$\quad - (\text{area of inner rectangle})$$
$$= 72 - 55 = 17 \text{ sq feet}$$

19. The perimeter of a right-angled triangle is k times the shortest side. If the ratio of the other side to hypotenuse is 4 : 5, then what is the value of k?

(a) 2   (b) 3   (c) 4   (d) 5

⊙ *(c)* ΔABC is right angle triangle at B
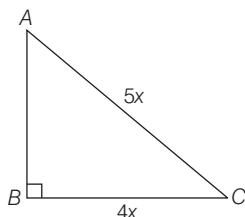
$$AC = 5x, BC = 4x$$

AB is shortest side of triangle.

$$(AB)^2 + (BC)^2 = (AC)^2$$
$$(AB)^2 + (4x)^2 = (5x)^2$$
$$AB = \sqrt{25x^2 - 16x^2} = \sqrt{9x^2}$$
$$AB = 3x$$

Perimeter of triangle is k times the shortest side

$$AB + BC + CA = k \times (AB)$$
$$3x + 4x + 5x = k \times (3x)$$
$$k = \frac{12x}{3x} = 4 \Rightarrow k = 4$$

20. A 12 m long wire is cut into two pieces, one of which is bent into a circle and the other into a square enclosing the circle. What is the radius of the circle?

(a) $\dfrac{12}{\pi + 4}$ (b) $\dfrac{6}{\pi + 4}$

(c) $\dfrac{3}{\pi + 4}$ (d) $\dfrac{6}{\pi + 2\sqrt{2}}$

⊙ *(b)* A square enclosing the circle
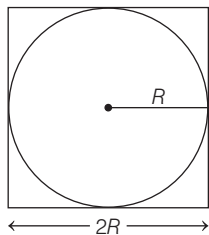
Radius of circle = R
and Side of square = $2R$
Circumference of circle = $2\pi R$
Perimeter of square = $4(2R) = 8R$
Total length of wire

$$2\pi R + 8R = 12$$
$$2(\pi R + 4R) = 12$$
$$R(\pi + 4) = 6$$
$$R = \frac{6}{\pi + 4}$$

Radius of circle = $\dfrac{6}{\pi + 4}$

21. The angles of a triangle are in the ratio 1 : 1 : 4. If the perimeter of the triangle is k times its largest side, then what is the value of k?

(a) $1 + \dfrac{2}{\sqrt{3}}$ (b) $1 - \dfrac{2}{\sqrt{3}}$

(c) $2 + \dfrac{2}{\sqrt{3}}$ (d) 2

⊙ *(a)* The angle of triangle are in the ratio 1 : 1 : 4.
Then, two angle are equal.
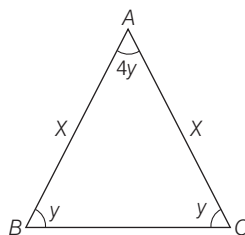
Then, ABC is isosceles triangle
Let $\qquad AB = x$
A perpendicular drawn from vertex A to BC is D.
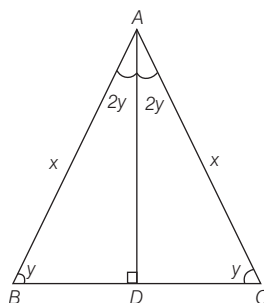
$$BD = DC \text{ [isosceles triangle]}$$

AD is also angle bisector
In ΔADB,

$$2y + y + 90 = 180°$$

[sum of triangle's interior angles]

$$y = 30°$$
$$\cos 30° = \frac{BD}{AB}$$
$$\frac{\sqrt{3}}{2} = \frac{BD}{x} \Rightarrow BD = \frac{\sqrt{3}x}{2}$$

Similarly, $\quad DC = \dfrac{\sqrt{3}x}{2}$

$$BC = BD + DC$$
$$BC = \frac{\sqrt{3}x}{2} + \frac{\sqrt{3}x}{2} = \sqrt{3}x$$

Perimeter of triangle equal to k times larger side of triangle.

$$x + x + \sqrt{3}x = k\sqrt{3}x$$
$$\sqrt{3}xk = 2x + \sqrt{3}x$$
$$k = \frac{\sqrt{3}x + 2x}{\sqrt{3}x}$$
$$k = 1 + \frac{2}{\sqrt{3}}$$

22. The hypotenuse of a right angled triangle is 10 cm and its area is 24 cm^2. If the shorter side is halved and the longer side is doubled, the new hypotenuse becomes

(a) $\sqrt{245}$ cm   (b) $\sqrt{255}$ cm
(c) $\sqrt{265}$ cm   (d) $\sqrt{275}$ cm

⊙ *(c)* ABC is right angle triangle at B.
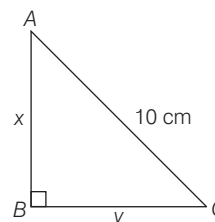
$$AC = 10 \text{ cm}$$
$$AB = x$$
$$BC = y$$
$$(AB)^2 + (BC)^2 = (AC)^2$$
$$x^2 + y^2 = 100 \qquad \text{...(i)}$$

Area of triangle $= \dfrac{1}{2} \times AB \times BC$

$$24 = \frac{1}{2} \times x \times y$$
$$xy = 48 \qquad \text{...(ii)}$$

We know, $(x + y)^2 = x^2 + y^2 + 2xy$

$$(x + y)^2 = 100 + 2 \times 48 = 196$$
$$x + y = 14 \qquad \text{...(iii)}$$

and $(x - y)^2 = x^2 + y^2 - 2xy$

$$(x - y)^2 = 100 - 2 \times 48 = 4$$
$$x - y = 2 \qquad \text{...(iv)}$$

From Eqs. (iii) and (iv), we get

$$x = 8 \Rightarrow y = 6$$

The shorter side is halved

$$y_1 = \frac{6}{2} = 3 \text{ cm}$$

The longer side is doubled

$$x_2 = 8 \times 2 = 16 \text{ cm}$$

Now, new hypotenuse

$$= \sqrt{x_1^2 + y_1^2} = \sqrt{16^2 + 3^2}$$
$$= \sqrt{256 + 9} = \sqrt{265} \text{ cm}$$

23. Consider the following statements :

1. The perimeter of a triangle is greater than the sum of its three medians.
2. In any triangle ABC, if D is any point on BC, then $AB + BC + CA > 2AD$.

Which of the above statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

> *(c)* (1) The perimeter of a triangle is greater than the sum of its three medians.
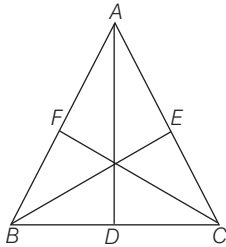
It is property of triangle.

AD, BE and CF are three medians of triangle.

(2) ABC is triangle and D is a point on BC.
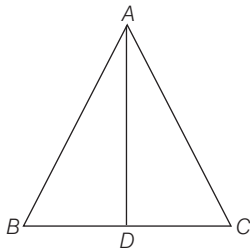
By triangle properties,

ΔABD, $AB + BD > AD$ …(i)

ΔADC, $AC + DC > AD$ …(ii)

On adding Eqs. (i) and (ii), we get

$AB + AC + BD + DC > 2\,AD$

$AB + AC + BC > 2\,AD$

$[\because BD + DC = AD]$

Option (c) is correct.

Directions (Q. Nos. 24-26) *Read the given information carefully and answer the given questions below. ABCD is a quadrilateral with $AB = 9$ cm, $BC = 40$ cm, $CD = 28$ cm, $DA = 15$ cm and angle ABC is a right-angle.*

Diagram for questions (24-26)
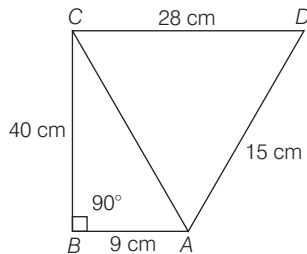
24. What is the area of triangle ADC?

(a) 126 cm^2 (b) 124 cm^2
(c) 122 cm^2 (d) 120 cm^2

> *(a)* In ΔABC, $\angle B = 90°$

$(AC)^2 = AB^2 + BC^2$

$AC = \sqrt{(9)^2 + (40)^2}$

$AC = \sqrt{81 + 1600}$

$AC = 41$ cm

Area of ΔADC

$A = \sqrt{s(s - a)\,(s - b)\,(s - c)}$

$S = \dfrac{a + b + c}{2}$

      [a, b and c side of triangle]

$S = \dfrac{41 + 15 + 28}{2} = \dfrac{84}{2} = 42$ cm

$A = \sqrt{42(42 - 28)\,(42 - 41)\,(42 - 15)}$

$\quad = \sqrt{42 \times 14 \times 1 \times 27}$

$A = 7 \times 3 \times 2 \times 3 = 126$ cm^2

25. What is the area of quadrilateral $ABCD$?

(a) 300 cm^2 (b) 306 cm^2
(c) 312 cm^2 (d) 316 cm^2

> *(b)* Area of quadrilateral $ABCD$
= Area of ΔABC + Area of ΔADC

Area of $\Delta ABC = \dfrac{1}{2} \times 40 \times 9 = 180$ cm^2

Area of quadrilateral $= 180 + 126$

$\qquad\qquad\qquad\qquad = 306$ cm^2

26. What is the difference between perimeter of triangle ABC and perimeter of triangle ADC?

(a) 4 cm   (b) 5 cm
(c) 6 cm   (d) 7 cm

> *(c)* Difference between perimeter of ΔABC and ΔADC.

Perimeter of $\Delta ABC = 40 + 41 + 9$

$\qquad\qquad\qquad\quad = 90$ cm

Perimeter of $\Delta ADC = 28 + 41 + 15$

$\qquad\qquad\qquad\quad = 84$ cm

Difference of perimeter of ΔABC

and $\qquad \Delta ADC = 90 - 84 = 6$ cm

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27. If base and hypotenuse of a right triangle are $(u^2 - v^2)$ and $(u^2 + v^2)$ respectively and the area of the triangle is 2016 square units, then the perimeter of the triangle may be

(a) 224 units   (b) 288 units
(c) 448 units   (d) 576 units

> *(b)* According to the question,
In right angle ΔABC
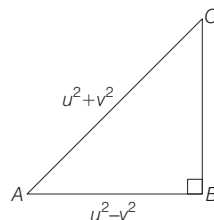
Here,

$AC^2 = AB^2 + BC^2$

$\Rightarrow \quad BC^2 = AC^2 - AB^2$

$\Rightarrow \quad BC = \sqrt{AC^2 - AB^2}$

$\qquad\quad = \sqrt{(u^2 + v^2)^2 - (u^2 - v^2)^2}$

$\qquad\quad = \sqrt{4u^2 v^2} = 2uv$

Now, area of $\Delta ABC = \dfrac{1}{2} \times$ base $\times$ height

$\qquad\quad = \dfrac{1}{2} \times (u^2 - v^2) \times (2uv)$

$\qquad\quad = uv(u^2 - v^2)$

$\Rightarrow uv(u + v)\,(u - v) = 2016$

$\Rightarrow uv\,(u + v)\,(u - v) = 9 \times 7 \times 16 \times 2$

Comparing both sides,

$u = 9, v = 7$

Perimeter of triangle

$\qquad = (u^2 + v^2) + (u^2 - v^2) + 2uv$

$\qquad = 2u^2 + 2uv$

$\qquad = 2u(u + v)$

$\qquad = 2 \times 9 \times (9 + 7)$

$\qquad = 288$ units

28. A circle is inscribed in an equilateral triangle of side of length e.e. The area of any square inscribed in the circle is

(a) $\dfrac{l^2}{2}$ (b) $\dfrac{\sqrt{3}l^2}{4}$

(c) $\dfrac{l^2}{4}$ (d) $\dfrac{l^2}{6}$

> *(d)* Side of equilateral $\Delta ABC = l$

Radius of circle inscribed in ΔABC

$r = \dfrac{\text{Area of } \Delta ABC}{\text{Semi - perimeter of } \Delta ABC}$

$\Rightarrow \qquad r = \dfrac{\dfrac{\sqrt{3}}{4} l^2}{\dfrac{3l}{2}}$
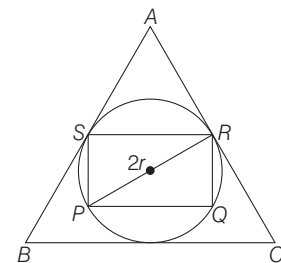
$\Rightarrow \qquad r = \dfrac{l}{2\sqrt{3}}$

$PR = 2r$

Area of square $PQRS = \dfrac{(\text{diagonal})^2}{2}$

$\qquad = \dfrac{PR^2}{2} = \dfrac{4r^2}{2} = 2r^2$

$\qquad = 2\left(\dfrac{l}{2\sqrt{3}}\right)^2 = \dfrac{2l^2}{4 \times 3} = \dfrac{l^2}{6}$

29. Let S be the parallelogram obtained by joining the mid-points of the parallelogram T. Consider the following statements

1. The ratio of area of T to that S is $2 : 1$
2. The perimeter of S is half of the sum of diagonals of T.

Which of the above statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ **(a)** Given,

Area of parallelogram $ABCD = T$

Area of parallelogram $PQRS = S$

Area of $\Delta PQS = \dfrac{1}{2} \times$ area of ||gm $ABQS$

Area of $\Delta RSQ = \dfrac{1}{2} \times$ area of ||gm $SQCD$
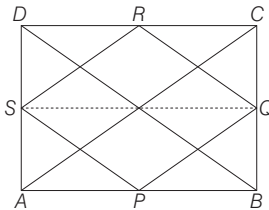
$\therefore$ Area of parallelogram $PQRS = \dfrac{1}{2}$

[area of parallelogram $ABCD$]

$$S = \dfrac{1}{2}T$$

$\Rightarrow \qquad S : T = 1 : 2$

$\Rightarrow \qquad T : S = 2 : 1$

$\therefore$ Statement 1 is correct

2. Perimeter of parallelogram $PQRS$

$= PQ + RQ + RS + PS$

$PQ = \dfrac{1}{2} AC = RS$

$RQ = PS = \dfrac{1}{2} BD$

$\therefore PQ + RQ + RS + PS$

$= \dfrac{1}{2}AC + \dfrac{1}{2}BQ + \dfrac{1}{2}AC + \dfrac{1}{2}BQ$

$\therefore PQ + RQ + RS + PS = (AC + BD)$

Perimeter of S is equal to sum of diagonals T

$\therefore$ Statement 2 is incorrect

30. The sides of a triangle are 5 cm, 6 cm and 7 cm. The area of the triangle is approximately

(a) 14.9 cm^2 (b) 14.7 cm^2
(c) 14.5 cm^2 (d) 14.3 cm^2

⊙ **(b)** The sides of triangles are 5cm , 6 cm and 7cm respectively

Area of $\Delta = \sqrt{s(s-a)(s-b)(s-c)}$

Where $\quad s = \dfrac{a+b+c}{2}$

$\therefore \qquad s = \dfrac{5+6+7}{2} = 9$

$\Delta = \sqrt{9(9-5)(9-6)(9-7)}$

$\Delta = \sqrt{9 \times 4 \times 3 \times 2}$

$\Delta = 6\sqrt{6} = 6 \times 2.44$

$\quad = 14.69$

$\quad = 14.7$ cm^2

31. There is a path of width 5 m around a circular plot of land whose area is 144π m^2. The total area of the circular plot including the path surrounding it is

(a) 349π m^2 (b) 289π m^2
(c) 209π m^2 (d) 149π m^2

⊙ **(b)** Area of circular

Plot of land $= 144\pi$ m^2
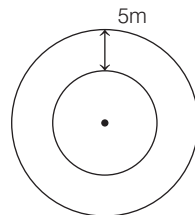
Let $r =$ radius of circular plot

$\therefore \qquad 144\pi = \pi r^2$

$\Rightarrow \qquad r^2 = 144$

$\Rightarrow \qquad r = 12$

Area of circular plot including the path

$= \pi(r+5)^2$

$= \pi(12+5)^2$

$= \pi(17)^2 = 289\pi$ m^2

32. An equilateral triangle, a square and a circle have equal perimeter. If T, S and C denote the area of the triangle, area of the square and area of the circle respectively, then which one of the following is correct?

(a) $T < S < C$ (b) $S < T < C$
(c) $C < S < T$ (d) $T < C < S$

⊙ **(a)** An equilateral triangle, a square and a circle of perimeter are equal

Let side of triangle $= l$ cm

Side of square $= x$ cm

Radius of circle $= r$ cm

$\therefore \qquad 3l = 4x = 2\pi r = k$

$\Rightarrow l = k/3, \ x = k/4, \ r = \dfrac{k}{2\pi}$

Area of equilateral $\Delta = \dfrac{\sqrt{3}}{4} l^2$

$= \dfrac{\sqrt{3}}{4}\left(\dfrac{k^2}{9}\right) = \dfrac{k^2}{12\sqrt{3}}$

Area of square $= x^2 = \dfrac{k^2}{16}$

Area of circle $= \pi r^2 = \pi \dfrac{k^2}{4\pi^2} = \dfrac{k^2}{4\pi}$

$\dfrac{k^2}{4\pi} > \dfrac{k^2}{16} > \dfrac{k^2}{12\sqrt{3}}$

$C > S > T$

$\Rightarrow \qquad T < S < C$

33. The areas of two similar triangles are $(7 - 4\sqrt{3})$ cm^2 and $(7 + 4\sqrt{3})$ cm^2 respectively. The ratio of their corresponding sides is

(a) $7 - 4\sqrt{3}$ (b) $7 - 3\sqrt{3}$
(c) $5 - \sqrt{3}$ (d) $5 + \sqrt{3}$

⊙ **(a)** Ratio of area of two similar triangle = Ratio of square of their corresponding sides

$\therefore \quad \sqrt{\dfrac{7-4\sqrt{3}}{7+4\sqrt{3}}} =$ ratio of their

corresponding sides

$= \sqrt{\dfrac{7-4\sqrt{3}}{7+4\sqrt{3}}} \times \sqrt{\dfrac{7-4\sqrt{3}}{7-4\sqrt{3}}}$

$= \sqrt{\dfrac{(7-4\sqrt{3})^2}{(7)^2 - (4\sqrt{3})^2}} = \dfrac{7-4\sqrt{3}}{\sqrt{49-48}}$

$= 7 - 4\sqrt{3}$

34. The area of the region bounded internally by a square of side $2a$ cm and externally by the circle touching the four sides of the square is

(a) $(4-\pi)a^2$ (b) $(\pi-2)a^2$
(c) $\dfrac{(8-\pi)a^2}{2}$ (d) $\dfrac{(\pi-2)a^2}{2}$

⊙ **(a)** Side of square $ABCD$ is 2a cm
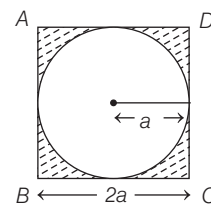
$\therefore$ Radius of circle

$= a$ cm

Area of shaded region

$=$ area of square $-$ area of circle

$= (2a)^2 - \pi a^2$

$= 4a^2 - \pi a^2 = (4-\pi)a^2$

35. In the figure given below, ABC is a right-angled triangle where $\angle A = 90°$, $AB = p$ cm and $AC = q$ cm. On the three sides as diameters semi-circles are drawn as shown in the figure. The area of the shaded portion, in square cm, is
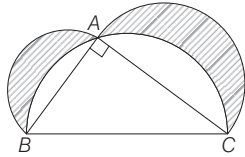
(a) pq (b) $\dfrac{\pi(p^2 + q^2)}{2}$

(c) $\pi(p^2 + q^2)$ (d) $\dfrac{pq}{2}$

$\odot$ *(d)*
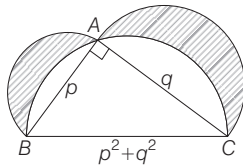
Area of shaded region
= area of semi-circle on AB + area of semi-circle on AC + area of $\triangle ABC$ − area of semi-circle on BC

$= \dfrac{\pi}{2}\left(\dfrac{p^2}{4}\right) + \dfrac{\pi}{2}\left(\dfrac{q^2}{4}\right) + \dfrac{1}{2}pq$
$\qquad - \dfrac{\pi}{2}\left(\dfrac{p^2 + q^2}{4}\right)$

$\left[\because \text{ara of semi−circle} = \dfrac{\pi r^2}{2}\right]$

$= \dfrac{1}{2}pq$

36. In the figure given below, $ABCD$ is the diameter of a circle of radius 9 cm. The lengths AB, BC and CD are equal. Semi-circles are drawn on AB and BD as diameters as shown in the figure. What is the area of the shaded region?

(a) 9π (b) 27π
(c) 36π (d) 81π
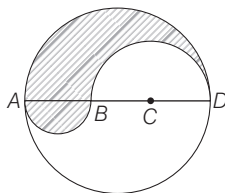
$\odot$ *(b)* Area of shaded regions
= Area of semi-circle on AD
$\quad$ + area of semicircle on AB
$\quad$ − area of semi-circle on BD
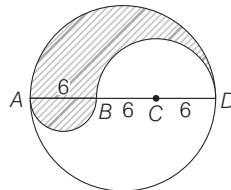
$= \dfrac{\pi}{2}(9)^2 + \dfrac{\pi}{2}(3)^2 - \dfrac{\pi}{2}(6)^2$

$\left[\because \text{ area of semi-circle} = \dfrac{\pi r^2}{2}\right]$

$= \dfrac{\pi}{2}(9^2 + 3^2 - 6^2)$

$= \dfrac{\pi}{2}(81 + 9 - 36)$

$= \dfrac{\pi}{2}(54) = 27\pi$

37. In the figure given below, the diameter of bigger semi-circle is 108 cm. What is the area of the shaded region?
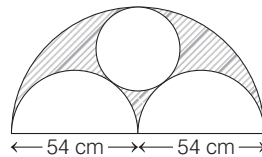
(a) 201π cm^2
(b) 186.3π cm^2
(c) 405π cm^2
(d) 769.5π cm^2

$\odot$ *(c)* Given, $AO = OB = OD = 54$ cm

$\therefore \qquad OP = OQ = 27$ cm and $CD = r$
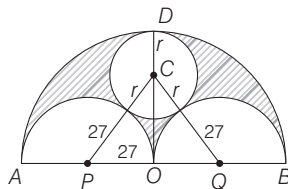
In $\triangle OPC$, $PC^2 = OP^2 + OC^2$
$\quad (27 + r)^2 = 27^2 + (54 - r)^2$
$\qquad\qquad \{\because OC = OD - CD\}$
$\Rightarrow (27)^2 + 54r + r^2$
$\qquad = 27^2 + (54)^2 - 108r + r^2$
$\quad 54r = 2916 - 108r$
$\quad 162r = 2916$
$\Rightarrow \qquad r = 18$

$\therefore$ Area of shaded region
= Area of bigger semi-circle
$\quad$ − 2(area of smaller semi-circle)
$\qquad$ − area of smallest circle

$= \dfrac{\pi}{2}(54)^2 - 2\left(\dfrac{\pi}{2}(27)^2\right) - \pi(18)^2$

$\left[\because \text{ area of semi-circle} = \dfrac{\pi r^2}{2} \text{ and area of}\right.$
$\left.\qquad\qquad\qquad\qquad\quad \text{circle} = \pi r^2\right]$

$= \dfrac{\pi}{2}[54^2 - 2(27)^2 - 2(18)^2]$

$= \dfrac{\pi}{2}[2916 - 1458 - 648]$

$= \dfrac{\pi}{2} \times 810 = 405\pi$ cm^2

38. In the figure given below, $ABCD$ is a square of side 4 cm. Quadrants of a circle of diameter 2 cm are removed form the four corners and a circle of diameter 2 cm is also removed. What is the area of the shaded region?
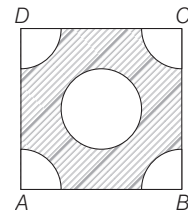
(a) $5\dfrac{7}{9}$ cm^2 (b) $7\dfrac{7}{9}$ cm^2
(c) $9\dfrac{5}{7}$ cm^2 (d) $9\dfrac{5}{6}$ cm^2

$\odot$ *(c)* Area of shaded region =
= Area of square
$\quad$ − 4 (area of quadrant)− area of circle

$= a^2 - 4 \times \dfrac{\pi}{4}r^2 - \pi r^2$

$= (4)^2 - 4\left(\dfrac{\pi}{4}(1)^2\right) - \pi(1)^2$

$\qquad\qquad \left\{\because a = 4, r = \dfrac{2}{2} = 1\right\}$

$= 4^2 - 2\pi$

$= 16 - 2 \times \dfrac{22}{7}$

$= 16 - \dfrac{44}{7}$

$= \dfrac{112 - 44}{7}$

$= \dfrac{68}{7} = 9\dfrac{5}{7}$ cm^2

39. Walls (excluding roofs and floors) of 5 identical rooms having length, breadth and height 6 m, 4 m and 2.5 m respectively are to be painted.

Out of five rooms, two rooms have one square window each having a side of 2.5 m.

Paints are availbable only in cans of 1 L; and 1 L of paint can be used for painting 20 m². The number of cans required for painting is

(a) 10   (b) 12   (c) 13   (d) 14

⊙ *(b)* Length (l), breadth (b) and height (h) of walls are 6 m, 4m and 2.5 m respectively,

∴ Area of 4 walls = $2 h (l + b)$

$= 2 \times 2.5(6 + 4) = 50 \, m^2$

Area of 4 walls of 5 rooms

$= 5 \times 50 = 250 \, m^2$

Area of windows = $(2.5)^2 = 6.25 \, m^2$

Area of windows = $2 \times 6.25 = 12.50 \, m^2$

Total area required for painting

$= 250 - 12.50 \, m^2$

$= 237.50$

Now, one cans paints = $20 \, m^2$

∴ Number of cans required for painting

$= \dfrac{237.50}{20} = 11.875 = 12$ cans

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40. Two equal circular regions of greatest possible area are cut off from a given circular sheet of area A. what is the remaining area of the sheet?

(a) $\dfrac{A}{2}$ (b) $\dfrac{A}{3}$

(c) $\dfrac{3A}{5}$ (d) $\dfrac{2A}{5}$

⊙ *(a)* Let the radius of circular sheet be 'R'
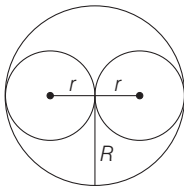
∴ Area of sheet = $\pi R^2 = A$

Let two circular regions of 'r' radius are cut off from circular sheet.

∵ $2r = R$

∴ $r = \dfrac{R}{2}$

[∵ greatest area possible are cut off]

Area of two smaller circles = $2 \pi r^2$

$= 2 \pi \left(\dfrac{R}{2}\right)^2 = \dfrac{\pi R^2}{2}$

Remaining area = $\pi R^2 - \dfrac{\pi R^2}{2}$

$= \dfrac{\pi R^2}{2} = \dfrac{A}{2}$

41. In a room whose floor is a square of side 10 m, an equilateral triangular table of side 2 m is placed. Four book shelves of size $4 \, m \times 1 \, m \times 9 \, m$ are also placed in the room. If half of the rest of the area in the room is to be carpeted at the rate of ₹ 100 per square metre, what is the cost of carpeting (approximately)?

(a) ₹ 7,600   (b) ₹ 5,635
(c) ₹ 4,113   (d) ₹ 3,200

⊙ *(c)* Area of the rest of the room

= Area of floor – Area of triangular table

     – Area of four book shelves

$= (\text{side})^2 - \dfrac{\sqrt{3}}{2}(\text{side})^2$

     $- 4 \times (\text{length} \times \text{breadth})$

$= (10)^2 - \dfrac{\sqrt{3}}{4}(2)^2 - 4 \times 4 \times 1$

$= 100 - \sqrt{3} - 16$

$= 84 - \sqrt{3} \, m^2$

The area of the rest of the room to be

carpeted = $\dfrac{84 - \sqrt{3}}{2} m^2$

Cost of carpeting = ₹$\left(\dfrac{84 - \sqrt{3}}{2}\right) \times 100$

$= ₹ \, 4113.5$

$= ₹ \, 4,113$ [approximate]

42. If the length of a side of a square is increased by 8 cm, its area increases by 120 square cm. What is the length of a side of the square?

(a) 2.5 cm   (b) 3.5 cm
(c) 4.5 cm   (d) 5.5 cm

⊙ *(b)* Let the side of square be x cm

∴ New side of square = $x + 8$ cm

According to the question,

$(x + 8)^2 - x^2 = 120$

[∵ area of square = side²]

$\Rightarrow x^2 + 64 + 2(8)(x) - x^2 = 120$

[∵ $(a + b)^2 = a^2 + 2ab + b^2$]

$\Rightarrow \quad 16x = 120 - 64$

$x = \dfrac{56}{16} = 3.5$ cm

Hence, side of square = 3.5 cm.

43. Walls (excluding their roofs and floors) of 5 identical rooms having length, breadth and height 6 m, 4 m and 2.5 m respectively are to be painted. Paints are available only in cans of 1 L and one litre of paint can be used for painting 20 square metres. What is the number of cans required for painting?

(a) 10   (b) 12   (c) 13   (d) 14

⊙ *(c)* Length, breadth and height of room are 6m, 4m and 2.5m respectively.

∵ Area of four walls of room

$= 2(l + b) \times h$

∴Area of four walls = $2(6 + 4) \times 2.5$

$= 50 \, m^2$

Area of 5 such rooms = $50 \times 5 = 250 \, m^2$

Paint required to paint

$250 \, m^2 = \dfrac{250}{20} = 12.5 L$

∵ 1 can contains 1 L paint

∴ Number of cans required = 13

44. A rectangular pathway having width 4.5 m and length 10 m will have to be tiled using square tiles of side 50 cm. Each packet of such tiles contains 20 pieces and cost ₹ 100. What will be the total cost of tiles for the pathway.

(a) ₹ 1,200   (b) ₹ 1, 100
(c) ₹ 1,000   (d) ₹ 900

⊙ *(d)* Area of rectangular pathway

$= \text{length} \times \text{width}$

$= 4.5 \times 10 = 45 \, m^2$

Area of 1 square tile = $\dfrac{50}{100} \times \dfrac{50}{100}$

$= \dfrac{1}{4} m^2$

∴ Number of tiles required

$= \dfrac{45}{\frac{1}{4}} = 45 \times 4 = 180$

Number of backets of tiles = $\dfrac{180}{20} = 9$

∴ Total cost of tiles = $9 \times 100 = ₹ \, 900$

45. A wire is in the form of a circle of radius 98 cm. A square is formed out of the wire. What is the length of a side of the square? (Use $\pi = \dfrac{22}{7}$)

(a) 146 cm   (b) 152 cm
(c) 154 cm   (d) 156 cm

⊙ *(c)* Radius of circle

$= 98$ cm

∵ Length of wire = Circumference of circle

∴ Length of wire = $2\pi r$

$$= 2 \times \frac{22}{7} \times 98 = 616 \text{ cm}$$

Now, it is transformed into a square which means circumference of circle will be equal to the perimeter of square.

∵ Perimeter of square = $4 \times$ side

∴ Side of square = $\frac{616}{4} = 154$ cm

46. What is the area of the largest circular disc cut from a square of side $\frac{2}{\sqrt{\pi}}$ units?

(a) π sq units   (b) 1 sq units
(c) π^2 sq units   (d) 2 sq units

⟩ *(b)*
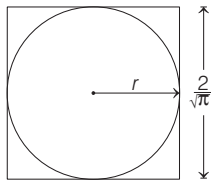
Let the radius of circle be r unit.

∴ $r = \frac{\text{side of square}}{2} = \frac{1}{2} \times \frac{2}{\sqrt{\pi}} = \frac{1}{\sqrt{\pi}}$

Area of circle = $\pi r^2 = \pi \left(\frac{1}{\sqrt{\pi}}\right)^2$

$$= \frac{\pi}{\pi} = 1 \text{ sq units}$$

47. The product of the lengths of the diagonals of a square is 50 sq units. What is the length of a side of the square?

(a) $5\sqrt{2}$ units   (b) 5 units
(c) 10 units   (d) $2\sqrt{5}$ units

⟩ *(b)* Let the side of square be 'a' unit

∴ Diagonal of square = $a\sqrt{2}$ unit

According to the question,

Product of diagonals = 50 sq units

∴ $a\sqrt{2} \times a\sqrt{2} = 50$

⟹ $2a^2 = 50$

∴ Side of square = $a = 5$ units

48. A square and an equilateral triangle have the same perimeter. If the diagonal of the square is $6\sqrt{2}$ cm, then what is the area of the triangle?

(a) $12\sqrt{2}$ cm^2 (b) $12\sqrt{3}$ cm^2
(c) $16\sqrt{2}$ cm^2 (d) $16\sqrt{3}$ cm^2

⟩ *(d)* Let the side of square be 'x' cm and side of equilateral triangle be 'a' cm.

∴ Diagonal of square = $x\sqrt{2}$ cm

∴ $x\sqrt{2} = 6\sqrt{2}$

or $x = 6$ cm

According to the question,

Perimeter of square = Perimeter of parlateral triangle

$$4x = 3a$$

∴ $4 \times 6 = 3a$

∴ $a = 8$ cm

Hence, area of triangle

$$= \frac{\sqrt{3}}{4}a^2 = \frac{\sqrt{3}}{4} \times 8^2 = 16\sqrt{3} \text{ cm}^2$$

49. What is the area of the region bounded internally by a square of side of length 'a' and internally by a circle passing through the four corners of the square?

(a) $(\pi - 1)a^2$ sq units
(b) $\frac{(\pi - 1)a^2}{2}$ sq units
(c) $(\pi - 2)a^2$ sq units
(d) $\frac{(\pi - 2)a^2}{2}$ sq units

⟩ *(d)*
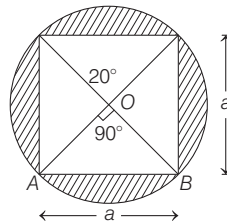
Let the edge of the square is a units

diameter of circle = diagonal of square

$$= \sqrt{2}a$$

The radius of circle

$$(r) = \frac{\sqrt{2}a}{2} = \frac{a}{\sqrt{2}} \text{ units}$$

Area of shaded region

= Area of circle – Area of square

$$= \pi \left(\frac{a}{\sqrt{2}}\right)^2 - a^2$$

$$= \frac{\pi a^2}{2} - a^2 = \frac{a^2}{2}(\pi - 2)$$

50. In the equilateral triangle ABC given below, $AD = DB$ and $AE = EC$, if l is the length of a side of the triangle, then what is the area of the shaded region?
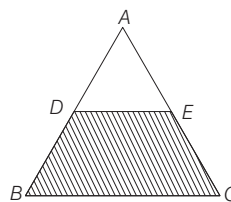
(a) $\frac{3\sqrt{3}l^2}{16}$ (b) $\frac{3l^2}{16}$ (c) $\frac{3\sqrt{3}l^2}{32}$ (d) $\frac{3l^2}{32}$

⟩ *(a)*
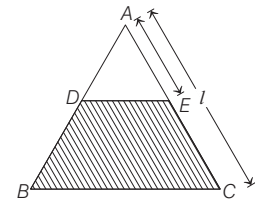
$\Delta\ ABC$ and $\Delta\ ADE$ are equilateral triangles.

∴ Area of shaded region

= ar$(\Delta\ ABC) - ar(\Delta\ ADE)$

$$= \frac{\sqrt{3}}{4}l^2 - \frac{\sqrt{3}}{4}\left(\frac{l}{2}\right)^2 = \frac{\sqrt{3}}{4}\left(l^2 - \frac{l^2}{4}\right)$$

$$= \frac{\sqrt{3}}{4} \times \frac{3l^2}{4} = \frac{3\sqrt{3}l^2}{16}$$

2017 (II)

51. The diameters of two given circles are in the ratio $12 : 5$ and the sum of their areas is equal to the area of a circle of diameter 65 cm. What are their radii?

(a) 12 cm and 5 cm
(b) 24 cm and 10 cm
(c) 60 cm and 25 cm
(d) 30 cm and 12.5 cm

⟩ *(d)* Let the radius of two circle are $12x$ and $5x$

∴ Sum of area of two circles are

$$\pi(12x)^2 + \pi(5x)^2$$
$$\{\because \text{ area of circle} = \pi r^2\}$$

Area of circle whose diameter is 65 cm

is $\pi\left(\frac{65}{2}\right)^2$

According to question,

$$\pi(144x^2) + \pi(25x^2) = \pi\left(\frac{4225}{4}\right)$$

$$\Rightarrow\ 169x^2 = \frac{4225}{4} \Rightarrow x^2 = \frac{4225}{4 \times 169}$$

$$\Rightarrow\qquad x = \frac{65}{26} = \frac{5}{2}$$

∴ Radii of circle are

$$12 \times \frac{5}{2} = 30 \text{ cm}$$

and $\quad 5 \times \frac{5}{2} = 12.5$ cm

52. Two straight lines AB and AC include an angle. A circle is drawn in this angle which touches both these lines. One more circle is drawn which touches both these lines as well 2as the previous circle. If the area of the bigger circle is 9 times the area of the smaller circle, then what must be the angle A?

(a) 45°   (b) 60°   (c) 75°   (d) 90°

> **(b)** We have
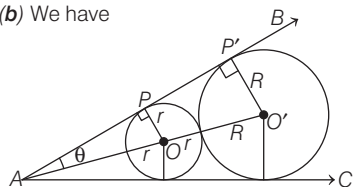
Area of largest circle is 9 times of area of smaller circle

$$\therefore \qquad \pi R^2 = 9\pi r^2 \Rightarrow \frac{R}{r} = 3$$

In ΔAOP

$$\sin\theta = \frac{OP}{AO} = \frac{r}{AO} \qquad ...(i)$$

In $\Delta AO'P'$

$$\sin\theta = \frac{O'P'}{AO'} = \frac{R}{AO'} \qquad ...(ii)$$

From Eqs. (i) and (ii),

$$\frac{r}{AO} = \frac{R}{AO'}$$

$$\frac{R}{r} = \frac{AO'}{AO}$$

$$\Rightarrow \qquad 3 = \frac{AO + OO'}{AO} = 1 + \frac{4r}{AO}$$

$$\{\because OO' = r + R = r + 3r = 4r\}$$

$$\Rightarrow \qquad 2 = \frac{4r}{AO} \Rightarrow \frac{1}{2} = \frac{r}{AO}$$

$$\Rightarrow \qquad \sin\theta = \frac{1}{2} \Rightarrow \theta = 30°$$

$$\therefore \qquad \angle BAC = 2 \times 30° = 60°$$

53. An isosceles triangle is drawn outside on one of the sides of a square as base in which a way that the perimeter of the complete figure is $\frac{7}{6}$ times the perimeter of the original square. What is the ratio of area of the triangle to the area of the original square?

(a) 1 : 1   (b) 2 : 3   (c) 1 : 2   (d) 1 : 3

> **(d)** We have
Perimetre of $PDABC = 2y + 3x$
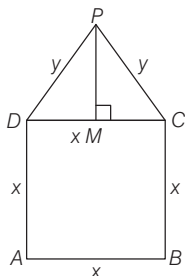
Perimetre of Square
$ABCD = 4x$
According to question,

$$2y + 3x = \frac{7}{6}(4x) \Rightarrow y = \frac{5}{6}x \quad ...(i)$$

In ΔPDM,

$$PM^2 = PD^2 - DM^2 = y^2 - \frac{x^2}{4}$$

$$= \frac{25}{36}x^2 - \frac{x^2}{4} \qquad \text{[from Eq. (i)]}$$

$$= \frac{16x^2}{36}$$

$$\Rightarrow \quad PM = \frac{4x}{6} = \frac{2}{3}x$$

Area of $\Delta PDC = \frac{1}{2}DC \times PM$

$$= \frac{1}{2} \times x \times \frac{2}{3}x = \frac{1}{3}x^2$$

Area of square $= x^2$

$\therefore$ Ratio of area of ΔPDC to area of square $= \frac{x^2}{3} : x^2 = 1 : 3$

54. What is the area of the triangle whose sides are 51 cm, 37 cm and 20 cm?

(a) 300 square cm   (b) 305 square cm
(c) 306 square cm   (d) 307 square cm

> **(c)** Area of ΔABC

$$= \sqrt{s(s-a)(s-b)(s-c)}$$

$$s = \frac{20 + 37 + 51}{2} = \frac{108}{2}$$
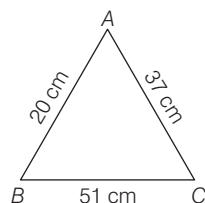
$$s = 54$$
$$\Delta = \sqrt{54(54-20)(54-37)(54-51)}$$
$$= \sqrt{54 \times 34 \times 17 \times 3}$$
$$= \sqrt{9 \times 3 \times 2 \times 17 \times 2 \times 17 \times 3}$$
$$= 3 \times 3 \times 2 \times 17 = 306\, cm^2$$

55. Segment QR of length r is a tangent at Q to a circle of radius r with centre at P.

What is the area of the part of the triangle PQR, which is outside the circular region?

(a) $\frac{\pi r^2}{16}$ (b) $\frac{r^2}{2} - \frac{\pi r^2}{8}$

(c) $\frac{r^2}{2} - \frac{\pi r^2}{16}$ (d) $\frac{r^2}{4} - \frac{\pi r^2}{8}$

> **(b)** We have, QR is a tangent of length r
Radius of circle $= r$
In ΔPQR, $PQ = QR = r$
$$\angle PQR = 90°$$
$$\angle QPR = \angle QRP \{PQ = QR\}$$
$\therefore \angle PQR + \angle QRP + \angle QPR = 180°$
$$90° + \angle QRP + \angle QRP = 180°$$

$$2\angle QRP = 180° - 90° = 90°$$
$$\angle QRP = \angle QPR = 45°$$
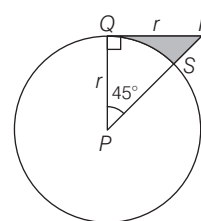
Area of shaded region
= Area of ΔPQR − Area of sector $PQSP$
$$= \frac{1}{2}r^2 - \frac{45°}{360} \times \pi r^2 = \frac{r^2}{2} - \frac{\pi r^2}{8}$$

56. An arc of a circle subtents an angle π at the centre. If the length of the arc is 22 cm, then what is the radius of the circle? $\left(\text{take } \pi = \frac{22}{2}\right)$

(a) 5 cm   (b) 7 cm   (c) 9 cm   (d) 11 cm

> **(b)** We know that,

$$l = r\theta, r = \frac{1}{\theta}$$
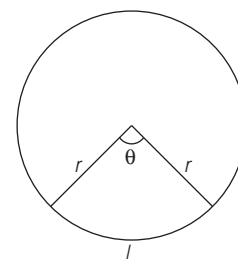
$$r = \frac{22}{\pi}, r = \frac{22}{22} \times 7 = 7\, cm$$

2017 (I)

57. If the perimeter of a rectangle is 10 cm and the area is 4 cm², then its length is

(a) 6 cm   (b) 5 cm   (c) 4.5 cm   (d) 4 cm

> **(d)** Let l and b the length and breadth of the rectangle respectively.
Now, according to the question
$$2(l + b) = 10$$
$$\Rightarrow \qquad l + b = 5 \qquad ...(i)$$
and $\qquad lb = 4 \qquad ...(ii)$
From Eqs. (i) and (ii), we have
$$l(5 - l) = 4$$
$$\Rightarrow \qquad 5l - l^2 = 4$$
$$\Rightarrow \qquad l^2 - 5l + 4 = 0$$
$$\Rightarrow \qquad (l - 4)(l - 1) = 0$$
$$\Rightarrow \qquad l = 4, 1$$
Hence, the length of triangle is 4 cm.

58. The areas of two circular fields are in the ratio $16:49$. If the radius of the bigger field is 14 m, then what is the radius of the smaller field?

(a) 4 m   (b) 8 m   (c) 9 m   (d) 10 m

⊘ **(b)** Let r_1 and r_2 be the radius of the circles.

$$\therefore \quad \frac{\pi r_1^2}{\pi r_2^2} = \frac{16}{49}$$

$$\Rightarrow \quad \frac{r_1^2}{r_2^2} = \frac{16}{49}$$

$$\Rightarrow \quad \frac{r_1}{r_2} = \frac{4}{7}$$

$$\Rightarrow \quad r_1 = \frac{4}{7} r_2$$

$$\Rightarrow \quad r_1 = \frac{4}{7} \times 14 \qquad [\because r_2 = 14 \text{ m}]$$

$$\Rightarrow \quad r_1 = 8 \text{ m}$$

59. If each of the dimensions of a rectangle is increased by 200%, the area is increased by

(a) 300%   (b) 400%
(c) 600%   (d) 800%

⊘ **(d)** Let the length and width of the rectangle are x and y respectively,

Then, area of rectangle $= xy$

Now, Length of rectangle after increasing by 200% $= x + \frac{200}{100}x = 3x$

Width of rectangle after increasing by 200%

$$= y + \frac{200}{100}y = 3y$$

$\therefore$ New area $= (3x)(3y) = 9xy$

$\therefore$ Percentage increase in area

$$= \frac{9xy - xy}{xy} \times 100$$

$$= \frac{8xy}{xy} \times 100 = 800\%$$

Alternate method

Here, $a = 200\%$, $b = 200\%$

Percentage increase in $= \left(\frac{a + b + ab}{100}\right)\%$

Area of rectangle

$$= 200 + 200 + \frac{200 \times 200}{100}$$

$$= 400 + 400 = 800\%$$

60. Three circles each of radius 3.5 cm touch one another. The areas subtended between them is

(a) $6(\sqrt{3}\pi - 2)$ square units

(b) $6(2\pi - \sqrt{3})$ square units

(c) $\frac{49}{8}(2\sqrt{3} - \pi)$ square units

(d) $\frac{49}{8}(\sqrt{3} - \pi)$ square units

⊘ **(c)**
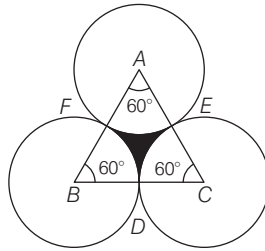
$\because$ $AF = 3.5$ cm and $BF = 3.5$ cm

$\therefore$ $AB = AF + BF = 3.5 + 3.5 = 7$ cm

$\therefore$ $AB = BC = AC = 7$ cm

$\therefore \triangle ABC$ is an equilateral triangle

Now, Required area = Area of $\triangle ABC$
                    $- 3 \times$ area of sector AFE

$$= \frac{\sqrt{3}}{4}(7)^2 - 3 \times \frac{60}{360} \times \pi(3.5)^2$$

$\{\because$ area of triangle $= \frac{\sqrt{3}}{4}$(side)^2 and area

of sector $= \frac{\pi r^2 \theta}{360°}\}$

$$= \frac{49\sqrt{3}}{4} - \frac{49}{8}\pi = \frac{49}{8}(2\sqrt{3} - \pi) \text{ cm}^2$$

61. A copper wire when bent in the form of a square encloses an area of 121 cm². If the same wire is bent in the form of a circle, it encloses an area equal to

(a) 121 cm²   (b) 144 cm²
(c) 154 cm²   (d) 168 cm²

⊘ **(c)** Let the length of the square be a cm

$\therefore \quad a^2 = 121$ $\{\because$ area pf square $= a^2\}$

$\Rightarrow \quad a = 11$ cm

$\therefore$ Length of the wire = Perimeter of square of side $a = 4a = 4 \times 11 = 44$ cm

Let the radius of circle be r cm

$\therefore$ Perimeter of circle = Length of wire

$\Rightarrow \quad 2\pi r = 44$

$$\Rightarrow \quad r = \frac{44}{2 \times \frac{22}{7}} = 7 \text{ cm}$$

$\therefore$ Area enclosed by circle

$$= \pi r^2 = \frac{22}{7} \times (7)^2 = 154 \text{ cm}^2$$

62. A field is divided into four regions as shown in the given figure. What is the area of the field in square metres?
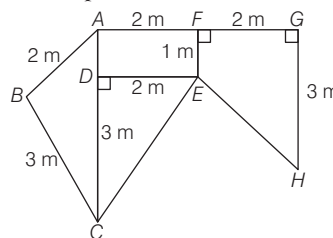
(a) $6 + \frac{3}{4}\sqrt{5}$ (b) $5 + \frac{3}{2}\sqrt{3}$

(c) $9 + \frac{3}{4}\sqrt{15}$ (d) $7 + 2\sqrt{2}$

⊘ **(c)**
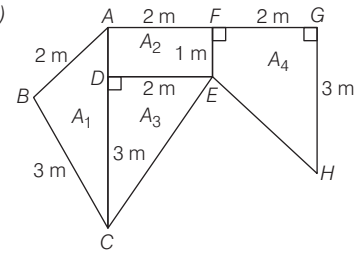
$\because$ $AD = EF = 1$ m

$\therefore AC = AD + DC = 1 + 3 = 4$ m

Now, in $\triangle ABC$,

$$s = \frac{a + b + c}{2} = \frac{2 + 3 + 4}{2} = \frac{9}{2}$$

$$\therefore \text{ ar}(\triangle ABC) = \sqrt{\frac{9}{2}\left(\frac{9}{2} - 2\right)\left(\frac{9}{2} - 3\right)\left(\frac{9}{2} - 4\right)}$$

$$= \sqrt{\frac{9}{2} \times \frac{5}{2} \times \frac{3}{2} \times \frac{1}{2}} = \frac{3}{4}\sqrt{15} \text{ m}^2$$

Area of rectangle $ADEF = DE \times EF$
                          $= 2 \times 1 = 2 \text{ m}^2$

Area of $\triangle CDE = \frac{1}{2} \times CD \times DE$

$$= \frac{1}{2} \times 3 \times 2 = 3 \text{ m}^2$$

Area of trapezium EFGH

$$= \frac{1}{2}(EF + GH) \times FG$$

$$= \frac{1}{2} \times (1 + 3) \times 2 = 4 \text{ m}^2$$

$\therefore$ Area of field $= \frac{3}{4}\sqrt{15} + 2 + 3 + 4$

$$= \left(9 + \frac{3}{4}\sqrt{15}\right) \text{ m}^2$$

2016 (II)

63. The sides of a triangle are given by $\sqrt{a^2 + b^2}$, $\sqrt{c^2 + a^2}$ and $(b + c)$, where a, b, c are positive. What is the area of the triangle?

(a) $\frac{\sqrt{a^2 + b^2 + c^2}}{2}$

(b) $\frac{\sqrt{a^2b^2 + b^2c^2 + c^2a^2}}{2}$

(c) $\frac{a(b + c)}{2}$

(d) $\frac{\sqrt{3(a^2b^2 + b^2c^2 + c^2a^2)}}{2}$

⊘ **(c)** Let $A = \sqrt{a^2 + b^2}$, $B = \sqrt{c^2 + a^2}$ and $C = (b + c)$ be the three sides of a given triangle.

$\therefore$ Semi-perimeter, $(s) = \frac{A + B + C}{2}$

$$= \frac{\sqrt{a^2 + b^2} + \sqrt{c^2 + a^2} + (b + c)}{2}$$

Now, $s(s - A)(s - B)(s - C)$

$$= \left[\frac{\sqrt{a^2 + b^2} + \sqrt{c^2 + a^2} + (b + c)}{2}\right]$$

$$\times \left[\frac{\sqrt{c^2 + a^2} - \sqrt{a^2 + b^2} + (b + c)}{2}\right]$$

$$\times \left[\frac{\sqrt{a^2 + b^2} - \sqrt{c^2 + a^2} + (b + c)}{2}\right]$$

$$\times \left[\frac{\sqrt{a^2 + b^2} + \sqrt{c^2 + a^2} - (b + c)}{2}\right]$$

$$= \frac{1}{16}\{[\sqrt{a^2 + b^2} \cdot \sqrt{c^2 + a^2} - a^2 - b^2$$
$$+ (b + c)\sqrt{a^2 + b^2}$$
$$+ c^2 + a^2 - \sqrt{a^2 + b^2} \cdot \sqrt{c^2 + a^2}$$
$$+ (b + c)\sqrt{c^2 + a^2}$$
$$+ (b + c)\sqrt{c^2 + a^2} - (b + c)\sqrt{a^2 + b^2}$$
$$+ b^2 + c^2 + 2bc]$$
$$\times [a^2 + b^2 + \sqrt{a^2 + b^2}$$
$$\cdot \sqrt{c^2 + a^2} - (b + c)\sqrt{a^2 + b^2}$$
$$- \sqrt{a^2 + b^2} \cdot \sqrt{c^2 + a^2}$$
$$- c^2 - a^2 + (b + c)\sqrt{c^2 + a^2}$$
$$+ (b + c)\sqrt{a^2 + b^2} + (b + c)\sqrt{c^2 + a^2}$$
$$- b^2 - c^2 - 2bc]\}$$

$$= \frac{1}{16}[(2c^2 + 2bc + 2(b + c)\sqrt{c^2 + a^2})$$
$$2(b + c)\sqrt{c^2 + a^2} - 2c^2 - 2bc)]$$

$$= \frac{4}{16}[(b + c)\sqrt{c^2 + a^2} + c(b + c)]$$
$$[(b + c)\sqrt{c^2 + a^2} - c(b + c)]$$

$$= \frac{1}{4}(b + c)[\sqrt{c^2 + a^2} + c](b + c)$$
$$[\sqrt{c^2 + a^2} - c]$$

$$= \frac{1}{4}(b + c)^2[(\sqrt{c^2 + a^2})^2 - c^2]$$

$$= \frac{1}{4}(b + c)^2[c^2 + a^2 - c^2]$$

$$\Rightarrow \quad \frac{1}{4}(b + c)^2 a^2$$

$$\Rightarrow \quad s(s - A)(s - B)(s - C)$$
$$= \frac{1}{4}a^2(b + c)^2 \qquad \ldots(i)$$

$\therefore$ Area of triangle

$$= \sqrt{s(s - A)(s - B)(s - C)}$$

$$= \sqrt{\frac{1}{4}a^2(b + c)^2} \qquad \text{[from Eq. (i)]}$$

$$= \frac{1}{2}a(b + c)$$

Alternate method

$PM \perp QR$

$$PQ = \sqrt{a^2 + b^2}$$
$$PR = \sqrt{a^2 + c^2}$$
$$QR = b + c$$

Let $QM = b$, then $MR = c$
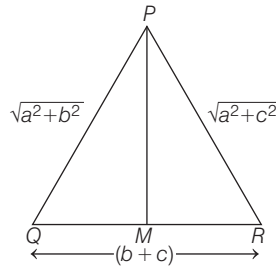
$\Delta PQM, (PQ)^2 = (PM)^2 + (QM)^2$
$(\sqrt{a^2 + b^2})^2 = (PM)^2 + (b)^2$
$\Delta PMR, (PR)^2 = (PM)^2 + (RM)^2$
$\Rightarrow (\sqrt{a^2 + c^2}) = (PM)^2 + (c)^2$
$\quad PM = a$

Then, it is proved that
$\quad QM = b$ and $MR = c$
$\because PM = a$

Area of triangle $= \frac{1}{2} \times$ Base $\times$ Height

$$= \frac{1}{2} \times (a + b) \times a$$

$$= \frac{1}{2}a(a + b)$$

64. What is area of largest triangle inscribed in a semi-circle of radius r units?

(a) r^2 sq units (b) $2r^2$ sq units
(c) $3r^2$ sq units (d) $4r^2$ sq units

⊗ **(a)** Largest triangle inscribed in a semi-circle is ΔABC.
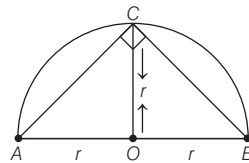
$\therefore$ Area of $\Delta ABC = \frac{1}{2} AB \times OC$

$$= \frac{1}{2} \times 2r \times r \quad [\because AB = 2r, OC = r]$$

$$= r^2 \text{ sq units}$$

65. The diameter of the front wheel of an engine is $2x$ cm and that of rear wheel is $2y$ cm. To cover the same distance, what is the number of times the rear wheel revolves when the front wheel revolves n times?

(a) $\dfrac{n}{xy}$ (b) $\dfrac{ny}{x}$ (c) $\dfrac{nx}{y}$ (d) $\dfrac{xy}{n}$

⊗ **(c)** Diameter of front wheel $= 2x$ cm
Diameter of rear wheel $= 2y$ cm
Total distance travelled by front wheel in one revolution $= \pi(2x) = 2\pi x$

Total distance travelled by rear wheel in one revolution $= \pi(2y) = 2\pi y$
Total distance travelled by front wheel in n revolutions

$$= 2nx\pi \qquad \ldots(i)$$

Let the same distance travelled by rear wheel in N revolutions
$\therefore$ Total distance $= 2Ny\pi \qquad \ldots(ii)$
Since, Eqs. (i) and (ii) are equal,

$\therefore \qquad 2nx\pi = 2Ny\pi$

$\Rightarrow \qquad N = \dfrac{nx}{y}$

$\therefore$ Rear wheel revolves $\dfrac{nx}{y}$ times.

66. The wheels of a car are of diameter 80 cm each. The car is travelling at a speed of 66 km/h. What is the number of complete revolutions each wheel makes in 10 min?

(a) 4275 (b) 4350
(c) 4375 (d) 4450

⊗ **(c)** Given, radius of wheel $= \dfrac{80}{2}$ cm

$$= 40 \text{ cm}$$

Speed $= 66$ km/h $= \dfrac{6600000}{60}$ cm/min

$$[1 \text{ km} = 100000 \text{ cm}]$$

and time $= 10$ min $\qquad [1 \text{ h} = 60 \text{ min}]$

$\therefore$ Distance travelled in 10 min

$$= \text{Speed} \times \text{Time}$$

$$= \frac{6600000}{60} \times 10 = 1100000 \text{ cm}$$

Now, number of complete revolutions

$$= \frac{\text{Distance}}{\text{Circumference of a wheel}}$$

$$= \frac{1100000}{2\pi r} = \frac{11\,00000 \times 7}{2 \times 22 \times 40}$$

$$= 625 \times 7 = 4375$$

67. What is the area of a triangle with sides of length 12 cm, 13 cm and 5 cm?

(a) 30 cm² (b) 35 cm²
(c) 40 cm² (d) 42 cm²

⊗ **(a)** Given, the length of the sides are

$$a = 12 \text{ cm}, b = 13 \text{ cm}$$

and $\quad c = 5$ cm

then, $\quad s = \dfrac{a + b + c}{2} = \dfrac{12 + 13 + 5}{2}$

$$= 15 \text{ cm}$$

$\therefore$ Area of triangle

$$= \sqrt{s(s - a)(s - b)(s - c)}$$

$$= \sqrt{15(15 - 12)(15 - 13)(15 - 5)}$$

$$= \sqrt{15 \times 3 \times 2 \times 10}$$

$$= \sqrt{900} = 30 \text{ cm}^2$$

68. If the perimeter of a circle is equal to that of a square, then what is the ratio of area of circle to that of square?

(a) 22 : 7   (b) 14 : 11
(c) 7 : 22   (d) 11 : 14

⊘ **(b)** Let r be the radius of a given circle and a be the length of each side of a given square.

According to question, we get

Perimeter of circle = Perimeter of square

$\Rightarrow \quad 2\pi r = 4a$

$\Rightarrow \quad a = \dfrac{\pi r}{2} \qquad \ldots(i)$

Now, $\dfrac{\text{Area of circle}}{\text{Area of square}} = \dfrac{\pi r^2}{a^2} = \dfrac{\pi r^2}{\left(\dfrac{\pi r}{2}\right)^2}$

$\qquad\qquad\qquad\qquad$ [from Eq. (i)]

$= \dfrac{\pi r^2}{\pi^2 r^2} \times 4 = \dfrac{4}{\pi}$

$= \dfrac{4 \times 7}{22} = \dfrac{14}{11}$

Hence, the required ratio is 14 : 11.

69. Two circles touch externally and sum of their areas is 130π cm^2 and the distance between their centres is 14 cm. What is the difference in the radii of the circles?

(a) 5 cm   (b) 6 cm
(c) 7 cm   (d) 8 cm

⊘ **(d)** Let r_1 and r_2 be the radius of the two circles.

Then, $\pi r_1^2 + \pi r_2^2 = 130\pi$ cm^2

$\Rightarrow \quad r_1^2 + r_2^2 = 130 \qquad \ldots (i)$

$\Rightarrow \quad (r_1 + r_2)^2 - 2r_1 r_2 = 130$

$\qquad [\because a^2 + b^2 = (a+b)^2 - 2ab]$

$\Rightarrow \quad (14)^2 - 2r_1 r_2 = 130$

$\qquad\qquad [\because r_1 + r_2 = 14 \text{ cm}]$

$\Rightarrow \quad 2r_1 r_2 = 66 \qquad \ldots (ii)$

Now, difference between radii = $r_1 - r_2$

On squaring,

$(r_1 - r_2)^2 = r_1^2 + r_2^2 - 2r_1 r_2$

$= 130 - 66 = 64$

$\qquad$ [from Eq. (i) and Eq. (ii)]

$\therefore \quad (r_1 - r_2) = 8$ cm

70. What is the number of rounds that a wheel of diameter $\dfrac{5}{11}$ m will make in traversing 7 km?

(a) 3300   (b) 3500
(c) 4400   (d) 4900

⊘ **(d)** Given, diameter of wheel = $\dfrac{5}{11}$ m

$\therefore$ Radius of wheel = $\dfrac{5}{22}$ m

Distance to be covered = 7 km = 7000 m
Now, distance traversed in one round = $2\pi r$
Now, let the wheel traversed 7 km in n rounds, then

7 km $= n \times 2\pi r$

$\Rightarrow \quad 7000 = n \times 2 \times \dfrac{22}{7} \times \dfrac{5}{22}$

$\Rightarrow \quad 700 \times 7 = n \Rightarrow n = 4900$

71. A circle and a square have the same perimeter. Which one of the following is correct?

(a) Their areas are equal
(b) The area of the circle is larger
(c) The area of the square is $\dfrac{\pi}{2}$ times area of circle
(d) The area of the square is π times area of circle

⊘ **(b)** Let r and a be the radius of a circle and side of a square respectively.

According to question,

circumference of circle = perimeter of square,

$2\pi r = 4a \Rightarrow a = \dfrac{\pi r}{2}$

Now, area of circle = πr^2

and area of square = $a^2 = \dfrac{\pi^2 r^2}{4}$

Clearly, the area of circle is larger than the area of square.

72. In an equilateral triangle another equilateral triangle is drawn inside joining the mid-points of the sides of given equilateral triangle and the process is continued up to 7 times. What is the ratio of area of fourth triangle to that of seventh triangle?

(a) 256 : 1   (b) 128 : 1
(c) 64 : 1   (d) 16 : 1

⊘ **(c)** Let the side of equilateral triangle be x. Now, another equilateral triangle is drawn inside joining the mid-points of the sides of given equilateral triangle and process is continued upto 7 times. Then, the side of the fourth triangle be $\dfrac{x}{2^3}$ and seventh triangle be $\dfrac{x}{2^6}$.

$\therefore$ Required ratio = area of fourth triangle : area of seventh triangle

$= \dfrac{\sqrt{3}}{4}\left(\dfrac{x}{2^3}\right)^2 : \dfrac{\sqrt{3}}{4}\left(\dfrac{x}{2^6}\right)^2$

$= 2^6 : 1 = 64 : 1$

73. The area of four walls of a room is 120 m^2. The length of the room is twice its breadth. If the height of the room is 4 m, what is area of the floor?

(a) 40 m^2 (b) 50 m^2 (c) 60 m^2 (d) 80 m^2

⊘ **(b)** Let l, b and h be the length, breadth and height of the room.

Now, area of four walls = $2(l + b)h$

$120 = 2(l + b) \times 4$

$\Rightarrow \quad 120 = 8(2b + b) \qquad [\because l = 2b]$

$\Rightarrow \quad b = 5$ m

$\therefore \qquad l = 2 \times 5 = 10$ m

$\therefore$ Area of the floor = $l \times b$

$= (10 \times 5) = 50$ m^2

2016 (I)

74. AD is the diameter of a circle with area 707 m^2 and $AB = BC = CD$ as shown in the figure. All curves inside the circle are semi-circles with their diameters on AD. What is the cost of levelling the shaded region at the rate of ₹ 63 per m^2?
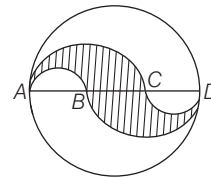
(a) ₹ 29700   (b) ₹ 22400
(c) ₹ 14847   (d) None of these

⊘ **(c)** Area of circle with diameter (AD)

$= \dfrac{\pi (AD)^2}{4}$

So, $\dfrac{\pi (AD)^2}{4} = 707$

$\Rightarrow \quad AD = \sqrt{\dfrac{707}{\pi} \times 4} = 2\sqrt{\dfrac{707}{\pi}}$ m

As, $AB = BC = CD = \dfrac{AD}{3}$

$= \dfrac{2}{3}\sqrt{\dfrac{707}{\pi}}$ m

and $AC = 2AB = BD = 2CD$

$= \dfrac{4}{3}\sqrt{\dfrac{707}{\pi}}$ m

$\therefore$ Area of shaded portion = 2 (Area of semi-circle with AC as diameter

$\qquad$ – Area of semi-circle with AB as diameter)

$= \dfrac{2\pi(AC)^2}{8} - \dfrac{2\pi(AB)^2}{8}$

$$= \frac{2\pi}{8}\left[\frac{16}{9}\cdot\frac{707}{\pi} - \frac{4}{9}\cdot\frac{707}{\pi}\right]$$

$$= \frac{1}{3} \times 707 \, \text{m}^2$$

∴ Cost of levelling the shaded portion

$$= \frac{707}{3} \times 63 = ₹14847$$

75. A circle of 3 m radius is divided into three areas by semi-circles of radii 1 m and 2 m as shown in the figure. The ratio of the three areas *A, B* and *C* will be
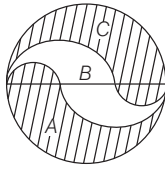
(a) 2 : 3 : 2   (b) 1 :1 : 1
(c) 4 : 3 : 4   (d) 1 : 2 : 1

⊘ *(b)* Given a radius of 3 m is divided in such a way that the radius of smaller semi-circle is 1 m and radius of bigger semi-circle is 2 m.
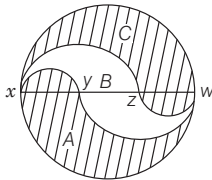
Area of shaded portion *A*
= Area of semi-circle of radius 3 m
    – Area of semi-circle of radius 2 m
    + Area of semi-circle of radius 1 m

$$= \frac{1}{2}\pi(3)^2 - \frac{1}{2}\pi(2)^2 + \frac{1}{2}\pi(1)^2$$

$$= \frac{1}{2}\pi(9 - 4 + 1) = 3\pi$$

Area of portion *B* = 2 (Area of semi-circle of radii 2 m
    – Area of semi-circle of radius 1 m)

$$= 2\left[\frac{1}{2}\pi(2)^2 - \frac{1}{2}\pi(1)^2\right] = 3\pi$$

Similarly, area of shaded portion C
= Area of portion *A* = 3π
Hence, the ratio of areas *A*, *B* and *C* is
1 : 1 : 1.

76. A truck moves along a circular path and describes 100 m when it has traced out 36° at the centre. The radius of the circle is equal to

(a) $\frac{100}{\pi}$ m   (b) $\frac{250}{\pi}$ m

(c) $\frac{500}{\pi}$ m   (d) $\frac{600}{\pi}$ m

⊘ *(c)* Let *r* be the radius of the circle.

∴   Length of arc = $2\pi r\left(\frac{\theta}{360°}\right)$
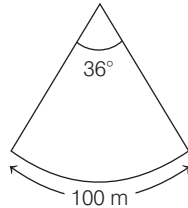
⇒ $100 = 2\pi r\left(\frac{36°}{360°}\right)$

⇒ $100 = 2\pi r \times \frac{1}{10}$

∴ $r = \frac{1000}{2\pi} = \frac{500}{\pi}$ m

77. The number of rounds that a wheel of diameter 7/11 m will make in traversing 4 km will be
(a) 500   (b) 1000
(c) 1700   (d) 2000

⊘ *(d)* Number of rounds that a wheel of diameter *D* will make in traversing a distance = *n*(π*D*)
Given that, distance = 4 km
⇒ $n(\pi D) = 4000$ m
⇒ $n\left(\pi \times \frac{7}{11}\right) = 4000$
⇒ $n\left(\frac{22}{7} \times \frac{7}{11}\right) = 4000$
⇒ $n = 2000$
Hence, the number of rounds is 2000.

78. The base of an isosceles triangle is 300 units and each of its equal sides is 170 units. Then, the area of the triangle is
(a) 9600 sq units
(b) 10000 sq units
(c) 12000 sq units
(d) None of the above

⊘ *(c)* Here, base = 300 units
and side = 170 units
We know that, Area of an isosceles triangle

$$= \frac{\text{Base}}{4}\sqrt{4\,(\text{Side})^2 - (\text{Base})^2}$$

$$= \frac{300}{4}\sqrt{4(170)^2 - (300)^2}$$

$$= 75\sqrt{4 \times 28900 - 90000}$$

$$= 75\sqrt{115600 - 90000}$$

$$= 75\sqrt{25600}$$

$$= 75 \times 160$$

$$= 12000 \text{ sq units}$$

79. Four equal discs are placed such that each one touches two others. If the area of empty space enclosed by them is 150/847 sq cm, then the radius of each disc is equal to
(a) 7 /6 cm   (b) 5/6 cm
(c) 1/2 cm   (d) 5/11 cm

⊘ *(d)* Let the radius of the circle be *r*.
Then, side of square *ABCD* = 2 *r*
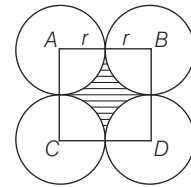
∴ Area of empty space
= Area of square – 4 (Area of quadrant)

⇒ $\frac{150}{847} = (2r)^2 - 4\left[\frac{1}{4} \times \pi r^2\right]$

⇒ $\frac{150}{847} = \frac{6}{7}r^2$

⇒ $r^2 = \frac{25}{121}$ $\left[\because \pi = \frac{22}{7}\right]$

⇒ $r = \frac{5}{11}$ cm

80. A circular path is made from two concentric circular rings in such a way that the smaller ring when allowed to roll over the circumference of the bigger ring, takes three full revolutions. If the area of the pathway is equal to *n* times the area of the smaller ring, then *n* is equal to
(a) 4   (b) 6   (c) 8   (d) 10

⊘ *(c)* Let the radius of smaller ring be r_1 and the radius of bigger ring be *r*.
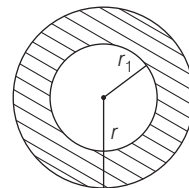
Since, the smaller ring takes three full revolutions to roll over the circumference of bigger ring.

∴ $2\pi r = 3(2\pi r_1) \Rightarrow r = 3r_1$
Now, area of pathway = $\pi r^2 - \pi r_1^2 = n(\pi r_1^2)$
⇒ $\pi r^2 = (n + 1)\pi r_1^2$
⇒ $r^2 = (n + 1)\frac{r^2}{9}$
∴ $n = 9 - 1 = 8$

2015 (II)

81. A square and an equilateral triangle have equal perimeter. If the diagonal of the square is $12\sqrt{2}$cm, then the area of the triangle is

(a) $24\sqrt{2}$ cm^2 (b) $24\sqrt{3}$ cm^2
(c) $48\sqrt{3}$ cm^2 (d) $64\sqrt{3}$ cm^2

⊘ **(d)** Let length of side of square and equilateral triangle be x and y, respectively.

Then, Perimeter of square
    = Perimeter of equilateral triangle
⇒ $4x = 3y$ ...(i)
    $= x\sqrt{2} = 12\sqrt{2}$

[∵ diagonal of square]
    $x = 12$ cm   ...(ii)
From Eq. (i),
∴ $y = \dfrac{4x}{3} = \dfrac{4}{3} \times 12 = 16$ cm

So, area of triangle $= \dfrac{\sqrt{3}}{4} \times 16 \times 16$

    $= 64\sqrt{3}$ cm^2

82. A boy is cycling such that the wheels of the cycle are making 140 revolutions per minute. If the radius of the wheel is 30 cm, then the speed of the cycle is

(a) 15.5 km/h   (b) 15.84 km/h
(c) 16 km/h   (d) 16.36 km/h

⊘ **(b)** Radius of wheel = 30 cm
    $= \dfrac{30}{100} = 0.3$ m

Distance covered in 1 revolution
$= 2\pi(0.3)$ m $= 0.6\pi$ m
∵ Distance covered in 140 revolutions
$= 140 \times 0.6\pi$ m
⇒ Speed the cycle = distance/time
    $= \dfrac{140 \times 0.6\pi}{60}$ m/s
    $= \dfrac{84 \times 22}{7 \times 60} = 4.4$ m/s
    $= 4.4 \times \dfrac{18}{5} = 15.84$ km/h

83. There are 437 fruit plants in an orchard planted in rows. The distance between any two adjacent rows is 2 m and the distance between any two adjacent plants is 2 m. Each row has the same number of plants. There is 1 m clearance on all sides of the orchard. What is the cost of fencing the area at the rate of ₹ 100 per metre?

(a) ₹ 15600
(b) ₹ 16800
(c) ₹ 18200
(d) More information is required

⊘ **(b)** There are 437 fruit plants.
∵ $437 = 19 \times 23$
∴ There are 19 rows and 23 trees or there are 23 rows and 19 trees.
Given, the distance between any two adjacent plants is 2 m and the distance between any two adjacent rows is 2 m.
∴ Length of orchard
    $= [1 + 22(2) + 1] = 46$m
Breadth of orchard
    $= [1 + 18(2) + 1] = 38$ m
∴ Perimeter of orchard
    $= [(46 \times 2) + (38 \times 2)] = 168$ m
∴ Cost of fencing at the rate of ₹ 100 per metre $= 168 \times 100 =$ ₹ 16800

84. The circumference of a circle is 100 cm. The side of the square inscribed in the circle is

(a) $50\sqrt{2}$ cm   (b) $\dfrac{100}{\pi}$ cm
(c) $\dfrac{50\sqrt{2}}{\pi}$ cm   (d) $\dfrac{100\sqrt{2}}{\pi}$ cm

⊘ **(c)** We have, circumference of circle
    $= 2\pi r = 100$
∴ $2r = \dfrac{100}{\pi}$ cm = diagonal of circle
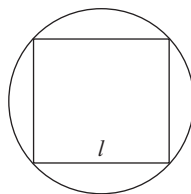
Let the side of square be l cm.
∵ Diagonal of square
    = diameter of circle
∴ $l\sqrt{2} = \dfrac{100}{\pi} \Rightarrow l = \dfrac{50\sqrt{2}}{\pi}$ cm

85. The diameter of a wheel that makes 452 revolutions to move 2 km and 26 dm is equal to

(a) $1\dfrac{9}{22}$ m   (b) $1\dfrac{13}{22}$ m
(c) $2\dfrac{5}{11}$ m   (d) $2\dfrac{7}{11}$ m

⊘ **(b)** 1 km = 1000 m, 1 dm = 10 m
∵ 2 km and 26 dm = 2000 + 260
    = 2260 m
Let radius be r m.
Distance covered in revolution = $2\pi r$

Distance covered in 452 revolution
    $= 452 \times 2\pi r$
∵ $452 \times 2\pi r = 2260$
∴ $r = \dfrac{2260 \times 7}{452 \times 2 \times 22} = \dfrac{35}{44}$
Diameter $= 2r = 2 \times \dfrac{35}{44}$
    $= \dfrac{35}{22} = 1\dfrac{13}{22}$ m

86. A square is inscribed in a right triangle with legs x and y and has common right angle with the triangle. The perimeter of the square is given by

(a) $\dfrac{2xy}{x + y}$ (b) $\dfrac{4xy}{x + y}$
(c) $\dfrac{2xy}{\sqrt{x^2 + y^2}}$ (d) $\dfrac{4xy}{\sqrt{x^2 + y^2}}$

⊘ **(b)** Let length of the side of square be l.
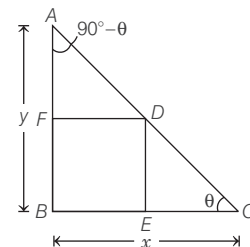
In ΔDEC, $\tan\theta = \dfrac{DE}{EC} = \dfrac{l}{x - l}$ ...(i)

In ΔAFD,
$\tan(90° - \theta) = \cot\theta$
    $= \dfrac{FD}{AF} = \dfrac{l}{y - l}$ ...(ii)

On multiplying Eqs. (i) and (ii), we get
$\tan\theta \cdot \cot\theta = \dfrac{1}{x - 1} \times \dfrac{1}{y - 1}$
    $1 = \dfrac{l^2}{(x - l)(y - l)}$
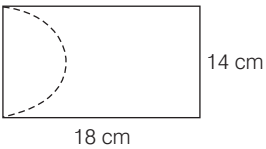
[∵ $\tan\theta \cot\theta = 1$]
⇒ $xy - xl - yl + l^2 = l^2$
∵ $l(x + y) = xy$

⇒ $l = \dfrac{xy}{x + y}$

∴ Perimeter of square $= 4l = \dfrac{4xy}{x + y}$

87. From a rectangular sheet of sides 18 cm and 14 cm, a semi-circular portion with smaller side as diameter is taken out. Then, the area of the remaining sheet will be

(a) 98 cm^2 (b) 100 cm^2
(c) 108 cm^2 (d) 175 cm^2

⊘ (*d*) Diameter of semi-circle = 14 cm
Radius of semi-circle,

$$r = \frac{14}{2} = 7 \text{ cm}$$

Area of remaining portion
= Area of rectangle
– Area of semi-circle

$$= l \times b - \frac{\pi r^2}{2}$$

$$= 18 \times 14 - \frac{1}{2} \times \frac{22}{7} \times 7 \times 7$$
$$= 252 - 77 = 175 \text{ cm}^2$$

88. *ABCD* is a square. If the sides *AB* and *CD* are increased by 30%, sides *BC* and *AD* are increased by 20%, then the area of the resulting rectangle exceeds the area of the square by

(a) 50%   (b) 52%   (c) 54%   (d) 56%

⊘ (*d*) Let the side of square be x.
Area of square = x^2
Now, increased length

$$= x\left(1 + \frac{30}{100}\right) = \frac{13x}{10}$$

and increased breadth

$$= x\left(1 + \frac{20}{100}\right) = \frac{12x}{10}$$

Now, new area of rectangle

$$= \text{length} \times \text{breadth} = \frac{13x}{10} \times \frac{12x}{10} = \frac{156x^2}{100}$$

Increased in area $= \frac{156x^2}{100} - x^2 = \frac{56x^2}{100}$

Percentage increased in area

$$= \frac{56x^2}{100x^2} \times 100 = 56\%$$

Alternate method
Here, a = 30%, b = 20%
Required percentage increase

$$= \left(a + b + \frac{ab}{100}\right)\%$$

$$= 30 + 20 + \frac{30 \times 20}{100}$$

$$= 50 + 6 = 56\%$$

89. The area of a trapezium is 336 cm^2. If its parallel sides are in the ratio 5 : 7 and the perpendicular distance between them is 14 cm, then the smaller of the parallel sides is

(a) 20 cm (b) 22 cm (c) 24 cm (d) 26 cm

⊘ (*a*) Let parallel sides of trapezium are $5x$ and $7x$ respectively.
Area of trapezium

$$= \frac{1}{2} \text{ (Sum of parallel side)}$$
$$\times \text{ Distance between them}$$

$$\Rightarrow \quad \frac{1}{2}(5x + 7x) \times 14 = 336$$

$$\Rightarrow \quad 12x \times 7 = 336 \Rightarrow x = 4$$

The length of smaller side
$$= 4 \times 5 = 20 \text{ cm}$$

90. *AB* is a line segment of length 2*a*, with *M* as mid-point. Semi-circles are drawn on one side with *AM, MB* and *AB* as diameter as shown in the figure. A circle with centre *O* and radius *r* is drawn such that this circle touches all the three semi-circles. The value of *r* is

(a) $\frac{2a}{3}$ (b) $\frac{a}{2}$ (c) $\frac{a}{3}$ (d) $\frac{a}{4}$
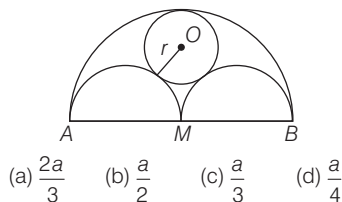
⊘ (*c*) Since, two circles touch each other externally if distance between their centres
= Sum of their radii

$$O_1 O_2 = r + \frac{a}{2}$$
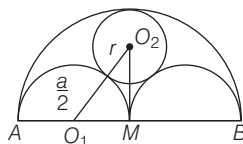
and $O_2 M = CM - O_2C = a - r, O_1M = \frac{a}{2}$

In right ΔO_1MO_2,

$$(O_1O_2)^2 = (O_1M)^2 + (O_2M)^2$$

$$\Rightarrow \left(r + \frac{a}{2}\right)^2 = \frac{a^2}{4} + (a - r)^2$$

$$\Rightarrow r^2 + \frac{a^2}{4} + ra = \frac{a^2}{4} + a^2 + r^2 - 2ar$$

$$\Rightarrow \quad 3r = a$$

$$\therefore \quad r = \frac{a}{3}$$

2015 (I)

91. The area of a rhombus with side 13 cm and one diagonal 10 cm will be

(a) 140 sq cm   (b) 130 sq cm
(c) 120 sq cm   (d) 110 sq cm

⊘ (*c*) Given, a side of rhombus (a) = 13 cm and a diagonal of rhombus (d_1) = 10 cm
∵ Diagonals bisect each other at 90°
∴   ∠AEB = 90°

and $AE = EC = \frac{10}{2} = 5$ cm
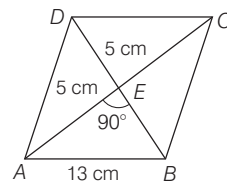
Now, in right angled ΔABE,
$$AB^2 = AE^2 + BE^2$$
$$\Rightarrow \quad 13^2 = 5^2 + BE^2$$
$$\Rightarrow \quad BE^2 = 169 - 25 = 144$$
$$\therefore \quad BE = 12 \text{ cm}$$
$$\therefore \quad BD = 2 \times BE = 2 \times 12 = 24 \text{ cm}$$

Length of second diagonal (d_2) = 24 cm

Now, area of rhombus $= \frac{1}{2} \times d_1 \times d_2$

$$= \frac{1}{2} \times 10 \times 24 = 120 \text{ sq cm}$$

Alternate Method
Here, a = 13 cm, d_1 = 10 cm
We know that, $4a^2 = d_1^2 + d_2^2$
$$\Rightarrow \quad 4 \times 13^2 = 10^2 + d_2^2$$
$$\Rightarrow \quad 4 \times 169 = 100 + d_2^2$$
$$\Rightarrow \quad 676 - 100 = d_2^2$$
$$\Rightarrow \quad d_2 = \sqrt{576} = 24 \text{ cm}$$

Now, area of rhombus $= \frac{1}{2} \times d_1 \times d_2$

$$= \frac{1}{2} \times 10 \times 24 = 120 \text{ sq cm}$$

92. Two circles, each of radius *r*, with centres *P* and *Q* are such that each circle passes through the centre of the other circle. Then, the area common to the circles is less than one-third of the sum of the areas of the two circles by

(a) $\frac{\sqrt{3}r^2}{4}$ (b) $\frac{\sqrt{3}r^2}{3}$

(c) $\frac{\sqrt{3}r^2}{2}$ (d) $\sqrt{3}r^2$

⊘ (*c*) Given, radius of two circles be *r*.
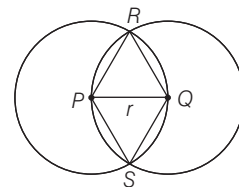
∴ Area of sector $PQRP = \frac{\pi r^2 \theta}{360°}$

$$= \frac{\pi r^2 \times 60°}{360°} = \frac{\pi r^2}{6}$$

Now, area of segment *PQR*
= Area of sector *PQRP*
                        – Area of equilateral triangle
$$= \frac{\pi r^2}{6} - \frac{\sqrt{3}}{4} r^2$$

Area of half common circle
$$= \frac{\pi r^2}{6} + \frac{\pi r^2}{6} - \frac{\sqrt{3}}{4} r^2 = \frac{\pi r^2}{3} - \frac{\sqrt{3}}{4} r^2$$

Area of common circle
$$= 2 \times \left[\frac{\pi r^2}{3} - \frac{\sqrt{3}}{4} r^2 \right] = 2 r^2 \left[\frac{\pi}{3} - \frac{\sqrt{3}}{4} \right]$$

According to the question,

Required area $= \frac{2}{3} \pi r^2 - 2 r^2 \left[\frac{\pi}{3} - \frac{\sqrt{3}}{4} \right]$

$$= \frac{2 \pi r^2}{3} - \frac{2 \pi r^2}{3} + \frac{2\sqrt{3} r^2}{4} = \frac{\sqrt{3} r^2}{2}$$

93. The sides of a triangle are 25 cm, 39 cm and 56 cm. The perpendicular from the opposite vertex on the side of 56 cm is
(a) 10 cm   (b) 12 cm
(c) 15 cm   (d) 16 cm

⊘ *(c)* Let the three sides of a triangle be *a*, *b* and *c*, respectively.
∴ *a* = 56 cm, *b* = 39 cm and *c* = 25 cm
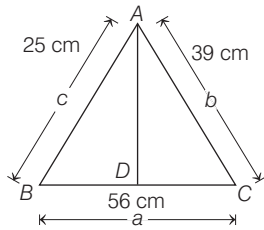
Perimeter of triangle,
$$2s = a + b + c$$
⇒ $\quad 2s = 25 + 39 + 56$
⇒ $\quad s = 60$ cm

Now, area of triangle
$$= \sqrt{s(s-a)(s-b)(s-c)}$$
$$= \sqrt{60(60-56)(60-39)(60-25)}$$
$$= \sqrt{60 \times 4 \times 21 \times 35}$$
$$= 420 \text{ sq cm} \qquad \dots(i)$$

Again, area of triangle
$$= \frac{1}{2} \times \text{Base} \times \text{Altitude}$$
$$= \frac{1}{2} \times BC \times AD \qquad \dots(ii)$$

From Eqs. (i) and (ii), we get
$$\frac{1}{2} \times BC \times AD = 420$$
⇒ $\quad \frac{1}{2} \times 56 \times AD = 420$
⇒ $\quad AD = \frac{420}{28} = 15$ cm

Hence, the length of *AD* is 15 cm.

94. From a circular piece of cardboard of radius 3 cm, two sectors of 40° each have been cut off. The area of the remaining portion is
(a) 11 sq cm   (b) 22 sq cm
(c) 33 sq cm   (d) 44 sq cm

⊘ *(b)* Given, radius of circle, *r* = 3 cm
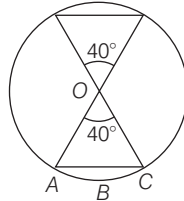
Area of remaining portion
= Area of circle – 2 (Area of sector *OABCO*)
$$= \pi r^2 - 2 \times \frac{\pi r^2 \theta}{360}$$
$$= \pi r^2 \left[1 - \frac{2\theta}{360°} \right] \qquad [\because \theta = 40°]$$
$$= \pi r^2 \left[1 - \frac{2 \times 40°}{360°} \right]$$
$$= \frac{22}{7} \times 9 \left[1 - \frac{8}{36} \right] = \frac{22}{7} \times 9 \left[1 - \frac{2}{9} \right]$$
$$= \frac{22}{7} \times \frac{7}{9} \times 9 = 22 \text{ sq cm}$$

95. Three equal circles each of diameter *d* are drawn on a plane in such a way that each circle touches the other two circles. A big circle is drawn in such a manner that it touches each of the small circles internally. The area of the big circle is
(a) πd^2 (b) $\pi d^2 (2 - \sqrt{3})^2$
(c) $\frac{\pi d^2 (\sqrt{3} + 1)^2}{2}$ (d) $\frac{\pi d^2 (\sqrt{3} + 2)^2}{12}$

⊘ *(d)* Given, diameter of each circle = *d*
∴ Radius of each circle = *d* /2,
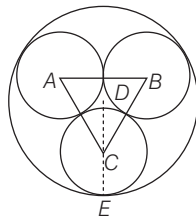
$$CE = d/2$$
Here, ΔABC is an equilateral triangle.
∴ Altitude of equilateral triangle
$$= \frac{\sqrt{3}}{2} \text{ (Side)}$$
$$= \frac{\sqrt{3}}{2} (AB) = \frac{\sqrt{3}}{2} d$$
$$[\because AB = AF + FB = d]$$

∵ Ratio of centroid of equilateral triangle = 2 : 1
∴ Length of $DC = \frac{2}{3} \times \frac{\sqrt{3}}{2} d = \frac{\sqrt{3}}{3} d$

Now, radius of big circle,
$$R = DE = DC + CE$$
$$= \frac{\sqrt{3}}{3} d + \frac{d}{2}$$
$$= d \left[\frac{\sqrt{3}}{3} + \frac{1}{2} \right]$$
$$= d \left[\frac{\sqrt{3}}{3} + \frac{3}{3 \times 2} \right] = d\sqrt{3} \left[\frac{1}{3} + \frac{\sqrt{3}}{6} \right]$$
$$= \frac{d \times \sqrt{3}(2 + \sqrt{3})}{6}$$

∴ Area of big circle $= \pi R^2$
$$= \pi \left[d \times \frac{\sqrt{3}(2 + \sqrt{3})}{6} \right]^2$$
$$= \pi \times \left[\frac{d^2 \times 3(2 + \sqrt{3})^2}{36} \right]$$
$$= \frac{\pi d^2 (2 + \sqrt{3})^2}{12}$$

Hence, the area of big circle is $\frac{\pi d^2 (2 + \sqrt{3})^2}{12}$.

96. The sides of a triangular field are 41 m, 40 m and 9 m. The number of rose beds that can be prepared in the field if each rose bed, on an average, needs 900 sq cm space, is
(a) 2000   (b) 1800
(c) 900   (d) 800

⊘ *(a)* Let the sides of a triangular field be *a*, *b* and *c*, respectively.
∴   *a* = 41 m, *b* = 40 m and *c* = 9 m
Perimeter of triangular field
$$2s = a + b + c = (41 + 40 + 9)$$
⇒ $\quad 2s = 90 \quad \Rightarrow \quad s = 45$ m
∵ Area of triangular field
$$= \sqrt{s(s-a)(s-b)(s-c)}$$
$$= \sqrt{45(45-41)(45-40)(45-9)}$$
$$= \sqrt{45 \times 4 \times 5 \times 36}$$
$$= \sqrt{9 \times 5 \times 4 \times 5 \times 9 \times 4}$$
$$= 9 \times 5 \times 4 = 180 \text{ sq m}$$

Given, area of each rose bed
$$= 900 \text{ sq cm} = \frac{900}{100 \times 100} \text{ sq m}$$
∴ Number of rose beds
$$= \frac{\text{Area of triangular field}}{\text{Area of each rose bed}}$$
$$= \frac{180 \times 100 \times 100}{900}$$
$$= 2000$$
Hence, the number of rose beds is 2000.

97. The ratio of the outer and inner perimeters of a circular path is 23 : 22. If the path is 5 m wide, then the diameter of the inner circle is

(a) 55 m   (b) 110 m
(c) 220 m   (d) 230 m

⊙ *(c)* Let the radius of outer circle and inner circle be R_m and r_m, respectively.
Perimeter of outer circle = $2\pi R_m$
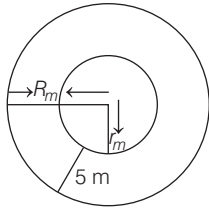
and perimeter of inner circle = $2\pi r_m$

∴ $\dfrac{2\pi R_m}{2\pi r_m} = \dfrac{23}{22}$

⇒ $\dfrac{R_m}{r_m} = \dfrac{23}{22}$

From the figure,
$$R_m = 5 + r_m$$
$$\dfrac{5 + r_m}{r_m} = \dfrac{23}{22}$$

⇒ $110 + 22\,r_m = 23\,r_m$
⇒ $r_m = 110\,\text{m}$

So, diameter of the inner circle is
$2 \times 110 = 220$ m.

98. Let a, b, c be the sides of a right triangle, where c is the hypotenuse. The radius of the circle which touches the sides of the triangle is

(a) $(a + b - c)/2$
(b) $(a + b + c)/2$
(c) $(a + 2b + 2c)/2$
(d) $(2a + 2b - c)/2$

⊙ *(a)* Given, a, b and c are the sides of a right triangle, where c is the hypotenuse.
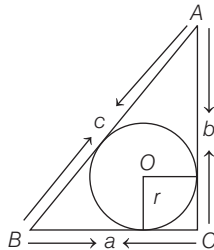
Area of $\triangle ABC = \dfrac{1}{2} \times$ Base $\times$ height

$$= \dfrac{1}{2} \times a \times b$$
$$= \dfrac{1}{2} ab \qquad \text{…(i)}$$

Semi-perimeter of triangle
$$= \dfrac{a + b + c}{2} \qquad \text{…(ii)}$$

$\triangle ABC$

$$c^2 = a^2 + b^2$$
$$c^2 = (a + b)^2 - 2ab$$
$$ab = \dfrac{(a + b)^2 - c^2}{2} \qquad \text{…(iii)}$$

Radius of circle

$$= \dfrac{\text{Area of triangle}}{\text{Semi-perimeter of triangle}}$$

$$= \dfrac{\dfrac{1}{2} ab}{\dfrac{a + b + c}{2}}$$

[by Eq. (i) and Eq. (ii)]

$$= \dfrac{\dfrac{1}{2}\left[\dfrac{(a + b)^2 - c^2}{2}\right]}{\dfrac{a + b + c}{2}} \quad \text{[by Eq. (iii)]}$$

$$= \dfrac{1}{2}\dfrac{(a + b + c)(a + b - c)}{(a + b + c)}$$

$$[\because a^2 - b^2 = (a + b)(a - b)]$$

$$= \dfrac{1}{2}(a + b - c)$$

99. The area of the largest triangle that can be inscribed in a semi-circle of radius r is

(a) r^2 (b) $2r^2$ (c) $3r^2$ (d) $4r^2$

⊙ *(a)* Let the r be the radius of semi-circle.
In $\triangle ABC$, $AO = OB = OC = r$

[radius of circle]
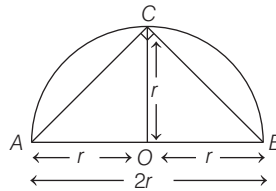
∴ Area of largest triangle

$$= \dfrac{1}{2} \times \text{Base} \times \text{Height}$$

$$= \dfrac{1}{2} \times AB \times OC \quad [\because AB = OA + OB]$$

$$= \dfrac{1}{2} \times 2r \times r = r^2$$

Hence, the area of the largest triangle in circle is r^2.

100. Four equal-sized maximum circular plates are cut off from a square paper sheet of area 784 sq cm. The circumference of each plate is

(a) 11 cm   (b) 22 cm
(c) 33 cm   (d) 44 cm

⊙ *(d)* Let the side of a square paper sheet be a cm.
Given, area of square paper sheet
$$= 784 \text{ sq cm}$$
⇒ $a^2 = 784$
⇒ $a = 28$ cm
∵ Diameter of one circle
$$= \dfrac{28}{2} = 14 \text{ cm}$$
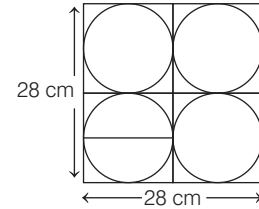
and radius of one circle
$$= \dfrac{14}{2} = 7 \text{ cm}$$

∴ Circumference of each plate
$$= 2\pi r = 2\pi \times 7$$
$$= 2 \times \dfrac{22}{7} \times 7$$
$$= 44 \text{ cm}$$

Hence, the circumference of each plate is 44 cm.

2014 (II)

101. A railroad curve is to be laid on a circle. What radius (approximate) should be used, if the track is to change direction by 25° in a distance of 120 m?

(a) 300 m   (b) 280 m
(c) 275 m   (d) 264 m

⊙ *(c)* We know that,

$$\text{arc length } PQ = \dfrac{2\pi r\theta}{360°}$$
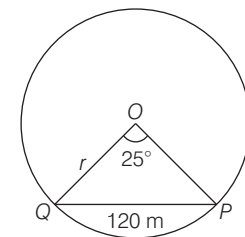
∴ $120 = \dfrac{2 \times 3.14 \times r \times 25°}{360°}$

⇒ $r = \dfrac{120 \times 360}{2 \times 3.14 \times 25} = \dfrac{43200}{157}$

$$= 275.15 \text{ m}$$

∴ $r = 275$ m   [approx.]

Directions (Q. Nos. 105-106) *Read the following information carefully and answer the given questions that follow.*

A piece of land is in the form of a parallelogram and the perimeter of the land is 86 m. The length of one side exceeds the other by 13 m and one of the diagonals is 41 m.

102. What is the area of the parallelogram?
(a) 63 m² (b) 96 m²
(c) 126 m² (d) 252 m²

⊙ **(d)** Given, perimeter of parallelogram land = 86 m and diagonal = 41 m. Let one side of parallelogram be x m.

Then, other side = $(x + 13)$ m

∴ Perimeter = $2(x + x + 13) = 86$

⇒ $2x + 13 = \dfrac{86}{2} = 43$

⇒ $2x = 43 - 13 = 30$

∴ $x = \dfrac{30}{2} = 15$

So, one side of parallelogram = 15 m and other side = 15 + 13 = 28 m
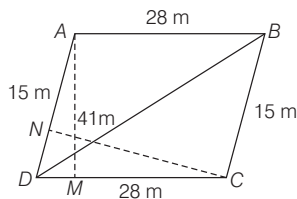
In $\triangle ABD$, $AB = 28$m, $AD = 15$m $BD = 41$m

∴ $S = \dfrac{a + b + c}{2} = \dfrac{28 + 15 + 41}{2} = \dfrac{84}{2}$

$S = 42$ m

Area of triangle = $\sqrt{s(s-a)(s-b)(s-c)}$

Now, area of $\triangle ABD$

$= \sqrt{42(42-15)(42-28)(42-41)}$
$= \sqrt{42 \times 27 \times 14 \times 1}$
$= 126$ m²

∴ Required area of parallelogram
= 2 × Area of $\triangle ABD$
= 2 × 126 = 252 m²

103. What is the shorter height of the parallelogram?
(a) 9.0 m (b) 7.5 m
(c) 5.5 m (d) 4.5 m

⊙ **(a)** From the above figure, shorter height of parallelogram = AM

∴ Area of parallelogram = Base × Height
= 252 [calculated in question 24]

⇒ $28 \times AM = 252$

⇒ $AM = \dfrac{252}{28} = 9$ m

Hence, shorter height of the parallelogram is 9 m.

104. Consider the following statements
1. The difference between the diagonals of the parallelogram is more than 20 m.
2. The difference between the heights of the parallelogram is more than 10 m.

Which of the above statement(s) is/are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ **(a)** 1. Let second diagonal be x.

We know that, in parallelogram,
$AC^2 + BD^2 = 2(DC^2 + BC^2)$
Then, $x^2 + 41^2 = 2(15^2 + 28^2)$
⇒ $x^2 = 337 = 18.36$ (approx.)
∴ Difference between the diagonals
= $41 - 18.36 = 22.64$
which is more than 20.
So, Statement 1 is correct.

2. ∵ Second height of parallelogram
∴ Base × Height = Area
⇒ $15 \times CN = 252$
⇒ $CN = \dfrac{252}{15} = 16.8$ m
∴ Difference between the heights
= $16.8 - 9 = 7.8$
which is not more than 10.
So, Statement 2 is not correct.

105. If the radius of a circle is increased by 6%, then its area will increase by
(a) 6% (b) 9%
(c) 12.36% (d) 16.64%

⊙ **(c)** Let the radius of circle = r

Then, area of a circle = πr^2

After increase, new radius
$= r + 6\%$ of r
$= r + \dfrac{6}{100}r = \dfrac{106}{100}r$

∴ New area $= \pi \left(\dfrac{106}{100}r\right)^2$

$= \pi \dfrac{11236}{10000}r^2$

Then, increament in area

$= \dfrac{\dfrac{11236}{10000}\pi r^2 - \pi r^2}{\pi r^2} \times 100\%$

$= \dfrac{11236 - 10000}{10000} \times 100\%$

$= \dfrac{1236}{10000} \times 100\%$

$= 0.1236 \times 100\% = 12.36\%$

Alternate Method
If radius of a circle is increased by 6% area of circle is increased

$= \left(2a + \dfrac{a^2}{100}\right)\%$

$= \left[2 \times 6 + \dfrac{6 \times 6}{100}\right]\%$ [∵ $a = 6\%$]

$= 12 + 0.36$
$= 12.36\%$

106. The sides of a triangle are in the ratio $\dfrac{1}{2} : \dfrac{1}{3} : \dfrac{1}{4}$. If its perimeter is 52 cm, then what is the length of the smallest side?
(a) 9 cm (b) 10 cm
(c) 11 cm (d) 12 cm

⊙ **(d)** Given, sides of a triangle are in the ratio

$= \dfrac{1}{2} : \dfrac{1}{3} : \dfrac{1}{4}$

i.e. 6 : 4 : 3

Let the sides of a triangle be $6x$, $4x$ and $3x$, respectively.

We know that,

Perimeter of a triangle = Sum of all sides of a triangle

⇒ $52 = 6x + 4x + 3x$

⇒ $52 = 13x$

∴ $x = \dfrac{52}{13} = 4$

∴ Smallest side of a triangle = $3x$

= 3 × 4

= 12 cm

107. If every side of an equilateral triangle is doubled, then the area of new triangle becomes times the area of the old one. What is k equal to?
(a) $\sqrt{3}$ (b) 2
(c) 4 (d) 8

⊙ **(c)** Let the sides of an old triangle be a, then area of an old equilateral triangle,

$A_{old} = \dfrac{\sqrt{3}}{4}a^2$

Again, let the sides of a new triangle be $2a$, then area of a new equilateral

triangle, $A_{new} = \dfrac{\sqrt{3}}{4}(2a)^2$

$= \dfrac{\sqrt{3}}{4} \times 4a^2$

According to the given condition,

$A_{new} = kA_{old}$

⇒ $\dfrac{\sqrt{3}}{4} \times 4a^2 = k \times \dfrac{\sqrt{3}}{4}a^2$

∴ $k = 4$

2014 (I)

108. How many circular plates of diameter d be taken out of a square plate of side $2d$ with minimum loss of material?

(a) 8   (b) 6   (c) 4   (d) 2

⊙ *(c)* From the figure, it is clear that, 4 circular plates of diameter d can be made of a square plate of side $2d$ with minimum loss of material.
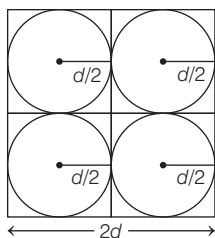
109. What is the total area of three equilateral triangles inscribed in a semi-circle of radius 2 cm?

(a) 12 cm^2 (b) $\dfrac{3\sqrt{3}}{4}$ cm^2

(c) $\dfrac{9\sqrt{3}}{4}$ cm^2 (d) $3\sqrt{3}$ cm^2

⊙ *(d)* Since, ΔAOB, ΔBOC and ΔCOD are equilateral.

∴   Side = 2 cm
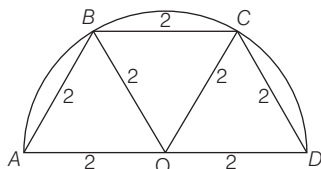
Now, total area = $3 \times \dfrac{\sqrt{3}}{4}$ (side)^2

$$= 3 \times \dfrac{\sqrt{3}}{4} \times 4 = 3\sqrt{3}\ \text{cm}^2$$

110. The area of a sector of a circle of radius 36 cm is 72π cm^2. The length of the corresponding arc of the sector is

(a) π cm   (b) 2π cm
(c) 3π cm   (d) 4π cm

⊙ *(d)* Area of sector = 72π cm^2
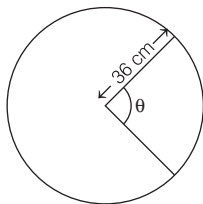
$$\Rightarrow \quad \dfrac{\pi r^2 \theta}{360°} = 72\pi$$

$$\therefore \quad \theta = \dfrac{72 \times 360}{36 \times 36} = 20°$$

Now, length of arc = $\dfrac{\pi r \theta}{180°}$

$$= \dfrac{\pi \times 36 \times 20}{180} = 4\pi\ \text{cm}$$

111. A square is inscribed in a circle of diameter $2a$ and another square is circumscribing circle. The difference between the areas of outer and inner squares is

(a) a^2 (b) $2a^2$ (c) $3a^2$ (d) $4a^2$

⊙ *(b)* For inscribed circle,

Diameter of circle = Diagonal of square
Since, sides of square are equal.
Now, in ΔABC by Pythagoras theorem,

$$AB^2 + BC^2 = AC^2$$
$$\Rightarrow \quad 2AB^2 = 4a^2$$
$$AB^2 = 2a^2$$
$$\Rightarrow \quad AB = \sqrt{2}a$$

∴ Area of inner square

$$= AB^2 = (\sqrt{2}a)^2 = 2a^2$$
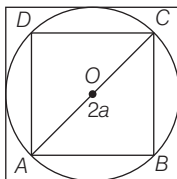
For circumscribed square,
Diameter of circle = Side of square
∴ Area of circumscribed square

$$= (2a)^2 = 4a^2$$

∴ Difference between areas of outer and inner squares = $4a^2 - 2a^2 = 2a^2$

112. ABC is a triangle right angled at A. $AB = 6$ cm and $AC = 8$ cm. Semi-circles drawn (outside the triangle) on AB, AC and BC as diameters which enclose areas x, y, z square units, respectively. What is $x + y - z$ equal to?

(a) 48 cm^2 (b) 32 cm^2
(c) 0   (d) None of these

⊙ *(c)* In ΔABC, by Pythagoras theorem,
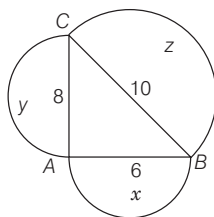
$$BC^2 = AB^2 + AC^2$$
$$= 6^2 + 8^2$$
$$= 36 + 64$$
$$= \sqrt{100}\ \text{cm}$$
$$\Rightarrow \quad BC = 10\ \text{cm}$$

Now, area of semi-circle

$$= x = \dfrac{\pi(3)^2}{2} = \dfrac{9\pi}{2}\ \text{cm}^2$$

Area of semi-circle = $y = \dfrac{\pi(4)^2}{2}$

$$= \dfrac{16\pi}{2}\ \text{cm}^2$$

Area of semi-circle = $z = \dfrac{\pi(5)^2}{2}$

$$= \dfrac{25\pi}{2}\ \text{cm}^2$$

Now, value of

$$x + y - z = \left(\dfrac{9\pi}{2} + \dfrac{16\pi}{2}\right) - \dfrac{25\pi}{2}$$
$$= 0$$

113. Consider an equilateral triangle of a side of unit length. A new equilateral triangle is formed by joining the mid-points of one, then a third equilateral triangle is formed by joining the mid-points of second. The process is continued. The perimeter of all triangles, thus formed is

(a) 2 units   (b) 3 units
(c) 6 units   (d) Infinity

⊙ *(c)* Perimeters of triangles
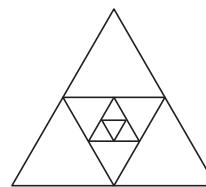
Perimeter of all triangles

$$= 3 + 3 \times \dfrac{1}{2} + 3 \times \dfrac{1}{4} + 3 \times \dfrac{1}{8} + \dots$$
$$= 3 + 3\left[\dfrac{1}{2} + \dfrac{1}{4} + \dfrac{1}{8}\dots\right]$$

Now, $\dfrac{1}{2} + \dfrac{1}{4} + \dfrac{1}{8}\dots$ is a infinite series in GP

$$\therefore \dfrac{1}{2} + \dfrac{1}{4} + \dfrac{1}{8} + \dots = \dfrac{\dfrac{1}{2}}{1 - \dfrac{1}{2}} \quad \left[\because S_\infty = \dfrac{a}{1-r}\right]$$

$$= \dfrac{\dfrac{1}{2}}{\dfrac{1}{2}} = 1$$

∴ Perimeter of all triangles

$$= 3 + 3[1] = 6\ \text{units}$$

114. What is the area of the major segment of a circle formed by a chord of length 5 cm subtending an angle of 90° at the centre?

(a) $\dfrac{25}{4}\left(\dfrac{\pi}{2}+1\right)\text{cm}^2$

(b) $\dfrac{25}{4}\left(\dfrac{\pi}{2}-1\right)\text{cm}^2$

(c) $\dfrac{25}{4}\left(\dfrac{3\pi}{2}+1\right)\text{cm}^2$

(d) None of the above

⊗ *(c)* In ΔAOB,

$$AO = OB = r \quad \text{[radius of circle]}$$
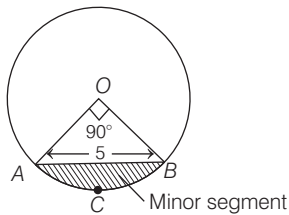
Minor segment

Using Pythagoras theorem,

$$AB^2 = OA^2 + OB^2$$
$$\Rightarrow \qquad (5)^2 = r^2 + r^2$$
$$\therefore \qquad r^2 = \dfrac{25}{2}\,\text{cm}$$

Now, area of sector AOB

$$= \dfrac{\theta}{360°}\times \pi r^2 = \dfrac{90°}{360°}\times \pi \times \dfrac{25}{2}$$
$$= \dfrac{25\pi}{8}\,\text{cm}^2$$

Now, area of minor segment
= Area of sector − Area of triangle

$$= \dfrac{25\pi}{8} - \dfrac{r^2}{2}$$
$$= \dfrac{25\pi}{8} - \dfrac{25}{4} = \left(\dfrac{25\pi - 50}{8}\right)$$

Area of major segment
= Area of circle
  − Area of minor segment

$$= \pi r^2 - \left(\dfrac{25\pi - 50}{8}\right)$$
$$= \dfrac{25\pi}{2} - \dfrac{(25\pi - 50)}{8}$$
$$= \dfrac{100\pi - 25\pi + 50}{8}$$
$$= \dfrac{75\pi + 50}{8} = \dfrac{25}{8}(3\pi + 2)$$
$$= \dfrac{25}{4}\left(\dfrac{3\pi}{2}+1\right)\text{cm}^2$$

115. A rectangle of maximum area is drawn inside a circle of diameter 5 cm. What is the maximum area of such a rectangle?

(a) 25 cm^2
(b) 12.5 cm^2
(c) 12cm^2
(d) None of the above

⊗ *(b)* Let $ABCD$ be the rectangle inscribed in the circle of diameter $DB = 5$ cm
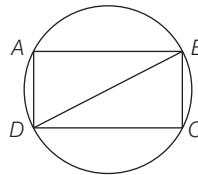
For maximum area of rectangle, we know that, length = breadth = a

Then, $(BC)^2 + (DC)^2 = (DB)^2$
$$\Rightarrow \qquad a^2 + a^2 = (5)^2$$
$$\Rightarrow \qquad 2a^2 = 25$$
$$\therefore \qquad a = \dfrac{5}{\sqrt{2}}$$

Area of rectangle = Length × breadth

$$= \dfrac{5}{\sqrt{2}}\times\dfrac{5}{\sqrt{2}} = \dfrac{25}{2} = 12.5\,\text{cm}^2$$

116. If AB and CD are two diameters of a circle of radius r and they are mutually perpendicular, then what is the ratio of the area of the circle to the area of the ΔACD ?

(a) $\dfrac{\pi}{2}$ 　(b) π 　(c) $\dfrac{\pi}{4}$ 　(d) 2π
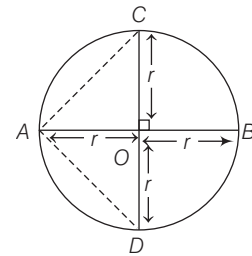
⊗ *(b)* Required ratio = $\dfrac{\text{Area of circle}}{\text{Area of } \Delta ACD}$

$$= \dfrac{\pi r^2}{\dfrac{1}{2}\times 2r \times r} = \pi$$

21

VOLUME AND SURFACE AREA

1. A hollow right circular cylindrical vessel of volume V whose diameter is equal to its height, is completely filled with water. A heavy sphere of maximum possible volume is then completely immersed in the vessel. What volume of water remains in the vessel?

(a) $\dfrac{V}{2}$ (b) $\dfrac{V}{3}$

(c) $\dfrac{2V}{3}$ (d) $\dfrac{V}{4}$

⟩ **(b)** Let the radius of cylinder $= r$

Height of cylinder $(h) = 2r$

Maximum possible sphere can be immersed of radius r.

Volume of cylinder $(V) = \pi r^2 h$

$\qquad = \pi r^2 (2r) = 2\pi r^3$

Volume of sphere $= \dfrac{4}{3}\pi r^3$

After immersing sphere in the cylinder the remain water

$\qquad = 2\pi r^3 - \dfrac{4}{3}\pi r^3$

$\qquad = \dfrac{6\pi r^3 - 4\pi r^3}{3} = \dfrac{2\pi r^3}{3}$

Volume of cylinder $(V) = 2\pi r^3$

$\therefore$ Remaining volume $= \dfrac{V}{3}$.

2. The areas of three adjacent faces of a cuboid are x, y and z. If V is the volume of the cuboid, then which one of the following is correct?

(a) $V = xyz$ (b) $V^2 = xyz$
(c) $V^3 = xyz$ (d) $V = (xyz)^2$

⟩ **(b)** Area of three faces of cuboid are x, y and z. Let l, b and h be the length, breadth and height of cuboid.

According to the question,

$\qquad x = l \times b$

$\qquad y = b \times h$

$\qquad z = h \times l$

$\qquad xyz = l \times b \times b \times h \times h \times l$

$\qquad\quad = l^2\,b^2\,h^2 = (lbh)^2$

$\therefore\ xyz = V^2 \qquad (\because V = l \times b \times h)$

3. Two cylinders of equal volume have their heights in the ratio $2 : 3$. What is the ratio of their radii?

(a) $\sqrt{3} : 1$ (b) $\sqrt{3} : \sqrt{2}$
(c) $2 : \sqrt{3}$ (d) $\sqrt{3} : 2$

⟩ **(b)** Let radius of the cylinders be r_1 and r_2 and their heights be $2x$ and $3x$, respectively.

According to the question,

$\qquad \pi\,r_1^2 \times 2x = \pi r_2^2 \times 3x$

$\qquad\qquad\qquad [\because \text{Volume} = \pi r^2 h]$

$\Rightarrow \qquad \dfrac{r_1^2}{r_2^2} = \dfrac{3}{2}$

$\Rightarrow \qquad \dfrac{r_1}{r_2} = \dfrac{\sqrt{3}}{\sqrt{2}}$

$\therefore \qquad r_1 : r_2 = \sqrt{3} : \sqrt{2}$

4. A right circular cylinder has a diameter of 20 cm and its curved surface area is 1000 cm^2. What is the volume of the cylinder?

(a) 4000 cm^3 (b) 4500 cm^3
(c) 5000 cm^3 (d) 5200 cm^3

⟩ **(c)** Radius of circle $= \dfrac{\text{Diameter}}{2}$

$\qquad = \dfrac{20}{2} = 10$ cm

Curved surface area $= 1000$ cm^2

$\qquad 2\,\pi rh = 1000$ cm^2

$\qquad\qquad (\because h = \text{height of cylinder})$

$\Rightarrow \qquad \pi rh = 500$ cm^2

Volume of cylinder $= \pi r^2 h$

$\qquad = \pi rh \times r$

$\qquad = 500 \times 10 = 5000$ cm^3

5. A hollow sphere of external and internal diameters 6 cm and 4 cm, respectively is melted into a cone of base diameter 8 cm. What is the height of the cone?

(a) 4.75 cm (b) 5.50 cm
(c) 6.25 cm (d) 6.75 cm

⟩ **(a)** The external radius of hollow sphere

$\qquad (r_1) = \dfrac{\text{Diameter}}{2} = \dfrac{6}{2} = 3$ cm

The internal radius of hollow sphere

$\qquad r_2 = \dfrac{4}{2} = 2$ cm

Volume of hollow sphere $= \dfrac{4}{3}\pi(r_1^3 - r_2^3)$

$\qquad = \dfrac{4}{3}\pi(3^3 - 2^3) = \dfrac{19}{3} \times 4\pi$

According to the question, volume of hollow sphere = Volume of cone

$\qquad \dfrac{19}{3} \times 4\pi = \dfrac{1}{3}\pi(4)^2 \times h$

(h = height of cone, radius of cone = 4 cm)

$\therefore \qquad h = \dfrac{19}{4} = 4.75$ cm

6. A solid metallic cylinder of height 10 cm and radius 6 cm is melted to make two cones in the ratio of volume $1 : 2$ and of same height as 10 cm. What is the percentage increase in the flat surface area?

(a) 25% (b) 50%
(c) 75% (d) 100%

⊘ *(b)* Radius of cylinder $(r) = 6$ cm
Height of cylinder $(h) = 10$ cm
Let volume of cone be v_1 and v_2.
Ratio of volume of two cones
$$v_1 : v_2 \text{ is } 1 : 2$$
If v_1 is x, v_2 will be $2x$.
Hence, volume of cylinder
$$= v_1 + v_2 = 3x$$
Volume of cylinder $= \pi r^2 h$
$$= \frac{22}{7} \times 6 \times 6 \times 10$$
$$= \frac{7920}{7} \text{ cm}^3$$

Surface area of flat surface of cylinder
$$= 2\pi r^2 = 2 \times 6 \times 6 \times \pi = 72\pi$$
Now, this cylinder is recast into 2 cones in the ratio 1 : 2.
So, volume of cone $(v_1) = $ volume of cylinder $\times \dfrac{x}{x + 2x} = \dfrac{x}{3x} \times \dfrac{7920}{7}$
$$= \frac{2640}{7} \text{ cm}^3$$
Volume of cone $(V_2) = \dfrac{2x}{3x} \times \dfrac{7920}{7}$
$$= \frac{5280}{7} \text{ cm}^3$$

Let the radii of the 2 cones be R_1 and R_2, respectively.
The height of both cones is 10 cm.
$$\pi R_1^2 h = \frac{2640}{7} \text{ and } \pi R_2^2 h = \frac{5280}{7}$$
$$\pi R_1^2 = \frac{264}{7} \text{ and } \pi R_2^2 = \frac{528}{7}$$
$$[\because h = 10]$$
$$R_1^2 = \frac{84}{7} \text{ and } R_2^2 = \frac{168}{7}$$
$$\pi R_1^2 = 12\pi \text{ and } \pi R_2^2 = 24\pi$$
Combined surface area of flat surface of both cones
$$= 12\pi + 24\pi = 36\pi.$$
Change in flat surface area
$$= \frac{72\pi - 36\pi}{72\pi} \times 100$$
$$= \frac{36\pi}{72\pi} \times 100 = 50\%$$

7. A thin rod of length 24 feet is cut into rods of equal size and joined, so as to form a skeleton cube. What is the area of one of the faces of the largest cube thus constructed?
(a) 25 sq feet   (b) 24 sq feet
(c) 9 sq feet   (d) 4 sq feet

⊘ *(d)* Length of rod $= 24$ feet
Let the side of cube $= x$ feet
Cube consist 12 edges,
so, $12x = 24$ feet
$$x = 2 \text{ feet}$$

Edge of the largest cube that can be constructed of 24 feet rod is 2 feet.
Now, the area of one of the face
$= 2 \times 2 = 4$ sq feet.

8. Three copper spheres of radii 3 cm, 4 cm and 5 cm are melted to form a large sphere. What is its radius?
(a) 12 cm (b) 10 cm (c) 8 cm   (d) 6 cm

⊘ *(d)* Sphere of radii 3 cm, 4 cm and 5 cm are melted to form a large sphere of radius r.
According to the question,
$$\frac{4}{3}\pi 3^3 + \frac{4}{3}\pi 4^3 + \frac{4}{3}\pi 5^3 = \frac{4}{3}\pi r^3$$
$$\Rightarrow \qquad 3^3 + 4^3 + 5^3 = r^3$$
$$\Rightarrow \qquad 27 + 64 + 125 = r^3$$
$$\Rightarrow \qquad r^3 = 216$$
$$\Rightarrow \qquad r = 6 \text{ cm}$$

9. The volume of a hemisphere is 155232 cm^3. What is the radius of the hemisphere?
(a) 40 cm   (b) 42 cm
(c) 38 cm   (d) 36 cm

⊘ *(b)* Let the radius of hemisphere be 'r' cm.
According to the question,
$$\frac{2}{3}\pi r^3 = 155232$$
$$\Rightarrow \quad \frac{2}{3} \times \frac{22}{7} \times r^3 = 155232$$
$$\Rightarrow r^3 = 74088 \Rightarrow r = 42 \text{ cm}$$

10. A bucket is in the form of a truncated cone. The diameters of the base and top of the bucket are 6 cm and 12 cm, respectively. If the height of the bucket is 7 cm, what is the capacity of the bucket?
(a) 535 cm^3 (b) 462 cm^3
(c) 234 cm^3 (d) 166 cm^3

⊘ *(b)* Given,
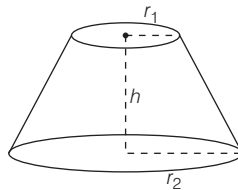
Here, $r_1 = 3$ cm, $r_2 = 6$ cm, $h = 7$ cm
Volume of bucket $= \dfrac{1}{3}\pi h(r_1^2 + r_2^2 + r_1 r_2)$
$$= \frac{1}{3} \times \frac{22}{7} \times 7(3^2 + 6^2 + 3 \times 6)$$
$$= \frac{1}{3} \times \frac{22}{7} \times 7 \times 63$$
$$= 22 \times 21 = 462 \text{ cm}^3$$

11. A right circular cone has height 8 cm. If the radius of its base is 6 cm, then what is its total surface area?
(a) 96π cm^2 (b) 69π cm^2
(c) 54π cm^2 (d) 48π cm^2

⊘ *(a)* Given,
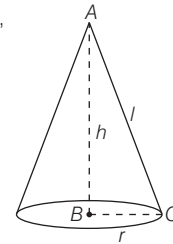
Here, $r = 6$ cm, $h = 8$ cm
ΔABC is right angled triangle,
Using Pythagoras theorem,
$$r^2 + h^2 = l^2$$
$$6^2 + 8^2 = l^2$$
$$36 + 64 = l^2$$
$$l^2 = 100 = 10$$
According to the question,
Total surface area $= \pi r^2 + \pi r l$
$$= \pi r(r + l)$$
$$= \pi \times 6(6 + 10)$$
$$= \pi \times 6 \times 16$$
$$= 96\pi \text{ cm}^2$$

12. Six cubes, each with 12 cm edge are joined end to end. What is the surface area of resulting cuboid?
(a) 3000 cm^2 (b) 3600 cm^2
(c) 3744 cm^2 (d) 3777 cm^2

⊘ *(c)* When six cubes are joined end to end, then resulting solid is a cuboid.
Length $(l) = 6 \times 12 = 72$ cm
Breadth $(b) = 12$ cm
Height $(h) = 12$ cm
Surface area of cuboid
$$= 2(lb + bh + lh)$$
$$= 2(72 \times 12 + 12 \times 12 + 12 \times 72)$$
$$= 2 \times 1872 \text{ cm}^2 = 3744 \text{ cm}^2$$

2019 (I)

13. The volume of a spherical balloon is increased by 700%. What is the percentage increase in its surface area?
(a) 300% (b) 400% (c) 450% (d) 500%

⊘ *(a)* Let the radius of spherical balloon $= r$
Volume of sphere $= \dfrac{4}{3}\pi r^3$

Surface area of balloon $= 4\pi r^2$

According to question,

Volume of balloon is increased by 700%

$\therefore$ New Volume $= \dfrac{4}{3}\pi r^3 \times \dfrac{800}{100}$

$\qquad\qquad = \dfrac{4}{3}\pi(2r)^3$

$\therefore$ New radius $= 2r$

$\therefore$ New surface area $= 4\pi(2r)^2$

$\qquad\qquad\qquad = 4\pi \times 4r^2 = 16\pi r^2$

$\therefore$ Required percentage increases

$\qquad = \dfrac{16\pi r^2 - 4\pi r^2}{4\pi r^2} \times 100$

$\qquad = \dfrac{12}{4} \times 100$

$\qquad = 300\%$

Directions (Q. Nos. 14-16) *Read the given information carefully and answer the given questions below.*

A cube is inscribed in a sphere. A right circular cylinder is with in the cube touching all the vertical faces. A right circular cone is inside the cylinder. Their heights are same and the diameter of the cone is equal to that of the cylinder.

14. What is the ratio of the volume of the sphere to that of the cone?

(a) $6\sqrt{3} : 1$ (b) $7 : 2$
(c) $3\sqrt{3} : 1$ (d) $5\sqrt{3} : 1$

⊙ *(a)*

Fig. (i)   Fig. (ii)
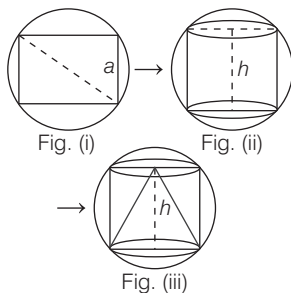
Fig. (iii)

Radius of sphere $= R$

Then, $2 \times$ (Radius of sphere)

$\qquad\qquad\qquad$ = Diagonal of cube

$\qquad 2 \times R = \sqrt{3}a$ $[a$ = side of cube]

$\qquad\qquad a = \dfrac{2R}{\sqrt{3}}$

Height of cylinder (h) = Side of cube

$\qquad\qquad\qquad\qquad\qquad$ [fig. (ii)]

$\qquad\qquad h = \dfrac{2R}{\sqrt{3}}$

Radius of cylinder $= \dfrac{1}{2} \times$ Side of cube

$\qquad r = \dfrac{1}{2} \times \dfrac{2R}{\sqrt{3}} = \dfrac{R}{\sqrt{3}}$

Radius of cone = Radius of cylinder

$\qquad\qquad r = \dfrac{R}{\sqrt{3}}$

Height of cone (h) = Height of cylinder

$\qquad\qquad h = \dfrac{2R}{\sqrt{3}}$

Volume of sphere : Volume of cone

$\qquad = \dfrac{4}{3}\pi R^3 : \dfrac{1}{3}\pi \dfrac{R^2}{3} \times \dfrac{2R}{\sqrt{3}}$

$\qquad = 6\sqrt{3} : 1$

$\because$ Volume of sphere $V = \dfrac{4}{3}\pi r^3$,

Volume of curve $= \dfrac{1}{3}\pi r^2 h$

Option (a) is correct.

15. What is the ratio of the volume of the cube to that of the cylinder?

(a) $4 : 3$ (b) $21 : 16$
(c) $14 : 11$ (d) $45 : 32$

⊙ *(c)* Volume of cube : Volume of cylinder

$\qquad = \left(\dfrac{2R}{\sqrt{3}}\right)^3 : \pi\left(\dfrac{R}{\sqrt{3}}\right)^2 \dfrac{2R}{\sqrt{3}}$

$\qquad = a^3 : \pi r^2 h$

$\qquad = \dfrac{8R^3}{3\sqrt{3}} : \dfrac{22}{7} \times \dfrac{2R^3}{3\sqrt{3}}$

$\qquad = 14 : 11$

Option (c) is correct.

16. Consider the following statements :

1. The surface area of the sphere is $\sqrt{5}$ times the curved surface area of the cone.
2. The surface area of the cube is equal to the curved surface area of the cylinder.

Which of the above statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ *(d)* (1) Surface area of the sphere is $\sqrt{5}$ times of the curved surface area of cone.

Surface area of the sphere : Curved surface area of cone

$\qquad = 4\pi R^2 : \pi r l$ $[\because l = \sqrt{r^2 + h^2}]$

$l = \sqrt{\left(\dfrac{R}{\sqrt{3}}\right)^2 + \left(\dfrac{2R}{\sqrt{3}}\right)^2}$

$\qquad\qquad \left[l = \sqrt{\dfrac{5R^2}{3}} = \dfrac{\sqrt{5}}{\sqrt{3}}R\right]$

$\qquad = 4\pi R^2 : \pi \dfrac{R}{\sqrt{3}} \times \dfrac{\sqrt{5}}{\sqrt{3}} R$

$\qquad = 12 : \sqrt{5}$

Surface area of sphere is not $\sqrt{5}$ times of the curved surface area.

(2) Surface area of the cube $= 6 \times a^2$

$\qquad = 6 \times \dfrac{2R}{\sqrt{3}} \times \dfrac{2R}{\sqrt{3}} = 8R^2$

Curved surface area of the cylinder

$\qquad = 2\pi r h$

$\qquad = 2 \times \dfrac{22}{7} \times \dfrac{R}{\sqrt{3}} \times \dfrac{2R}{\sqrt{3}}$

$\qquad = \dfrac{44R^2}{21}$

The surface area of the cube is not equal to curved surface area of the cylinder.

Then, option (d) is correct.

Directions (Q. Nos. 17 and 18) *Read the given information carefully and answer the given question below.*

The sum of length, breadth and height of a cuboid is 22 cm and the length of its diagonal is 14 cm.

17. What is the surface area of the cuboid?

(a) 288 cm^2
(b) 216 cm^2
(c) 144 cm^2
(d) Cannot be determined due to insufficient data

⊙ *(a)*   Length of cuboid $= l$

Breadth of cuboid $= b$

Height of cuboid $= h$

$\qquad l + b + h = 22$ cm   …(i)

Length of diagonal is $= 14$ cm

$\qquad \sqrt{l^2 + b^2 + h^2} = 14$

$\qquad l^2 + b^2 + h^2 = (14)^2$

$\qquad\qquad\qquad = 196$ cm   …(ii)

Surface area of cuboid

$\qquad = 2(lb + bh + hl)$

Taking square of Eq. (i),

$\qquad (l + b + h)^2 = l^2 + b^2 + h^2$
$\qquad\qquad\qquad\qquad\qquad + 2(lb + bh + hl)$

$(22)^2 = 196 + 2(lb + bh + hl)$
$\qquad\qquad 484 - 196 = 2(lb + bh + hl)$

$2(lb + bh + hl) = 288$ cm^2

Option (a) is correct.

18. If S is the sum of the cubes of the dimensions of the cuboid and V is its volume, then what is $(S - 3V)$ equal to?

(a) 572 cm^3 (b) 728 cm^3
(c) 1144 cm^3 (d) None of these

⊙ *(c)* S is the sum of the cube of the dimensions of the cuboid.

$\qquad S = l^3 + b^3 + h^3$

$\qquad V = lbh$

$\therefore (S - 3V) = l^3 + b^3 + h^3 - 3lbh$
$[\because (a^3 + b^3 + c^3 - 3abc$
$= (a + b + c)(a^2 + b^2 + c^2)$
$- (ab + bc + ca)]$
$= (l + b + h)[l^2 + b^2 + h^2$
$- (lb + bh + hl)]$
$= 22[196 - 144] = 22 \times 52$
$\begin{bmatrix} \because 2(lb + bh + hl) = 288 \\ lb + bh + hl = 144 \end{bmatrix}$
$= 1144 \text{ cm}^3$

Option (c) is correct.

2018 (II)

19. Walls (excluding roofs and floors) of 5 identical rooms having length, breadth and height 6 m, 4 m and 2.5 m respectively are to be painted. Out of five rooms, two rooms have one square window each having a side of 2.5 m. Paints are available only in cans of 1 L; and 1 L of paint can be used for painting 20 m². The number of cans required for painting is

(a) 10   (b) 12
(c) 13   (d) 14

⊚ **(b)** Length (*l*), breadth (*b*), and height (*h*) of walls are 6m, 4m and 2.5 m respectively

$\therefore$ Area of 4 walls $= 2h(l + b)$
$= 2 \times 2.5(6 + 4)$
$= 50 \text{ m}^2$

Area of 4 walls of 5 rooms
$= 5 \times 50 = 250 \text{ m}^2$

Area of windows $= (2.5)^2 = 6.25 \text{ m}^2$

Area of two windows $= 2 \times 6.25$
$= 12.50 \text{ m}^2$

Total area required for painting
$= 250 - 12.50 \text{ m}^2$
$= 237.50$

Now, one cans paints $= 20 \text{ m}^2$

$\therefore$ Number of cans required for painting
$= \dfrac{237.50}{20} = 11.875$
$= 12 \text{ cans}$

20. The lateral surface area of a cone is 462 cm². Its slant height is 35 cm. The radius of the base of the cone is

(a) 8.4 cm   (b) 6.5 cm
(c) 4.2 cm   (d) 3.2 cm

⊚ **(c)** Lateral surface area of cone $= \pi rl$
$\therefore \quad 462 = \pi r(35) \qquad [\because l = 35]$

$\Rightarrow \qquad r = \dfrac{462}{\pi \times 35}$
$\therefore \qquad r = \dfrac{462 \times 7}{22 \times 35} = 4.2 \text{ cm}$

21. A semi-circular plate is rolled up to form a conical surface. The angle between the generator and the axis of the cone is

(a) 60°   (b) 45°   (c) 30°   (d) 15°

⊚ **(c)** Clearly, the radius of semi-circle
$= $ slant height of cone $= r$

And the circumference of semi-circle
$= $ Circumference of the base of cone
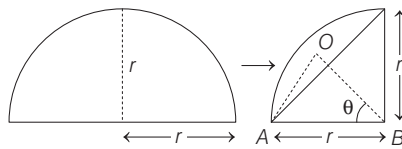
$\Rightarrow \qquad \pi r = 2\pi R \Rightarrow R = \dfrac{r}{2}$

Now, In $\triangle AOB$, we have

$\therefore \qquad \sin\theta = \dfrac{\frac{r}{2}}{r} = \dfrac{1}{2}$
$\Rightarrow \qquad \theta = 30°$

22. A solid right cylinder is of height π cm. If its lateral surface area is half its total surface area, then the radius of its base is

(a) $\pi / 2$ cm   (b) π cm
(c) $1/\pi$ cm   (d) $2/\pi$ cm

⊚ **(b)** Height of cylinder $= \pi$ cm
Lateral surface area
$= \dfrac{1}{2}$ total surface area

$\therefore \qquad 2\pi rh = \dfrac{1}{2}(2\pi r^2 + 2\pi rh)$
$\Rightarrow \qquad 2\pi rh = \dfrac{1}{2}2\pi r(r + h)$
$\Rightarrow \qquad 2h = r + h \Rightarrow r = h$
$\therefore \qquad r = \pi$ cm

23. A rectangular block of length 20 cm, breadth 15 cm and height 10 cm is cut up into exact number of equal cubes. The least possible number of cubes will be

(a) 12   (b) 16
(c) 20   (d) 24

⊚ **(d)** Volume of rectangular block
$= 20 \times 15 \times 10 = 3000 \text{ cm}^3$
Let n is the number of cube formed
H.C.F of 20, 10 and 15 = 5
Side of cube is 5 cm possible
$\therefore \qquad n = \dfrac{20 \times 15 \times 10}{5 \times 5 \times 5} = 24$

24. If the diagonal of a cube is of length *l*, then the total surface area of the cube is

(a) $3l^2$ (b) $\sqrt{3}l^2$ (c) $\sqrt{2}l^2$ (d) $2l^2$

⊚ **(d)** Diagonal of cube
$= \sqrt{3} \times $ side of cube
$\therefore \qquad l = \sqrt{3} \times $ side of cube
Side of cube $= \dfrac{l}{\sqrt{3}}$
Surface area of cube $= 6(\text{side})^2$
$= 6 \times \left(\dfrac{l}{\sqrt{3}}\right)^2$
$= \dfrac{6l^2}{3} = 2l^2$

25. Two cones have their heights in the ratio 1 : 3. If the radii of their bases are in the ratio 3 : 1, then the ratio of their volumes will be

(a) 1 : 1   (b) 2 : 1
(c) 3 : 1   (d) 9 : 1

⊚ **(c)** Let the height of cones be *h* and 3*h* and their radii of bases be 3*r* and *r*.

$\therefore$ Volumes of cones are $\dfrac{1}{3}\pi(3r)^2(h)$

and $\qquad \dfrac{1}{3}\pi(r^2)(3h)$

$\therefore$ Ratio of volumes will be
$= \dfrac{\frac{1}{3}\pi \, 9r^2 h}{1/3 \, \pi r^2 3h} = \dfrac{3}{1} = 3 : 1$

2018 (I)

26. The radius and slant height of a right circular cone are 5 cm and 13 cm respectively. What is the volume of the cone?

(a) 100π cm³   (b) 50π cm³
(c) 65π cm³   (d) 169π cm³

⊚ **(a)** Radius of cone $= 5$ cm $= r$
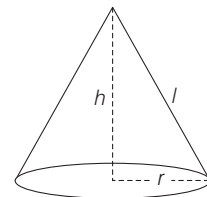
Slant height of cone $= 13$ cm $= l$
$\because$ Height of cone $= h = \sqrt{l^2 - r^2}$
$= \sqrt{13^2 - 5^2}$
$= \sqrt{144}$
$= 12$ cm

Now, volume of cone $= \frac{1}{3}\pi r^2 h$

$$= \frac{1}{3}\times\pi\times(5)^2\times(12)$$

$$= 100\pi \text{ cm}^3$$

27. A right circular cone is sliced into a smaller cone and a frustum of a cone by a plane perpendicular to its axis. The volume of the smaller cone and the frustum of the cone are in the ratio $64 : 61$. Then, their curved surface areas are in the ratio

(a) 4 : 1   (b) 16 : 9
(c) 64 : 61   (d) 81 : 64

⊙ *(b)* According to the question,
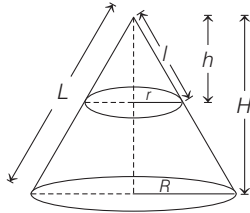
Ratio of volume of smaller cone and frustum is 64 : 61.

∴ $\dfrac{\text{Volume of smaller cone}}{\text{Volume of bigger cone}} = \dfrac{64}{61 + 64}$

$\Rightarrow \dfrac{\frac{1}{3}\pi r^2 h}{\frac{1}{3}\pi R^2 H} = \dfrac{64}{125} \Rightarrow \dfrac{r^2 h}{R^2 H} = \dfrac{64}{125}$

$\Rightarrow \left(\dfrac{r}{R}\right)^3 = \left(\dfrac{4}{5}\right)^3 \quad \left[\because \dfrac{r}{R} = \dfrac{h}{H} = \dfrac{l}{L}\right]$

∴ $\dfrac{r}{R} = \dfrac{4}{5}$

Now, $\dfrac{\text{Curved surface area of smaller cone}}{\text{Curved surface area of bigger cone}}$

$$= \dfrac{\pi rl}{\pi RL} = \dfrac{r^2}{R^2} = \dfrac{16}{25}$$

∴ Ratio of curved surface area of smaller cone and frustum

$$= \dfrac{16}{25 - 16} = \dfrac{16}{9} = 16 : 9$$

28. There are as many square centimetres in the surface area of a sphere as there are cubic centimetres in its volume. What is the radius of the sphere?

(a) 4 cm   (b) 3 cm   (c) 2 cm   (d) 1 cm

⊙ *(b)* Given, surface area of sphere
$$= \text{Volume of sphere}$$
Let r be the radius of sphere

∴ $4\pi r^2 = \dfrac{4}{3}\pi r^3$

∴ $r = 3 \text{ cm}$

29. The curved surface area of a right circular cone is 1.76 m^2 and its base diameter is 140 cm. What is the height of the cone?

(a) 10 cm   (b) $10\sqrt{2}$ cm
(c) $20\sqrt{2}$ cm   (d) $10\sqrt{15}$ cm

⊙ *(d)* Diameter = 140 cm
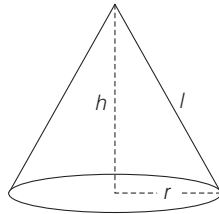
∴ Radius $= \dfrac{140}{2} = 70 \text{ cm} = r$

Let h be the height and be the slant height of the cone

∴ $\pi rl = 1.76 \text{ m}^2$
$$= 17600 \text{cm}^2$$

$\Rightarrow \dfrac{22}{7}\times 70 \times l = 17600$

∴ $l = 80 \text{ cm}$

Now, $h = \sqrt{l^2 - r^2}$

$$= \sqrt{80^2 - 70^2}$$

$$= \sqrt{1500}$$

Height of cone $= 10\sqrt{15}$ cm

30. A cube of maximum volume (each corner touching the surface from inside) is cut from a sphere. What is the ratio of the volume of the cube to that of the sphere?

(a) $3 : 4\pi$ (b) $\sqrt{3} : 2\pi$
(c) $2 : \sqrt{3}\pi$ (d) $4 : 3\pi$

⊙ *(c)* Let the edge of the cube be a cm

Then, radius of sphere $(r) = \dfrac{\sqrt{3}a}{2}$

$\dfrac{\text{Volume of cube}}{\text{Volume of sphere}} = \dfrac{a^3}{\dfrac{4}{3}\pi\left(\dfrac{\sqrt{3}a}{2}\right)^3}$

$$= \dfrac{8\times 3a^3}{4\pi\times 3\sqrt{3}a^3}$$

$$= \dfrac{2}{\sqrt{3}\pi} = 2 : \sqrt{3}\pi$$

31. If the ratio of the circumference of the base of a right circular cone of radius r to its height is $3 : 1$, then what is the area of the curved surface of the cone?

(a) $3\pi r^2$ (b) $\dfrac{2\pi r^2\sqrt{4\pi^2 + 9}}{3}$

(c) $\dfrac{\pi r^2\sqrt{\pi^2 + 1}}{3}$ (d) $\dfrac{\pi r^2\sqrt{4\pi^2 + 9}}{3}$

⊙ *(d)* Let the radius of cone be 'r' and height be 'h'

Circumference of base of cone $= 2\pi r$

According to the question,

$$\dfrac{2\pi r}{h} = \dfrac{3}{1}$$

$\Rightarrow \qquad h = \dfrac{2\pi r}{3}$

Now, slant height of cone 'l'

$$= \sqrt{r^2 + h^2}$$

$$= \sqrt{r^2 + \left(\dfrac{2\pi r}{3}\right)^2}$$

$$= \dfrac{r}{3}\sqrt{4\pi^2 + 9}$$

∴ Curved surface area of cone $= \pi rl$

$$= \pi r\times\dfrac{r\sqrt{4\pi^2 + 9}}{3}$$

$$= \dfrac{\pi r^2\sqrt{4\pi^2 + 9}}{3}$$

32. The surface area of a closed cylindrical box is 352 cm^2. If its height is 10 cm, then what is its diameter? (use $\pi = \dfrac{22}{7}$)

(a) 4 cm   (b) 8 cm
(c) 9.12 cm   (d) 19.26 cm

⊙ *(b)* Let 'r' be radius of base of cylindrical box.

Height of cylindrical box = 10 cm
Surface area of cylinder $= 2\pi r(h + r)$
$$= 352 \text{ cm}^2$$

∴ $2\times\dfrac{22}{7}\times r(10 + r) = 352$

$\Rightarrow \qquad (10 + r)r = 56$
$\Rightarrow \qquad r^2 + 10r - 56 = 0$
$\Rightarrow \quad r^2 + 14r - 4r - 56 = 0$
$\Rightarrow \quad r(r + 14) - 4(r + 14) = 0$
$\Rightarrow \qquad (r - 4)(r + 14) = 0$
∴ $\qquad r = 4 \text{ cm}$
Hence, diameter $= 2r = 8 \text{ cm}$

33. If the ratio of the radius of the base of a right circular cone to its slant height is $1 : 3$, what is the ratio of the total surface area to the curved surface area?

(a) 5 : 3   (b) 3 : 1
(c) 4 : 1   (d) 4 : 3

⊙ *(d)* Ratio of the radius of base and slant height of cone = 1 : 3
Let radius be x cm.
∴ Slant height $= 3x$ cm

Now, $\dfrac{\text{Total surface area}}{\text{Curved surface area}} = \dfrac{\pi r(1 + r)}{\pi rl}$

$$= \dfrac{l + r}{l} = \dfrac{3x + x}{3x} = 4 : 3$$

34. What is the volume of a cone of maximum volume cut out from a cube of edge $2a$ such that their bases are on the same plane?

(a) πa^3 (b) $\dfrac{\pi a^3}{3}$

(c) $\dfrac{2\pi a^3}{3}$ (d) $\dfrac{3\pi a^3}{4}$

◐ *(c)*
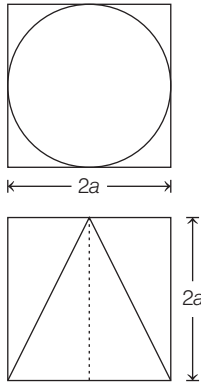
Radius of cone $= r = \dfrac{2a}{2} = a$

Height of cone $= h = 2a$

$\therefore$ Required volume of cone

$$= \dfrac{1}{3}\pi r^2 h = \dfrac{1}{3}\pi a^2 \times 2a$$

$$= \dfrac{2\pi a^3}{3}$$

2017 (II)

35. A hollow cube is formed by joining six identical squares. A rectangular cello tape of length 4 cm and breadth 0.5 cm is used for joining each pair of edges. What is the total area of cello tape used?

(a) 12 cm^2 (b) 24 cm^2
(c) 36 cm^2 (d) 48 cm^2

◐ *(b)* There are 12 edges in a cube
cello tape used for an edge is
$$= 4 \times 0.5 = 2\,\text{cm}^2$$
$\therefore$ Total area of cello tape used
$$= 12 \times 2 = 24\,\text{cm}^2$$

36. The cylinder of height $2x$ is the circumscribed by a sphere of radius $2x$ such that the circular ends of the cylinder are two small circles on the sphere. What is the ratio of the curved surface area of the cylinder to the surface area of the sphere?

(a) $\sqrt{3}:4$ (b) $\sqrt{3}:3$
(c) $\sqrt{3}:2$ (d) $\sqrt{3}:1$

◐ *(a)* We have, height of cylinder$= 2x$
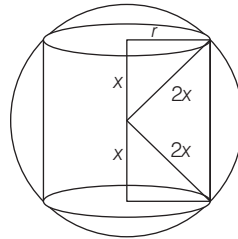
Radius of sphere $= 2x$
Let radius of cylinder $= r$
$$r^2 = (2x)^2 - x^2$$
$$r^2 = 3x^2$$
$$\Rightarrow \qquad r = \sqrt{3}x$$
Curved surface area of cylinder
$$= 2\pi r h = 2 \cdot \pi \cdot (\sqrt{3}x)(2x)$$
Surface area of sphere $= 4\pi r^2 = 4\pi(2x)^2$
$\therefore$ Ratio of curved surface area of cylinder to the surface area of sphere
$$= 4\pi\sqrt{3}x^2 : 16\pi x^2 = \sqrt{3} : 4$$

37. A cylindrical vessels 60 cm in diameter is partially filled with water. A sphere 30 cm in diameter is gently dropped into the vessel and is completely immersed. To what further height will the water in the cylinder rise?

(a) 20 cm (b) 15 cm (c) 10 cm (d) 5 cm

◐ *(d)* Let h be the height of water in cylinder rise.
$\therefore$ Volume of water in cylinder
$$= \text{Volume of sphere}$$
$$\Rightarrow \qquad \pi r^2 h = \dfrac{4}{3}\pi R^3$$
$$\Rightarrow \qquad (30)^2 \times h = \dfrac{4}{3}(15)^3$$
$$[\because r = 30\,\text{cm}, R = 15\,\text{cm}]$$
$$\Rightarrow \qquad h = \dfrac{4 \times 15 \times 15 \times 15}{3 \times 30 \times 30}$$
$$\therefore \qquad h = 5\,\text{cm}$$

38. The vertical angle of a right circular cone is $\dfrac{\pi}{2}$ and the slant height is $\sqrt{2}\,r$ cm. Where 'r' is the radius of cone What is the volume of the cone in cubic cm?

(a) πr^3 (b) $9\pi r^3$ (c) $\dfrac{\pi r^3}{3}$ (d) $3\pi r^3$

◐ *(c)* We have,

vertical angle of cone $= \dfrac{\pi}{2}$
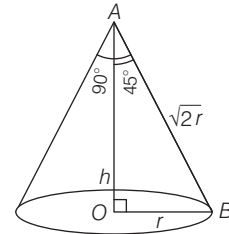
Slant height $= \sqrt{2}r$

In $\triangle OAB$
$$\cos 45° = \dfrac{OA}{AB}$$
$$\Rightarrow \qquad \dfrac{1}{\sqrt{2}} = \dfrac{h}{\sqrt{2}r}$$
$$\Rightarrow \qquad h = r$$
$\therefore$ Volume of cone $= \dfrac{1}{3}\pi r^2 h$
$$= \dfrac{1}{3}\pi r^3$$

39. The radii of the frustum of a right circular cone are in the ratio 2 : 1. What is the ratio of the volume of the frustum of the cone to that to the whole cone?

(a) 1 : 8   (b) 1 : 4   (c) 3 : 4   (d) 7 : 8

◐ *(d)* Volume of cone $= \dfrac{1}{3}\pi r^2 h$
$$= \dfrac{1}{3}\pi(2r)^2 \times (2h)$$
$$= \dfrac{8}{3}\pi r^2 h$$
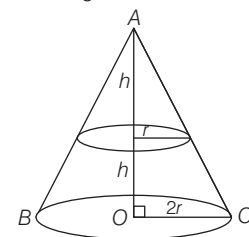
Volume of frustum
$$= \dfrac{1}{3}\pi h(r^2 + (2r)^2 + 2r \cdot r)$$
$$= \dfrac{1}{3}\pi h(7r^2)$$

$$\dfrac{\text{Volume of frustum}}{\text{Volume of whole cone}} = \dfrac{\dfrac{1}{3}\pi h\, 7r^2}{\dfrac{1}{3}\pi h\, 8r^2}$$
$$= \dfrac{7}{8} = 7 : 8$$

40. From a solid cylinder whose height is 8 cm and of base radius 6 cm, a conical cavity of height 8 cm and of base radius 6 cm is formed by hollowing out. What is the inner surface area of the cavity?

(a) 6π cm^2 (b) 8π cm^2
(c) 10π cm^2 (d) $60\ \pi$ cm^2

⊙ **(d)** We have,

Height of cylinder = Height of cone
= 8 cm
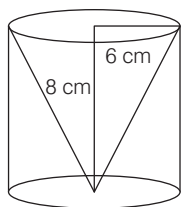
Radius of cylinder = Radius of cone (r)
= 6 cm
Slant height of cone = $\sqrt{h^2 + r^2}$
$= \sqrt{8^2 + 6^2} = 10$
Inner surface area of cavity = Curved surface area of cone $= \pi r l = \pi \times 6 \times 10$
$= 60\pi$ cm^2

41. A tent has been constructed which is in the form of right circular cylinder surmounted by a right circular cone whose axis coincides with the axis of the cylinder.

If the radius of the base of the cylinder is 50 m, the height of the cylinder is 10 m and the total height of he tent is 15 m, then what is the capacity of the tent is cubic metres?

(a) 37500 π (b) $\dfrac{87500\ \pi}{3}$

(c) $\dfrac{36500\ \pi}{3}$ (d) 25000 π

⊙ **(b)** We have, height of cylinder = 10 m
Radius of cylinder = 50 m
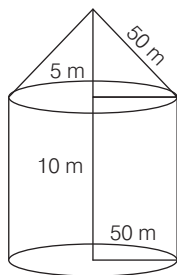
Height of cone = 5 m
Radius of cone = 50 m

Capacity of tent = Volume of cylinder
+ Volume of cone

$= \pi r^2 h + \dfrac{1}{3}\pi r^2 h$

$= \pi(50)^2 \times 10 + \dfrac{\pi}{3}(50)^2 \times 5$

$= \pi(50)^2\left(10 + \dfrac{5}{3}\right)$

$= \dfrac{\pi}{3} \times 2500 \times 35 = \dfrac{87500\pi}{3}$ m^3

42. Two rectangular sheets of sizes of $2\pi \times 4\pi$ and $\pi \times 5\pi$ are available. A hollow right circular cylinder can be formed by joining a pair of parallel sides of any sheet. What is the maximum possible volume of that circular cylinder that can be formed this way?

(a) $4\ \pi^2$ (b) $8\ \pi^2$ (c) $125\ \pi^2$ (d) $6.25\ \pi^2$

⊙ **(b)** We have,
Rectangular sheet of size = $2\pi \times 4\pi$
∴ Area of rectangular sheet = $8\pi^2$
Rectangular sheet of size = $\pi \times 5\pi$
Area of rectangular sheet = $5\pi^2$
∴ Maximum possible value of circular cylinder that can formed by $8\pi^2$.

2017 (I)

43. A ball of radius 1 cm is put into a cylindrical pipe so that it fits inside the pipe. If the length of the pipe is 14 m, what is the surface area of the pipe?

(a) 2200 square cm
(b) 4400 square cm
(c) 8800 square cm
(d) 17600 square cm

⊙ **(c)** Diameter of the cylinder
= Diameter of spherical ball = 2 cm
∴ Radium of cylinder = $\dfrac{\text{Diameter}}{2} = 1$ cm
It is given that length of cylinder
= 14 m = 1400 cm
∴ Surface area of pipe = $2\pi r h$

$= 2 \times \dfrac{22}{7} \times 1 \times 1400$

= 8800 square cm.

44. If the radius of a right circular cone is increased by p% without increasing its height, then what is the percentage increase in the volume of the cone?

(a) p^2 (b) $2p^2$
(c) $\dfrac{p^2}{100}$ (d) $p\left(2 + \dfrac{P}{100}\right)$

⊙ **(d)** Let r and h be the original radius and height of the cone respectively.
Again, let r' and b' be the new radius and height of the cone respectively.
Now, according to the question

$r' = r + p\%$ of $r = r + \dfrac{P}{100}r = \left(\dfrac{100 + P}{100}\right)r$

and $h' = h$

Now, original volume = $\dfrac{1}{3}\pi r^2 h$

and new volume = $\dfrac{1}{3} \times \pi (r^1)^2 h'$

∴ Percentage increase in the volume

$= \dfrac{\text{New volume} - \text{Original volume}}{\text{Original volume}} \times 100$

$= \dfrac{\dfrac{1}{3}\pi r'^2 h' - \dfrac{1}{3}\pi r^2 h}{\dfrac{1}{3}\pi r^2 h} \times 100$

$= \dfrac{r'^2 h' - r^2 h}{r^2 h} \times 100$

$= \dfrac{\left(\dfrac{100 + P}{100}\right)^2 r^2 h - r^2 h}{r^2 h} \times 100$

$= \dfrac{(100 + P)^2 - 100^2}{100} = \dfrac{(200 + P)P}{100}$

$= P\left(2 + \dfrac{P}{100}\right)$

45. If the surface area of a sphere is reduced to one ninth of the area, its radius reduces to

(a) One-fourth   (b) One-third
(c) One-fifth   (d) One-ninth

⊙ **(b)** Let original and new radius of the sphere are r and r' respectively.
Now, according to the question

$4\pi r'^2 = \dfrac{1}{9}4\pi r^2$

∴ $r'^2 = \dfrac{1}{9}r^2 \Rightarrow r' = \dfrac{1}{3}r$

46. Ice-cream, completely filled in a cylinder of diameter 35 cm and height 32 cm, is to be served by completely filling identical disposable cones of diameter 4 cm and height 7 cm. The maximum number of persons that can be served in this way is

(a) 950   (b) 1000   (c) 1050   (d) 1100

⊙ **(c)** Number of persons

$= \dfrac{\text{Volume of the cylinder}}{\text{Volume of each cone}} = \dfrac{\pi r_{cy}^2 h_{cy}}{\dfrac{1}{3}\pi r_{co}^2 h_{co}}$

$= \dfrac{\pi\left(\dfrac{35}{2}\right)^2 (32)}{\dfrac{1}{3}\pi (2)^2 (7)} = \dfrac{35 \times 35 \times 32 \times 3}{2 \times 2 \times 2 \times 2 \times 7} = 1050$

2016 (II)

Directions (Q. Nos. 47-49) *A tent of a circus is made of canvas and is in the form of right circular cylinder and right circular cone above it. The height and diameter of the cylindrical part of the tent are 5m and 126 m, respectively. The total height of the tent is 21 m.*

47. What is the slant height of the cone?

(a) 60 m   (b) 65 m   (c) 68 m   (d) 70 m

⊙ **(b)** Given, height of tent = 21 m
and height of cylindrical part (h_1) = 5 m
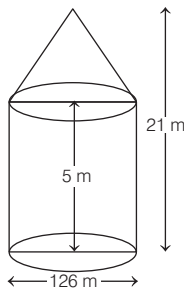
$\therefore$ Height of cone (h_2) = (21 − 5) m = 16 m

and radius of cone $(r) = \dfrac{\text{Diameter}}{2}$

$= \dfrac{126}{2} = 63$ m

Now, slant height $(l) = \sqrt{r^2 + h_2^2}$

$= \sqrt{(63)^2 + (16)^2}$

$= \sqrt{3969 + 256}$

$= \sqrt{4225}$

$= 65$ m

48. What is the curved surface area of the cylinder?

(a) 1980 m²   (b) 2010 m²
(c) 2100 m²   (d) 2240 m²

⊙ **(a)** Curved surface area of the cylinder

$= 2\pi r h_1$

$= 2 \times \dfrac{22}{7} \times 63 \times 5 = 1980\,\text{m}^2$

49. How many square metres of canvas are used?

(a) 14450   (b) 14480
(c) 14580   (d) 14850

⊙ **(d)** Total canvas used = Curved surface area of cylinder + Curved surface area of cone

$= 2\pi r h_1 + \pi r l = \pi r(2h_1 + l)$

$= \dfrac{22}{7} \times 63(2 \times 5 + 65)$

$= 14850\,\text{m}^2$

50. A building is in the form of a cylinder surmounted by a hemispherical dome on the diameter of the cylinder. The height of the building is three times the radius of the base of the cylinder. The building contains $67\dfrac{1}{21}$ m³ of air. What is the height of the building?

(a) 6 m   (b) 4 m
(c) 3 m   (d) 2 m

⊙ **(a)** Let r be the radius of the cylinder.

Given, air in building = $67\dfrac{1}{21}$m³

and height of building (h) = 3r.
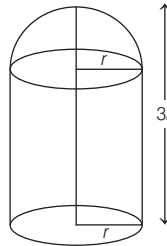
Now, height of cylindrical part

$h_1 = 3r - r = 2r$

Then, air in building = capacity of building

i.e. $67\dfrac{1}{21} = \pi r^2 h_1 + \dfrac{2}{3}\pi r^3$

$\Rightarrow \quad \dfrac{1408}{21} = \pi r^2\left(h_1 + \dfrac{2}{3}r\right)$

$\Rightarrow \quad \dfrac{1408}{21} = \pi r^2\left(2r + \dfrac{2}{3}r\right)$

$\Rightarrow \quad \dfrac{1408}{21} = \pi r^2\left(\dfrac{8r}{3}\right)$

$\Rightarrow \quad r^3 = 8 \Rightarrow r = 2$

$\therefore$ Height of building = $3r = 3 \times 2 = 6$ m.

51. The radius of the base and the height of a solid right circular cylinder are in the ratio 2 : 3 and its volume is 1617 cm³. What is the total surface area of the cylinder?

(a) 462 cm²   (b) 616 cm²
(c) 770 cm²   (d) 786 cm²

⊙ **(c)** Let radius of the base be $2x$.

Height of the cylinder be $3x$
and volume = 1617 cm³.

i.e. $\pi r^2 h = 1617$

$\Rightarrow \dfrac{22}{7}(2x)^2(3x) = 1617$

$\Rightarrow \qquad x^3 = \dfrac{1617 \times 7}{22 \times 12}$

$\Rightarrow \qquad x = \dfrac{7}{2}$

$\therefore \qquad r = 2 \times \dfrac{7}{2} = 7$ cm

and $\qquad h = 3 \times \dfrac{7}{2} = \dfrac{21}{2}$

Now, total surface area = $2\pi r h + 2\pi r^2$

$= 2\pi r(h + r)$

$= 2 \times \dfrac{22}{7} \times 7\left(\dfrac{21}{2} + 7\right)$

$= 2 \times 22 \times \dfrac{35}{2} = 770\,\text{cm}^2$

52. The cost of painting a spherical vessel of diameter 14 cm is ₹ 8008. What is the cost of painting per square centimetre?

(a) ₹ 8   (b) ₹ 9
(c) ₹ 13   (d) ₹ 14

⊙ **(c)** Given, diameter of vessel is 14 cm
and cost of painting is ₹ 8008.

$\therefore$ Cost of painting per square centimetre

$= \dfrac{\text{Total cost}}{\text{Surface area of vessel}} = \dfrac{8008}{4\pi r^2}$

$= \dfrac{8008 \times 7}{4 \times 22 \times 7 \times 7} = ₹\ 13$

53. A drinking glass of height 24 cm is in the shape of frustum of a cone and diameters of its bottom and top circular ends are 4 cm and 18 cm respectively. If we take capacity of the glass as πx cm³, then what is the value of x?

(a) 824   (b) 1236
(c) 1628   (d) 2472

⊙ **(a)** Here, h = 24 cm,

$r = \dfrac{4}{2}$ cm = 2 cm
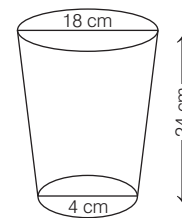
and $\qquad R = \dfrac{18}{2}$ cm = 9 cm

Now, capacity of glass

$= \dfrac{\pi h}{3}(r^2 + R^2 + rR)$

$= \pi\left\{\dfrac{24}{3}(2^2 + 9^2 + 2 \times 9)\right\}$

$= \pi\{8(4 + 81 + 18)\}$

$= 824\pi\,\text{cm}^3$

According to question,

capacity = πx cm³

On comparing, we get

$x = 824$

54. Rain water from a roof of $22 \text{ m} \times 20 \text{ m}$ drains into a cylindrical vessel having diameter of base 2m and height 3.5 m. If the vessel is just full, what is the rainfall?

(a) 3.5 cm　　　　(b) 3 cm
(c) 2.5 cm　　　　(d) 2 cm

⊘ *(c)* Given, area of roof = length × breadth
$$= 22 \text{ m} \times 20 \text{ m}$$
and radius of cylindrical vessel
$$= \frac{2}{2} = 1\,\text{m}$$
Height of cylindrical vessel = 3.5 m

∴ Rainfall = $\dfrac{\text{Capacity of cylindrical vessel}}{22 \text{ m} \times 20 \text{ m}}$

$$= \frac{\pi r^2 h}{22 \text{ m} \times 20 \text{ m}}$$

$$= \frac{22 \times 1 \times 1}{7} \times \frac{3.5 \text{ m}^3}{22 \times 20 \text{ m}^2}$$

$$= 2.5 \text{ cm}$$

55. The height of a cone is 60 cm. A small cone is cut off at the top by a plane parallel to the base and its volume is $\dfrac{1}{64}$ the volume of original cone. What is the height from the base at which the section is made?

(a) 15 cm　　　　(b) 20 cm
(c) 30 cm　　　　(d) 45 cm

⊘ *(d)* In ΔAOE and ΔADC
∵　　$\Delta AOE \sim \Delta ADC$
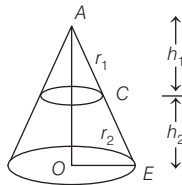
∴　$\dfrac{h_1}{h_1 + h_2} = \dfrac{r_1}{r_2}$　　　…(i)

According to question,
$$\frac{1}{3}\pi r_1^2 h_1 = \frac{1}{64} \times \frac{1}{3}\pi r_2^2 (h_1 + h_2)$$

$$\Rightarrow \quad r_1^2 h_1 = \frac{1}{64} r_2^2 (h_1 + h_2)$$

$$\Rightarrow \left(\frac{h_1}{h_1 + h_2}\right) = \frac{r_2^2}{r_1^2} \times \frac{1}{64}$$

$$\Rightarrow \quad \frac{h_1}{60} = \frac{(h_1 + h_2)^2}{h_1^2} \times \frac{1}{64}$$

$$\therefore \quad h_1^3 = \frac{(60)^3}{64} \;\Rightarrow\; h_1 = 15$$

Hence, required height,
$$h_2 = 60 - h_1 = 45 \text{ cm}$$

56. The ratio of the curved surface area to the total surface area of a right circular cylinder is 1 : 2. If the total surface area is 616 cm^2, what is the volume of the cylinder?

(a) 539 cm³　　　(b) 616 cm³
(c) 1078 cm³　　(d) 1232 cm³

⊘ *(c)* Let r and h be the radius and height of cylinder.

Then, $\dfrac{\text{Curved surface area}}{\text{Total surface area}} = \dfrac{1}{2}$

$$\Rightarrow \quad \frac{2\pi r h}{2\pi r(r + h)} = \frac{1}{2}$$

$$\Rightarrow \qquad\qquad 2h = r + h$$

$$\Rightarrow \qquad\qquad\quad h = r$$

Now, total surface area = 616 cm²
i.e.　　$2\pi r(r + r) = 616$　　　$[\because r = h]$

$$\Rightarrow \quad 2 \times \frac{22}{7} \times 2 \times r^2 = 616$$

$$\Rightarrow \qquad r^2 = 49 \Rightarrow r = 7 \text{ cm}$$

∴ Volume of cylinder = $\pi r^2 h$

$$= \frac{22}{7} \times (7)^3$$

$$= 1078 \text{ cm}^3$$

57. A cubic metre of copper weighing 9000 kg is rolled into a square bar 9 m long. An exact cube is cut off from the bar. How much does the cube weigh?

(a) 1000 kg　　　(b) $\dfrac{1000}{3}$ kg

(c) 300 kg　　　　(d) $\dfrac{500}{3}$ kg

⊘ *(b)* Density of copper = $\dfrac{\text{Mass}}{\text{Volume}}$

$$= \frac{9000}{1} \text{ kg/m}^3 = 9000 \text{ kg/m}^3$$

Let x be the side of cross-section of square bar.
∴ Volume of square bar = Volume of copper
$$\Rightarrow \qquad 9 \times x^2 = 1 \Rightarrow x = 1/3 \text{ m}$$
Volume of cube of side $x = x^3$

$$= \left(\frac{1}{3}\right)^3 = \frac{1}{27} \text{ m}^3$$

∴ Mass of cube = Volume × density

$$= \frac{1}{27} \times 9000 = \frac{1000}{3} \text{ kg}$$

58. Into a conical tent of radius 8.4 m and vertical height 3.5 m, how many full bags of wheat can be emptied, if space required for the wheat in each bag is 1.96 m^3?

(a) 264　　　　　(b) 201
(c) 132　　　　　(d) 105

⊘ *(c)* Volume of conical tent = $\dfrac{1}{3}\pi r^2 h$

$$= \frac{1}{3} \times \frac{22}{7} \times 8.4 \times 8.4 \times 3.5$$

$$= 258.72 \text{ m}^3$$

and volume of 1 wheat bag = 1.96 m³
∴ Required number of bags
$$= \frac{\text{Volume of tent}}{\text{Volume of wheat bag}}$$

$$= \frac{258.72}{1.96} = 132$$

2015 (II)

59. A pipe with square cross-section is supplying water to a cistern which was initially empty. The area of cross-section is 4 cm² and the nozzle velocity of water is 40m/s. The dimensions of the cistern 10 m × 8m × 6m. Then, the cistern will be full in

(a) 9.5 h
(b) 9 h
(c) 8 h and 20 min
(d) 8 h

⊘ *(c)* We have, area of cross-section of pipe
$$= 4\text{cm}^2 = 4 \times 10^{-4} \text{ m}^2$$
Volume of water folows in 1 sec
$$= \text{Area of cross-section of pipe} \times \text{velocity of water}$$
$$= 4 \times 10^{-4} \times 40 \text{ m}^3.$$
Let cistern fill in t s.
Volume of water follows in t sec
$$= \text{volume of cistern}$$
$$\Rightarrow 4 \times 10^{-4} \times 40 \times t = 10 \times 8 \times 6$$
$$[\because \text{Volume of cuboid} = lbh]$$
$$\Rightarrow \quad t = 30000 \text{ s}$$

$$= \frac{30000}{60 \times 60} \text{ h}$$

$$= \frac{50}{6} \text{ h}$$

$$= 8 \text{ h and } 20 \text{ min}$$

60. A hollow cylindrical drum has internal diameter of 30 cm and a height of 1 m. What is the maximum number of cylindrical boxes of diameter 10 cm and height 10 cm each that can be packed in the drum?

(a) 60　　　　　(b) 70
(c) 80　　　　　(d) 90

⊘ *(d)* Let n cylindrical boxes be packed
$$\Rightarrow \quad n \cdot \pi\, 5 \times 5 \times 10 = \pi\, 15 \times 15 \times 100$$
$$\therefore \qquad\qquad n = 90 \text{ boxes}$$

61. Consider the following statements.
1. If the height of a cylinder is doubled, the area of the curved surface is doubled.
2. If the radius of a hemispherical solid is doubled, its total surface area becomes fourfold.

Which of the above statement(s) is/are correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ *(c)* 1. Area of curved surface = $2\pi rh$

∵ $2\pi r\,(2h) = 2\cdot 2\pi rh$

∴ Curved surface area is also doubled.
It is correct.

2. Total surface area of hemisphere
$$= 3\pi r^2$$

∵ $3\pi\,(2r)^2 = 3\pi\,4r^2 = 4\cdot 3\cdot \pi r^2$
$$= 4 \text{ times the area}$$
It is also correct.

62. A large water tank has the shape of a cube. If 128 m³ of water is pumped out, the water level goes down by 2m. Then, the maximum capacity of the tank is

(a) 512 m³   (b) 480 m³
(c) 324 m³   (d) 256 m³

⊙ *(a)* Let the side of water tank be *l*m.

Then, $l^3 - 128 = l^2\,(l - 2)$

⇒ $2l^2 = 128 \Rightarrow l^2 = 64$

∴ $l = 8$ m

So, volume of cubical tank = (side)³
$$= 8^3 = 512 \text{ m}^3.$$

63. From the solid gold in the form of a cube of side length 1 cm, spherical solid balls each having the surface area $\pi^{1/3}$ cm² are to be made. Assuming that there is no loss of the material in process of making the balls, the maximum number of balls made will be

(a) 3   (b) 4
(c) 6   (d) 9

⊙ *(c)* Let *n* spherical balls be made and *r* be the radius of each sphere.
Then, Surface area of ball (sphere)
$$= 4\pi r^2 = \pi^{\frac{1}{3}}$$

⇒ $r^2 = \dfrac{\pi^{\frac{1}{3}}}{4\pi} = \dfrac{1}{4}\,\pi^{-\frac{2}{3}}$

⇒ $r^2 = \left(\dfrac{1}{2}\,\pi^{-\frac{1}{3}}\right)^2$

⇒ $r = \dfrac{1}{2}\,\pi^{-\frac{1}{3}}$

According to the question,

⇒ $n\cdot \dfrac{4}{3}\,\pi\left(\dfrac{1}{2}\,\pi^{-\frac{1}{3}}\right)^3 = 1\times 1\times 1$

⇒ $n\cdot \dfrac{4}{3}\,\pi \times \dfrac{1}{8} \times \dfrac{1}{\pi} = 1$

⇒ $\dfrac{n}{6} = 1$

∴ $n = 6$

64. 30 metallic cylinders of same size are melted and cast in the form of cones having the same radius and height as those of the cylinders.
Consider the following statements

Statement I A maximum of 90 cones will be obtained.

Statement II The curved surface of the cylinder can be flattened in the shape of a rectangle but the curved surface of the cone when flattened has the shape of triangle.

Which one of the following is correct in respect of the above?

(a) Both Statements I and II are correct and Statement II is the correct explanation of Statement I
(b) Both Statements I and II are correct and Statement II is not the correct explanation of Statement I
(c) Statement I is correct but Statement II is not correct
(d) Statement I is not correct but Statement II is correct

⊙ *(b)* Let radius be *r* and height be *h* of the cylinder.

Then, $30\cdot \pi r^2 h = \dfrac{1}{3}\,\pi r^2 h \times n$

∵ $n = 30\times 3 = 90$ cones

Statement I is true. Statement II is also correct. But II is not correct explanation of Statement of I.

65. A water tank, open at the top, is hemispherical at the bottom and cylindrical above it. The radius is 12 m and the capacity is $3312\,\pi$ m³. The ratio of the surface areas of the spherical and cylindrical portions, is

(a) 3 : 5   (b) 4 : 5
(c) 1 : 1   (d) 6 : 5

⊙ *(b)* Let the height of cylindrical part be *h*.

Then, $\dfrac{2}{3}\,\pi r^3 + \pi r^2\,h = 3312\,\pi$

$\dfrac{2}{3}\,\pi (12)^3 + \pi (12)^2 \times h = 3312\,\pi$

$(12)^2[8 + h] = 3312$
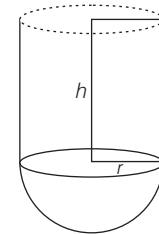
∴ $h = 15$ m

∴ $\dfrac{\text{Surface area of spherical}}{\text{Surface area of cylindrical}} = \dfrac{2\,\pi r^2}{2\,\pi rh}$

$$= \dfrac{r}{h} = \dfrac{12}{15} = \dfrac{4}{5}$$

∴ $r : h = 4 : 5$

66. The areas of three mutually perpendicular faces of a cube are x, y, z. If V is the volume, then xyz is equal to

(a) V (b) V^2
(c) $2V$ (d) $2V^2$

⊙ *(b)* Let the sides of cube be *l*.
Then, $x = l^2,\ y = l^2,\ z = l^2$ and $xyz = l^6$
⇒ $xyz = (l^3)^2$
∴ $xyz = v^2$ [∵ volume of cube = l^3]

67. Let V be the volume of an inverted cone with vertex at origin and the axis of the cone is along positive Y-axis. The cone is filled with water up to half of its height. The volume of water is

(a) $\dfrac{V}{8}$ (b) $\dfrac{V}{6}$

(c) $\dfrac{V}{3}$ (d) $\dfrac{V}{2}$

⊙ *(a)* $\dfrac{r}{r_1} = \dfrac{h}{\dfrac{h}{2}} = \dfrac{2}{1}$

We have, $V = \dfrac{1}{3}\,\pi r^2 h$
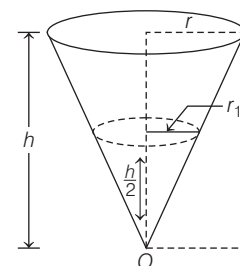
∵ $r^2 = \dfrac{3V}{\pi h}$

∴ $r_1 = \dfrac{r}{2} \Rightarrow r_1^2 = \dfrac{r^2}{4}$

Hence, volume of water

$$= \frac{1}{3}\pi r_1^2 \frac{h}{2} = \frac{1}{6}\pi h \frac{r^2}{4}$$

$$= \frac{1}{24}\pi h \frac{3V}{\pi h} = \frac{3V}{24} = \frac{V}{8}$$

68. Three rectangles R_1, R_2 and R_3 have the same area. Their lengths x_1, x_2 and x_3 respectively are such that $x_1 < x_2 < x_3$. If V_1, V_2 and V_3 are the volumes of the cylinders formed from the rectangles R_1, R_2 and R_3 respectively by joining the parallel sides along the breadth, then which one of the following is correct?

(a) $V_3 < V_2 < V_1$ (b) $V_1 < V_3 < V_2$
(c) $V_1 < V_2 < V_3$ (d) $V_3 < V_1 < V_2$

⊙ **(a)** Let the area be A.
Then, breadth of R_1, R_2

and $R_3 = \dfrac{A}{x_1}, \dfrac{A}{x_2}, \dfrac{A}{x_3}$

Cylinder formed by joining parallel side of breadth.
Here, length becomes height

and $2\pi r = $ breadth $= \dfrac{A}{x}$

∵ $r = \dfrac{A}{2\pi x}$

∴ $V = \pi r^2 h = \pi \dfrac{A^2}{4\pi^2 x^2} \times x = \dfrac{A^2}{4\pi\, x}$

Now, V_1, V_2, $V_3 = \dfrac{A^2}{4\pi\, x_1}, \dfrac{A^2}{4\pi x_2}, \dfrac{A^2}{4\pi x_3}$

∵ $x_1 < x_2 < x_3$

⇒ $\dfrac{1}{x_1} > \dfrac{1}{x_2} > \dfrac{1}{x_3}$

[∵ Volume of cylinder inversly proportional to the length of rectangle $V \propto \dfrac{1}{x}$]

Then, $V_1 > V_2 > V_3$
∴ $V_3 < V_2 < V_1$

69. If the surface area of a cube is $13254\ \text{cm}^2$, then the length of its diagonal is

(a) $44\sqrt{2}$ cm   (b) $44\sqrt{3}$ cm
(c) $47\sqrt{2}$ cm   (d) $47\sqrt{3}$ cm

⊙ **(d)** Let the sides of a cube be l cm.
Then, surface area of a cube
     $= 6l^2 = 13254$

⇒ $l^2 = \dfrac{13254}{6} = 2209$

⇒ $l = 47$
∴ Length of diagonal $= l\sqrt{3}$
           $= 47\sqrt{3}$ cm

70. How many spherical bullets each of 4 cm in diameter can be made out of a cube of lead whose edge is 44 cm?

(a) 2541   (b) 2551   (c) 2561   (d) 2571

⊙ **(a)** Let n bullets be made.
Then, Volume of spherical bullet $\times h$
         = volume of cube of lead.

$$\frac{4}{3}\pi(2)^3 \times n = 44 \times 44 \times 44$$

∴ $n = 2541$ bullets

71. A river 2.5 m deep and 45m wide is flowing at the speed of 3.6 km/h. The amount of water that runs into the sea per minute, is

(a) 6650 m³   (b) 6750 m³
(c) 6850 m³   (d) 6950 m³

⊙ **(b)** We have, speed of water = 3.6 km/h

$$= \frac{3600}{60} \text{ m/min} = 60 \text{ m/min}$$

∴ Amount of water runs into the sea in
1 min $= 2.5 \times 45 \times 60$ m³ $= 6750$ m³

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2015 (I)

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72. A sphere and a cube have same surface area. The ratio of square of their volumes is

(a) $6 : \pi$ (b) $5 : \pi$ (c) $3 : 5$ (d) $1 : 1$

⊙ **(a)** Let the radius of the sphere and side of cube be r and a respectively.
∴ Total surface area of sphere
             $(S_1) = 4\pi r^2$ sq units
and total surface area of cube $(S_2) = 6a^2$ sq units
Now, according to the question,
          $S_1 = S_2$

⇒ $4\pi r^2 = 6a^2$

⇒ $\dfrac{r^2}{a^2} = \dfrac{6}{4\pi}$ …(i)

∴ Volume of sphere $(V_1) = \dfrac{4}{3}\pi r^3$ cu units
and volume of cube $(V_2) = a^3$ cu units

Now, $\left(\dfrac{V_1}{V_2}\right)^2 = \left(\dfrac{\frac{4}{3}\pi r^3}{a^3}\right)^2 = \dfrac{16}{9}\pi^2 \left(\dfrac{r^2}{a^2}\right)^3$

$$= \frac{16}{9}\pi^2 \left(\frac{6}{4\pi}\right)^3 \quad \text{[from Eq. (i)]}$$

$$= \frac{16}{9}\pi^2 \times \frac{6 \times 6 \times 6}{4 \times 4 \times 4 \times \pi^3}$$

$$= \frac{6}{\pi} = 6 : \pi$$

Hence, the ratio of square of their volumes is $6 : \pi$.

73. The radius of a sphere is equal to the radius of the base of a right circular cone and the volume of the sphere is double the volume of the cone. The ratio of the height of the cone to the radius of its base is

(a) $2 : 1$ (b) $1 : 2$
(c) $2 : 3$ (d) $3 : 2$

⊙ **(a)** Let radius of sphere and cone be r.

∴ Volume of sphere $V_1 = \dfrac{4}{3}\pi r^3$ cu units

and volume of cone $V_2 = \dfrac{1}{3}\pi r^2 h$ cu units

Now, according to the question,
          $V_1 = 2V_2$

⇒ $\dfrac{4}{3}\pi r^3 = 2 \times \dfrac{1}{3}\pi r^2 h$

⇒ $2r^3 = r^2 h \Rightarrow 2r = h$

⇒ $\dfrac{h}{r} = \dfrac{2}{1}$

∴ $h : r = 2 : 1$

74. Water flows through a cylindrical pipe of internal diameter 7 cm at the rate of 5 m/s. The time, in minutes, the pipe would take to fill an empty rectangular tank $4m \times 3m \times 2.31$ m is

(a) 28   (b) 24   (c) 20   (d) 12

⊙ **(b)** Given, diameter of cylindrical pipe
          $= 7$ cm

∴ Radius of pipe, $r = \dfrac{7}{2}$ cm

$$= \frac{7}{2 \times 100} \text{ m}$$

$$= \frac{7}{200} \text{ m}$$

∴ Volume of water flows through a cylindrical pipe

$$= \pi r^2 h = \frac{22}{7} \times \left(\frac{7}{200}\right)^2 \times 5 \times 60 \text{ m}^3$$

Now, required time
$$= \frac{\text{Volume of rectangular tank}}{\text{Volume of pipe}}$$

$$= \frac{4 \times 3 \times 2.31 \times 7 \times 200 \times 200}{22 \times 49 \times 5 \times 60}$$

$$= 24 \text{ min}$$

75. The total outer surface area of a right circular cone of height 24 cm with a hemisphere of radius 7 cm upon its base is

(a) $327\ \pi$ sq cm   (b) $307\ \pi$ sq cm
(c) $293\ \pi$ sq cm   (d) $273\ \pi$ sq cm

⊙ **(d)** Let the slant height of cone be l cm.
Given, $h = 24$ cm and $r = 7$ cm

$\Rightarrow \quad l^2 = h^2 + r^2 \Rightarrow l^2 = 24^2 + 7^2$

$\qquad = 576 + 49$

$\Rightarrow \quad l^2 = 625 \Rightarrow l = 25$ cm

$\therefore$ Total surface area = Curved surface area of cone + Curved surface area of hemisphere

$\qquad = \pi r l + 2\pi r^2 = \pi r(l + 2r)$

$\qquad = \pi \times 7(25 + 2 \times 7) = 7\pi[25 + 14]$

$\qquad = 7\pi \times 39 = 273\pi$ sq cm

76. A rectangular block of wood having dimensions $3m \times 2\,m \times 1.75\,m$ has to be painted on all its faces. The layer of paint must be 0.1 mm thick. Paint comes in cubical boxes having their edges equal to 10 cm. The minimum number of boxes of paint to be purchased is

(a) 5   (b) 4   (c) 3   (d) 2

⊘ *(c)* Given, dimensions of a rectangular block of wood is 3m, 2m and 1.75 m.

i.e. 300 cm, 200 cm and 175 cm.

and thickness of layer of paint = 0.1 mm

$\qquad = \dfrac{1}{100}$ cm $\qquad \left[\because 1\,mm = \dfrac{1}{10}cm \right]$

$\therefore$ Volume of rectangular block of wood with paint

$\qquad = 2\left[200 \times 300 \times \dfrac{1}{100} + 200 \right.$

$\qquad \left. \times 175 \times \dfrac{1}{100} + 175 \times 300 \times \dfrac{1}{100} \right]$

$\qquad = 2\,[600 + 350 + 525]$

$\qquad = 2 \times 1475 = 2950$ cm^3

Given, edge of a cubical box = 10 cm

$\therefore$ Volume of cubical box

$\qquad = (\text{Edge})^3 = 10^3 = 1000$ cm^3

Now, Minimum number of boxes

$\qquad = \dfrac{2950}{1000} = 2.95 = 3$ (approx.)

Hence, the minimum number of boxes is 3.

77. The diagonals of three faces of a cuboid are 13, $\sqrt{281}$ and 20 linear units. Then, the total surface area of the cuboid is

(a) 650 sq units   (b) 658 sq units
(c) 664 sq units   (d) 672 sq units

⊘ *(c)* Let the dimensional of cuboid be *l*, *b* and *h*, respectively.
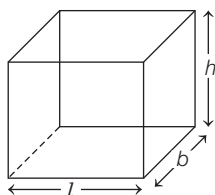
For first face,

$\qquad l^2 + b^2 = 13^2 \; [\because l^2 + b^2 = d^2]$

$\Rightarrow \qquad l^2 + b^2 = 169 \qquad \qquad …(i)$

For second face,

$\qquad b^2 + h^2 = (\sqrt{281})^2$

$\Rightarrow \qquad b^2 + h^2 = 281 \qquad \qquad …(ii)$

For third face, $h^2 + l^2 = 20^2$

$\Rightarrow \qquad h^2 + l^2 = 400 \qquad \qquad …(iii)$

On adding Eqs. (i), (ii) and (iii), we get

$\qquad 2(l^2 + b^2 + h^2) = 850$

$\Rightarrow \qquad l^2 + b^2 + h^2 = 425 \qquad …(iv)$

On putting $l^2 + b^2 = 169$, in above equation, we get

$\qquad 169 + h^2 = 425$

$\Rightarrow \qquad\qquad h^2 = 425 - 169$

$\Rightarrow \qquad\qquad h^2 = 256$

$\Rightarrow \qquad\qquad h = 16$ units

From Eq. (ii), $b^2 + h^2 = 281$

$\Rightarrow \qquad b^2 + 16^2 = 281 \; [\because h = 16]$

$\Rightarrow \qquad b^2 + 256 = 281$

$\Rightarrow \qquad\qquad b^2 = 25$

$\Rightarrow \qquad\qquad b = 5$ units

From Eq. (iii), $h^2 + l^2 = 400$

$\Rightarrow \qquad 16^2 + l^2 = 400$

$\Rightarrow \qquad\qquad l^2 = 400 - 256$

$\Rightarrow \qquad\qquad l = 12$ units

$\therefore$ Total surface area of cuboid

$\qquad = 2(lb + bh + hl)$

$\qquad = 2(12 \times 5 + 5 \times 16 + 16 \times 12)$

$\qquad = 2(60 + 80 + 192)$

$\qquad = 2 \times 332 = 664$ sq units

Hence, the total surface area of the cuboid is 664 sq units.

78. A rectangular paper of 44 cm long and 6 cm wide is rolled to form a cylinder of height equal to width of the paper. The radius of the base of the cylinder so rolled is

(a) 3.5 cm   (b) 5 cm
(c) 7 cm   (d) 14 cm

⊘ *(c)* Given, a rectangular paper of 44 cm long and 6 cm wide is rolled to form a cylinder of height equal to width of the paper.

$\therefore$ Circumference of the base of cylinder

$\qquad = 44$ cm

i.e. $\quad 2\pi r = 44$

$\Rightarrow \qquad r = \dfrac{44}{2\pi} = \dfrac{44 \times 7}{2 \times 22} \Rightarrow r = 7$ cm

Hence, the radius of the base of the cylinder is 7 cm.

79. If three metallic spheres of radii 6 cm, 8 cm and 10 cm are melted to form a single sphere, then the diameter of the new sphere will be

(a) 12 cm   (b) 24 cm
(c) 30 cm   (d) 36 cm

⊘ *(b)* Since, three metallic spheres are melted to form a single sphere.

So, the sum of volume of three metallic spheres = Volume of new solid spheres

$\Rightarrow \quad \dfrac{4}{3}\pi(6)^3 + \dfrac{4}{3}\pi(8)^3 + \dfrac{4}{3}\pi(10)^3$

$\qquad = \dfrac{4}{3}\pi(6^3 + 8^3 + 10^3)$

$\qquad \left[\because \text{Volume of a sphere} = \dfrac{4}{3}\pi r^3 \right]$

$\therefore \quad \dfrac{4}{3}\pi r^3 = \dfrac{4}{3}\pi(6^3 + 8^3 + 10^3)$

$\Rightarrow \qquad r^3 = 6^3 + 8^3 + 10^3$

$\Rightarrow \qquad r^3 = 216 + 512 + 1000$

$\Rightarrow \qquad r^3 = 1728$

$\Rightarrow \qquad r^3 = 12 \times 12 \times 12$

$\Rightarrow \qquad r = 12$ cm

$\therefore$ Diameter of the new sphere

$\qquad = 2r = 2 \times 12 = 24$ cm

80. A cylindrical vessel of radius 4 cm contains water. A solid sphere of radius 3 cm is lowered into the water until it is completely immersed. The water level in the vessel will rise by

(a) 1.5 cm   (b) 2 cm
(c) 2.25 cm   (d) 4.5 cm

⊘ *(c)* Let the radius of cylindrical vessel and solid sphere be *R* cm and *r* cm, respectively.

Given, $R = 4$ cm and $r = 3$ cm

$\therefore$ Volume of cylindrical vessel = $\pi R^2 h$

$\qquad = \pi \times 4^2 \times h$

$\qquad = 16\pi h$ cm^3

and volume of solid sphere

$\qquad = \dfrac{4}{3}\pi r^3 = \dfrac{4}{3}\pi \times 3^3$

$\qquad = 36\pi$ cm^3

Now, according to the question,

$\qquad 16\pi h = 36\pi$

$\Rightarrow \qquad h = \dfrac{36}{16} = 2.25$ cm

Hence, the water level in the vessel will rise 2.25 cm.

81. If the height of a right circular cone is increased by 200% and the radius of the base is reduced by 50%, then the volume of the cone

(a) remains unaltered
(b) decreases by 25%
(c) increases by 25%
(d) increases by 50%

⊘ *(b)* Let the radius and height of the cone be *r* and *h*, respectively.

$\therefore$ Initial volume of cone

$\qquad (V) = \dfrac{1}{3}\pi r^2 h \qquad\qquad …(i)$

According to the question, If the height of a right circular cone is increased by 200% and the radius of the base is reduced by 50%. Then, new height,

$$H = h + h \times 200\%$$
$$= h + \frac{200h}{100} = 3h$$

and new radius,

$$R = r - r \times 50\%$$
$$= r - \frac{50r}{100} = r - \frac{r}{2} \Rightarrow R = \frac{r}{2}$$

∴ New volume of cone $(V_2) = \frac{1}{3}\pi R^2 H$

$$= \frac{1}{3}\pi\left(\frac{r}{2}\right)^2 \times 3h$$
$$= \frac{1}{3}\pi \times \frac{r^2}{4} \times 3h$$
$$= \frac{1}{3}\pi r^2 h \times \frac{3}{4} = \frac{3V}{4}\ \text{[from Eq. (i)]}$$

Decrease in volume $= V - V_2$
$$= V - \frac{3V}{4} = \frac{V}{4}$$

∴ Decrease percentage in volume

$$= \frac{\text{Decrease in volume}}{\text{Initial volume}} \times 100\%$$
$$= \frac{V/4}{V} \times 100\%$$
$$= \frac{V}{4V} \times 100\% = 25\%$$

Alternate Method

Here, $a = -50\%, b = -50\%, c = 200\%$
Required percentage change in volume

$$= \left(a + b + c + \frac{ab + bc + ca}{100} + \frac{abc}{(100)^2}\right)\%$$

$$= -50 - 50 + 200 +$$
$$\frac{(-50)\times(-50)+(-50)\times 200 + 200\times(-50)}{100}$$
$$+ \frac{(-50)\times(-50)\times 200}{10000}$$

$$= 100 + \frac{2500 - 10000 - 10000}{100} + \frac{2500\times 2}{100}$$

$$= 100 + \frac{(-17500)}{100} + 50$$

$$= 150 - 175 = -25\%$$

$$= 25\%\ \text{decreases}$$

[here '–' shows decrement]

82. If the radius of a sphere is increased by 10%, then the volume will be increased by

(a) 33.1% (b) 30%   (c) 50%   (d) 10%

⊙ **(a)** Let the radius of sphere be r.

∴ Volume of sphere $= \frac{4}{3}\pi r^3$,

According to the question,
If the radius of a sphere is increased by 10%.
Then, new radius $r' = r + r \times 10\%$
$$= r + \frac{r}{10} = \frac{11r}{10}$$

∴ New volume of sphere $= \frac{4}{3}\pi r'^3$

$$= \frac{4\pi}{3}\left(\frac{11r}{10}\right)^3 = \frac{4}{3}\pi \times \frac{1331}{1000}r^3$$

Increased volume

$$= \frac{4}{3}\pi \times \frac{1331}{1000}r^3 - \frac{4}{3}\pi r^3$$
$$= \frac{4}{3}\pi r^3\left[\frac{1331}{1000} - 1\right]$$
$$= \frac{4}{3}\pi r^3 \times \frac{331}{1000}$$

Increased percentage

$$= \frac{\frac{4}{3}\pi r^3 \times \frac{331}{1000}}{\frac{4}{3}\pi r^3} \times 100\%$$
$$= \frac{331}{1000} \times 100\% = 33.1\%$$

Alternate Method

Here, $a = 10\%$
Required percentage increase in volume

$$= \left(3a + \frac{3a^2}{100} + \frac{a^3}{(100)^2}\right)\%$$

$$3 \times 10 + \frac{3 \times (10)^2}{100} + \frac{(10)^3}{(100)^2}$$

$$= 30 + \frac{300}{100} + \frac{1000}{10000}$$

$$= 30 + 3 + 0.1 = 33.1\%$$

2014 (II)

83. What is the maximum distance between two points of a cube of side 2 cm?

(a) $\sqrt{3}$ cm   (b) $2\sqrt{3}$ cm
(c) $4\sqrt{3}$ cm   (d) $2\sqrt{2}$ cm

⊙ **(b)** Given, side of a cube = 2 cm

∴ Maximum distance between two points of a cube = Length of diagonal
$$= \sqrt{3} \times \text{Side} = 2\sqrt{3}\ \text{cm}$$

84. The areas of the three adjacent faces of a cuboidal box are $x, 4x$ and $9x$ sq unit. What is the volume of the box?

(a) $6x^2$ cu units   (b) $6x^{3/2}$ cu units
(c) $3x^{3/2}$ cu units (d) $2x^{3/2}$ cu units

⊙ **(b)** Let length, breadth and height of a cuboidal box be l, b and h, respectively.
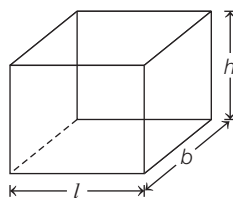
Given, areas of the three adjacent faces are x, $4x$ and $9x$ sq unit.

Now, $lb = x$ [∵ area of rectangular face = length × breadth]
Similarly, $bh = 4x$
and $lh = 9x$
Now, $(lb)\cdot(bh)\cdot(lh) = (x)\cdot(4x)\cdot(9x)$
⇒ $(lbh)^2 = 36x^3$
⇒ $lbh = \sqrt{36x^3}$
∴ $lbh = 6x^{3/2}$

Hence, volume of cuboidal box = lbh
$$= 6x^{3/2}\ \text{cu units}$$

85. A cylinder circumscribes a sphere. What is the ratio of volume of the sphere to that of the cylinder?

(a) 2 : 3   (b) 1 : 2   (c) 3 : 4   (d) 3 : 2

⊙ **(a)** Let radius of the sphere be r.
Since, cylinder circumscribes a sphere.
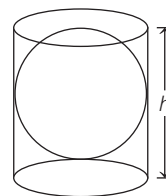
∴ Radius of the base of cylinder = r
and height of cylinder = $2r$ = Diameter of sphere

Now, volume of sphere $= \frac{4}{3}\pi r^3$

and volume of cylinder
$$= \pi r^2 h = \pi r^2 (2r) = 2\pi r^3$$

∴ Required ratio $= \dfrac{\frac{4}{3}\pi r^3}{2\pi r^3} = \dfrac{4}{3 \times 2}$

$$= \frac{2}{3} = 2 : 3$$

Directions (Q. Nos. 86-87) *Read the following information carefully and answer the given questions that follow.*

A toy is in the form of a cone mounted on the hemisphere with the same radius. The diameter of the base of the conical portion is 12 cm and its height is 8 cm.

86. What is the total surface area of the toy?

(a) 132π cm^2 (b) 112π cm^2
(c) 96π cm^2 (d) 66π cm^2

⊙ **(a)** Given, diameter of the base of the conical portion = 12 cm
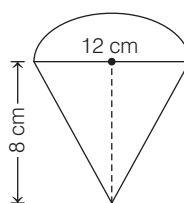
∴ Radius of conical portion = 6 cm
    Radius of hemisphere = 6 cm
and height of conical portion = 8 cm
∴ Slant height of conical portion

$$= \sqrt{6^2 + 8^2} = \sqrt{36 + 64}$$

$$[\because l = \sqrt{r^2 + h^2}]$$

$$= \sqrt{100} = 10 \text{ cm}$$

Now, total surface area of the toy =
Surface area of conical portion
        + Surface area of hemisphere

$$= \pi r l + 2\pi r^2 = \pi(r l + 2r^2)$$
$$= \pi[6 \times 10 + 2 \times 6 \times 6]$$
$$= \pi[60 + 72] = 132\pi \text{ cm}^2$$

87. What is the volume of the toy?
(a) 180π cm^3 (b) 240π cm^3
(c) 300π cm^3 (d) 320π cm^3

⊘ *(b)* Volume of the toy
        = Volume of conical portion
                + Volume of hemisphere

$$= \frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3$$

$$= \pi\left[\frac{1}{3}r^2 h + \frac{2}{3}r^3\right]$$

$$= \pi\left[\frac{1}{3} \times (6)^2 \times 8 + \frac{2}{3} \times (6)^3\right]$$

$$= \pi[96 + 144] = 240\pi \text{ cm}^3$$

Directions (Q. Nos. 88-89) *Read the following information carefully and answer the given questions that follow.*

A right triangle having hypotenuse 25 cm and legs in the ratio 3 : 4 is made to revolve about its hypotenuse. ($\pi = 3.14$)

88. What is the volume of the double cone so formed?
(a) 3124 cm^3 (b) 3424 cm^3
(c) 3768 cm^3 (d) 3924 cm^3

⊘ *(c)* Let *ABC* be a right angled triangle.
Then, hypotenuse, $AC = 25$ cm
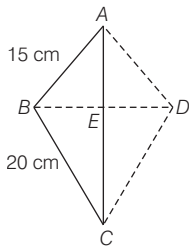
Let $AB = 3x$ and $BC = 4x$
Thus, $AC^2 = AB^2 + BC^2$
                [by Pythagoras theorem]
⇒ $(25)^2 = (3x)^2 + (4x)^2$
⇒ $(25)^2 = 9x^2 + 16x^2$

⇒ $25 = x^2 \Rightarrow x = 5$
∴ $AB = 15$ cm
and $BC = 20$ cm
Now, $\triangle ABC$ revolves about *AC*, so it forms two cones *ABD* and *BCD*.
Since, $\triangle AEB$ and $\triangle ABC$ are similar.

∴ $\dfrac{BE}{BC} = \dfrac{AB}{AC}$

⇒ $\dfrac{BE}{20} = \dfrac{15}{25}$

⇒ $BE = \dfrac{15 \times 20}{25} = 12$ cm

So, radius of the base of cone
        $= BE = 12$ cm
In right angled $\triangle AEB$,

$$AE = \sqrt{(AB)^2 - (BE)^2}$$

$$= \sqrt{(15)^2 - (12)^2}$$

$$= \sqrt{225 - 144} = \sqrt{81} = 9 \text{ cm}$$

So, height of cone $ABD = AE = 9$ cm
∴ Height of cone $BCD = AC - AE$
        $= 25 - 9 = 16$ cm
Now, volume of cone $ABD = \dfrac{1}{3}\pi r^2 h$

$$= \frac{1}{3}\pi(12)^2 \times 9$$

$$= 432\pi \text{ cm}^3$$

and volume of cone

$$BCD = \frac{1}{3}\pi(12)^2 \times 16 = 768\pi \text{ cm}^3$$

∴ Required volume of double cone
        $= 432\pi + 768\pi$
        $= 1200 \times 3.14$ $[\because \pi = 3.14]$
        $= 3768$ cm^3

89. What is the surface area of the double cone so formed?
(a) 1101.2 cm^2
(b) 1111.4 cm^2
(c) 1310.4 cm^2
(d) 1318.8 cm^2

⊘ *(d)* $\because$ Surface area of cone $ABD = \pi r l$
        $= \pi \times 12 \times 15 = 180\pi$ cm^2
and surface area of cone
$BCD = \pi \times 12 \times 20 = 240\pi$ cm^2
∴ Required surface area of double cone
        $= 180\pi + 240\pi = 420\pi$
        $= 420 \times 3.14$
        $= 1318.8$ cm^2

90. Consider the following statements
1. The volume of the cone generated when the triangle is made to revolve about its longer leg is same as the volume of the cone generated when the triangle is made to revolve about its shorter leg.

2. The sum of the volume of the cone generated when the triangle is made to revolve about its longer leg and the volume of the cone generated when the triangle is made to revolve about its shorter leg is equal to the volume of the double cone generated when the triangle is made to revolve about its hypotenuse.

Which of the above statement(s) is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ *(d)* Suppose we have a right angled $\triangle ABC$, in which
        $AB = 3$ cm, $BC = 4$ cm
and $AC = 5$ cm
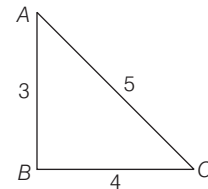
1. When the triangle revolve about its longer leg, $BC = 4$ cm.
Then, volume of cone

$$= \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(3)^2 \times 4$$

$$= 12\pi \text{ cm}^3 \qquad ...(i)$$

When the triangle revolve about its shorter leg, $AB = 3$ cm.
Then, volume of cone

$$= \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(4)^2 \times 3$$

$$= 16\pi \text{ cm}^3 \qquad ...(ii)$$

From Eqs. (i) and (ii), it is clear that volume of both cones are not same. So, Statement 1 is incorrect.

2. When the triangle revolve about hypotenuse, then we get double cones *ABD* and *BCD*.
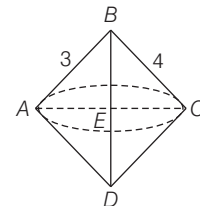
$\because$ $\triangle BEA \sim \triangle BAC$

∴ $\dfrac{BE}{BC} = \dfrac{AB}{AC}$

⇒ $\dfrac{BE}{4} = \dfrac{3}{5}$

⇒ $BE = 2.4$ cm
So, radius of the base of cone,
        $BE = 2.4$ cm

In right angled ΔBEA,

$$AE = \sqrt{(AB)^2 - (BE)^2}$$
$$= \sqrt{9 - (2.4)^2} = 1.8 \, \text{cm}$$

So, height of cone

$$ABD = AE = 1.8 \, \text{cm}$$
$\therefore$ Height of cone $BCD = AC - AE$
$$= 5 - 1.8 = 3.2 \, \text{cm}$$

Now, volume of cone,

$$ABD = \frac{1}{3}\pi r^2 h$$
$$= \frac{1}{3}\pi (2.4)^2 \times 1.8$$
$$= 3.456\pi \, \text{cm}^3$$

Volume of cone

$$BCD = \frac{1}{3}\pi (2.4)^2 \times 3.2$$
$$= 6.144\pi \, \text{cm}^3$$
$\therefore$ Volume of double cone
$$= 3.456\pi + 6.144\pi$$
$$= 9.6\pi \, \text{cm}^3 \qquad \ldots\text{(iii)}$$

From Eqs. (i) and (ii), we get

Volume of both cones
$$= 12\pi + 16\pi$$
$$= 28\pi \, \text{cm}^3 \quad \ldots\text{(iv)}$$

From Eqs. (iii) and (iv), we get

Volume of double cone $\neq$ Volume of both cones

So, Statement 2 is also not correct.

91. If the side of a cube is increased by 100%, then by what percentage is the surface area of the cube increased?
(a) 150%   (b) 200%
(c) 300%   (d) 400%

⊙ *(c)* Let side of a cube be x.

Then, surface area of cube $= 6x^2$

If the side of cube is increased by 100%.

Then, new side of cube
$$= x + 100\% \text{ of}$$
$$x = x + x = 2x$$
$\therefore$ New surface area of cube $= 6(2x)^2$
$$= 6 \times 4x^2 = 24x^2$$
Now, percent increases in surface area
$$= \frac{24x^2 - 6x^2}{6x^2} \times 100$$
$$= \frac{18}{6} \times 100 = 300\%$$

Alternate Method

Here, $a = 100\%$

Required percent increased in surface area
$$= \left(2a + \frac{a^2}{100}\right)\%$$
$$= 2 \times 100 + \frac{100 \times 100}{100}$$
$$= 200 + 100$$
$$= 300\%$$

92. Consider the following statements in respect of four spheres A, B, C and D having respective radii 6, 8, 10 and 12 cm.
1. The surface area of sphere C is equal to the sum of surface areas of spheres A and B.
2. The volume of sphere D is equal to the sum of volumes of spheres A, B and C.

Which of the above statement(s) is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(c)* **1.** Given, radius of sphere $A = 6$ cm

Radius of sphere $B = 8$ cm

Radius of sphere $C = 10$ cm

and Radius of sphere $D = 12$ cm
$\therefore$ Surface area of sphere
$$A = 4\pi r^2$$
$$= 4\pi(6)^2 = 144\pi \, \text{cm}^2$$
Surface area of sphere
$$B = 4\pi(8)^2 = 256\pi \, \text{cm}^2$$
Surface area of sphere
$$C = 4\pi(10)^2 = 400\pi \, \text{cm}^2$$
Now, sum of surface area of spheres
$$A \text{ and } B = 144\pi + 256\pi$$
$$= 400\pi \, \text{cm}^2$$
$$= \text{Surface area of sphere } C$$
Hence, Statement 1 is correct.

2. $\because$ Volume of sphere
$$D = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(12)^3$$
$$= 2304\pi \, \text{cm}^3$$
Volume of sphere
$$A = \frac{4}{3}\pi(6)^3 = 288\pi \, \text{cm}^3$$
Volume of sphere
$$B = \frac{4}{3}\pi(8)^3 = \frac{2048}{3}\pi \, \text{cm}^3$$
and volume of sphere
$$C = \frac{4}{3}\pi(10)^3$$
$$= \frac{4000}{3}\pi \, \text{cm}^3$$
Now, sum of volumes of spheres A, B and C
$$= \left(288\pi + \frac{2048\pi}{3} + \frac{4000}{3}\pi\right)\text{cm}^3$$
$$= \left(\frac{864 + 2048 + 4000}{3}\right)\pi \, \text{cm}^3$$
$$= \frac{6912}{3}\pi \, \text{cm}^3$$
$$= 2304\pi \, \text{cm}^3$$
$$= \text{Volume of sphere } D$$
Hence, Statement 2 is also correct.

93. What is the number of pairs of perpendicular planes in a cuboid?
(a) 4
(b) 8
(c) 12
(d) None of the above

⊙ *(c)* In a cuboid, 4 perpendicular face pairs in bottom surface, 4 perpendicular face pairs in top surface and 4 perpendicular face pairs in vertical surface.

Hence, total perpendicular pairs are 12.

94. How many equilateral triangles can be formed by joining any three vertices of a cube?
(a) 0
(b) 4
(c) 8
(d) None of the above

⊙ *(c)* We know that, there are six faces in a cube.

Let the sides of a cube be a.
$\therefore$ Diagonal of a face $= \sqrt{a^2 + a^2}$
$$= a\sqrt{2}$$
So, there is no equilateral triangle will be formed in faces.
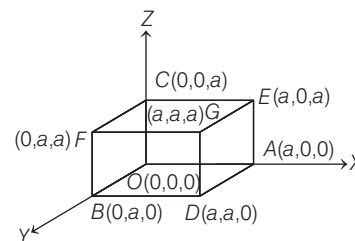
In ΔABC,
$$AB = \sqrt{a^2 + a^2} = a\sqrt{2}$$
$$BC = \sqrt{a^2 + a^2} = a\sqrt{2}$$
and $$AC = \sqrt{a^2 + a^2} = a\sqrt{2}$$
Hence, ΔABC is an equilateral triangle.

Similarly,

$\Delta ABE, \Delta ODG, \Delta ODF, \Delta CEB, \Delta CEA, \Delta FGO$ and ΔFGD are possible equilateral triangles.

Hence, eight equilateral triangles are possible.

95. The diameter of a metallic sphere is 6 cm. The sphere is melted and drawn into a wire of uniform circular cross-section. If the length of the wire is 36 m, then what is its radius equal to?
(a) 0.1 cm   (b) 0.01 cm
(c) 0.001 cm   (d) 1.0 cm

⊘ *(a)* Given, diameter of a sphere, $d = 6\,cm$

∴ Radius of a sphere,

$$r = \frac{d}{2} = \frac{6}{2} = 3\,cm$$

Let the radius of wire be R cm.
Also, given the length of wire,

$$H = 36\,m = 3600\,cm$$

According to the given condition,

Volume of sphere = Volume of wire

$$\Rightarrow \quad \frac{4}{3}\pi r^3 = \pi R^2 H$$

$$\Rightarrow \quad \frac{4}{3} \times (3)^3 = R^2 \times 3600$$

$$\Rightarrow \quad R^2 = \frac{4 \times 3^2}{3600} = \frac{(6)^2}{(60)^2}$$

$$\therefore \quad R = \frac{6}{60} = \frac{1}{10} = 0.1\,cm$$

2014 (I)

96. The volume of a hollow cube is $216x^3$. What surface area of the largest sphere which can be enclosed in it?

(a) $18\pi x^2$ (b) $27\pi x^2$
(c) $36\pi x^2$ (d) $72\pi x^2$

⊘ *(c)* ∵ Volume of cube $= 216x^3$

$$(\text{Side})^3 = 216x^3$$

$$\Rightarrow \quad \text{Side} = 6x$$

Since, sphere is enclosed in hollow cube.

∴ Diameter of sphere $= 6x$
Now, surface area of sphere $= 4\pi r^2$

$$= 4\pi\left(\frac{6x}{2}\right)^2 = 36\pi x^2$$

97. What is the diameter of the largest circle lying on the surface of a sphere of surface area 616 sq cm?

(a) 14 cm   (b) 10.5 cm
(c) 7 cm   (d) 3.5 cm

⊘ *(a)* ∵ Surface area of sphere $= 616\,cm^2$

$$4\pi r^2 = 616$$

$$\Rightarrow \quad r^2 = \frac{616 \times 7}{4 \times 22}$$

$$\Rightarrow \quad r^2 = 7 \times 7$$

$$\therefore \quad r = 7\,cm$$

∴ Diameter of largest circle lying on sphere $= 2 \times r = 14\,cm$

98. The dimensions of a field are 15 m by 12 m. A pit 8 m long, 2.5 m wide and 2 m deep is dug in one corner of the field and the earth removed is evenly spread over the remaining area of the field. The level of the field is raised by

(a) 15 cm   (b) 20 cm
(c) 25 cm   (d) $\frac{200}{9}$ cm

⊘ *(c)* Volume of earth dug out

$$= 8 \times 2.5 \times 2 = 40\,m^3$$
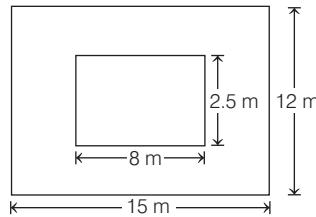
Area where earth is spread × Field level raised = Volume of earth dug out

$$\Rightarrow [(12 \times 15) - (8 \times 2.5)] \times h = 40$$

$$\therefore \quad h = \frac{40}{180 - 20}$$

$$= \frac{40}{160} = \frac{1}{4}\,m$$

$$= 25\,cm$$

99. If 64 identical small spheres are made out of big sphere of diameter 8 cm, then what is surface area of each small sphere?

(a) $\pi\,cm^2$ (b) $2\pi\,cm^2$
(c) $4\pi\,cm^2$ (d) $8\pi\,cm^2$

⊘ *(c)* Volume of each small sphere

$$= \frac{\text{Volume of bigger sphere}}{\text{Number of small spheres}}$$

$$= \frac{\frac{4}{3}\pi(4)^3}{64}$$

$$= \frac{4}{3} \times \frac{\pi \times 4 \times 4 \times 4}{64} = \frac{4}{3}\pi\,cm^3$$

Let radius of small sphere be r'.

$$\therefore \quad \frac{4}{3}\pi r'^3 = \frac{4}{3}\pi$$

$$\Rightarrow \quad r' = 1\,cm$$

Now, surface area of small sphere

$$= 4\pi r'^2$$

$$= 4\pi\,cm^2$$

100. A cone of radius r cm and height h cm is divided into two parts by drawing a plane through the middle point of its height and parallel to the base. What is the ratio of the volume of the original cone to the volume of the smaller cone?

(a) 4 : 1   (b) 8 : 1
(c) 2 : 1   (d) 6 : 1

⊘ *(b)* Let the cone is divided into two parts by a line *l*.
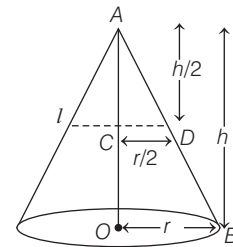
In $\triangle AOB$ and $\triangle ACD$,

$$\triangle AOB \sim \triangle ACD$$

By basic proportionality theorem,

$$CD = \frac{r}{2}, \text{ since } AC = \frac{h}{2}$$

Now, Ratio $= \dfrac{\text{Volume of original cone}}{\text{Volume of smaller cone}}$

$$= \frac{\frac{1}{3}\pi r^2 h}{\frac{1}{3}\pi\left(\frac{r}{2}\right)^2\left(\frac{h}{2}\right)} = \frac{8}{1}$$

∴ Required ratio $= 8 : 1$

101. A cube has each edge 2 cm and a cuboid is 1 cm long, 2 cm wide and 3 cm high. The paint in a certain container is sufficient to paint an area equal to 54 cm².

Which one of the following is correct?

(a) Both cube and cuboid can be painted
(b) Only cube can be painted
(c) Only cuboid can be painted
(d) Neither cube nor cuboid can be painted

⊘ *(a)* Surface area of cube which can be painted $= 6\,(\text{Side})^2$

$$= 6(2)^2 = 24\,cm^2$$

Now, surface area of cuboid which can be painted

$$= 2(lb + bh + lh)$$
$$= 2(2 + 6 + 3) = 22 \text{ cm}^2$$

Total surface area of both cube and cuboid

$$= 22 + 24 = 46 \text{ cm}^2 < 54 \text{ cm}^2$$

Hence, both cube and cuboid can be painted.

102. For a plot of land of $100 \text{ m} \times 80$ m, the length to be raised by spreading the earth from stack of a rectangular base $10 \text{ m} \times 8$ m and vertical section being a trapezium of height 2 m. The top of the stack is $8 \text{ m} \times 5 \text{ m}$. How many centimetres can the level raised?

(a) 3 cm   (b) 2.5 m (c) 2 cm (d) 1.5 cm

⊘ *(d)* Since, the stack is in the form having vertical cross section of trapezium.

∴ Volume of Earth in the stack = Area of cross section of trapezium × Height

∴ Volume $= \dfrac{1}{2} \times (10 + 5) \times 2 \times 8$

$$= 15 \times 8 \text{ m}^2$$

Now, according to the question,
Volume of Earth to be spread = Area of field × Level raised

∴ Level raised $= \dfrac{15 \times 8}{100 \times 80}$

$$= \dfrac{15}{1000} = 1.5 \text{ cm}$$

103. A drainage tile is a cylindrical shell 21 cm long. The inside and outside diameters are 4.5 cm and 5.1 cm, respectively. What is the volume of the clay required for the tile?

(a) $6.96\pi \text{ cm}^3$ (b) $6.76\pi \text{ cm}^3$
(c) $5.76\pi \text{ cm}^3$ (d) None of these

⊘ *(d)* Volume of clay required

$$= \pi[r_1^2 - r_2^2] \times h$$
$$= \pi \left[\left(\dfrac{5.1}{2} \right)^2 - \left(\dfrac{4.5}{2} \right)^2 \right] \times 21$$
$$= \pi \, [(2.55)^2 - (2.25)^2] \times 21$$
$$= \pi \, (0.3 \times 4.8) \times 21$$
$$= 30.24 \, \pi \text{ cu cm}$$

104. The diameter of the base of a cone is 6 cm and its altitude is 4 cm. What is the approximate curved surface area of the cone?

(a) 45 cm²   (b) 47 cm²
(c) 49 cm²   (d) 51 cm²

⊘ *(b)* Radius of cone $= \dfrac{6}{2} = 3 \text{ cm}$
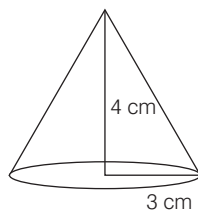
and height of cone = 4 cm
Now, curved surface area = $\pi r l$
where, $l = \sqrt{r^2 + h^2} = \sqrt{3^2 + 4^2} = 5 \text{ cm}$

∴ Curved surface area $= \pi \times 3 \times 5$
$$= 15\pi \approx 47 \text{ sq cm}$$

105. A cylinder is surmounted by a cone at one end, a hemisphere at the other end. The common radius is 3.5 cm, the height of the cylinder is 6.5 cm and the total height of the structure is 12.8 cm. The volume V of the structure lies between

(a) 370 cm³ and 380 cm³
(b) 380 cm³ and 390 cm³
(c) 390 cm³ and 400 cm³
(d) None of these

⊘ *(a)* Let common radius be r cm.
Then, height of cylinder = h
and   height of cone = h'
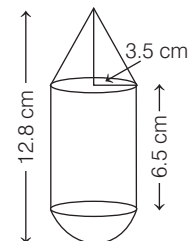
∴ Volume of the complete structure

$$= \dfrac{1}{3} \, \pi r^2 h' + \pi r^2 h + \dfrac{2}{3} \, \pi r^3$$
$$= \pi r^2 \left(\dfrac{h'}{3} + h + \dfrac{2}{3} \, r \right)$$
$$= \pi \, (3.5)^2 \left(\dfrac{2.8}{3} + 6.5 + \dfrac{2}{3} \times 3.5 \right)$$
$$= \pi \times 3.5 \times 3.5 \times 9.76$$
$$= 375.86 \text{ cm}^3$$

Hence, volume (V) of the structure lies between 370 cm³ and 380 cm³.

106. A swimming pool 70 m long, 44 m wide and 3 m deep is filled by water flowing from a pipe at the rate of 30800 cm^3/s. The time taken to fill the swimming pool is

(a) 71/2 h
(b) 80 h
(c) 250/3 h
(d) None of the above

⊘ *(c)* Required time taken to fill the pool

$$= \dfrac{\text{Volume of the pool}}{\text{Part of pool filled in 1s}}$$
$$= \dfrac{70 \times 44 \times 3 \times 100 \times 100 \times 100}{30800} s$$
$$= 900000 \, s = \dfrac{250}{3} \text{ h}$$

LINES AND ANGLES

1. Three parallel lines x, y and z are cut by two transversals m and n. Transversal m cuts the lines x, y, z at P, Q, R, respectively and transversal n cuts the lines x, y, z at L, M, N, respectively. If $PQ = 3$ cm, $QR = 9$ cm and $MN = 10.5$ cm, then what is the length of LM?

(a) 3 cm   (b) 3.5 cm
(c) 4 cm   (d) 4.5 cm

⊙ **(b)**
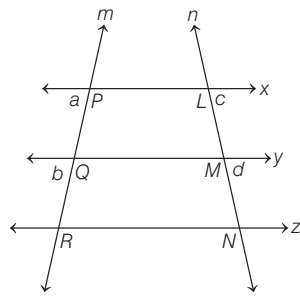
$x \parallel y \parallel z$

Then, by Basic proportionality theorem,

$$\frac{a}{b} = \frac{c}{d}$$

or $\quad \dfrac{a}{c} = \dfrac{b}{d}$

Here, $a = PQ = 3$ cm
$\qquad\quad b = QR = 9$ cm
$\qquad\quad c = LM = ?$
$\qquad\quad d = MN = 10.5$

$\Rightarrow \quad \dfrac{a}{b} = \dfrac{c}{d}$

$\Rightarrow \quad \dfrac{3}{9} = \dfrac{c}{10.5}$

$\qquad\quad c = 3.5 = LM$

$\qquad$ LM = 3.5 cm

2. Let the bisector of the angle BAC of a triangle ABC meet BC in X. Which one of the following is correct?

(a) $AB < BX$ (b) $AB > BX$
(c) $AX = CX$ (d) None of these

⊙ **(b)**
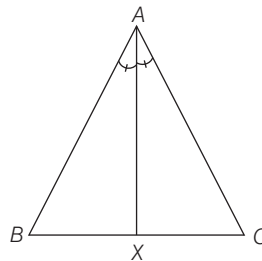
$\angle BXA$ is exterior angle of $\triangle AXC$

$\qquad \angle BXA = \angle XAC + \angle ACX$

$\therefore \quad \angle BXA > \angle XAC \qquad (\angle XAC = \angle BAX)$

$\qquad \angle BXA > \angle BAC$

$\therefore \; AB > BX$ (side opposite to greater angle is greater)

3. If two lines AB and CD intersect at O such that $\angle AOC = 5\,\angle AOD$, then the four angles at O are

(a) 40°, 40°, 140°, 140°
(b) 30°, 30°, 150°, 150°
(c) 30°, 45°, 75°, 210°
(d) 60°, 60°, 120°, 120°

⊙ **(b)** We have,
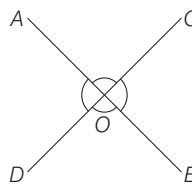
$\angle AOC = 5\angle AOD$

$\therefore \quad \angle AOD + \angle AOC = 180°$

$\Rightarrow 5\angle AOD + \angle AOD = 180°$

$\Rightarrow \qquad 6\angle AOD = 180°$

$\Rightarrow \qquad \angle AOD = 30°$

$\angle AOC = 5\angle AOD = 5 \times 30° = 150°$

$\angle DOB = 150°$

$\angle COB = 30°$ [vertical opposite angle]

$\therefore$ Other four angles are

$\qquad\qquad$ 30°, 30°, 150°, 150°

4. The length of a line segment AB is 2 cm. It is divided into two parts at a point C such that $AC^2 = AB \times CB$. What is the length of CB?

(a) $3\sqrt{5}$ cm   (b) $3 - \sqrt{5}$ cm
(c) $5\sqrt{3}$ cm   (d) $\sqrt{5} - 1$ cm

⊙ **(b)**
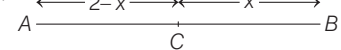
Let $\qquad BC = x$ cm
Then, $\qquad AC = (2 - x)$ cm
Now, $\qquad AC^2 = AB \times CB$

$\qquad\quad (2 - x)^2 = 2 \times x$

$\qquad 4 + x^2 - 4x = 2x$

$\qquad\qquad\qquad [(a - b)^2 = a^2 + b^2 - 2ab]$

$\qquad x^2 - 6x + 4 = 0$

$\qquad\qquad x = \dfrac{6 \pm \sqrt{36 - 4(4)}}{2}$

$\qquad\qquad x = \dfrac{6 \pm \sqrt{20}}{2}$

$\qquad\qquad x = 3 \pm \sqrt{5}$ cm

$\qquad\qquad x = 3 + \sqrt{5}$, [not possible]

$\therefore \qquad\qquad x = 3 - \sqrt{5}$ cm

5. The locus of a point equidistant from two intersecting lines is

(a) A straight line
(b) A circle
(c) A pair of straight lines
(d) None of the above

⊘ *(a)* The locus of point equidistant
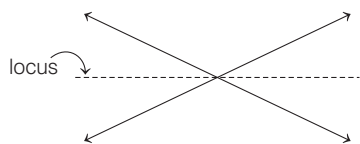
locus

(Locus of a point equidistant)

From two intersecting lines is a straight line.

6. In the figure given below, p, q, r are parallel lines; l and m are two transversals
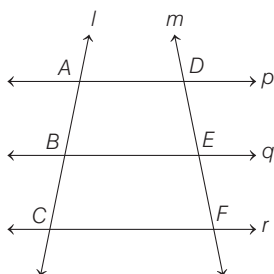
Consider the following

1. $AB : AC = DE : DF$
2. $AB \times EF = BC \times DE$

Which of the above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

⊘ *(c)* $\dfrac{AB}{BC} = \dfrac{DE}{EF}$

Because $p \,||\, q \,||\, r$ and l and m are transversal.   (By BPT Theorem)

(1) $\dfrac{AB}{BC} = \dfrac{DE}{EF}$

$\Rightarrow$ $\dfrac{BC}{AB} = \dfrac{EF}{DE}$

Adding 1 both sides

$\dfrac{BC}{AB} + 1 = \dfrac{EF}{DE} + 1$

$\dfrac{BC + AB}{AB} = \dfrac{EF + DE}{DE}$

$\dfrac{AC}{AB} = \dfrac{DF}{DE}$

$\Rightarrow$ $\dfrac{AB}{AC} = \dfrac{DE}{DF}$

(2) $\dfrac{AB}{BC} = \dfrac{DE}{EF}$

$\therefore AB \times EF = BC \times DE$

Both 1 and 2 are correct.

2017 (II)

7. Consider the following statements in respect of three straight lines A, B and C on a plane

1. If A and C are parallel and B and C are parallel; then A and B are parallel.
2. If A is perpendicular to C and B is perpendicular to C; then A and B are parallel.
3. If the acute angle between A and C is equal to the acute angle between B and C; then A and B are parallel.

Which of the above statements are correct?

(a) 1, 2 and 3
(b) 1 and 2
(c) 1 and 3
(d) 2 and 3

⊘ *(a)* 1. If A and C parallel and B and C are parallel

$\therefore$ $A || C, B || C$

$\therefore$ $A || B$
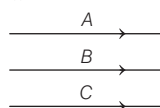
True

2. A is perpendicular to C
   B is perpendicular to C
   $\therefore A$ and B are parallel
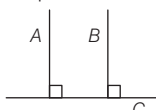
True

3. Acute angle between A and C equal to acute angle between B and C
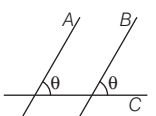
$\therefore A$ and B are parallel
   True

8. There are 8 lines in a plane, no two of which are parallel. What is the maximum number of points at which they can intersects?

(a) 15
(b) 21
(c) 28
(d) None of these

⊘ *(c)* We know that, two non-parallel, lines always intersect at a point.

$\therefore$ Required number of points is given by

$${}^{8}C_2 = \dfrac{8 \times 7}{2 \times 1} = 28$$

2017 (I)

9. In the figure given below, PQ is parallel to RS and PR is parallel to QS. If $\angle LPR = 35°$ and $\angle UST = 70°$, then what is $\angle MPQ$ equal to?
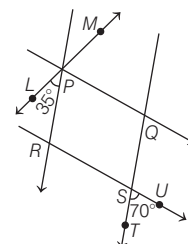
(a) 55°
(b) 70°
(c) 75°
(d) 80°

⊘ *(c)* We have,

$\angle UST = 70°$

$\therefore$ $\angle QSR = \angle UST = 70°$
     [vertically opposite angles]

Again, $\angle SRP + \angle QSR = 180°$
     [co-interior angles]

$\Rightarrow$ $\angle SRP = 180° - 70°$

$= 110°$

Again, $\angle RPQ = 180° - \angle SRP$

$= 180° - 110° = 70°$

Now, $\angle LPR + \angle RPQ + \angle MPQ = 180°$
     [sum of all angles on a line is 180°]

$\therefore$ $35° + 70° + \angle MPQ = 180°$

$\Rightarrow$ $\angle MPQ = 75°$

2016 (I)

10. If a transversal intersects four parallel straight lines, then the number of distinct values of the angles formed will be

(a) 2
(b) 4
(c) 8
(d) 16

⊘ *(a)* If line P intersects four parallel lines l, m, n and o, then 16 angles will be formed.
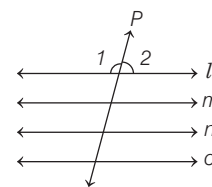
As these lines are parallel.
Hence, distinct angles will be $\angle 1$ and $\angle 2$.

11.
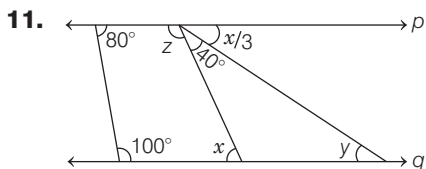
In the given figure above, p and q are parallel lines. What are the values of the angles x, y and z?

(a) $x = 80°$, $y = 40°$, $z = 100°$
(b) $x = 80°$, $y = 50°$, $z = 105°$
(c) $x = 70°$, $y = 40°$, $z = 110°$
(d) $x = 60°$, $y = 20°$, $z = 120°$

⊘ **(d)** In the given figure, lines p and q are parallel.
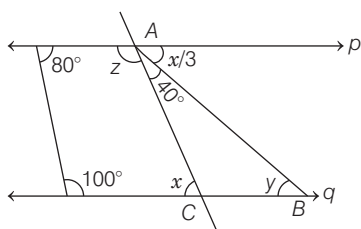
$$\therefore \quad x = 40° + \frac{x}{3}$$

[alternate angles]

$$\Rightarrow \quad \frac{2x}{3} = 40°$$

$$\Rightarrow \quad x = 60°$$

and $y + 40° = x$

[∵ x is exterior angle of $\triangle ABC$]

$$\Rightarrow \quad y = x - 40°$$

$$= 60° - 40° = 20°$$

Now, $z + 40° + \dfrac{x}{3} = 180°$

$$\Rightarrow \quad z + 20° = 180° - 40°$$

$$\therefore \quad z = 120°$$

12. There are five lines in a plane, no two of which are parallel. The maximum number of points in which they can intersect is

(a) 4 (b) 6
(c) 10 (d) None of these

⊘ **(c)** We know that, intersection point is formed by the intersection of two lines.

∴ Number of intersection points

= Number of ways of selecting 2 lines out of the given 5 non-parallel lines.

Required number of points = $^{5}C_2 = 10$

2015 (II)

13. A clock is started at noon. By 10 min past 5, through what angle, the hour hand moves?

(a) 160° (b) 145°
(c) 150° (d) 155°

⊘ **(d)** Since, hour hand moves 30° in hour and $\frac{1}{2}$ in 1 min and time given is noon to 5:10.

Total time is 5 h and 10 min.

∴ Total angle moved by minute hand.

$$= 5 \times 30° + \frac{1}{2} \times 10$$

$$= 150° + 5° = 155°$$

2015 (I)

14. Let OA, OB, OC and OD be rays in the anti-clockwise direction. Such that $\angle AOB = \angle COD = 100°$, $\angle BOC = 82°$ and $\angle AOD = 78°$.

Consider the following statements

I. AOC and BOD are lines.
II. $\angle BOC$ and $\angle AOD$ are supplementary.

Which of the statement(s) given above is/are correct?

(a) Only I (b) Only II
(c) Both I and II (d) Neither I nor II

⊘ **(d)** Given, $\angle AOB = \angle COD = 100°$ and $\angle BOC = 82°$, $\angle AOD = 78°$
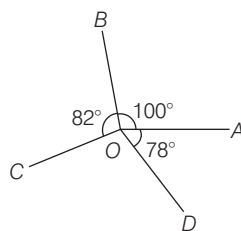
If AOC is a straight line.

∴ $\angle AOB + \angle BOC = 180°$

$$\Rightarrow \quad 100° + 82° = 180°$$

$$\Rightarrow \quad 182° \neq 180°$$

[AOC is not a straight line]

If BOD is a straight line.

∴ $\angle BOA + \angle AOD = 180°$

$$\Rightarrow \quad 100° + 78° = 180°$$

$$\Rightarrow \quad 178° \neq 180°$$

[∴ BOD is not a straight line]

If $\angle BOC$ and $\angle AOD$ are supplementary angles.

∴ $\angle BOC + \angle AOD = 180°$

$$\Rightarrow \quad 82° + 78° = 180°$$

$$\Rightarrow \quad 160° \neq 180°$$

[∴ $\angle BOC$ and $\angle AOD$ are not supplementary]

Hence, Statements I and II are incorrect.

15. The complement angle of $80°$ is

(a) $\dfrac{18}{\pi}$ radian (b) $\dfrac{5\pi}{9}$ radian
(c) $\dfrac{\pi}{18}$ radian (d) $\dfrac{9}{5\pi}$ radian

⊘ **(c)** Let the angle be θ.

Then, $\theta = 80°$

∴ Complement angle

$$= 90° - \theta = 90° - 80° = 10°$$

[∵ sum of two complementary angles is 90°]

$$= 10° \times \frac{\pi}{180°} = \frac{\pi}{18} \text{ radian}$$

2014 (I)

16. At what point of time after 3 O'clock, hour hand and the minute hand of a clock occur at right anles for the first time?

(a) 9 O'clock (b) $4 \text{ h } 37\frac{1}{6}$ min
(c) $3 \text{ h } 30\frac{8}{11}$ min (d) $3 \text{ h } 32\frac{8}{11}$ min

⊘ **(d)** Clock will make right angle at

$(5n + 15) \times \dfrac{12}{11}$ min past n.

Here, $n = 3$

∴ $(5 \times 3 + 15) \times \dfrac{12}{11}$ min past 3

$$= 30 \times \frac{12}{11} \text{ min past 3}$$

$$= 32\frac{8}{11} \text{ min past 3 i.e } 3 \text{ h } 32\frac{8}{11} \text{ min}$$

1. Which one of the following is correct in respect of a right angled triangle?

(a) Its orthocentre lies inside the triangle
(b) Its orthocentre lies outside the triangle
(c) Its orthocentre lies on the triangle
(d) It has no orthocentre

⊙ **(c)** Orthocentre of a right angle triangle lies on the triangle.
It is a property of a right angle triangle.

2. The perimeters of two similar triangles ABC and PQR are 75 cm and 50 cm, respectively. If the length of one side of the triangle PQR is 20 cm, then what is the length of corresponding side of the triangle ABC?

(a) 25 cm (b) 30 cm (c) 40 cm (d) 45 cm

⊙ **(b)** $\triangle ABC$ and $\triangle PQR$ are two similar triangles.

Then, $\dfrac{AB}{PQ} = \dfrac{BC}{QR} = \dfrac{AC}{PR} = k$

∴ $AB = kPQ,\ BC = kQR,\ AC = kPR$

$AB + BC + AC = K(PQ + QR + PR)$

$75 = 50 \times k$

$k = \dfrac{75}{50} \Rightarrow k = \dfrac{3}{2}$

$\dfrac{AB}{PQ} = \dfrac{3}{2}$

$AB = \dfrac{3}{2} \times PQ = \dfrac{3}{2} \times 20$

∴ $AB = 30$ cm

3. Suppose P, Q and R are the mid-points of sides of a triangle of area 128 cm^2. If a triangle ABC is drawn by joining the mid-points of sides of triangle

PQR, then what is the area of triangle ABC?

(a) 4 cm^2 (b) 8 cm^2
(c) 16 cm^2 (d) 32 cm^2

⊙ **(b)**
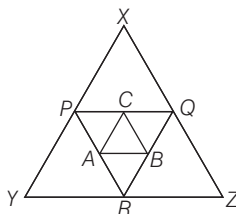
We know, by mid-point theorem, in $\triangle XYZ$ and $\triangle PQR$

$\dfrac{1}{4}$ ar$(\triangle XYZ)$ = ar $(\triangle PQR)$

Similarly, $\dfrac{1}{4}$ ar $(\triangle PQR)$ = ar $(\triangle ABC)$

$\dfrac{1}{16}$ ar $(\triangle XYZ)$ = ar$(\triangle ABC)$

ar$(\triangle ABC) = \dfrac{128}{16}$ cm^2

∴   ar$(\triangle ABC) = 8$ cm^2

4. let two lines p and a be parallel.

Consider two points B and C on the line p and two points D and E on the line q. The line through B and E intersects the line through C and D at A in between the two lines p and q. If $AC : AD = 4 : 9$, then what is the ratio of area of triangle ABC to that of traingle ADE?

(a) 2 :.3   (b) 4 : 9
(c) 16 : 81   (d) 1: 2

⊙ **(c)**
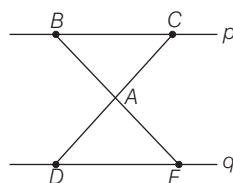
In $\triangle ABC$ and $\triangle ADE$,
$\angle BAC = \angle DAE$ [opposite angle]
$\angle ACB = \angle ADE$
[alternate interior angle]
$\angle ABC = \angle AED$
[alternate interior angle]
∴ $\triangle ABC \approx \triangle AED$
$\dfrac{Ar(\triangle ABC)}{Ar(\triangle AED)} = \dfrac{AC^2}{AD^2} = \dfrac{4^2}{9^2}$
∴ $\dfrac{Ar(\triangle ABC)}{Ar(\triangle AED)} = \dfrac{16}{81}$

5. ABC is a triangle right angled at B. If $AB = 5$ cm and $BC = 10$ cm, then what is the length of the perpendicular drawn from the vertex B to the hypotenuse?

(a) 4 cm   (b) $2\sqrt{5}$ cm
(c) $\dfrac{4}{\sqrt{5}}$ cm   (d) 8 cm

⊙ **(b)**
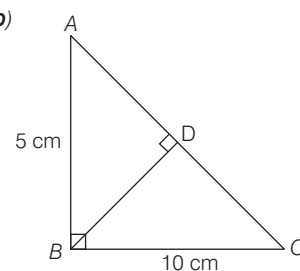
In $\triangle ABC$, $AB = 5$ cm
$BC = 10$ cm
Using Pythagoras theorem, we get
$AB^2 + BC^2 = AC^2$
$5^2 + 10^2 = AC^2$
$AC = 5\sqrt{5}$
$BD = \dfrac{AB \times BC}{AC} = \dfrac{5 \times 10}{5\sqrt{5}}$

$BD = \dfrac{10}{\sqrt{5}}$

$= \dfrac{10}{\sqrt{5}} \times \dfrac{\sqrt{5}}{\sqrt{5}}$

$BD = 2\sqrt{5}$ cm

2019 (I)

6. Three consecutive integers form the lengths of a right angled triangle. How many sets of such three consecutive integers is/are possible?

(a) Only one
(b) Only two
(c) Only three
(d) Infinitely many

⊘ (**a**) Three consecutive integers form the lengths of a right-angled triangle.
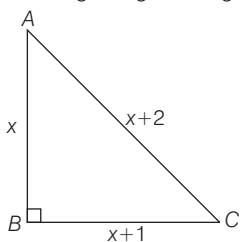
$(x)^2 + (x + 1)^2 = (x + 2)^2$
$x^2 + x^2 + 2x + 1 = x^2 + 4x + 4$
$x^2 - 2x - 3 = 0$

$(x - 3)(x + 1) = 0$ $\quad \begin{bmatrix} x = 3 \\ x + 1 = 4 \\ x + 2 = 5 \end{bmatrix}$

$x = 3$ or $x = -1$

Only one set have consecutive integers.
[not possible length never be negative]
Option (a) is correct.

7. Consider the following inequalities in respect of any triangle ABC:

1. $AC - AB < BC$
2. $BC - AC < AB$
3. $AB - BC < AC$

Which of the above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

⊘ (**d**) Property of triangle
Difference of two side of triangle is less than third side of the triangle.
Then, all the statement is correct.
Option (d) is correct.

Directions (Q. Nos. 8 and 9) Read the given information carefully and answer the given question below.

An equilateral triangle ABC is inscribed in a circle of radius $20\sqrt{3}$ cm.

8. What is the length of the side of the triangle?

(a) 30 cm   (b) 40 cm
(c) 50 cm   (d) 60 cm

⊘ (**d**) Let length of the side of the triangle
$= a$

Circumradius of triangle $= \dfrac{a}{\sqrt{3}}$

$20\sqrt{3} = \dfrac{a}{\sqrt{3}}$

$a = 60$ cm

Option (d) is correct.

9. The centroid of the triangle ABC is at a distance d from the vertex A. What is d equal to?

(a) 15 cm
(b) 20 cm
(c) $20\sqrt{3}$ cm
(d) $30\sqrt{3}$ cm

⊘ (**c**) Centroid of the triangle ABC is at a distance "d" from the vertex A.
All the centres of triangle at one point in equilateral triangle.
Then, circumradius of circumcircle is equal to "d" distance $= 20\sqrt{3}$ cm
Option (c) is correct.

10. A ladder is resting against a vertical wall and its bottom is 2.5 m away from the wall. If it slips 0.8 m down the wall, then its bottom will move away from the wall by 1.4 m.

What is the length of the ladder?

(a) 6.2 m   (b) 6.5 m
(c) 6.8 m   (d) 7.5 m

(**b**) A ladder is resting against a vertical wall.
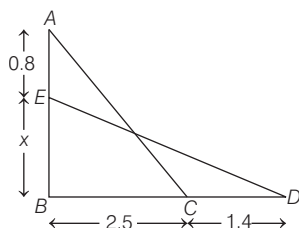
AC is length of ladder.
After slip,
DE is length of ladder
$\quad AC = DE \qquad\qquad …(i)$
$\triangle ABC$ using pythogoras theorem
$\quad (0.8 + x)^2 + (2.5)^2 = (AC)^2$
$\quad x^2 + 0.64 + 1.6x + 6.25 = AC^2 \ …(ii)$
In $\triangle BDE$ using pythogoras theorem
$\quad x^2 + (2.5 + 1.4)^2 = (DE)^2$
$\quad\quad x^2 + 15.21 = DE^2 \qquad …(iii)$
From Eqs. (ii) and (iii) equal
by $(AC = DE)$ Eq. (i)
Then,
$x^2 + 15.21 = x^2 + 0.64 + 1.6x + 6.25$
$\quad x = \dfrac{15.21 - 6.89}{1.6}$

$x = 5.2$ m $\qquad\qquad …(iv)$
On putting $x = 5.2$ in Eq. (iii), we get
$\quad (5.2)^2 + 15.21 = (DE)^2$
$\quad DE = \sqrt{27.04 + 15.21}$
$\quad DE = \sqrt{42.5}$
$\quad\quad = 6.5$ m
Option (b) is correct.

2018 (II)

11. In the figure given below, ABC is an equilateral triangle with each side of length 30 cm. XY is parallel to BC. XP is parallel to AC and YQ is parallel to AC and YQ is parallel to AB. If $XY + XP + YQ$ is 40 cm, then the value of PQ is
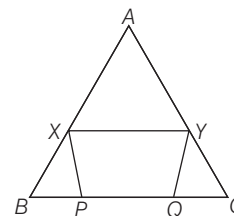
(a) 5 cm   (b) 12 cm (c) 15 cm (d) 10 cm

⊘ (**d**) Given, $AB = BC = AC = 30$
XY is parallel to BC
$\therefore AXY$ is also equilateral triangle
similarly, XBP and CYQ is an equilateral triangle
$\therefore\ XY = AX$, $XP = BX \Rightarrow QY = CY = CQ$
$XY + XP + QY = 40$
$AX + BX + CY = 40$
$AB + CQ = 40 \Rightarrow$
$CQ = 40 - 30 = 10 = BP$
$\qquad PQ = BC - (BP + CQ)$
$\qquad\qquad = 30 - 20 = 10$ cm

12. In a triangle ABC, the sides AB, AC are produced and the bisectors of exterior angles of $\angle ABC$ and $\angle ACB$ intersect at D. If $\angle BAC = 50°$, then $\angle BDC$ is equal to

(a) 115°   (b) 65   (c) 55°   (d) 40°

⊘ (**b**) $\angle BDC = 180° - (u + v)$
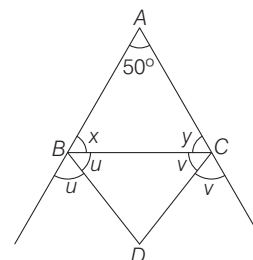
$$= 180° - \left(\frac{50 + y}{2} + \frac{50 + x}{2}\right)$$

{∵ exterior angle is equal to the sum of interior opposite angles}

$$= 180° - \left(50 + \frac{x + y}{2}\right)$$

$$= 180° - \left(50° + \frac{180° - 50°}{2}\right)$$

$$= 180° - (50° + 65°)$$

$$= 180° - (25 + 90) = 180° - 115° = 65°$$

13. If ABC is a right-angled triangle with AC as its hypotenuse, then which one of the following is correct?

(a) $AC^3 < AB^3 + BC^3$
(b) $AC^3 > AB^3 + BC^3$
(c) $AC^3 \leq AB^3 + BC^3$
(d) $AC^3 \geq AB^3 + BC^3$

⟩ (**b**) Here, ABC is a right angle triangle with AC as its hypotenuse
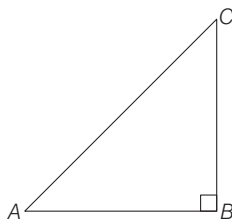
Let $AC = 5$, $AB = 3$, $BC = 4$

∴ $AC^3 = (5)^3 = 125$

$AB^3 = (3)^3 = 27$

$BC^3 = (4)^3 = 64$

$AB^3 + BC^3 = 27 + 64 = 91$

∴ $AC^3 > AB^3 + BC^3$

14. In the figure given below, $\Delta ABR \sim \Delta PQR$. If $PQ = 3$ cm, $AB = 6$ cm, $BR = 8.2$ cm and $PR = 5.2$ cm, then QR and AR are respectively
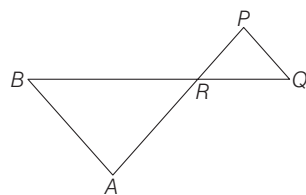
(a) 8.2 cm, 10.4 cm (b) 4.1 cm, 6 cm
(c) 2.6 cm, 5.2 cm (d) 4.1 cm, 10.4 cm

⟩ (**d**) Given, $PQ = 3$ cm, $AB = 6$ cm, $BR = 8.2$ cm, $PR = 5.2$ cm
and $\Delta ABR \sim \Delta PQR$
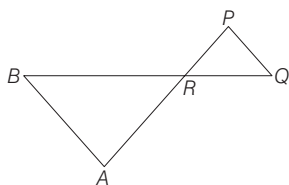
∴ $\frac{AB}{PQ} = \frac{AR}{PR} = \frac{BR}{QR}$

$\frac{6}{3} = \frac{AR}{5.2} = \frac{8.2}{QR}$

Solving and, we get
$QR = 4.1$ cm and $AR = 10.4$ cm

15. In the figure given below ABC is a triangle with AB perpendicular to BC. Further BD is perpendicular to AC. If $AD = 9$ cm and $DC = 4$ cm, then what is the length of BD?
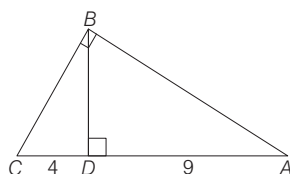
(a) 13/36 cm (b) 36/13 cm
(c) 13/2 cm (d) 6 cm

⟩ (**d**) In ΔABD,
$$BD^2 = AB^2 - AD^2 \quad \ldots(i)$$
In ΔBCD,
$$BD^2 = BC^2 - CD^2 \quad \ldots(ii)$$
Adding Eqs. (i) and (ii), we get
$$2BD^2 = (AB^2 + BC^2) - (AD^2 + CD^2)$$
$$= (AC^2) - (AD^2 + CD^2)$$
$$= (13)^2 - (4^2 + 9^2)$$
$$2BD^2 = 169 - 97 = 72$$
$$BD = \sqrt{\frac{72}{2}} = 6$$

Alternate Method
We know that,
$$BD^2 = CD \times AD$$
$$BD^2 = 4 \times 9 = 36$$
$$BD = 6 \text{ cm}$$

2018 (I)

16. ABC is a triangle right angled at C with $BC = a$ and $AC = b$. If p is the length of the perpendicular from C on AB, then which one of the following is correct?

(a) $a^2 b^2 = p^2(a^2 + b^2)$
(b) $a^2 b^2 = p^2(b^2 - a^2)$
(c) $2a^2 b^2 = p^2(a^2 + b^2)$
(d) $a^2 b^2 = 2p^2(a^2 + b^2)$

⟩ (**a**) According to the question,
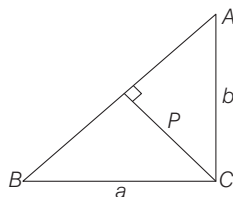
Area of $\Delta ABC = \frac{1}{2} ab$

$$= \frac{1}{2} \times p \times AB$$

⇒ $AB = \frac{ab}{p}$

Using pythagoras theorem in ΔABC, we get

$$AB^2 = AC^2 + BC^2$$
$$\frac{a^2 b^2}{p^2} = b^2 + a^2$$

⇒ $a^2 b^2 = p^2(a^2 + b^2)$

17. Consider the following statements
1. The orthocentre of a triangle always lies inside the triangle.
2. The centroid of a triangle always lies inside the triangle.
3. The orthocentre of a right angled triangle lies on the triangle.
4. The centroid of a right angled triangle lies on the triangle.
Which of the above statements are correct?
(a) 1 and 2 (b) 1 and 4
(c) 2 and 3 (d) 2 and 4

⟩ (**c**) 2 and 3

18. Consider the following statements Two triangles are said to be congruent, if
1. Three angles of one triangle are equal to the corresponding three angles of the other triangle.
2. Three sides of one triangle are equal to the corresponding three sides of the other triangle.
3. Two sides and the included angle of one triangle are equal to the corresponding two sides and the included angle of the other triangle.
4. Two angles and the included side of one triangle are equal to the corresponding two angles and the included side of the other triangle.

Which of the above statements are correct?
(a) 1, 2 and 3
(b) 1, 3 and 4
(c) 1, 2 and 4
(d) 2, 3 and 4

(**d**) 2, 3 and 4 are correct.

Directions (Q. No. 19 and 20)
Consider the following for the next two (02) questions

In a triangle ABC, a, b and c are the lengths of the sides and p, q and r are the lengths of its medians.

19. Which one of the following is correct?

(a) $2(p+q+r)=(a+b+c)$
(b) $2(p+q+r)>3(a+b+c)$
(c) $2(p+q+r)<3(a+b+c)$
(d) $11(p+q+r)>10(a+b+c)$

⊙ **(c)** Let $AB=c$, $BC=a$,
$CA=b$, $AD=p$,
$BE=q$, $CF=r$
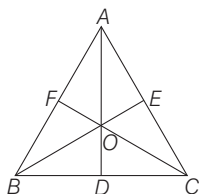
In $\triangle ABD$,
$AB+BD>AD$
$\Rightarrow \quad c+\dfrac{a}{2}>p$ ...(i)

In $\triangle BCE$,
$BC+CE>BE$
$\Rightarrow \quad a+\dfrac{b}{2}>q$ ...(ii)

In $\triangle AFC$,
$AC+AF>CF$
$\Rightarrow \quad b+\dfrac{c}{2}>r$ ...(iii)

Add Eqs. (i), (ii) and (iii) Eqs. we get
$3\dfrac{(a+b+c)}{2}>p+q+r$

$3(a+b+c)>2(p+q+r)$

20. Which one of the following is correct

(a) $(a+b+c)<(p+q+r)$
(b) $3(a+b+c)<4(p+q+r)$
(c) $2(a+b+c)>3(p+q+r)$
(d) $3(a+b+c)>4(p+q+r)$

⊙ **(b)** $AO=\dfrac{2}{3}P$, $BO=\dfrac{2}{3}q$, $CO=\dfrac{2}{3}r$
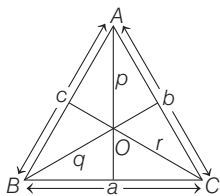
In $\triangle AOB$, $AO+BO>AB$
$\dfrac{2}{3}(p+q)>c$

Similarly, In $\triangle BOC$ and $\triangle AOC$
$\dfrac{2}{3}(q+r)>a$

and $\dfrac{2}{3}(p+r)>b$

$\because \dfrac{2}{3}(p+q+q+r+r+p)>a+b+c$

$\Rightarrow \quad 4(p+q+r)>3(a+b+c)$

2017 (II)

21. If angle A of triangle ABC is $30°$ and the circum-radius of the triangle is 10 cm, then what is the length of side BC?

(a) 5 cm   (b) 10 cm
(c) $5\sqrt{3}$ cm   (d) $10\sqrt{3}$ cm

⊙ **(b)** We have, in $\triangle ABC$,
$\angle A=30°$
$\angle BOC=2\angle A$
{∵ angle at the center is double the angle at the circumference}
$\angle BOC=2\times30°=60°$
In $\triangle BOC$,
$BO=OC=$ radius of circle
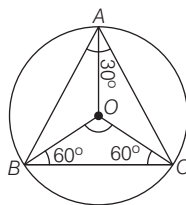
∴ $\triangle BOC$ is an equilateral triangle
Hence, $BO=OC=BC=10$ cm

22. If a triangle ABC, AD is perpendicular on BC. If $\angle BAC=90°$, $AB=c$, $BC=a$, $CA=b$ and $AD=p$, then which one of the following correct?

(a) $p=abc$ (b) $p^2=bc$
(c) $p=\dfrac{bc}{a}$ (d) $p=\dfrac{ab}{c}$

⊙ **(c)** In $\triangle ABC$, AD is perpendicular on BC
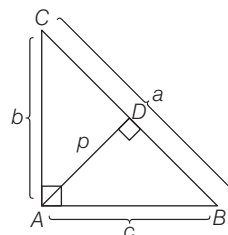
$\angle BAC=90°$
$AB=c$, $BC=a$
$CA=b$, $AD=p$
Area of $\triangle ABC$
$=\dfrac{1}{2}\times AC\times AB=\dfrac{1}{2}\times AD\times BC$
$\dfrac{1}{2}\times b\times c=\dfrac{1}{2}\times p\times a$
$bc=pa\Rightarrow p=\dfrac{bc}{a}$

23. In an equilateral triangle ABC, BD is drawn perpendicular to AC. What is BD^2 equal to?

(a) AD^2 (b) $2AD^2$ (c) $3AD^2$ (d) $4AD^2$

⊙ **(c)** We have, ABC is an equilateral triangle
∴ $AB=BC=AC$
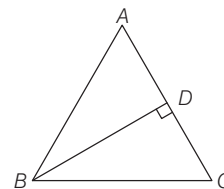
BD, is perpendicular on AC
In $\triangle ABD$,
$AB^2=AD^2+BD^2$
$\Rightarrow BD^2=AB^2-AD^2$
$\Rightarrow BD^2=AC^2-AD^2$ [∵ $AB=AC$]
$\Rightarrow BD^2=(2AD)^2-AD^2$ $\left[\because AD=\dfrac{1}{2}AC\right]$
$\Rightarrow BD^2=3AD^2$

24. If PL, QM and RN are the altitudes of triangle PQR whose orthocentre is O, then Q is the orthocentre of the triangle.

(a) OPQ (b) OQR (c) PLR (d) OPR

⊙ **(d)** We know that, orthocentre is intersection point of altitude of triangle.
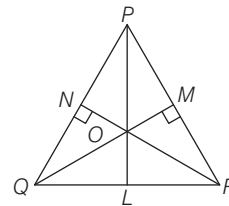
We can see that, Q is outside the $\triangle OPR$ and $\triangle OPR$ is obtuse-angled triangle. Since, on the centre of an obtuse-angled triangle is always outside the triangle, therefore Q is the orthocentre of $\triangle OPR$.

25. In triangle ABC, $\angle C=90°$ and CD is the perpendicular from C to AB. If $(CD)^{-2}=(BC)^{-2}+(CA)^{-2}$, then which one of following is correct?

(a) $BC\cdot CD=AB\cdot CA$
(b) $AB\cdot BC=CD\cdot CA$
(c) $CA^2+CB^2=2(AD^2+CD^2)$
(d) $AB\cdot CD=BC\cdot CA$

⊙ **(d)**
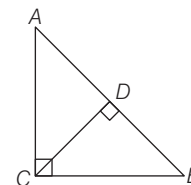
$AC^2+CB^2=AB^2$ ...(i)
$\dfrac{1}{CD^2}=\dfrac{1}{BC^2}+\dfrac{1}{AC^2}$ [given]

$$\frac{1}{CD^2} = \frac{AC^2 + BC^2}{AC^2 BC^2}$$

$$\frac{1}{CD^2} = \frac{AB^2}{AC^2 BC^2} \quad \text{[by Eq. (i)]}$$

$$AB^2 \cdot CD^2 = AC^2 \cdot BC^2$$

$$AB \cdot CD = AC \cdot BC$$

26. In a triangle ABC, the medians AD and BE intersect at G. A line DF is drawn parallel to BE such that F is on AC. If $AC = 9$ cm, then what is CF equal to?

(a) 2.25 cm   (b) 3 cm
(c) 4.5 cm   (d) 6 cm

⊙ **(a)** In ΔBEC,
GE is parallel to DF
∴ BE is parallel to DF
D is mid point of BC
∴ F is also mid point of EC
[∵ by mid-point theorem]
∴ $FC = \frac{1}{2} EC$
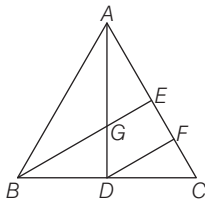
$$\Rightarrow \quad FC = \frac{1}{2}\left(\frac{AC}{2}\right) = \frac{AC}{4}$$

$$\Rightarrow \quad FC = \frac{9}{4} = 2.25 \text{ cm} \quad [AC = 9 \text{ cm}]$$

27. In a trianlge PQR, X is a point on PR and Y is a point on QR such that $PR = 10$ cm, $RX = 4$ cm, $YR = 2$ cm, $QR = 5$ cm. What one of the following is correct?

(a) XY is parallel to PQ
(b) $PQ = 2XY$
(c) $PX = QY$
(d) $PQ = 3XY$

⊙ **(a)** We have, In ΔPQR
$PR = 10$ cm, $RX = 4$ cm, $RY = 2$ cm
$QR = 5$ cm
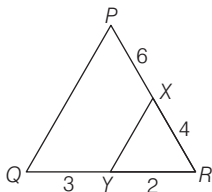
∴ $PX = PR - RX = 10 - 4 = 6$ cm
  $QY = QR - YR = 5 - 2 = 3$ cm
$$\frac{PX}{XR} = \frac{QY}{YR} = \frac{3}{2}$$
∴ XY is parallel to PQ [by BPT]

28. Consider the following statements
1. The point of intersection of the perpendicular bisectors of the sides of a triangle may lie outside the triangle.
2. The point of intersection of the perpendicular drawn from the vertices to the opposite side of a triangle may lie on two sides.

Which of the above statements is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ **(c)**
1. The point of intersection of the perpendicular bisectors of the sides of a triangle is the circumcentre of triangle,
Therefore, the circumcentre of obtuse-angle triangle lies outside the circle.
∴ Statement 1 is correct.

2. Yes, In case of right angled triangle, the point of intersection of the perpendiculars drawn from the vertices to the opposites sides *i.e* on the right angle vertex, which lies on two sides.
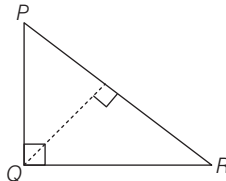
∴ Statement 2 is correct.

29. The diagonals of a cyclic quadrilateral $ABCD$ intersect at P and the area of the triangle APB is 24 square cm. If $AB = 8$ cm and $CD = 5$ cm, then what is the area of the triangle CPD

(a) 24 cm^2
(b) 15 cm^2
(c) 12.5 cm^2
(d) 9.375 cm^2

⊙ **(d)** We have $ABCD$ is cyclic quadrilateral
$AB = 8$ cm
$CD = 5$ cm area $\Delta APB = 24$ cm^2
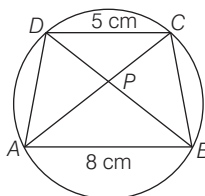
Since, $ABCD$ is cyclic quadrilateral
In ΔAPB and ΔCPD,

∠APB = ∠DPC [opposite angle]
∠PAB = ∠PCD [alternate interior angle]
∠ABP = ∠PDC [alternate interior angle]
∴ $\Delta PDC \sim \Delta PAB$
∴ $\dfrac{\text{area of } \Delta PDC}{\text{area of } \Delta PAB} = \dfrac{CD^2}{AB^2}$
$\Rightarrow$ $\dfrac{\text{area of } \Delta PDC}{24} = \dfrac{(5)^2}{(8)^2}$
$\Rightarrow$ area of $\Delta PDC = \dfrac{25 \times 24}{64}$
           $= 9.375$ cm^2

30. One-fifth of the area of a triangle ABC is cut off by a line DE drawn parallel to BC such that D is on AB and E is on AC. If $BC = 10$ cm, then what is DE equal to?

(a) $\sqrt{5}$ cm   (b) $2\sqrt{5}$ cm
(c) $3\sqrt{5}$ cm   (d) $4\sqrt{5}$ cm

⊙ **(b)** Since, $DE \parallel BC$, therefore
    ∠ADE = ∠ABC
and   ∠AED = ∠ACB
         [corresponding angles]
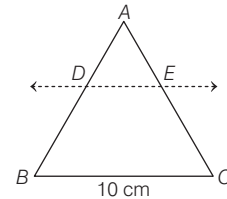
Thus, $\Delta ADE \sim \Delta ABC$
       [By AA – similarity criterion]
$\Rightarrow$ $\dfrac{\text{ar}(\Delta ADE)}{\text{ar}(\Delta ABC)} = \left(\dfrac{DE}{BC}\right)^2$
$\Rightarrow$ $\dfrac{1}{5} = \dfrac{DE^2}{10^2}$
     $\left[\because \text{ar}(\Delta ADE) = \dfrac{1}{5}\text{ar}(\Delta ABC)\right]$
$\Rightarrow$ $DE^2 = 20$
$\Rightarrow$ $DE = 2\sqrt{5}$ cm

2017 (I)

31. Which one of he following triples does not represent the sides of a triangle?

(a) (3, 4, 5)   (b) (4, 7, 10)
(c) (3, 6, 8)   (d) (2, 3, 6)

⊙ **(d)** If, a, b, c represents the sides of the triangle, then sum of the two sides must be greater than the third side.
Since, $2 + 3 < 6$
∴ (2, 3, 6) can't be side of a triangle.

32. The angles of a triangle are in the ratio $2:4:3$. The smallest angle of the triangle is

(a) 20° (b) 40°
(c) 50° (d) 60°

⊗ (**b**) Since, the angles of a triangle are in the ratio 2 : 4 : 3.

∴ Smallest angle $= \dfrac{2}{2+4+3} \times 180°$

$= \dfrac{2}{9} \times 180° = 40°$

33. ABC is a triangle and D is a point on the side BC. If $BC = 12$ cm, $BD = 9$ cm and $\angle ADC = \angle BAC$, then the length of AC is equal to

(a) 5 cm (b) 6 cm
(c) 8 cm (d) 9 cm

⊗ (**b**) In ΔABC and ΔDAC,

$\angle BAC = \angle ADC$ [given]
$\angle ACB = \angle DCA$ [common]
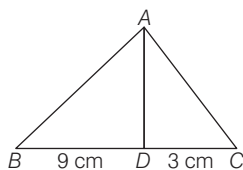
∴ $\Delta ABC \sim \Delta DAC$ [by AA similarity]

∴ $\dfrac{AC}{DC} = \dfrac{BC}{AC}$

$\Rightarrow$ $AC^2 = DC \times BC$
$\Rightarrow$ $AC^2 = 3 \times 12$
$\Rightarrow$ $AC^2 = 36$
$\Rightarrow$ $AC = 6$ cm

34. In a trapezium $ABCD$, AB is parallel to CD and the diagonals intersect each other at O. What is the ratio of OA to OC equal to?

(a) Ratio of OB to OD
(b) Ratio of BC to CD
(c) Ratio of AD to AB
(d) Ratio of AC to BD

⊗ (**a**)
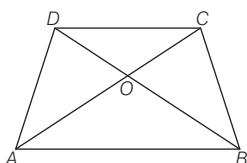
Since, $AB \parallel CD$
Now, In ΔAOB and ΔCOD

$\angle OAB = \angle OCD$
$\angle OBA = \angle ODC$
  [alternate interior angles]
$\angle AOB = \angle COD$
  [vertically opposite angle]
$\Delta AOB \sim \Delta COD$ [by AA similarity rule]

∴ $\dfrac{OA}{OC} = \dfrac{OB}{OD}$

35. In the figure given below $\angle A = 80°$ and $\angle ABC = 60°$. BD and CD bisect angles B and C respectively. What are the values of x and y respectively?
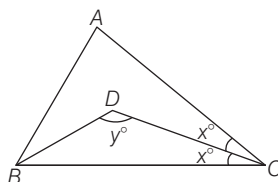
(a) 10 and 130 (b) 10 and 125
(c) 20 and 130 (d) 20 and 125

⊗ (**c**) We have,

$\angle A = 80°$ and $\angle ABC = 60°$
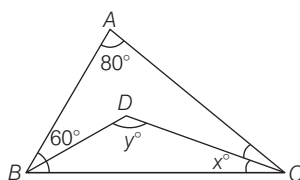
Now, in ΔABC

$\angle A + \angle B + \angle C = 180°$
$\Rightarrow$ $80° + 60° + \angle C = 180°$
$\Rightarrow$ $\angle C = 180° - 140°$
$= 40°$

∵ BD and CD are the bisectors of angle B and C respectively.

∵ $\angle DCB = \dfrac{1}{2}\angle C$

$= \dfrac{1}{2} \times 40° = 20° = x°$

and $\angle DBC = \dfrac{1}{2}\angle B = \dfrac{1}{2} \times 60° = 30°$

Again, in ΔBCD,

$\angle BDC + \angle DBC + \angle DCB = 180°$
$\Rightarrow$ $y° + 30° + 20° = 180°$
$\Rightarrow$ $y° = 180° - 50°$
$= 130°$

36. In the figure given below, PQR is a non-isosceles right-angled triangle, right angled at Q. If LM and QT are parallel and $QT = PT$ then what is $\angle RLM$ equal to?
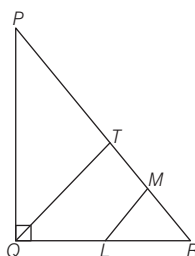
(a) $\angle PQT$ (b) $\angle LRM$
(c) $\angle RML$ (d) $\angle QPT$

⊗ (**b**)
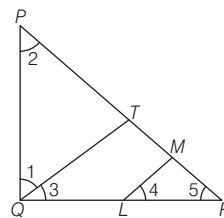
Since, $QT = PT$ [given]
∴ $\angle 1 = \angle 2$
  [angles opposite to equal side are also equal] ...(i)
Again, $\angle PQR = 90°$
∴ $\angle 3 = 90 - \angle 1$ ...(ii)
Now, $\angle 4 = \angle 3$ ...(iii) [$LM \parallel QT$]
$\angle 4 = 90° - \angle 1$ ...(iv)
  [from Eq. (ii)]

Again, in ΔPQR,

$\angle P + \angle Q + \angle R = 180°$
$\Rightarrow$ $\angle 2 + 90° + \angle 5 = 180°$
$\Rightarrow$ $\angle 5 = 90 - \angle 2$
$\Rightarrow$ $\angle 5 = 90 - \angle 1$ ...(iv)
  [from Eq. (i)]

∴ From Eqs. (iv) and (v)

$\angle 4 = \angle 5$
$\Rightarrow$ $\angle RLM = \angle LRM$

37. In the figure given below, ABC is a triangle with $AB = BC$ and D is an interior point of the triangle ABC such that $\angle DAC = \angle DCA$.
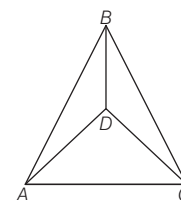
Consider the following statements
1. Triangle ADC is an isosceles triangle.
2. D is the centroid of the triangle ABC.
3. Triangle ABD is congruent to the triangle CBD.

Which of the above statements are correct?

(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

⊗ (**c**)
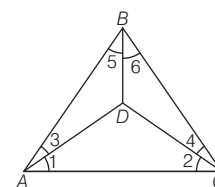
In Δ ADC, $\angle 1 = \angle 2$ [given]
∴ $AD = CD$
[∵ if two angles of a triangle are equal then corresponding sides are also equal]

$\therefore \Delta ADC$ is an isosceles triangle'.

$\therefore$ Statement 1 is correct.

Now, in ΔABD and ΔCBD,

$$AB = BC \qquad \text{[given]}$$
$$AD = CD \qquad \text{[proved above]}$$
$$BD = BD \qquad \text{[common]}$$

$\therefore$ By sss, $\Delta ABD \cong \Delta CBD$

$\therefore$ Statement 3 is correct.

$\therefore$ by $CPCT$, $\angle 3 = \angle 4$

and $\angle 5 = \angle 6$

$\therefore D$ is the intersecting point of angle bisector. So, D is incentre of ΔABC.

38. In the figure given below, M is the mid-point of AB and $\angle DAB = \angle CBA$ and $\angle AMC = \angle BMD$. Then the triangle ADM is congruent to the triangle BCM by
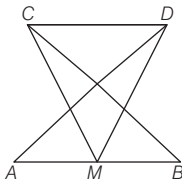
(a) SAS rule   (b) SSS rule
(c) ASA rule   (d) AAA rule

⊘ (*c*)
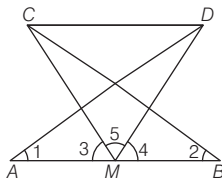
We have, $\angle 3 = \angle 4$ [given]

On adding $\angle 5$ to both the sides, we get

$$\angle 3 + \angle 5 = \angle 4 + \angle 5$$
$$\Rightarrow \qquad \angle AMD = \angle BMC$$

Now, In ΔADM and ΔBCM

$$\angle 1 = \angle 2 \qquad \text{[given]}$$
$$AM = BM$$

[M is mid-point of AB]

$$\angle AMD = \angle BMC \qquad \text{[proved above]}$$
$$\therefore \qquad \Delta ADM \cong \Delta BCM$$

[by ASA congruence rule]

39. $ABCD$ is a square. X is the mid-point of AB and Y is the mid-point of BC.

Consider the following statements

1. Triangles ADX and BAY are congruent
2. $\angle DXA = \angle AYB$
3. DX is inclined at an angle 60° with AY
4. DX is not perpendicular to AY

Which of the above statements are correct?

(a) 2, 3 and 4   (b) 1, 2 and 4
(c) 1, 3 and 4   (d) 1 and 2

⊘ (*d*)
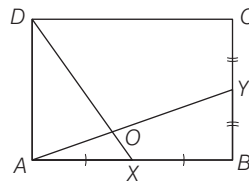
In ΔADX and ΔBAY

$$AD = BA \qquad \text{[side of square]}$$
$$\angle DAX = \angle ABY = 90°$$
$$AX = BY$$
$$[AB = BC \Rightarrow \tfrac{1}{2} AB = \tfrac{1}{2} BC]$$
$$\Delta ADX \cong \Delta BAY$$

[by SAS congruence rule]

$\therefore$ Statement 1 is correct.

$$\angle DXA = \angle AYB \qquad \text{[by CPCT]}$$

$\therefore$ Statement 2 is correct.

Now, $\Delta ADX \cong \Delta BAY$

$\therefore \qquad \angle XDA = \angle YAB$

Again, $\angle OAD = 90° - \angle OAX$

$$= 90° - \angle YAB$$
$$= 90° - \angle XDA$$

In ΔAOD,

$$\angle ODA + \angle OAD + \angle AOD = 180°$$
$$\Rightarrow \angle XDA + (90 - \angle XDA) + \angle AOD = 180°$$
$$\Rightarrow \qquad \angle AOD = 180° - 90° = 90°$$

[from Eq. (i)]

$\therefore$ DX is perpendicular to AY.

$\therefore$ Statements 1 and 2 are not correct.

2016 (II)

40. Let ABC be a right angled triangle with $BC = 5$ cm and $AC = 12$ cm. Let D be a point on the hypotenuse AB such that $\angle BCD = 30°$. What is length of CD?

(a) $\dfrac{60}{13}$ cm   (b) $\dfrac{17}{2}$ cm

(c) $\dfrac{120}{5 + 12\sqrt{2}}$ cm   (d) $\dfrac{120}{5 + 12\sqrt{3}}$ cm

⊘ (*d*) Given, ΔACB is a right angled triangle, at C, Where, $BC = 5$ cm and $AC = 12$ cm.
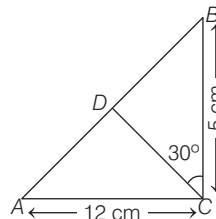
In ΔABC, by pythagoras theorem,

$$AB^2 = AC^2 + BC^2 = 12^2 + 5^2$$
$$= 144 + 25 = 169$$
$$\Rightarrow \qquad AB = 13 \text{ cm} \qquad \dots \text{(i)}$$

In ΔABC, taking sine rule on both sides, we get

$$\Rightarrow \quad \frac{\sin A}{BC} = \frac{\sin B}{AC} = \frac{\sin C}{AB}$$
$$\Rightarrow \quad \frac{\sin A}{5} = \frac{\sin B}{12} = \frac{\sin 90°}{13}$$
$$\Rightarrow \quad \frac{\sin A}{5} = \frac{\sin 90°}{13} \text{ and } \frac{\sin B}{12} = \frac{\sin 90°}{13}$$
$$\Rightarrow \quad \sin A = \frac{5}{13} \text{ and } \sin B = \frac{12}{13} \quad \dots \text{(ii)}$$

Again, in ΔACD and ΔBCD taking sine rule,

we get $\quad \dfrac{\sin A}{CD} = \dfrac{\sin \angle ACD}{AD}$

and $\quad \dfrac{\sin B}{CD} = \dfrac{\sin \angle BCD}{BD}$

$$\Rightarrow \quad \frac{5/13}{CD} = \frac{\sin(90° - 30°)}{AD}$$

and $\quad \dfrac{12/13}{CD} = \dfrac{\sin 30°}{BD}$

[∵ from Eq. (ii) and $\angle ACD = 90° - \angle BCD$, $\angle BCD = 30°$]

$$\Rightarrow \quad \frac{5}{13 CD} = \frac{\sin 60°}{AD}$$

and $\quad \dfrac{12}{13 CD} = \dfrac{\sin 30°}{BD}$

$$\Rightarrow \quad 5AD = 13CD \times \frac{\sqrt{3}}{2}$$

and $\quad 12 BD = 13CD \times \dfrac{1}{2}$

$$\Rightarrow \quad AD = \frac{13}{10}\sqrt{3}\, CD$$

and $\quad BD = \dfrac{13}{24} CD$

Then, $\quad AD + BD = \dfrac{13}{10}\sqrt{3} CD + \dfrac{13}{24} CD$

$$\Rightarrow \quad AB = 13CD \left[\frac{\sqrt{3}}{10} + \frac{1}{24} \right]$$

$$\Rightarrow \quad 13 = 13CD \left(\frac{12\sqrt{3} + 5}{120} \right) \text{[from Eq. (i)]}$$

$$\Rightarrow \quad 1 = CD \left(\frac{12\sqrt{3} + 5}{120} \right)$$

$$\Rightarrow \quad CD = \left(\frac{120}{12\sqrt{3} + 5} \right) \text{cm}$$

2016 (I)

41. In a ΔPQR, point X is on PQ and point Y is on PR such that $XP = 1.5$ units, $XQ = 6$ units, $PY = 2$ units and $YR = 8$ units. Which of the following are correct?

1. $QR = 5XY$
2. QR is parallel to XY.
3. ΔPYX is similar to ΔPRQ.

Select the correct answer using the codes given below.

(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 2 and 3

⊙ *(d)* In $\triangle PQR$, $\dfrac{PX}{XQ} = \dfrac{1.5}{6} = \dfrac{1}{4}$

and $\dfrac{PY}{YR} = \dfrac{2}{8} = \dfrac{1}{4}$
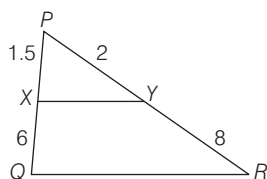
So, $\dfrac{PX}{XQ} = \dfrac{PY}{YR}$

1. $\dfrac{PX}{XY} = \dfrac{PQ}{QR} \Rightarrow \dfrac{1.5}{XY} = \dfrac{7.5}{QR}$

$\Rightarrow QR = 5XY$

2. Also, $\dfrac{PX}{PQ} = \dfrac{PY}{PR} = \dfrac{1}{5}$

$\Rightarrow QR$ is parallel of XY.

3. $\triangle PYX$ is similar to $\triangle PRQ$.

Hence, all statements are correct.

42. ABC is a triangle in which D is the mid-point of BC and E is the mid-point of AD. Which of the following statement(s) is/are correct?

1. The area of $\triangle ABC$ is equal to four times the area of $\triangle BED$.
2. The area of $\triangle ADC$ is twice the area of $\triangle BED$.

Select the correct answer using the codes given below.

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(c)* In $\triangle ABC$, AD is the median and median AD bisects the area of $\triangle ABC$.

Area of $\triangle ABD = \dfrac{1}{2} \times$ Area of $\triangle ABC$
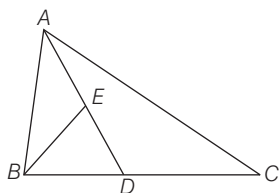
Since, E is the mid-point of AD. Then, BE is the median of $\triangle ABD$. So, BE bisects the area of $\triangle ABD$.

1. Area of $\triangle BED = \dfrac{1}{2} \times$ Area of $\triangle ABD$

$= \dfrac{1}{2}\left[\dfrac{1}{2} \times \text{Area of } \triangle ABC\right]$

$= \dfrac{1}{4} \times$ Area of $\triangle ABC$

Hence, statement 1 is correct.

2. Area of $\triangle ADC =$ Area of $\triangle ABD$

$= 2 \times$ Area of $\triangle BED$

So, Statement 2 is also correct.

43. ABC is a triangle right angled at C as shown below. Which one of the following is correct?
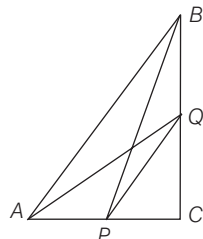
(a) $AQ^2 + AB^2 = BP^2 + PQ^2$
(b) $AQ^2 + PQ^2 = AB^2 + BP^2$
(c) $AQ^2 + BP^2 = AB^2 + PQ^2$
(d) $AQ^2 + AP^2 = BK^2 + KQ^2$

⊙ *(c)* In the given triangle,

$AQ^2 + BP^2$

$= (AC^2 + QC^2) + (PC^2 + BC^2)$

$= AC^2 + PQ^2 - PC^2 + PC^2 + BC^2$

     $[\because$ in $\triangle PQC, QC^2 = PQ^2 - PC^2]$

$= PQ^2 + AC^2 + BC^2 = PQ^2 + AB^2$

     $[\because$ in $\triangle ABC, AC^2 + BC^2 = AB^2]$

44. In the given figure, $AD = CD = BC$. What is the value of $\angle CDB$?
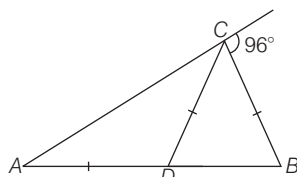
(a) $32°$ (b) $64°$
(c) $78°$
(d) Cannot be determined due to insufficient data

⊙ *(b)* Let $\angle CDB = y$ and $\angle CAD = x$
As, $AD = CD$
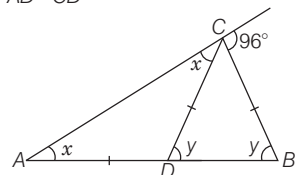
$\Rightarrow \qquad \angle ACD = \angle CAD = x$
and $\qquad CD = CB$
$\Rightarrow \qquad \angle CBD = \angle CDB = y$
From exterior angle property,
$\qquad \angle CDB = \angle CAD + \angle ACD$
$\Rightarrow \qquad\qquad y = x + x \Rightarrow y = 2x$
Now, $\angle ACD + \angle DCB + 96° = 180°$
$\Rightarrow \qquad x + 180° - 2y + 96° = 180°$
$\Rightarrow \qquad\qquad \dfrac{y}{2} - 2y + 96° = 0$
$\Rightarrow \qquad\qquad\qquad \dfrac{3}{2}y = 96°$
$\therefore \qquad\qquad\qquad y = 64°$
$\therefore \qquad\qquad \angle CDB = y = 64°$

45. ABC is an equilateral triangle and X, Y and Z are the points on BC, CA and AB respectively, such that $BX = CY = AZ$. Which of the following is/are correct?

1. XYZ is an equilateral triangle.
2. $\triangle XYZ$ is similar to $\triangle ABC$.

Select the correct answer using the codes given below.

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(c)* In an equilateral $\triangle ABC$,

$\qquad AB = BC = CA$

and $\qquad \angle B = \angle C = \angle A$
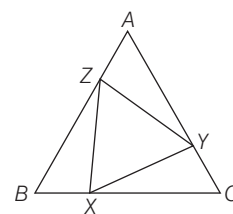
Given that, $BX = CY = AZ$
Now, in $\triangle XYC, \triangle ZYA$ and $\triangle XZB$,

$\qquad BX = CY = AZ \qquad …(i)$
$\Rightarrow (BC - XC) = (AC - AY) = AB - BZ$
$\Rightarrow \qquad XC = AY = BZ \qquad …(ii)$
and $\qquad \angle B = \angle C = \angle A \qquad …(iii)$
From Eqs. (i), (ii) and (iii), we get
$\triangle XYC, \triangle ZYA$ and $\triangle XZB$ are congruent triangles.
$\therefore \qquad\qquad XY = YZ = XZ$
So, $\triangle XYZ$ is an equilateral triangle and $\triangle XYZ$ is similar to $\triangle ABC$.
So, both statements are correct.

46. A square is inscribed in a right angled triangle with legs p and q and has a common right angle with the triangle. The diagonal of the square is given by

(a) $\dfrac{pq}{p + 2q}$ (b) $\dfrac{pq}{2p + q}$

(c) $\dfrac{\sqrt{2}\,pq}{p + q}$ (d) $\dfrac{2pq}{p + q}$

⊙ *(c)* In $\triangle ABC$ and $\triangle ADE$,
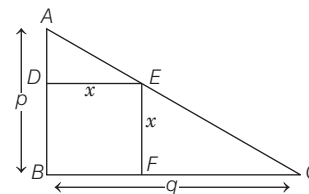
$\dfrac{AD}{AB} = \dfrac{DE}{BC}$

     $[\because \triangle ADE$ is similar to $\triangle ABC]$

$$\Rightarrow \quad \frac{p - x}{p} = \frac{x}{q}$$

$$\Rightarrow \quad (p + q)\, x = pq$$

$$\Rightarrow \quad x = \frac{pq}{p + q}$$

$\therefore$ Diagonal of square $= \sqrt{2}\, x = \dfrac{\sqrt{2}\, pq}{p + q}$

47. In a ΔABC, if $A - B = \dfrac{\pi}{2}$, then $C + 2B$ is equal to

(a) $\dfrac{2\pi}{3}$ (b) $\dfrac{3\pi}{4}$

(c) π (d) $\dfrac{\pi}{2}$

⊙ **(d)** We have, $A + B + C = \pi$

$$\Rightarrow \quad \frac{\pi}{2} + B + B + C = \pi$$

$$\Rightarrow \quad 2B + C = \pi - \frac{\pi}{2} = \frac{\pi}{2}$$

48. Let ABC be a triangle in which $AB = AC$. Let L be the locus of points X inside or on the triangle such that $BX = CX$. Which of the following statements are correct?

1. L is a straight line passing through A and incentre of Δ ABC is on L.
2. L is a straight line passing through A and orthocentre of Δ ABC is a point on L.
3. L is a straight line passing through A and centroid of ΔABC is a point on L.

Select the correct answer using the codes given below.

(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 2 and 3

⊙ **(d)** In ΔABC,
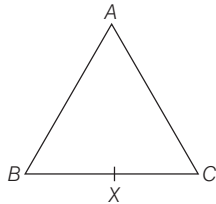
$AB = AC$ i.e. ΔABC is isosceles triangle. If L is the locus of points X inside or on the triangle, such that $BX = CX$. Then, L is a straight line passing through A.
As, AX is bisecting the line BC, then it passes through the centroid.
As, $AB = AC$ in ΔABC, then AX is perpendicular to BC, hence it passes through the orthocentre.
In ΔABC, $AB = AC$ and $AX \perp BC$. So, AX is angle bisector of $\angle A$, hence it passes through the incentre. Hence, all statements are correct.

49. Suppose ABC is a triangle with AB of unit length. D and E are the points lying on AB and AC respectively, such that BC and DE are parallel. If the area of Δ ABC is twice the area of ΔADE, then the length of AD is

(a) $\dfrac{1}{2}$ unit   (b) $\dfrac{1}{3}$ unit

(c) $\dfrac{1}{\sqrt{2}}$ unit   (d) $\dfrac{1}{\sqrt{3}}$ unit

⊙ **(c)** In ΔABC, DE is parallel to BC.

$$\therefore \quad \frac{\text{Area of } \Delta ADE}{\text{Area of } \Delta ABC} = \frac{AD^2}{AB^2}$$

$$\Rightarrow \quad \frac{\text{Area of } \Delta ADE}{2[\text{Area of } \Delta ADE]} = \frac{AD^2}{AB^2}$$
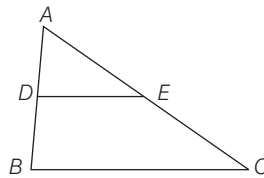
$$\Rightarrow \quad \frac{AD}{AB} = \sqrt{\frac{1}{2}}$$

$$\Rightarrow \quad AD = \frac{1}{\sqrt{2}}\, AB$$

$$\Rightarrow \quad AD = \frac{1}{\sqrt{2}}\, \text{unit} \; [\because \; AB = 1\,\text{unit}]$$

50. Let ΔABC and ΔDEF be such that $\angle ABC = \angle DEF$, $\angle ACB = \angle DFE$ and $\angle BAC = \angle EDF$. Let L be the mid-point of BC and M be the mid-point of EF.

Consider the following statements

I. ΔABL and ΔDEM are similar.

II. ΔALC is congruent to ΔDMF even, if $AC \neq DF$.

Which one of the following is correct in respect of the above statements?

Codes

(a) Both Statement I and Statement II are true and Statement II is the correct explanation of Statement I

(b) Both Statement I and Statement II are true but Statement II is not the correct explanation of Statement I

(c) Statement I is true but Statement II is false

(d) Statement I is false but Statement II is true

⊙ **(c)** Given that, $\angle ABC = \angle DEF$, $\angle ACB = \angle DFE$ and $\angle BAC = \angle EDF$
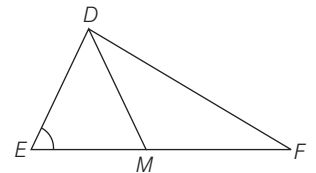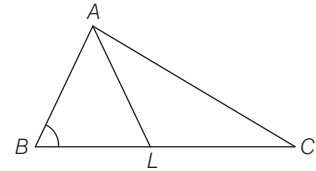
So, ΔABC and ΔDEF are similar.

$$\therefore \quad \frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF}$$

Now, L is the mid-point of BC, then

$$BL = \frac{1}{2}\, BC$$

Also, M is the mid-point of EF, then

$$EM = \frac{1}{2}\, EF$$

$$\Rightarrow \quad \frac{AB}{DE} = \frac{2BL}{2EM} = \frac{BL}{EM}$$

and $\angle ABL = \angle DEM$

$\therefore \Delta ABL$ is similar to ΔDEM.
Hence, statement I is true but statement II is false.

51. ABC and DEF are similar triangles. If the ratio of side AB to side DE is $(\sqrt{2} + 1) : \sqrt{3}$, then the ratio of area of ΔABC to that of ΔDEF is

(a) $(3 - 2\sqrt{2}) : 3$ (b) $(9 - 6\sqrt{2}) : 2$
(c) $1 : (9 - 6\sqrt{2})$ (d) $(3 + 2\sqrt{2}) : 2$

⊙ **(c)** Given, $\Delta ABC \sim \Delta DEF$

$$\frac{\text{Area of } \Delta ABC}{\text{Area of } \Delta DEF} = \frac{AB^2}{DE^2}$$

$$= \frac{(\sqrt{2} + 1)^2}{(\sqrt{3})^2} = \frac{3 + 2\sqrt{2}}{3}$$

$$= \frac{(3 + 2\sqrt{2})(3 - 2\sqrt{2})}{3(3 - 2\sqrt{2})}$$

$$= \frac{1}{9 - 6\sqrt{2}}$$

Hence, the required ratio is $1 : (9 - 6\sqrt{2})$.

52. Let ABC and $A'\,B'\,C'$ be two triangles in which $AB > A'B'$, $BC > B'C'$ and $CA > C'A'$. Let D, E and F be the mid-points of the sides BC, CA and AB, respectively. Let D', E' and F' be the mid-points of the sides $B'\,C', C'\,A'$ and $A'\,B'$, respectively.

Consider the following statements

I. $AD > A'D'$, $BE > B'E'$ and $CF > C'F'$ are always true.

II. $\dfrac{AB^2 + BC^2 + CA^2}{AD^2 + BE^2 + CF^2}$
$= \dfrac{A'B'^2 + B'C'^2 + C'A'^2}{A'D'^2 + B'E'^2 + C'F'^2}$

Which one of the following is correct in respect of the above statements?

(a) Both Statement I and Statement II are true and Statement II is the correct explanation of Statement I
(b) Both Statement I and Statement II are true but Statement II is not the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

⊙ **(a)** Given, in ΔABC and $\Delta A'B'C'$,
$AB > A'B'$, $BC > B'C'$ and $CA > C'A'$
and statement I, which is always true, is as follows
$AD > A'D'$, $BE > B'E'$ and $CF > C'F'$
where, D, E and F are mid-points of sides BC, CA and AB, respectively and D', E' and F' are mid-points of sides $B'C', C'A'$ and $A'B'$, respectively.

Verification

Let in ΔABC, each side = 4 and in $\Delta A'B'C'$, each side = 2
∴ $AD = \sqrt{16 - 4}$
$= \sqrt{12} = 2\sqrt{3}$

Now, $\dfrac{AB^2 + BC^2 + CA^2}{AD^2 + BE^2 + CF^2} = \dfrac{3 \times (4)^2}{3 \times (2\sqrt{3})^2}$

$= \dfrac{16}{12} = \dfrac{4}{3}$ ...(i)
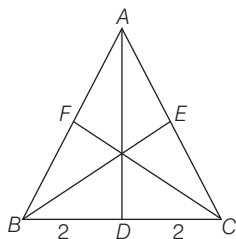
Now, $A'D' = \sqrt{4-1} = \sqrt{3}$

∴ $\dfrac{A'B'^2 + B'C'^2 + C'A'^2}{A'D'^2 + B'E'^2 + C'F'^2}$

$= \dfrac{3 \times (2)^2}{3 \times (\sqrt{3})^2} = \dfrac{12}{9} = \dfrac{4}{3}$ ...(ii)
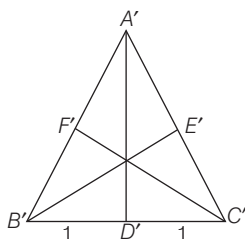
From Eqs. (i) and (ii),
$\dfrac{AB^2 + BC^2 + CA^2}{AD^2 + BE^2 + CF^2}$

$= \dfrac{A'B'^2 + B'C'^2 + C'A'^2}{A'D'^2 + B'F'^2 + C'F'^2} = \dfrac{4}{3}$

Thus, if Statement I is correct, then Statement II is also correct.

53. Two poles are placed at P and Q on either side of a road such that the line joining P and Q is perpendicular to the length of the road. A person moves x m away from P parallel to the road and places another pole at R. Then, the person moves further x m in the same direction and turns and moves a distance y m away from the road perpendicularly, where he finds himself, Q and R on the same line. The distance between P and Q (i.e. the width of the road) in metre is

(a) x (b) $\dfrac{x}{2}$ (c) y (d) $2y$

(c) We can draw the figure on the basis of given statements, which is as follows
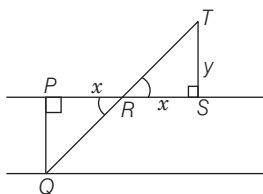
In ΔPQR and ΔRST, $PR = RS = x$
$\angle P = \angle S = 90°$
[as PQ is perpendicular to PS]
and $\angle PRQ = \angle TRS$ [opposite angles]
∴ΔPRQ and ΔRST are congruent.
∴ $PQ = TS = y$
Hence, the width of the road is y m.

54. The point O is equidistant from the three sides of a ΔABC. Consider the following statements:

I. $\angle OAC + \angle OCB + \angle OBA = 90°$

II. $\angle BOC = 2\angle BAC$

III. The perpendiculars drawn from any point on OA to AB and AC are always equal

Which of the above statements are correct?

(a) I and II
(b) II and III
(c) I and III
(d) I, II and III

⊙ **(c)** Given, O is equidistant from AB, BC and CA.
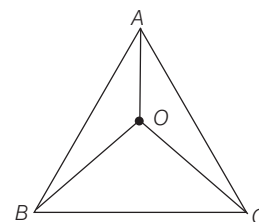
Join OA, OB and OC.
In ΔABC, OA, OB and OC are angle bisectors and point O is incenter.

∵ $\angle OAB = \angle OAC = \dfrac{1}{2}\angle BAC$

∴ $\angle OBA = \angle OBC = \dfrac{1}{2}\angle ABC$

and $\angle OCB = \angle OCA = \dfrac{1}{2}\angle ACB$

Now, in ΔABC,
$\angle ABC + \angle BAC + \angle ACB = 180°$
[∵ angle sum property]

∴ $\angle OAC + \angle OCB + \angle OBA = 90°$

$\angle BOC = 2\angle BAC$

It is not ture because, It is possible when O point is circumcenter but here, O point is in center.
[option 3]
The statement perpendiculars drawn from any point on OA to AB and AC are always equal so it is true, because O is equidistant from AB and AC.

2015 (I)

55. If the angles of a triangle are in the ratio $4 : 1 : 1$. Then, the ratio of the largest side to the perimeter is

(a) $\dfrac{2}{3}$ (b) $\dfrac{1}{2 + \sqrt{3}}$

(c) $\dfrac{\sqrt{3}}{2 + \sqrt{3}}$ (d) $\dfrac{2}{1 + \sqrt{3}}$

⊙ **(c)** Let the angles of a triangle be $4x$, x and x, respectively.

i.e. $\angle A = 4x$, $\angle B = x$ and $\angle C = x$
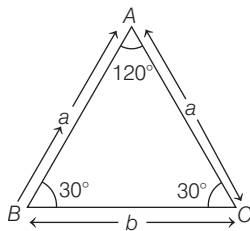
∵ Sum of all angles of a triangle = 180°

∴ $\angle A + \angle B + \angle C = 180°$

⇒ $4x + x + x = 180°$

⇒ $6x = 180°$

⇒ $x = 30°$

∴ $\angle A = 4x = 4 \times 30° = 120°$

     $\angle B = x = 30°$ and $\angle C = x = 30°$

So, it is clear that, given triangle is isosceles triangle.

Let the sides of a isosceles triangle be a, a and b, respectively.

∴ Perimeter of triangle $= a + a + b$

                  $= 2a + b$

Using sine rule,

$$\dfrac{b}{\sin 120°} = \dfrac{a}{\sin 30°}$$

⇒ $\dfrac{b}{\sqrt{3}/2} = \dfrac{a}{1/2}$

⇒ $\dfrac{2b}{\sqrt{3}} = 2a$

⇒ $a = \dfrac{b}{\sqrt{3}}$

Now, $\dfrac{b}{2a + b} = \dfrac{b}{2 \times \dfrac{b}{\sqrt{3}} + b}$

          $= \dfrac{b}{\dfrac{2b + \sqrt{3}b}{\sqrt{3}}} = \dfrac{\sqrt{3}}{2 + \sqrt{3}}$

56. Consider the following statements

I. Let D be a point on the side BC of a $\triangle ABC$. If area of $\triangle ABD =$ area of $\triangle ACD$, then for all points O on AD, area of $\triangle ABO =$ area of $\triangle ACO$.

II. If G is the point of concurrence of the medians of a $\triangle ABC$, then area of $\triangle ABG =$ area of $\triangle BCG =$ area of $\triangle ACG$.

Which of the above statement(s) is/are correct?

(a) Only I
(b) Only II
(c) Both I and II
(d) Neither I nor II

⊙ **(c)** I. **Given** D be a point on the side BC of a $\triangle ABC$

and area of $\triangle ABD =$ area of $\triangle ACD$

To prove Area of $\triangle ABO =$ Area of $\triangle ACO$

Construction From A draw $AG \perp BC$ and from O, draw $OF \perp BC$
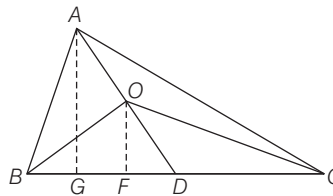
Proof ∵ Area of $\triangle ABD = \dfrac{BD \times AG}{2}$

and Area of $\triangle ADC = \dfrac{DC \times AG}{2}$

But $BD = DC$

      [∵ D is the mid-point of BC, AD being of median]

Area of $\triangle ABD =$ Area of $\triangle ACD$ …(i)

Again, area of $\triangle OBD = \dfrac{BD \times OF}{2}$

and   area of $\triangle ODC = \dfrac{DC \times OF}{2}$

But $BD = DC$

∴   Area of $\triangle OBD =$ Area of $\triangle ODC$ …(ii)

Now, subtracting Eq. (ii) from Eq. (i), we get

Area of $\triangle ABD -$ Area of $\triangle OBD$

    $=$ Area of $\triangle ACD -$ Area of $\triangle ODC$

∴ Area of $\triangle ABO =$ Area of $\triangle ACO$

Statement II

G is the point of concurrence of the medians.

then,

area of $\triangle ABG =$ area of $\triangle BCG$

            $=$ Area of $\triangle ACG$
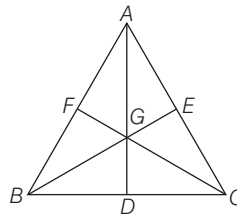
Hence, both statements are true.

2014 (II)

57. In a $\triangle ABC$, AD is the median through A and E is the mid-point of AD and BE produced meets AC at F. Then, AF is equal to

(a) $AC / 5$ (b) $AC / 4$
(c) $AC / 3$ (d) $AC / 2$

⊙ **(c)** Given, in $\triangle ABC$, AD is the median and E is the mid-point of AD. Through point D, draw a line $l \parallel BF$ which intersect AC at G.
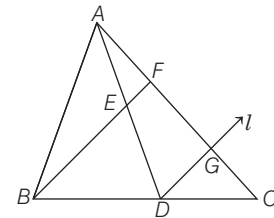
In $\triangle ADG$, $BF \parallel l$ or $EF \parallel DG$ and E is the mid-point of AD.

So, F is the mid-point of AG.

i.e. $AF = FG$ …(i)

Again, in $\triangle FBC$, $BF \parallel DG$ and D is mid-point of BC.

Now, G will be the mid-point of CF.

i.e. $CG = GF$ …(ii)

From Eqs. (i) and (ii), we get

       $AF = FG = CG$ …(iii)

Now, $AC = AF + FG + CG$

             $= AF + AF + AF$

             $= 3AF$ [from Eq. (iii)]

⇒ $AF = \dfrac{1}{3} AC$

58. Three straight lines are drawn through the three vertices of a $\triangle ABC$, the line through each vertex being parallel to the opposite side. Then $\triangle DEF$ is bounded by these parallel lines.

Consider the following statements in respect of the $\triangle DEF$.

I. Each side of $\triangle DEF$ is double the side of $\triangle ABC$ to which it is parallel.

II. Area of $\triangle DEF$ is four times the area of $\triangle ABC$.

Which of the above statement(s) is/are correct?

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊙ *(c)*

I. On drawing the three straight lines through the three vertices of Δ *ABC*, we get the following figure
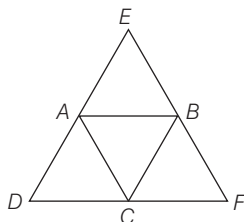
Here, $AB \parallel DF$, $BC \parallel DE$ and $AC \parallel EF$.

Obviously, A, B and C are the mid-points of DE, EF and DF, respectively.

By mid-point theorem,

$$BC = \frac{1}{2} DE$$

or $\qquad DE = 2BC$

Similarly, $DF = 2AB$ and $EF = 2AC$

Hence, statement I is correct.

II. Also, area of $\triangle ABC = \frac{1}{4}$ area of $\triangle DEF$

or area of $\triangle DEF = 4$ area of $\triangle ABC$

Hence, statement II is also correct.

59. In a $\triangle ABC$, if $\angle B = 2\angle C = 2\angle A$. Then, what is the ratio of AC to AB?

(a) $\sqrt{2} : 1$ (b) $\sqrt{3} : 1$ (c) $1 : 1$ (d) $1 : \sqrt{2}$

⊙ *(a)* Given, in $\triangle ABC$, $\angle B = 2\angle C = 2\angle A$

We know that, sum of angles of a triangle $= 180°$

$\Rightarrow \qquad \angle A + \angle B + \angle C = 180°$

$\Rightarrow \qquad \angle A + 2\angle A + \angle A = 180°$

$\qquad\qquad [\because 2\angle C = 2\angle A = \angle B]$

$\Rightarrow \qquad\qquad 4\angle A = 180°$

$\Rightarrow \qquad\qquad \angle A = \frac{180°}{4} = 45°$

$\therefore \qquad\qquad \angle B = 90°$

and $\qquad\qquad \angle C = 45°$

Thus, $\triangle ABC$ is a right angled triangle, right angle at B and $AB = BC$.
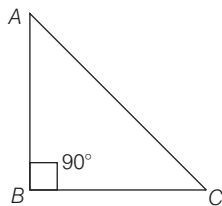
In $\triangle ABC$, by Pythagoras theorem,

$$AB^2 + BC^2 = AC^2$$

$\Rightarrow \quad AB^2 + AB^2 = AC^2 \quad [\because AB = BC]$

$\Rightarrow \quad 2AB^2 = AC^2 \Rightarrow \sqrt{2} AB = AC$

[taking square root on both sides]

$\Rightarrow \qquad \frac{AC}{AB} = \frac{\sqrt{2}}{1}$

$\therefore \qquad AC : AB = \sqrt{2} : 1$

60. Consider the following statements in respect of an equilateral triangle

I. The altitudes are congruent.

II. The three medians are congruent.

III. The centroid bisects the altitude.

Which of the above statements are correct?

(a) I and II   (b) II and III

(c) I and III   (d) I, II and III

⊙ *(a)* Since, the altitude and medians of an equilateral triangle are congruent but centroid divide the altitude in 2 : 1. So, statements I and II are correct.

61. Consider the following

ABC and DEF are triangles in a plane such that AB is parallel to DE, BC is parallel to EF and CA is parallel to FD.

Statement I If $\angle ABC$ is a right angle, then $\angle DEF$ is also a right angle.

Statement II Triangles of the type ABC and DEF are always congruent.

Which one of the following is correct in respect of the above statements?

(a) Statements I and II are correct and Statement II is the correct explanation of Statement I

(b) Statements I and II are correct and Statement II is not the correct explanation of Statement I

(c) Statement I is correct and Statement II is incorrect

(d) Statement I is incorrect and Statement II is correct

⊙ *(c)* In $\triangle ABC$ and $\triangle DEF$, $AB \parallel DE$, $BC \parallel EF$ and $CA \parallel FD$
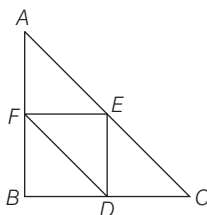
In $\triangle ABC$ and $\triangle AFE$,

$\qquad FE \parallel BC$

$\triangle ABC \sim \triangle AFE$

$\angle AFE = \angle ABC = 90°$

$\angle EFB = 180° - \angle AFE$

$\angle EFB = 180° - 90° = 90° \qquad \dots(i)$

In $\triangle ABC$ and $\triangle EDC$,

$\qquad AB \parallel DE$

$\triangle ABC \sim \triangle EDC$

$\angle ABC = \angle EDC = 90°$

$\angle BDE = 180° - \angle EDC$

$\angle BDE = 180° - 90° = 90° \qquad \dots(ii)$

In quadrilateral $FEBD$,

$\angle EFB + \angle FBD + \angle BDE + \angle DEF = 360°$

$90° + 90° + 90° + \angle DEF = 360°$

(by eq. (1) and eq. (2))

$\qquad\qquad \angle DEF = 90°$

Then, statement I is true

$\triangle DEF$ and $\triangle ABC$ are similar but not congruent,

Statement II is not true.

2014 (I)

62. The three sides of a triangle are 15, 25, x units. Which one of the following is correct?

(a) $10 < x < 40$ (b) $10 \leq x \leq 40$

(c) $10 \leq x < 40$ (d) $10 < x \leq 40$

⊙ *(a)* In a triangle, sum of two sides is always greater than third side.

i.e. $\qquad\qquad x < 40 \qquad \dots(i)$

Difference of two sides is always less than third side.

i.e. $\qquad\qquad 10 < x \qquad \dots(ii)$

From Eqs. (i) and (ii),

$\qquad\qquad 10 < x < 40$

63. Which one of the following is a Pythagorean triple in which one side differs from the hypotenuse by two units?

(a) $(2n + 1, 4n, 2n^2 + 2n)$

(b) $(2n, 4n, n^2 + 1)$

(c) $(2n^2, 2n, 2n + 1)$

(d) $(2n, n^2 - 1, n^2 + 1)$

where, n is a positive real number.

⊙ *(d)* By hit and trial method,

$[(2 \times 2), (2)^2 - 1, (2)^2 + 1] = (4, 3, 5)$

$\qquad\qquad$ [put $n = 2$ in option (d)]

which satisfy Pythagoras theorem and one side differs from hypotenuse by 2 units.

64. The sides of a right angled triangle are equal to three consecutive numbers expressed in centimetres. What can be the area of such a triangle?

(a) 6 cm^2 (b) 8 cm^2

(c) 10 cm^2 (d) 12 cm^2

⊘ (**a**) Since, the triangle is right angled. So, all the three consecutive sides must satisfy Pythagoras theorem.
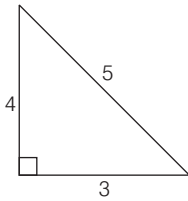
Hence, 3, 4 and 5 are the sides of triangle which satisfy Pythagoras theorem.

$\therefore$ Area of triangle $= \frac{1}{2} \times 4 \times 3 = 6\,cm^2$

65. If triangles ABC and DEF are similar such that $2\,AB = DE$ and $BC = 8$ cm, then what is EF equal to?

(a) 16 cm (b) 12 cm (c) 10 cm (d) 8 cm

⊘ (**a**) $\because$　$\Delta ABC \sim \Delta DEF$
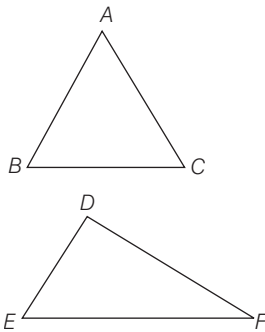
$\therefore$　$\dfrac{AB}{DE} = \dfrac{BC}{EF}$

$\Rightarrow$　$\dfrac{1}{2} = \dfrac{8}{EF}$

$\Rightarrow$　$EF = 16$ cm

66. The sides of a triangle are in geometric progression with common ratio $r < 1$. If the triangle is a right angled triangle, the square of common ratio is given by

(a) $\dfrac{\sqrt{5}+1}{2}$　　(b) $\dfrac{\sqrt{5}-1}{2}$

(c) $\dfrac{\sqrt{3}+1}{2}$　　(d) $\dfrac{\sqrt{3}-1}{2}$

⊘ (**b**) Let the sides of triangle be $\dfrac{a}{r}$, a, ar and since $r < 1$.

$\therefore$　$\dfrac{a}{r} > a > ar$

Now, triangle is right angled. Using Pythagoras theorem,

$$\left(\frac{a}{r}\right)^2 = (a)^2 + (ar)^2$$

$\Rightarrow$　$\dfrac{a^2}{r^2} = a^2 + a^2 r^2$

$\Rightarrow$　$\dfrac{a^2}{r^2} = a^2(1 + r^2)$

$\Rightarrow$　$r^2 + r^4 = 1$

Put　$r^2 = x \Rightarrow x^2 + x - 1 = 0$

$\therefore$　$x = \dfrac{-1 \pm \sqrt{1-4\,(-1)}}{2}$

　　$= \dfrac{-1 \pm \sqrt{5}}{2}$

$\Rightarrow$　$r^2 = \dfrac{\sqrt{5}-1}{2}$

67. In a ΔABC, AD is perpendicular to BC and BE is perpendicular to AC. Which of the following is correct?

(a) $CE \times CB = CA \times CD$
(b) $CE \times CA = CD \times CB$
(c) $AD \times BD = AE \times BE$
(d) $AB \times AC = AD \times BE$

⊘ (**c**) Two sides of triangle have perpendiculars then $\dfrac{AD}{AC} = \dfrac{BE}{BC}$

BE and AD is $\perp$ on sides AC and AD then

　　$\Delta ADC \cong \Delta BEC$

So,　$\Delta AEB \cong \Delta ADB$

Area of $\Delta ABD = \dfrac{1}{2} \times BD \times AD$　…(i)

and area of $\Delta ABE = \dfrac{1}{2} \times AE \times BE$　…(ii)
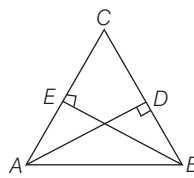
From Eqs. (i) and (ii),

$\dfrac{1}{2} \times BD \times AD = \dfrac{1}{2} \times AE \times BE$

$\Rightarrow$　$BD \times AD = AE \times BE$

68. Let ABC be a triangle right angled at B. If $AB = 6$ cm and $BC = 8$ cm, then what is the length of the circumradius of the ΔABC ?

(a) 10 cm (b) 7cm　(c) 6 cm　(d) 5 cm

⊘ (**d**) Given, ΔABC is right angled at B.
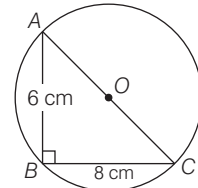
Using Pythagoras theorem,
　　$AC^2 = AB^2 + BC^2$
　　　$= 6^2 + 8^2 = 100$
$\therefore$　　$AC = 10$ cm

We know that, circumradius of right angled triangle is equal to half of hypotenuse.

$\therefore$ Radius of circumcircle $= \dfrac{10}{2} = 5$ cm

69. If AD is the internal angle bisector of $\angle A$ in ΔABC with $AB = 3$ cm and $AC = 1$, then what is $BD : BC$ equal to?

(a) 1 : 3　(b) 1 : 4　(c) 2 : 3　(d) 3 : 4

⊘ (**d**) In ΔABC, AD is the internal angle bisector of $\angle A$.
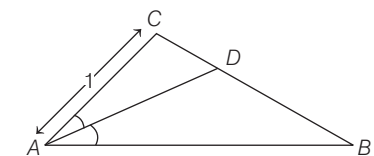
Using property of internal angle bisector,

　　$\dfrac{BD}{CD} = \dfrac{AB}{AC}$

$\Rightarrow$　$\dfrac{CD}{BD} = \dfrac{AC}{AB}$

$\Rightarrow$　$\dfrac{CD}{BD} + 1 = \dfrac{AC}{AB} + 1$

$\Rightarrow$　$\dfrac{CD + BD}{BD} = \dfrac{AC + AB}{AB}$

$\Rightarrow$　$\dfrac{BC}{BD} = \dfrac{3+1}{3}$

$\Rightarrow$　$\dfrac{BD}{BC} = \dfrac{3}{4}$

$\therefore$　$BD : BC = 3 : 4$

24

QUADRILATERAL AND POLYGON

1. The sides AD, BC of a trapezium $ABCD$ are parallel and the diagonals AC and BD meet at O. If the area of triangle AOB is 3 cm^2 and the area of triangle BDC is 8 cm^2, then what is the area of triangle AOD?

(a) 8 cm^2 (b) 5 cm^2
(c) 3.6 cm^2 (d) 8 cm^2

⊙ **(d)**
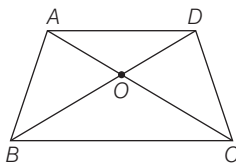
ΔABC and ΔBDC

Lie on the same base BC and between same parallel AD and BC.

$\therefore ar(\Delta ABC) = ar(BDC)$

Subtracting $ar(\Delta BOC)$ both sides, we get $ar(\Delta ABC) - ar(\Delta BOC)$

$ar(BDC) - ar(BOC), ar(\Delta AOB) = ar(DOC)$

Then, $ar(\Delta DOC) = 3$ cm^2

So, $ar(\Delta BOC) = ar(BDC) - ar(\Delta DOC)$
$= 8$ cm$^2 - 3$cm$^2 = 5$ cm^2

In ΔABO and ΔBOC,

$$\frac{ar(\Delta ABO)}{ar(\Delta BOC)} = \frac{\frac{1}{2} \times AO \times \text{height}}{\frac{1}{2} \times CO \times \text{height}}$$

$$\frac{3}{5} = \frac{AO}{CO}$$

$\Delta AOD \sim \Delta BOC \ \{AAA\}$

$$\frac{ar(\Delta AOD)}{ar(BOC)} = \left(\frac{AO}{CO}\right)^2$$

$$= \left(\frac{3}{5}\right)^2 = \frac{9}{25}$$

$$ar(\Delta AOD) = \frac{9}{25} \times 5 = 1.8 \text{ cm}^2$$

2. Let $PQRS$ be a parallelogram whose diagonals PR and QS intersect at O. If triangle QRS is an equilateral triangle having a side of length 10 cm, then what is the length of the diagonal PR?

(a) $5\sqrt{3}$ cm (b) $10\sqrt{3}$ cm
(c) $15\sqrt{3}$ cm (d) $20\sqrt{3}$ cm

⊙ **(b)**
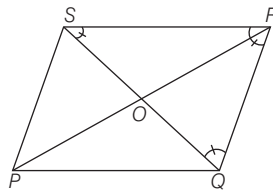
In triangle QRS, each angle is 60°. AO is altitude of triangle QRS. Altitude in equilateral triangle $= \frac{\sqrt{3}}{2}a$

Altitude $= \frac{\sqrt{3}}{2} \times 10$ [∵ $a = 10$ cm]

$= 5\sqrt{3}$ cm

ΔQSR is similar to ΔPQS and both are equilateral triangle with side 10 cm.

Then, diagonal $PR = 2 \times$ Altitude

$= 2 \times 5\sqrt{3}$

$= 10\sqrt{3}$ cm

3. The corners of a square of side 'a' are cut away so as to form a regular octagon. What is the side of the octagon?

(a) $a(\sqrt{2} - 1)$ (b) $a(\sqrt{3} - 1)$
(c) $\dfrac{a}{\sqrt{2} + 2}$ (d) $\dfrac{a}{3}$

⊙ **(a)**
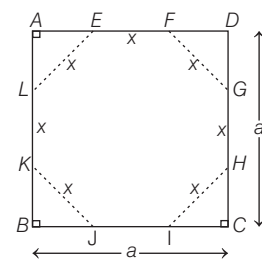
$ABCD$ is square.

The corners of square are cut away by doted line.

$EFGHIJKL$ is octagon.

Let side of octagon $= x$

$AE + FD = a - x$ [∵ $AE = FD$]

$2 AE = a - x$

$$AE = \left(\frac{a - x}{2}\right) \qquad \text{...(i)}$$

Similarly, $AL = \left(\dfrac{a - x}{2}\right)$

ΔAEL $(AL)^2 + (AE)^2 = (LE)^2$

$$\left(\frac{a - x}{2}\right)^2 + \left(\frac{a - x}{2}\right)^2 = x^2$$

$$\sqrt{2\left(\frac{a - x}{2}\right)^2} = x$$

$$x = \sqrt{2}\left(\frac{a - x}{2}\right)$$

$$\sqrt{2}x = a - x$$

$$\Rightarrow \quad \sqrt{2}\,x + x = a$$

$$x\,(\sqrt{2} + 1) = a$$

$$x = \frac{a}{\sqrt{2} + 1}$$

$$x = a\,(\sqrt{2} - 1)\left[\because \frac{1}{\sqrt{2} + 1} = \sqrt{2} - 1\right]$$

Then, option (a) is correct.

4. Consider the following statements:

1. An isosceles trapezium is always cyclic.
2. Any cyclic parallelogram is a rectangle.

Which of the above statements is/are correct?`

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

⊚ *(c)*
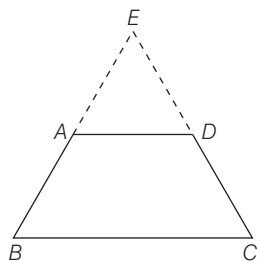
We produce *BA* and *CD* and meet them at *E*.

$AB = CD$	(given)…(1)
$AD \parallel BC$	(given)

them,

$$AE = DE \qquad \qquad …(2)$$

On adding Eq. (1) and (2), we get

$$AB + AE = CD - DE$$
$$BE = EC$$
$$\therefore \quad \angle EBC = \angle ECB = \theta$$

then,

$$\angle BAD = 180 - \angle ABC$$
$$\angle BAD = 180 - \theta \qquad …(3)$$

Similarly

$$\angle CDA = 180° - \theta \qquad …(4)$$

then

$$\angle ABC + \angle CDA = \theta + 180 - \theta$$
$$= 180°$$

and $\angle DAB + \angle DCB = 180° - \theta + \theta$
$$= 180°$$

Then, an isosceles trapezium is always cyclic.

∵ Statement I is true.

(2) Any cyclic parallelogram is rectangle.
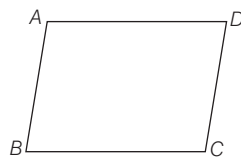
In parallelogram $\angle B = \angle D = x$ … (i)
In cyclic parallelogram,

$$\angle B + \angle D = 180°$$
$$x + x = 180° \ \{\text{from Eq. (i)}\}$$
$$2x = 180° \Rightarrow x = 90°$$

Then,
It is a rectangle.
Statement 2nd also correct.

2018 (II)

5. In the figure given below, *ABC* is an equilateral triangle with each side of length 30 cm. *XY* is parallel to *BC*, *XP* is parallel to *AC* and *YQ* is parallel to *AB*. If *XY* + *XP* + *YQ* is 40 cm, then the value of *PQ* is

(a) 5 cm (b) 12 cm (c) 15 cm (d) 10 cm

⊚ *(d)* Given, $AB = BC = AC = 30$

XY is parallel to *BC*
∴ *AXY* is also equilateral triangle.
Similarly, *XBP* and *CYQ* is an equilateral triangle

∴ $XY = AX$, $XP = BX \Rightarrow QY = CY = CQ$
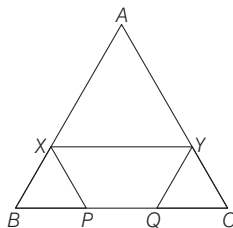
$$XY + XP + QY = 40$$
$$AX + BX + CY = 40$$
$$AB + CQ = 40$$
$$\Rightarrow \quad CQ = 40 - 30 = 10 = BP$$
$$PQ = BC - (BP + CQ)$$
$$= 30 - 20 = 10 \text{ cm}$$

2018 (I)

6. Given, that the angles of a polygon are all equal and each angle is a right angle.
Statement 1 : The polygon has exactly four sides.

Statement 2 : The sum of the angles of a polygon having *n* sides is $(3n - 8)$ right angles.

Which one of the following is correct in respect of the above statements?

(a) Both statements 1 and statements 2 are true and statement 2 is the correct explanation of statement 1.
(b) Both statement 1 and statement 2 are true, but statement 2 is not the correct explanation of statement 1.
(c) Statement 1 is true, but statement 2 is false.
(d) Statement 1 is false, but statement 2 is true.

⊚ *(c)* Statement 1 is true, but Statement 2 is false as the sum of angle of polygon is $(n - 2)\,180°$.

2017 (II)

7. If a point *O* in the interior of a rectangle *ABCD* is joined with each of the vertices *A, B C* and *D*, then $OB^2 + OD^2$ will be equal to

(a) $2OC^2 + OA^2$ (b) $OC^2 - OA^2$
(c) $OC^2 + OA^2$ (d) $OC^2 + 2OA^2$

⊚ *(c)* We have *ABCD* is rectangle
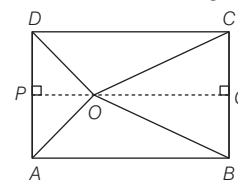
$$PD = QC$$
$$PA = QB$$

In $\triangle OPD$

$$OD^2 = OP^2 \times PD^2 \qquad …(i)$$

In $\triangle OBQ$

$$OB^2 = OQ^2 + BQ^2 \qquad …(ii)$$

On adding Eqs. (i) and (ii), we get

$$OD^2 + OB^2 = OP^2 + PD^2$$
$$+ OQ^2 + BQ^2$$
$$\Rightarrow OD^2 + OB^2 = OP^2 + AP^2$$
$$+ CQ^2 + OQ^2$$
$$[\because AP = BQ, PD = OQ]$$
$$\Rightarrow OD^2 + OB^2 = OA^2 + OC^2$$

8. A closed polygon has six sides and one of its angles is 30° greater than each of the other five equal angles. What is the value of one of the equal angles?

(a) 55° (b) 115°
(c) 150° (d) 175°

⊚ *(b)* We know that, if a polygon has *n* sides, then the sum of its interior angles is given by $(n - 2)\,180°$

∴ Sum of interior angles of given polygon

∴ $\quad = (6 - 2) \times 180° = 720°$

Now, let the value of each of the equal angles be $x°$. Then,

$(30 + x)° + x° + x° + x° + x° + x°$

$\quad = 720$

$\Rightarrow \quad 6x° + 30° = 720°$

$\therefore \quad 6x° = 690°$

$\Rightarrow \quad x = 115°$

2017 (I)

9. Let $ABCD$ be a rectangle. Let P, Q, R, S be the mid-points of sides AB, BC, CD, DA respectively. Then the quadrilateral $PQRS$ is a

(a) Square
(b) Rectangle, but need not be a square
(c) Rhombus, but need not be a square
(d) Parallelogram, but need not be a rhombus

⊙ *(c)*
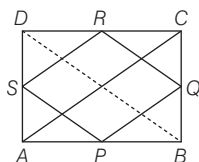
Given, $ABCD$ is a Rectangle

∴ $\quad \angle A = \angle B = \angle C = \angle D = 90°$

and $AD = BC$, $AB = DC$

   [∵ In a rectangle each angle is 90° and opposite sides are equal]

Also, given P, Q, R and S are mid-points of AB, BC, CD and DA, respectively.

In ΔABD, P and S are the mid-points of AB and DA, respectively.

∴ $PS \parallel BD$ and $PS = \dfrac{1}{2}BD$ …(i)

   [by mid-point theorem]

and in ΔACD, R and S are the mid-points of DC and AD, respectively.

∴ $SR \parallel AC$ and $SR = \dfrac{1}{2}AC$ …(ii)

   [by mid-point theorem]

In rectangle $ABCD$, $AC = BD$

   [since, diagonals of a rectangle are equal]

∴ $PS = SR$

   [from Eqs. (i) and (ii)] …(iii)

Now, in ΔASP and ΔBQP,

$AP = BP$

[∵ P is mid-point of AB]

$AS = BQ$

[∵ $AD = BC$ and S, Q are mid-points of AD and BC]

$\angle A = \angle B$ [each 90°]

∴ $\quad \Delta ASP \cong \Delta BQP$

   [by SAS congruence rule]

Then, $\quad PS = PQ$ [by CPCT] …(iv)

Similarly, In ΔRDS and ΔRCQ,

$SD = CQ$

[∵ $AD = BC$ and S, Q are mid-points of AD and BC]

$DR = RC$ [∵ R is mid-point of DC]

$\angle C = \angle D$ [each 90°]

∴ $\Delta RDS \cong \Delta RCQ$

   [by SAS congruence rule]

Then, $\quad SR = RQ$ [by CPCT] …(v)

From Eqs. (iii), (iv) and (v), we get

$PS = SR = RQ = PQ$

Hence, quadrilateral $PQRS$ is a rhombus.

10. The area of a regular hexagon of side 'a' is equal to

(a) $\dfrac{\sqrt{2}}{3}a^2$ square units

(b) $\dfrac{3\sqrt{3}}{2}a^2$ square units

(c) $\dfrac{1}{3}a^2$ square units

(d) $\dfrac{\sqrt{3}}{2}a^2$ square units

⊙ *(b)*
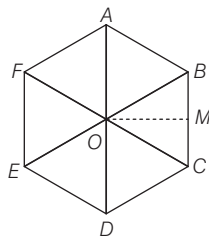
In ΔOBC

$\angle BOC = 60°$

   [∵ $ABCDEF$ is a regular hexagon]

Also, $\quad OC = OB$

∴ $\quad \angle OCB = \angle OBC = 60°$

   [∵ $\angle OBC + \angle OCB + \angle BOC = 180°$]

∴ ΔOBC is an equilateral triangle.

Now, let the side of hexagon be a

∴ $\quad BM = CM = \dfrac{a}{2}$

∴ $\quad OM = \sqrt{OB^2 - BM^2}$

$\quad = \sqrt{a^2 - \dfrac{a^2}{4}} = \dfrac{\sqrt{3}}{2}a$

∴ area (ΔOBC)

$\quad = \dfrac{1}{2} \times BC \times OM$

$\quad = \dfrac{1}{2} \times a \times \dfrac{\sqrt{3}}{2}a = \dfrac{\sqrt{3}}{4}a^2$

∴ Area of hexagon $ABCDEF$

$\quad = 6 \times$ area (ΔOBC)

$\quad = 6 \times \dfrac{\sqrt{3}}{4}a^2 = \dfrac{3\sqrt{3}}{2}a^2$

11. $ABCDEF$ is a regular polygon. Two poles at C and D are standing vertically and subtend angles of elevation 30° and 60° at A respectively. What is the ratio of the height of the pole at C to that of the pole at D?

(a) 1 : 1
(b) $1 : 2\sqrt{3}$
(c) $2\sqrt{3} : 1$
(d) $2 : \sqrt{3}$

⊙ *(b)* Here, two poles CT and DS are standing vertically at C and D respectively.
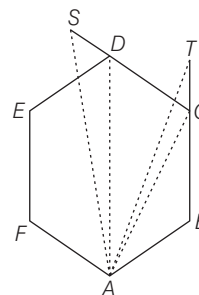
∵ Each angle in regular hexagon is equal to 120

∴ $\angle ABC = 120°$

$\angle BAC = \angle BCA = \dfrac{180° - 120°}{2} = 30°$

$\angle DCA = \angle DCB - \angle BCA$

$\quad = 120° - 30 = 90°$

∴ ΔDCA is a right angled triangle.

Let side $DC = a$

$\tan 30° = \dfrac{CD}{AC} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{a}{AC} \Rightarrow AC = \sqrt{3}a$

$\sin 30° = \dfrac{DC}{AD} \Rightarrow \dfrac{1}{2} = \dfrac{a}{AD} \Rightarrow AD = 2a$
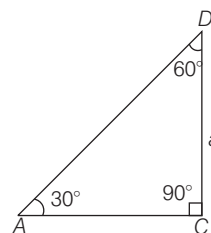
Now in ΔASD

$\tan 60° = \dfrac{DS}{AD}$

$\Rightarrow \quad \sqrt{3} = \dfrac{DS}{2a}$

$\Rightarrow \quad DS = 2\sqrt{3}a$
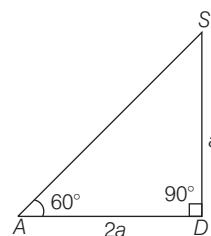
Now, in ΔACT,

$\tan 30° = \dfrac{CT}{AC} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{CT}{\sqrt{3}a} \Rightarrow CT = a$
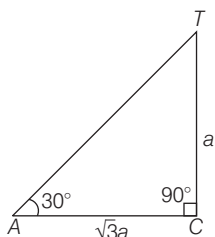
Required ratio = $CT : DS$

$\qquad = a : 2\sqrt{3}a = 1 : 2\sqrt{3}$

12. *ABCD* is a rectangle. The diagonals *AC* and *BD* intersect at *O*. If $AB = 32$ cm and $AD = 24$ cm, then what is *OD* equal to?

(a) 22 cm   (b) 20 cm
(c) 18 cm   (d) 16 cm

⊙ **(b)**
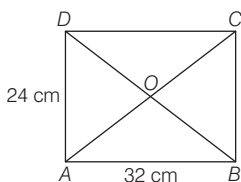
We have,

$\qquad AB = 32$ cm, $AD = 24$ cm

Since, $\angle A = 90°$

$\therefore\quad BD^2 = AB^2 + AD^2 = (32)^2 + (24)^2$

$\qquad\qquad = 1024 + 576 = 1600$

$\therefore\quad BD = 40$ cm

Since, diagonals of a rectangle bisects each other

$\therefore\quad OD = \dfrac{1}{2}BD = \dfrac{1}{2} \times 40 = 20$ cm

13. In the figure given below, *AC* is parallel to *ED* and $AB = DE = 5$ cm and $BC = 7$ cm. What is the area $ABDE :$ area $BDE :$ area BCD equal to?
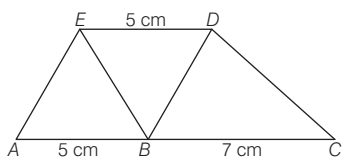
(a) 10 : 5 : 7   (b) 8 : 4 : 7
(c) 2 : 1 : 2   (d) 8 : 4 : 5

⊙ **(a)**
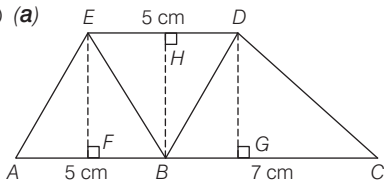
Since, $AC \parallel ED$

$\therefore\quad EF = BH = DG = x$

Now, in quadrilateral *ABDE*,

$\qquad AB \parallel ED \qquad [\because AC \parallel ED \Rightarrow AB \parallel ED]$

and $AB = ED = 5$ cm

$\therefore$ Quadrilateral *ABDE* is a parallelogram.

Now,

$\qquad \text{ar} \parallel \text{gm} \,(ABDE) = AB \times EF = 5x$

$\qquad \text{ar}\,(\Delta BDE) = \dfrac{1}{2} \times ED \times BH = \dfrac{5}{2}x$

$\qquad \text{ar}\,(\Delta BCD) = \dfrac{1}{2} \times BC \times DG = \dfrac{7}{2}x$

$\therefore$ Area of *ABDE* : Area of *BDE* : Area of

$BCD = 5x : \dfrac{5}{2}x : \dfrac{7}{2}x = 10 : 5 : 7$

14. In the figure given below, *PQRS* is a parallelogram *PA* bisects angle *P* and *SA* bisects angle *S*. What is angle *PAS* equal to?
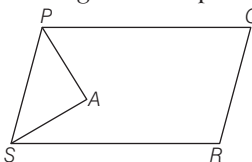
(a) 60°   (b) 75°
(c) 90°   (d) 100°

⊙ **(c)** Since, PQRS is a parallelogram

$\therefore\quad PQ \parallel SR$

$\therefore\quad \angle QPS + \angle RSP = 180°$

$\qquad\qquad [\because \text{ cointerior angles}]$

$\Rightarrow\qquad\quad \dfrac{1}{2}\angle QPS + \dfrac{1}{2}\angle RSP$

$\qquad\qquad = \dfrac{1}{2} \times 180°$

$\Rightarrow\quad \angle APS + \angle ASP = 90°$

$[\because PA$ and SA are the angle bisectors of $\angle P$ and $\angle Q$ respectively] $\qquad ...(i)$

Now, In ΔAPS,

$\qquad \angle APS + \angle ASP + \angle PAS = 180°$

$\Rightarrow\qquad\qquad 90° + \angle PAS = 180°$

$\Rightarrow\qquad\qquad \angle PAS = 180° - 90° = 90°$

2016 (I)

15. Consider the following statements

1. If $n \geq 3$ and $m \geq 3$ are distinct positive integers, then the sum of the exterior angles of a regular polygon of *m* sides is different from the sum of the exterior angles of a regular polygon of *n* sides.

2. Let *m, n* be integers such that $m > n \geq 3$. Then, the sum of the interior angles of a regular polygon of *m* sides is greater

than the sum of the interior angles of a regular polygon of *n* sides and their sum is

$(m + n)\dfrac{\pi}{2}.$

Which of the above statement(s) is/are correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ **(d)** 1. In regular ploygon,

Sum of exterior angles = 360°
[which is always constant]
So, Statement 1 is incorrect.

2. Sum of interior angles of *m* sides
$\qquad = (m - 2) \times 180°$ of regular polygon

Total sum of interior angles of *m* sides and *n* sides of regular polygon

$= (m - 2) \times 180° + (n - 2) \times 180°$

$= (m + n - 4) \times 180°$

So, statement 2 is incorrect.

Hence, neither 1 nor 2 is correct.

16. Consider the following statements

1. There exists a regular polygon whose exterior angle is 70°.

2. Let $n \geq 5$, then the exterior angle of any regular polygon of *n* sides is acute.

Which of the above statement(s) is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ **(b)** Exterior angle of regular polygon

$\qquad = \dfrac{360°}{\text{Number of sides}}$

1. If exterior angle is 70°.
Then, number of sides

$\qquad = \dfrac{360°}{70°} = \dfrac{36}{7} = $ A rational number

So, statement 1 is incorrect.

2. If number of sides ≥ 5, then

Exterior angle $= \dfrac{360°}{5} = 72°$

For number of sides ≥ 5, there is always an acute exterior angle.
So, statement 2 is correct.

17. A rhombus is formed by joining mid-points of the sides of a rectangle in the suitable order. If the area of the rhombus is 2 sq units, then the area of the rectangle is

(a) $2\sqrt{2}$ sq units   (b) 4 sq units
(c) $4\sqrt{2}$ sq units   (d) 8 sq units

> **(b)** We know that,
Area of rhombus
$= \frac{1}{2} \times$ Product of diagonals $= \frac{1}{2} \times d_1 \times d_2$
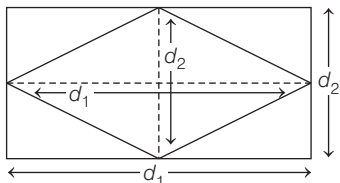
From the above figure,
Area of rectangle $= d_1 \times d_2$
$= 2$ (Area of rhombus)
$= 2 \times 2 = 4$ sq units

18. If each interior angle of a regular polygon is $140°$, then the number of vertices of the polygon is equal to
(a) 10   (b) 9
(c) 8   (d) 7

> **(b)** Given, each interior angle $= 140°$
Then, each exterior angle
$= (180° - 140°) = 40°$
∴ Number of sides
$= \dfrac{360°}{\text{Each exterior angle}}$
$= \dfrac{360°}{40°} = 9$

Hence, the number of vertices of polygon is 9.

2015 (II)

19. $ABCD$ is a parallelogram with AB and AD as adjacent sides. If $\angle A = 60°$ and $AB = 2AD$, then the diagonal BD will be equal to
(a) $\sqrt{2}\, AD$ (b) $\sqrt{3}\, AD$
(c) $2AD$ (d) $3AD$

> **(b)** Given, $\angle A = 60°$
and $\qquad BD = 2AD$
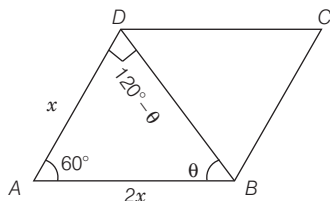
In $\triangle ABD$, from the sine rule,
$\dfrac{\sin\theta}{x} = \dfrac{\sin(120° - \theta)}{2x}$
$\Rightarrow \qquad 2\sin\theta = \sin(120° - \theta)$
$\Rightarrow \quad 2\sin\theta = \sin 120° \cos\theta$
$\qquad\qquad\qquad - \cos 120° \sin\theta$

$\Rightarrow \quad 2\sin\theta = \dfrac{\sqrt{3}}{2}\cos\theta + \dfrac{1}{2}\sin\theta$

$\Rightarrow \quad 4\sin\theta = \sqrt{3}\cos\theta + \sin\theta$
$\Rightarrow \quad 3\sin\theta = \sqrt{3}\cos\theta$
$\Rightarrow \qquad \tan\theta = \dfrac{1}{\sqrt{3}}$
$\Rightarrow \qquad\quad \theta = 30°$
∴ $\quad \angle ADB = 120° - \theta$
$\qquad\qquad = 120° - 30° = 90°$
In $\triangle ADB$,
$\qquad \sin 60° = \dfrac{BD}{AB}$
$\Rightarrow \qquad \dfrac{\sqrt{3}}{2} = \dfrac{BD}{2AD}$
∴ $\qquad BD = \sqrt{3}\,AD$

Alternate Method
Cosine rule
$\cos\phi = \dfrac{(AD)^2 + (AB)^2 - (BD)^2}{2(AD)(AB)}$

$AD = x$
$AB = 2x$
$\phi = 60$
Then,
$\cos 60° = \dfrac{x^2 + (2x)^2 - (BD)^2}{2 \times x \times 2x}$
$\quad \dfrac{1}{2} = \dfrac{5x^2 - (BD)^2}{4x^2}$
$\quad 2x^2 = 5x^2 - (BD)^2$
$\qquad BD = \sqrt{3}x$
$\qquad BD = \sqrt{3}AD$

20. An equilateral $\triangle BOC$ is drawn inside a square $ABCD$. If $\angle AOD = 2\theta$, what is $\tan\theta$ equal to?
(a) $2 - \sqrt{3}$ (b) $1 + \sqrt{2}$
(c) $4 - \sqrt{3}$ (d) $2 + \sqrt{3}$

> **(d)** Let side of square $ABCD$ be x and drawn an equilateral $\triangle BOC$ inside $ABCD$ such that $BO = OC = BC = x$ and
$BP = \dfrac{BC}{2} = \dfrac{x}{2}$
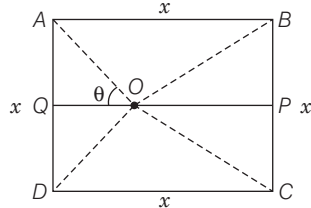
∴ $\qquad PO = \sqrt{x^2 - \left(\dfrac{x}{2}\right)^2}$
$= \sqrt{x^2 - \dfrac{x^2}{4}} = \sqrt{\dfrac{3x^2}{4}} = \dfrac{\sqrt{3}}{2}x$

and $\quad OQ = AB - PO = x - \dfrac{\sqrt{3}}{2}x$
$= x\left(\dfrac{2 - \sqrt{3}}{2}\right)$

Since, $\angle AOD = 2\theta \Rightarrow \angle AOQ = \theta$

In $\triangle AOD$,

$\tan\theta = \dfrac{AQ}{OQ} = \dfrac{\dfrac{AD}{2}}{OQ} = \dfrac{\dfrac{x}{2}}{x\left(\dfrac{2 - \sqrt{3}}{2}\right)}$

$= \dfrac{x}{2} \times \dfrac{2}{x(2 - \sqrt{3})}$

$= \dfrac{1}{2 - \sqrt{3}} \times \dfrac{2 + \sqrt{3}}{2 + \sqrt{3}} = \dfrac{2 + \sqrt{3}}{4 - 3}$

$[\because (a + b)(a - b) = a^2 - b^2]$
$= 2 + \sqrt{3}$

21. If X is any point with in a square $ABCD$ and on AX, a square $AXYZ$ is described. Which of the following is/are correct?
1. $BX = DZ$ or $\quad BZ = DX$
2. $\angle ABX = \angle ADZ$ or $\angle ADX = \angle ABZ$

Select the correct answer using the codes given below.
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

> **(c)** Here, $\quad \angle DAB = \angle XAZ = 90°$
$\Rightarrow \angle DAB - \angle XAB = \angle XAZ - \angle XAB$
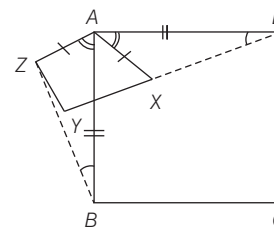
$\Rightarrow \qquad\qquad \angle DAX = \angle BAZ$
Now, in $\triangle DAX$ and $\triangle BAZ$,
$\quad AD = AB \qquad$ [sides of squares]
$\angle DAX = \angle BAZ \qquad$ [proved earlier]
$\quad AX = AZ \qquad$ [sides of square]
∴ $\quad \triangle DAX \cong \triangle BAZ \quad$ [by SAS criteria]
$\Rightarrow \quad BZ = DX \qquad$ [by CPCT]
and $\angle ABZ = \angle ADX \qquad$ [by CPCT]
Hence, both statements are correct.

22.
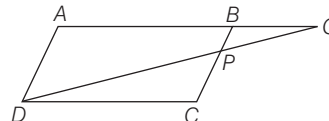
In the above figure, $ABCD$ is a parallelogram. P is a point on BC such that $PB : PC = 1 : 2$. DP and AB when both produced meet at Q. If area of $\triangle BPQ$ is 20 sq units, the area of $\triangle DCP$ is
(a) 20 sq units   (b) 30 sq units
(c) 40 sq units   (d) None of these

⊙ *(d)* Given, $\dfrac{PB}{PC} = \dfrac{1}{2}$ … (i)

∴ $BQ \parallel DC$ [∵ $AB \parallel DC$]

In ΔBPQ and ΔDPC,

     $\angle BPQ = \angle DPC$
         [vertically opposite angles]

     $\angle QBP = \angle PCD$
         [alternate interior angles]

∴ $\Delta BPQ \sim \Delta DPC$
         [by AA similarity]

We know, that area of two similar triangles are in the ratio of the square of the corresponding sides

$$\dfrac{\text{ar}(\Delta BPQ)}{\text{ar}(\Delta DPC)} = \left(\dfrac{PB}{PC}\right)^2$$

$\Rightarrow$ $\dfrac{20}{\text{ar}(\Delta DPC)} = \left(\dfrac{1}{2}\right)^2$ [from Eq. (i)]

∴ $\text{ar}(\Delta DPC) = 80$ sq units

23. A circle of radius r is inscribed in a regular polygon with n sides (the circle touches all sides of the polygon). If the perimeter of the polygon is p, then the area of the polygon is

(a) $(p + n)\, r$ (b) $(2p - n)\, r$

(c) $\dfrac{pr}{2}$ (d) None of these

⊙ *(c)* We know that, perimeter of

polygon $= p = 2\, nr \sin\left(\dfrac{\pi}{n}\right)$ … (i)

and area of polygon

$= A = \dfrac{nr^2}{2} \sin\left(\dfrac{2\pi}{n}\right)$

$= \dfrac{nr^2}{2}\, 2\sin\left(\dfrac{\pi}{n}\right)\cos\left(\dfrac{\pi}{n}\right)$

$= nr^2 \times \dfrac{p}{2nr} \cos\dfrac{\pi}{n}$ [from Eq. (i)]

$= \dfrac{pr}{2} \cos\left(\dfrac{\pi}{n}\right)$

$= \dfrac{pr}{2}$ $\left[\text{as } n \text{ increases, } \cos\left(\dfrac{\pi}{n}\right) = 1\right]$

2015 (I)

24. The diagonals of a trapezium are at right angles and the slant sides, if produced, form an equilateral triangle with the greater of the two parallel sides. If the area of the trapezium is 16 sq cm, then the distance between the parallel side is

(a) 2 cm
(b) 4 cm
(c) 8 cm
(d) Cannot be determined due to insufficient data

⊙ *(d)*
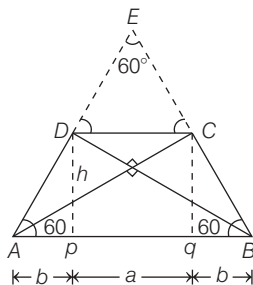
Let $AP = qB = b$ cm

         $pq = DC = a$ cm

         $DP = cq = h$ cm

and $AB = BE = AE$
     [∵ ΔABE is equilateral triangle]

     $DC \parallel AB$

then $\Delta AEB \sim \Delta DCE$

     $ED = EC$

     $AD = CB$

So, $AC = BD = d$

area of trapezium

$= \dfrac{1}{2} \times AC \times BD \times \sin\theta$

$16 = \dfrac{1}{2} \times d \times d \times \sin 90°$

$32\ \text{cm} = d^2$ …(i)

Also, area of trapezium

$= \dfrac{1}{2} \times (AB + DC) \times h$

$16 = \dfrac{1}{2}(a + b + a + a) \times h$

$16 = (a + b) \times h$

$a + b = \dfrac{16}{h}$ cm   …(ii)

In ΔDPB,

$(DB)^2 = (DP)^2 + (PB)^2$

$(d)^2 = (m)^2 + (a + b)^2$

$32 = h^2 + \left(\dfrac{16}{h}\right)^2$

     [by Eqs. (i) and (ii)]

Put the value of h from the option

Let $h = 4$,

then $= (4)^2 + \left(\dfrac{16}{4}\right)^2 = 16 + 16 = 32$ cm

L.H.S $=$ R.H.S

∴ $h = 4$ cm

25. If each interior angle of a regular polygon is 135°, then the number of diagonals of the polygon is equal to

(a) 54   (b) 48   (c) 20   (d) 18

⊙ *(c)* Given, each interior angle of a regular polygon = 135°

∵   Each exterior angle

   = 180° − Interior angle

   = 180° − 135° = 45°

∴   Number of sides in the polygon (n)

   $= \dfrac{360°}{\text{Each exterior angle}}$

   $= \dfrac{360°}{45°} = 8$

∴   Number of diagonals of a polygon

   $= \dfrac{n(n-1)}{2} - n = \dfrac{8(8-1)}{2} - 8$

   $= \dfrac{8 \times 7}{2} - 8 = 28 - 8 = 20$

Hence, the number of diagonals of the polygon is 20.

26. If a star figure is formed by elongating the sides of a regular pentagon, then the measure of each angle at the angular points of the star figure is

(a) 36°   (b) 35°
(c) 32°   (d) 30°

⊙ *(a)* ∵ Each interior angle of a regular polygon of n sides

   $= \dfrac{(n-2) \times 180°}{n}$

Here, $n = 5$
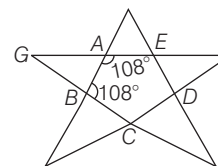
∴   Each interior angle of the pentagon

   $= \dfrac{(5-2) \times 180°}{5} = \dfrac{3 \times 180°}{5}$

   $= 3 \times 36° = 108°$

Since, GAF is a straight line.

∴ $\angle GAE = 180°$

$\Rightarrow$ $\angle GAB + \angle BAE = 180°$

$\Rightarrow$ $\angle GAB + 108° = 180°$

$\Rightarrow$ $\angle GAB = 180° - 108° = 72°$

Similarly, GBC is a straight line.

∴ $\angle GBC = 180°$

$\Rightarrow \angle GBA + \angle ABC = 180°$

$\Rightarrow$ $\angle GBA = 180° - 108° = 72°$

In ΔABG,

   $\angle GAB + \angle ABG + \angle BGA = 180°$

$\Rightarrow$ $72° + 72° + \angle BGA = 180°$

$\Rightarrow$ $\angle BGA = 180° - 144°$

∴ $\angle BGA = 36°$

27. *ABCD* is a parallelogram, where $AB : AD = 2 : 1$. One of the angles of the parallelogram is 60°. The two diagonals are in the ratio

(a) 7 : 3   (b) $\sqrt{7} : \sqrt{3}$
(c) 7 : 5   (d) None of these

⊙ *(b)*
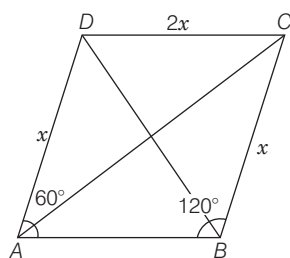
cosine rule

In $\triangle ABC$,

$$\cos B = \frac{AB^2 + BC^2 - AC^2}{2\,AB.BC}$$

$$\cos 120° = \frac{(2x)^2 + (x)^2 - AC^2}{2(2x)(x)}$$

$$-\frac{1}{2} = \frac{5x^2 - AC^2}{4x^2}$$

$$\left[\because \cos 120° = -\sin 30° = \frac{-1}{2} \right]$$

$$-2x^2 - 5x^2 = -AC^2$$
$$AC = \sqrt{7}x$$
$$-2x^2 - 5x^2 = -AC^2$$
$$AC = \sqrt{7}x$$

In $\triangle ADB$,

$$\cos A = \frac{AB^2 + AD^2 - BD^2}{2\,AB.\,AD}$$

$$\cos 60° = \frac{(2x)^2 + x^2 - BD^2}{2 \times 2x.x}$$

$$\frac{1}{2} = \frac{5x^2 - BD^2}{4x^2}$$

$$2x^2 - 5x^2 = -BD^2$$
$$BD = \sqrt{5}x$$

∴ Required ratio

$$= AC : BD$$
$$= \sqrt{7} : \sqrt{3}$$

28. Consider the following statements

 I. If non-parallel sides of a trapezium are equal, then it is cyclic.
 II. If the chord of a circle is equal to its radius, then the angle subtended by this chord at a point in major segment is 30°.

Which of the above statement(s) is/are correct?

(a) Only I
(b) Only II
(c) Both I and II
(d) Neither I nor II

⊙ *(c)* I. $\triangle ALD$ and $\triangle BMC$,
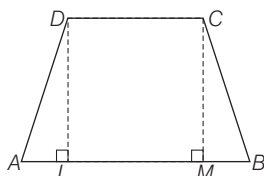
$$AD = BC \qquad \text{[given]}$$
$$DL = CM$$

[distance between parallel sides]
$$\angle ALD = \angle BMC \quad \text{[each 90°]}$$
$$\triangle ALD \cong \triangle BMC$$

[by RHS congruence criterion]
$$\Rightarrow \qquad \angle DAL = \angle CBM$$
$$\text{[by CPCT]} \quad ...(i)$$

Since, $AB \parallel CD$

$$\Rightarrow \quad \angle DAL + \angle ADC = 180°$$

[sum of adjacent interior angles is supplementary]
$$\Rightarrow \quad \angle CBM + \angle ADC = 180°$$
$$\text{[from Eq. (i)]}$$
$$\Rightarrow \quad ABCD \text{ is a cyclic trapezium.}$$

II. Given, the chord of the circle is equal to its radius.

i.e. $$AB = BC = AC$$

∴ $\triangle ABC$ is a equilateral triangle.
i.e. each angle is 60°.
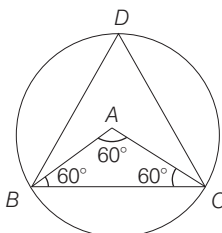
We know that, the angle subtended by an arc of a circle at the centre is double the angle subtended by it at any point on the circumference of circle.

∴ $$\angle D = \frac{\angle A}{2} = \frac{60°}{2} = 30°$$

2014 (II)

29. Let $ABCD$ be a parallelogram. Let X and Y be the mid-points of the sides BC and AD, respectively. Let M and N be the mid-points of the sides AB and CD, respectively.

Consider the following statements
1. The straight line MX cannot be parallel to YN.
2. The straight lines AC, BD, XY and MN meet at a point.

Which of the above statement(s) is/are correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ *(b)* 1. Given, $ABCD$ is a parallelogram. X and Y are mid-points of BC and AD, respectively. M and N are the mid-points of AB and CD, respectively.
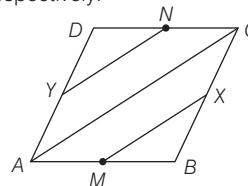
Now, join AC.
In $\triangle ABC$, M and X are mid-points of AB and BC.

∴ $$MX \parallel AC$$

and $$MX = \frac{1}{2}AC \qquad ...(i)$$

In $\triangle ADC$, Y and N are mid-points of AD and CD.

∴ $$YN \parallel AC \text{ and } YN = \frac{1}{2}AC \ ...(ii)$$

From Eqs. (i) and (ii), we get
$$MX \parallel YN$$

So, statement 1 is not correct.
2. Obviously, straight lines AC, BD, XY and MN meet at a point.
So, statement 2 is correct.

Directions (Q. Nos. 30-31) *Read the following information carefully and answer the given questions that follow.*

$ABCD$ is a trapezium, in which AB is parallel to CD. Let M be the mid-point of BC.

30. Consider the following statements
1. 'Area of $\triangle AMD$ + Area of $\triangle DCM$' is equal to three-fourth of the area of trapezium $ABCD$, if $AB = CD$.
2. 'Area of $\triangle DCM$ + Area of $\triangle ABM$' is always greater than half of the area of trapezium $ABCD$.

Which of the above statement(s) is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ *(c)* 1. Given, *ABCD* is a trapezium.

If $AB = CD$, then it becomes a parallelogram.

Since, *M* is the mid-point of *BC*.

Now, area of

$$\Delta AMD = \frac{1}{2} \text{ area of } ABCD \quad ...(i)$$

[since, both are between same parallels and in same base]
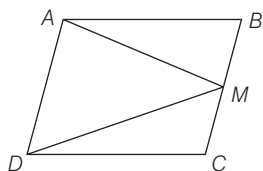
Now, area of ΔABM + area of $\Delta DCM = \frac{1}{2}$ area of *ABCD*

[∵ *M* is the mid-point of *BC*]

∵ Area of ΔABM = Area of ΔDCM

⇒ 2 Area of $\Delta DCM = \frac{1}{2}$ Area of *ABCD*

⇒ Area of

$$\Delta DCM = \frac{1}{4} \text{ Area of } ABCD \quad ...(ii)$$

On adding Eqs. (i) and (ii), we get
Area of ΔAMD + Area of

$$\Delta DCM = \frac{1}{2}$$

Area of $ABCD + \frac{1}{4}$ Area of

$$ABCD = \frac{3}{4} \text{ Area of } ABCD$$

So, statement 1 is correct.

2. Now, *ABCD* is a trapezium.
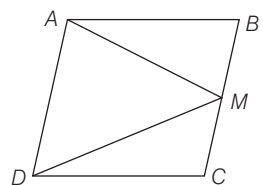
∴ Area of trapezium
= Area of ΔDCM + Area of ΔABM
             + Area of ΔAMD
⇒ Area of ΔDCM + Area of ΔABM
= Area of trapezium
     ABCD – Area of ΔAMD

If $AD = BC$, then using Eq. (i), we get
Area of ΔDCM + Area of ΔABM

$$= \frac{1}{2} \text{ Area of trapezium } ABCD$$

If $AD = BD$, then it is true, otherwise area of ΔDCM and area of ΔABM is greater than half of the area of trapezium *ABCD*.
So, statement 2 is also correct.

31. Consider the following statements
1. 'Area of ΔADM – Area of ΔABM' is always equal to area of ΔDCM, if $AB = CD$.
2. Half of area of ΔABM is equal to one-eighth of area of trapezium *ABCD*, if $AB = CD$.

Which of the above statement(s) is/are correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊘ *(c)* 1. If $AB = CD$, then *ABCD* is a parallelogram.

Area of $\Delta ADM = \frac{1}{2}$ Area of *ABCD*

[since, both are in same base and between same parallels]
⇒ Area of ΔADM – Area of ΔABM

$$= \frac{1}{2} \text{ Area of } ABCD - \frac{1}{4}$$

Area of $ABCD = \frac{1}{4}$ Area of *ABCD*

$$= \text{Area of } \Delta DCM$$

So, statement 1 is correct.

2. Now, Area of ΔABM + Area of
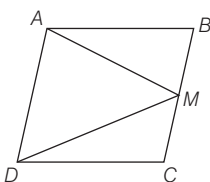
$$\Delta DCM = \frac{1}{2} \text{ Area of } ABCD$$

⇒ 2 Area of

$$\Delta ABM = \frac{1}{2} \text{ Area of } ABCD$$

[∵ area of ΔABM = area of ΔDCM]

⇒ Area of ΔABM

$$= \frac{1}{4} \text{ Area of } ABCD$$

⇒ $\frac{1}{2}$ Area of ΔABM

$$= \frac{1}{8} \text{ Area of } ABCD$$

So, statement 2 is correct.

32. *ABCD* is a parallelogram. *P* and *R* are the mid-points of *DC* and *BC*, respectively. The line *PR* intersects the diagonal *AC* at *Q*. The distance *CQ* will be

(a) *AC*/4   (b) *BD*/3
(c) *BD*/4   (d) *AC*/3

⊘ *(a)* Given, *ABCD* is a parallelogram. Join *AC* and *BD* which intersect each other at *O*.

∴ $OC = \frac{1}{2} AC$
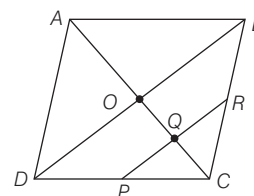
Now, in ΔCBD, *P* and *R* are mid-points of *DC* and *BC*.
∴ *PR* || *BD* or *PQ* || *DO* and *RQ* || *BO*
Now, in ΔOCD, *PQ* || *OD*
So, *Q* is mid-point of *OC*.

∴ $CQ = \frac{1}{2}OC = \frac{1}{2}\left(\frac{1}{2}AC\right) = \frac{1}{4}AC$

33. Bisectors of two adjacent angles *A* and *B* of a quadrilateral *ABCD* intersect each other at a point *P*. Which one of the following is correct?

(a) $2\angle APB = \angle C + \angle D$
(b) $\angle APB = \angle C + \angle D$
(c) $\angle APB = 180° - (\angle A + \angle B)$
(d) $\angle APB = 180° - (\angle C + \angle D)$

⊘ *(a)* Given, a quadrilateral *ABCD*, *AP* and *BP* are bisectors of $\angle A$ and $\angle B$, respectively.
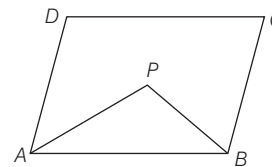
∴ $\angle APB = 180° - \left(\frac{1}{2}\angle A + \frac{1}{2}\angle B\right)$ ...(i)

Now, sum of all angles of a quadrilateral
                   = 360°
⇒ $\angle A + \angle B + \angle C + \angle D = 360°$
⇒ $\frac{1}{2}\angle A + \frac{1}{2}\angle B + \frac{1}{2}\angle C + \frac{1}{2}\angle D = \frac{360°}{2}$
⇒ $\frac{1}{2}\angle C + \frac{1}{2}\angle D = 180° - \left(\frac{1}{2}\angle A + \frac{1}{2}B\right)$
⇒ $\frac{1}{2}(\angle C + \angle D) = \angle APB$ [from Eq. (i)]
∴ $\angle C + \angle D = 2\angle APB$

2014 (I)

34. Two light rods $AB = a + b$ and $CD = a - b$ symmetrically lying on a horizontal AB. There are kept intact by two strings AC and BD. The perpendicular distance between rods is a. The length of AC is given by

(a) a (b) b
(c) $\sqrt{a^2 - b^2}$ (d) $\sqrt{a^2 + b^2}$

⊙ **(d)** Since, they are symmetrically lying on horizontal plane.
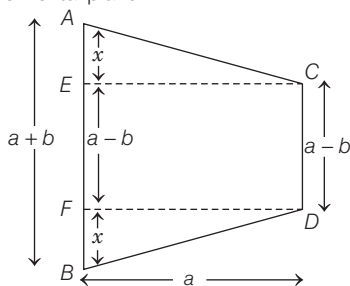
$$\therefore \qquad AC = BD$$
$$\therefore \qquad AE = BF = x \qquad \text{[say]}$$
Now, $\qquad AB = (a - b) + 2x$
i.e. $\qquad a + b = a - b + 2x$
$$\Rightarrow \qquad 2b = 2x$$
$$\therefore \qquad x = b$$
Now in ΔACE,
$$x^2 + a^2 = AC^2$$
$$\Rightarrow \qquad AC^2 = b^2 + a^2$$
$$\Rightarrow \qquad AC = \sqrt{b^2 + a^2}$$

35. If $PQRS$ is a rectangle such $PQ = \sqrt{3}\ QR$. Then, what is $\angle PRS$ equal to?

(a) 60°   (b) 45°   (c) 30°   (d) 15°

⊙ **(c)** In rectangle $PQRS$, $PQ \parallel RS$
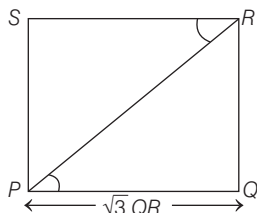
$$\therefore \qquad \angle RPQ = \angle PRS$$
$$\text{[alternate interior angles]} \quad \dots\text{(i)}$$
Now in ΔPQR, $\tan \angle QPR = \dfrac{RQ}{PQ}$
$$\Rightarrow \quad \tan \angle QPR = \dfrac{QR}{\sqrt{3}\ QR}$$
$$\Rightarrow \qquad \angle QPR = 30°$$
$$\therefore \qquad \angle PRS = 30° \qquad \text{[from Eq. (i)]}$$

36. In a trapezium, the two non-parallel sides are equal in length, each being of 5 cm. The parallel sides are at a distance of 3 cm apart. If the smaller side of the parallel sides is of length 2 cm, then the sum of the diagonals of the trapezium is

(a) $10\sqrt{5}$ cm   (b) $6\sqrt{5}$ cm
(c) $5\sqrt{5}$ cm   (d) $3\sqrt{5}$ cm

⊙ **(b)** In ΔBCF, by Pythagoras theorem,
$$(5)^2 = (3)^2 + (BF)^2$$
$$\Rightarrow \qquad BF = 4 \text{ cm}$$
$$\therefore \qquad AB = 2 + 4 + 4 = 10 \text{ cm}$$
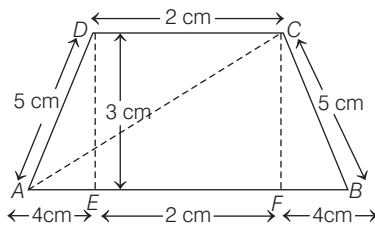
Now in ΔACF, $AC^2 = CF^2 + FA^2$
$$\Rightarrow \qquad AC^2 = 3^2 + 6^2$$
$$AC = \sqrt{45} \text{ cm}$$
Similarly, $\quad BD = \sqrt{45}$ cm
$$\therefore \quad \text{Sum of diagonal} = 2 \times \sqrt{45}$$
$$= 2 \times 3\sqrt{5} = 6\sqrt{5} \text{ cm}$$

37. The area of a rectangle lies between 40 cm² and 45 cm². If one of the sides is 5 cm, then its diagonal lies between

(a) 8 cm and 10 cm
(b) 9 cm and 11 cm
(c) 10 cm and 12 cm
(d) 11 cm and 13 cm

⊙ **(b)** Area of rectangle lies between 40 cm² and 45 cm².
Now, one side = 5 cm
Since, area cannot be less than 40 cm².
∴ Other side cannot be less than
$$= \dfrac{40}{5} = 8 \text{ cm}$$
Since, area cannot be greater than 45 cm².
∴ Other side cannot be greater than
$$= \dfrac{45}{5} = 9 \text{ cm}$$
∴ Minimum value of diagonal
$$= \sqrt{8^2 + 5^2} = \sqrt{89} = 9.43 \text{ cm}$$
Maximum value of diagonal
$$= \sqrt{9^2 + 5^2} = \sqrt{106}$$
$$= 10.3 \text{ cm}$$
So, diagonal lies between 9 cm and 11 cm.

38. Let $ABCD$ be a parallelogram. Let P, Q, R and S be the mid-points of sides AB, BC, CD and DA, respectively. Consider the following statements.

I. Area of $\Delta APS <$ Area of ΔDSR, if $BD < AC$.
II. Area of $\Delta ABC = 4$ (Area of ΔBPQ).

Select the correct answer using the codes given below.

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊙ **(b)** Area of ΔAPS = Area of ΔDSR
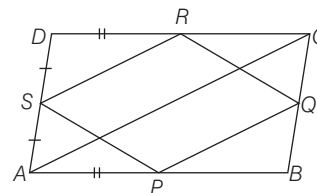
$$\because \qquad AS = SD \text{ and } AP = DR$$
$$\therefore \quad \text{ar}(\Delta ABC) = 4 \text{ ar}(\Delta BPQ)$$
Hence, only statement II is correct.

39. Consider the following statements

I. Let $ABCD$ be a parallelogram which is not a rectangle. Then, $2(AB^2 + BC^2)$
$$\neq AC^2 + BD^2$$
II. If $ABCD$ is a rhombus with $AB = 4$ cm, then $AC^2 + BD^2 = n^3$ for some positive integer n.

Which of the above statement(s) is/are correct?

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊙ **(b)** I. If $ABCD$ is a parallelogram, then
$$AC^2 + BD^2 = 2(AB^2 + BC^2)$$
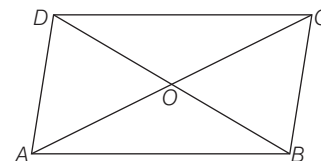
II. $ABCD$ is a rhombus and diagonals AC and BD bisect each other.
$$\therefore \quad AO = OC \text{ and } OB = OD$$
In ΔAOB, $AB^2 = AO^2 + OB^2$
$$(4)^2 = \left(\dfrac{AC}{2}\right)^2 + \left(\dfrac{BD}{2}\right)^2$$
$$\therefore \quad AC^2 + BD^2 = 64 = (4)^3 \text{ i.e., } n^3$$

40. *ABCD* is a parallelogram. *E* is a point on *BC* such that *BE* : *EC* = *m* : *n*. If *AE* and *DB* intersect in *F*, then what is the ratio of the area of ΔFEB to the area of ΔAFD?

(a) m / n (b) $(m / n)^2$
(c) $(n / m)^2$ (d) $[m / (m + n)]^2$

⊙ *(d)* In ΔAFD and ΔBFE,
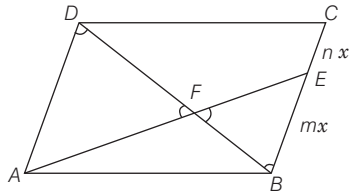
$\angle AFD = \angle BFE$
      [vertically opposite angles]
and $\angle ADF = \angle FBE$
      [alternate angles]
$\therefore$ $\Delta AFD \sim \Delta BFE$
      [by AA criteria]

So, $\dfrac{\text{ar}(\Delta FEB)}{\text{ar}(\Delta AFD)} = \dfrac{EB^2}{AD^2}$

$= \dfrac{mx^2}{(mx + nx)^2}$

$= \dfrac{m^2}{(m + n)^2}$

$= \left[\dfrac{m}{(m + n)} \right]^2$

41. *AB* is a straight line, *C* and *D* are points on the same side of *AB* such that *AC* is perpendicular to *AB* and *DB* is perpendicular to *AB* Let *AD* and *BC* meet at *E*. What is $\dfrac{AE}{AD} + \dfrac{BE}{BC}$ equal to?

(a) 2   (b) 1.5
(c) 1   (d) None of these

⊙ *(c)* Since, *AB* is a straight line and *C* and *D* are points such that $AC \perp AB$ and $BD \perp AB$.
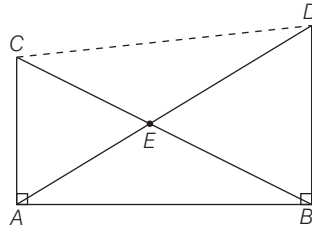
$\therefore$ *AC*||*BD*
So, *ABCD* forms a trapezium.
Now, by property of trapezium diagonals intersect each other in the ratio of lengths of parallel sides.

$\therefore$ $\dfrac{AE}{ED} = \dfrac{CE}{BE}$

$\Rightarrow$ $\dfrac{AE}{AD - AE} = \dfrac{CE}{BC - CE}$

$\Rightarrow$ $\dfrac{AD - AE}{AE} = \dfrac{BC - CE}{CE}$

$\Rightarrow$ $\dfrac{AD}{AE} - 1 = \dfrac{BC}{CE} - 1$

$\Rightarrow$ $\dfrac{AD}{AE} = \dfrac{BC}{CE}$

$\therefore$ $\dfrac{AE}{AD} = \dfrac{CE}{BC}$ …(i)

Now, $\dfrac{AE}{AD} + \dfrac{BE}{BC} = \dfrac{CE}{BC} + \dfrac{BE}{BC}$
                   [from Eq. (i)]

$= \dfrac{CE + BE}{BC}$

$= \dfrac{BC}{BC}$ $[\because BC = CE + BE]$

$= 1$

1. A line segment AB is the diameter of a circle with centre at O having radius 6.5 cm. Point P is in the plane of the circle such that $AP = x$ and $BP = y$. In which one of the following cases the point P does not lie on the circle?

(a) $x = 6.5$ cm and $y = 6.5$ cm
(b) $x = 12$ cm and $y = 5$ cm
(c) $x = 5$ cm and $y = 12$ cm
(d) $x = 0$ cm and $y = 13$ cm

⊘ **(a)**
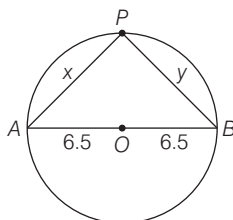
Circle with centre O having AB as a diameter.

We know that, diameter create 90° angle on the circumference of the circle.

$\therefore \quad x^2 + y^2 = 13^2$

$x^2 + y^2 = 169$

Now, by putting option we can get the required answer,

On putting option (a)

$\qquad x = 6.5, \ y = 6.5$

$\Rightarrow (6.5)^2 + (6.5)^2 = 169$

$\Rightarrow 42.25 + 42.25 = 169$

$\Rightarrow \qquad 84.50 \ne 169$

So, option (a) cannot be possible.

2. Consider a trapezium $ABCD$, in which AB is parallel to CD and AD is perpendicular to AB. If the trapezium has an incircle which touches AB at E and CD at F, where $EB = 25$ cm and $FC = 16$ cm, then what is the diameter of the circle?

(a) 16 cm   (b) 25 cm
(c) 36 cm   (d) 40 cm

⊘ **(d)**
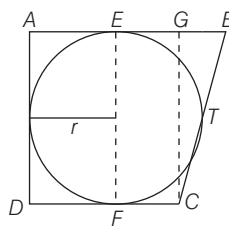
$ABCD$, is trapezium in which AB is parallel to CD. Let BC touches circle at T.

$\qquad FC = CT = 16$ cm

$\qquad EB = BT = 25$ cm [tangent of circle]

$\qquad BC = CT + BT = 16 + 25 = 41$

Let radius of the circle is r,

$\triangle CGB$, is right angled triangle,

From Pythagoras theorem,

$\qquad CB^2 = CG^2 + BG^2$

Here, $CB = 2r, \ BC = 41$

$\qquad BG = BE - FC = 25 - 16 = 9$

$\qquad 41^2 = (2r)^2 + 9^2$

$\qquad (2r)^2 = 41^2 - 9^2$

$\qquad 4r^2 = 50 \times 32$

$\therefore \qquad r = 20$ cm

Diameter of the circle $= 2 \times 20 = 40$ cm

3. If the lengths of two parallel chords in a circle of radius 10 cm are 12 cm and 16 cm, then what is the distance between these two chords?

(a) 1 cm or 7 cm   (b) 2 cm or 14 cm
(c) 3 cm or 21 cm   (d) 4 cm or 28 cm

⊘ **(b)** Radius of circle = 10 cm

Length of chords = 12 cm and 16 cm

If chords opposite side from centre.

O is centre of circle.
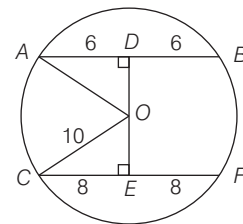
AB and CD are two chords 12 cm and 16 cm, respectively.

In $\triangle AOD$,

$\qquad AO = 10$ cm   [radius of circle]

$\qquad AD = 6$ cm

$\qquad (AO)^2 = (AD)^2 + (OD)^2 (10)^2 = (6)^2 + (OD)^2$

$(10)^2 - (6)^2 = OD^2$

$\sqrt{100 - 36} = OD$

$\qquad OD = 8$ cm

In $\triangle CEO, \ (CO)^2 = (CE)^2 + (OE)^2$

$\qquad (10)^2 = (8)^2 + (OE)^2$

$\sqrt{100 - 64} = OE$

$\qquad OE = 6$ cm

Distance between two chords

$(DE) = DO + OE = 8 + 6 = 14$ cm

If both chords are in same side from centre.
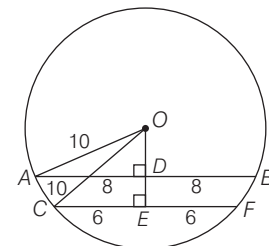
O is centre of circle.

$\qquad AB = 16$ cm

$\qquad CD = 12$ cm

In $\triangle AOD$,

$(AO)^2 = (AD)^2 + (OD)^2$

$(10)^2 = (8)^2 + OD^2$

$OD^2 = 100 - 64$

$OD = \sqrt{36}$

$OD = 6$ cm

In $\triangle COE$,

$(CO)^2 = (OE)^2 + (CE)^2$

$(10)^2 = (OE)^2 + (6)^2$

$OE = \sqrt{100 - 36}$

$OE = 8$ cm

The distance between two chords

$DE = OE - OD$

$= 8 - 6 = 2$ cm

4. In a circle of radius 8 cm, AB and AC are two chords such that $AB = AC = 12$ cm. What is the length of chord BC ?

(a) $2\sqrt{6}$ cm   (b) $3\sqrt{6}$ cm

(c) $3\sqrt{7}$ cm   (d) $6\sqrt{7}$ cm

⊙ **(d)** In a circle,

Radius = 8 cm

$AB = AC = 12$ cm

AB and AC are chords of circle.
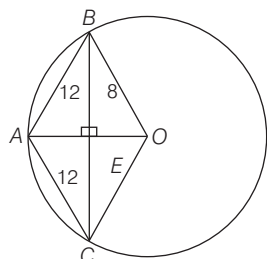
$AO = 8$ cm is also radius

$s = \dfrac{12 + 8 + 8}{2} = \dfrac{28}{2} = 14$ cm

Area of $\triangle ABO = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{14 \times (14-12)(14-8)(14-8)}$

$= \sqrt{14 \times 2 \times 6 \times 6}$

$= 12\sqrt{7}$ cm^2

BE is height of $\triangle BAO$

Area of $\triangle ABO = \dfrac{1}{2} \times BE \times AO$

$12\sqrt{7} = \dfrac{1}{2} \times BE \times 8$

$BE = 3\sqrt{7}$ cm

Length of $BC = 2 \times BE$

$= 2 \times 3\sqrt{7} = 6\sqrt{7}$ cm

5. Two equal circles intersect such that each passes through the centre of the other. If the length of the common chord of the circles is $10\sqrt{3}$ cm, then what is the diameter of the circle?

(a) 10 cm   (b) 15 cm

(c) 20 cm   (d) 30 cm

⊙ **(c)** Two equal circles intersect such that each passes through the centre of the other.
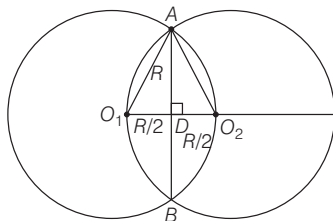
Radius of circles = R

AB is common chord = $10\sqrt{3}$ cm

$AD = \dfrac{AB}{2} = \dfrac{10\sqrt{3}}{2} = 5\sqrt{3}$ cm

In $\triangle AO_1D$,

$(O_1A)^2 = (O_1D)^2 + (AD)^2$

$R^2 = \left(\dfrac{R}{2}\right)^2 + (5\sqrt{3})^2$

$R^2 - \dfrac{R^2}{4} = 25 \times 3$

$\dfrac{3R^2}{4} = 25 \times 3$

$R = \sqrt{25 \times 4}$

$R = 10$ cm

Then, diameter of circle

$= 2R = 2 \times 10 = 20$ cm

Option (c) is correct.

Alternate Method

We know that, Length of common chord

$= \sqrt{3}r$

$10\sqrt{3} = \sqrt{3}r$

Diameter of circle = $2 \times 10 = 20$ cm

6. Consider the following statements.

I. The number of circles that can be drawn through three non-collinear points is infinity.

II. Angle formed in minor segment of a circle is acute.

Which of the above statements is/are correct?

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

⊙ **(d)** I. Only one circle can be drawn from three non-collinear points.

II. (i) Angle formed in minor segment of a circle is obtuse.

(ii) Angle formed in major segment of a circle is acute.

Then, Option (d) is correct.

7. The chord of a circle is $\sqrt{3}$ times its radius. The angle subtended by this chord at the minor arc is k times the angle subtended at the major arc. What is the value of k ?

(a) 5   (b) 2

(c) 1/2   (d) 1/5

⊙ **(b)**
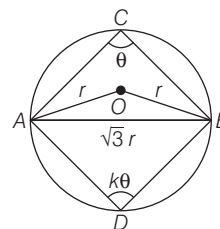
O is center of circle.

In $\triangle ABO$,

Cosine rule

$\cos \angle AOB = \dfrac{AO^2 + OB^2 - AB^2}{2(AO)(OB)}$

$\cos \angle AOB = \dfrac{r^2 + r^2 - (\sqrt{3}r)^2}{2r.r}$

$[AO = OB = r$, radius of circle$]$

$\cos \angle AOB = \dfrac{2r^2 - 3r^2}{2r^2}$

$\cos \angle AOB = -\dfrac{1}{2}$

$\angle AOB = 120°$

Then, $\angle ACB = \dfrac{1}{2} \angle AOB$

$\angle ACB = \theta = \dfrac{1}{2} \times 120° = 60°$ ...(i)

$\angle ADB + \angle ACB = 180°$

[cyclic quadrilateral's opposite angle]

$\angle ADB = 120°$ ...(ii)

$k\theta = 120°$ $[\because \angle ADB = k\theta]$

$k = \dfrac{120°}{60°} = 2$ $[\because \theta = 60°]$

8. If a point P moves such that the sum of the squares of its distances from two fixed points A and B is a constant, then the locus of the point P is

(a) a straight line

(b) a circle

(c) perpendicular bisector of AB

(d) an arbitrary curve

⊗ **(b)** Given, $PA^2 + PB^2$ = Constant

$$P\ (x, y)$$

$$A\ (x_1, y_1) \qquad B\ (x_2, y_2)$$

∴ $(x - x_1)^2 + (y - y_1)^2 + (x - x_2)^2$
$\qquad + (y - y_2)^2$ = Constant

⇒ $2(x^2 + y^2) - 2x(x_1 + x_2)$
$\qquad - 2y(y_1 + y_2) + x_1^2 + x_2^2 + y_1^2 + y_2^2$
$\qquad$ = Constant

Which represents the locus circle.

9. In the figure given below, the radius of the circle is 6 cm and $AT = 4$ cm. The length of tangent PT is
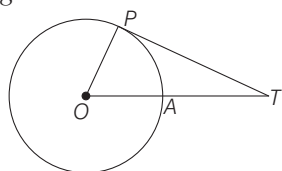
(a) 6 cm $\qquad$ (b) 8 cm
(c) 9 cm $\qquad$ (d) 10 cm

⊗ **(b)** Here, $OP = 6$ cm

$\qquad OT = OA + AT = 6 + 4 = 10$ cm
∴ $\qquad PT^2 = OT^2 - OP^2$
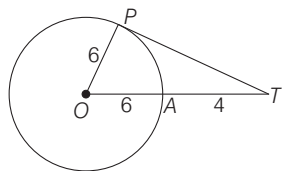
⇒ $\qquad PT = \sqrt{(10)^2 - (6)^2}$

⇒ $\sqrt{100 - 36} = \sqrt{64} = 8$ cm

10. In the figure given below, what is $\angle BCD$ equal to?
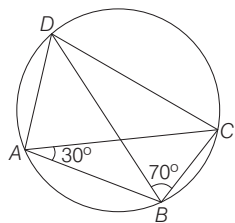
(a) 70° $\quad$ (b) 75° $\quad$ (c) 80° $\quad$ (d) 90°
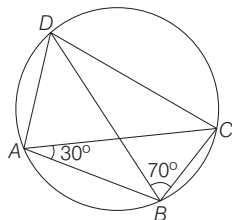
⊗ **(c)** $\angle CAD = \angle CBD$

$\angle CAD = \angle CBD$
$\qquad$ [angle on same segment]
∴ $\angle CAD = 70°$
∴ $\angle BAD = \angle BAC + \angle CAD$
$\qquad = 30° + 70° = 100°$
$\angle BAD + \angle BCD = 180°$
$\qquad$ [$ABCD$ is cycle quadrilateral]
∴ $\angle BCD = 180° - \angle BAD$
$\qquad = 180° - 100° = 80°$

11. In the figure given below, AB is the diameter of the circle whose centre is at O. Given that $\angle ECD = \angle EDC = 32°$, then $\angle CEF$ and $\angle COF$ respectively are
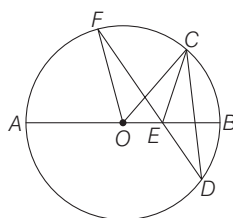
(a) 32°, 64° $\qquad$ (b) 64°, 64°
(c) 32°, 32° $\qquad$ (d) 64°, 32°

⊗ **(b)** Given, $\angle ECD = \angle EDC = 32°$
$\qquad \angle CEF = \angle ECD + \angle EDC$
$\qquad$ [exterior angle of Δ is sum of
$\qquad$ interior opposite angle]
∴ $\angle CEF = 32° + 32° = 64°$
$\quad \angle COF = 2\angle CDF = 2(32°) = 64°$

> **2018 (I)**

12. A region of area A bounded by a circle C is divided into n regions, each of area $\dfrac{A}{n}$, by drawing circles of radii $r_1, r_2, r_3, ..., r_{n-1}$ such that $r_1 < r_2 < r_3 < ...r_{n-1}$ concentric with the circle C. If $p_m = \dfrac{r_{m+1}}{r_m}$, where $m = 1, 2, 3, ..., (n-2)$, then which one of the following is correct?

(a) p increases as m increases
(b) p decreases as m increases
(c) p remains constant as m increases
(d) p increases for some values of m as m increases and then decreases thereafter

⊗ **(b)**
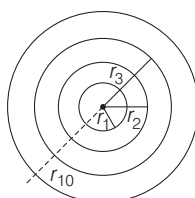
According to the question,
$\qquad r_1 < r_2 < r_3 < .....r_{n-1}$
Now, $\qquad p_m = \dfrac{r_{m+1}}{r_m}$
⇒ $\qquad p_m > 1 \qquad [\because r_{m+1} > r_m]$
From $m = 1, 2, 3$, when r_m increases, then p_m decreases.

13. The radii of two circles are 4.5 cm and 3.5 cm respectively. The distance between the centres of the circles is 10 cm. What is the length of the transverse common tangent?

(a) 4 cm $\quad$ (b) 5 cm $\quad$ (c) 6 cm $\quad$ (d) 7 cm

⊗ **(c)**
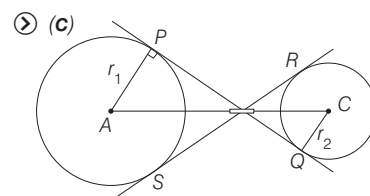
$r_1 = 4.5$ cm, $r_2 = 3.5$ cm
$AC = 10$ cm
PQ and RS are transverse common tangents.
$\qquad PQ^2 = RS^2 = d^2 - (r_1 + r_2)^2$
$\qquad PQ^2 = (10)^2 - (4.5 + 3.5)^2$
$\qquad PQ^2 = 100 - 8^2$
$\qquad PQ^2 = 100 - 64$
⇒ $\qquad PQ^2 = 36$
$\qquad PQ = 6$ cm
⇒ $\qquad PQ = RS = 6$ cm

14. The locus of the mid-points of the radii of length 16 cm of a circle is

(a) A concentric circle of radius 8 cm
(b) A concentric circle of radius 16 cm
(c) The diameter of the circle
(d) A straight line passing through the centre of the circle

⊗ **(a)** The locus of mid-points of the radii of a circle would also be a circle with same centre, but half the radius.
∴ It is a concentric circle of radius 8 cm.

15. In the figure given below, XA and XB are two tangents to a circle. If $\angle AXB = 50°$ and AC is parallel to XB, then what is $\angle ACB$ equal to ?

(a) 70° $\quad$ (b) 65° $\quad$ (c) 60° $\quad$ (d) 55°

▷ (b)
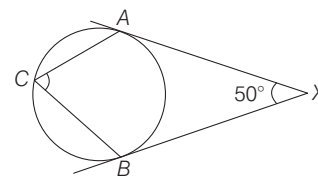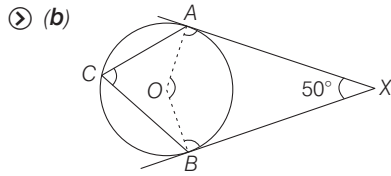
Let 'O' be the center of the circle.

$\therefore\ \angle AOB = 360° - (90° + 90° + 50°)$

$= 360° - 230° = 130°$

$\angle ACB = \dfrac{\angle AOB}{2} = \dfrac{130°}{2} = 65°$

16. In the figure given below, SPT is a tangent to the circle at P and O is the centre of the circle. If $\angle QPT = \alpha$, then what is $\angle POQ$ equal to?

(a) α (b) 2α
(c) $90° - \alpha$ (d) $180° - 2\alpha$

▷ (b)

$\angle QPT = \alpha$ [given]
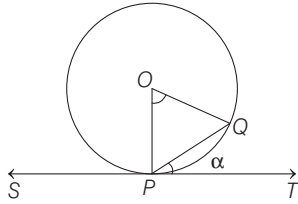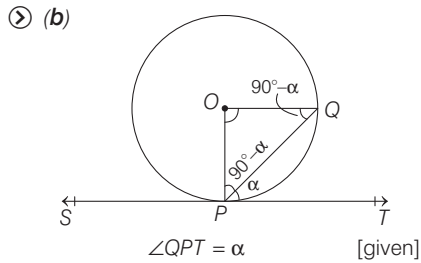
Now, $\because SPT$ is a tangent,

$\therefore$ $\angle OPT = 90°$

and $\angle OPQ = 90° - \alpha$

In $\triangle OPQ$, $OP = OQ$ = radius of circle

$\therefore$ $\angle OQP = 90° - \alpha$

Now, sum of angles of a triangle = 180°

$\therefore$ $\angle POQ = 180° - 2(90° - \alpha)$

$= 180° - 180° + 2\alpha$

$\therefore$ $\angle POQ = 2\alpha$

17. In the figure given below, two equal chords cut at point P. If $AB = CD = 10$ cm, $OC = 13$ cm (O is the centre of the circle) and $PB = 3$ cm, then what is the length of OP ?
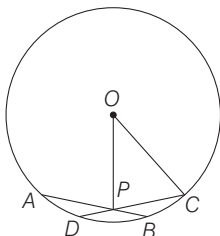
(a) 5 cm   (b) 6 cm
(c) $2\sqrt{29}$ cm   (d) $2\sqrt{37}$ cm

▷ (d)
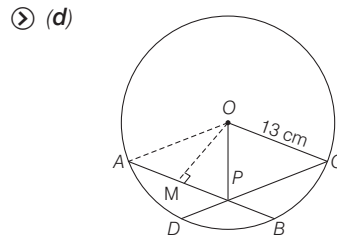
$AB = CD = 10$ cm

$OC = 13$ cm

$OM \perp AB$

$\therefore$

$AM = \dfrac{1}{2} AB$

$AM = MB = \dfrac{1}{2} \times 10 = 5$ cm

$AM = 5$ cm

In $\triangle OMA$,

$OM^2 = \sqrt{OA^2 - AM^2}$

$= \sqrt{(13)^2 - (5)^2}$

$= \sqrt{169 - 25} = \sqrt{144}$

$OM = 12$ cm

In $\triangle OMP$,

$OP^2 = OM^2 + MP^2$

$OP = \sqrt{(12)^2 + (5-3)^2}$

$= \sqrt{144 + 4}$

$= \sqrt{148} = 2\sqrt{37}$ cm

2017 (II)

18. AB and CD are parallel chords of a circle 3 cm apart. If $AB = 4$ cm, $CD = 10$ cm, then what is the radius of the circle?

(a) 7 cm   (b) $\sqrt{19}$ cm
(c) $\sqrt{29}$ cm   (d) 14 cm

▷ (c) We have,

AB and CD are parallel chord of circle 3 cm a part

$AB = 4, CD = 10$

$\therefore$

$MB = \dfrac{1}{2} AB = 2$

$\therefore$

$ND = \dfrac{1}{2} CD = 5$

In $\triangle OMB$, $OB^2 = OM^2 + MB^2$

$= (ON + MN)^2 + (MB)^2$

$\Rightarrow$ $r^2 = (x + 3)^2 + 4$ ...(i)

Similarly, in $\triangle OND$,

$r^2 = x^2 + 25$ ...(ii)

On solving Eqs. (i) and (ii), we get $x = 2$

$r^2 = (2)^2 + 25$

$r^2 = 29 \Rightarrow r = \sqrt{29}$ cm

19. The distance between the centres of two circles having radii 9 cm and 4 cm is 13 cm. What is the length of the direct common tangent of these circles?

(a) 12 cm   (b) 11 cm
(c) 10 cm   (d) 9.5cm

▷ (a) We have,

$AP = 4$ cm

$BQ = 9$ cm

$AB = 13$ cm

$QM = BQ - MB = 9 - 4 = 5$ cm

$AB = PM = 13$ cm

In $\triangle PQM$, $PQ^2 = PM^2 - QM^2$

$PQ^2 = 13^2 - 5^2$

$= 169 - 25 = 144$

$PQ = 12$ cm

Alternate Method

Here, $d = 13$ cm, $r_1 = 9$ cm, $r_2 = 4$ cm

Length of common tangent

$= \sqrt{d^2 - (r_1 - r_2)^2}$

$= \sqrt{13^2 - (9 - 4)^2}$

$= \sqrt{169 - 25}$

$= \sqrt{144} = 12$ cm

2017 (I)

20. Two parallel chords of a circle whose diameter is 13 cm are respectively 5 cm and 12 cm in length. If both the chords are on the same side of the diameter, then the distance between these chords is

(a) 5.5 cm (b) 5 cm   (c) 3.5 cm (d) 3 cm

▷ (c)

Since, *AB* and *CD* are parallel, then *OM* and *ON* are perpendicular to *AB* and *CD* respectively.

We have,

$AB = 12$ cm $\Rightarrow AM = \dfrac{1}{2} AB = 6$ cm

$CD = 5$ cm $\Rightarrow CN = \dfrac{1}{2} CD = 2.5$ cm

and $OA = OC = \dfrac{1}{2} \times 13 = 6.5$ cm

Now, in ΔOAM,

$$OM^2 = OA^2 - AM^2$$
$$= 6.5^2 - 6^2 = 6.25$$
$$\Rightarrow \qquad OM = 2.5 \text{ cm}$$

Again, in ΔOCN,

$$ON^2 = OC^2 - CN^2$$
$$= 6.5^2 - 2.5^2 = 36$$
$$\Rightarrow \qquad ON = 6 \text{ cm}$$

$\therefore$ Distance between *AB* and *CD* = *MN*

$$= ON - OM$$
$$= 6 - 2.5 = 3.5 \text{ cm}$$

21. In the figure given below, *D* is the diameter of each circle. What is the diameter of the shaded circle?
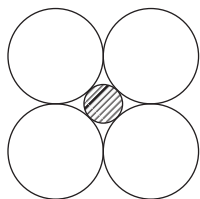
(a) $D(\sqrt{2} - 1)$ (b) $D(\sqrt{2} + 1)$
(c) $D(\sqrt{2} + 2)$ (d) $D(2 - \sqrt{2})$

⊘ **(a)** Let *P*, *Q*, *R* and *S* be the centres of the outer four circles. Whose diameter is *D* from figure, it is clear that

$$\dfrac{D}{2} + \dfrac{D}{2} = D$$

Similarly, $QR = D$

Again, Let *d* be the diameter of the shaded circle.

$\therefore \qquad PR = \dfrac{D}{2} + d + \dfrac{D}{2} = D + d \qquad \text{...(i)}$
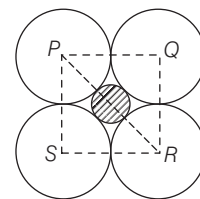
Since, ΔPQR is a right angled triangle

$\therefore \qquad PR^2 = PQ^2 + QR^2$

$(PR)^2 = D^2 + D^2$

$PR^2 = 2D^2$

$PR = \sqrt{2}D$

$D + d = \sqrt{2}D \qquad$ [by Eq. (i)]

$d = \sqrt{2}D - D$

$d = D(\sqrt{2} - 1)$

2016 (II)

22. *ABCDA* is a con-cyclic quadrilateral of a circle *ABCD* with radius *r* and centre at *O*. If *AB* is the diameter and *CD* is parallel and half of *AB* and if the circle completes one rotation about the centre *O*, then the locus of the middle point of *CD* is a circle of radius.

(a) $\dfrac{3r}{2}$ (b) $\dfrac{2r}{3}$ (c) $\dfrac{2\sqrt{3}r}{3}$ (d) $\dfrac{\sqrt{3}r}{2}$

⊘ **(d)** Given, *AB* is the diameter of circle.

$\therefore \qquad AB = 2r$
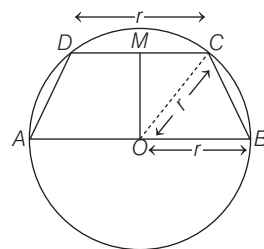
Since, *CD* is parallel and half of *AB*.

$\therefore \qquad CD = \dfrac{1}{2} AB = r$

Let *M* be the mid-point of *CD*.

Then, $\qquad CM = \dfrac{CD}{2} = \dfrac{r}{2}$

By Pythagoras theorem,

$$OM = \sqrt{r^2 - \left(\dfrac{r}{2}\right)^2} = \dfrac{\sqrt{3}}{2}r$$

Hence, the locus of mid-point of *CD*, i.e. *M* is a circle of radius $\dfrac{\sqrt{3}}{2}r$.

23. In a circle of radius 3 units, a diameter *AB* intersects a chord of length 2 units perpendicular at *P*. If $AP > BP$, then what is the ratio of *AP* to *BP*?

(a) $3 + \sqrt{10} : 3 - \sqrt{10}$
(b) $3 + \sqrt{8} : 3 - \sqrt{8}$
(c) $3 + \sqrt{3} : 3 - \sqrt{3}$
(d) $3 : \sqrt{3}$

⊘ **(b)** In ΔOPC,

$$OP = \sqrt{(3)^2 - (1)^2} = \sqrt{9 - 1} = \sqrt{8}$$
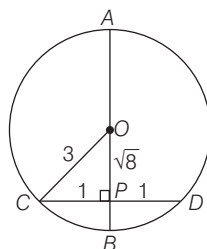
Now, $AP = AO + OP$

$= (3 + \sqrt{8})$ cm

$[\because AO = \text{radius}]$

Also, $BP = BO - OP$

$= (3 - \sqrt{8})$ cm

$[\because BO = \text{radius}]$

$\therefore$ Required ratio $= 3 + \sqrt{8} : 3 - \sqrt{8}$

24. If a quadrilateral has an inscribed circle, then the sum of a pair of opposite sides equals
(a) half the sum of the diagonals
(b) sum of the other pair of opposite sides
(c) sum of two adjacent sides
(d) None of the above

⊘ **(b)** Let *ABCD* be the quadrilateral, which has an inscribed circle.
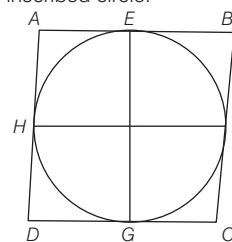
Now, $AE = AH \qquad \text{...(i)}$

$BE = BF \qquad \text{...(ii)}$

$DG = DH \qquad \text{...(iii)}$

$CG = CF \qquad \text{...(iv)}$

$[\because$ tangents from same point on the circle are equal in lengths]

On adding Eqs. (i), (ii), (iii) and (iv), we get

$AE + BE + DG + CG$

$= AH + BF + DH + CF$

$\Rightarrow AB + DC = AD + BC$

Hence, sum of a pair of opposite sides is equal to sum of the another pair of opposite sides.

25. If two tangents inclined at an angle 60° are drawn to a circle of radius 3 cm, then what is the length of each tangent?
(a) $3\sqrt{3}$ cm   (b) $\sqrt{3}$ cm
(c) 6 cm   (d) $2\sqrt{2}$ cm

⊘ **(a)** In ΔAOC,
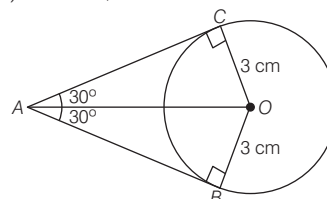
$\tan 30° = \dfrac{OC}{AC} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{3}{AC}$

$\therefore \qquad AC = 3\sqrt{3}$

Hence, the length of each tangent is $3\sqrt{3}$ cm.

26. If a square of side x and an equilateral triangle of side y are inscribed in a circle, then what is the ratio of x to y?

(a) $\sqrt{\dfrac{2}{3}}$ (b) $\sqrt{\dfrac{3}{2}}$

(c) $\dfrac{3}{\sqrt{2}}$ (d) $\dfrac{\sqrt{2}}{3}$

> **(a)** Let r be the radius of the circle with centre O.
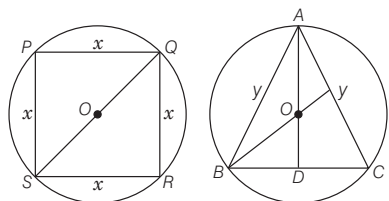
In ΔABC, AD is the median of equilateral triangle.

$$\therefore \qquad AD = \frac{\sqrt{3}}{2} \, AB = \frac{\sqrt{3}}{2} \, y$$

Centre of circumcircle of equilateral triangle divide the median into the ratio $2 : 1$.

$$\therefore \qquad AO = r = \frac{2}{3} \times AD = \frac{2}{3} \times \frac{\sqrt{3}}{2} y$$

$$\Rightarrow \qquad r = \frac{y}{\sqrt{3}} \qquad \dots \text{(i)}$$

In the first figure, $PQRS$ is a square inscribed in a circle.

Diagonal of square $= \sqrt{2} x = 2r$

$$\Rightarrow \qquad r = \frac{x}{\sqrt{2}} \qquad \dots\text{(ii)}$$

From Eqs. (i) and (ii), we get

$$\frac{y}{\sqrt{3}} = \frac{x}{\sqrt{2}}$$

$$\therefore \qquad\qquad \frac{x}{y} = \sqrt{\frac{2}{3}}$$

27. A pole stands vertically inside a triangular park ABC. If the angle of elevation of the top of the pole from each corner of the park is same, then in the triangle ABC, the foot of the pole is at the

(a) centroid   (b) circumcentre
(c) incentre   (d) orthocentre

> **(b)** Let OP be the pole inside the ΔABC,
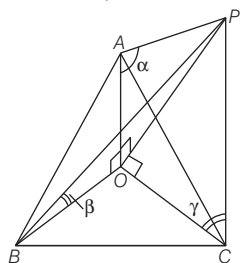
Since, angle of the elevation of the top of the pole are same from each corner of ΔABC.

$\therefore$ In ΔAOP,

$$\tan \alpha = \frac{OP}{OA} \qquad \dots\text{(i)}$$

In ΔBOP,

$$\tan \beta = \frac{OP}{OB} \qquad \dots\text{(ii)}$$

In ΔCOP,

$$\tan \gamma = \frac{OP}{OC} \qquad \dots\text{(iii)}$$

$$\because \qquad\qquad \alpha = \beta = \gamma$$

$$\therefore \qquad\qquad OA = OB = OC$$

Hence, O is the circumcentre of ΔABC.

Option (b) is correct.

2016 (I)

28. Consider a circle with centre at O and radius 7 cm. Let QR be a chord of length 2 cm and let P be the mid-point of QR. Let CD be another chord of this circle passing through P such that $\angle CPQ$ is acute. If M is the mid-point of CD and $MP = \sqrt{24}$ cm, then which of the following statements are correct ?

I. $\angle QPD = 135°$

II. If $CP = m$ cm and $PD = n$ cm, then m and n are the roots of the quadratic equation $x^2 - 10x + 1 = 0$.

III. The ratio of the area of ΔOPR to the area of ΔOMP is $1 : 2\sqrt{2}$.

Select the correct answer using the codes given below.

(a) I and II   (b) II and III
(c) I and III   (d) I, II and III

> **(a)** We have, $MP = \sqrt{24}$ cm,

$OQ = OR = 7$ cm

and $\qquad QP = PR = \dfrac{QR}{2} = \dfrac{2}{2} = 1$
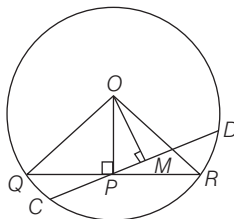
I. In ΔOPQ,

$$OP = \sqrt{OQ^2 - QP^2}$$
$$= \sqrt{49 - 1} = \sqrt{48} = 4\sqrt{3} \text{ cm}$$

In ΔOMP,

$$OP^2 = PM^2 + OM^2$$

$$\Rightarrow \qquad OM = \sqrt{48 - 24} = \sqrt{24} \text{ cm}$$

So, $\qquad OM = PM = \sqrt{24}$ cm

$$\therefore \qquad \angle OPM = \angle POM = 45°$$

Now, $\angle QPD = 90° + \angle OPM$

$$= 90° + 45° = 135°$$

Hence, Statement I is correct.

II. Now, if $CP = m$ and $PD = n$, then

$$QP \times PR = CP \times PD$$

$$\Rightarrow \quad 1 \times 1 = m \times n$$

$$\Rightarrow \qquad mn = 1 \qquad \dots\text{(i)}$$
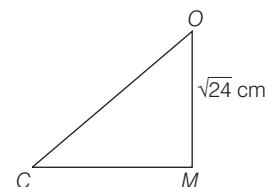
In ΔOMC,

$$CM = \sqrt{49 - 24} = 5 \text{ cm}$$

and $\quad CM = CP + PM = m + \sqrt{24}$

$$\Rightarrow \quad m + \sqrt{24} = 5$$

$$\Rightarrow \qquad m = 5 - \sqrt{24}$$

Now, $PD = PM + MD = PM + CM$

$$= \sqrt{24} + 5$$
$$n = 5 + \sqrt{24}$$

$$\therefore \quad m + n = 10 \qquad \dots\text{(ii)}$$

From Eqs. (i) and (ii), m and n are roots of equation

$$x^2 - 10x + 1 = 0$$

Hence, Statement II is correct.

III. Now,

$$\frac{\text{Area of } \Delta OPR}{\text{Area of } \Delta OMP} = \frac{\dfrac{1}{2} \times OP \times PR}{\dfrac{1}{2} \times OM \times PM}$$

$$= \frac{4\sqrt{3} \times 1}{\sqrt{24} \times \sqrt{24}}$$

$$= \frac{4\sqrt{3}}{24} = \frac{\sqrt{3}}{6} = \frac{1}{2\sqrt{3}}$$

Hence, Statement III is incorrect.

29. Consider a circle with centre at C. Let OP, OQ denote respectively the tangents to the circle drawn from a point O outside the circle. Let R be a point on OP and S be a point on OQ such that $OR \times SQ = OS \times RP$. Which of the following statements is/are correct?

I. If X is the circle with centre at O and radius OR and Y is the circle with centre at O and radius OS, then $X = Y$.

II. $\angle POC + \angle QCO = 90°$

Select the correct answer using the codes given below.

(a) Only I
(b) Only II
(c) Both I and II
(d) Neither I nor II

⊗ **(c)** In the given figure, OP and OQ are tangents to the circle with centre C.
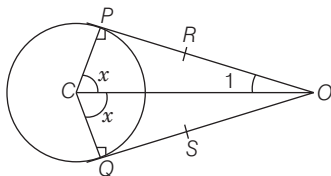
Then, $OP = OQ$
and $\angle CPO = \angle CQO = 90°$

I. We have, $OR \times SQ = OS \times RP$

$\Rightarrow (OP - RP) \times SQ = (OQ - SQ)$
$\qquad\qquad\qquad \times PR$

$\Rightarrow (OP - RP) \times SQ = (OP - SQ)$
$\qquad\qquad\qquad \times PR$

$OP \times SQ - RP \times SQ = OP \times PR$
$\qquad\qquad\qquad - SQ \times PR$

$\Rightarrow\ SQ = PR$

$\Rightarrow\ OR = OS$

Hence, Statement I is correct.

II. $\because \Delta OPC \cong \Delta OCQ$

In ΔOPC, $90° + x + \angle 1 = 180°$
$\Rightarrow x + \angle 1 = 90°$
$\Rightarrow$
$\angle POC + \angle QCO = x + \angle 1 = 90°$

Hence, Statement II is correct.

30. Suppose chords AB and CD of a circle intersect at a point P inside the circle. Two right angled $\Delta A'P'B'$ and $\Delta C'Q'D'$ are formed as shown in the figures below such that $A'P' = AP$, $B'P' = BP$, $C'Q' = CP$, $D'Q' = DP$ and $\angle A'P'B' = 90° = \angle C'Q'D'$.
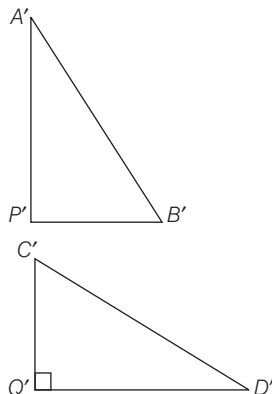
Which of the following statements are not correct?

I. $\Delta A'P'B'$ and $\Delta C'Q'D'$ are similar triangles but need not be congruent.

II. $\Delta A'P'B'$ and $\Delta C'Q'D'$ are congruent triangles.

III. $\Delta A'P'B'$ and $\Delta C'Q'D'$ are triangles of same area.

IV. $\Delta A'P'B'$ and $\Delta C'Q'D'$ are triangles of same perimeter.

Select the correct answer using the codes given below.

(a) II and III
(b) I and III
(c) I, II and IV
(d) I, II, III and IV

⊗ **(b)** From the given circle,
$AP \times BP = CP \times PD$ …(i)
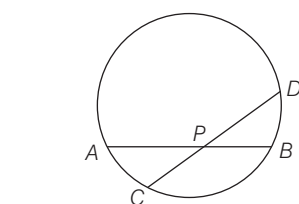
Let $\Delta A'P'B'$ and $\Delta C'Q'D'$ are congruent.
Then, $A'P' = C'Q'$ and $P'B' = Q'D'$
$\qquad\qquad\qquad$ [by CPCT]
$\Rightarrow\quad AP = CP$ and $PB = DP$ …(ii)
$\qquad [\because\ A'P' = AP, C'Q' = CP, P'B'$
$\qquad\qquad = PB, Q'D' = DP$, given]

From Eq. (i),
$\qquad\qquad AP \times BP = CP \times PD$
$\Rightarrow\qquad\qquad CP \times PD = CP \times PD$
$\qquad\qquad\qquad$ [from Eq. (ii)]
So, $\Delta A'P'B'$ and $\Delta C'Q'D'$ are congruent.

Let areas of $\Delta A'P'B'$ and $\Delta C'Q'D'$ be same.
$\therefore\ \dfrac{1}{2} \times A'P' \times P'B' = \dfrac{1}{2} \times C'Q' \times Q'D'$
$\Rightarrow\qquad AP \times PB = CP \times PD$
which is same as Eq. (i).
So, areas of $\Delta A'P'B'$ and $\Delta C'Q'D'$ are same.

Hence, Statements I and III are incorrect.

31. A tangent is drawn from an external point O to a circle of radius 3 units at P such that $OP = 4$ units. If C is the centre of the circle, then the sine of $\angle COP$ is

(a) 4/5 $\qquad\qquad$ (b) 3/4
(c) 3/5 $\qquad\qquad$ (d) 1/2

⊗ **(c)** Since, OP is tangent to the circle $OP \perp PC$.
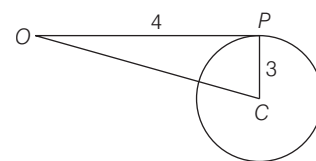
Here, ΔOPC is right angled triangle with $\angle P = 90°$

$$OC = \sqrt{(3)^2 + (4)^2} = 5 \text{ units}$$

$\therefore\ \sin(\angle COP) = \dfrac{3}{5}$

32. In a circle of radius 2 units, a diameter AB intersects a chord of length 2 units perpendicularly at P. If $AP > BP$, then AP is equal to

(a) $(2 + \sqrt{5})$ units
(b) $(2 + \sqrt{3})$ units
(c) $(2 + \sqrt{2})$ units
(d) 3 units

⊗ **(b)** Given, radius of a circle = 2 units

$\therefore\quad CP = PD = \dfrac{CD}{2} = \dfrac{2}{2} = 1$ unit
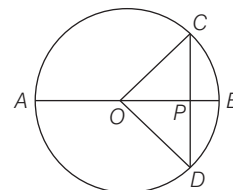
Now, $OP = OD^2 - PD^2$
$\qquad = \sqrt{4 - 1} = \sqrt{3}$ units
$\therefore\qquad AP = AO + OP = (2 + \sqrt{3})$ units

2015 (II)

33. The two adjacent sides of a cyclic quadrilateral are 2 cm and 5 cm and the angle between them is 60°. If the third side is 3 cm, then the fourth side is of length

(a) 2 cm $\quad$ (b) 3 cm $\quad$ (c) 4 cm $\quad$ (d) 5 cm

⊗ **(a)** Let $ABCD$ be cyclic quadrilateral.
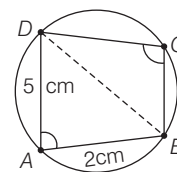
in which $\angle A = 60°$, $AB = 2$ cm,
$\qquad\qquad AD = 5$ cm

Since, $\angle A + \angle C = 180°$
[property of cyclic quadrilateral]
$\Rightarrow \quad 60° + \angle C = 180°$
$\Rightarrow \quad \angle C = 180° - 60° = 120°$
In ΔABD, let BD be x cm.

$$\cos A = \frac{AB^2 + AD^2 - BD^2}{2 \times AD \times AB}$$

$$\cos 60° = \frac{2^2 + 5^2 - x^2}{2 \times 2 \times 5}$$

$$\Rightarrow \quad \frac{1}{2} = \frac{4 + 25 - x^2}{2 \times 2 \times 5}$$

$$\Rightarrow \quad 29 - x^2 = 10$$
$$\Rightarrow \quad x^2 = 29 - 10$$
$$\Rightarrow \quad x^2 = 19$$

Let length of fourth side of cyclic quadrilateral be y cm.
Again, in ΔBCD,

$$\cos 120° = \frac{3^2 + y^2 - x^2}{2 \times 3 \times y}$$

[by cosine formula]

$$\Rightarrow \quad -\frac{1}{2} = \frac{9 + y^2 - 19}{2 \times 3 \times y} \quad [\because x^2 = 19]$$

$$\Rightarrow \quad -3y = 9 + y^2 - 19$$
$$\Rightarrow \quad y^2 + 3y - 10 = 0$$
$$\Rightarrow \quad y^2 + 5y - 2y - 10 = 0$$
$$\Rightarrow \quad y(y + 5) - 2(y + 5) = 0$$
$$\Rightarrow \quad (y + 5)(y - 2) = 0$$
$$\Rightarrow \quad y + 5 = 0 \text{ or } y - 2 = 0$$
$$\Rightarrow \quad y = -5$$
[neglect '–' sign]
$$\therefore \quad y = 2 \text{ cm}$$

34.
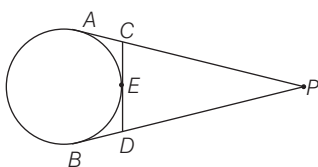
From an external point P, tangents PA and PB are drawn to the circle as shown in the above figure.

CD is the tangent to the circle at E. If $AP = 16$ cm, then the perimeter of the ΔPCD is equal to
(a) 24 cm (b) 28 cm (c) 30 cm (d) 32 cm

⟩ *(d)* Since, $AP = BP$; $DE = BD$
and $AC = CE$ [tangent of circle]
$\because$ Perimeter of ΔPCD
$= PC + PD + CD$
$= PC + PD + CE + DE$
$= (PC + CE) + (PD + DE)$
$= (PC + CA) + (PD + BD)$
$= PA + PB = 2PA$
$= 2 \times 16 = 32$ cm

35. Chord CD intersects the diameter AB of a circle at right angle at a point P in the ratio 1:2. If diameter of circle is d, then CD is equal to

(a) $\dfrac{\sqrt{2}d}{3}$ (b) $\dfrac{2d}{3}$

(c) $\dfrac{2\sqrt{2}d}{3}$ (d) $\dfrac{2\sqrt{3}d}{3}$

⟩ *(c)* Given, $AB = d$ is diameter of circle and CD intersect AB at P in the ratio 1 : 2.

$$\therefore \quad AP = \frac{d}{3} \text{ and } PB = \frac{2d}{3}$$

$$\Rightarrow \quad OA = OC = OB = \frac{d}{2}$$

$$\left[\because \text{radius of circle} = \frac{1}{2}\text{ diameter}\right]$$
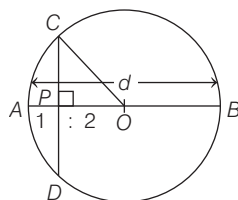
In ΔOPC,

$$OP = OA - AP = \frac{d}{2} - \frac{d}{3} = \frac{d}{6}$$

On applying Pythagoras theorem in ΔOPC,

$$OC^2 = OP^2 + PC^2$$

$$\Rightarrow \left(\frac{d}{2}\right)^2 = \left(\frac{d}{6}\right)^2 + PC^2$$

$$\Rightarrow (PC)^2 = \frac{d^2}{4} - \frac{d^2}{36} = \frac{9d^2 - d^2}{36} = \frac{8d^2}{36}$$

$$\Rightarrow \quad PC = \frac{2\sqrt{2}\,d}{6} = \frac{\sqrt{2}d}{3}$$

$$\therefore \quad CD = 2PC = \frac{2\sqrt{2}d}{3}$$

2015 (I)

36. AD is the diameter of a circle and AB is a chord. If $AD = 34$ cm, $AB = 30$ cm, then the distance of AB from the centre of the circle is
(a) 17 cm   (b) 15 cm
(c) 13 cm   (d) 8 cm

⟩ *(d)* Given, $AD = 34$cm and $AB = 30$cm
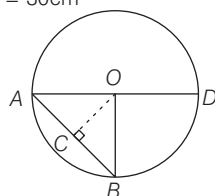
Here, O is centre of circle.
$$\therefore \quad OA = OD = OB$$
$$= \frac{34}{2} = 17 \text{ cm [radius of circle]}$$
In ΔOAC,
$$OC = \sqrt{OA^2 - AC^2}$$
$$= \sqrt{17^2 - 15^2} = 8$$
$$\left[\because AC = \frac{1}{2}AB = 15\right]$$

Hence, distance of AB from the centre of the circle is 8 cm.

37. If the angle between the radii of a circle is 130°, then the angle between the tangents at the ends of the radii is
(a) 90°   (b) 70°
(c) 50°   (d) 40°

⟩ *(c)* Given, AB and AC are the tangents of the circle.
$$\because \quad OB = OC \quad \text{[radius of circle]}$$
$$\therefore \quad \angle B = \angle C = 90°$$
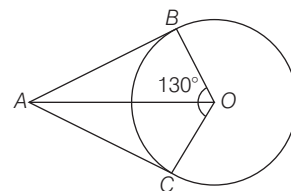
In quadrilateral $ABOC$,
$\angle BAC + \angle BOC + \angle ABO + \angle ACO = 360°$
$\Rightarrow \angle BAC + 130° + 90° + 90° = 360°$
$\Rightarrow \angle BAC = 360° - 130° - 90° - 90°$
$\qquad = 50°$

Hence, the angle between the tangents at the ends of the radii is 50°.

38. Out of two concentric circles, the diameter of the outer circle is 26 cm and the chord MN of length 24 cm is tangent to the inner circle. The radius of the inner circle is
(a) 5 cm   (b) 6 cm
(c) 8 cm   (d) 10 cm

⟩ *(a)* Given,
$$MN = 24 \text{ cm}$$
and $\quad AN = \frac{26}{2} \text{ cm} = 13 \text{ cm}$
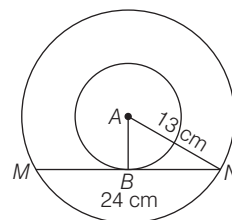
Now, we draw a perpendicular bisector from A to MN, which meets MN at B.

Then, $MB = BN = \dfrac{MN}{2}$

$= \dfrac{24}{2} = 12\,cm$

[∵ perpendicular from centre to the chord bisect the chord]

In right angled ΔABN,

$AN^2 = AB^2 + BN^2$

$\Rightarrow \qquad 13^2 = AB^2 + 12^2$

$\Rightarrow \qquad 169 = AB^2 + 144$

$\Rightarrow \qquad AB^2 = 169 - 144 = 25$

$\Rightarrow \qquad AB = 5\,cm$

∴ Radius of the inner circle is 5 cm.

39. A ΔABC is inscribed in a circle. If sum of the squares of sides of the triangle is equal to twice the square of the diameter, then $\sin^2 A + \sin^2 B + \sin^2 C$ is equal to

(a) 2   (b) 3

(c) 4   (d) None of these

⊘ **(a)** Let sides of ΔABC be a, b and c and radius of circle be R.
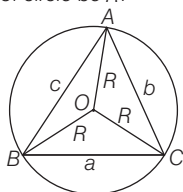
∵ ΔABC is inscribed in a circle.

∴ $\qquad R = \dfrac{a}{2\sin A} = \dfrac{b}{2\sin B} = \dfrac{c}{2\sin C}$

$\Rightarrow \qquad \sin A = \dfrac{a}{2R}, \sin B = \dfrac{b}{2R}$

and $\quad \sin C = \dfrac{c}{2R}$

According to the question,

$a^2 + b^2 + c^2 = (2R)^2 \times 2$

$\Rightarrow \qquad a^2 + b^2 + c^2 = 8R^2 \qquad ...(i)$

Now, $\sin^2 A + \sin^2 B + \sin^2 C = \left(\dfrac{a}{2R}\right)^2$

$+ \left(\dfrac{b}{2R}\right)^2 + \left(\dfrac{c}{2R}\right)^2$

$= \dfrac{a^2}{4R^2} + \dfrac{b^2}{4R^2} + \dfrac{c^2}{4R^2}$

$= \dfrac{a^2 + b^2 + c^2}{4R^2} \qquad$ [from Eq. (i)]

$= \dfrac{8R^2}{4R^2} = 2$

2014 (II)

40. If the chord of an arc of a circle is of length x, the height of the arc is y and the radius of the circle is z. Then, which one of the following is correct?

(a) $y(2z - y) = x^2$

(b) $y(2z - y) = 4x^2$

(c) $2y(2z - y) = x^2$

(d) $4y(2z - y) = x^2$

⊘ **(d)** Let O be the centre of circle and AB be the chord of an arc.

According to the question,

Length of chord $AB = x$, radius of circle $OA = z$

and height of an arc $MN = y$

Now, $\qquad AM = MB = \dfrac{x}{2}$

[since, perpendicular from the centre to a chord bisect the chord]
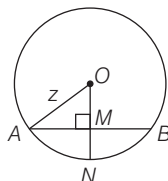
and $\quad OM = ON - MN = z - y$

$\qquad\qquad [\because ON = z \text{ (radius)}$

$\qquad\qquad\qquad \text{ and } MN = y]$

In $\Delta OMA, \quad OA^2 = OM^2 + AM^2$

[by Pythagoras theorem]

$\Rightarrow \qquad z^2 = (z - y)^2 + \left(\dfrac{x}{2}\right)^2$

$\Rightarrow \qquad z^2 = z^2 + y^2 - 2yz + \dfrac{x^2}{4}$

$\Rightarrow \qquad 2yz - y^2 = \dfrac{x^2}{4}$

$\Rightarrow \qquad 4(2yz - y^2) = x^2$

$\Rightarrow \qquad 4y(2z - y) = x^2$

41. For a triangle, the radius of the circumcircle is double the radius of the inscribed circle, then which one of the following is correct?

(a) The triangle is a right angled

(b) The triangle is an isosceles

(c) The triangle is an equilateral

(d) None of the above

⊘ **(c)** Let $OA = r$ be the inradius of circle. Then, circumradius $= OB = 2r$
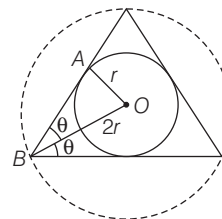
We know that, inradius is the perpendicular distance of centre O from side and circumradius OB bisect $\angle B$.

Again, let $\angle OBA = \theta$

In right angled ΔOAB,

$\sin\theta = \dfrac{OA}{OB} = \dfrac{r}{2r} \Rightarrow \sin\theta = \dfrac{1}{2} = \sin 30°$

∴ $\qquad \theta = 30°$

Then, $\angle B = 2 \times \theta = 2 \times 30° = 60°$

Hence, given triangle is an equilateral triangle.

42. Let the incircle to a ΔABC touch BC, AC and AB respectively at the points X, Y and Z.

Statement I If $AB > BC$, then $AB + AZ < BC + XC$

Statement II $AZ = AY$

Which one of the following is correct in respect of the above statements?

(a) Statements I and II are correct and Statement II is the correct explanation of Statement I

(b) Statements I and II are correct and Statement II is not the correct explanation of Statement I

(c) Statement I is correct and Statement II is incorrect

(d) Statement I is incorrect and Statement II is correct

⊘ **(d)** In ΔAOZ and ΔAOY,
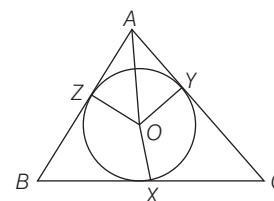
$AO = OA \qquad$ [common]

$\angle OAZ = \angle OAY$

[since, OA bisect $\angle A$]

and $\angle AZO = \angle AYO$ [each 90°]

∴ $\Delta AZO \cong \Delta AYO$

        [by AAS congruency rule]

Then, $AZ = AY$ [by CPCT]

Similarly, $CX = CY$

and $BX = BZ$

Now, $AB > BC$

$\Rightarrow$ $AZ + ZB > BX + XC$

$\Rightarrow$ $AZ > XC$ [∵ $BX = ZB$]

If $AB > BC$,

then $AB + AZ > BC + XC$

So, Statement I is incorrect and Statement II is correct.

43. Let ABC be a triangle in which $\angle ACB = 60°$ and $AC = x < BC$. Let the circle with centre at C and radius x meet BC at D. Let CF be the perpendicular drawn from C meeting AD at F.

Statement I ΔACD is isosceles but not equilateral.
Statement II $DF = x / 2$

Which one of the following is correct in respect of the above statements?

(a) Statements I and II are correct and Statement II is the correct explanation of Statement I
(b) Statements I and II are correct and Statement II is not the correct explanation of Statement I
(c) Statement I is correct and Statement II is incorrect
(d) Statement I is incorrect and Statement II is correct

⊙ (**d**) Given in ΔABC, $\angle ACB = 60°$
and $AC = x < BC$
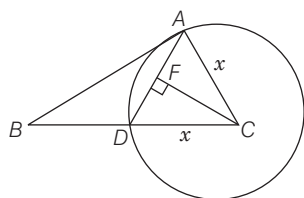
Since, the circle with centre at C and radius x meet BC at D.

∴ $CD = x =$ Radius

Now, in ΔACD,
       $AC = CD = x$

∴ $\angle CAD = \angle CDA$
        $= \dfrac{120°}{2} = 60°$

So, ΔACD is an equilateral triangle.

Now, AD is a chord of circle, then perpendicular from C on chord AD bisect the chord.

∴ $DF = AF = \dfrac{AD}{2} = \dfrac{x}{2}$

So, Statement I is incorrect and Statement II is correct.

2014 (I)

44. A circle of radius 10 cm has an equilateral triangle inscribed in it. The length of the perpendicular drawn from the centre to any side of the triangle is

(a) $2.5\sqrt{3}$ cm
(b) $5\sqrt{3}$ cm
(c) $10\sqrt{3}$ cm
(d) None of the above

⊙ (**d**) Let a be the side of equilateral triangle.

∵ Circumradius of equilateral triangle
$$= \dfrac{a}{\sqrt{3}}$$
$$10 = \dfrac{a}{\sqrt{3}}$$
$$a = 10\sqrt{3}$$

Height of equilateral triangle
$$= \dfrac{\sqrt{3}}{2}a = \dfrac{\sqrt{3}}{2} \times 10\sqrt{3}$$
$$= 5 \times 3 = 15 \text{ cm}$$
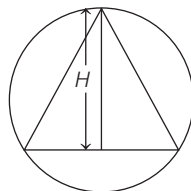
So, length of perpendicular drawn from centre = 15 − 10 = 5 cm

45. AB and CD are two chords of a circle meeting externally at P. Then, which of the following is/are correct?

I. $PA \times PD = PC \times PB$
II. ΔPAC and ΔPDB are similar.

Select the correct answer using the codes given below.

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊙ (**d**) AB and CD are chords when produced meet externally at P.
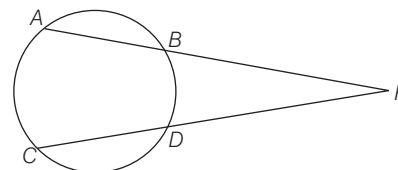
∴ $PB \times PA = PD \times PC$

Now, as $AC \nparallel BD$ and ΔPAC is not similar to ΔPDB.

46. In a ΔABC, $AB = BC = CA$. The ratio of the radius of the circumcircle to that of the incircle is

(a) 2 : 1   (b) 3 : 1
(c) 3 : 2   (d) None of these

⊙ (**a**) In ΔABC, $AB = BC = AC$
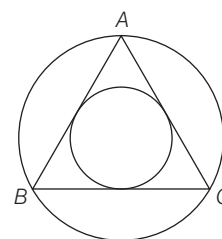
Hence, ΔABC is equilateral triangle.

Let r be the radius of incircle and R be the radius of circumcircle.

Now, radius of incircle,
$$r = \dfrac{\text{Side}}{2\sqrt{3}} = \dfrac{AB}{2\sqrt{3}}$$

and radius of circumcircle,
$$R = \dfrac{\text{Side}}{\sqrt{3}} = \dfrac{AB}{\sqrt{3}}$$

So, the required ratio
$$= \dfrac{R}{r} = \dfrac{AB/\sqrt{3}}{AB/2\sqrt{3}}$$
$$= \dfrac{2}{1} = 2 : 1$$

Directions (Q. Nos. 1 and 2) *Read the following frequency distribution for two series of observations and answer the given question in below.*

Class interval	Frequency	
	Series-I	Series-II
10 - 20	20	4
20 - 30	15	8
30 - 40	10	4
40 - 50	x	$2x$
50 - 60	y	y
Total	100	100

1. What is the mean of frequency distribution of Series-I?

(a) 33.6 (b) 35.6
(c) 37.6 (d) 39.6

⊙ **(c)** First of all we have to find x and y from the given table

$$20 + 15 + 10 + x + y = 100$$
$$x + y = 55 \qquad …(i)$$
$$4 + 8 + 4 + 2x + y = 100$$
$$2x + y = 84 \qquad …(ii)$$

On solving Eqs. (i) and (ii), we get
$$x = 29, y = 26$$

Class interval	Class mean x_i	Freq. series-I f_1	Freq. series-II f_2	$f_1 x_i$	$f_2 x_i$
10-20	15	20	4	300	60
20-30	25	15	8	375	200
30-40	35	10	4	350	140
40-50	45	29	58	1305	2610
50-60	55	26	26	1430	1430
Total		100	100	3760	4440

Mean of frequency distribution of series-I

$$\therefore \quad \bar{x} = \frac{\Sigma f_1 x_i}{\Sigma f_1} = \frac{3760}{100} = 37.6$$

2. What is the mode of the frequency distribution of Series-II?

(a) 26 (b) 36 (c) 46 (d) 56

⊙ **(c)**

Class Interval	10-20	20-30	30-40	40-50	50-60
Frequency (II)	4	8	4	58	26

Since, the highest frequency is 58. Therefore, modal class is 40-50.

$\therefore \qquad l = 40, h = 10, f_1 = 58,$
$\qquad f_0 = 4, f_2 = 26$

$$\therefore \quad \text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$= 40 + \left(\frac{58 - 4}{2 \times 58 - 4 - 26} \right) \times 10$$

$$= 40 + \frac{54}{86} \times 10 = 40 + 6.2 = 46.2 \approx 46$$

Direction (Q. Nos. 3) *Read the following information and answer the given question in below.*

Let the distribution of number of scooters of companies X and Y sold by 5 showrooms (A, B, C, D and E) in a certain year be denoted by S1 and the distribution of number of scooters of only company X sold by the five show-rooms in the same year be denoted by S2.

Showroom	A	B	C	D	E	Total number of scooters sold
S1 (in %)	19	21	15	33	12	6400
S2 (in %)	24	18	20	30	8	3000

3. Number of scooters of company Y sold by showroom E is what per cent of the number of scooters of both companies sold by showroom C ?

(a) 52 (b) 54
(c) 55 (d) 56

⊙ **(c)** Scooters of both companies sold by showroom $E = \dfrac{12}{100} \times 6400 = 768$

Scooters of company X sold by showroom $E = \dfrac{8}{100} \times 3000 = 240$

Scooters of company Y sold by $E = 768 - 240 = 528$

Scooters of both company is i.e., sold by showroom
$$C = \frac{15}{100} \times 6400 = 960$$

$$\therefore \text{Required } \% = \frac{528}{960} \times 100 = 55\%$$

4. Consider the following grouped frequency distribution

x	f
0-10	8
10-20	12
20-30	10
30-40	p
40-50	9

If the mean of the above data is 25.2, then what is the value of p?

(a) 9 (b) 10 (c) 11 (d) 12

⊙ **(c)**

x	x_i	f_i	$x_i f_i$
0-10	5	8	40
10-20	15	12	180
20-30	25	10	250
30-40	35	p	$35p$
40-50	45	9	405
		$\Sigma f_i = 39 + p$	$\Sigma x_i f_i = 875 + 35p$

$$\bar{x}(\text{Mean}) = \frac{\Sigma x_i f_i}{\Sigma f_i}$$

$$25.2 = \frac{875 + 35p}{39 + p}$$

$$25.2(39 + p) = 875 + 35p$$
$$982.8 + 25.2p = 875 + 35p$$

$982.8 - 875 = 35p - 252p$

$107.8 = 9.8p$

$p = \dfrac{107.8}{9.8} = 11$

Option (c) is correct.

5. Consider the following frequency distribution

x	f
8	6
5	4
6	5
10	8
9	9
4	6
7	4

What is the median for the distribution?

(a) 6   (b) 7   (c) 8   (d) 9

⊙ (**c**) Arrange in ascending order

(x)	(f)
4	6
5	4
6	5
7	4
8	6
9	9
10	8
	$n = 42$

Here, $\dfrac{N}{2} = \dfrac{42}{2} = 21$

21th observation = 8

22th observation = 8

$\text{Median} = \dfrac{\left(\dfrac{n}{2}\right)\text{th term} + \left(\dfrac{n}{2} + 1\right)\text{th term}}{2}$

$= \dfrac{21\text{th term } + 22\text{th term}}{2}$

$= \dfrac{8 + 8}{2} = \dfrac{16}{2} = 8$

6. Diagrammatic representation of data includes which of the following?
1. Bar-diagram   2. Pie-diagram
3. Pictogram

Select the correct answer using the code given below

(a) 1 and 2 only   (b) 2 and 3 only
(c) 1 and 3 only   (d) 1, 2 and 3

⊙ (**d**) Diagrammatic representation of data includes
1. Bar-diagram   2. Pie-diagram
3. Pictogram

Option (d) is correct.

7. The data collected from which one of the following methods is not a primary data?

(a) by direct personal interviews
(b) by indirect personal interviews
(c) by schedules sent through enumerators
(d) from published thesis

⊙ (**d**) The data collected from published thesis is not a primary data.
Option (d) is correct.

8. The monthly expenditure of a person is ₹ 6000. The distribution of expenditure on various items is as follows

	Item of expenditure	Amount (in ₹)
1.	Food	2000
2.	Clothing	660
3.	Fuel and rent	1200
4.	Education	480
5.	Miscellaneous	1660

If the above data is represented by a percentage bar-diagram of height 15 cm, then what are the lengths of the two segments of the bar-diagram corresponding to education and miscellaneous, respectively?

(a) 1.25 cm and 5 cm
(b) 1.2 cm and 4.15 cm
(c) 1.2 cm and 3.5 cm
(d) 4.15 cm and 6 cm

⊙ (**b**) The monthly expenditure of a person is 6000.

Percentage of educations expenditure

$= \dfrac{480}{6000} \times 100 = 8\%$

15 cm height of bar-diagram.
Length of the education in bar-diagram

$= 15 \times \dfrac{8}{100} = 12$ cm

Percentage of miscellaneous's

expenditure $= \dfrac{1660}{6000} \times 100 = \dfrac{166}{600}\%$

Length of the miscellaneous's in bar-diagram

$= 15 \times \dfrac{166}{600} = 4.15$ cm

Option (b) is correct.

9. If the mean of m observations out of n observations is n and the mean of remaining observations is m, then what is the mean of all n observations?

(a) $2m - \dfrac{m^2}{n}$ (b) $2m + \dfrac{m^2}{n}$

(c) $m - \dfrac{m^2}{n}$ (d) $m + \dfrac{m^2}{n}$

⊙ (**a**) The mean of m observations $= n$

The sum of observations $= mn$

The mean of $(n - m)$ observations $= m$

The sum of observations $= (n - m)\,m$

The mean of all observations

$= \dfrac{\text{Sum of all observations}}{\text{Number of observations}}$

$= \dfrac{mn + (n - m)m}{n}$

$= \dfrac{m(n + n - m)}{n}$

$= \dfrac{2nm - m^2}{n} = 2m - \dfrac{m^2}{n}$

Option (a) is correct.

10. Which one of the following pairs is correctly matched?
(a) Median   = Graphical location
(b) Mean   = Graphical location
(c) Geometric   = Ogive
     Mean
(d) Mode   = Ogive

⊙ (**a**) Median is graphical location.
Then, Option (a) is correct.

11. The following pairs relate to frequency distribution of a discrete variable and its frequency polygon. Which one of the following pairs is not correctly matched?
(a) Base line of the X-axis
     polygon
(b) Ordinates of the   Class frequencies
     vertices of the
     polygon
(c) Abscissa of the   Class marks of the
     vertices of the   frequency
     polygon   distribution
(d) Area of the polygon Total frequency of
     the distribution

⊙ (**d**) Area of the polygon is not related to the total frequency of the distribution.
Then, option (d) is correct.

12. If a, b and c are positive integers such that $\dfrac{1}{a + \dfrac{1}{b + \dfrac{1}{c + \dfrac{1}{2}}}} = \dfrac{16}{23}$

then what is the mean of a, b and c?

(a) 1
(b) 2
(c) 1.33
(d) 2.33

⊙ (**b**) $\dfrac{1}{a + \dfrac{1}{b + \dfrac{1}{c + \dfrac{1}{2}}}} = \dfrac{16}{23}$

$\Rightarrow \dfrac{16}{23} = \dfrac{1}{\dfrac{23}{16}} = \dfrac{1}{1 + \dfrac{7}{16}}$

$= \dfrac{1}{1 + \dfrac{1}{\dfrac{16}{7}}} = \dfrac{1}{1 + \dfrac{1}{2 + \dfrac{2}{7}}}$

$$= \cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{\frac{7}{2}}}} = \cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{3+\frac{1}{2}}}}$$

Then, $a = 1$, $b = 2$, $c = 3$

Mean of a, b and c

$$= \frac{a+b+c}{3} = \frac{1+2+3}{3} = 2$$

2018 (II)

13. Data on ratings of hotels in a city is measured on

(a) Nominal scale
(b) Ordinal scale
(c) Interval scale
(d) Ratio scale

⊙ **(b)** Data on rating of hotels in a city is measured on ordinal scale.

14. The median of 19 observations is 30. Two more observations are made and the values of these are 8 and 32. What is the median of the 21 observations?

(a) 32   (b) 30
(c) 20
(d) Cannot be determined due to insufficient data

⊙ **(b)** The median of the 21 observations will not change because 8 is less than 30 and 32 is greater than 30.

15. As the number of observations and classes increases, the shape of a frequency polygon

(a) Tends to become jagged
(b) Tends to become increasingly smooth
(c) Stays the same
(d) Varies only if data become more reliable

⊙ **(b)** We know that, when the number of observations and classes increases then the shape of a frequency polygon tends to become increasingly smooth.

16. Let $\bar{x}_1$ and $\bar{x}_2$ (where $\bar{x}_2 > \bar{x}_1$) be the means of two sets comprising n_1 and n_2 (where $n_2 < n_1$) observations respectively. If $\bar{x}$ is the mean when they are pooled, then which one of the following is correct?

(a) $\bar{x}_1 < \bar{x} < \bar{x}_2$ (b) $\bar{x} > \bar{x}_2$
(c) $\bar{x} < \bar{x}_1$
(d) $(\bar{x}_1 - \bar{x}) + (\bar{x}_2 - \bar{x}) = 0$

⊙ **(a)** $\bar{x} = \dfrac{\bar{x}_1 n_1 + \bar{x}_2 n_2}{n_1 + n_2}$

$$\Rightarrow \quad n_1\bar{x} + n_2\bar{x} = n_1\bar{x}_1 + n_2\bar{x}_2$$
$$\Rightarrow \quad n_1(\bar{x} - \bar{x}_1) = n_2(\bar{x}_2 - \bar{x})$$
$$\Rightarrow \quad \frac{\bar{x}_2 - \bar{x}}{\bar{x} - \bar{x}_1} = \frac{n_1}{n_2} \Rightarrow \frac{\bar{x}_2 - \bar{x}}{\bar{x} - \bar{x}_1} > 1 \quad [n_1 > n_2]$$
$$\therefore \quad \bar{x}_2 - \bar{x} > \bar{x} - \bar{x}_1 \Rightarrow \bar{x}_2 > \bar{x} > \bar{x}_1$$

17. Consider the following statements:

Statement I Median can be computed even when the end intervals of a frequency distribution are open.

Statement II Median is a positional average.

Which one of the following is correct in respect of the above statements?

(a) Both Statements I and II are true and Statement II is the correct explanation of Statement I
(b) Both Statements I and II are true and Statement II is not the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

⊙ **(a)** We know that, median always lies in the center of the distribution therefore it is called a positional average and so we can compute it even when the end intervals of a frequency distribution are open.

2018 (I)

18. A pie chart is drawn for the following data.

Sector	Percentage
Agriculture and Rural Development	12.9
Irrigation	12.5
Energy	27.2
Industry and Minerals	15.4
Transport and Communication	15.9
Social Services	16.1

What is the angle (approximately) subtended by the social services Sector at the centre of the circle?

(a) 45°   (b) 46°   (c) 58°   (d) 98°

⊙ **(c)** Social services sector percentage
$$= 16.1\%$$
∴ Central angle of social services sector
$$= \frac{16.1}{100} \times 360 = 57.96° \approx 58°$$

19. The arithmetic mean of 11 observations is 11. The arithmetic mean of the first 6 observations is 10.5 and the

arithmetic means of the last 6 observations is 11.5. What is the sixth observation?

(a) 10.0   (b) 10.5
(c) 11.0   (d) 11.5

⊙ **(c)** Arithmetic mean of 11 observations
$$= 11$$
∴ Sum of 11 observations
$$= 11 \times 11 = 121$$
Similarly, sum of first 6 observations
$$= 6 \times 10.5 = 63$$
And sum of last 6 observations
$$= 11.5 \times 6 = 69$$
∴ 6th observation $|121 - (63 + 69)|$
$$= |121 - 132| = 11$$

2017 (II)

20. Frequency density of a class is computed by the ratio

(a) Class frequency to the class width
(b) Class frequency to total frequency
(c) Class frequency to total number of classes
(d) Cumulative frequency upto that class total frequency

⊙ **(a)** Frequency density of a class is computed by the ratio of class frequency to the class width.

21. The pie diagram on the monthly expenditure of two families A and B are drawn with radii of two circles taken in the ratio $16 : 9$ to compare their expenditures.

Which one of the following is the appropriate data used for the above mentioned pie diagrams?

(a) ₹ 16000 and ₹ 9000
(b) ₹ 8000 and ₹ 4500
(c) ₹ 25600 and ₹ 8100
(d) ₹ 4000 and ₹ 3000

⊙ **(c)** Let r_1 and r_2 be the radii of two circles such that $r_1 : r_2 = 16 : 9$

Then, ratio of expenditures of A and B = ratio of area of corresponding circles

$$= \frac{\pi r_1^2}{\pi r_2^2} = \left(\frac{r_1}{r_2}\right)^2 = \left(\frac{16}{9}\right)^2 = \frac{256}{81}$$

∴ The appropriate data used the above mentioned pie diagram is ₹ 25600 and ₹ 8100.

22. Consider the following statements

Statement I The value of a random variable having the highest frequency is mode.

Statement II Mode is unique. Which one of the following is correct is the respect of the above statements?

(a) Both Statements I and II are true and Statements II is the correct explanation of Statement I.
(b) Both Statements I and II are true and Statement II is not the correct explanation of Statement I.
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

⟩ **(c)** We know that, mode is the value of the variable for which the frequency is maximum.

∴ Statement I is correct.

But statement II is incorrect, as mode may not be unique.

For e.g. For the data set {2, 4, 9, 6, 4, 6, 6, 2, 8, 2} there are two modes namely 2 and 6.

23. Which one of the following is not correct?

The proportion of various items in a pie diagram is not proportional to the

(a) areas of slices
(b) angles of slices
(c) lengths of the curved area of the slices
(d) perimeters of the slices

⟩ **(d)** We know that, pie chart is a circular chart divided into sectors in which the arc length, its central angle and area are proportional to the quantities that it represents.

So, proportion of various items in a pie diagram can't be proportional to the perimeters of the slices.

24. The total number of live births in a specific locality during different months of a specific years was obtained from the office of the Birth Registrar. This set of data may be called

(a) primary data   (b) secondary data
(c) recorded data   (d) countable data

⟩ **(b)** We know that, data which are not originally collected rather obtained from published or unpublished sources are known as secondary data.

So, the given set of data may be called secondary data.

25. The heights (in cm) of 5 students are 150, 165, 161, 144 and 145. What are the value of mean and median (in cm) respectively?

(a) 165 and 161   (b) 155 and 155
(c) 160 and 155   (d) 155 and 161

⟩ **(b)** Clearly, mean
$$= \frac{150 + 165 + 161 + 144 + 155}{5} = 155$$

Now, to find median, arrange data in ascending or decending order, as shown below

144, 150, 155, 161, 165

Here, $n = 5$, which is odd

∴ Median $= \left(\frac{5 + 1}{2}\right)$ the observation

$= $ 3rd observation $= 155$

26. The geometric mean of x and y is 6 and then geometric mean of x, y and z is also 6. Then the value of z is

(a) 12   (b) $\sqrt{6}$
(c) 6   (d) $\sqrt[3]{6}$

⟩ **(c)** Given, $\sqrt{xy} = 6 \Rightarrow xy = 36$ …(i)

and $\sqrt[3]{xyz} = 6$

⟹ $xyz = 216$ …(ii)

On dividing Eq. (ii) by Eq. (i), we get

$z = 6$

2017 (I)

27. In a pie diagram there are four slices with angles 150°, 90°, 60°, 60°. A new pie diagram is formed by deleting one of the slices having angle 60° in the given pie diagram. In the new pie diagram

(a) the largest slice has angle 150°
(b) the smallest slice has angle 70°
(c) the largest slice has angle 180°
(d) the smallest slice has angle 90°

⟩ **(c)** When one slice of pie-diagram is deleted, the portion of other slices will increase proportionally.

New total $= 150° + 90° + 60° = 300°$

New slice of $150° = \frac{150°}{300°} \times 360° = 180°$

New slice of $90° = \frac{90°}{300°} \times 360° = 108°$

New slice of $60° = \frac{60°}{360°} \times 360° = 72°$

∴ The smallest slice has angle 72° and the largest slice has angle 180°.

28. In an asymmetrical distribution, if the mean and median of the distribution are 270 and 220 respectively, then the mode of the date is

(a) 120   (b) 220   (c) 280   (d) 370

⟩ **(a)** We know that,

3 Median = Mode + 2 Mean

⟹   Mode = 3 Median − 2 Mean
$= 3 \times 220 − 2 \times 270$
$= 660 − 540 = 120$

29. Consider the following frequency distribution

x	Frequency	Cumulative frequency
1	8	8
2	10	18
3	f_1	29
4	f_2	45

What are the values of f_1 and f_2 respectively?

(a) 10 and 17   (b) 17 and 10
(c) 11 and 16   (d) 16 and 11

⟩ **(c)**

x	Frequency	Cumulative frequency
1	8	8
2	10	18
3	f_1	$18 + f_1$
4	f_2	$18 + f_1 + f_2$

On comparing, we get
$18 + f_1 = 29$
⟹ $f_1 = 29 − 18 = 11$
and $18 + f_1 + f_2 = 45$
$18 + 11 + f_2 = 45$
$f_2 = 45 − 29$
$f_2 = 16$
∴ $f_1 = 11$ and $f_2 = 16$

30. The mean of 5 numbers is 15. If one more number is included, the mean of the 6 numbers becomes 17. What is the included number?

(a) 24   (b) 25
(c) 26   (d) 27

⟩ **(d)** Since, mean of 5 numbers is 15.
∴ Sum of these 5 numbers = Mean × Number of data $= 15 \times 5 = 75$
Let the number included is x.

∴ $\frac{75 + x}{6} = 17$

⟹ $75 + x = 17 \times 6$
⟹ $x = 102 − 75$
⟹ $x = 27$

31. The mean marks obtained by 300 students in a subject are 60. The mean of top 100 students was found to be 80 and the mean of last 100 students was found to be 50. The mean marks of the remaining 100 students are

(a) 70   (b) 65
(c) 60   (d) 50

⊙ **(d)** Total marks of middle 100 students

$= 300 \times 60 - 100 \times 80 - 100 \times 50$

$= 18000 - 8000 - 5000$

$= 18000 - 13000 = 5000$

∴ Mean marks of remaining 100 students

$= \dfrac{5000}{100} = 50$

2016 (II)

32. For $x > 0$, if a variable takes discrete values $x + 4$, $x - 3.5$, $x - 2.5$, $x - 3$, $x - 2$, $x + 0.5$, $x - 0.5$, $x + 5$, then what is the median?

(a) $x - 125$ (b) $x - 0.5$

(c) $x + 0.5$ (d) $x + 125$

⊙ **(a)** We have, $x > 0$

$x + 4$, $x - 3.5$, $x - 2.5$, $x - 3$, $x - 2$, $x + 0.5$, $x - 0.5$, $x + 5$

Arrange in ascending order

$x - 3.5$, $x - 3$, $x - 2.5$, $x - 2$, $x - 0.5$, $x + 0.5$, $x + 4$, $x + 5$

Total number of observations = 8

∴ Median $= \dfrac{(4\text{th} + 5\text{th}) \text{observations}}{2}$

$= \dfrac{(x - 2) + (x - 0.5)}{2}$

$= \dfrac{2x - 2.5}{2} = x - 1.25$

33. The median of set of 9 distinct observations is 20.5. If each of the largest 4 observations of the set is increased by 2, then the median of the new set

(a) is increased by 2

(b) is decreased by 2

(c) is two times the original median

(d) remains the same as that of original set

⊙ **(d)** Let the 9 observations be

$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9$.

∴ Median of 9 observations is x_5.

∴ $x_5 = 20.5$

If x_6, x_7, x_8, x_9 are increased by 2.

The median of 9 observations is also $x_5 = 20.5$.

∴ Median remains the same as that of original set.

34. The mean of 20 observations is 17. On checking it was found that the two observations were wrongly copied as 3 and 6. If wrong observations are replaced by correct values 8 and 9, then what is the correct mean?

(a) 17.4   (b) 16.6   (c) 15.8   (d) 14.2

⊙ **(a)** We have,

mean of 20 observations, $\bar{x} = 17$

∴ $\bar{x} = \dfrac{\sum\limits_{i=1}^{20} x_i}{20}$

⇒ $\Sigma x_i = 17 \times 20 = 340$

∴ $\Sigma x_i = 340 - (3 + 6) + (8 + 9)$

⇒ $\Sigma x_i = 348$

∴   New mean $= \dfrac{348}{20} = 17.4$

35. Consider the following statements.

I. The classes of type 15-19, 20-24, 25-29 etc, are exclusive classes.

II. The classes of type 15-20, 20-25, 25-30 etc, are inclusive classes.

Which of the above statements is/are correct?

(a) I only   (b) II only

(c) Both I and II   (d) Neither I nor II

⊙ **(d)** In exclusive classes, upper limit of a class is not included in the class.

So, 15-20, 20-25, 25-30 are exclusive classes.

In inclusive classes, upper limit of a class is included in the class.

So, 15-19, 20-24, 25-29 are inclusive classes.

Hence, neither statement I nor statement II are correct.

36. Suppose the class interval 10-15 has frequency 30, then what is the frequency density of this class interval?

(a) 2   (b) 3   (c) 5   (d) 6

⊙ **(d)** ∵ Class width = 15 − 10 = 5

and frequency of class 10-15 = 30

∴ Frequency density

$= \dfrac{\text{Frequency}}{\text{Class width}} = \dfrac{30}{5} = 6$

37. If the mean age of combined group of boys and girls is 18 yr and the mean of age of boys is 20 and that of girls is 16, then what is the percentage of boys in the group?

(a) 60   (b) 50   (c) 45   (d) 40

⊙ **(b)** Let the number of boys and girls be x and y respectively.

Total sum of ages of boys = $20x$

and total sum of ages of girls = $16y$

Given, that $\dfrac{20x + 16y}{x + y} = 18$

⇒ $20x + 16y = 18x + 18y$

⇒ $2x = 2y \Rightarrow x = y$

Hence, percentage of boys in group is 50%.

2016 (I)

38. The election result in which six parties contested was depicted by a pie chart. Party A had an angle 135° on this pie chart. If it secured 21960 votes, then how many valid votes in total were cast?

(a) 51240   (b) 58560

(c) 78320   (d) 87840

⊙ **(b)** Let the total votes be x.

Then, central angle of party

$A = \dfrac{360°}{x} \times 21960$

⇒ $135° = \dfrac{360°}{x} \times 21960$

∴ $x = \dfrac{360° \times 21960}{135°} = 58560$

39. The mean and median of 5 observations are 9 and 8, respectively. If 1 is subtracted from each observation, then the new mean and the new median will respectively be

(a) 8 and 7

(b) 9 and 7

(c) 8 and 9

(d) Cannot be determined due to insufficient data

⊙ **(a)** ∵ $\dfrac{\text{Sum of 5 observations}}{\text{Number of observations}} = 9$

⇒ Sum of 5 observations = $9 \times 5 = 45$

If 1 is subtracted from each observation, then

New mean of 5 observations

$= \dfrac{\text{Sum of 5 observations} - 5}{5}$

$= \dfrac{45 - 5}{5} = 8$

Median of 5 observations

$= \left(\dfrac{5 + 1}{2}\right) \text{th term} = 3\text{rd term} = 8$

If 1 is subtracted from each observation, then

New median = $8 - 1 = 7$

Hence, the new mean and median are 8 and 7, respectively.

40. The age distribution of 40 children are as follows

Age (in years)	Number of children
5-6	4
6-7	7
7-8	9
8-9	12
9-10	6
10-11	2

Consider the following statements in respect of the above frequency distribution

1. The median of the age distribution is 7 yr.
2. 70% of the children are in the age group 6-9 yr.
3. The modal age of the children is 8 yr.

Which of the above statements are correct?

(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 2 and 3

⊙ *(b)*

Age (in years)	Number of children	Cumulative frequency
5-6	4	4
6-7	7	11
7-8	9	20
8-9	12	32
9-10	6	38
10-11	2	40
Total	$N = 40$	

1. Here, $N = 40 \Rightarrow \dfrac{N}{2} = 20$

   Thus, 7-8 is the median class.

   $\therefore \quad l = 7, f = 9, C = 11, \dfrac{N}{2} = 20$

   and $h = 1$

   $\text{Median} = l + \dfrac{\dfrac{N}{2} - C}{f} \times h$

   $= 7 + \dfrac{20 - 11}{9} \times 1$

   $= 7 + 1 = 8 \text{ yr}$

   Hence, statement 1 is incorrect.

2. Total number of children $(N) = 40$

   Number of children in the age group 6-9

   $= 7 + 9 + 12 = 28$

   $\therefore$ Required percentage

   $= \dfrac{28}{40} \times 100\% = 70\%$

   Hence, statement 2 is correct.

3. $\because$ Modal group = 8-9

   $\therefore$ Modal age = 8 yr

   Since, 9 is not included in this group.

   Hence, statement 3 is correct.

41. Suppose $x_i = \lambda^i$ for $0 \le i \le 10$, where $\lambda > 1$. Which one of the following is correct?

(a) AM < Median   (b) GM < Median
(c) GM = Median   (d) AM = Median

⊙ *(c)* We have 11 observations as follow

$1, \lambda, \lambda^2, \lambda^3, \lambda^4, \lambda^5, \lambda^6, \lambda^7, \lambda^8, \lambda^9, \lambda^{10}$

Here, number of observations = 11 [odd]

$\text{Median} = \left(\dfrac{11 + 1}{2}\right)\text{th term} = \text{6th term}$

$= \lambda^5$ …(i)

$\therefore \text{AM} = \dfrac{1 + \lambda + \lambda^2 + \dots + \lambda^{10}}{11} = \left(\dfrac{\lambda^{11} - 1}{11(\lambda - 1)}\right)$

and $\text{GM} = (1 \cdot \lambda \cdot \lambda^2 \cdot \lambda^3 \dots \lambda^{10})^{\frac{1}{11}}$

$= (\lambda^{1 + 2 + 3 + \dots + 10})^{1/11}$

$= (\lambda)^{55/11} = \lambda^5$ …(ii)

From Eqs. (i) and (ii), we get

GM = Median

42. Suppose $x_i = \dfrac{1}{i}$ for $i = 1, 2, 3, \dots, 11$. Which one of the following is not correct?

(a) AM > 1/6   (b) GM > 1/6
(c) HM > 1/6   (d) Median = HM

⊙ *(d)* We have 11 observations are as follow

$1, \dfrac{1}{2}, \dfrac{1}{3}, \dfrac{1}{4}, \dfrac{1}{5}, \dots, \dfrac{1}{11}$

Here, number of observations = 11

[odd]

$\therefore \quad \text{Median} = \left(\dfrac{11 + 1}{2}\right)\text{th term} = \text{6th term}$

$= \dfrac{1}{6}$ …(i)

and $\dfrac{1}{\text{HM}}$

$= \dfrac{1}{11}\left(\dfrac{1}{1} + \dfrac{1}{1/2} + \dfrac{1}{1/3} + \dfrac{1}{1/4} + \dots + \dfrac{1}{1/11}\right)$

$\Rightarrow \quad \dfrac{1}{\text{HM}} = \dfrac{1}{11}(1 + 2 + 3 + \dots + 11)$

$\Rightarrow \quad \dfrac{1}{\text{HM}} = \dfrac{66}{11} \Rightarrow \text{HM} = \dfrac{1}{6}$

$\therefore \quad$ HM = Median   [from Eq. (i)]

2015 (II)

43. If each of n numbers $x_i = i$ $(i = 1, 2, 3, \dots, n)$ is replaced by $(i + 1)x_i$, then the new mean is

(a) $\dfrac{n + 3}{2}$ (b) $\dfrac{n(n + 1)}{2}$

(c) $\dfrac{(n + 1)(n + 2)}{3n}$ (d) $\dfrac{(n + 1)(n + 2)}{3}$

⊙ *(d)* We have, $x_i = i$

Mean

$= \dfrac{2x_1 + 3x_2 + 4x_3 + \dots + (n + 1)x_n}{n}$

$= \dfrac{2 \times 1 + 3 \times 2 + 4 \times 3 + \dots + (n + 1) \times n}{n}$

$= \dfrac{\Sigma n(n + 1)}{n} = \dfrac{\Sigma n^2 + \Sigma n}{n}$

New mean

$= \dfrac{\dfrac{n(n + 1)(2n + 1)}{6} + \dfrac{n(n + 1)}{2}}{n}$

$= \dfrac{n(n + 1)}{2n}\left[\dfrac{2n + 1}{3} + 1\right]$

$= \dfrac{n + 1}{2}\left[\dfrac{2n + 4}{3}\right] = \dfrac{(n + 1)(n + 2)}{3}$

---

44. The weighted arithmetic mean of first 10 natural numbers whose weights are equal to the corresponding numbers is equal to

(a) 7   (b) 14
(c) 35   (d) 38.5

⊙ *(d)* Weighted AM

$= \dfrac{1 \times 1 + 2 \times 2 + 3 \times 3 + \dots + 10 \times 10}{10}$

$= \dfrac{1 + 2^2 + 3^2 + \dots + 10^2}{10}$

$= \dfrac{\dfrac{10 \times (10 + 1)(2 \times 10 + 1)}{6}}{10}$

$= \dfrac{\dfrac{10 \times 11 \times 21}{6}}{10} = \dfrac{21 \times 11}{6} = \dfrac{77}{2} = 38.5$

2015 (I)

Directions (Q. Nos. 45-48) Consider the following frequency distribution.

Class	Frequency
0-10	4
10-20	5
20-30	7
30-40	10
40-50	12
50-60	8
60-70	4

45. What is the mean of the distribution?

(a) 37.2   (b) 38.1
(c) 39.2   (d) 40.1

46. What is the median class?

(a) 20-30   (b) 30-40
(c) 40-50   (d) 50-60

47. What is the median of the distribution?

(a) 37   (b) 38
(c) 39   (d) 40

48. What is the mode of the distribution?

(a) 38.33   (b) 40.66
(c) 42.66   (d) 43.33

⊙ **(Q. Nos. 45-48)**

Class	Mid value (x)	Frequency (f)	cf	$f \times x$
0-10	5	4	4	20
10-20	15	5	9	75
20-30	25	7	16	175
30-40	35	10	26	350
40-50	45	12	38	540
50-60	55	8	46	440
60-70	65	4	50	260
Total		$\Sigma f = N = 50$		$\Sigma fx = 1860$

45. (*a*) Mean $= \dfrac{\Sigma fx}{\Sigma f} = \dfrac{1860}{50} = 37.2$

Hence, the value of mean is 37.2.

46. (*b*) Here, $N = 50$

Now, $\dfrac{N}{2} = \dfrac{50}{2} = 25$

which lies in the cumulative frequency corresponding class interval for *cf* 26 is 30-40.

47. (*c*) From the table,

$l_1 = 30, l_2 = 40, f = 10$ and $C = 16$

$\therefore$ Median $= l_1 + \dfrac{l_2 - l_1}{f}\left(\dfrac{N}{2} - C\right)$

$= 30 + \dfrac{40 - 30}{10}(25 - 16)$

$= 30 + \dfrac{10}{10} \times 9 = 30 + 9 = 39$

48. (*d*) Modal class of the given data is 40-50, because it has largest frequency among the given classes of the data i.e. 12.

Here, $l = 40, f_1 = 12, f_0 = 10, f_2 = 8$ and $h = 10$

$\therefore$ Mode $= l + \left\{\dfrac{f_1 - f_0}{2f_1 - f_0 - f_2}\right\} \times h$

$= 40 + \left\{\dfrac{12 - 10}{2 \times 12 - 10 - 8}\right\} \times 10$

$= 40 + \dfrac{2 \times 10}{24 - 18} = 40 + \dfrac{20}{6}$

$= 40 + 3.33 = 43.33$

Hence, the mode of given data is 43.33.

49. There are five parties A, B, C, D and E in an election. Out of total 100000 votes cast, 36000 were cast to party A, 24000 to to party B, 18000 to party C, 7000 to party D and rest to party E. What angle will be allocated for party E in the pie-chart?

(a) 15°   (b) 54°   (c) 60°   (d) 72°

⟩ (*b*) Given, total number of votes = 100000

Get votes of party E

= 100000 − (36000 + 24000 + 18000 + 7000)

= 100000 − 85000 = 15000

$\therefore$ Angle allocated for party

$E = \dfrac{15000}{100000} \times 360° = 54°$

2014 (II)

50. The class which has maximum frequency is known as
(a) median class   (b) mean class
(c) modal class   (d) None of these

⟩ (*c*) The class which has maximum frequency is known as modal class.

51. Consider the following statements related to cumulative frequency polygon of a frequency distribution, the frequencies being cumulated from the lower end of the range:
1. The cumulative frequency polygon gives an equivalent representation of frequency distribution table.
2. The cumulative frequency polygon is a closed polygon with one horizontal and one vertical side. The other sides have non-negative slope.

Which of the above statement(s) is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⟩ (*a*) Here, statement 1 is correct but statement 2 is not correct.

52. Consider the following data
1. Number of complaints lodged due to road accidents in a state within a year for 5 consecutive years.
2. Budgetary allocation of the total available funds to the various items of expenditure.

Which of the above data is/are suitable for representation of a pie diagram?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⟩ (*c*) Both statements 1 and 2 are suitable for representation of a pie diagram.

53. When we take class intervals on the X-axis and corresponding frequencies on the Y-axis and draw rectangles with the areas proportional to the frequencies of the respective class intervals, the graph so obtained is called
(a) bar diagram   (b) frequency curve
(c) ogive   (d) None of these

⟩ (*d*) When we take class intervals on the X-axis and corresponding frequencies on the Y-axis and draw rectangles with the areas proportional to the frequencies of the respective class intervals, the graph so obtained is called histogram.

54. If x_i's are the mid-points of the class intervals of grouped data, f_i's are the corresponding frequencies and $\bar{x}$ is the mean, then what is $\Sigma f_i(x_i - \bar{x})$ equal to?
(a) 0   (b) −1   (c) 1   (d) 2

⟩ (*a*) If x_i's are the mid-points of the class intervals of grouped data, f_i's are the corrresponding frequencies and $\bar{x}$ is the mean, then $\Sigma f_i(x_i - \bar{x}) = 0$

55. Ten observations 6, 14, 15, 17, $x + 1, 2x - 13$, 30, 32, 34 and 43 are written in ascending order. The median of the data is 24. What is the value of x?
(a) 15   (b) 18   (c) 20   (d) 24

⟩ (*c*) Given observations in ascending order are

6, 14, 15, 17, $x + 1, 2x - 13$, 30, 32, 34 and 43.

Here, $n = 10$ [even]

$\therefore$ Median $= \dfrac{\left[\text{Value of } \left(\dfrac{n}{2}\right)\text{th term} + \text{Value of } \left(\dfrac{n}{2} + 1\right)\text{th term}\right]}{2}$

$= \dfrac{\left[\text{Value of } \left(\dfrac{10}{2}\right)\text{th term} + \text{Value of } \left(\dfrac{10}{2} + 1\right)\text{th term}\right]}{2}$

$= \dfrac{\text{Value of 5th term} + \text{Value of 6th term}}{2}$

$= \dfrac{x + 1 + 2x - 13}{2} = \dfrac{3x - 12}{2}$

But given, median = 24

$\therefore$ $\dfrac{3x - 12}{2} = 24$

$\Rightarrow$ $3x - 12 = 24 \times 2 = 48$

$\Rightarrow$ $3x = 48 + 12 \Rightarrow 3x = 60$

$\therefore$ $x = 20$

Hence, the value of x is 20.

2014 (I)

56. Consider the following
I. The arithmetic mean of two unequal positive numbers is always greater than their geometric mean.
II. The geometric mean of two unequal positive numbers is always greater than their harmonic mean.

Which of the above statement(s) is/are correct?
(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⟩ (*c*) The decreasing order of means is Arithmetic mean > Geometric mean > Harmonic mean.

57. Consider the following statements in respect of a discrete set of numbers.

I. The arithmetic mean uses all the data and is always uniquely defined.

II. The median uses only one or two numbers from the data and may not be unique.

Which of the above statement(s) is/are correct?

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊘ *(c)* Arithmetic mean uses all the data and is always uniquely defined. Median uses only one or two numbers from the data and may not be unique. e.g. $\left(\dfrac{n+1}{2}\right)$th term for odd n and $\left(\dfrac{n}{2}+1\right)$ and $\dfrac{n}{2}$th term for even n.

58. The geometric mean of $(x_1, x_2, x_3, \ldots, x_n)$ is x and the geometric mean of $(y_1, y_2, y_3, \ldots, y_n)$ is y. Which of the following is/are correct?

I. The geometric mean of $(x_1 y_1, x_2 y_2, x_3 y_3, \ldots, x_n y_n)$ is XY.

II. The geometric mean of $\left(\dfrac{x_1}{y_1}, \dfrac{x_2}{y_2}, \dfrac{x_3}{y_3}, \ldots, \dfrac{x_n}{y_n}\right)$ is $\dfrac{X}{Y}$.

Select the correct answer using the codes given below.

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊘ *(c)* Geometric mean of $(x_1, x_2, x_3, \ldots, x_n) = (x_1 \cdot x_2 \ldots x_n)^{1/n} = X$ and geometric mean of $(y_1, y_2, y_3, \ldots, y_n)$
$$= (y_1 \cdot y_2 \ldots y_n)^{1/n} = Y$$
∴ Geometric mean of
$$(x_1 y_1, x_2 y_2, \ldots, x_n y_n)$$
$$= (x_1 \cdot x_2 \ldots x_n)^{1/n} \times (y_1 \cdot y_2 \ldots y_n)^{1/n}$$
$$= (x_1 y_1 \cdot x_2 y_2 \ldots x_n y_n)^{1/n} = XY$$
Geometric mean of $\left(\dfrac{x_1}{y_1}, \dfrac{x_2}{y_2}, \ldots, \dfrac{x_n}{y_n}\right)$
$$= \dfrac{(x_1 \cdot x_2 \ldots x_n)^{1/n}}{(y_1 \cdot y_2 \ldots y_n)^{1/n}}$$
$$= \left(\dfrac{x_1}{y_1} \cdot \dfrac{x_2}{y_2} \ldots \dfrac{x_n}{y_n}\right)^{1/n} = \dfrac{X}{Y}$$

59. The following table gives 'less than' type frequency distribution of income per day.

Income (in ₹) less than	Number of persons
1500	100
1250	80
1000	70
750	55
500	32
250	12

What is the modal class?

(a) 250-500
(b) 500-750
(c) 750-1000
(d) None of the above

⊘ *(b)*

Income less than	Class interval	Number of persons	Frequency
1500	1250-1500	100	20
1250	1000-1250	80	10
1000	750-1000	70	15
750	500-750	55	23
500	250-500	32	20
250	0-250	12	12

Clearly, 500 – 750 is the modal class as it has maximum frequency.

60. Which of the following items of information is a good example of statistical data?

(a) A table of logarithms of numbers
(b) A list of names of 120 students of a class
(c) A list of annual incomes of the members of a club
(d) Holiday list of the offices of Government of India in the year 2013

⊘ *(c)* A list of annual incomes of the members of a club is a good example of statistical data.

61. Consider the following in respect of variate which takes values 2, 2, 2, 2, 7, 7, 7 and 7.

I. The median is equal to mean.

II. The mode is both 2 and 7.

Which of the above statement(s) is/are correct?

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊘ *(c)* I. Mean of all observations
$$= \dfrac{2 \times 4 + 7 \times 4}{8} = 4.5$$
For median, first we arrange the data in ascending order
$$= 2, 2, 2, 2, 7, 7, 7, 7$$
∴ Median $= \dfrac{4\text{th} + 5\text{th}}{2} = \dfrac{2 + 7}{2} = 4.5$

II. Mode is both 2 and 7, since frequency of occurrence is same i.e. maximum frequency.

62. Consider the following statements pertaining to a frequency polygon of a frequency distribution of a continuous variable having seven class intervals of equal width.

I. The original frequency distribution can be reconstructed from the frequency polygon.

II. The frequency polygon touches the X-axis in its extreme right and extreme left.

Which of the above statement(s) is/are correct?

(a) Only I   (b) Only II
(c) Both I and II   (d) Neither I nor II

⊘ *(a)* Frequency polygon is formed by joining the mid-points of histogram. Original frequency distribution can be reconstructed from frequency polygon. Frequency polygon does not touch the X-axis in its extreme right and extreme left.

63. The mean of the following distribution is 18.

Class interval	Frequency
11-13	3
13-15	6
15-17	9
17-19	13
19-21	f
21-23	5
23-25	4

What is the value of f?

(a) 8   (b) 9
(c) 10   (d) 11

⊘ *(a)*

Class interval	x_i	f_i	$x_i f_i$
11-13	12	3	36
13-15	14	6	84
15-17	16	9	144
17-19	18	13	234
19-21	20	f	$20f$
21-23	22	5	110
23-25	24	4	96
Total		$\Sigma f_i = 40 + f$	$\Sigma f_i x_i = 704 + 20f$

∴ Mean, $\bar{x} = \dfrac{\Sigma x_i f_i}{\Sigma f_i}$

$\Rightarrow \quad 18 = \dfrac{704 + 20f}{40 + f}$

$\Rightarrow \quad 720 + 18f = 704 + 20f$

$\Rightarrow \quad 20f - 18f = 720 - 704$

$\Rightarrow \quad 2f = 16$

∴ $\quad f = 8$

27

ANTONYMS

2019 (II)

Directions (Q. Nos. 1-59) *Each item in this section consists of a sentence with an underlined word followed by four words/group of words. Select the option that is opposite in meaning to the underlined word and mark your response on your answer sheet accordingly.*

1. Beauty lies is the eyes of the beholder.
(a) Allure   (b) Charm
(c) Inelegance   (d) Ideal

⊙ *(c)* From the given options 'inelegance' is the correct antonym of underlined word 'beauty'. It means ungraceful or ugly.

2. Reading details about suicide cases can push vulnerable people taking the extreme step.
(a) Imperious   (b) Impervious
(c) Helpless   (d) Defenseless

⊙ *(b)* The underlined word 'vulnerable' means exposed to the possibility of being attacked or harmed. Its correct antonym is 'impervious' which means unable to be affected by anything.

3. Standing before a judge in a courtroom can be daunting for anyone.
(a) Uncomfortable   (b) Encouraging
(c) Demoralising   (d) Off-putting

⊙ *(b)* The underline word 'daunting' means to make (some one) feel intimidated or apprehensive. Its correct antonym is 'encouraging' which means to persuade someone to do something.

4. He has been facing a kind of intimidation by his friends for last two years.
(a) Wiles
(b) Conviction
(c) Persuasion
(d) Support

⊙ *(c)* The underlined, word 'intimidation' means to frighten or threaten someone. Its correct antonym is 'persuasion' which means the act of reasoning or pleading with someone.

5. There are many factors that constrain the philosophy of job enrichment in practice.
(a) Oblige   (b) Pressure
(c) Restrict   (d) Support

⊙ *(d)* The underlined word 'constrain' means compel or force (someone) to follow a particular course of action.
So, among the given options its correct antonym is 'support'.

6. People look for plausible remedies to the problems which they do not know.
(a) Acceptable
(b) Unthinkable
(c) Solvable
(d) Believable

⊙ *(b)* The underlined word 'plausible' means believable or probable. So, its correct antonym would be 'unthinkable' or incredulous.

7. The departing speech of the Chairperson ended with a plaintive note.
(a) Melancholic
(b) Gleeful
(c) Doleful
(d) Adventurous

⊙ *(b)* The underlined word 'plaintive' means sad or mournful.Its correct antonym would be 'gleeful' which means full of happiness.

8. The members have taken a unanimous decision to discord some of the rulings of the Managing Committee on problems relating to maintenance.
(a) Accord
(b) Dissension
(c) Dispute
(d) Friction

⊙ *(a)* The underlined word 'discord' means disagreement between people. Its correct antonym would be 'accord' means an official agreement or treaty.

9. The insolent nature of the speaker had provoked the members of the house and this led to pandemonium.
(a) Respectful
(b) Autocratic
(c) Impudent
(d) Thought provoking

⊙ *(a)* The underlined word 'insolent' means showing a rude and arrogant behaviour. Its correct antonym is 'respectful' which means showing regards or respect.

10. Incessant rains have resulted in failure of crops during this season.
(a) Sporadic
(b) Persistent
(c) Continual
(d) Ceaseless

⊙ *(a)* The underlined word 'incessant' means continuous or non-stop.
Its correct antonym would be 'sporadic' which means happening only sometimes, not regular or continuous.

2019 (I)

11. His religious views are rather <u>fanatical</u>.
(a) Bigoted   (b) Rabid
(c) Moderate   (d) Militant

⊚ *(c)* The underlined word 'fanatical' means extremely interested in something, to a degree that some people find unreasonable. So, among the given options, 'moderate' would be its correct antonym. Moderate means make or become less extreme interested in something.

12. Religious fundamentalists often consider the followers of other religions to be <u>heretics</u>.
(a) Dissenter   (b) Believer
(c) Renegade   (d) Apostate

⊚ *(b)* The underlined word 'heretics' means a person who belongs to a particular religion but whose beliefs or actions seriously disagree with the principles of that religion. So, among the given options, 'believer' is the correct antonym of the word 'heretics. Believer is an adherent of a particular religion.

13. According to GB Shaw, mean have become <u>inert</u>. Therefore, life force has chosen women to perform its functions.
(a) Lively   (b) Quiescent
(c) Dormant   (d) Apathetic

⊚ *(a)* The underlined word 'inert' means motion less or still. Its correct antonym from the given options would be 'lively' and it means full of energy, moving or active.

14. Some of the men are highly <u>misanthropic</u>.
(a) Anti-social   (b) Philosophic
(c) Atrophic   (d) Philanthropic

⊚ *(d)* The underlined word 'misanthropic' means unsociable or unfriendly'. Its correct antonym would be 'philanthropic' which means humanitarian, liberal, unselfish etc.

15. The teacher was a very <u>profound</u> man.
(a) Sincere   (b) Erudite
(c) Scholarly   (d) Superficial

⊚ *(d)* The underlined word 'profound' means felt or experienced very strongly or in an extreme way. Its correct antonym from the given options is 'superficial' which means concerned only what is obvious or apparent, not deep or serious.

16. His hand-writing is <u>readable.</u>
(a) Well-written
(b) Decipherable
(c) Illegible
(d) Comprehensible

⊚ *(c)* The word 'readable' means which can be read clearly. Its correct antonym is 'illegible' which means the writing which is not clear or hard to read.

17. Mohan is his <u>steadfast</u> friends.
(a) Committed   (b) Unwavering
(c) Unfaltering   (d) Unreliable

⊚ *(d)* The word 'steadfast' here means loyal or dedicated. Its correct antonym is 'unreliable' which means untrustworthy or undependable.

18. Radha often goes <u>tempestuous</u> while debating.
(a) Calm   (b) Violent
(c) Fierce   (d) Vehement

⊚ *(a)* The word 'tempestuous' means angry or violent. Its correct antonym is 'calm' which means peaceful.

19. The thief had very <u>vital</u> information to pass on to the police.
(a) Crucial   (b) Inessential
(c) Indispensable   (d) Fundamental

⊚ *(b)* The underlined word 'vital' means absolutely necessary or essential. Its correct antonym is 'inessential' which means not necessary.

20. His lectures are often <u>wordy</u> and pointless.
(a) Diffuse   (b) Concise
(c) Garrulous   (d) Voluble

⊚ *(b)* The underlined word 'wordy' means unnecessary repetition of language. Its antonym is 'concise' which means very brief or to the point.

2018 (II)

21. His ideas are <u>obscure</u>.
(a) New   (b) Clear
(c) Infamous   (d) Obscene

⊚ *(b)* Clear is antonym of word 'obscure' which means something uncertain or doubtful. 'Clear' means which is easy to understand or transparent.

22. Ravi is jovial and he makes the environment <u>sanguine</u>.
(a) Pessimistic   (b) Optimistic
(c) Humorous   (d) Rebellious

⊚ *(a)* The underlined word 'sanguine' means optimistic or positive especially in a bad or difficult situation. So, its correct antonym would be 'pessimistic' which means tending to see the worst aspect of things or believe that the worst will happen.

23. There prevailed a <u>woebegone</u> feeling in the room.
(a) Sad   (b) Cheerful
(c) Sleepy   (d) Thoughtful

⊚ *(b)* The underlined word 'woebegone' means someone sad or miserable in appearance. Its correct antonym would be 'cheerful' which means noticeably happy and optimistic.

24. It appears that the whole group is <u>mutinous</u>.
(a) Arrogant   (b) Lucky
(c) Obedient   (d) Sincere

⊚ (*c*) The given underlined word 'mutinous' means refusing to obey the orders of a person in authority or disobedient. So, among the given options, 'obedient is its correct antonym. 'Obedient' means doing or willing to do, what you have been told to do by someone in authority.

25. They consider themselves as foes <u>from</u> birth.
(a) Protagonists   (b) Opponents
(c) Friends   (d) Soulmates

⊚ *(c)* 'Foe' means enemy or opponent. Its correct antonym would be friends which means a person with whom one has bond of affection.

26. This painting has a <u>distinctive</u> element which can be noticed well.
(a) Salient   (b) Common
(c) Great   (d) Unique

⊚ *(b)* The underlined word 'distinctive' means unique or remarkable or uncommon. So, among the options given 'common' is appropriate antonym which means ordinary, usual etc.

27. The entry was carried out <u>inadvertently</u>.
(a) Purposely   (b) Purposively
(c) Accidently   (d) Not noticing

⊚ *(a)* The underlined word 'inadvertently' means something done without intention or accidentally. Its correct antonym is 'purposely' which means something done deliberately or intentionally.

28. The whole audience showed a <u>disdainful</u> attitude during the match.
(a) Sneering   (b) Respectful
(c) Mocking   (d) Cheerful

(b) The underlined word 'disdainful' means showing lack of respect or derisive. Its correct antonym would be 'respectful' which means showing respect or reverence.

29. Efficacy of the project needs an examination.
(a) Inefficiency   (b) Efficiency
(c) Value   (d) Effectiveness

(a) The underlined word 'efficacy' means the ability to produce a desired or intended result. Its correct antonym would be 'inefficiency' which means failure to make the best use of time or resources.

30. Her rebuttal that she was not involved in the case, was considered by the court.
(a) Refusal   (b) Denial
(c) Acceptance   (d) Kindness

(c) The word 'rebuttal' means denial or negation. Its correct antonym from the given option is 'acceptance' which means a general agreement, or the act the agreeing.

31. The baby could not move as the place was soggy.
(a) Sodden   (b) Dry
(c) Hot   (d) Wet

(b) The underlined word 'soggy' means wet and soft. Its correct antonym is 'dry' which means something free of moisture, not wet.

2018 (I)

32. It was a mystery as to where the young girl had acquired such a naive belief.
(a) Credulous   (b) Childlike
(c) Wise   (d) Innocent

(c) 'Naive' means 'showing a lack of experience, wisdom or judgement'. Hence, 'wise' will be its correct antonym.

33. It's the only treatment suitable for cancer.
(a) Insufficient   (b) Impertinent
(c) Befitting   (d) Congenial

(a) 'Suitable' means desirable or appropriate. Hence, 'insufficient' will be its correct antonym which means lacking in what is necessary or required.

34. Some of the criticisms which they had to put up were very unfair.
(a) Scold   (b) Scorn
(c) Appreciation   (d) Censure

35. I would beg of all friends neither rush to Birla house nor try to dissuade me or be anxious about me.
(a) Certain   (b) Composed
(c) Careless   (d) Needless

(b) 'Anxious' means worried or concerned. Hence, 'composed' will be its correct antonym that means clam or controlled.

36. It could not have been expected that, with such a bent of mind of the people, there should have been much activity for the cultivation of the physical sciences in this part of the world.
(a) Dull   (b) Dormant
(c) Indolence   (d) Idle

(c) 'Activity' means busy or vigorous action or movement while 'indolence' means laziness which no action is being done. So, 'indolence' is the correct antonym.

37. Indian culture has been from time immemorial, of a peculiar cast and mould.
(a) Common   (b) Customary
(c) Natural   (d) Familiar

(a) 'Peculiar' means different to what is normal or expected; strange or unusual. Hence, 'common' will be its correct antonym.

38. The princess charming was the centre of attraction today.
(a) Enchanting   (b) Hypnotic
(c) Repulsive   (d) Fascinating

(c) 'Charming' means very pleasant or attractive. Hence, 'repulsive' will be its correct antonym that means disgusting or offensive.

39. Macbeth is a/an abominable figure.
(a) Abhorrent   (b) Repugnant
(c) Reputable   (d) Attractive

(d) 'Abominable' means hateful which 'attractive' means pleasing or appealing. So, option (d) is its correct answer.

40. Terrorists profess fanatical ideology.
(a) Bigoted   (b) Militant
(c) Moderate   (d) Fervid

(c) The given underlined word 'fanatical' means obsessively concerned with something or passionate. So, 'moderate' will be its correct antonym. Moderate means make or become less passionate or dwindle.

41. Rakesh is vulnerable to political pressure.
(a) Weak
(b) Unguarded
(c) Exposed
(d) Resilient

(d) The underlined word 'vulnerable' means in danger, at risk or unprotected. So, among the given options 'resilient' would be its correct antonym. Resilint means able to withstand or recover quickly from danger or risky conditions.

2017 (II)

42. Whether the rewards are in Commensurate with the efforts or not, a society will always have workaholics and the shirk work groups.
(a) Disproportionate
(b) Equal to
(c) Matched
(d) Unparalleled

(a) 'Commensurate' means proportionate or equal. Hence, 'disproportionate' will be its correct antonym.

43. Wars leave behind a large number of Emaciated soldiers in the camps of both the victorious and the vanquished.
(a) Hefty   (b) Thin
(c) Disillusioned   (d) Determined

(a) 'Emaciated' means thin or skinny. Hence, 'hefty' will be its correct antonym that means fatty or heavy.

44. There was a Mammoth gathering to listen to the leader.
(a) Negligible   (b) Tiny
(c) Poor   (d) Large

(b) The word 'Mammoth' means huge. Hence, 'tiny' will be its correct antonym.

45. The audience thoroughly enjoyed the Hilarious drama.
(a) Amusing   (b) Delightful
(c) Serious   (d) Momentous

(c) 'Hilarious' means very funny. Hence, 'serious' is its correct antonym.

46. The writer's Erudition in science is revealed in every page of the book.
(a) Unenlightened (b) Ignorance
(c) Intelligence (d) Hollowness

⊙ (**b**) The underlined word 'Erudition' means having or containing a lot of knowledge that is known by very few people. So, among the given options, 'Ignorance' would be its correct antonym. Ignorance means lack of knowledge or information.

47. The seminar which Ravi organised proved to be Momentous event.
(a) Trivial (b) Futile (c) Vain (d) Useless

⊙ (**a**) 'Momentous' means of great importance or significance 'trivial' means unimportant. Hence, they are antonyms to each other.

48. The question is not whether the court Vindicates him with regard to his involvement in the case, but how he feels about it.
(a) Reprieves (b) Absolveds
(c) Indicts (d) Summons

⊙ (**c**) Vindicate means clear (someone) of blame or suspicion while indicts means formally accuse of or charge with a crime. Hence, they are antonyms.

49. In those days many monarchs enjoyed vast Ecclesiastical powers
(a) Permanent (b) Temporal
(c) Contemporary (d) Constitutional

⊙ (**b**) The underlined word 'Ecclesiastical' means relating to the Christian Church or its clergy; spiritual. So, among the given options 'temporal' is its correct antonym. Temporal means relating to practical matters or physical things rather than spiritual ones.

2015 (II)

50. The officer Exaggerated the damage caused by the rowdies.
(a) Underwrote (b) Condemned
(c) Ignored (d) Underestimated

⊙ (**d**) 'Exaggerated' means 'to make or show something greater then usual,' but 'underestimated' means 'to diminish or lessen the quality of something or someone.' Hence, they both are antonyms to each other.

51. The speaker was unable to Pacify the crowd.
(a) Excite (b) Antagonise
(c) Threaten (d) Challenge

⊙ (**a**) 'Pacify' means 'to make someone calm and silent', but 'excite' means 'to provoke someone to do something'. Hence, they both are antonyms to each other.

52. His officer was a very Strict person.
(a) Pleasant
(b) Open hearted
(c) Lenient
(d) Indifferent

⊙ (**c**) 'Strict' means 'hard or tough in attitude or action', but 'lenient' means 'soft hearted and friendly'. Hence, option (c) is its correct answer.

53. Servitude is not helpful for mental growth.
(a) Disservice (b) Retirement
(c) Freedom (d) Termination

⊙ (**c**) 'Servitude' means 'slavery or bondage of any kind', but 'freedom' means 'to free from all bonds'. Hence, they be are antonyms.

54. His attitude to poor people is Deplorable.
(a) Commendable (b) Miserable
(c) Equitable (d) Desirable

⊙ (**a**) 'Deplorable' means 'dishonourable, unforgivable', but 'commendable' means 'deserving praise'. Hence, they are antonyms.

55. The guest made Derogatory remarks about the food he was served.
(a) Interesting (b) Complimentary
(c) Unnecessary (d) Cheerful

⊙ (**b**) 'Derogatory' means 'showing a critical or disrespectful attitude', but 'complimentary' means 'showing respect to other or praise someone' or something. Hence, they are antonyms.

56. He has an Aversion to milk.
(a) Dear (b) Loving (c) Liking (d) Pet

⊙ (**c**) 'Aversion' means 'strong dislike for something', but 'liking' means 'a feeling of fondness for something'. Hence, option (c) is its correct answer.

57. The Paucity of good teachers is the chief reason for the present condition of these schools.
(a) Presence (b) Surplus
(c) Appointment (d) Retention

⊙ (**b**) The underlined word 'Paucity' means 'the presence of something in only small or insufficient quantities or amounts'. So, among the given options, 'surplus' is its correct antonym as it means more than what is needed or used; excess.

58. Don't you think his account of things was Monotonous?
(a) Agreeable (b) Acceptable
(c) Varied (d) Indecent

⊙ (**c**) 'Monotonous' means 'lacking in variety or interest or unvarying', but 'varied' means 'showing variation or variety'. Hence, they are antonyms.

59. Spurious drugs can prove to be fatal.
(a) Virtuous (b) Inferior
(c) Genuine (d) Contemptuous

⊙ (**c**) 'Spurious' means 'something without having its genuine qualities; fake' but 'genuine' means 'authentic; real'. Hence, they both are antonyms.

2015 (I)

Directions (Q. Nos. 60-74) *In the following questions, a word is given followed by four words/group of words. Select the option that is opposite in meaning to the given word and mark your response on answer sheet accordingly.*

60. FORBID
(a) Forgive (b) Allow
(c) Refuse (d) Deprive

⊙ (**b**) 'Forbid' means 'restrictions'. So, its correct antonym will be 'allow' which means 'to give permission to do something'.

61. AMBIGUOUS
(a) Definite (b) Constant
(c) Shapeless (d) Determined

⊙ (**a**) 'Ambiguous' means 'not having one obvious meaning'. So, its antonym will be 'definite'.

62. COUNTERFEIT
(a) Destructive (b) Genuine
(c) Affirm (d) Harmonise

⊙ (**b**) 'Counterfeit' means 'fake'. So, its correct antonym will be 'genuine'.

63. FUSION
(a) Melting (b) Fixture
(c) Amendment (d) Separation

⊙ (**d**) 'Fusion' means 'the process or result of joining two or more things together to form a single entity'. So, 'separation' is its correct antonym.

64. ESCALATE
(a) Bring down (b) Isolate
(c) Slope down (d) Reject

⊙ (**a**) 'Escalate' means 'to go up'. So, its correct antonym will be 'to bring down'.

65. TERMINATE
(a) Imitate   (b) Interrupt
(c) Initiate   (d) Examine

⊚ *(c)* 'Terminate' means 'to stop'. So, its correct antonym will be 'initiate' which means cause a process to begin.

66. GRAVITATE
(a) Meditate   (b) Become serious
(c) Deteriorate   (d) Retreat

⊚ *(d)* 'Gravitate' means 'tend to move towards a centre of gravity or other attractive force. Among the given options, 'Retreat' would be its correct antonym as it means an act of moving back or withdrawing.

2014 (II)

67. FRESH
(a) Laden (b) Soft   (c) Sour   (d) Stale

⊚ *(d)* 'Fresh' means 'new' so 'stale' is its correct opposite which means 'old' or 'dried'. So, both fresh and stale are antonyms.

68. DENY
(a) Accept   (b) Accuse
(c) Curse   (d) Except

⊚ *(a)* 'Deny' means 'to refuse' so 'accept' is its correct opposite which means 'to admit'.

69. CHEERFUL
(a) Sad   (b) Happy
(c) Expensive   (d) Careless

⊚ *(a)* Cheerful' means 'in happy mood' so 'sad' is its correct opposite which means 'in dejected mood'.

70. AFFLUENCE
(a) Continuance   (b) Poverty
(c) Diffidence   (d) Insurance

⊚ *(b)* 'Affluence' means 'the state of having a great deal of money; wealth'. So, 'poverty' is its correct antonym among the given options. 'Poverty' means 'a state or condition in which a person lacks the financial resources or the state of being extremely poor'.

71. TIMID
(a) Bold   (b) Bashful
(c) Nervous   (d) Soft

⊚ *(a)* 'Timid' means 'showing a lack of courage or confidence; easily frightened or fearful. So, 'bold' is its correct antonym which means 'fearless'.

72. CREATE
(a) Destroy   (b) Envy
(c) Satisfy   (d) Begin

⊚ *(a)* 'Create' means 'to produce' so 'destroy' is its correct antonym which means 'to demolish'.

73. FORBID
(a) Defy   (b) Dislike
(c) Permit   (d) Understand

⊚ *(c)* 'Forbid' means 'to prohibit an action' so 'permit' is its correct antonym which means 'to allow'.

74. MASTER
(a) Companion   (b) Follower
(c) Slave   (d) Boss

⊚ *(c)* 'Master' means 'boss' or 'supreme' so 'slave' is its correct antonym which means 'to work for someone or subordinate'.

2014 (I)

Directions (Q. Nos. 75-84) *Each item in this section, consists of a sentence with an underlined word followed by four words/group of words. Select the option that is opposite in meaning to the underlined word and mark your response on answer sheet accordingly.*

75. Kapil's bowling yesterday proved very <u>Costly</u>.
(a) Economical   (b) Frugal
(c) Thrifty   (d) Expensive

⊚ *(a)* 'Costly' means 'expensive'. 'Economical' means 'inexpensive' or 'low-priced'. So, they both are antonyms.

76. I cannot see much <u>Likeness</u> between the two boys.
(a) Enmity   (b) Hatred
(c) Difference   (d) Dislike

⊚ *(c)* Here, 'Likeness' means 'resemblence, similarities, so 'difference' is the most appropriate antonym of the given word.

77. I am still <u>Dubious</u> about that plan.
(a) Certain   (b) Doubtful
(c) Docile   (d) Faithful

⊚ *(a)* 'Dubious' means 'doubtful, questionable' and 'certain' means 'unquestionable' or 'undoubtful. So, they both are antonyms.

78. The wise say that life is meant not merely to <u>Accumulate</u> wealth but for self-realisation.
(a) Amass   (b) Produce
(c) Scatter   (d) Gather

⊚ *(c)* The underlined word 'Accumulate' means gather together or acquire an increasing number or quantity. Among the given options, 'Scatter' is its correct antonym. Scatter means separate and move off quickly or disperse.

79. He will never <u>Turn down</u> your request.
(a) Turn up   (b) Turn over
(c) Reject   (d) Accept

⊚ *(d)* 'Turn down' means 'reject'. So, its correct antonym would be 'accept'.

80. Real happiness does not lie in <u>Material</u> possessions alone.
(a) Physical   (b) Essential
(c) Spiritual   (d) Manual

⊚ *(c)* Here, the word 'Material' means 'denoting or consisting of physical objects rather than the mind; non-spiritual'. So, among the given options, 'spiritual' is its correct antonym.

81. I was upset by his <u>Hostile</u> attitude.
(a) Friendly   (b) Negative
(c) Positive   (d) Inimical

⊚ *(a)* 'Hostile' refers to 'of enemy', so its correct opposite is 'friendly'.

82. Ashoka was a <u>Magnanimous</u> king.
(a) Small   (b) Petty
(c) Kind   (d) Majestic

⊚ *(b)* The underlined word 'Magnanimous' means 'generous in forgiving an insult or injury; free from petty resentfulness or vindictiveness'. Among the given options, 'petty', is its correct antonym. Petty means 'marked by or reflective of narrow interests and sympathies'.

83. Mala is always <u>Defiant</u> in her behaviour.
(a) Obedient
(b) Rebellious
(c) Meek
(d) Friendly

⊚ *(a)* 'Defiant' means 'disobedient'. So, its correct opposite would be 'obedient'.

84. I find his views <u>Repugnant</u>.
(a) Amiable   (b) Repulsive
(c) Amoral   (d) Apolitical

⊚ *(a)* Here, the underlined word 'Repugnant' means 'objectionable or unacceptable'. Among the given options, 'Amiable' is its correct antonym. 'Amiable' means 'agreeable obliging or pleasing'.

28

SYNONYMS

Directions *(Q. Nos. 1-40) Each item in the following questions consists of a sentence with an underlined word followed by four words. Select the option that is nearest in meaning to the underlined word and mark your response on your answer sheet accordingly.*

1. The properties of the family have been <u>impounded</u> by the order of the court.
   (a) Confiscated   (b) Permitted
   (c) Sold   (d) Put on hold
   ⊙ (**a**) The word 'Confiscated' is the correct synonym of the given word 'Impounded'. Both words mean to seize and take legal custody of something.

2. The officer in charge of the operations has been <u>impugned</u> for the excesses.
   (a) Expelled   (b) Rewarded
   (c) Challenged   (d) Given allowance
   ⊙ (**c**) 'Challenged' is correct synonym of 'Impugned'. Both means to challenge or oppose as false or lacking integrity impugned the defendant's character.

3. Cognitivist and linguists believe that every child is born with <u>innate</u> qualities.
   (a) Biological   (b) Intrinsic
   (c) Extrinsic   (d) Unnatural
   ⊙ (**b**) 'Intrinsic' is the correct synonym of the given word 'Innate' both words mean inborn or natural.

4. It was <u>obligatory</u> for the board to implement the rule.
   (a) Compulsory   (b) Unnecessary
   (c) By chance   (d) Problematic
   ⊙ (**a**) 'Compulsory' is the appropriate synonym of the given underlined word 'Obligatory'. Both means mandatory or required by a legal, moral or other rule.

5. They describe the act as a blatant <u>betrayal</u> of faith.
   (a) Loyal   (b) Faithfulness
   (c) Treachery   (d) Honesty
   ⊙ (**c**) 'Treachery' is the appropriate synonym of the given underlined word 'Betrayal'. Both words mean disloyalty or to expose to an enemy by treachery.

6. However, if it must decide, then it should do so on the <u>narrowest</u> ground possible.
   (a) Widest   (b) Slightly
   (c) Smallest   (d) Thick
   ⊙ (**b**) 'Slightly' is the appropriate synonym of the word 'Narrowest'. Both words mean limited in extent, amount or scope.

7. This is <u>akin</u> to a contractual relationship that places obligations on the entities entrusted with data.
   (a) Removed   (b) Narrow
   (c) Similar   (d) Unparallel
   ⊙ (**c**) 'Similar' is the appropriate synonym of the given underlined word 'Akin'. Both mean corresponding or alike.

8. Many communication problems can be <u>attributed</u> directly to misunderstanding and inaccuracies.
   (a) Disapproved   (b) Unofficial
   (c) Ascribed   (d) Tribute
   ⊙ (**c**) 'Ascribed' is the correct synonym of the underlined word 'Attributed'. Both words mean regard something as being caused by.

9. The exemptions granted to state institutions for <u>acquiring</u> informed consent from processing personal data in many cases appear to be too blanket.
   (a) Obtain   (b) Lose
   (c) Giving   (d) Thinking
   ⊙ (**a**) 'Obtain' is the correct synonym of the underlined word 'Acquiring'. Both words mean to obtain or to begin to have.

10. The manner in which this exercise has been undertaken leaves much to be <u>desired</u>.
    (a) Disliked   (b) Unlikely
    (c) Wish for   (d) Asked for
    ⊙ (**c**) 'Wish for' is the appropriate synonym of the underlined word 'Desire'. Both means strongly wished for or intended.

11. A <u>provocative</u> message had been doing rounds on social media to instigate the mob against migrants.
    (a) Dexterous   (b) Inflammatory
    (c) Valiant   (d) Prudent
    ⊙ (**b**) 'Inflammatory' and 'Provocative' are synonyms. Both words mean arousing or intended to arouse angry or violent feelings (especially of speech or writing).

12. The differences include increase in mean temperature and heavy <u>precipitation</u> in several regions.
    (a) Drought   (b) Oasis
    (c) Rainfall   (d) Snowing
    ⊙ (**c**) 'Rainfall' is the correct synonym of the word 'Precipitation'. Precipitation means rain, snow or hail that falls to or condenses on the ground.

13. The portal will help victims and complainants to <u>anonymously</u> report cyber crime.
    (a) Incognito   (b) Directly
    (c) Unfailingly   (d) Is Situ
    ⊙ (**a**) 'Incognito' is the correct synonym of the word 'Anonymously'. Both words mean unknown or having one's true identity concealed.

14. He is suffering from a <u>terminal</u> disease.
    (a) Sublunary   (b) Terrific
    (c) Chronic   (d) Incurable

⊙ (**d**) 'Terminal and Incurable' are synonyms. Both words mean predicted to lead to death (of a disease) especially slowly.

15. Doctors are <u>reluctant</u> to take rural postings despite big salary offers.
(a) Disinclined
(b) Eager
(c) Fervent
(d) Unrepentant

⊙ (**a**) 'Disinclined' is synonym of the word 'Reluctant'. Both words mean unenthusiastic on unwilling.

16. The authorities have <u>reprimanded</u> to subordinate officer for violating the protocol.
(a) Extolled
(b) Purported
(c) Admonished
(d) Required an apology

⊙ (**c**) 'Admonished' is the correct synonym of the word 'Reprimanded'. Both words mean meaning is blamed or scolded.

17. For Gandhiji, India's religious and linguistic diversity was an <u>asset</u>, not a liability.
(a) Obligation
(b) Advantage
(c) Attribute
(d) Reinforcement

⊙ (**b**) 'Advantage' is the closest synonym to the word 'Asset'. Both words mean benefit or advantage.

18. How <u>hysterical</u> he is!
(a) Berserk
(b) Inconsistent
(c) Duplicitous
(d) Insincere.

⊙ (**a**) 'Berserk' is the correct synonym of the word 'Hysterical'. Both words mean crazy or out of control with anger excitement.

19. Mahesh is mostly <u>prejudiced</u> in his political opinion.
(a) Objectionable
(b) Predatory
(c) Jaundiced
(d) Intimate

⊙ (**c**) The word 'Jaundiced' means the same as 'Prejudiced'. Both words mean biased or influenced.

20. Do not indulge in <u>tautology</u>.
(a) Truth telling
(b) Prolixity
(c) Foretelling
(d) Telepathic conversation

⊙ (**b**) The word 'Prolixity' means the same as 'Tautology'. Both words mean a phrase or expression in which the same thing is said twice in different words.

2018 (II)

21. Rahul is always <u>thrifty</u>.
(a) Reckless
(b) Economical
(c) Naive
(d) Extravagant

⊙ (**b**) 'Economical' is the correct synonym of the underlined word 'Thrifty' which means using money and other resources carefully not wastefully. Other options are antonyms and do not given similar meaning.

22. His <u>salubrious</u> words calmed the students.
(a) Provoking
(b) Pleasant
(c) Ridiculous
(d) Thanking

⊙ (**b**) 'Pleasant' is nearer to the meaning of underlined word 'Salubrious'. Both words mean favourable to or healthful.

23. He felt <u>desolated</u> after he lost his business.
(a) Deserted
(b) Joyful
(c) Strong
(d) Annoyed

⊙ (**a**) 'Deserted' is closest in meaning to the word 'Desolated'. The word means to leave someone in a situation when they have no one to support. The word desolated also means to feel miserable or gloomy.

24. Don't <u>condone</u> such acts which lead to unrest in the country.
(a) Regard
(b) Punish
(c) Aware of
(d) Overlook

⊙ (**d**) 'Overlook' is closest in meaning to the word 'Condone'. The word condone means to accept or allow behaviour that is morally wrong or offensive.

25. A good word place shall not encourage <u>inaptitude</u> even in a hidden manner.
(a) Incompetence
(b) Courage
(c) Gossip
(d) Radical thinking

⊙ (**a**) 'Incompetence' is closent in meaning to the word 'Inaptitude'. The word inaptitude means lack of skill or effective and incompetence also means the same.

26. Learning or foreign language should not <u>impede</u> one's mother tongue learning.
(a) Facilitate
(b) Acts for
(c) Hinder
(d) Accept

⊙ (**c**) 'Hinder' is the most suitable meaning of the word 'Impede'. Both words mean to delay or prevent someone by obstructing them.

27. <u>Extradition</u> of the leader of the group was debated for hours in the meeting.
(a) Acceptance
(b) Sentence
(c) Extension
(d) Deportation

⊙ (**d**) 'Deportation', is closest in meaning to the underlined word 'Extradition'. Both word means sending someone back to the country or state where they have been accused of a crime.

28. It was felt that the decision to remove the group from the exercise would be <u>detrimental</u> to the organisation.
(a) Beneficial
(b) Harsh
(c) Disadvantageous
(d) Demanding

⊙ (**c**) 'Disadvantageous' is closest is closest in meaning to the underlined word 'Detrimental'. Detrimental means tending to cause harm.

29. His <u>derisive</u> behaviour has led to the situation we face now.
(a) Mockery
(b) Conducive
(c) Encouraging
(d) Contemptuous

⊙ (**d**) The word 'Derisive' means expressing contempt or ridicule. So, option (d) 'Contemptuous' is the most suitable answer.

30. Every classroom should provide an <u>engaging</u> environment for learners.
(a) Carefree
(b) Appealing
(c) Thinking
(d) Dreaming

⊙ (**b**) 'Appealing' is closest in meaning to the underlined word 'Engaging' which means delightful or attractive.

2018 (I)

31. A truly respectable old man is a <u>ripe</u> person.
(a) Senior
(b) Mature
(c) Perfect
(d) Seasoned

⊙ (**b**) 'Ripe' and 'Mature' are synonyms as here they mean old and wise enough or fully-fledged.

32. The soldiers <u>repulsed</u> the enemy.
(a) Defeated
(b) Destroyed
(c) Rejected
(d) Repelled

⊙ (**d**) 'Repulsed' and 'Repelled' both means drive and forced back (an attack or attacker) by force.

33. She deftly <u>masked</u> her feelings.
(a) Hid
(b) Flaunted
(c) Oblique
(d) Obscured

⊙ (**a**) 'Masked' and 'Hid' are the synonyms as they both mean to conceal something of one's true character of feelings.

34. <u>Vendors</u> must have license.
(a) One who drives a car
(b) One who works in a hospital
(c) One who is employed in food serving
(d) One engaged in selling

⊙ (**d**) 'Vendors' mean persons or companies offering something for sale, especially traders in the street. Hence, option (d) is the correct choice as a synonym of vendors.

35. They will not <u>admit</u> children under fourteen.
(a) Avow
(b) Receive
(c) Accept
(d) Concede

> *(c)* Here, the underlined word 'Admit' means allow someone to enter a place. So, among the given options, 'Accept' is the correct synonym.

36. The jewels have been <u>stolen</u> from her bedroom.
(a) Embezzled
(b) Asserted
(c) Yielded
(d) Abdicated

> *(a)* 'Embezzled' means stolen. Hence, 'Stolen and Embezzle' are synonyms.

37. The soldier showed an <u>Exemplary</u> courage.
(a) Flawed
(b) Faulty
(c) Ideal
(d) Boisterous

> *(c)* 'Exemplary' and 'Ideal' both means serving as a desirable model and suitable to be copied by other people. Hence, they are synonyms.

38. They <u>served</u> fruits after the dinner.
(a) Assisted
(b) Obliged
(c) Waited
(d) Offered

> *(d)* Here, the underlined word 'Served' means to offer or distribute food, beverages as a host or hostees.
> So, among the given options, the word 'Offered' is nearest in meaning to the given word.

39. The committee should <u>recommend</u> his name to the government.
(a) Praise
(b) Advise
(c) Counsel
(d) Suggest

> *(d)* 'Recommend' and 'Suggest' both mean put forward (someone or something) with approval as being suitable for a particular purpose or role. Hence, they are synonyms.

40 . Can medicines <u>save</u> us from death?
(a) Hide
(b) Rescue
(c) Protect
(d) Liberate

> *(b)* 'Save' means to keep safe or 'Rescue' (someone or something) from harm or danger. So', rescue is its correct synonym.

2016 (I)

Directions *(Q. Nos 41-49) In the following questions, a word is given followed by four words. Select the option that is nearest in meaning to the given word and mark your response in answer sheet.*

41. AMBIGUOUS
(a) Contrasting
(b) Connivance
(c) Vague
(d) Wilful

> *(c)* 'Ambiguous' and 'Vague' are the synonyms to each other which means 'not clear' or decided.

42. ELUCIDATE
(a) Clarify
(b) Calculate
(c) Summarise
(d) Update

> *(a)* 'Elucidate' and 'Clarify' are the synonyms to each other which means make something clear or explain.

43. MONOTONOUS
(a) Dreary
(b) Dreadful
(c) Single-minded
(d) Monologue

> *(a)* 'Monotonous' and 'Dreary' have the same meaning which means uninteresting repetitious or boring.

44. KINDLE
(a) Make fun of
(b) Excite
(c) Very kind
(d) Kind-hearted

> *(b)* 'Kindle' and 'Excite' have the same meaning which means arouse or inspire (an emotion or feeling).

45. PALATIAL
(a) Very clean
(b) Very special
(c) Sense of taste
(d) Magnificent

> *(d)* 'Palatial' and 'Magnificent' have the same meaning which means resembling a palace in being spacious and splendid.

46. TACTFUL
(a) Diplomatic
(b) Indifferent
(c) Intelligent
(d) Deceitful

> *(a)* 'Tactful' and 'Diplomatic' are synonyms have the same meaning which means having or showing skill and sensitivity in dealing with others or with difficult issues.

47. VORACIOUS
(a) Very bad
(b) Insatiable
(c) Stingy
(d) Malicious

> *(b)* 'Voracious' and 'Insatiable' are synonyms and have the same meaning with means exceedingly fond of eating or avid.

48. STRICTURE
(a) Strictness
(b) Stinging
(c) Discipline
(d) Censure

> *(d)* 'Stricture' and 'Censure' are synonyms have the same meaning which means a sternly critical or censorious remark or instruction.

49. OBEISANCE
(a) Homage
(b) Pilgrimage
(c) Subjugation
(d) Obligation

> *(a)* 'Obeisance' and 'Homage' are synonyms as they have same meaning i.e. 'to express deep respect'.

2015 (II)

Directions *(Q. Nos. 50-64) Each item in the following questions consist of a sentence with an underlined word. Select the option that is nearest in meaning to the underlined word and mark your response on your answer sheet accordingly.*

50. All these items have been <u>marked down</u>.
(a) Reserved
(b) Packed up
(c) Reduced in price
(d) Entered

> *(c)* Here, 'Marked down' means 'reduce in price'. Hence, option (c) is the correct meaning of the underlined word.

51. How can you have the <u>effrontery</u> to ask for another loan?
(a) Right
(b) Impudence
(c) Heart
(d) Courage

> *(b)* 'Effrontery' and 'Impudence' both have same meaning as 'insolent or impertinent behaviour', or side, disrespectful.

52. There was a <u>devastating</u> attack on his work.
(a) Terrible
(b) Casual
(c) Unethical
(d) Motivated

> *(a)* 'Devastating' and 'Terrible' both means the same, i.e. 'causing severe shock, distress or grief'.

53. The committee conducted an <u>exhaustive</u> inquiry.
(a) Time-consuming
(b) Complicated
(c) Renewed
(d) Thorough

> *(d)* 'Exhaustive' and 'Thorough' are synonyms and both have same meaning as including or considering all elements or aspect or complete.

54. He is just <u>laying up</u> a lot of trouble for himself.
(a) Clearing
(b) Accumulating
(c) Accepting
(d) Removing

> *(b)* 'Laying up' and 'Accumulating' both have same meaning i.e. to gather or collect little by little.

55. He fought the demon with all his <u>might</u>.
(a) Heaviness
(b) Strength
(c) Density
(d) Popularity

> *(b)* The word 'Strength is the correct synonym of the given word 'Might'. Both means the same, i.e. 'impressive power'.

56. Devotees believe that God <u>dwells</u> is their heart.
(a) Lives
(b) Insists
(c) Travels
(d) Enters

⊙ *(a)* 'Dwells' and 'Lives' are the correct synonyms and both have the same meaning which means 'to live in or at a specified place.

57. Not everyone can <u>respond</u> a difficult question quickly.
(a) Discuss   (b) Argue
(c) Answer   (d) Deny

⊙ *(c)* 'Respond' and 'Answer' have the same meaning which means 'say something is reply'. So, answer is the correct synonym of the underlined word.

58. The sage did not want to be bethered with <u>mundane</u> Concerns.
(a) Worldly   (b) Meaningless
(c) Trivial   (d) Superfluous

⊙ *(a)* 'Mundane' and 'Worldly' both means the same, i.e. 'of this earthly word rather then a heavenly or spiritual one'. So, 'Worldly' is the correct synonym of the given underline word.

59. Mountaineering in bad weather is <u>dangerous</u>.
(a) Threatening   (b) Shaky
(c) Perilous   (d) Slippery

⊙ *(c)* 'Dangerous' and 'Perilous' both have same meaning, i.e.,'likely to cause harm of injury'.
So, 'Perilous' is the correct answer.

60. Stellar groupings tend to be <u>unlimited</u>.
(a) Lengthy   (b) Heavenly
(c) Huge   (d) Infinite

⊙ *(d)* 'Infinite' is the correct synonym to the given underlined word 'Unlimited'. Both means the same, i.e. 'without any limit'.

61. One who rules with unlimited power is called a <u>dictator</u>.
(a) Anarchist   (b) Autocrate
(c) Egoist   (d) Sycophant

⊙ *(b)* 'Autocrate' is the correct synonym to the given underlined word 'Dictator'. Both means the same, i.e. 'a ruler with total power over a country'.

62. He was not ready with his <u>annual</u> accounts.
(a) Yearly   (b) Important
(c) Monthly   (d) Permanent

⊙ *(a)* 'Annual' and 'Yearly' are the synonyms and both have the same meaning i.e. 'occurring once every year'.

63. Society cannot depend upon a <u>fanatic</u> for guidance.
(a) Optimist   (b) Martyr
(c) Bigot   (d) Anarchist

⊙ *(c)* 'Fanatic' and 'Bigot' are synonyms and both means the same, i.e. 'a person with an entrance and uncritical enthusiasm or zeal as in religion or politics.

64. A busy person cannot waste his time on <u>trivial</u> issues.
(a) Unimportant   (b) Rude
(c) Crude   (d) Tribal

⊙ *(a)* 'Trivial' and 'Unimportant' are synonyms and both have the same meaning which means of little value or importance'.

2015 (I)

Directions *(Q. Nos. 65-84) In the following questions, a word is given, capital letters followed by four words. Select the option, that is nearest in meaning to the given word and mark your response on your answer sheet accordingly.*

65. DEPLORE
(a) Lose heart   (b) Entreat
(c) Regret   (d) Malign

⊙ *(c)* The given word 'Deplore' means feel or express strong disapproval of something. So among the given options, 'Regred' is its correct synonym or nearest in meaning to the given word.

66. MOTIVATION
(a) Inducement   (b) Emotion
(c) Ambition   (d) Incitement

⊙ *(a)* 'Motivation' means enthusiasm for doing something. Among the given options, 'Inducement' is the nearest in meaning to the given word as it means a motive or consideration that leads one to action or to additional or more effective actions.

67. RESIDUE
(a) Remainder   (b) Nothing
(c) Recede   (d) Little

⊙ *(a)* The word 'Residue' means a small amount of something that remains after the main part has gone or been taken or used. So, among the options, the word 'Remainder' is its nearest in meaning.

68. PERPETUAL
(a) Perfect   (b) Confused
(c) Never ending   (d) Seasonal

⊙ *(c)* The word 'Perpetual' means never ending or changing. So, option (c) is nearest in meaning to the given word.

69. ASSENT
(a) Climb   (b) Confirm
(c) Answer   (d) Agree

⊙ *(d)* The word 'Assent' means the expression of approval or agreement. So, 'Agree' is the correct word which is nearest in meaning to the given word.

70. DEFIANCE
(a) Insult   (b) Denial
(c) Degradation   (d) Resistance

⊙ *(d)* 'Defiance' means open resistance or behaviour in which your refuse to obey someone or something. Hence, the word 'Resistance' is nearest in meaning to the given word.

71. EMANCIPATE
(a) Liberate   (b) Release
(c) Acquit   (d) Unchain

⊙ *(a)* 'Emancipate' and 'Liberate' both have same meaning, i.e. 'to set free', especially from legal, social or political restrictions.

72. HOSTILITY
(a) Hospitality   (b) Jealousy
(c) Enmity   (d) Envy

⊙ *(c)* The word 'Hostility' means hostile behaviour or unfriendliness or opposition. So, among the given options, 'Enmity' is the nearest meaning word to the given word as it also means a state or feeling of active opposition or hostility.

2014 (II)

73. ASPIRE
(a) Breathe   (b) Stairs
(c) Hope for   (d) Thorn

⊙ *(c)* The word 'Aspire' means direct one's hopes or ambitions towards achieving something. So, among the given options, 'Hope for' is its correct nearest meaning word.

74. SEQUEL
(a) Ending   (b) Beginning
(c) Continuation   (d) Similarity

⊙ *(c)* The word 'Sequel' means a book, film or play that continues the story of a previous book. So, 'Continuation' is its correct nearest meaning word.

75. PERPETUAL
(a) Constant   (b) Real
(c) Mistaken   (d) Painful

⊙ *(a)* The word 'Perpetual' means never ending or never changing. So, among the given options, 'Constant' is the most nearest meaning word to the given word.

76. ASSENT
(a) Despatch   (b) Climb
(c) Flavour   (d) Agreement

⊙ *(d)* The word 'Assent' means the expression of approval or agreement. So, 'Agreement' is the correct word which is nearest in meaning to the given word.

77. DEFIANCE
(a) Attack   (b) Disobedience
(c) Protection   (d) Shyness

⊙ *(b)* 'Defiance' means open resistance or behaviour in which your refuse to obey someone or something. Hence, the word 'Disobedience' is nearest in meaning to the given word.

78. HOSTILITY
(a) Kindness   (b) Enmity
(c) Entertainment   (d) Illness

⊙ *(b)* The word 'Hostility' means hostile behaviour or unfriendliness or opposition. So, among the given options, 'Enmity' is the nearest meaning word to the given word as it also means a state or feeling of active opposition or hostility.

79. INDIFFERENT
(a) Similar   (b) Various
(c) Unconcerned   (d) Shy

⊙ *(c)* The word 'Indifferent' means having no particular interest or sympathy; unconcerned.

80. CONDEMN
(a) Censure   (b) Approve
(c) Qualify   (d) Despair

⊙ *(a)* The word 'Condemn' means censure or express complete disapproval of. So, 'Censure' is its nearest meaning word which also means the same.

81. CONFIDENT
(a) Full   (b) Friendly
(c) Sure   (d) Secret

⊙ *(c)* The word 'Confident' means feeling or showing certainty about something. So, among the given options, 'Sure' is the nearest meaning word.

82. DEFECT
(a) Truth   (b) Deception
(c) Shortcoming   (d) Loss

⊙ *(c)* 'Defect' means 'imperfection, so 'Shortcoming' is its perfect nearest meaning word which also means fault or imperfection.

83. JEALOUS
(a) Envious   (b) Happy
(c) Prisoner   (d) Enthusiastic

⊙ *(a)* The word 'Jealous' means feeling or showing an envious resentment of someone or their achievements. So, among the given options, 'Envious' is the most nearest meaning word to the given word as it also means feeling or showing jealous.

84. TRIP
(a) Journey   (b) Plant
(c) Design   (d) Press

⊙ *(a)* 'Trip' means travelling, so 'Journey' is correct synonym which also means the same.

2014 (I)

Directions (Q. Nos 85-94) *Each item in the following questions consists of a sentence with an underlined word followed by four words. Select the option that is nearest in meaning to the underlined word and mark your response on your answer sheet accordingly.*

85. She is a woman of STERLING qualities.
(a) Interesting   (b) Genuine
(c) Irritating   (d) Exciting

⊙ *(b)* 'Sterling' means genuine or reliable. When used for a person. So, option (b) is the correct answer.

86. Although the boys in his class were naughty, he never resorted to CORPORAL punishment.
(a) Harsh   (b) Physical
(c) Unjust   (d) General

⊙ *(b)* Here 'Corporal punishment' means 'Physical punishment' as corporal means physical or corporal suffering.

87. He wanted to MITIGATE his burdens.
(a) Lessen   (b) Increase
(c) Postpone   (d) Leave

⊙ *(a)* The given underlined word 'Mitigate' means make (something bad) less severe, serious or painful. So, among the given options 'Lessen' is its nearest meaning word as it also means less strong.

88. Shw adjusted quite well with her husbands IDIOSYNCRASIES.
(a) Peculiar habits
(b) Bad habits
(c) Weaknesses
(d) Stupid manners

⊙ *(a)* The given underlined word 'Idiosyncracies' means a mode of behaviour or way of thought peculiar to an individual. So, 'Peculiar' is its most nearest meaning word.

89. The Deputy Inspector General made a PERFUNCTORY inspection of the police station.
(a) Thorough and complete
(b) Superficial
(c) Done as a routine but without interest
(d) Intensive

⊙ *(b)* Here, the underlined word 'Perfunctory' means characterised by routine or superficiality.

So, 'Superficial' is its nearest meaning word among the given options.

90. The decision to drop the atom bomb on Hiroshima was a GRAVE one.
(a) Serious
(b) Momentous
(c) Instinctive
(d) Impulsive

⊙ *(a)* The word 'Grave' mean serious. Hence, option (a) is its nearest meaning word.

91. A scientist generally carries out his investigations EMPIRICALLY.
(a) By intuitively
(b) By verbally
(c) By through written communication
(d) By observation and experiment

⊙ *(d)* The word 'Empirically' means based on observation or experience, not on theory. Hence, option (d) is its nearest meaning word.

92. He is employed in an ORDNANCE factory.
(a) Orthodox
(b) Arms and ammunition
(c) Electrical and electronic
(d) Ordinary and common

⊙ *(b)* The given underlined word 'Ordnance' means military supplies especially weapons and bombs. So, option (b) 'Arms and ammunition' is the nearest meaning word to the given word.

93. He is a SYCOPHANT who tries to win over politicians.
(a) A psychologist
(b) An opportunist
(c) An unscrupulous man
(d) A flatterer

⊙ *(d)* The given underlined word 'Sycophant' means a person who acts obsequiously towards someone in order to gain advantage or a servile self- seeking flatterer. Hence, option (d) is the nearest meaning word.

94. I cannot believe in the VERACITY of his statement.
(a) Truth
(b) Usefulness
(c) Sincerity
(d) Falsity

⊙ *(a)* The word 'Veracity' means the quality of being true or the habit of telling the truth. So, option (a) 'Truth' is its nearest meaning word.

SPOTTING THE ERRORS

Directions (Q. Nos. 1-15) *Each item in this section has a sentence which has multiple parts. Find out the error part from the given option and indicate your response from the options (a), (b), (c) and (d) on the answer sheet.*

1. Experience has shown that the change-over from a closed economy to a mercantile economy has presented in human society innumerable problems.

(a) Experience has shown that
(b) The change over from a closed economy
(c) to a mercantile economy has presented
(d) in human society innumerable problems

⊚ *(d)* In the given sentence, part (d) has an error. 'In' should be replaced by article 'the' to make the sentence grammatically correct.

2. A closed economy is identified as a human community which produces all it consumes and consumed all it produces.

(a) A closed economy is identified
(b) as a human community
(c) which produces all it consumes
(d) and consumed all it produces

⊚ *(d)* Here, part (d) of the given sentence has an error. The word 'consumed' should be replaced with 'consumes' as the whole sentence is in simple present tense.

3. Iron is the most useful against all metals.

(a) Iron is
(b) the most useful
(c) against all metals
(d) No error

⊚ *(c)* Here, part (c) of the given sentence has an error. The word 'against' should be replaced with 'among' because the sentence talks about all metals. 'Among' is for more than two things.

4. Mumbai is largest cotton centre in the country.

(a) Mumbai is
(b) largest cotton centre
(c) in the country
(d) No error

⊚ *(b)* Here, part (b) has an error. Before superlative word 'largest' we should use definite article 'the.'

5. While every care have been taken in preparing the results, the company reserves the right to correct any inadvertent errors at a later stage.

(a) While every care have been taken
(b) in preparing the results
(c) the company reserves the right to correct
(d) any inadvertent errors at a later stage

⊚ *(a)* Here, part (a) has an error. The subject (every care) of the given sentence is singular. So, verb should also be used in singular form. Therefore, we must use 'has been' in place of 'have been' to make the given sentence grammatically correct.

6. My sister and me are planning a trip from Jaipur to Delhi.

(a) My sister and me are
(b) planning a trip
(c) from Jaipur to Delhi
(d) No error

⊚ *(a)* Here, part(a) has an error of pronoun with noun (my sister), use 'I' in place of 'me' to make the given sentence grammatically correct.

7. Despite the thrill of winning the lottery last week, my neighbour still seems happy.

(a) Despite the thrill of winning
(b) the lottery last week,
(c) my neighbour
(d) still seems happy

⊚ *(b)* In the given sentence, part (b) is an erroneous part. Article 'a' should be used in place of 'the' before lottery. Because lottery is a non-specific or non-particular noun and with non-specific or indefinite nouns article 'a' should be used.

8. Children are not allowed to use the swimming pool unless they are with an adult.

(a) Children are not allowed
(b) to use the swimming pool
(c) unless they are with an adult
(d) No error

⊚ *(d)* There is no error. Sentence is grammatically correct.

9. Here knowledge of Indian languages are far beyond the common.

(a) Her knowledge
(b) of Indian languages
(c) are far beyond the common
(d) No error

⊙ *(c)* Here, part (c) has an error. Use 'is' in place of 'verb' are as the subject knowledge is singular, to make the given sentence grammatically correct.

10. The care, as well as the love of a father, were missing in her life.

(a) The care, as well as the love
(b) of a father
(c) were missing in her life
(d) No error

⊙ *(c)* Here, part (c) is an erroneous part. As we know that with singular subject, singular verb should be used. Therefore, 'was' should be used in place of 'were' as the subject of the given sentence (care) is singular.

11. You look as if you have ran all the way home.

(a) you look as if   (b) you have ran
(c) all the way home (d) No error

⊙ *(b)* Here, part (b) has an error. With present perfect verb have, we use third form of verb, so run should be used in place of 'ran' to make the given sentence grammatically correct.

12. The real voyage of discovery consist not in seeking new landscapes, but in having new eyes.

(a) The real voyage of discovery
(b) consist not in seeking new landscapes,
(c) but in having new eyes
(d) No error

⊙ *(b)* Here, part (b) has an error. Write 'consists' in place of 'consist' to make the given sentence correct.

13. No struggle can ever succeeded without women participating side by side with men.

(a) No struggle can ever succeeded
(b) without women participating
(c) side by side with men
(d) No error

⊙ *(a)* Here, part (a) has an error. Remove succeeded and write 'succeed' as sentence is in simple present tense.

14. Education is the passport to the future, for tomorrow belong to those who prepare for it today.

(a) Education is the passport to the future,
(b) for tomorrow belong to those
(c) who prepare for it today
(d) No error

⊙ *(b)* Here, part (b) has an error, 'belongs' should be used in place of 'belong' to make the given sentence grammatically correct.

15. There come a time when you have to choose between turning the page and closing the book.

(a) There come a time
(b) when you have to choose
(c) between turning the page
(d) and closing the book

⊙ *(a)* Here, part (a) has an error. Replace 'there come' with 'there comes' to make the given sentence grammatically correct.

2019 (I)

Directions (Q. Nos. 16-35) *Each item in this section has a sentence with three parts labelled as (a), (b) and (c). Read each sentence to find out whether there is any error in any part and indicate you response on the answer sheet against the corresponding letter i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d)*

16. Except for few days(a)/in a year during the monsoon(b)/ the river cannot flow on its own.(c)/ No error.(d)

⊙ *(b)* There is no error, sentence is grammatically correct.

17. Being apprised with our approach (a)/ the whole neighbourhood (b)/ came out to meet the minister.(c)/ No error(d)

⊙ *(a)* Here, in part (a) 'of' should be used in place of 'with' because the word 'apprised' is followed by preposition 'of'.

18. The celebrated grammarian Patanjali(a)/ was(b)/ a contemporary to Pushyamitra Sunga.(c)/No error(d)

⊙ *(c)* Here, remove 'to' and use 'of' before pushyamitra to make the given sentence grammatically correct.

19. His appeal for funds(a)/ met(b)/ a poor responses. (c)/ No error (d)/

⊙ *(b)* Here, in part(b) 'met with' should be used in place of 'met' to make the given sentence grammatically correct.

20. Buddhism teaches that(a)/ freedom from desires(b)/ will lead to escape suffering. (c)/ No error (d)

⊙ *(c)* Write 'from' between escape and suffering to make the given sentence grammatically correct.

21. This hardly won liberty(a)/ was not to be (b)/ lightly abandoned. (c)/ No error (d)

⊙ *(a)* Here use of adverb hardly is incorrect. It should be 'This hard' won liberty to make the sentence grammatically correct.

22. My friend said(a)/ he never remembered(b)/ having read a more enjoyable book.(c)/ No error(d)/

(d) No error, the sentence is grammatically correct.

23. With a population of over one billion, (a)/ India is second most popular country(b)/ in the world ofter China.(c)/ No error(d)

⊙ *(b)* Here, article 'the' should be used before second as 'most' is the superlative degree word. Before superlative degree, use of 'the' is must.

24. There are hundred of superstitions(a)/ which survive(b)/ in the various parts of the country. (c)/ No error. (d)

(d) There is no error in the sentence as it is grammatically correct sentence.

25. It is(a)/ in the temperate countries of Northern Europe(b)/ that the beneficial effects of cold is most clearly manifest.(c)/ No error(d)

⊙ *(c)* With plural noun 'effects' verb 'are' should be used in place of 'is' to make the given sentence grammatically correct.

26. The effects of female employment(a)/ on gender equality(b)/ now appear to be trickling at the next generation. (c)/No error(d)

⊙ *(c)* Here in part (c) preposition 'to' is used in place of 'at' after the word 'trickling' to make the given sentence correct.

27. Since the 15 minutes that she drives,(a)/ she confesses that she feels like(b)/ a woman with wings.(c)/ No error(d)

⊙ *(a)* Remove 'since' and use 'in' here. Use of since is incorrect according to the given syntax.

28. India won(a)/ by an innings(b)/ and three runs.(c)/No error(d)

⊙ *(d)* The sentence has no error .

29. Each one(a)/ of these chairs(b)/ are broken.(c)/ No error(d)

⊚ *(c)* Here, in part (c) singular verb 'is' should be used in place of 'are' because the subject of the sentence (Each one) is singular, so verb also be used in singular form.

30. Few creature(a)/ outwit(b)/ the fox in Aesop's Fables.(c)/ No error(d)

⊚ *(a)* Here, in part(a) 'Few creatures' should be used in place of 'Few creature' to make the given syntax correct.

31. Anywhere in the world(a)/ when there is conflict(b)/ women and children suffer the mos.(c)/No error(d)

⊚ *(b)* For place, 'where' should be used instead of 'when'. So, here in part (b) replace 'when' with 'where' to make the given sentence grammatically correct.

32. The man is(a)/ the foundational director (b)/ of this company.(c)/ No error(d)

⊚ *(b)* Here, in part (b) of the given sentence, article 'a' will be used in place of 'the' before 'foundational' to make the sentence more appropriate.

33. Parents of LGBT community members(a)/ are coming in(b)/ with a little help from NGOs.(c)/ No error(d)

⊚ *(b)* Here, 'coming in' should be replaced with 'coming up' to make the given syntax correct.

34. To love one art form is great(a)/ but to be able to appreciate another(b)/ and find lateral connections are priceless.(c)/No error(d)

⊚ *(d)* There is no error and the sentence is grammatically correct.

35. Female literacy rate has gone up by11%(a) in the past decade as opposed to(b)/ a 3% increase in male literacy.(c)/No error(d)

⊚ *(c)* Write 'literacy rate' in place of 'literacy' to make the sentence meaningfully and grammatically correct.

2018 (II)

Directions. (Q. Nos. 36-45) *Each item in this section has a sentence with three parts labelled as (a), (b) and (c) Read each sentence to find out whether there is any error in any part and indicate your response on the answer sheet against the corresponding letter i.e., (a), (b), (c). If you find no error, your response should be indicated as (d).*

36. The letter has been written(a)/ I insist on(b)/ it being sent at once.(c)/No error(d)

⊚ *(c)* 'Insist on' is supposed to be followed by an immediate gerund i.e. V_1 + ing Moreover, active voice is required here. Hence, 'sending it at once' should be used in part (c), in place of it being sent at once.

37. "I'm tired of my boys," said the mother,(a)/ " Both of them keep quarreling all the time(b)/ right now also they are quarreling with one another."(c)/No error(d)

⊚ *(c)* Use 'each other' in place of 'one another'. As the clause 'both of them' in part (b) deduces that number of boys is two and for two persons, we use 'each other.'

38. Sherly wants to known(a)/ whether you are going(b)/ to Delhi today night.(c)/No error(d)

⊚ *(c)* Here, 'today night' is not correct. We must write 'tonight' in place of 'today night' that means approaching evening or night.

39. The visitor's to the zoo are requested,(a)/ in the interest of all concerned,(b)/ not to carry sticks, stones or food inside and not to tease animals.(c)/No error(d)

⊚ *(a)* Here, in part (a) of the given sentence, replace possessive noun 'visitors' with concrete noun 'visitor's' to make the given sentence grammatically correct.

40. The legendary hero(a)/ laid down his precious life(b)/ for our country.(c)/No error(d)

⊚ *(d)* There is no error and given sentence is grammatically correct.

41. Our gardener, which is very lazy,(a)/ says that(b)/ there will be no apples this year.(c)/No error(d)

⊚ *(a)* Here, in part (a) use of 'which' pronoun is incorrect. Use 'who' for gardener. 'Who' is generally used to refer to people where as 'which' is used to refer to animals or things.

42. When I asked the guest(a)/ what she would like to drink(b)/ she replied that she preferred coffee much more than tea.(c)/No error(d)

⊚ *(c)* Here, in part (c) replace 'much more than tea' with 'much more to tea' 'prefer' takes preposition 'to' with it. The word prefer means more liking to a particular thing.

43. No sooner did I reached there(a)/ the children left the place(b)/ with their parents.(c)/No error(d)

⊚ *(*)* The question is incorrect in itself as there are two errors in the same question. Firstly, 'No sooner did I reach' is needed to be replaced with 'No sooner did I reached' as No sooner / hardly / scarcely + did + subject + base form of the verb is used. Secondly, such sentences beginning with No sooner, hardly, scarcely etc. take 'perfect form of tense'. Hence 'the children left the place' is needed to be replaced with 'the children had left the place'.

44. I did not want to listen to him,(a)/ but he was adamant(b)/ and discussed about the matter.(c)/No error(d)

⊚ *(c)* Here, use of preposition 'about' after discussed in part (c) is not correct, remove it. The word 'discussed' itself means to talk about something.

45. Please note(a)/ that the interview for the post(b)/ shall be held on 15th June, 2019 between 10.00 a.m. to 2.00 p.m.(c)/No error(d)

⊚ *(c)* Here, in part (c) use of 'shall' is incorrect here. As interview is singular in form, it should be replaced by 'will be held' to make the given sentence grammatically correct.

2018 (I)

Directions (Q. Nos. 46-65) *Each item in this section has a sentence with three parts labelled (a), (b), and (c). Read each sentence to find out whether there is any error in any part and indicate your response on the answer sheet against the corresponding letter i.e (a) or (b) or (c). If you find no error, your response should be indicated as (d).*

46. The best way in which you can(a)/ open the bottle is(b)/ by putting it into hot water first.(c)/ No error(d)

⊙ (*a*) Here, replace preposition 'in' with 'by' after 'way' to make the given syntax correct.

47. Somebody(a)/ who I enjoy reading(b)/ is Tagore.(c)/ No error(d)

⊙ (*b*) Here, 'whom' will be used in place of 'who' in part(b) to make the given sentence grammatically correct.

48. Electricity companies are(a)/ working throughout(b)/ days and nights to repair the damage.(c)/ No error(d)

⊙ (*b*) Delete 'throughout' from the given sentence as it is superfluous with days and nights.

49. The students(a)/ test results(b)/ were pleasant.(c)/ No error(d)

⊙ (*d*) There is no error in the given sentence and if it grammatically correct

50. Two thirds of the book(a)/ were(b)/ rubbish.(c)/ No error(d)

⊙ (*b*) 'Was' will be used in place of 'were' as subject of the sentence is singular as two-thirds represents a part of whole.

51. You will be(a)/ answerable for the court with(b)/ any lies you have told.(c)/ No error(d)

⊙ (*b*) Use preposition 'to' in place of 'for' after the word 'answerable', as 'answerable' is always followed by preposition 'to'.

52. She felt(a)/ terribly anxious for have to sing(b)/ in front of such a large audience.(c)/ No error(d)

⊙ (*b*) Use 'about singing' in place of 'for have to sing' to make the sentence correct. The word 'anxious' is used about something or for someone.

53. I don't agree(a)/ with smacking children(b)/ if they do something wrong.(c)/ No error(d)

⊙ (*d*) There is no error and the sentence is grammatically correct.

54. The fruit(a)/ can be made(b)/ to jam.(c)/ No error(d)

⊙ (*c*) Here, in part (c) Replace the preposition 'to' with 'into' to make the sentence correct and meaningful.

55. I asked him(a)/ what he(b)/ has done.(c)/ No error(d)

⊙ (*c*) 'Has done' should be replaced with 'had done' to make the given syntax correct.

56. There have been a tornado watch(a)/ issued for Texas country(b)/ until 11 O' clock tonight.(c)/ No error(d)

⊙ (*a*) Here, in part (a) Replace 'have' with 'has' as the subject of the verb is singular to make the given sentence grammatically correct.

57. Although the Red Cross accepts blood from the donors(a)/ the nurses will not leave you give blood(b)/ if you have just had cold.(c)/ No error(d)

⊙ (*b*) Here, in part (b) Replace 'leave' with 'let' to make it correct and meaningful.

58. A prism is used to refract white light(a)/ so it spreads out(b)/ in a continuous spectrum.(c)/ No error(d)

⊙ (*b*) Here, in part (b) 'so that it' will be used in place of 'so it' to make the given sentence grammatically correct and meaningful.

59. Because of the movement of a glacier(a)/ the form(b)/ of the Great Lakes was very slow.(c)/ No error(d)

⊙ (*b*) According to the given sentence, in part (b) 'forming' will be used in place of 'form' to make the given sentence grammatically correct.

60. The new model costs(a)/ twice more than(b)/ last year's model.(c)/ No error(d)

⊙ (*b*) Use 'as much as' in place of 'more than' to make the sentence correct and meaningful.

61. Gandhi ji always regretted for the fact(a)/ that people gave him adulation while what he wanted (b)/ was acceptance of his way of life.(c)/ No error(d)

⊙ (*a*) Here, remove 'for' before the fact to make the given sentence correct.

62. The party(a)/ was ousted in power(b)/ after twelve years.(c)/ No error(d)

⊙ (*b*) Replace preposition 'in' with 'from' to make the sentence correct. As the word 'ousted' is followed by preposition 'from'.

63. He was(a)/ held in(b)/ the prevention of terrorism act.(c)/ No error(d)

⊙ (*b*) Use 'under' in place of 'in' after held to make the given sentence meaningfully correct.

64. He has great fascination(a)/ for each and everything(b)/ that are connected with drama.(c)/ No error(d)

⊙ (*c*) Here, use 'is' in place of 'are' before the word 'connected' as 'each and every thing' is considered as singular subject.

65. It's no secret(a)/ that the President wants to(b)/ have a second term of office.(c)/ No error(d)

⊙ (*d*) There is no error and the sentence is grammatically correct.

2017 (II)

Directions (Q. Nos. 66-90) *Each item in this section with three parts labelled (a), (b) and (c). Read each sentence to find out whether there is any error in any part and indicate your response in the Answer Sheet against the corresponding letter i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d).*

66. It is identification with the audience (a)/ that makes one come home from the play so much more(b)/satisfied ever is after merely passive enjoyment of the show.(c) No error(d)

⊙ (*c*) Here, in part (c) of the given sentence 'mere' should be used in place of 'merely'. Mere is used to emphasize how small or insignificant someone or something is and it is correct according to given syntax.

67. CV Raman was one of the greatest sons of India(a)/ who has earned everlasting fame(b)/ for scientific researches.(c)/ No error(d)

⊙ *(b)* 'Has' should be removed from part (b) of the sentence to make it grammatically correct.

68. This box(a)/ is heavy than(b)/ the other one.(c)/ No error(d)

⊙ *(b)* Here, 'heavy' should be replaced by 'heavier' as the comparison is made between two boxes.

69. The writer does not have the freedom(a)/ to choose his own themes,(b)/ society thrusts them on him.(c)/ No error(d)

⊙ *(a)* Here, in part (a) of the given sentence, 'A writer' will be used in place of 'The writer' because here 'writer' is not specific or definite, so article 'a' is more appropriate.

70. No one knows(a)/ as to why he did it.(b)/ or who was behind his doing it.(c)/ No error(d)

⊙ *(d)* There is no error and the sentence is grammatically correct.

71. How long(a)/ you are(b)/ in this profession?(c)/ No error(d)

⊙ *(b)* Here, in part (b) 'You are' should be changed to 'have you been' to make the sentence grammatically correct.

72. I know that(a)/ ignorance is not bliss(b)/ yet I am ignorant in many things.(c)/ No error(d)

⊙ *(c)* Here, in part (c) 'In' should be changed to 'of' to correct the sentence and to make it grammatically correct.

73. You are(a)/ just sixteen years old,(b)/ isn't it?(c)/ No error(d)

⊙ *(c)* Here, 'isn't it' is the wrong question tag. The correct question tag that should be used here is 'aren't you' because the subject of the sentence is 'you are'.

74. The old widower,(a)/ living in remittances from his sons, (b)/ could not make both ends meet.(c)/ No error(d)

⊙ *(b)* Here 'living' on' should be used in place of 'living in' to correct the given sentence.

75. Debate about biotechnology(a)/ and genetic engineering is under way around the world,(b)/ and India is fully engrossed with the discussion.(c)/ No error(d)

⊙ *(c)* Here, in part (c) 'With' should be changed to 'in' because the word 'engrossed' followed by preposition 'in'.

76. I like to(a)/ listen the song of the nightingale(b)/ in the evening.(c)/ No error(d)

⊙ *(b)* Here, 'To' should be added after 'listen' in part (b) to make the sentence grammatically correct and meaningful.

77. Each student(a)/ from amongst the hundred students in the class(b)/ want to watch this movie.(c)/ No error(d)

⊙ *(c)* 'Want' should be changed to 'wants' to correct the sentence grammatically as 'Each' takes a singular verb.

78. Although there is virtually no production in India, (a)/ the Encyclopaedia Britannica estimate(b)/ that India has perhaps the largest accumulated stocks of silver in the world. (c)/ No error(d)

⊙ *(b)* 'Estimates' should be used in place of 'estimate' to make the sentence grammatically correct.

79. We have to reach(a)/ there at ten(b)/ will you please walk little faster.(c)/ No error(d)

⊙ *(c)* 'Little' means a negligible quantity. So, a little should be used here before the word 'faster' to convey the correct meaning.

80. It is almost difficult,(a)/ in case impossible (b)/ to keep awake late after dinner.(c)/ No error(d)

⊙ *(b)* Here, in part (b) 'In case' should be replaced by 'even' to make the given sentence correct and meaningful.

81. What most students need, above all else(a)/ is practice in writing(b)/ and particularly in writing things that matter to them.(c)/ No error(d)

⊙ *(d)* There is no error and the sentence is grammatically correct.

82. She was out of the mind,(a)/ when she made that plan to go abroad(b)/ without taking into consideration her present family position.(c)/ No error(d)

⊙ *(a)* Here, in part (a) 'out of her mind' should be used in place of 'out of the mind'. As, 'Out of your mind' is the correct phrasal verb which means unable to behave or deal with things normally because something has made you very worried or unhappy.

83. Are you(a)/ through with(b)/ that newspaper?(c)/ No error(d)

⊙ *(d)* There is no error and the sentence is grammatically correct.

84. My college(a)/ is besides(b)/ the lake.(c)/ No error(d)

⊙ *(b)* 'Beside' should be used in place of 'besides' to correct the sentence. As Beside means nearby, at the side of and Besides means in addition to.

85. The Department of Fine Arts has been criticised(a)/ for not having much required courses(b)/ Scheduled for this semester.(c)/ No error(d)

⊙ *(b)* Here, in part (b) 'Many' should be replaced with 'much' to make the given sentence grammatically correct.

86. If you have thought about the alternatives,(a)/ you would not have chosen(b)/ such a difficult topic for the term paper.(c)/ No error(d)

⊙ *(a)* Part (a) should be 'Had you thought about the alternatives' to make the sentence grammatically correct.

87. The duties of the secretary are to take the minutes,(a)/ mailing the correspondence,(b)/ and calling the members before meeting.(c)/ No error(d)

⊙ *(b)* Here, 'To take' should be replaced by 'taking' to make the sentence grammatically correct.

88. If I was you,(a)/ I would not go to film(b)/ in my mother's absence.(c)/ No error(d)

⊙ *(a)* Here, 'was' should be changed to 'were', in conditional sentences, 'were' should be used.

89. Those of us who have a family history of heart disease(a)/ should make a yearly appointment(b)/ with their doctors(c)/ No error(d)

⊙ *(c)* Here, 'A' should be replaced by 'an' to make the sentence grammatically and contextually correct.

90. The old furniture's(a)/ was disposed of(b)/ and the new ones were placed.(c)/ No error(d)

⊙ *(a)* 'Furniture's is incorrect usage as it is not the name of a person or place. So, we would use 'furniture' in place of that to make the sentence correct.

2017 (I)

Directions (Q. Nos. 91-116) *Each question in this section has a sentence with three parts labelled as (a), (b) and (c). Read each sentence to find out, whether there is any error in any part and indicate your response against the corresponding letter i.e., (a) or (b) or (c). If you find no error, your response should be indicated as (d).*

91. I waited(a)/ for her return(b)/ with growing unease(c)/ No error(d)

⊙ *(b)* 'For here return' will be replaced by 'for her to return'.

92. I do not understand why(a)/ in spite of my best efforts to please him(b)/ my boss is so angry at me.(c)/ No error(d)

⊙ *(c)* 'My boss is so angry at me' will be replaced by 'my boss is so angry with me', to make the given syntax correct.

93. Being a rainy day(a)/, we did not feel like going out or doing anything(b)/ except playing chess in our room.(c)/ No error(d)

⊙ *(a)* Here, 'Being a rainy day', will be replaced by 'It being a rainy day' to make the given syntax correct.

94. It is not difficult to believe that a man(a)/ who has lived in this city for a long time(b)/ he will never feel at home anywhere else in the world(c)/ No error(d)

⊙ *(c)* Here, in part (c) remove 'he' before 'will' to make the given sentence grammatically correct.

95. Although we reached his house on time(a)/ he was left(b)/ for the airport.(c)/ No error(d)

⊙ *(b)* Write in part (b) here, 'he had already left' in place of 'he was left' to make the given sentence grammatically correct.

96. If a thing(a)/ is wroth doing at all(b)/ it is worth done well.(c)/ No error(d)

⊙ *(c)* Here, in part (c), 'It is worth doing well' replace 'it is wroth done well', to make the given sentence grammatically correct.

97. All the boys(a)/ returned back home(b)/ well in time for lunch.(c)/ No error(d)

⊙ *(b)* Here, in part (b) 'returned back home' will be replaced by 'returned home'. The use of 'back' is superfluous here.

98. Tell me the name(a)/ of a country where every citizen is law-abiding (b)/ and no trouble is there.(c)/ No error(d)

⊙ *(c)* Here, in part (c) 'and no trouble is there' will be replaced by 'and there is no trouble', to make the given syntax correct.

99. Considering about these facts(a)/ the principal has offered(b)/ him a seat.(c)/ No error(d)

⊙ *(a)* Here, the starting of the sentence is 'Considering these facts' not 'Considering about these facts'. Here, the use of 'about' after 'considering' is superfluous.

100. His friends feel that(a)/ he will be suspended(b)/ unless he does not report for duty immediately.(c)/ No error(d)

⊙ *(c)* Here, in part (c) 'unless he does not report for duty immediately' will be replaced by 'unless he reports for duty immediately', to make the given sentence grammatically correct.

(c) RPQS is the correct sequence.

101. One of the most interesting feature of travel in Himachal Pradesh is(a)/ the large nubmer of travellers' lodges(b)/ provided by the State Government.(c)/ No error(d)

⊙ *(a)* Here, in part (a), the word 'feature' will be replaced by 'features' to make the given sentence grammatically correct.

102. It(a)/ was raining(b)/ cats and dogs(c)/ No error(d)

⊙ *(d)* There is no error, in the sentence and the, sentence is grammatically correct.

103. I prefer(a)/ this book(b)/ than that one.(c)/ No error(d)

⊙ *(c)* 'To that one' will replace 'than that one', as the word 'prefer' is followed by preposition 'to'.

104. Their belongings(a)/ were lost(b)/ in the fire.(c)/ No error(d)

⊙ *(d)* The sentence is correct. No error.

105. Tell him to take(a)/ another photograph(b)/ of the group.(c)/ No error(d)

⊙ *(d)* This sentence is grammatically correct.

106. I courteously asked him(a)/ where was he going(b)/ but he did not reply.(c)/ No error(d)

⊙ *(b)* Here, in part (b) 'where was he going' will be replaced by 'where he as going', to make the given sentence grammatically correct.

107. The memoranda(a)/ are(b)/ on the table.(c)/ No error(d)

⊙ *(d)* No error. This sentence is grammatically correct.

108. Nandita asked me(a)/ if I was working(b)/ hardly these days.(c)/ No error(d)

⊙ *(c)* Here, in part (c) the use of adverb 'hardly' is inappropriate, according to the given sentence. So, it will be replaced by 'hard' to make the sentence grammatically correct.

109. He couldn't(a)/ find(b)/ an answer.(c)/ No error(d)

⊙ *(d)* This sentence is grammatically correct.

110. Whom you think(a)/ will be dismissed(b)/ first?(c)/ No error(d)

⊙ *(a)* 'Whom you think' will be replaced by 'Whom do you think' as 'Whom' is used as the object of a verb or preposition.

111. Of the many problems that confront the leaders of the world(a)/ none are of grave consequence (b)/ than the problem of saving the normal human race from extinction.(c)/ No error(d)

⊙ *(b)* Here, in part (b) 'none are of grave consequence' will be replaced by 'none is of grave consequence'. When 'none' is followed by 'of', use a singular verb not plural.

112. All of them(a)/ can speak(b)/ good English. (c)/ No error(d)

⊙ *(a)* Here, in part (a) 'All of them' will be replaced by 'Each of them'.

113. The peon(a)/ has not sweeped(b)/ the floor today.(c)/ No error(d)

⊙ *(b)* Here, in part (b) 'has not swept' will replace 'has not sweeped', to make the given syntax correct.

114. Her parents(a)/ has not permitted her(b)/ to marry Sunil.(c)/ No error(d)

⊙ *(b)* Here, in part (b), 'has not permitted her' will be replaced by 'have not permitted her' to make the given syntax correct.

115. Emperor Ashoka(a)/ have conquered Kalinga(b)/ before he embraced Buddhism.(c)/ No error(d)

⊙ *(b)* Here, in part (b) 'have conquered Kalinga', will be replaced by 'had conquered Kalinga' as the subject of the sentence is in singular form.

116. Every student(a)/ should be asked(b)/ to give their ideas on the subject.(c)/ No error(d)

⊙ *(c)* Here, in part (c) 'to give their ideas on the subject' will be replaced by 'to give his ideas on the subject, to make the given syntax correct.

2016 (II)

Directions (Q. Nos. 117-231) *Each questions in this section has a sentence with three parts labelled (a), (b) and (c). Read each sentence to find out whether there is any error in any part and indicate your response against the corresponding letter i.e. (a) or (b) or (c). If you find no error, your response should be indicated as (d).*

117. I am senior(a)/ than him(b)/ by two years.(c)/ No error(d)

⊙ *(b)* The word 'senior' is usually used with the preposition 'to'. So 'to' will be used in place of 'than' in part (b) of the given sentence.

118. When I finished writing the letter(a)/, I could not help admiring myself(b)/ to have achieved the impossible.(c)/ No error(d)

⊙ *(c)* In the given sentence, of part (c) 'for achieving' should be used in place of 'to have achieved', to make the correct.

119. I am(a)/ glad(b)/ that you are here.(c)/ No error(d)/

⊙ *(d)* The given sentence is grammatically correct.

120. He will be(a)/ cured from(b)/ his fever.(c)/ No error(d)

⊙ *(b)* Since 'cured' is followed by the preposition 'of', 'cured from' as used in the sentence, is wrong. Hence, 'from' will be replaced by 'of'.

121. Though he is a gifted comedian, (a)/ he prefers spend his spare time(b)/ watching horror movies.(c)/ No error(d)

⊙ *(b)* Here, in part (b) the verb 'spend' used in the sentence should be substituted with 'spending', to make the given syntax correct.

122. The writer(a)/ of this poetry(b)/ is Wordsworth.(c)/ No error(d)

⊙ *(b)* In this sentence, the word 'poetry' should be replaced with 'poem' according to the given syntax.

123. The jug(a)/ is made(b)/ out of China clay.(c)/ No error(d)

⊙ *(c)* Here, in part (c) the correct sentence is 'the jug is made of China clay'. Thus, 'out' is to be omitted from the sentence.

124. Sita(a)/ with all her sisters(b)/ were here.(c)/ No error(d)

⊙ *(c)* Here, the words joined to a singular subject by 'with' are parenthetical. Thus, the verb 'were' should be put in the singular as 'was', to make the given sentence grammatically correct.

125. As you know(a)/ that the ignorant(b)/ are easily duped.(c)/ No error(d)

⊙ *(d)* There is no error and the sentence is grammatically correct.

126. Pay attention(a)/ to what(b)/ I am saying.(c)/ No error(d)

⊙ *(d)* The sentence is grammatically correct.

127. One of the assistant(a)/ was(b)/ Alfred.(c)/ No error(d)

⊙ *(a)* Here, the word assistant should be used in the plural form because the phrase 'one of the' agrees to a plural noun. So, 'one of the assistants'.

128. Though George is a (a)/ honourable man his activities(b)/ arouse suspicion.(c)/ No error(d)

⊙ *(a)* Here, 'a' should be replaced with 'an' because 'honourable' gives a vowel sound.

129. She told her teacher(a)/ that she could not be able to attend the class(b)/ the previous day because of heavy rains.(c)/ No error(d)

⊙ *(b)* Here, could expresses only ability to do an act, but not performance of the act. Therefore, we should use 'was not able' for ability + action in the past.

130. Coleridge as well as Wordsworth were(a)/ of the opinion that the opposite of poetry(b)/ is not rose but science.(c)/ No error(d)

⊙ *(a)* The words joined to a singular subject by 'as well as' are parenthetical. Thus, the verb 'were' as used in the sentence should be put in the singular as 'was', to make the given syntax correct.

131. He was courted arrest(a)/ in order to protest against corruption(b)/ among the government servants.(c)/ No error(d)

⊙ *(a)* Here, in part (a) remove 'was' before the word 'courted' as the use of 'was' is superfluous here. 'He courted arrest' is the correct system.

132. Mr. Joshi was, however, sure(a)/ that the idea would never work(b)/ in practice.(c)/ No error(d)

⊙ *(d)* The sentence is grammatically correct.

133. As I was leaving for Delhi(a)/ he asked me whether(b)/ I could buy a tape recorder for him.(c)/ No error.(d)

⊙ *(d)* The sentence is grammatically correct.

134. The boy's parents(a)/ pleaded with the Principal(b)/ that they were too poor to pay his tuition fee.(c)/ No error(d)

⊙ *(d)* The sentence is grammatically correct.

135. For young Donald,(a)/ peace in Vietnam(b)/ was almost terrible as war.(c)/ No error(d)

⊙ *(c)* In the given sentence, 'peace' has been compared to 'war'. Thus, we should use 'almost as terrible as war', to make the given syntax correct.

136. That Brutus, who was his trusted friend(a)/ had attacked on him(b)/ caused heartbreak to Julius Caesar.(c)/ No error(d)

⊙ *(b)* The given part (b) of the sentence is grammatically wrong, as the verb 'attack' is not followed by any preposition and should be used directly without 'on'. 'Had attacked him' as the correct syntax.

2016 (I)

137. This hardly won freedom(a)/ should not be lost(b)/ so soon.(c)/ No error(d)

⊙ *(a)* Here, in part (a) 'Hardly' should be replaced by 'hard' as hardly shows negativity.

138. I tried to meet the person(a)/ whom you said(b)/ was looking for me.(c)/ No error(d)

> (*b*) 'Who' should replace 'whom' in the sentence as 'who' represents nominative case and 'whom' is used for objective case.

139. We looked after the thief(a)/ but he was nowhere(b)/ to be found.(c)/ No error(d)

> (*a*) 'Looked after' is not to be used for 'thief' here 'looked' should be followed by 'for', to make the given syntax correct.

140. I hoped that the train(a)/ will arrive on time,(b)/ but it did not.(c)/ No error(d)

> (*b*) Here, in part (b) 'will' should be replaced by 'would' as the sentence is in past tense future tense is being indicated by 'will' and 'would' is the past form of 'will'.

141. Their all belongings(a)/ were lost(b)/ in the fire.(c)/ No error(d)

> (*a*) 'All' will come before 'their', to make the sentence grammatically correct.

142. He was in the temper(a)/ and refused.(b)/ to discuss the matter again.(c)/ No error(d)

> (*a*) Here, in part (a) 'the' should be removed before 'temper' as 'temper' is an abstract noun and abstract noun is not used with articles.

143. The decorations in your house(a)/ are similar(b)/ to his house.(c)/ No error(d)

> (*c*) In part (c), 'to that of his house' (Case of Attribute) should be used in the sentence, to make the given syntax correct.

144. Despite of the increase in air fares,(a)/ most people still prefer(b)/ to travel by plane.(c)/ No error(d)

> (*a*) 'Of' should be removed in part (a) of the given sentence as 'despite' is not followed by a preposition.

145. He told the boys that(a)/ if they worked hard,(b)/ they will surely pass.(c)/ No error(d)

> (*c*) In part (c), 'will' should be replaced with 'would' as the reporting verb is in past tense.

146. I shall write(a)/ to you(b)/ when I shall reach Chennai.(c)/No error(d)

> (*c*) 'Shall' should be removed from part (c) of the given sentence because when the condition is in present tense then result should be in future tense.

147. Neither of these two documents(a)/ support your claim(b)/ on the property.(c)/ No error(d)

> (*b*) Here, in part (b) of the given sentence 'supports' should be used in place of 'support' as the subjective case (Neither) is singular.

148. He is school teacher,(a)/ but all his sons(b)/ are doctors.(c)/ No error(d)

> (*a*) In part (a) of the given sentence, 'Article a' should be used before 'school teacher' as a countable noun is always preceded by an article.

149. His grandfather(a)/ had told him the to smoke(b)/ was a bad habit.(c)/ No error(d)

> (*b*) In part (b) 'to smoke' should be replaced by 'smoking' because here, use of gerund is more appropriate than infinitive.

150. My book, which(a)/ I gave it to you yesterday,(b)/ is very interesting.(c)/ No error(d)

> (*b*) Here, 'It to' should be removed from the given sentence to make it grammatically correct.

151. I am entirely agreeing with you(a)/ but I regret(b)/ I can't help you.(c)/ No error(d)

> (*a*) 'Agreeing' is wrong form of 'agree', so it should be replaced with 'agree'. Also, 'am' is inappropriate. I entirely agree with you, but I regret I can't help you is the correct sentence.

2015 (II)

152. Of all those involved(a)/ with the accident(b)/ none was seriously injured.(c)/ No error(d)

> (*b*) According to the context of the sentence, in part (b) 'with' should be replaced by 'in'.

153. Radar equipments(a)/ that is to be used(b)/ for ships must be installed carefully.(c)/ No error(d)

> (*a*) Here, in part (a), the use of word 'equipments' is incorrect. It should be 'equipment' because we cannot add 'S' is it to make it plural as it is remain constant in both singular and plural form.

154. New types of electrical circuits(a)/ has been developed(b)/ by our engineers.(c)/ No error(d)

> (*b*) Here, in part (b) 'has' should be replaced by 'have' as the subject of the verb is plural.

155. Recently I visited Kashmir(a)/ and found the sceneries(b)/ to be marvellous.(c)/ No error(d)

> (*b*) Here, in part (b) 'sceneries' is wrong in this sense as 'scenery' is always used as it is in both singular and plural form.

156. It is of primary importance(a)/ in swimming to learn(b)/ to breathe properly.(c)/ No error(d)

> (*a*) Here, in part (a) 'utmost' should be used in place 'primary' as the importance of breathing is always most important rather than primary or secondary.

157. When the party was over,(a)/ he looked around for the girl(b)/ who had come with him.(c)/ No error(d)

> (*d*) The sentence is grammatically correct.

158. After we were driving for miles(a)/ on the winding road(b)/ I was suddenly sick.(c)/ No error(d)

> (*a*) Here, in part (a) use 'we had driven for miles' in place of 'we were driving for miles' to make the sentence grammatically correct.

159. The forecast was for fair(a)/ and warm weather(b)/ and the day dawned dark and chill.(c)/ No error(d)

> (*c*) Here, in part (c) 'and' should be replaced by 'but' to make the given sentence grammatically correct is the sentence has two contradictory statements.

160. To write, to speak or to act(a)/ seems(b)/ very easy.(c)/ No error(d)

> (*a*) Here, 'or' should be replaced by 'and' because 'to write, to speak and to act' is the combination of actions that happens together.

161. I have not had tea(a)/ since(b)/ two days.(c)/ No error(d)

> (*b*) In part (b) 'since' should be replaced by 'for' because 'two days' defines the time period.

162. Beside(a)/ his mother he has two aunts(b)/ who stay with him.(c)/ No error(d)

⊘ *(a)* 'Beside' should be replaced by 'besides' because 'beside' means next to and 'besides' means except or in addition to, which is suitable to given context.

163. This photograph(a)/ appears to be(b)/ the best of the two.(c)/ No error(d)

⊘ *(c)* Here, in part (c) 'the best' should be replaced by the 'better' because there is a comparison between two objects (photographs) not more than two.

164. Either the operator(a)/ or the foreman are(b)/ to be blamed for the accident.(c)/ No error(d)

⊘ *(b)* Here, in part (b) 'are' should be replaced by 'is' because conjunction 'either or' connects two subjects, but the verb depends on the nearer subject. Here 'foreman' is nearer subject which is singular.

165. The article offers(a)/ good advice to(b)/ whomever must accept it.(c)/ No error(d)

⊘ *(c)* 'Whomever must accept it' should be replaced by 'those who accept it' as 'must' shows the compulsion which is wrong to use in this context.

166. She dislikes(a)/ you being most organised(b)/ rewritten than she is.(c)/ No error(d)

⊘ *(b)* In part (b) use 'you for being more organised' in place of 'you being most organised' because use of 'than' indicates that comparative degree is required here.

2015 (I)

167. The reason for(a)/ his failure is because(b)/ he did not work hard.(c)/ No error(d)

⊘ *(b)* Use of 'because' is superfluous here as starting of the sentence is with 'the reason' so using 'because' is improper here according to the given context.

168. Food as well as water(a)/ is necessary (b)/ for life.(c)/ No error(d)

⊘ *(d)* The sentence is grammatically correct.

169. India is larger than(a)/ any democracies(b)/ in the world.(c)/ No error(d)

⊘ *(b)* Here, use 'any other democracy'. Saying just 'any democracies' meant for India also which is not suitable according to the given context.

170. The Judge heard the arguments(a)/ of the lawyers and found(b)/ that the boy was innocent.(c)/ No error(d)

⊘ *(b)* Here, in part (b) replace 'lawyers' by 'lawyer' as there is no need to use it in plural form, to make the given syntax correct.

171. I have lived(a)/ in Delhi(b)/ from 1965.(c)/ No error(d)

⊘ *(c)* According to the given sentence, use 'since' in place of 'from'.

172. All scientists agree(a)/ that there should be(b)/ a total ban on nuclear explosions.(c)/ No error(d)

⊘ *(c)* In part (c) replace 'total' by 'complete'. 'Total' is used to show the sum of individual but 'complete' means 'thorough'.

173. Such books(a)/ which you read(b)/ are not worth reading.(c)/ No error(d)

⊘ *(a)* In part (a) of the given sentence replace 'such' by 'the'. 'Such' is used with the noun that has already been stated earlier for a particular trait.

174. Tagore was(a)/ one of the greatest poet(b)/ that ever lived.(c)/ No error(d)

⊘ *(b)* Replace 'poet' by 'poets'. Phrase 'one of the' agrees with plural noun and singular verb after it.

175. You may please(a)/ apply for an advance of salary(b)/ to cover costs of transport.(c)/ No error(d)

⊘ *(a)* Use of 'please' is inappropriate here. There is no mention of a request as such in the sentence. So, remove 'please' in the given sentence to make it grammatically correct.

176. The taxi that will take the family to Haridwar (a)/ had to be ready(b)/ at six the next morning.(c)/ No error(d)

⊘ *(b)* In part (b) use 'has to be ready' in place of 'had to be ready' to make the given syntax correct.

177. Employees are expected to(a)/ adhere the rules(b)/ laid down by the management.(c)/ No error(d)

⊘ *(b)* Here, in part (b) use of preposition 'to' after adhere, is required for e.g. 'adhere to the rules.'

178. The owner of the horse(a)/ greedily ask(b)/ too high a price.(c)/ No error(d)

⊘ *(b)* Here, 'asks' should be used in place of 'ask' as the subject of the verb is singular (the owner) in the given sentence.

179. I convinced(a)/ him to(b)/ see the play.(c)/ No error(d)

⊘ *(c)* Better word to use here in place of 'see' is 'watch' the play and it is also appropriate in context of the given sentence.

180. Some man(a)/ are born(b)/ of the great.(c)/ No error(d)

⊘ *(a)* 'Some' always takes a plural noun after it. So, use 'men' in place of 'man' here, to make the given syntax correct.

181. We must sympathise(a)/ for others(b)/ in their troubles.(c)/ No error(d)/

⊘ *(b)* 'Sympathise' is followed by 'with' not by 'for'. So, 'with' should be used in place of 'for'.

182. My detailed statement(a)/ is respectively(b)/ submitted.(c)/ No error(d)

⊘ *(b)* Here, according to the given sentence 'respectively' is inappropriate usage. Use 'respectfully' in place of it, to make the given syntax correct.

183. I am waiting(a)/ for my friend(b)/ since this morning.(c)/ No error(d)

⊘ *(a)* For a continued action of Past to Present, we use Perfect Continuous Tense. So, use 'have been' in place of 'am'. To make the given sentence grammatically correct.

184. He is representing(a)/ my constituency(b)/ for the last five years.(c)/ No error(d)

⊘ *(a)* For a continued action of Past to Present, we use Perfect Continuous Tense. So, use 'has been' in place of 'is' in the given sentence to make it grammatically correct.

185. If he hears(a)/ of your conduct(b)/ he is to be unhappy.(c)/ No error(d)

⊘ *(c)* In the given sentence, use 'will' in place of 'is to' because the sentence reflects a futuristic approach, to make the syntax grammatically correct.

186. No sooner he appeared(a)/ on the stage than the people(b)/ began to cheer loudly.(c)/ No error(d)

⊘ *(a)* Here, part (a) has an error in the given sentence, 'had' should be used after 'No sooner' to make the given syntax grammatically correct. When we begin a sentence with a negative word, we put the auxiliary verb before the subject.

2014 (II)

187. He want to England to work as a doctor(a)/ but returned back(b)/ as he could not endure the weather there.(c)/ No error(d)

⊙ (**b**) Use of 'back' in part (b) of the given sentence is superfluous here.

188. She inquired whether(a)/ anyone(b)/ has seen(c)/ her baby.(d)/ No error(e)

⊙ (**c**) Here, in part (c) use 'had seen' in place of 'has seen' as sentence requires Past Perfect.

189. When I went(a)/ outdoor(b)/ I found frost everywhere.(c)/ No error(d)

⊙ (**b**) Use 'outside' in place of 'outdoor' in part (b) to make the sentence more appropriate.

190. These are(a)/ his(b)/ conclusion remarks.(c)/ No error(d)

⊙ (**c**) Here, in part (c) replace 'conclusion' with 'concluding' to make the given sentence grammatically correct.

191. The shopkeeper either offered to exchange(a)/ the goods(b)/ or refund the money.(c)/ No error(d)/

⊙ (**c**) Here, in part (c) use 'to' before 'refund' as infinitive is required here.

192. Churchill was(a)/ one of the greatest(b)/ war leaders.(c)/ No error(d)

⊙ (**d**) There is no error and the given sentence is grammatically correct.

193. We should keep(a)/ such people (b)/ at an arm's length.(c)/ No error(d)

⊙ (**c**) Remove 'an' as it is not required here to make the syntax correct.

194. He did not know(a)/ as much as(b)/ he claimed he knew.(c)/ No error(d)

⊙ (**c**) Here, in part (c), use 'he had claimed' in place of 'he claimed' as here two past events are given, so prior should be in Past Perfect.

195. That was very dangerous(a)/ you might(b)/ have been killed.(c)/ No error(d)

⊙ (**b**) Here, use, 'could' in place of 'might' as here is speculation about something that didn't happen in the sentence.

196. My friend(a)/ is going(b)/ to a movie(c)/ every week. No error(d)

⊙ (**b**) Here, in part (b) use goes' in place of 'is going' as habitual verbs are not used in progressive forms.

197. They sit(a)/ at the window(b)/ and watch the traffic.(c)/ No error(d)

⊙ (**c**) Here, in part (c) use 'observe' in place of 'watch' to make the sentence more appropriate.

198. I started early(a)/ for the station lest I(b)/ should not miss the train.(c)/ No error(d)

⊙ (**c**) Here, remove 'not' after 'should' as 'lest' contains a negative meaning itself. So, remove it from the given sentence.

199. I wanted to see(a)/ that whether they(b)/ had actually read the notes.(c)/ No error(d)

⊙ (**b**) Use either 'whether' or 'that' as both are connectives and we can't use them simultaneously. So, remove 'that' from the given sentence.

200. They made him treasurer(a)/ because they considered(b)/ him as honest and efficient.(c)/ No error(d)

⊙ (**c**) Here, remove 'as because 'consider' takes no preposition. 'Considered him honest and efficient' is the correct phrase.

201. Having finished the paper early(a)/ he came out of the hall(b)/ almost an hour before the bell rang.(c)/ No error(d)

⊙ (**b**) Use 'had come' in place of came' as here former event should be in Past Perfect tense.

202. The(a)/ young man(b)/ had no manner.(c)/ No error(d)

⊙ (**c**) Here, use 'manners' in place of 'manner' as it is always used in plural form.

203. No news(a)/ are(b)/ good news.(c)/ No error(d)

⊙ (**b**) Use 'is' in place of 'are' as 'news' is the word which look plural but always used in singular and also followed by singular verb.

204. The work involved(a)/ is almost impossible(b)/ to cope with.(c)/ No error(d)

⊙ (**c**) Remove 'with' as 'cope' takes preposition only when any object comes after it. And there is no object after it so it should be removed.

205. There is (a)/ no place(b)/ in this compartment.(c)/ No error(d)

⊙ (**b**) Here, use 'room' in place of 'place', to make the sentence, more appropriate and grammatically correct.

206. Shakespeare(a)/ is greater than(b)/ any poet.(c)/ No error(d)

⊙ (**c**) In part (c), use 'other' before 'poet' because here comparative degree is used.

207. I should(a)/ have preferred(b)/ to go by myself.(c)/ No error(d)

⊙ (**c**) Use 'going' in place of 'to go' as 'prefer' always agree with gerund, form of verb.

208. The minister announced(a)/ compensation for(b)/ the victims from the accident.(c)/ No error(d)

⊙ (**c**) Here, in part (c) use 'of' in place of 'from' as 'victim' takes preposition 'of'.

209. The Australian team(a)/ losed the match(b)/ yesterday.(c)/ No error(d)

⊙ (**b**) Here, in part (b) use 'lost' in place of 'losed' to make the given sentence grammatically correct.

210. He told us(a)/ that(b)/ he has not read the book.(c)/ No error(d)

⊙ (**c**) Here, use 'had' in place of 'has' as sentence belongs to indirect narration and also is in Past tense.

211. The composition contained(a)/ even no less(b)/ than twenty mistakes.(c)/ No error(d)

⊙ (**b**) Use of 'even' is not required. Remove 'even', to make the given sentence correct.

2014 (I)

212. He asked her that(a)/ whether she knew(b)/ what had happened last week when she was on leave.(c)/ No error(d)

⊙ (**a**) Delete 'that' in part (a) of use either 'wheather' or 'that' as both are connectives and we can't use them simultaneously.

213. Until you do not go to the station(a)/ to receive him(b)/ I can hardly feel at ease.(c)/ No error(d)

⊙ (**a**) Delete 'do not' in part (a) of the given sentence. 'Do not' is not used with 'until'.

214. I did not know where they were going(a)/ nor could I understand(b)/ why had they left so soon.(c)/ No error(d)

⊙ *(c)* Here, in part (c) replace 'why had they' with 'why they had', to make the given syntax grammatically correct.

215. The distinguished visitor said that he had great pleasure to be with us for some time(a)/ and that the pleasure was all the greater(b)/ because his visit afforded him an opportunity to study the working of an institution of such eminence as ours.(c)/ No error(d)

⊙ *(c)* Here, add 'that of' before 'ours' in part (c) of the given sentence.

216. Please convey(a)/ my best wishes(b)/ back to your parents.(c)/ No error(d)

⊙ *(c)* Here, in part (c) remove 'back' to make the sentence grammatically correct.

217. The call of the seas(a)/ have always(b)/ found an echo in me.(c)/ No error(d)

⊙ *(b)* Use 'has' in place of 'have' as the subject of the given sentence (the call of the seas) is singular, so verb should also be used in singular form.

218. Hardly, I had left home for Mumbai(a)/ when my son who is settled in Kolkata arrived(b)/ without any prior information.(c)/ No error(d)

⊙ *(a)* Here, replace 'hardly I had with 'Hardly had I', to make the given sentence grammatically correct.

219. Now, it can be easily said(a)/ that the population of this city is greater(b)/ than any other city in India.(c)/ No error(d)

⊙ *(c)* Here, add that of' after 'than' in part (c) of the given sentence, to make it grammatically correct.

220. It is difficult to explain(a)/ why did Rajagopalachari resigned(b)/ from the Congress in 1940.(c)/ No error(d)

⊙ *(b)* Here, in part (b) write 'resign' in place of 'resigned' according to the given sentence.

221. The boss reminded them of the old saying(a)/ that honesty was the best policy(b)/ and told them that they had better be honest in their work.(c)/ No error(d)

⊙ *(b)* Here, in part (b) write 'is' in place of 'was' as it is a proverb.

222. 'Gulliver's Travels' are(a)/ the most fascinating adventure story(b)/ that I have ever read.(c)/ No error(d)

⊙ *(a)* Use 'is' in place of 'are' because the subject of the given sentence (Gulliver's Travel's) is singular.

223. The teenager reassured his father at the station(a)/ "Don't worry, dad'(b)/ I will pull on very nicely at the hostel."(c)/ No error(d)

⊙ *(c)* According to the given context, use 'carry on' in place of 'pull on' as 'carry on' means behave in a specified way.

224. The way he's behaving (a)/ he'll soon spill the beans(b)/ I'm afraid.(c)/ No error(d)

⊙ *(a)* Here, replace 'behaving' with 'behaving in' to make the given sentence grammatically correct.

225. Most of the developing countries find it(a)/ difficult to cope up with the problems(b)/ created by the sudden impact of technological progress.(c)/ No error(d)

⊙ *(b)* Here, in part (b) 'cope up with' is inappropriate, it is 'cope with'. 'Cope' is an intransitive verb and it means to deal with something well or in the face of some difficulty. So, use 'cope with' in place of 'cope up with'.

226. People blamed him(a)/ for being(b)/ a coward person.(c)/ No error(d)

⊙ *(c)* Remove 'person' after 'coward' to make the given syntax, correct.

227. We swam up to the drowning man, caught hold of his clothes(a)/ before he could go down again(b)/ and pulled him out, safe to the shore.(c)/ No error(d)

⊙ *(a)* Here, according to the given sentence, use 'got hold' in place of 'caught hold'. 'hold' is not used with 'caught'.

228. Meena was so tired(a)/ that she could not hardly(b)/ talk to the guests for a few minutes.(c)/ No error(d)

⊙ *(b)* Here, in part (b) remove 'not' before hardly because 'hardly' is itself means not.

229. If I was knowing(a)/ why he was absent,(b)/ I would have informed you.(c)/ No error(d)

⊙ *(a)*Use 'I knew' in place of 'I was knowing' to make the given syntax correct.

230. He goes(a)/ to office(b)/ by foot.(c)/ No error(d)

⊙ *(c)* Use 'on foot' in place of 'by foot' as with the word 'foot' preposition 'on' is suitable.

231. The hundred-rupees notes(a)/ that he gave them for the goods bought from them looked genuine(b)/ but later they reliably learnt that the notes were all counterfeit.(c)/ No error(d)

⊙ *(a)* Here, in part (a), it should be 'hundred rupee notes' in place of 'hundred rupees notes' to make the given sentence grammatically correct.

ORDERING OF WORDS IN A SENTENCE

Directions (Q. Nos. 1-148) *Each of the following items in this section consists of a sentence, the parts of which have been jumbled. These parts have been labelled as P, Q, R and S. Given below each sentence are four sequence namely (a), (b), (c) and (d). You are required to rearrange the jumbled parts of the sentence and mark your response accordingly.*

2019 (II)

1. the company are often asked
  (P)
the formal or informal interviews
  (Q)
employees who are leaving for their opinions during
  (R)   (S)

The correct sequence should be
(a) RPSQ   (b) RQPS   (c) PSQR   (d) PQSR

⊙ *(a)* RPSQ is the correct sequence.

2. a hailstorm activity in the evenings
  (P)
there is a possibility of while there could be
  (Q)   (R)
heavy rain towards the weekend
  (S)

The correct sequence should be
(a) SQPR   (b) QSRP   (c) QRPS   (d) SPRQ

⊙ *(b)* QSRP is the correct sequence.

3. has been below normal since last week
  (P)
the minimum temperature in some part of the city
  (Q)   (R)
when rain and hailstorm activity recorded
  (S)

The correct sequence should be
(a) RSPQ   (b) SPRQ   (c) QPSR   (d) PSQR

⊙ *(c)* QPSR is the correct sequence.

4. for guest teachers
  (P)
in the Department of Biotechnology was also held
  (Q)   (R)
a Selection Committee meeting
  (S)

The correct sequence should be
(a) SPRQ   (b) QRSP   (c) PRQS   (d) RSPQ

⊙ *(a)* SPRQ is the correct sequence.

5. for contractual assignment at Cultural Centres abroad
  (P)
as Teacher of Indian Culture for two years
  (Q)
applications are invited in a prescribed format
  (R)
from Indian Nationals for deployment
  (S)

The correct sequence should be
(a) QPRS   (b) SRPQ   (c) PQRS   (d) RSQP

⊙ *(d)* RSQP is the correct sequence.

6. while they are small and do the great things
  (P)   (Q)
while they are easy do the difficult things
  (R)   (S)

The correct sequence should be
(a) SRQP   (b) PSQR   (c) SRPQ   (d) QPSR

⊙ *(a)* SRQP is the correct sequence.

7. then you sure   if you can't
  (P)   (Q)
don't deserve me at my best handle me at my worst
  (R)   (S)

The correct sequence should be
(a) PRQS   (b) QSPR
(c) RQSP   (d) PSRQ

⊙ *(b)* QSPR is the correct sequence.

8. you will be more disappointed
         (P)
than by the ones you did do
         (Q)
by the things you didn't do   twenty years from now
         (R)   (S)

The correct sequence should be
(a) PRSQ   (b) PRQS   (c) PQSR   (d) SPRQ

⊙ *(d)* SPRQ is the correct sequence.

9. man is one who can lay
         (P)
a firm foundation with the bricks   a successful
         (Q)   (R)
others have thrown at him
         (S)

The correct sequence should be
(a) PQSR   (b) RQSP   (c) RPQS   (d) QSPR

⊙ *(c)* RPQS is the correct sequence.

10. what we may be   but not we not know
         (P)   (Q)
 we know   what we are
   (R)   (S)

The correct sequence should be
(a) RSQP   (b) QPRS   (c) QRPS
         (d) RQPS

⊙ *(a)* RSQP is the correct sequence.

11. for the ordinary   not willing to risk the unusual
         (P)   (Q)
if you are   you will have to settle
   (R)   (S)

The correct sequence should be
(a) PRQS   (b) SPQR   (c) RQSP   (d) QSRP

⊙ *(c)* RQSP is the correct sequence.

12. as mere stepping stones   his major achievements
         (P)   (Q)
for the next advance   he regarded
         (R)   (S)

The correct sequence should be
(a) SPQR   (b) SQPR
(c) SPRQ   (d) RPQS

⊙ *(b)* SQPR is the correct sequence.

13. have a great influence
         (P)
and they often shape our personality
         (Q)
on our adult lives   events in our childhood
         (R)   (S)

The correct sequence should be
(a) SPRQ   (b) SQRP
(c) SRQP   (d) PQRS

⊙ *(a)* SPRQ is the correct sequence.

14. the prize money   for refusing her
         (P)   (Q)
pepsico was ordered   to compensate the woman
         (R)   (S)

The correct sequence should be
(a) RSQP   (b) SPQR   (c) RPSQ   (d) QRSP

⊙ *(a)* RSQP is the correct sequence.

15. trade operating from a colony   held a meeting
         (P)   (Q)
demanding a probe into the illegal drug
         (R)
the residents of the city
         (S)

The correct sequence should be
(a) QRSP   (b) SPQR   (c) SQRP   (d) RSQP

⊙ *(c)* SQRP is the correct sequence.

16. the university authorities cancelled the ongoing
students' union election and
         (P)
following students' unrest on campus
         (Q)
closed till further orders
         (R)
declared the institution
         (S)

The correct sequence should be
(a) QRSP   (b) QPSR   (c) SQRP   (d) RSQP

⊙ *(b)* QPSR is the correct sequence.

17. brushed past the latter's pet dog
         (P)
stabbed to death by a man
         (Q)
after his vehicle accidentally
         (R)
a cargo van driver was allegedly
         (S)

The correct sequence should be
(a) QRSP   (b) QPSR   (c) SQRP   (d) SQPR

⊙ *(c)* SQRP is the correct sequence.

18. an earthquake and tsunami
         (P)
the disaster mitigation agency
         (Q)
said that the death toll from
         (R)
in Indonesia has crossed 1500
         (S)

The correct sequence should be
(a) PQSR   (b) RPSQ   (c) SQRP   (d) QRPS

⊙ *(d)* QRPS is the correct sequence.

19. scientists say they have developed a new
  (P)
illnesses such as heart disease and cancer
  (Q)
DNA tool that uses machine learning to accurately
  (R)
predict people's height and assess their risk for serious
  (S)
The correct sequence should be
(a) PRSQ   (b) RPSQ   (c) PSRQ   (d) QRPS

⊙ (*a*) PRSQ is the correct sequence.

20. a rare evergreen tree in the Southern-Western Ghats
  (P)
researchers have found that
  (Q)
common white-footed ants are the best pollinators of
  (R)
bees might be the best known pollinators but
  (S)
The correct sequence should be
(a) PRSQ   (b) SQRP   (c) QSRP   (d) PQRS

⊙ (*b*) SQRP is the correct sequence.

21. say from their forties onwards
  (P)
it is thus a good idea
  (Q)
and continue to exercise early enough
  (R)
for senior citizens to start
  (S)
The correct sequence should be
(a) PRSQ   (b) QRSP   (c) QSRP   (d) PQRS

⊙ (*c*) QSRP is the correct sequence.

22. scientists have determined
  (P)
injury in animals and humans
  (Q)
that is linked to the severity of spinal cord
  (R)
a gene signature
  (S)
The correct sequence should be
(a) PSRQ   (b) QRPS   (c) QSPR   (d) PQRS

⊙ (*a*) PSRQ is the correct sequence.

23. like a muscle and repeating the process
  (P)
and stable reading circuit
  (Q)
helps the child build a strong   the brain works
  (R)   (S)
The correct sequence should be
(a) QSRP   (b) SPRQ   (c) QSPR   (d) RQPS

⊙ (*b*) SPRQ is the correct sequence.

2018 (II)

24. have become integral to most people's lives
  (P)
debate for years as the devices
  (Q)
have drawn intense interest and
  (R)
safety questions about cell phones
  (S)
The correct sequence should be
(a) PQRS   (b) RSPQ   (c) SPQR   (d) SRQP

⊙ (*d*) SRQP is the correct sequence.

25. by means of education   civilisation to bring about
  (P)   (Q)
it is difficult in modern   an integrated individual
  (R)   (S)
The correct sequence should be
(a) RQSP   (b) RSPQ   (c) SPQR   (d) PRQS

⊙ (*a*) RQSP is the correct sequence.

26. is that it is not professional enough
  (P)
have not done their home work
  (Q)
a valid criticism of the profession of politics in India
  (R)
as the majority of its practitioners
  (S)
The correct sequence should be
(a) RSPQ   (b) RPSQ   (c) SPQR   (d) PQRS

⊙ (*b*) RPSQ is the correct sequence.

27. that suit partisan political objectives
  (P)
when great historical figures are appropriated
  (Q)
we are living at a time   and reduced into stereotype
  (R)   (S)
The correct sequence should be
(a) RQPS   (b) RQSP
(c) SQRP   (d) PRQS

⊙ (*b*) RQSP is the correct sequence.

28. it is in this context that
  (P)
and prosperity must be viewed
  (Q)
the role of agriculture   as a provider of jobs
  (R)   (S)
The correct sequence should be
(a) PQRS   (b) RSPQ   (c) PRSQ   (d) RSQP

⊙ (*c*) PRSQ is the correct sequence.

29. and they largely relied on agriculture, fishing and hunting
      (P)
the people had a subsistence economy
      (Q)
from excavation sites indicate that
      (R)
rich materials found
      (S)
The correct sequence should be
(a) RQPS   (b) QSPR   (c) SPQR   (d) SRQP
⊙ *(d)* SRQP is the correct sequence.

30. and that is 'To learn to say I am sorry'
      (P)
something important enough that
      (Q)
but surely there must be
      (R)
everyone should learn it
      (S)
The correct sequence should be
(a) RQSP   (b) RQPS   (c) SPQR   (d) PRQS
⊙ *(a)* RQSP is the correct sequence.

31. or an independent judiciary
      (P)
a free press is
      (Q)
as essential a limb of democracy as a Parliament
      (R)
freely elected by the people
      (S)
The correct sequence should be
(a) RQSP   (b) QRPS   (c) SPQR   (d) QRSP
⊙ *(d)* QRSP is the correct sequence.

32. the opinion that a human life
      (P)
and that he would quite like to live that long
      (Q)
could span 125 years
      (R)
there was a time when Gandhi expressed
      (S)
The correct sequence should be
(a) SPRQ   (b) RQPS   (c) SPQR   (d) QRPS
⊙ *(a)* SPRQ is the correct sequence.

33. I must say what I feel
      (P)
I am a votary of truth and
      (Q)
to what I may have said before
      (R)

and think at a given moment without regards
      (S)
The correct sequence should be
(a) RQSP   (b) QRPS   (c) PSRQ   (d) QPSR
⊙ *(d)* QPSR is the correct sequence.

34. The man in the competition
      (P)
has been elected
      (Q)
as the chairperson of the sports committee
      (R)
in red who stood first
      (S)
The correct sequence should be
(a) SPQR   (b) SRPQ   (c) PSRQ   (d) QRSP
⊙ *(a)* SPQR is the correct sequence.

35. One of the difficulties the whole of mankind
      (P)
or affect the masses   the day after tomorrow
      (Q)   (R)
is that we want to transform
      (S)
The correct sequence should be
(a) SPQR   (b) PRSQ
(c) SPRQ   (d) QRSP
⊙ *(a)* SPQR is the correct sequence.

36. The speaker of their inaction   has identified
      (P)   (Q)
charging the opponents many issues besides
      (R)   (S)
The correct sequence should be
(a) PSQR   (b) QSRB   (c) SPRQ   (d) QSPR
⊙ *(b)* QSRP is the correct sequence.

37. The government and job markets
      (P)
must offer convincing solutions
      (Q)
to the crises in the rural economy
      (R)
that are causing social ferment
      (S)
The correct sequence should be
(a) QRPS   (b) QSRP   (c) SPRQ   (d) PRSQ
⊙ *(a)* QRPS is the correct sequence.

38. The best part of literary flourishes
      (P)
and locates the story with the larger framework of our world
      (Q)
long-formed journalism is that
      (R)

it brings back the importance of writing skills,
(S)
The correct sequence should be
(a) QRPS   (b) RSPQ   (c) SPRQ   (d) PRSQ

> *(b)* RSPQ is the correct sequence.

39. Children that grow into beautiful trees
(P)
of a warm home and supportive surroundings
(Q)
are like the tender samplings
(R)
with the sunshine and rain
(S)
The correct sequence should be
(a) QRPS   (b) RPQS   (c) RPSQ   (d) PRSQ

> *(b)* RPQS is the correct sequence.

40 . We with real life experiences
(P)
tend to learn with interest
(Q)
when we see beauty in our work
(R)
and connect learning
(S)
The correct sequence should be
(a) QRSP   (b) RPQS   (c) SPRQ   (d) PRSQ

> *(a)* QRSP is the correct sequence.

41. Elementary education ensuring the growth of
(P)
a nation is inevitable in developing the children
(Q)   (R)
to further education, thereby
(S)
The correct sequence should be
(a) QRPS   (b) RPQS   (c) SPRQ   (d) QRSP

> *(b)* RPQS is the correct sequence.

42. National Building Organisation besides conducting surveys on housing
(P)
and disseminates the statistical information
(Q)
collects, tabulates
(R)
on housing and building construction activities
(S)
The correct sequence should be
(a) QRPS   (b) RPQS   (c) SPRQ   (d) RQSP

> *(d)* RQSP is the correct sequence.

43. The Himalayan range sacred to the Gaddi people
(P)
is home to a chain of high altitude lakes
(Q)   (R)

that towers over the Kangra valley
(S)
The correct sequence should be
(a) QRPS   (b) SPQR   (c) SQRP   (d) RQSP

> *(c)* SQRP is the correct sequence.

2018 (I)

44. the British manufacturer
(P)
popularity of Indian textiles
(Q)
were jealous of the
(R)
from the very beginning
(S)
The correct sequence should be
(a) PQRS   (b) SPQR   (c) SPRQ   (d) QRSP

> *(c)* SPRQ is the correct sequence.

45. dress fashions changed and light cotton
(P)
of the English textiles began to replace
(Q)   (R)
the coarse woollens
(S)
The correct sequence should be
(a) PRSQ   (b) RSPQ   (c) QPRS   (d) SPRQ

> *(a)* PRSQ is the correct sequence.

46. put pressure on their government
(P)
Indian goods in England the British manufacturers
(Q)   (R)
to restrict and prohibit
(S)
The correct sequence should be
(a) PQRS   (b) SPRQ   (c) RPSQ   (d) QRSP

> *(c)* RPSQ is the correct sequence.

47. However still held their own in foreign markets
(P)   (Q)
in spite of these laws Indian silk and cotton textiles
(R)   (S)
The correct sequence should be
(a) QPRS   (b) SPRQ   (c) SRPQ   (d) RPSQ

> *(d)* RPSQ is the correct sequence.

48. and it led to rapid economic development
(P)
the Industrial Revolution
(Q)
transformed the British
(R)

society in a fundamental manner
(S)
The correct sequence should be
(a) SPRQ   (b) QPRS   (c) QRSP   (d) SRPQ

⊙ (**c**) QRSP is the correct sequence.

49. Muhammad Iqbal
(P)
the philosophical and religious outlook of people
through his poetry
(Q)
profoundly influenced
(R)
one of the greatest poets of modern India
(S)
The correct sequence should be
(a) QRSP   (b) SRQP   (c) SRPQ   (d) SPRQ

⊙ (**d**) SPRQ is the correct sequence.

50. to accept any of the important
(P)
disillusionment   demands of the nationalists produced
(Q)   (R)
the failure of the British Government.
(S)
The correct sequence should be
(a) SPRQ   (b) PQRS   (c) SRQP   (d) QRPS

⊙ (**a**) SPRQ is the correct sequence.

51. showed that a backward   the rise of
(P)   (Q)
modern Japan after 1868   Asian country could
(R)   (S)
develop itself without Western control
The correct sequence should be
(a) PQRS   (b) SRQP   (c) PRQS   (d) QRPS

⊙ (**d**) QRPS is the correct sequence.

52. and the current Hindu emphasis
(P)
and urged the people to imbibe the spirit of
free-thinking
(Q)
or rituals, ceremonies and superstitions
(R)
Vivekananda condemned the caste system
(S)
The correct sequence should be
(a) PQRS   (b) SPRQ   (c) SPQR   (d) RPSQ

⊙ (**b**) SPRQ is the correct sequence.

53. Mr. John who was hardly six months old
(P)
Charles   as his son   adopted
(Q)   (R)   (S)
The correct sequence should be
(a) SQRP   (b) PSQR   (c) RSPQ   (d) PRSQ

⊙ (**a**) SQRP is the correct sequence.

2017 (II)

54. My unmarried aunt is creating a lot
(P)
of problems for us who stays with us
(Q)
because of her interfering nature in our personal lives
(R)
and there is a misunderstanding among family
members
(S)
The correct sequence should be
(a) QSRP   (b) QPSR
(c) PQSR   (d) SPQR

⊙ (**b**) PQSR is the correct sequence.

55. no criminal proceeding in any
(P)
Court during his term of office
(Q)
what so ever shall be initiated or continued
against the President   or a Governor
(R)   (S)
The correct sequence should be
(a) QRSP   (b) PQRS   (c) QPSR   (d) SQPR

⊙ (**a**) PQRS is the correct sequence.

56. The dentist with a severe tooth-ache
(P)
when he was brought to hospital
(Q)
extracted Manish's tooth   and relieved his pain
(R)   (S)
The correct sequence should be
(a) PQRS   (b) QPRS   (c) RSPQ   (d) RQPS

⊙ (**d**) RQPS is the correct sequence.

57. The actress has been selected   as the best heroine
(P)   (Q)
who is the daughter of a famous male singer
(R)
of the year
(S)
The correct sequence should be
(a) RPQS   (b) QPSR   (c) QSRP   (d) QSRP

⊙ (**a**) RPQS is the correct sequence.

58. Last summer everyday   kept pestering a pretty girl
(P)   (Q)
one persistent admirer   with phone calls
(R)   (S)
The correct sequence should be
(a) QRSP   (b) RSQP
(c) RQSP   (d) PQRS

⊙ (**c**) RQSP is the correct sequence.

59. In many cultures <u>to make wishes come true</u>
                              (P)
<u>that blue has the power</u> <u>people believe</u>
       (Q)   (R)
<u>and be successful in life</u>
       (S)

The correct sequence should be
(a) PSRQ   (b) RSPQ   (c) RQPS   (d) SQPR

⊙ *(c)* RQPS is the correct sequence.

60. From a picnic table <u>through the playground</u>
                                (P)
<u>while we unpacked a basket</u>
        (Q)
<u>we watched them laugh and leap</u>
        (R)
<u>bulging with sandwhiches and cookies</u>
             (S)

The correct sequence should be
(a) RSQP   (b) QPRS   (c) RPQS   (d) QSRP

⊙ *(c)* RPQS is the correct sequence.

61. My father retired at the age of 68
<u>where he had served,</u> <u>in South</u>
        (P)   (Q)
 <u>Carolina as Pastor for 12 years,</u>
                (R)
<u>from a Baptist Church</u>
        (S)

The correct sequence should be
(a) PRSQ   (b) SQPR   (c) SPQR   (d) QPRS

⊙ *(b)* SQPR is the correct sequence.

62. The completion <u>it enables employees to feel a sense of</u>
<u>accomplishment</u>
      (P)
<u>and makes them take pride in their work</u>
               (Q)
<u>of high quality products</u>
            (R)
<u>also enhances employee satisfaction, because</u>
        (S)

The correct sequence should be
(a) PQRS   (b) RQPS   (c) PSRQ   (d) RSPQ

⊙ *(c)* PSRQ is the correct sequence.

63. But, Kuala Lumpur <u>where modern Malaya executives</u>
                            (P)
<u>but will never miss Friday prayers</u>
        (Q)
<u>might have a cellular phone in hand,</u>
        (R)
<u>is a city firmly rooted in tradition</u>
        (S)

The correct sequence should be
(a) RQSP   (b) SPRQ   (c) RPSQ   (d) SQRP

⊙ *(b)* SPRQ is the correct sequence.

64. Perhaps the most significant factor <u>is a failure of</u>
<u>planning and</u>
     (P)
<u>in the growth of all metropolitan crimes,</u>
               (Q)
<u>governance in the urban sprawl</u>
          (R)
<u>including crimes against the elderly,</u>
           (S)

The correct sequence should be
(a) QSPR   (b) PRQS
(c) QRPS   (d) PSQR

⊙ *(a)* QSPR is the correct sequence.

65. He said that <u>a small college</u>
                    (P)
<u>he'd rather go to</u>   <u>not studying at all</u>   <u>instead of</u>
      (Q)   (R)   (S)

The correct sequence should be
(a) QSPR   (b) PRQS
(c) QPRS   (d) QPSR

⊙ *(d)* QPSR is the correct sequence.

66. Teaching a child <u>since there are few</u>
                          (P)
<u>is becoming difficult and expensive</u>
               (Q)
<u>open ponds around</u> <u>how to swim</u>
      (R)   (S)

The correct sequence should be
(a) SQPR   (b) QRSP
(c) SRQP   (d) PRQS

⊙ *(a)* SQPR is the correct sequence.

67. The doctor <u>able to find out</u> <u>what had caused</u>
                        (P)   (Q)
<u>the food poisoning</u> <u>had not been</u>
      (R)   (S)

The correct sequence should be
(a) SPRQ   (b) PRQS
(c) PRSQ   (d) SPQR

⊙ *(d)* SPQR is the correct sequence.

68. The officer <u>was suspended</u>   <u>being corrupt</u>
                        (P)   (Q)
   <u>from service</u> <u>before his dismissal</u>
        (R)   (S)

The correct sequence should be
(a) QPSR   (b) QPRS
(c) RSQP   (d) RSPQ

⊙ *(b)* QPRS is the correct sequence.

69. She gave her old coat   to a beggar
          (P)   (Q)
the one with the brown fur on it
          (R)
shivering with cold
        (S)

The correct sequence should be
(a) PRQS   (b) SQPR
(c) PQRS   (d) RPQS
⟩ *(a)* PRQS is the correct sequence.

70. The medical teams at the ground said that the injured
                         (P)
by the surging crowds, included women and children
       (Q)   (R)
who were trampled
        (S)

The correct sequence should be
(a) PRQS   (b) PQRS
(c) QPRS   (d) PSQR
⟩ *(d)* PSQR is the correct sequence.

71. He at the hurdles on his way who has his eyes
             (P)   (Q)
does not look fixed on the goal
     (R)   (S)

The correct sequence should be
(a) PQRS   (b) SRPQ
(c) QSRP   (d) RQPS
⟩ *(c)* QSRP is the correct sequence.

72. We do not know when but we know
                        (P)
the exact date of his death for certain
         (Q)   (R)
Shakespeare was born
        (S)

The correct sequence should be
(a) SPRQ   (b) PQRS
(c) PSQR   (d) SRQP
⟩ *(a)* SPRQ is the correct sequence.

73. the purpose is to advance knowledge
             (P)
the two have to work together
        (Q)
and disseminate it
         (R)
at university is essentially a community of students
and teachers
             (S)

The correct sequence should be
(a) SRQP   (b) SPQR
(c) PQRS   (d) SQPR
⟩ *(d)* SQPR is the correct sequence.

2017 (I)

74. he almost   planned the entire strategy of operation
   (P)   (Q)   (R)
single-handed
    (S)

The correct sequence should be
(a) RSPQ   (b) PRQS   (c) SQRP   (d) QPSR
⟩ *(b)* PRQS is the correct sequence.

75. it is a fact that rice is one of the most prolific
                   (P)
than almost any other crop
         (Q)
yielding a greater return per acre
              (R)
food crops
     (S)

The correct sequence should be
(a) SRQP   (b) RPSQ   (c) QRSP   (d) PSRQ
⟩ *(d)* PSRQ is the correct sequence.

76. up to the end of the eighteenth century, not only
because it was often fatal,
          (P)
smallpox was a particularly dreaded disease,
          (Q)
but also because those who recovered
          (R)
were permanently disfigured
         (S)

The correct sequence should be
(a) PQRS   (b) QRSP   (c) PRSQ   (d) QPRS
⟩ *(d)* QPRS is the correct sequence.

77. a person bitten by a rabid dog
          (P)
would be seized by violent symptoms
          (Q)
after an incubation period of a month
          (R)
or two and die an agonising death
         (S)

The correct sequence should be
(a) PRSQ   (b) SRQP   (c) PRQS   (d) PQRS
⟩ *(d)* PQRS is the correct sequence.

78. The traveller, sat down   to rest by the roadside
               (P)   (Q)   (R)
being weary
     (S)

The correct sequence should be
(a) PQRS   (b) RSPQ   (c) SPQR   (d) RPQS
⟩ *(c)* SPQR is the correct sequence.

79. the house was　　away
　　　(P)　　　　　(Q)
with its liveliest member　gloomy
　　　　(R)　　　　　　(S)

The correct sequence should be
(a) PQRS　　(b) PSRQ　　(c) RSPQ　　(d) QRPS

⊗ (*b*) PSRQ is the correct sequence.

80. he was a tiny man　with a sprightly walk　tall
　　　　(P)　　　　　　(Q)　　　　　(R)
barely five feet
　　(S)

The correct sequence should be
(a) RSQP　　(b) SRQP　　(c) QSPR　　(d) PSRQ

⊗ (*d*) PSRQ is the correct sequence.

81. rules and regulations
　　　　　　(P)
he cheerfully ignored its demands
　　　(Q)
a life of　　unaccustomed to
　　(R)　　　　(S)

The correct sequence should be
(a) PQRS　　(b) QRPS　　(c) SRPQ　　(d) QSRP

⊗ (*c*) SRPQ is the correct sequence.

82. The man for a moment　looked at me
　　　　　(P)　　　　　(Q)
and thus emptied my pockets
　　　　(R)
turned me upside down
　　　(S)

The correct sequence should be
(a) PQRS　　(b) QPRS　　(c) QPSR　　(d) PQSR

⊗ (*c*) QPSR is the correct sequence.

83. The lady today　is visiting　us
　　　　(P)　　(Q)　　(R)
who composed this poem
　　　(S)

The correct sequence should be
(a) RQPS　　　　　(b) PRQS
(c) QRPS　　　　　(d) SQRP

⊗ (*d*) SQRP is the correct sequence.

84. Animals are able to measure
　　　　　(P)
the passing of the seasons　changes in day-length
　　　(Q)　　　　　　　(R)
by recognising
　　(S)

The correct sequence should be
(a) PQSR　　　　　(b) SQPR
(c) PRSQ　　　　　(d) SRPQ

⊗ (*a*) PQSR is the correct sequence.

85. Many people inaudible to others
　　　　　　(P)
in the ears or head　suffer persistent noises
　　　(Q)　　　　　(R)
with hearing problems
　　　(S)

The correct sequence should be
(a) RQSP　　　　　(b) PSQR
(c) SRQP　　　　　(d) RSQP

⊗ (*c*) SRQP is the correct sequence.

86. Researchers found that allergic reactions are brought about
　(P)
in the bloodstream　in the 1940s
　　(Q)　　　　(R)
by the liberation of small quantities of a substance called histamine
　　(S)

The correct sequence should be
(a) RPSQ　　　　　(b) QRPS
(c) RQSP　　　　　(d) PSQR

⊗ (*a*) RPSQ is the correct sequence.

87. Attempts at transplanting other organs, but that which most caught the public fancy
　　　　(P)
was the heart transplant
　　　(Q)
such as the lungs or the liver
　　　(R)
have been made
　　(S)

The correct sequence should be
(a) SRQP　　　　　(b) RSPQ
(c) RPSQ　　　　　(d) QRPS

⊗ (*b*) RSPQ is the correct sequence.

88. sports cars　appeal　to some motorists only
　　(P)　　(Q)　　　(R)
with noisy exhausts
　　(S)

The correct sequence should be
(a) RQSP　　　　　(b) PSQR
(c) RSPQ　　　　　(d) PQSR

⊗ (*b*) PSQR is the correct sequence.

89. friendship has its place in　truth and justice
　　　(P)　　　　　(Q)
but it cannot override　life
　　　(R)　　　　(S)

The correct sequence should be
(a) PQRS　　　　　(b) RSPQ
(c) PSRQ　　　　　(d) RQPS

⊗ (*c*) PSRQ is the correct sequence.

90. the workaholic often becomes a prisoner of success
                    (P)   (Q)
inadvertently   reaping greater and greater rewards
        (R)   (S)
The correct sequence should be
(a) SPRQ   (b) SPQR   (c) RPQS   (d) PQRS

⊙ *(c)* RPQS is the correct sequence.

91. the school masters and the professors tend to believe
                        (P)
that innate intelligence is a quality
        (Q)
but that you can't do much about it except measure it
        (R)
which varies very greatly from one individual to
another
        (S)
The correct sequence should be
(a) PSQR   (b) PRSQ   (c) PQSR   (d) QSRP

⊙ *(c)* PQSR is the correct sequence.

92. People do not realise   that modern society
                (P)   (Q)
who object to driver education
        (R)
is built around the automobile
        (S)
The correct sequence should be
(a) RPQS   (b) QRSP   (c) RSPQ   (d) SPQR

⊙ *(a)* RPQS is the correct sequence.

93. with an idea to reach the deprived child
                    (P)
by the United Nations Organisation
                (Q)
the year 1979 has been declared as
                (R)
the International Year of the Child
                (S)
The correct sequence should be
(a) PQRS   (b) PSQR   (c) PRSQ   (d) RSPQ

⊙ *(c)* PRSQ is the correct sequence.

2016 (II)

94. Georgian loyalists and rebel forces after a week of
fighting
        (P)
agreed to   a cease fire today
        (Q)   (R)
in which 51 people were killed
                (S)
The correct sequence should be
(a) PQRS   (b) QRSP   (c) QPSR   (d) QRPS

⊙ *(d)* QRPS is the correct sequence.

95. The ultimate hope will force the nations
                                    (P)
that the destructive nature of weapons
                    (Q)
to give up war has not been fulfilled
        (R)   (S)
The correct sequence should be
(a) PSQR   (b) PQRS
(c) QPRS   (d) PRQS

⊙ *(c)* QPRS is the correct sequence.

96. The leader of the opposition, in the manner he had
planned to convince them,
                (P)
on realising that he had failed to convince the
assembly,
                (Q)
who had a reputation for speech making,
                (R)
was very much disappointed
                (S)
The correct sequence should be
(a) PSRQ   (b) QSRP
(c) RSQP   (d) SPRQ

⊙ *(c)* RSQP is the correct sequence.

97. We can think of often confused in the public mind
                                            (P)
which suggest the need for two factors
        (Q)   (R)
an international language
        (S)
The correct sequence should be
(a) PRQS   (b) RPQS   (c) RQSP   (d) SQRP

⊙ *(c)* RQSP is the correct sequence.

98. The man is generally the one
                        (P)
who can work very hard when he must work
        (Q)   (R)
who can play most heartily when he has the chance
of playing
        (S)
The correct sequence should be
(a) QRSP   (b) PSQR   (c) SPQR   (d) QRPS

⊙ *(c)* SPQR is the correct sequence.

99. Dear Lodger, I agree, the roof is leaking; but there
would be no need   while it is raining
        (P)   (Q)
and when the Sun shines, I can't get it repaired
        (R)   (S)
The correct sequence should be
(a) QRSP   (b) SQRP   (c) RSPQ   (d) PRQS

⊙ *(b)* SQRP is the correct sequence.

100. There is no reason that life may exist
                                    (P)
in great profusion why we should not be willing to think
        (Q)   (R)
in other worlds
        (S)

The correct sequence should be
(a) RSPQ   (b) PQSR
(c) RPQS   (d) RQSP

> *(c)* RPQS is the correct sequence.

101. The Regent released Voltaire
                              (P)
having discovered that
        (Q)
he had imprisoned an innocent man
        (R)
and gave him a pension
        (S)

The correct sequence should be
(a) PQRS   (b) PRSQ
(c) QRSP   (d) QRPS

> *(d)* QRPS is the correct sequence.

102. which is sold for its horn
     (P)   (Q)
the Rhinoceros is hunted by poachers at high prices
        (R)   (S)

The correct sequence should be
(a) SQPR   (b) QRSP
(c) RQPS   (d) QPSR

> *(c)* RQPS is the correct sequence.

103. as environmental tools for military purposes
           (P)   (Q)
are finding various new uses the world's fastest
        (R)   (S)

The correct sequence should be
(a) SPQR   (b) PQRS
(c) RPSQ   (d) QPSR

> *(a)* SPQR is the correct sequence.

104. is a painful feeling
            (P)
without this indirect appeal to our self love,
        (Q)
the sense of inferiority in others,
        (R)
and not an exalting one
        (S)

The correct sequence should be
(a) PRSQ   (b) RSPQ
(c) SRQP   (d) RQSP

> *(b)* RSPQ is the correct sequence.

105. that it would affect the investigation process
                    (P)
they refused   of these raids saying
      (Q)   (R)
to divulge the venues
        (S)

The correct sequence should be
(a) PQRS   (b) SRPQ   (c) QSRP   (d) RPQS

> *(c)* QSRP is the correct sequence.

106. that he already has buying things
          (P)   (Q)
that rich man   goes on
      (R)   (S)

The correct sequence should be
(a) PSQR   (b) RSQP   (c) SQRP   (d) RPQS

> *(b)* RSQP is the correct sequence.

107. the police commissioner rushed
      (P)
the crowd   to control   the police force
      (Q)   (R)   (S)

The correct sequence should be
(a) QRSP   (b) PQRS   (c) PSRQ   (d) RSPQ

> *(c)* PSRQ is the correct sequence.

108. my brother   to attend his friend's wedding
        (P)   (Q)
is going to Chennai   tomorrow
        (R)   (S)

The correct sequence should be
(a) PSQR   (b) QPSR   (c) RQPS   (d) PRSQ

> *(d)* PRSQ is the correct sequence.

109. quickly   he gave orders
      (P)   (Q)
to catch the thief   to his men
        (R)   (S)

The correct sequence should be
(a) SPRQ   (b) QSRP
(c) PSRQ   (d) RSPQ

> *(b)* QSRP is the correct sequence.

110. to give a definition   if I were
              (P)   (Q)
I would begin   like this
        (R)   (S)

The correct sequence should be
(a) QPRS   (b) PQRS
(c) SRQP   (d) RSPQ

> *(a)* QPRS is the correct sequence.

111. deserve all honour in society
            (P)
in doing their job well
            (Q)
men of conscience who take pride
            (R)
whatever its nature
            (S)
The correct sequence should be
(a) RQSP   (b) QRPS   (c) PRSQ   (d) SPQR
⊙ *(a)* RQSP is the correct sequence.

112. while some live   to eat and drink
            (P)   (Q)
many do not have enough   in luxury
            (R)   (S)
The correct sequence should be
(a) PSRQ   (b) PRSQ
(c) SPQR   (d) RQSP
⊙ *(a)* PSRQ is the correct sequence.

113. I believed then that no matter
                        (P)
one should always find some time for exercise
            (Q)
and I believe even now
            (R)
the amount of work one has
            (S)
The correct sequence should be
(a) PRQS   (b) PSRQ
(c) RPQS   (d) RPSQ
⊙ *(d)* RPSQ is the correct sequence.

114. I wonder
      (P)
whenever I decide to go to the cinema
            (Q)
with my scooter
            (R)
why I always have trouble
            (S)
The correct sequence should be
(a) QSPR   (b) QRSP
(c) PSRQ   (d) PRSQ
⊙ *(c)* PSRQ is the correct sequence.

115. The bird-catcher by means of snares
                        (P)
knew all the birds of the forest
            (Q)
by the hundred
            (R)
and was accustomed to capturing the winged
creatures
            (S)

The correct sequence should be
(a) QPSR   (b) QSRP   (c) PQSR   (d) PRQS
⊙ *(b)* QSRP is the correct sequence.

116. Man is a biological being
                (P)
his physical and material needs
            (Q)
confined to   not merely
      (R)   (S)
The correct sequence should be
(a) RSPQ   (b) SRQP
(c) RPSQ   (d) SPRQ
⊙ *(d)* SPRQ is the correct sequence.

117. A gang of robbers while they were fast asleep
                                    (P)
entered the village
            (Q)
and stole the property of the villagers   at night
            (R)   (S)
The correct sequence should be
(a) QSRP   (b) SQPR   (c) SPQR   (d) QPSR
⊙ *(a)* QSRP is the correct sequence.

118. The opposition members the ruling of the Speaker
                                    (P)
to protest against to the Parliament walked out
            (Q)   (R)   (S)
The correct sequence should be
(a) SPQR   (b) QRPS   (c) RSPQ   (d) SRQP
⊙ *(d)* SRQP is the correct sequence.

119. When a boy saved her by a speeding car
                (P)   (Q)
at the risk of his life
            (R)
a little girl was about to be run over
            (S)
The correct sequence should be
(a) SPRQ   (b) RSQP   (c) SQPR   (d) QPSR
⊙ *(c)* SQPR is the correct sequence.

2015 (I)

120. When the car passed by he threw a stone,
                                    (P)
raising dust in the road with all his might
            (Q)   (R)
and hit the man who was driving it
            (S)
The correct sequence should be
(a) PQRS   (b) QPRS   (c) RPQS   (d) RPSQ
⊙ *(b)* QPRS is the correct sequence.

121. A moment comes <u>when we step out from the old to</u>
<u>the new</u>
(P)
<u>which comes but rarely in history</u>
(Q)
<u>and when the soul of a nation</u>
(R)
<u>long suppressed, finds utterance</u>
(S)

The correct sequence should be
(a) QPRS   (b) PRSQ   (c) QRSP   (d) RSQP

⊙ *(a)* QPRS is the correct sequence.

122. She had a blind belief that inside the bag <u>two or</u>
<u>three other children</u>
(P)
<u>there were perhaps</u> <u>which the big man carried</u>
(Q)   (R)
<u>like herself</u>
(S)

The correct sequence should be
(a) QRPS   (b) QPSR   (c) RQSP   (d) RQPS

⊙ *(d)* RQPS is the correct sequence.

123. He approached the teacher <u>at school</u>
(P)
<u>to know</u>   <u>in his studies</u>
(Q)   (R)
<u>how his son was getting on</u>
(S)

The correct sequence should be
(a) PQRS   (b) PQSR   (c) QSRP   (d) QSPR

⊙ *(b)* PQSR is the correct sequence.

124. I was so angry that <u>if I had met him in the street</u>
(P)
<u>and not waited to ask him</u>
(Q)
<u>why he had written me an insulting letter</u>
(R)
<u>I would have knocked him down</u>
(S)

The correct sequence should be
(a) PSQR   (b) PQRS   (c) SQRP   (d) RSQP

⊙ *(a)* PSQR is the correct sequence.

125. On the contrary <u>about family planning and its</u>
<u>benefits</u>
(P)
<u>to all citizens</u> <u>the government wants</u>
(Q)   (R)
<u>to provide information and education</u>
(S)

The correct sequence should be
(a) RQSP   (b) SPQR   (c) RSPQ   (d) QPRS

⊙ *(c)* RSPQ is the correct sequence.

126. In spite of <u>the poor and hungry people</u>
(P)
<u>made by medical sciences</u>
(Q)
<u>the extraordinary progress</u> <u>often die</u>
(R)   (S)

The correct sequence should be
(a) RPSQ   (b) RQPS   (c) PQSR   (d) RSPQ

⊙ *(b)* RQPS is the correct sequence.

2014 (II)

127. The soldiers <u>decided to hold out</u>   <u>in the fort</u>
(P)   (Q)
<u>was killed</u> <u>till the last man among them</u>
(R)   (S)

The correct sequence should be
(a) QPSR   (b) PQSR   (c) QRSP   (d) SRPQ

⊙ *(b)* PQSR is the correct sequence.

128. Her friend <u>when she was</u> <u>very ill last year</u>
(P)   (Q)
<u>on Sheila</u> <u>could not attend</u>
(R)   (S)

The correct sequence should be
(a) PQRS   (b) SRPQ   (c) RSPQ   (d) RPQS

⊙ *(b)* SRPQ is the correct sequence.

129. The poems and stories have<u> been taken</u>
(P)
<u>for this book</u> <u>from a variety of sources</u>
(Q)   (R)
<u>that have been selected</u>
(S)

The correct sequence should be
(a) SQPR   (b) RPQS   (c) QPSR   (d) PQRS

⊙ *(a)* SQPR is the correct sequence.

130. The belief <u>that the moon has great influence</u>
(P)
<u>still exists with great force</u> <u>over the weather</u>
(Q)   (R)
<u>among many people</u>
(S)

The correct sequence should be
(a) PRQS   (b) QPRS
(c) PQSR   (d) QSPR

⊙ *(d)* QSPR is the correct sequence.

131. There is an old saying in our country <u>that soldiers</u>
(P)
<u>not only cover themselves with glory on the earth</u>
(Q)
<u>who die for their motherland</u> <u>but attain heaven</u>
(R)   (S)

The correct sequence should be
(a) PSQR   (b) SPRQ   (c) QPSR   (d) PRQS

> (**d**) PRQS is the correct sequence.

132. Boys are <u>on their parents</u>
(P)
<u>invariably dependent</u> <u>until they can earn</u>
(Q)   (R)
<u>money to support themselves</u>
(S)

The correct sequence should be
(a) RSQP   (b) QRSP
(c) RPQS   (d) QPRS

> (**d**) QPRS is the correct sequence.

133. The principal said that <u>those students</u>
(P)
<u>would not be permitted to enter</u>
(Q)
<u>who do not produce</u> <u>identity cards</u>
(R)   (S)

The correct sequence should be
(a) RSPQ   (b) RPSQ
(c) PRSQ   (d) SRPQ

> (**c**) PRSQ is the correct sequence.

134. The doctor remarked that <u>lying in bed</u>
(P)
<u>if students are</u> <u>fond of reading</u>
(Q)   (R)
<u>it will be bad for the eyes</u>
(S)

The correct sequence should be
(a) PQRS   (b) QRSP
(c) SQRP   (d) QRPS

> (**c**) SQRP is the correct sequence.

135. We saw <u>while playing</u>   <u>with the boys</u>
(P)   (Q)
<u>that Ram fell down</u>   <u>and hurt his leg</u>
(R)   (S)

The correct sequence should be
(a) RSPQ   (b) PQRS
(c) RPQS   (d) RPSQ

> (**a**) RSPQ is the correct sequence.

136. <u>for an hour</u> <u>because it had to wait</u>
(P)   (Q)
<u>due to dense fog</u>   <u>the plane couldn't take off</u>
(R)   (S)

The correct sequence should be
(a) PQRS   (b) RQPS
(c) QPRS   (d) SPQR

> (**d**) SPQR is the correct sequence.

137. She complained that <u>that it took a month</u>
(P)
<u>to clean</u> <u>it the house</u>
(Q)   (R)
<u>was so dirty</u>
(S)

The correct sequence should be
(a) PQRS   (b) SPQR   (c) PSQR   (d) RSPQ

> (**d**) RSPQ is the correct sequence

.

2014 (I)

138. There must be countries now in which peasants <u>can</u>
<u>spend several years in universities</u>
(P)
<u>so that</u>   <u>a lot of young persons</u>
(Q)   (R)
<u>are going without substantial meals</u>
(S)

The correct sequence should be
(a) SRQP   (b) PQRS   (c) SQRP   (d) QPSR

> (**c**) SQRP is the correct sequence.

139. Athens <u>it was also</u>
(P)
<u>the first democracy in the world</u>
(Q)
<u>was not only</u>
(R)
<u>an almost perfect democracy</u>
(S)

The correct sequence should be
(a) RSPQ   (b) PQRS   (c) RQPS   (d) QPSR

> (**c**) RQPS is the correct sequence.

140. The practice of taking performance-boosting drugs among athletes, <u>but checking it is not going to be easy</u>
(P)
<u>is generally conceded to be unfair</u>
(Q)
<u>of the detection technology</u>
(R)
<u>for the user is generally one jump ahead</u>
(S)

The correct sequence should be
(a) RSPQ   (b) QPSR
(c) QPRS   (d) PQRS

> (**b**) QPSR is the correct sequence.

141. All religions are <u>to advance the cause of peace</u>
                                    (P)
<u>in a holy partnership</u> <u>justice and freedom</u>
          (Q)   (R)
<u>bound together</u>
      (S)

The correct sequence should be
(a) PRQS   (b) PQRS   (c) SQPR   (d) SPQR
⊙ *(c)* SQPR is the correct sequence.

142. Seventy-two people <u>reports PTI</u>
                                  (P)
<u>were affected by food poisoning</u>
            (Q)
<u>including several women and children</u>
              (R)
<u>of the central part of the city</u>
            (S)

The correct sequence should be
(a) SPQR   (b) PQRS   (c) RSPQ   (d) RSQP
⊙ *(d)* RSQP is the correct sequence.

143. The Prime Minister declared that <u>those states</u>
                                                    (P)
<u>will get all help and aid</u>
          (Q)
<u>where family planning</u>
          (R)
<u>is effected very efficiently</u>
            (S)

The correct sequence should be
(a) PRSQ   (b) PQRS   (c) RSPQ   (d) QPSR
⊙ *(a)* PRSQ is the correct sequence.

144. Hardly had my brother descended from the plane
<u>when the people</u>   <u>waved and cheered</u>
          (P)   (Q)
<u>who had come to receive him</u> <u>from the lounge</u>
            (R)   (S)

The correct sequence should be
(a) PRQS   (b) PQRS
(c) SPQR   (d) PRSQ
⊙ *(a)* PRQS is the correct sequence.

145. My friend <u>when he was going to his office</u>
                              (P)
<u>met with an accident</u>   <u>on his scooter</u>
          (Q)   (R)
<u>due to rash driving</u>
          (S)

The correct sequence should be
(a) PQRS   (b) PRQS   (c) SRQP   (d) QSRP
⊙ *(b)* PRQS is the correct sequence.

146. Mohan, the son of my friend,<u> gave me a set of pens</u>
                                                    (P)
<u>which is very precious</u> <u>while working in Japan</u>
            (Q)   (R)
<u>who died in an accident</u>
            (S)

The correct sequence should be
(a) PQRS   (b) SRPQ   (c) RSPQ   (d) SPQR
⊙ *(b)* SRPQ is the correct sequence.

147. The boy said <u>I am not goint to the school</u>
                                (P)
<u>with my friends in the class room</u>
            (Q)
<u>where my teacher scolds</u>
            (R)
<u>me when I want to play</u>
          (S)

The correct sequence should be
(a) PQRS   (b) PSQR
(c) SQPR   (d) PRSQ
⊙ *(d)* PRSQ is the correct sequence.

148. The clerk <u>on the desk</u>
                          (P)
<u>left the money</u>   <u>in the safe</u>
        (Q)   (R)
<u>which he should have locked up</u>
                (S)

The correct sequence should be
(a) PQRS   (b) RSPQ
(c) QPRS   (d) QPSR
⊙ *(d)* QPSR is the correct sequence.

ORDERING OF SENTENCES

Directions *(Q. Nos. 1-131) In this section, each item consists of six sentences of a passage. The first and sixth sentences are given in the beginning as S_1 and S_6. The middle four sentences in each item have been jumbled up and labelled as P, Q, R and S. You are required to find the proper sequence of the four sentences and mark you response accordingly.*

1. S_1 : The master always says, ''Refuse to be miserable''.

S_6: His is the art of right contact in life.

P : Before you fall into self-pity and blame games, remember that responsibility comes to only those who feel responsible.

Q : Challenges are faced by the strong and courageous, and if life brings you such opportunities, then turn failures into success.

R : Life can be painful, but it need not be sorrowful.

S : If you wan to be happy, find occasions to be cheerful.

The correct sequence should be
(a) RSPQ (b) SQPR (c) QRSP (d) RQSP

⊘ *(a)* RSPQ is the correct sequence.

2. S_1 : Gandhiji reached Newcastle and took charge of the agitation.

S_6 : The treatment that was meted out to these brave men and women in jail included

starvation and whipping and being forced to work in the mines by mounted military police.

P : During the course of the march, Gandhiji was arrested twice, released, arrested a third time and sent to jail.

Q : The employers retaliated by cutting off water and electricity to the workers' quarters, thus forcing them to leave their homes.

R : Gandhiji decided to march this army of over two thousand men, women and children over the border and thus see them lodged in Transvaal jails.

S : The morale of the workers, however, was very high and they continued to march till they were prosecuted and sent to jail.

The correct sequence should be
(a) QRPS   (b) SRQP
(c) QPSR   (d) RQSP

⊘ *(d)* RQSP is the correct sequence.

3. S_1 : One of the most important forces in the modern world, socialism was a direct result of the Industrial Revolution.

S_6 : This is how socialism as a theory and practice came into being.

P : Socialism was a direct challenge to capitalism and sought to put and end to such an exploitative economic structure.

Q : The gulf between the 'haves' and the 'have nots' continued to increase and out of this gap between the rich and poor sprang disputes.

R : It generated new wealth but as this new wealth only went to a minority, it could not solve the question of distribution.

S : The Industrial Revolution solved the question of production.

The correct sequence should be
(a) PQRS (b) SRQP (c) SRPQ (d) RQSP

⊘ *(b)* SRQP is the correct sequence.

4. S_1 : Institutions define and play a regulatory role with regard to human behaviour.

S_6 : It shows how important it is for a nation to build institutions for nurturing democracy.

P : Once established, institutions set a dynamic relationship with the members constituting them and they mutually affect each other.

Q : They shape preferences, power and privilege.

R : At the same time, institutions themselves can be transformed by the politics they produce and such transformation can affect social norms and behaviours.

S : They also provide a sense of order and predictability.

The correct sequence should be
(a) RPQS (b) QRSP (c) PSRQ (d) QSRP

⊘ *(b)* QRSP is the correct sequence.

5. S_1 : Idioms are a colourful and fascinating aspect of language.

S_6 : Idioms may also suggest a particular attitude of the person using them, for example, disapproval, humour, exasperation or admiration, so you must use them carefully.

P : Your language skills will increase rapidly if you can understand idioms and use them confidently and correctly.

Q : They are commonly used in all types of language, informal and formal, spoken and written.

R : In additions, idioms often have a stronger meaning than non-idiomatic phrases.

S : One of the main problems students have with idioms is that it is often impossible to guess the meaning of an idiom from the words it contains.

The correct sequence should be
(a) RQPS (b) RSPQ (c) SRQP (d) QPSR

⊚ *(d)* QPSR is the correct sequence.

6. S_1 : Each organism is adapted to its environment.

S_6 : What can be taken in and broken down depends on the body design and functioning.

P : There is a range of strategies by which the food is taken in and used by the organism.

Q : For example, whether the food source is stationary (such as grass) or mobile (such as deer), would allow for differences in how the food is accessed and what is nutritive apparatus used by a cow or a lion.

R : The form of nutrition differs depending on the type and availability of food material as well as how it is obtained by an organism.

S : Some organisms break down the food material outside the body and them absorb it and others take in the whole material and break it down inside their bodies.

The correct sequence should be
(a) RQPS (b) QPSR (c) SQPR (d) QPRS

⊚ *(a)* RQPS is the correct sequence.

7. S_1 : "When I was alive and had a human heart", answered the statue, "I did not know what tears were, for I lived in the Palace of Sans-Souci where sorrow is not allowed to enter.

S_6 : And now that I am dead they have set me up here so high that I can see all the ugliness and all the misery of may city, and though my heart is made of lead yet I cannot choose but weep."

P : So I lived, and so I died.

Q : Round the garden ran a very lofty wall, but I never cared to ask what lay beyond it, everything about me was so beautiful.

R : My courtiers called me the Happy Prince, and happy indeed I was, if pleasure be happiness.

S : In the daytime I played with my companions in the garden and in the evening I led the dance in the Great Hall.

The correct sequence should be
(a) QSRP (b) PQRS (c) PRQS (d) RPQS

⊚ *(*)* SQRP is the correct sequence.

8. S_1 : One day her mother, having made some cakes, said to her, "Go, my dear, and see how your grandmother is doing, for I hear she has been very ill. Take her a cake, and this little pot of butter."

S_6 : "Does she live far off?" said the wolf.

P : He asked her where she was going.

Q : The poor child who did not know that it was dangerous to stay and talk to a wolf, said to him, "I am going to see my grandmother and carry her a cake and a little pot of butter from my mother".

R : As she was going through the wood, she met with a wolf, who had a very great mind to eat her up, but he dared not, because of some woodcutters working nearby in the forest.

S : She set out immediately to go to her grandmother, who lived in another village.

The correct sequence should be
(a) PRQS (b) SRPQ
(c) PRSQ (d) RPQS

⊚ *(b)* SRPQ is the correct sequence.

9. S_1 : I had spent many nights in the jungle looking for game, but this was the first time I has ever spent a night lookign for a man-eater.

S_6 : It was in this position my men an hour later found me fast asleep; of the tiger I had neither heard nor seen anything.

P : I bitterly regretted the impulse that had induced me to place myself at the man-eather's mercy.

Q : The length of road immediately in front of me was brilliantly lit by the, moon, but to right and left the overhanging trees cast dark shadows and when the night wind agitated the branches and the shadows moved, I saw a dozen tigers advancing on me.

R : As the grey dawn was lighting up the snowy range which I was facing, I rested my head to my drawn-up knees.

S : I lacked the courage to return to the village and admit I was too frightened to carry out my self-imposed task, and with teeth chattering, as much from fear as from cold, I sat out the long night.

The correct sequence should be
(a) QPSR (b) SRPQ
(c) PRSQ (d) RPQS

⊚ *(a)* QPSR is the correct sequence.

2019 (I)

10. S_1 : He no longer dreamed of storms, nor of women, nor of great occurrences, nor of great fish, nor fights, nor contests of strength, nor of his wife.

S_6 : He urinated outside the shack and then went up the road to wake the boy.

P : He never dreamed about the boy.

Q : He only dreamed of places and of the lions on the beach now.

R : He simply woke, looked out through the open door at the moon and unrolled his trousers and put them on.

S : They played like young cats in the dusk and he loved them as he loved the boy.

The correct sequence should be

(a) RQPS   (b) SRQP
(c) QSPR   (d) RRSQ

⊙ *(c)* QSPR is the correct sequence.

11. S_1 : We do not know, after 60 years of education, how to protect ourselves against epidemics like cholera and plague.

S_6 : This is the disastrous result of the system under which we are educated.

P : If our doctors could have started learning medicine at an earlier age, they would not make such as poor show as they do.

Q : I have seen hundreds of homes. I cannot say that I have found any evidence in them of knowledge of hygiene.

R : I consider it a very serious blot on the state of our education that our doctors have not found it possible to eradicate these diseases.

S : I have the greatest doubt whether our graduates know what one should do in case one is bitten by a snake.

The correct sequence should be

(a) RQSP   (b) PRQS
(c) QRPS   (d) PQSR

⊙ *(c)* QRPS is the correct sequence.

12. S_1 : The weak have no place here, in this life or in any other life. Weakness leads to slavery.

S_6 : This is the great fact : strength is life weakness is death. Strength is felicity, life eternal; immortal; weakness is constant strain and misery; weakness is death.

P : They dare not approach us, they have no power to get a hold on us, until the mind is weakened.

Q : Weakness leads to all kinds of misery, physical and mental. Weakness is death.

R : But they cannot harm us unless we become weak, until the body is ready and predisposed to receive them.

S : There are hundreds of thousands of microbes surrounding us.

The correct sequence should be

(a) PQRS   (b) PRQS
(c) QRSP   (d) QSRP

⊙ *(d)* QSRP is the correct sequence.

13. S_1 : The Nobel Prize for Economics in 2018 was awarded to Paul Romer and William Nordhaus for their work in two separate areas : economic growth and environmental economics respectively.

S_6 : Among recent winners of Nobel Prize in Economics, it's hard to think of one issue which is more topical and relevant to India.

P : But there is a common thread in the work.

Q : In economic jargon it's termed as externality.

R : Productive activity often has spillovers, meaning that is can impact and unrelated party.

S : Romer and Nordhaus both studied the impact of externalities and came up with profound insights and economic models.

The correct sequence should be

(a) PQRS (b) PRQS (c) QSPR (d) QSRP

⊙ *(b)* PRQS is the correct sequence.

14. S_1 : India's museums tend to be dreary experiences.

S_6 : Because it's better to attract crowds than dust.

P : Even the Louvre that attracted an eye-popping 8.1 million visitors last year compared to India's 10.18 million foreign tourists, has hooked up with Beyonce and Jay-Z for promotion, where they take a selfie with Mona Lisa.

Q : Our museums need to get cool too.

R : A change of approach is clearly called for.

S : Troops of restless schoolchildren are often the most frequent visitors, endlessly being told to lower their voices and not touch ther art.

The correct sequence should be

(a) PQRS   (b) PRSQ
(c) SRPQ   (d) QSRP

⊙ *(c)* SRPQ is the correct sequence.

15. S_1 : A decade ago UN recognised that rape can constitute a war crime and a constitutive act of genocide.

S_6 : The fact that these two peace laureates come from two different nations underlines that this problem has been widespread, from Rwanda to Myanmar.

P : This year's Nobel Peace Prize has been awarded to two exceptional individuals for their fight to end the use of sexual violence as the weapon of war.

Q : Denis Mukwege is a doctor who has spent decades treating rape survivors in the Democratic Republic of Congo, where along civil war has repeatedly witnessed the horror of mass rapes.

R : Nadia Murad is herself a survivor of sexual war crimes, perpetuated by IS against the Yazidis.

S : Today she campaigns tirelessly to put those IS leaders in the dock in international courts.

The correct sequence should be

(a) PQRS (b) PRQS (c) SRQP (d) QRSP

⊙ *(a)* PQRS is the correct sequence.

16. S_1 : Few scientists manage to break down the walls of the so-called ivory tower of academia and touch and inspire people who may not otherwise be interested in science.

S_6 : Not many would have 6 survived this, let alone excelled in the manner he did.

P : Stephen Hawking was one of these few.

Q : Around this time he was diagnosed with Amyotrophic Lateral Sclerosis, an incurable motor neuron disease and given two years to live.

R : Judging by the odds he faced as a young graduated student of physics at Cambridge University, nothing could have been a more remote possibility.

S : When he was about 20 years old, he got the shattering news that he could not work with the great Fred Hoyle for his PhD, as he had aspired to.

The correct sequence should be

(a) PQSR   (b) PRQS
(c) SRPQ   (d) PRSQ

⊘ *(d)* PRSQ is the correct sequence.

17. S_1 : The climate question presents a leapfrog era for India's development paradigm.

S_6 : This presents a good template for India, building on its existing plans to introduce electric mobility through buses first and cars by 2030.

P : It is aimed at achieving a shift to sustainable fuels, getting cities to commit to eco-friendly mobility and delivering more walkable communities, all of which will improve the quality of urban life.

Q : At the Bonn conference, a new Transport Decerbonisation Alliance has been declared.

R : This has to be resolutely pursued, breaking down the barriers to wider adoption of rooftop solar energy at every level and implementing net metering systems for all categories of consumers.

S : Already, the country has chalked out an ambitious policy on renewable energy, hoping to generate 175 gigawatts of power from green sources by 2022.

The correct sequence should be

(a) SRQP   (b) SPRQ
(c) PRSQ   (d) QRSP

⊘ *(a)* SRQP is the correct sequence.

18. S_1 : The dawn of the information age opened up great opportunities for the beneficial use of data.

S_6 : To some, in this era of big data analytics and automated, algorithm based processing of zettabytes of information, the fear that their personal data may be unprotected may conjure up visions of a dystopian world in which individual liberties are compromised.

P : But it is the conflict between the massive scope for progress provided by the digital era and the fear of loss of individual autonomy that is foregrounded in any debates about data protection laws.

Q : It also enhanced that perils of unregulated and arbitrary use of personal data.

R : It is against this backdrop that the white paper made public to elicit views from the public on the shape and substance of a comprehensive data protection laws assumes significance.

S : Unauthorised leaks, backing and other cyber crimes have rendered data bases vulnerable.

The correct sequence should be

(a) SQRP   (b) QPRS
(c) SRPQ   (d) QSPR

⊘ *(d)* QSPR is the correct sequence.

19. S_1 : In a globalised world, no country can hope to impose tariffs without affecting its own economic interests.

S_6 : The ongoing trade war also threatens the rules-based global trade order which has managed to amicably handle trade disputes between countries for decades.

P : So both the US and China, which have blamed each other for the ongoing trade war, are doing no good to their own economic fortunes by engaging in this tit-for-tat tariff battle.

Q : Apart from disadvantaging its consumers, who will have to pay higher prices for certain goods, tariffs will also disrupt the supply chain of producers who rely on foreign imports.

R : China, which is fighting an economic slowdown, will be equally affected.

S : The minutes of the US Federal Reserve June policy meeting show that economic uncertainty due to the trade war is already affecting private investment in the US, with many investors deciding to scale back or delay their investment plans.

The correct sequence should be

(a) SQPR   (b) QPSR
(c) QRPS   (d) PSRQ

⊘ *(b)* QPSR is the correct sequence.

2018 (II)

20. S_1 : The giant wall of the Dhauladhar range in Himachal Pradesh is one of the most stunning sights in the Himalayas.

P : As the life line of the region it acts as a watershed ridge between Chamba's Ravi river system and Kangra's Beas river system.

Q : Although of modest altitude compared to other Himalayan ranges-the highest Dhauladhar peak is less than 5,000 m.

R : Thus, the Dhauladhar could be stated as the life line of the region.

S : Despite of that, the range sweeps up an astounding 12,000 ft. from the valley floor, creating a barrier wall in that is striking to look at.

S_6 : Looming over the hill stations of Dharmsala and Mcleodganj, the Dhauladhar is a popular trekking destination.

(a) QRPS   (b) SPQR
(c) QSRP   (d) RQSP

⊘ *(c)* QSRP is the correct sequence.

21. S_1 : Truth is far more important than the teacher.

P : Without self-knowledge, the airplane becomes the, most

destructive instrument in life; but with self-knowledge, it is a means of human help.

Q : Wisdom begins with self-knowledge; and without self-knowledge, mere information leads to destruction.

R : In other words, you have to be the perfect teacher to create a new society; and to bring the perfect teacher into being, you have to understand yourself.

S : Therefore you, who are the seeker of truth, have to be both the pupil and the teacher.

S_6 : So, a teacher must obviously be one who is not within the clutches of society, who does not play power politics or seeks position or authority.

(a) QRSP   (b) SRQP
(c) QSRP   (d) RQSP

⊙ **(b)** SRQP is the correct sequence.

22. S_1 : Though most of us talk of discipline, what do we mean by that word?

P : The teacher would understand each child and help him in the way required.

Q : But if you have five or six in a class and an intelligent understanding teacher with a warm heart, I am sure there would be no need discipline.

R : When you have a hundred boys in a class, you will have to have discipline; otherwise there will be complete chaos.

S : Discipline in schools becomes necessary when there is one teacher to the hundred boys and girls.

S_6 : And most of us are interested in mass movements, large schools with a great many boys and girls; we are not interested in creative intelligence, therefore we put up huge schools with enormous attendances.

(a) QRSP   (b) SRQP
(c) QSRP   (d) RQPS

⊙ **(d)** RQPS is the correct sequence.

23. S_1 : Tolstoy Farm was founded in 1910 by which time Gandhi had already conceptualised ideas that he would develop in India.

P : He was rich and used his money to buy the land and help set up the farm.

Q : A Jewish architect, Kallenbach was by his side through this period.

R : Tolstoy Farm became the subject of research for different kinds of cooperative communities across the world.

S : He first put in the social, moral, religious components of his doctrine.

S_6 : Both he and Gandhi often referred to the time that they spent in Tolstoy Farm as among the happiest in their lives.

(a) QRSP (b) SQPR (c) SQRP (d) RQPS

⊙ **(⋆)** SRQP is the correct sequence.

24. S_1 : Decentralised planning is a process of planning that begins from the grassroots level taking into confidence all the beneficiaries.

P : Under decentralised planning, the operation is from bottom to top.

Q : It can be said that it is more connected with the capitalistic economies.

R : It empowers the individuals and small groups to carry out their plans fro their achievement of a common goal.

S : The decentralised planning is implemented through market mechanism.

S_6 : But it cannot be described as undemocratic for most national states adopt such a planning now.

(a) QRSP (b) SRQP (c) SQRP (d) SRPQ

⊙ (**c**) SQRP is the correct sequence.

25. S_1 : It is doubtful if mankind, throughout his long histroy, has ever lived at all 'sustainably'.

P : But in general mankind has regarded the environment as an endless 'resource' to be exploited and plundered.

Q : May be a few isolated tribal groups found the necessary balance with nature lived without the desire for endless 'more'.

R : Now we have reached a point where we are on the verge of destroying ourselves and most of the life on Earth.

S : This process has accelerated greatly since the industrial revolution.

S_6 : The concept of 'sustainable' is so far from reality that it is almost laughable.

(a) PQRS   (b) QPSR
(c) PQSR   (d) SRQP

⊙ **(b)** QPSR is the correct sequence.

26. S_1 : Measurement is an important concept in performance management.

P : It also indicates where things are not going so well, so that corrective action can be taken.

Q : It identifies where things are going well to provide the foundations for building further success.

R : It is the basis for providing and generating feedback.

S : Measuring performance is relatively easy for those who are responsible for achieving quantified targets for example sales.

S_6 : It is more difficult in the case of knowledge workers e.g. scientists and teachers.

(a) RQPS   (b) QPSR
(c) PSQR   (d) SPQR

⊙ **(b)** QPSR is the correct sequence.

27. S_1 : Equity theory is concerned with the perception people have about how they are being treated compared with others.

P : To be dealt with equitably is to be treated fairly in comparison with another group of people or a relevant other person.

Q : Equity involves feelings and perceptions and is always a comparative process.

R : Equity theory states, in effect, that people will better motivated if they are treated equitably and demotivated if they are treated inequitably.

S : It is not synonymous with equality, which means treating everyone the same, since this would be inequitable if they deserve to be treated differently.

S_6 : This explains only one aspect of the process of motivation and job satisfaction, although it may be significant in terms of morale.

(a) PQRS (b) PQSR (c) RSQP (d) QPRS

⊙ *(c)* RSQP is the correct sequence.

28. S_1 : We cannot understand the power of rumours and prophecies in history by checking whether they are factually correct or not.

P : The rumours in 1857 began to make sense when seen in the context of the policies the British pursued from the late 1820s.

Q : Rumours circulate only when they resonant with the deeper fears and suspicions of people.

R : Under the leadership of Governor-General Lord William Bentinck, the British adopted policies aimed at reforming India society by introducing Western education, Western ideas and Western institutions.

S : We need to see what they reflect about the minds of people who believed them-their fears and apprehensions, their faiths and convictions.

S_6 : With the cooperation of sections of Indian society they set up English-medium schools, colleges and universities which taught Western sciences and liberal arts.

(a) SQPR (b) QSPR (c) PRSQ (d) RSPQ

⊙ *(a)* SQPR is the correct sequence.

29. S_1 : The Constitution of India thus emerged through a process of intense debate and discussion.

P : This was an unprecedented act of faith, for in other democracies the vote had been granted slowly, and in stages.

Q : However, on one central feature of the Constitution there was substantial agreement.

R : Many of the provisions were arrived at through a process of give and take, by forgiving a middle ground between two opposed positions.

S : This was on the granting of the vote to every adult Indian.

S_6 : In countries such as the United States and the United Kingdom, only men with education were allowed into the charmed circal.

(a) PRSQ (b) RQSP (c) SPRQ (d) QSRP

⊙ *(b)* RQSP is the correct sequence.

2018 (I)

30. S_1 : First and foremost, there are order and safety in our civilisation.

S_6 : Nobody may come and break into my house and steal my goods.

P : Thus in disputes between man and man, right has taken the place of might.

Q : If today I have a quarrel with another man, I do not get beaten merely because I am physically weaker.

R : I go to law and the law will decide fairly between the two of us.

S : Moreover, the law protects me from robbery and violence.

The correct sequence should be

(a) RQPS (b) SRQP
(c) QRPS (d) PRSQ

⊙ *(c)* QRPS is the correct sequence.

31. S_1 : In democratic countries, men are equal before the law.

S_6 : And they live like this not for fun, but because they are too poor to afford another room.

P : While some few people live in luxury, many have not enough to eat, drink and water.

Q : There are many families of five or six persons who live in a single room.

R : But the sharing-out of money which means the sharing-out of food and clothing and houses is still very unfair.

S : In this room, they sleep and dress and wash and eat in this same room they die.

The correct sequence should be

(a) RPQS (b) PRSQ
(c) QSPR (d) SPRQ

⊙ *(a)* RPQS is the correct sequence.

32. S_1 : Tomorrow it will be a year since we lost our great leader.

S_6 : Though he is no more with us, the qualities he possessed and the ideals he cherished remain with us.

P : To these he added a feminine sensitiveness to atmosphere.

Q : He was involved in the major events of his time.

R : He participate in them all while maintaining the highest standards of public conduct.

S : He was incomparably the greatest figure in our history—a man of dynamic force, intellectual power and profound vision.

The correct sequence should be

(a) PSRQ (b) RQPS
(c) RPQS (d) SPQR

⊙ *(d)* SPQR is the correct sequence.

33. S_1 : It would be possible to adduce many examples showing what could be done with the limited means at our ancestor's disposal in the way of making life comforable.

S_6 : I hope, in this essay, to make that connection manifest.

P : What have comfort and cleanliness to do with politics, moral and religion?

Q : But look more closely and you will discover that there exists the closest connection between the recent growth of comfort and the recent history of ideas.

R : They show that if they lived in filth and discomfort, it was because fifth and discomfort fitted in with their principles, political, moral and religious.

S : At a first glance one would say that there could be no casual connection between arm chairs and democracies, sofas and the family system, hot baths and religious orthodoxy.

The correct sequence should be

(a) PRQS (b) RPSQ
(c) QSRP (d) QSPR

⊙ *(c)* QSRP is the correct sequence.

34. S_1 : To most people, the term, technology conjures up images of mills or machines.

S_6 : It includes ways to make chemical reactions occurs, ways to breed fish, plant forests or teach history.

P : The classic symbol of technology is still the assembly line created by Henry Ford half a century ago.

Q : The invention of the horse collar in the Middle Ages led to changes in agricultural methods and was as such a technological advance.

R : Moreover, technology includes techniques, as well as the machines that may or may not be necessary to apply them.

S : This symbol, however, has always been inadequate, for technology has always been more than factories and machines.

The correct sequence should be
(a) SPRQ (b) PSQR (c) RSPQ (d) QSRP

⊙ **(b)** PSQR is the correct sequence.

35. S_1 : I as the secretary of the Philosophical Society of the Patna College.

S_6 : I have been to Kolkata many times since, but never has it been more pleasant than that first visit.

P : It was may first visit to the city and its impression on my mind was indelible.

Q : In that capacity, I once led a trip to Kolkata.

R : I felt I has landed in the midst of beautiful dream world of a fairy land.

S : I saw the roads, the trams, the skyscrapers and the magnificient shops at the Chowranghee lane.

The correct sequence should be
(a) QPSR (b) PSQR
(c) SRPQ (d) SQRP

⊙ **(a)** QPSR is the correct sequence.

36. S_1 : Union Finance Ministry announced a series of concessions to trade and industry last month.

S_6 : Manufacturers feel that prices of certain components may not be brought down because of the imposition of a 30% duty where there was none earlier.

P : Together, these will result in a loss of revenue of Rs.100 crore to the exchequers.

Q : Earlier, these were attracting customs duty varying from zero to 100%.

R : The chunk of the relief of Rs. 60 crore has gone to the electronics industry.

S : Raw materials and piece parts now carry customs duty of 30% and 40% ad valorem respectively.

The correct sequence should be
(a) RSQP (b) PRSQ
(c) SQPR (d) QPRS

⊙ **(b)** PRSQ is the correct sequence.

37. S_1 : At 4 O' clock this morning Hitler attacked and invaded Russia.

S_6 : Under its clock of false confidence, the German armies drew up in immense strength along a line which stretches from the White Sea to the Black Sea.

P : No complaint had been made by Germany of its non-fulfilment.

Q : All his usual formalities of perfidy were observed with scrupulous technique.

R : No one could have expected that Hitler would do it.

S : A non-aggression treaty had been solemnly signed and was in force between the two countries.

The correct sequence should be
(a) RQSP (b) RSQP (c) PSQR (d) QPSR

⊙ **(a)** RQSP is the correct sequence.

38. S_1 : Roderick Usher has always been a quiet person who talked little of himself.

S_6 : In the part of the country where he lived, the 'House of Usher' had come to mean both the family and its ancestral mansion.

P : Many of his ancestors had been famous for their artistic and musical abilities.

Q : Others were known for their exceptional generaosity and charity.

R : Yet I did know that his family was an old one.

S : So, I did not know too much about him.

The correct sequence should be
(a) PQRS (b) SRQP
(c) SPRQ (d) SRPQ

⊙ **(d)** SRPQ is the correct sequence.

39. S_1 : Mass production has increased the tendency to view things as useful rather than delightful.

S_6 : Indeed a lowering of quality usually results when mass production is substituted for more primitive methods.

P : These various things share nothing with the buttons except money value.

Q : All the rest you wish to exchange for food, shelter and many other things.

R : Suppose you are a manufacturer of buttons : however excellent your buttons may be, you do not want more than a few for your own use.

S : And it is not even the money value of the buttons that is important to you : what is important is profit which may be increased by lowering their quality.

The correct sequence should be
(a) PQRS (b) RQPS (c) SPQR (d) QRPS

⊙ **(b)** RQPS is the correct sequence.

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40. S_1 : Egypt lies in the North-East corner of Africa.

S_6 : The whole country depends on the water of the Niles.

P : Most of it is desert or semi-desert.

Q : It has very little rainfall.

R : It is four times as big as Great Britain in size.

S : Only a twenty-fifth of total area is cultivable.

The correct sequence should be
(a) PQRS (b) SRPQ
(c) RPSQ (d) QPRS

⊙ **(c)** RPSQ is the correct sequence.

41. S_1 : In mechanical efforts, you improve by perpetual practice.

S_6 : There is neither excuse nor temptation for the latter.

P : He cannot go on shooting wide or falling short, and still fancy that he is making progress.

Q : This is so because the object to be attained is a matter of actual experiment in which you either succeed or fail.

R : He must either correct his aim, or persevere in his error with his eyes open.

S : If a man aims at a mark with bow and arrow, he must either hit it or aim it.

The correct sequence should be

(a) PSQR   (b) RPSQ
(c) SQRP   (d) QSPR

⊘ *(d)* QSPR is the correct sequence.

42. S_1 : Isaac's mother married again.
    S_6 : He had a set of little tools and saw of various size made by himself.
   P : But he was known to be very clever at making things.
   Q : She sent him to school.
   R : Isaac was left to he care of his good old grandmother.
   S : In his early years Isaac did not appear to be a very bright student.

The correct sequence should be

(a) RQSP (b) QRSP (c) SQRP (d) RPQS

⊘ *(a)* RQSP is the correct sequence.

43. S_1 : The examination system must be regarded as the chief wrecker of young nerves.
    S_6 : If I become a Vice-Chancellor, my first act would be to abolish all examination in my university.
   P : It makes me jump out of the bed, all in a sweat.
   Q : It does this by building up a tension, for a part of the year, all through one's youth.
   R : And after four decades, the same nervousness sometimes recurs to me in nightmares.
   S : I remember the desperate nervousness that used to grip me from January to April every year.

The correct sequence should be

(a) RPQS   (b) RSPQ
(c) RQPS   (d) QSRP

⊘ *(d)* QSRP is the correct sequence.

44. S_1 : History is a subject that is so little valued today that is is almost impossible to win world fame as a historian; yet that is exactly what Toynbee was able so.
    S_6 : Among the civilisations that he studied was that of India.
   P : We usually think of history as a chronological account of the development of various states and empires under ruler.
   Q : Toynbee's view of history was different.
   R : He tries to find the pattern behind the birth, growth and decay of civilisation.
   S : Though he used the recorded history of mankind, but he was interested not merely in the chronology of single states or group but in the rise and fall of whole civilisations.

The correct sequence should be

(a) PSQR   (b) QSPR
(c) SQRP   (d) PQSR

⊘ *(d)* PQSR is the correct sequence.

45. S_1 : Science first began to become important after A.D. 1500.
    S_6 : Men read them, became inquisitive again, and began to want to find things out.
   P : As a result of this, books came to be circulated.
   Q : During the Middle Ages the coming of Science was hindered by the Church.
   R : In the middle of the fifteenth century, however, the Turks captured the city of Constantinople and the Greek books were scattered far and wide.
   S : It considered free inquiry into the nature of things to be wicked.

The correct sequence should be

(a) PQSR   (b) QSRP
(c) SRPQ   (d) RPQS

⊘ *(a)* PQSR is the correct sequence.

46. S_1 : Phatik was a mischievous boy of fourteen.
    S_6 : Ultimately he distinguished himself as a scholar.
   P : It was then that Phatik's uncle offered to take the boy to Kolkata.

Q : She was much worried about his education.

R : His mother found it difficult to bring him up.

S : Away from his home Phatik becomes sober and industrious.

The correct sequence should be

(a) PQRS   (b) SRQP
(c) RSPQ   (d) RQPS

⊘ *(d)* RQPS is the correct sequence.

47. S_1 : Whenever I met Baba Amte I was reminded of an anecdote my grandmother used to tell me.
    S_6 : He forgot that he had made it.
   P : He once made an idol of God.
   Q : As the idol was nearing completion, the sculptor was becoming more and more withdrawn into himself.
   R : And the movement it was complete, he threw away his chisel and hammer and bowed to the idol of God he had just created.
   S : There was a great sculpto.

The correct sequence should be

(a) PQRS   (b) SRPQ
(c) SPQR   (d) QPRS

⊘ *(a)* PQRS is the correct sequence.

48. S_1 : Ross sent an account of his work, together with slide and specimens to Manson.
    S_6 : Ross was elected a fellow of the Royal Society in 1901.
   P : They produced a profound sensation.
   Q : In July, 1898, Manson described Ross's results to the British Medical Association.
   R : The President of the Royal Society came to Manson's house and inspected Ross's materials and said that 'it was of remarkable interest and value'.
   S : When Manson had finished, the whole audience rose and cheered.

The correct sequence should be

(a) RSPQ   (b) PSRQ
(c) QPSR   (d) SPQR

⊘ *(c)* QPSR is the correct sequence.

49. S₁ : Civilisation dawned when early man learnt how to produce heat and energy by burning wood.

S₆ : When they have been used, they cannot be replaced.

P : Then steam was used to produce electricity.

Q : In this century great use has been made of oil and natural gas and the use of atomic reactors also has provided another source of energy.

R : Much later, the first industrial revolution was based on the production of steam by burning coal.

S : But none of these fuels is renewable.

The correct sequence should be

(a) PRQS   (b) RQSP
(c) RPQS   (d) RPSQ

⊙ *(c)* RPQS is the correct sequence.

50. S₁ : Ghost is a subject which baffles everyone everywhere throughout the world.

S₆ : Yet it is a subject which has held people spellbound and the belief in them continues to flourish.

P : But human beings have always been curious to know more about them.

Q : Needless to say, such attempts have proved to be useless.

R : There have been attempts even to photograph these creatures of darkness.

S : Even after the advancement of science, the reality of ghosts remains a mystery till this day.

The correct sequence should be

(a) QRPS (b) SQPR (c) SPRQ (d) SQRP

⊙ *(c)* SPRQ is the correct sequence.

51. S₁ : There have been two schools of thought which deal with the errors of learners.

S₆ : Both views are popular today but the second is gaining ground fast.

P : The philosophy of the second school is that errors are natural and they will occur in any learning.

Q : So errors, they say, is a sign of faulty teaching methods.

R : The first school maintains that if teaching methods are perfect, errors will never occurs.

S : They argue that we should concentrate on how to deal with errors, instead of on method of teaching.

The correct sequence should be

(a) QSRP   (b) PSQR
(c) QPSR   (d) RQPS

⊙ *(d)* RQPS is the correct sequence.

52. S₁ : Down the stair way of the Holiday Inn hotel, I enter the conference hall.

S₆ : Some are leaning against the sidewall.

P : I take a seat in the back row as more chairs are quietly slipped in for late corners.

Q : The hall is already packed with delegates.

R : Still quite a few people are left standing.

S : Most of the delegates are executives of Indian or Indo-US companies.

The correct sequence should be

(a) SQRP   (b) PRQS
(c) SRQP   (d) QSPR

⊙ *(d)* QSPR is the correct sequence.

53. S₁ : A sportsman is noted for his sense of discipline.

S₆ : Once discipline is accrued in the play field, it can be applied and practised in other spheres of life.

P : The first lesson in discipline is to win without pride and to lose without bitterness.

Q : One is not longer swayed by the sudden gusts of passion.

R : Then, one must larn that error or selfishness will disgrace and endanger the rest.

S : A sense of equanimity brings order and method into the life of the people.

The correct sequence should be

(a) QPRS (b) RQSP (c) PQSR (d) PRSQ

⊙ *(d)* PRSQ is the correct sequence.

54. S₁ : Mr. and Mrs. Robert went home late last night.

S₆ : Mr. Robert rushed to the police station immediately.

P : Somebody had broken open the lock.

Q : To their dismay they found all their things missing.

R : They got into the house with a lot of fear.

S : When they reached home they found the front door open.

The correct sequence should be

(a) RSPQ   (b) SPRQ
(c) QSRP   (d) RQPS

⊙ *(b)* SPRQ is the correct sequence.

55. S₁ : The miseries of the world cannot be cured by physical help only.

S₆ : Then alone will misery ease in the world.

P : Let men have light, let them be strong and educated.

Q : No amount of physical help will remove them completely.

R : Until man's nature changes, his physical needs will always rise, and miseries will always be felt.

S : The only solution is to make mankind enlightened.

The correct sequence should be

(a) QPRS   (b) RQSP
(c) SPQR   (d) PQRS

⊙ *(b)* RQSP is the correct sequence.

56. S₁ : Aristotle worked under limitations.

S₆ : The age was not a period of experiment.

P : Physical events were mostly attributed to the intervention of God.

Q : There had been little industrial invention in Greece, perhaps because slave labour was cheap and plentiful.

R : The only equipment he had for his study was a ruler and compass and some crude instruments.

S : The facts on which modern theories of science have been based had not been discovered.

The correct sequence should be

(a) RPQS   (b) RSPQ
(c) QSRP   (d) SQRP

⊙ *(a)* RPQS is the correct sequence.

57. S$_1$: The bus speed along the road.
S$_6$: The dog wailed for a long time.
P : But the bus could stop only after covering a few yards.
Q : It injured the dog in the leg.
R : The driver applied the brake.
S : Suddenly a stray dog ran on to the middle of the road.

The correct sequence should be
(a) SPRQ (b) SRPQ (c) RPQS (d) PRSQ

⊙ **(b)** SRPQ is the correct sequence.

58. S$_1$: The status of women in our country is, on the whole, far from high.
S$_6$: Education can lift women out of the depths of misery and ignorance into which they have sunk.
P : But the plight of women in villages is still miserable.
Q : The educated women in cities enjoy equality with the men folk.
R : The movement for the freedom and right of women has certainly been steadily gaining momentum.
S : Their education has been thoroughly neglected.

The correct sequence should be
(a) RPQS (b) RQPS (c) SQPR (d) SPQR

⊙ **(b)** RQPS is the correct sequence.

59. S$_1$: Hieun-tsang became a Buddhist monk at the age of twelve and soon discovered that the Buddhist texts available in China were insufficient.
S$_6$: But he was on a quest and returned after a while to his motherland with a rich collection of texts, documents and relics.
P : Wherever he went, he was asked by the local rulers and monks to stay in the place.
Q : He entered India through Kashmir, where he spent some time in Srinagar.
R : He therefore decided to go on a pilgrimage to India to collect further material.
S : From India, he attempted to go to Ceylon, but gave up the attempt.

The correct sequence should be
(a) PQSR (b) RSPQ
(c) QSRP (d) RQSP

⊙ **(d)** RQSP is the correct sequence.

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60. S$_1$: According to the legend it was during a famine in China many thousands of years ago that rice first came into the lives of the Asians.
S$_6$: And the little girl gathered a harvest of rice.
P : The golden sunbeams dropped through the meshes and transformed themselves into golden grains.
Q : A little girl went fishing.
R : But instead of catching fish she netted the King of Frogs.
S : The King told her to hold out the net to the sunbeams while he sang a magic song.

The correct sequence should be
(a) PSQR (b) RPSQ (c) QRSP (d) PQSR

⊙ **(c)** QRSP is the correct sequence.

61. S$_1$: Ramu was in a great hurry.
S$_6$: Fortunately, it wasn't a very serious one.
P : As a result of this carelessness, he met with an accident.
Q : The examination was to begin in five minutes time.
R : He just rushed across the road.
S : So he forgot to look to the left or right as he always did.

The correct sequence should be
(a) RQSP (b) SRPQ
(c) RSPQ (d) QSRP

⊙ **(d)** QSRP is the correct sequence.

62. S$_1$: Chandran was terribly angry.
S$_6$: Saro ran screaming.
P : His pen was in her hand and Chandran rushed at her.
Q : Just then his sister, Saro, appeared at the door-step.
R : His pen was missing from the place where he had left it.
S : He thought it was lost.

The correct sequence should be
(a) PRSQ (b) RSQP
(c) PSQR (d) SQPR

⊙ **(b)** RSQP is the correct sequence.

63. S$_1$: One fine morning, I heard a sound of fire engines with loud alarm bells.
S$_6$: It was a terrible scene, as huge flames of fire were coming put of the house.
P : I thought, perhaps a house was on fire.
Q : They were regulating the crowd.
R : The policemen were standing around a big house.
S : I immediately rushed out to see what was happening.

The correct sequence should be
(a) PQRS (b) RSQP
(c) SRPQ (d) PSRQ

⊙ **(d)** PSRQ is the correct sequence.

64. S$_1$: The sun-dried stalks of rice had caught fire and burst into flames.
S$_6$: Even those who were too feeble to keep up with the first rush were on their feet, eager to join the fire-fighters.
P : Then came most of the older people, and mothers with babies at their backs.
Q : And all the active women and girls followed them to assist them in fighting the fire.
R : All the young men and boys were soon on the spot.
S : Staring wildly at the blazing rice, the people of the village ran to extinguish the fire.

The correct sequence should be
(a) PSQR (b) QPRS (c) SRPQ (d) SRQP

⊙ **(d)** SRQP is the correct sequence.

65. S$_1$: People's fear of snakes seems to be based on a series of misconceptions.
S$_6$: Yet people will insist that they cannot touch a snake because of its sliminess.
P : The most common one is the conviction that all these creatures are poisonous.
Q : Another very popular idea is that these reptiles are slimy to touch.
R : Snakes are really dry and cold; not slimy like a wet cake of soap, but rather like a crocodile-skin handbag to the touch.

S : In fact, the non-poisonous ones outnumber the poisonous ones by about ten to one.

The correct sequence should be

(a) RQPS (b) PRQS (c) PSQR (d) RQSP

⊙ *(c)* PSQR si the correct sequence.

66. S_1 : The first great discovery that man probably made was that of fire.

S_6 : The animals were not clever enough to learn anything from this.

P : Fires sometimes occur by themselves in the forests perhaps by rubbing together of flints or something else.

Q : We light a fire now by a match.

R : In olden times fires were made by striking two flints against each other till a spark came for setting fire to a dry thing.

S : But matches are quite recent things.

The correct sequence should be

(a) PRSQ   (b) QSPR
(c) PQSR   (d) RPQS

⊙ *(d)* RPQS is the correct sequence.

67. S_1 : A common disease of the eye is conjunctivitis or 'pink eye', which often occurs in school-children.

S_6 : Students with this condition should be sent to the doctor.

P : This disease spreads among school-children.

Q : A white discharge also appears in the corners of the eyes.

R : One or both eyeballs turn quite red and have a feeling or irritation.

S : This discharge forms a crust which can often be seen in the morning after the eyes have been shut all night.

The correct sequence should be

(a) PSQR   (b) RSQP
(c) RQSP   (d) QSRP

⊙ *(c)* RQSP is the correct sequence.

68. S_1 : My office sent a message with a terrific urgency asking me to return.

S_6 : It was the evening before I could sit and write to my parents that I would join them soon.

P : I immediately sent a message requesting a few days of grace as I had to book the return ticket and attend sundry matters before winding up my establishment here.

Q : On the way, I went to the laundry and made sure I would get my clothes in time.

R : Then I rushed to the bank, collected all my money and made reservations for my return journey.

S : From the shop next to it, I bought a strong box to dump my books and other odd articles so that I could send them away in advance.

The correct sequence should be

(a) QRSP   (b) RQPS
(c) SPQR   (d) PRQS

⊙ *(d)* PRQS is the correct sequence.

69. S_1 : Harsten's theory was that plants definitely react to music.

S_6 : He found that this plant grew faster and 70% taller than the other plant.

P : In his experiment, he used two banana plants.

Q : The music was in fact a high-pitched humming sound.

R : He gave both plants the same light, heat and water.

S : But for about an hour a day, one of the plants 'listened' to some music.

The correct sequence should be

(a) QSRP   (b) PQRS
(c) PRSQ   (d) QRPS

⊙ *(c)* PRSQ is the correct sequence.

70. S_1 : Some students may feel that fast readers do not understand as much as slow readers.

S_6 : This statement, however, needs to be made with caution.

P : Some slow readers will have good comprehension and others poor.

Q : A quick glance at the scores will show that fast readers sometimes have very good comprehension and sometimes poor.

R : This fallacy can easily be disapproved when you give the first reading test in a class.

S : In short, there is little relation between reading speed and comprehension.

The correct sequence should be

(a) RQPS   (b) SQRP
(c) PQRS   (d) QSRP

⊙ *(a)* RQPS is the correct sequence.

71. S_1 : There isn't a cricketer worth his salt who does not aspire for captaincy.

S_6 : It is against this background that any emotions surrounding the captaincy should be viewed.

P : Even parents are proud when their sons become the captain.

Q : At the lower levels, it is the best player who gets to lead the team.

R : In cricket, the greatest honour any player can get is the captaincy.

S : Right from their school days, boys dream of leading the team.

The correct sequence should be

(a) PQRS (b) SRQP (c) PQSR (d) SQPR

⊙ *(d)* SQPR is the correct sequence.

72. S_1 : Systematic and ceaseless efforts are being made to tap scientifically the abundant solar energy available in the country.

S_6 : Installation of solar thermal systems and devices has helped to save or generate energy to the extent of 350 kWh per annum.

P : These include cooking, water heating, water desalination, space heating, etc.

Q : A large number of applications in the area have already become commercial.

R : Efforts are also afoot to develop economically viable solar collectors for high temperature applications.

S : A simple and common mode in solar energy utilisation is solar thermal conversion.

The correct sequence should be

(a) QSRP   (b) QPRS
(c) SQPR   (d) RQSP

⊙ *(d)* RQSP is the correct sequence.

73. S_1 : The houses in the Indus Valley were built of baked bricks.

S_6 : They led outside into covered sewers which ran down the side of the streets.

P : This staircase sometimes continued upwards on to the roof.

Q : Access to the upstairs rooms was by a narrow stone staircase at the back of the house.

R : The drains were built in the walls.

S : The houses had bathrooms and water closets, rubbish chutes and excellent drainage systems.

The correct sequence should be
(a) SPQR   (b) PSQR
(c) QRPS   (d) QPSR

⊙ **(d)** QPSR is the correct sequence.

74. S_1 : I remember, some years ago, the library of a famous divine and literary critic, who had died, being sold.

S_6 : Yet, he was a holy man and preached admirable sermons.

P : Multitudes of the books had the marks of libraries all over the country.

Q : It was a splendid library of rare books, chiefly concerned with seventeenth century writers,

R : Evidently, he was very possessive about the books he borrowed.

S : He had borrowed them and never found a convenient opportunity of returning them.

The correct sequence should be
(a) RPQS   (b) QPSR
(c) SPQR   (d) PSRQ

⊙ **(b)** QPSR is the correct sequence.

75. S_1 : Of course, it is silly to try to overcome fears that keep us from destroying ourselves.

S_6 : The only fears you need to avoid are silly fears which prevent you from doing what you should do.

P : This is sensible.

Q : You wait until it is out of the way before crossing.

R : You need some fears to keep you from doing foolish things.

S : You are afraid of an automobile coming rapidly down the street you wish to cross.

The correct sequence should be
(a) PRSQ   (b) RSQP
(c) RPSQ   (d) PQRS

⊙ **(b)** RSQP is the correct sequence.

76. S_1 : Nobody likes staying at home on a public holiday—especially if the weather is fine.

S_6 : It was very peaceful in the cool grass—until we heard bells ringing at the top of the hill.

P : We had brought plenty of food with us and we got it out of the car.

Q : The only difficulty was that millions of other people had the same idea.

R : Now everything was ready so we sat down near a path at the foot of a hill.

S : We moved out of the city slowly behind a long line of cars, but at last we came to a quiet country road and after some time, stopped at a lonely farm.

The correct sequence should be
(a) PSQR   (b) QSPR
(c) PQRS   (d) SPQR

⊙ **(b)** QSPR is the correct sequence.

77. S_1 : The teaching work for the term is over.

S_6 : For this, weekend trips do not suffice, and a longer stay is necessary.

P : That will end on October 13th and the Diwali vacation will begin from October 14th.

Q : After I complete the assessment of examination papers, I plan to go and stay at our house in Lonavala for at least a week.

R : Next week the terminal examination begins.

S : There is a lot of repair work that needs to be carried out in the house.

The correct sequence should be
(a) SQRP   (b) QSPR   (c) RPSQ   (d) RPQS

⊙ **(d)** RPQS is the correct sequences.

78. S_1 : A proposal to remove from circulation 5 paise coins has been given up by the Centre on advice from the Reserve Bank of India.

S_6 : It is, however, proposed to reduce the costs of minting these coins by changing their metallic content.

P : The government had been thinking of removing from circulation even the 10 paise coin.

Q : The cost of minting a 5 paise coin is said to be 7 paise while the cost of minting a 10 paise coin is 10.5 paise.

R : Moreover their removal would cause tremendous hardship to some people.

S : The RBI had opposed this saying that they figure largely in public transactions.

The correct sequence should be
(a) SRQP   (b) QPSR   (c) PSRQ   (d) PQSR

⊙ **(c)** PSRQ is the correct sequence.

79. S_1 : It is common knowledge that people go after different objects in the world to get happiness.

S_6 : He is conscious of the fact that happiness is within and not without.

P : The wise man with a properly attuned mind is happy with them, in spite of them and without them too.

Q : Can a condemned prisoner, awaiting execution on the morrow, relish food, however delicious?

R : But a little reflection will prove that in reality, these sense-objects, by themselves, can never make a person happy.

S : It is a folly to equate objects with happiness.

The correct sequence should be
(a) RQSP   (b) SQRP
(c) SPQR   (d) RSQP

⊙ **(a)** RQSP is the correct sequence.

2016 (II)

80. S_1 : History shows that the growth of civilisation depends upon the gifts of nature, particularly the wealth yielded by the soil.

S_6 : In fact, most of the wars in the beginning of humanity's history were fought for the gain of territory.

P : The more land they had, the more they were satisfied.

Q : The nature and the quality of the land they possessed were of great importance to them.

R : All ancient communities worked hard to produce food.

S : There was also a great desire among them to possess as much land as possible.

The correct sequence should be

(a) RQSP   (b) QRSP
(c) SQRP   (d) PRQS

⟩ **(a)** RQSP is the correct sequence.

81. S_1 : There were shots as I ran.

S_6 : Staying submerged was only too easy with, so much clothing and my army boots.

P : The water was icy, but I stayed until I thought my lungs would burst.

Q : I tripped at the edge and went in with a splash.

R : The minute I came up I took a breath and plunged down again.

S : I ducked down, pushed between two men and ran for the river.

The correct sequence should be

(a) SQPR   (b) PRQS
(c) SQRP   (d) QSPR

⟩ **(a)** SQPR is the correct sequence.

82. S_1 : Why do the English travel?

S_6 : For here, in cosmopolitan England, one is always exposed to the danger of meeting all sorts of peculiar aliens.

P : Besides, they are taught that travel broadens the mind.

Q : They do so mainly because their neighbour does this and they have caught the bug from him.

R : Although, they have now discovered the sad truth that whatever travel may do to the mind, it certainly broadens other parts of the body.

S : But, and perhaps mainly, they travel to avoid foreigners.

The correct sequence should be

(a) RSQP (b) PRSQ (c) SQPR (d) QPRS

⟩ **(d)** QPRS is the correct sequence.

83. S_1 : Jumbo, the famous 3-3 metre elephant was born in Africa over a hundred years ago.

S_6 : Before his death in September 1882, he had been seen by over 20 million Americans.

P : After disembarkation in New York, he was taken in a procession to the place where he was to be kept.

Q : Another admirer was the famous American showman Barnum who bought it for a huge sum in February, 1882.

R : Transported from his native land to London Zoo, he became a favourite of Queen Victoria.

S : He made his transatlantic voyage aboard SS Assyrian Monarch.

The correct sequence should be

(a) PQRS   (b) SRQP
(c) PSRQ   (d) RQSP

⟩ **(d)** RQSP is the correct sequence.

84. S_1 : The bureaucrat and the social worker are men of totally different orientations and styles of functioning.

S_6 : The world will be a better place to live in if they learn a little from each other.

P : The other is considered to be a man ever on the move.

Q : He is portrayed as a man fond of rules above all other things.

R : The one is regarded as given to sedentary habits, doing a lot of paper work.

S : Driven by an urge to help others he is impatient with red tape and unnecessary delays.

The correct sequence should be

(a) PQRS   (b) RQPS
(c) SRQP   (d) QPSR

⟩ **(b)** RQPS is the correct sequence.

85. S_1 : Universities are peculiar institutions.

S_6 : It is the most important institution in the complex process of knowledge creation and distribution.

P : Traditionally elite institutions, the modern university has provided social mobility to previously disfranchised groups.

Q : The contemporary university stands at the centre of its society.

R : They have common historical roots yet are deeply embedded in their societies.

S : Established in the medieval period to transmit established knowledge and provide training for a few key professions, universities have become a primary creator of new knowledge through basic research.

The correct sequence should be

(a) PSQR   (b) SQRP
(c) SPRQ   (d) RPSQ

⟩ **(c)** SPRQ is the correct sequence.

86. S_1 : At the age of eighteen Gandhi went to college, but remained for only part of the year.

S_6 : This was against his religion, and most of his relatives were against his going.

P : Soon after this, he was advised to go to England to study to be a lawyer.

Q : Studies did not interest him and he did not do well.

R : It was difficult for him to leave India and go to a foreign land where he would have to eat and drink with foreigners.

S : This would not be easy.

The correct sequence should be

(a) PSRQ   (b) SQPR
(c) PRQS   (d) QPSR

⟩ **(d)** QPSR is the correct sequence.

87. S_1 : Helen graduated in 1904 with special honours in English.

S_6 : Her dress was torn and roses were snatched from her hat.

P : She was twenty-four years old.

Q : She was invited to the St. Louis Exposition in 1904 to awaken worldwide interest in the education of the deaf-blind.

R : But on Helen Keller Day the crowds got out of hand.

S : Requests were already flowing in for appearances and for magazine articles.

The correct sequence should be

(a) QPSR   (b) SPRQ
(c) PSQR   (d) SQRP

⊙ *(c)* PSQR is the correct sequence.

88. S_1 : One of the many young scientists, who choose to throw in their lot with Rutherford was an Oxford physical chemist, Frederick Soddy.

S_6 : We now know that Gamma rays are a particularly fierce form of X-rays.

P : His association with Rutherford lasted only two years, but that was long enough to change the whole face of physics.

Q : He was just 23.

R : They found that thorium changed into a new element, thorium X, and in the process gave off what was apparently a gas and at the same time a third type of ray, which they named after the Greek letter 'Gamma'.

S : When he teamed up with Rutherford, they investigated thorium which, as Marie Curie had shown, was radioactive.

The correct sequence should be

(a) PQSR   (b) QPSR
(c) QPRS   (d) QSRP

⊙ *(a)* PQSR is the correct sequence.

89. S_1 : The boy felt his way up the creaking stairs through thick darkness.

S_6 : He was just telling himself he was safe, when the door was flung open and the gaunt old man grabbed his shoulder.

P : All he had to do was just get past the central door on the landing.

Q : He stopped as the great clock below whined for a few seconds and gave out a single, solemn stroke.

R : His eyes were raised to the faint moonlight that shone above the landing.

S : He hesitated as the sound died down and then crept on, thinking that if they could sleep through that, they would sleep through any noise he could make.

The correct sequence should be

(a) PQSR   (b) RQSP
(c) PRQS   (d) RQPS

⊙ *(d)* RQPS is the correct sequence.

90. S_1 : Don't you think that the housefly is a nuisance?

S_6 : When you see a fly rubbing its legs together, it is just cleaning itself, and scraping off some of the material that has gathered there.

P : For ages that's what man considered the fly to be—just a nuisance.

Q : It was discovered that these flies carried disease germs that cause the death of millions of people every year.

R : But now we know that the innocent-looking housefly is one of man's worst enemies.

S : It makes an irritating buzzing sound; it annoys you when it crawls on your skin; and so on.

The correct sequence should be

(a) RQPS   (b) PQSR
(c) QPRS   (d) SPRQ

⊙ *(d)* SPRQ is the correct sequence.

91. S_1 : *Iguanodon* was one of the first dinosaurs to be scientifically described.

S_6 : This quadrupedal dinosaur lived about 70 million years ago and its fossils are found in many parts of England, Europe, Asia and North Africa.

P : These teeth formed a dental battery in which replacing teeth were constantly growing.

Q : The forelimbs were slightly larger than other members of its group known as *Ornithischia.*

R : It had numerous teeth in the sides of the jaws, arranged in rows.

S : It was about 40 feet in length.

The correct sequence should be

(a) QSRP   (b) SRPQ
(c) RQPS   (d) PQSR

⊙ *(b)* SRPQ is the correct sequence.

92. S_1 : A single device can heat fluids without requiring an electrical element.

S_6 : Because there is no electrical element, there is no risk of fire, so the system is suitable for dangerous environments.

P : A heat exchanger transfers heat from the central cavity to an air heater, a water heater or an industrial processor.

Q : It has a container like the crank case of a car's engine, which contains the fluid to be heated.

R : Compression and friction at the nozzles heat the fluid, so that the temperature in the central cavity rises steadily.

S : A motor and pulley inside the container turn a rotor wheel, which in turn forces the fluid again and again through narrow nozzles into a central cavity.

The correct sequence should be

(a) RPSQ   (b) SPQR
(c) QSRP   (d) SRPQ

⊙ *(c)* QSRP is the correct sequence.

93. S_1 : There is no doubt that the rules governing imports, manufacture and the use of pesticides need to be further tightened up.

S_6 : At the same time, better pollution control measures are needed to check the discharge of poisonous gases and chemicals by a host of other industries which are equally responsible for poisoning our world.

P : But a more practical and feasible approach is required to tackle this problem.

Q : No one can deny the importance of pesticides in our agriculture.

R : The proposed amendment is an attempt at doing this, but in the process it seems to have gone overboard in most cases.

S : Even today, nearly a fourth of our crop is lost due to pests and weeds.

The correct sequence should be

(a) RPSQ   (b) RQSP
(c) QSPR   (d) PRSQ

⊙ *(c)* QSPR is the correct sequence.

2016 (I)

94. S_1 : Once upon a time there was a king who had a wonderfully nice garden.

S_6 : In the trees lived a nightingale that sang so sweetly that all who passed by stood still and listened.

P : In the middle of the garden there was a lovely forest with tall trees and deep lakes.

Q : In this garden were to be seen the most wonderful flowers with silver bells tied to them.

R : The garden was so large that even the gardener himself did not know where it began and where it ended.

S : These bells always sounded so that no body should pass by without noticing the flowers.

The correct sequence should be

(a) QPRS (b) SPQR (c) QSRP (d) QPSR

⊙ *(c)* QSRP is the correct sequence.

95. S_1 : One of the first things the learning of a new language teaches you is that language comes from the region of the unconscious.

S_6 : The test of how much you know is : how much can you say without having to think how you are going to say it?

P : What is often meant by 'thinking in a language' is really the ability to use it without thinking about it.

Q : We, grown-up people, have to filter it through our minds-a much more laborious process.

R : That is why children learn a new language so effortlessly : it comes straight from their instincts.

S : But we cannot say that we know a language or know what we have studied of it, until we can use it instinctively.

The correct sequence should be

(a) SQRP   (b) RPSQ
(c) PQSR   (d) RQSP

⊙ *(d)* RQSP is the correct sequence.

96. S_1 : For seventeen years she led a sheltered life in the convent.

S_6 : Two years later she left the Loreto Convent where she had spent many happy and useful years.

P : Her heart went out to the people living there.

Q : In 1946 she asked for permission to work in the slums.

R : Then one day, while she was returning from an errand, she saw the slums of Kolkata.

S : She felt she had found her second vocation, her real calling.

The correct sequence should be

(a) PRSQ   (b) RPSQ
(c) RPQS   (d) QRPS

⊙ *(b)* RPSQ is the correct sequence.

97. S_1 : Good memory is so common that we regard a man who does not possess it as eccentric.

S_6 : She wheeled away the perambulator, picturing to herself his terror when he would come out and find the baby gone.

P : I have heard of a father who having offered to take the baby out in a perambulator, was tempted by the sunny morning to pause on his journey and slip into a public house for a glass of beer.

Q : A little later, his wife had to do some shopping which took her past the public house where to her horror, she discovered her sleeping baby.

R : Leaving the perambulator outside, he disappeared into the drink shop.

S : Indignant at her husband's behaviour, she decided to teach him a lesson.

The correct sequence should be

(a) PQRS   (b) PRQS
(c) PSQR   (d) PQSR

⊙ *(b)* PRQS is the correct sequence.

98. S_1 : Human ways of life have steadily changed.

S_6 : Even if we try to do nothing, we cannot prevent change.

P : Ancient Egypt-Greece-the Roman Empire - the Dark Ages and the Middle Ages the Renaissance - the age of modern science and of modern nations one has succeeded the other; the history has never stood still.

Q : About ten thousand years ago, man lived entirely by hunting.

R : A settled civilised life only began when agriculture was discovered.

S : From that tiem to this, civilisation has always been changing.

The correct sequence should be

(a) QRSP (b) QPSR (c) QSRP (d) PRSQ

⊙ *(a)* QRSP is the correct sequence.

99. S_1 : In our youth we are apt to think that applause and publicity constitute success.

S_6 : So let us be initiated into the mysteries of maturity and be taught how to resist and spurn the lure of hollow shows.

P : The man who values that applause more than his own effort has not outgrown his youth.

Q : It is our achievement or work which wins lasting rewards.

R : But these are only the trappings, the ephemeral illusions.

S : One should concentrate on one's work knowing that applause will come unsought.

The correct sequence should be

(a) SRQP (b) PSRQ (c) QPSR (d) RQPS

⊙ *(d)* RQPS is the correct sequence.

100. S_1 : My office sent an urgent email asking me to return.

S_6 : It was evening before I could sit and write to my parents that I would be joining them soon.

P : I immediately replied requesting a few days of grace as I had to book the return passage, pack and attend sundry matters before winding up my establishment here.

Q : On the way, I went to the laundry and made sure I would get my clothes in time.

R : The I rushed to the bank, collected all my money and made reservations for my return journey.

S : From the shop next to it, I bought a couple of trunks to dump my books and other odd articles so that I could send them away in advance.

The correct sequence should be
(a) PQRS (b) PRQS (c) PRSQ (d) PSRQ

⊙ **(b)** PRQS is the correct sequence.

101.S_1 : Wordsworth knew the behaviour of owls in the night better than most of us know the ways of black birds in day time.

S_6 : His great poetry owes much to the night.

P : Out of school there were no restrictions on the hours he kept.

Q : No poet ever had happier school days.

R : He would skate by the light of the stars, snare woodcocks at dead of night, watch the sunrise after a log ramble.

S : Throughout life he was an inveterate walker by night.

The correct sequence should be
(a) QPRS   (b) PSQR
(c) QRPS   (d) SQPR

⊙ **(a)** QPRS is the correct sequence.

102.S_1 : Science has already conferred an immense boon on mankind by the growth of medicine.

S_6 : The general death rate in 1948 (10-8) was the lowest ever recorded up to that date.

P : It has continued ever since and is still continuing.

Q : In the 18th century people expected most of their children to die before they were grown-up.

R : In 1920, the infant mortality rate in England and Wales was 80 per thousand; in 1948 it was 34 per thousand.

S : Improvement began at the start of the 19th century, chiefly owing to vaccination.

The correct sequence should be
(a) RPQS   (b) QSPR
(c) SQRP   (d) PQSR

⊙ **(b)** QSPR is the correct sequence.

103.S_1 : The young traveller gazed out into the dismal country with a face of mingled repulsion and interest.

S_6 : He quickly restored it to his secret pocket.

P : At intervals he drew from his pocket a bulky letter to which he referred and on the margins of which he scribbled some notes.

Q : It was a navy revolver of the largest size.

R : From the back of his waist he produced something which one would hardly have expected to find in the possession of so mild-mannered a man.

S : As he turned it slantwise to the light, the glint upon the rims of the copper shells within the drum showed that it was fully loaded.

The correct sequence should be
(a) PQRS   (b) RPQS
(c) QPRS   (d) PRQS

⊙ **(d)** PRQS is the correct sequence.

2015 (I)

104.S_1 : While teaching in the class-room, our teacher suddenly fainted(d).

S_6 : The headmaster at once sanctioned his leave.

P : The headmaster soon joined us and spoke to them in a soft voice.

Q : He was told that the patient needed complete rest for a month.

R : He was at once taken to the hospital.

S : the doctors examined him with serious faces.

The correct sequence should be
(a) PQRS   (b) SPQR
(c) QPSR   (d) RSPQ

⊙ **(d)** RSPQ is the correct sequence.

105.S_1 : The colonial powers had a very simple technique to rule the world.

S_6 : Partition was the culmination.

P : They lumped tribes and people together, played one against the other.

Q : India's provinces were more elaborately designed to play the game of divide and rule.

R : Africa was divided, believe it or not, on the basis of the lines of longitude and latitude.

S : They also purchased the loyalties of those locals who were needed as supports for the colonial presence.

The correct sequence should be
(a) PRSQ   (b) PSRQ
(c) SPQR   (d) RPSQ

⊙ **(b)** PSRQ is the correct sequence.

106.S_1 : The bank opened at 10 : 00 am.

S_6 : The safe was empty.

P : The peon opened the safe and returned the keys to the manager.

Q : The manager and the peon went to the safe in the vault.

R : The manager and the peon looked into the safe.

S : They were shocked at what they saw there.

The correct sequence should be
(a) QRPS   (b) QPRS
(c) SQRP   (d) QRSP

⊙ **(b)** QPRS is the correct sequence.

107.S_1 : The crowd swelled round the thief.

S_6 : They were followed by the crowd which left the thief alone.

P : Suddenly he whipped out a knife from under his shift.

Q : The thief stood quiet, his head hung is shame.

R : The two young men holding him were scared by the sight of the shining knife.

S : They took to their heels.

The correct sequence should be
(a) QPRS   (b) SQPR
(c) SPQR   (d) RQSP

⊙ **(a)** QPRS is the proper sequence.

108. S_1 : The old man wanted to cross the road.

S_6 : Holding him by hand the driver helped him to cross the road.

P : The driver got off and came to him.

Q : He was fed up and was about to return.

R : Then a car stopped in front of him.

S : He waited for a long time.

The correct sequence should be

(a) SQRP   (b) SPRQ

(c) QRSP   (d) PSRQ

⊙ **(a)** SQRP is the proper sequence.

109. S_1 : The first thing you have to do is to speak with a strong foreign accent and speak broken English.

S_6 : Half a dozen people will immediately overwhelm you with directions.

P : He will interested in you because you are a foreigner and he will be pleased that he could figure out what you said.

Q : He will not expect you be polite and use elaborate grammatical phrases.

R : Then every English person to who you speak will at once know that you are a foreigner and try to understand you and be ready to help you.

S : If you shout, ''Please! Charing Cross! Which ways?'' you will have to difficulty..

The correct sequence should be

(a) SRQP   (b) SRPQ

(c) RQPS   (d) RSPQ

⊙ **(c)** RQPS is the correct sequence.

110. S_1 : When a lamb is born its mother may die.

S_6 : If a means of a overcoming this natural tendency is found, the lives of millions of lambs can be saved.

P : Thus, there will nearly always be both motherless lambs and sheep without lambs.

Q : However a sheep which has lost its own lamb will not feed or look after a motherless lamb.

R : At the same time some new born lambs are too weak to live.

S : This happens in large flocks where many sheep give birth to lambs at the same time.

The correct sequence should be

(a) PQRS (b) RPQS (c) SRQP (d) SRPQ

⊙ **(c)** SRPQ is the correct sequence.

111. S_1 : People very seldom have everything the want.

S_6 : Our decisions indicate our scale of preferences and therefore our priorities.

P : Usually we have to decide care fully how to spend our income.

Q : They may all seem important, but their true importance can be measured by deciding which we are prepared to live without.

R : When we exercise our choice, we do so according to our personal scale of preferences.

S : In this sclae of preferences essential commodities come first, then the kind of luxuries which helps us to be comfortable and finally those non-essentials which give us personal pleasure.

The correct sequence should be

(a) PSQR (b) PRSQ (c) QPSR (d) RPQS

⊙ **(b)** PRSQ is the correct sequence.

112. S_1 : On 5th October, 1818, when young Lincoln was approaching his 10th years, his mother Nancy died of fever.

S_6 : His total education at school comprised only about a year during which he, however, managed to master reading, writing, spelling and some arithmetic.

P : She was illiterate, but she brought with her several books, among which were Pilgrim's Progress, Sindbad the Sailor, Robinson Crusoe and Aesop's Fables.

Q : Lincoln always acknowledged this moral and intellectual debt to his step mother.

R : The following year, his father married Sarah Bush Johnson, a widow with three children.

S : These books provided Lincoln with a mass of knowledge.

The correct sequence should be

(a) RPQS (b) PSRQ(c) RPSQ   (d) PSQR

⊙ **(b)** RPSQ is the correct sequence.

113. S_1 : Crude oil obtained from the field is taken to a refinery for treatment.

S_6 : Lubricating oils os various grades are obtained last of all.

P : The gas that comes off later is condensed into paraffin.

Q : This allows substances with different boiling points to be separated.

R : The first vapours to rise when cooled provide the finest petrol.

S : The commonest form of treatments is heating.

The correct sequence should be

(a) SQRP   (b) RSPQ

(c) SRPQ   (d) RPQS

⊙ **(a)** SQRP is the correct sequence.

2014 (II)

114. S_1 : There have been many stories of propoises saving human lives.

S_6 : Marine Marine scientists point out that the porpoise's spirit of play is responsible for such incidents.

P : 'When I got to my feet no one was near, but in the water about 18 feet out a porpoise was leaping about'.

Q : One woman was wading waist deep off the Florida coast when an undertow pulled her down.

R : 'I felt something give me a terrific shove up on to the beach', she says.

S : 'A man standing nearby said that the porpoise has shoved me ashore'.

The correct sequence should be

(a) PRSQ (b) QPRS (c) QRPS (d) QPSR

⊙ **(c)** QRPS is the correct sequence.

115. S$_1$: Rome the greatest city of the ancient world, did not achieve its glory all of a sudden.

S$_6$: Achievement of great moment cannot be accomplished without patient perseverance and a considerable interval of time.

P : The same is true of every great achievement.

Q : We should carry on our work with patience and perseverance.

R : It took several years to build Rome and bring it to the state of pomp and splendor.

S : When we wish to do great thing, we cannot expect success in a moment.

The correct sequence should be

(a) RPSQ   (b) PQSR
(c) QSPR   (d) SRPQ

⊙ *(a)* RPSQ is the correct sequence.

116. S$_1$: The bus stopped.

S$_6$: Then, his eyes rested with cold malice on the dog.

P : The conductor came in and took the fares.

Q : A woman and a man got in together.

R : The young woman was carrying a pet dog.

S : They took their seats.

The correct sequence should be

(a) PQRS   (b) QSRP
(c) QPSR   (d) QSPR

⊙ *(b)* QSRP is the correct sequence.

117. S$_1$: James Watt used the power of steam to drive machines.

S$_6$: The jet engine is relatively more recent.

P : With petrol engines people were able to build motor cars and aeroplanes.

Q : Then, many years later, the petrol engine was invented.

R : These provided quicker means of travelling.

S : His invention was used later by other clever men to give us the railway engine.

The correct sequence should be

(a) SQPR   (b) PQRS
(c) PSRQ   (d) QSRP

⊙ *(a)* SQPR is the correct sequence.

118. S$_1$: A man handed a pair of trouser to the departmental store clerk and said, ''I'd like these altered, please''.

S$_6$: Triumphantly he put the trousers and the receipts on the counter and said, ''I'd like to have these altered, please.''

P : He said that free alteration is not possible without a receipt.

Q : The man said, ''Okay, I'd like to return the trousers.'' The clerk took them back and returned the money.

R : The man pushed the money and said, ''Now I want to buy them.'' The clerk put the trousers in a bag, issued a receipt and handed him both.

S : The clerk asked for the sales receipt but after searching his pockets the man replied that he had lost it.

The correct sequence should be

(a) QRPS   (b) SPQR
(c) PSRQ   (d) PSQR

⊙ *(b)* SPQR is the correct sequence.

119. S$_1$: It is generally assumed by the admirers of democracy that the right to vote also confers a right for power which threaten the very existence of democracy.

S$_6$: As a result, the political scene witnesses endless dogfights for power which threaten the very existence of democracy.

P : These qualities are very rare and cannot be had for the wishing.

Q : For the right for power must, if it is to be useful, be accompanied by the ability to exercise it with competence, wisdom, foresight and broadmindedness.

R : Yet all those who have the right to vote believe that they have them and try by hook or crook to capture power.

S : The former has much to commend it but one cannot be so sure about the latter.

The correct sequence should be

(a) PQRS   (b) SQPR
(c) PRQS   (d) RQPS

⊙ *(b)* SQPR is the correct sequence.

120. S$_1$: There are several tribes in East Africa.

S$_6$: All the other tribes were afraid of them because of their skill in war.

P : The Masias were famous fighters.

Q : They used to raid the neighbouring tribes and carry away their cattle.

R : They lived on the wide plains in Southern Kenya and Northern Tanzania.

S : But the most famous among them is Masai tribe.

The correct sequence should be

(a) SPRQ   (b) PRQS
(c) RQSP   (d) QRPS

⊙ *(a)* SPRQ is the correct sequence.

121. S$_1$: I had my eye especially on the long jump.

S$_6$: He turned out to be a German named Luz Long.

P : Everyone expected me to win that Olympic event hands down.

Q : I was in for a surprise.

R : When the time came for the long jump trails, I was startled to see a tall boy hitting the pit at almost 26 feet on his practice leaps.

S : A year before, I has set the world record of 26 feet 3 inches.

The correct sequence should be

(a) PQRS   (b) PSQR
(c) PRSQ   (d) SRPQ

⊙ *(b)* PSQR is the correct sequence.

2014 (I)

122. S$_1$: The lions used to be widely distributed in Africa and Asia.

S$_6$: no hunting is permitted in such reserved areas.

P : there special forest zones set aside for wildlife in various countries.

Q : indiscriminate killing by hunters has been the cause of this drastic fall in their numbers.

R : today they are a relatively rare species.

S : if the species survives at all, it will be only in National Parks.

The correct sequence should be
(a) RSQP   (b) SQRP
(c) RQSP   (d) SRPQ

⊙ **(c)** RQSP is the correct sequence.

123. S_1 : The woman who lives a normal life is able to check the swelling conceit and egotism of her menfolk simply because her outlook is so different

S_6 : and both ranges of interest make her what only fools deny her to be, namely, essentially practical, her eye is stedily fixed on the concrete thing and she mistrusts that chasing of the wild goose, which is one of the chief pastimes and delights of man.

P : She is primarily concerned with little ordinary things, the minutiae of talk and behaviour e.g., on the one hand and with very big ones, the colossal elementary facts of life, such as birth, mating and death on the other

Q : the first are personal and particular, whereas the second, those enormous facts about life which women are never allowed to lose sight of, are of course, universal meaning just as much in the Fiji Islands as they do here

R : her interest are at once narrower and wider than those of men

S : It is more personal and yet more impersonal

The correct sequence should be
(a) PQSR   (b) PRSQ
(c) SPQR   (d) SRPQ

⊙ **(a)** PQSR is the correct sequence.

124. S_1 : What soda water is composed of you may see for yourself if you watch your glass as it stands on the table after you have slaked your first thirst

S_6 : 'carbonic acid is the old name for it, but it is more correct to name it, when it is out of the water, 'carbon dioxide'.

P : The liquid is plain water, as you will find out if you are too slow about drinking

Q : you will see that it is separating into two different things, a liquid and a gas.

R : the gas is so heavy that you can fairly drink it from the glass and it has, as you know, a tingle tangle taste

S : the other is a heavy, sour and invisible gas that slips up through the water in little bubbles and collects in the empty half of the glass.

The correct sequence should be
(a) QRSP (b) PRQS (c) QPSR (d) RSPQ

⊙ **(c)** QPSR is the correct sequence.

125. S_1 : What Martin Luther King, the peaceful warrior and his followers suffered, it is very difficult to describe

S_6 : for they had taken an oath to refrain from the violence of the first, tongue or heart.

P : the police used fire hoses and ferocious dogs to rout them.

Q : the law courts sent them to solitary confinement where not a ray of the Sun entered

R : they were abused and stoned by the mob, slapped and kicked by the police

S : they suffered and tolerated all this without ever lifting a hand in self defence

The correct sequence should be
(a) SRPQ (b) RPQS (c) PRSQ (d) QRSP

⊙ **(b)** RPQS is the correct sequence.

126. S_1 : There are, I think, several factors that contribute to wisdom

S_6 : you have not time to consider the effect which your discoveries or inventions may have outside the field of medicine

P : this has become more difficult than it used to be owing to the extent and complexity of the specialised knowledge required of various kinds of technicians.

Q : of these I should put first a sense of proportion: the capacity to take account of all

the important factors in a problem and to attach to each its due weight

R : the work is difficult and is likely to absorb the whole of your intellectual energy

S : suppose, e.g., that you are engaged in research in scientific medicine.

The correct sequence should be
(a) QPSR (b) QRPS (c) QSPR (d) QSRP

⊙ **(d)** QSRP is the correct sequence.

127. S_1 : There were no finger prints anywhere

S_6 : These conclusions made the detectives think that it was a fake theft

P : first of all it was impossible even for a child to enter through the hole in the roof

Q : when the investigators tried to reconstruct the crime, they came up against facts

R : moreover, when the detectives tried to a silver vase, it was found to be double the size of the hole

S : again, the size of the hole was examined by the experts who said that nothing had been passed through it

The correct sequence should be
(a) PQRS   (b) QPRS
(c) SQRP   (d) QRSP

⊙ **(b)** QPRS is the correct sequence.

128. S_1 : If you want to film a scene in slow motion you run the camera twice as fast as usual, which sounds ridiculous but isn't

S_6 : on the screen, everything appears at half the speed at which the camera recorded it when it was filmed.

P : if you are filming in slow motion, however, the camera runs at twice the normal speed, yet, in spite of this, the projector which shows the film will be run at the normal speed and this means that the projector will show the film at half the speed at which it was photographed

Q : this is because the camera which took the pictures and the projector which shows them run at the same speed

R : when a film camera is running at normal speed, it takes twenty four pictures a second

S : when the film is run through the film projector the camera twenty - four pictures a second appear on the screen

The correct sequence should be

(a) PSRQ   (b) PSQR
(c) SRQP   (d) RSQP

⊙ *(a)* PSRQ is the correct sequence.

129. S_1 : Great quantities of animal oil come from whales

S_6 : a few other creatures also yield oil.

P : it produces a great quantity of oil which can be made into food for human consumption

Q : these enormous creatures of the sea are the largest remaining animals in the world

R : when the whale is killed, the blubber is stripped off and boiled down

S : to protect the whales from the cold of the Arctic seas, nature has provided it with a thick covering of fat called blubber

The correct sequence should be

(a) PSRQ   (b) QSRP
(c) PRQS   (d) RPQS

⊙ *(b)* QSRP is the correct sequence.

130. S_1 : The distance between theatre and reality has stretched so far that when we come across a truly contemporary play, it is a cause for rejoicing

S_6 : But the question is, have we forgotten his legacy in modern India?

P : it searches our collective psyche like an unrelenting laser beam

Q : most importantly, the play questions whether religion and politics can fuse together in modern India

R : Gandhiji had both the spiritual and political dimensions that we so lack today

S : Prasanna's 'Gandhiji' staged recently by the National School of Drama is one such play

The correct sequence should be

(a) SRPQ   (b) RSPQ
(c) SPQR   (d) RQPS

⊙ *(c)* SPQR is the correct sequence.

131. S_1 : We who live in the present day world are proud to call ourselves civilised

S_6 : in fact science has added to our worries.

P : but let us search our hearts and ask ourselves, 'Has science solved our problem?'

Q : is it because we live and dress better than our forefathers?

R : frankly speaking, the answer is 'No'.

S : of course, we have the advantages of the inventions of science which our ancestors had never know

The correct sequence should be

(a) PQRS   (b) QSPR
(c) PRSQ   (d) SPRQ

⊙ *(b)* QSPR is the correct sequence.

Directions (Q.Nos. 1-233) *In this section, you have few short passage. After each passage, you will find some items based on the passage. First, read a passage and answer the items based on it. You are required to select your answers based on the contents of the passage and opinion of the author only.*

2019 (II)

PASSAGE 1

Mankind's experience of various evolutionary changes from primitive times to the present day has been extensive and varied. However, man's problems were never before as complicated as they seem to be today. Man's economic activity centres primarily around production. Labour is said to be the primary factor of production; its role, therefore, has been given a lot of importance. It should be useful to have an overall view of the economic history of man from the nomadic times to the modern factory system and study its relevance to the various labour problems of today.

Initially, man passed through 'the hunting and fishing stage'. During this period, his basic needs were adequately met by Nature. Wild animals, birds and fruits satisfied his hunger, and his thirst was quenched by the waters of springs and rivers. Caves gave him shelter and barks of trees were used as clothing. During this stage of man's progress, labour problems did not exist because of the absence of any economic, political and social systems.

Then came 'the pastoral stage', which was marked by a certain amount of economic activity. The nomadic and migratory nature of man persisted and together with his goats and cattle, he moved on to fresh pastures and meadows. Some conflicts would sometimes take place among herd-owners, for, during this period, the institution of nominal private property ownership was not known.

This stage paves the way for 'the agricultural stage', during which the class system began to develop. There was a small artisan class mostly self-employed; and there were also landed proprietors or Zamindars as well as slaves. During the fourth stage of these developments, the handicrafts stage', a number of social and economic changes took place which marked the beginning of the labour problem in the world. The self-sufficient economy of the village underwent a drastic change. The community of traders and merchants emerged.

1. Humanity's evolution from primitive stage to the present has been

(a) static and smooth
(b) huge and diversified
(c) always violent
(d) always peaceful

⊘ (**b**) According to the passage, humanity's evolution has been very huge as well as diversified. It has evolved extensively and in various field.

2. .... "man's problems were never before as complicated as they seem to be today" means

(a) the present times are the best times of humanity
(b) the present times are the crucial period for humanity
(c) the present times pose much more challenges to humans than the previous times
(d) the present times provide much more facilities than the previous times

⊘ (**c**) The given sentence means that the present times pose much more challenges to humans that it was in primitive times. Man faces more complications and challenges in present time.

3. Why does the author say that labour problems did not exist during 'the hunting and fishing stage'?

(a) There was no nation existing at that time
(b) There were no economic, political and social systems
(c) There was no capitalism and market
(d) There was no labour law

⊙ (**b**) The author says that labour problem did not exist during the hunting and fishing state as society was not divided and did not have any economic, political and social system. Everybody lived in the same simple way.

4. "The pastoral stage was marked by a certain amount of economic activity." How?

(a) Humans started migrating and held goat-herds
(b) Humans started owning land
(c) Conflicts started as humans owned goats
(d) Humans started doing agriculture

⊙ (**a**) The pastoral stage was marked by a certain amount of economic activity as humans started migrating from one place to another alongwith his goats and cattle.

5. Which word in the passage means 'surfaced'?

(a) Quenched
(b) Emerged
(c) Nomadic
(d) Adequately

⊙ (**b**) The word 'surfaced' means 'having risen or emerged'. So, option (b) 'emerged' is the correct choice.

PASSAGE 2

Ever since independence, land reforms have been a major instrument of state policy to promote both equity and agricultural investment. Unfortunately, progress on land reforms has been slow, reflecting the resilience of structures of power that gave rise to the problem in the first place.

The main instrument for realising more equitable distribution of land is the land ceiling laws. These laws were enacted by several states during the late 1950s and 1960s, and the early 1970s saw more stringent amendments in the laws to plug loopholes in the earlier laws. But the record of implementation has not been satisfactory. Around 3 million hectares of land has been declared surplus so far, which is hardly 2 percent of net sown area in India. About 30 percent of this land has not yet been distributed as it is caught up in the litigations. Besides, a number of Benami and clandestine transactions have resulted in illegal possession of

significant amounts of land above ceiling limits. There are widespread reports of allotment of inferior, unproductive, barren and wasteland to landless household, many of whom have been forced to sell it off, in the absence of resources to make it productive. In many instances, lands allotted to the rural poor under the ceiling laws are not in their possession. In some cases, Pattas were issued to the beneficiaries, but possession of land shown in the Pattas was not given, or corresponding changes were not made in the records of right.

The balance of power in rural India is so heavily weighed against the landless and the poor that implementing land ceiling laws is difficult. It is clear that without massive mobilisation of the rural poor and depending on democratic governance in rural India very little can be achieved in this direction.

Although half of India's population continues to depend on agriculture as its primary source of livelihood, 83 percent of farmers operate holdings of less than 2 hectares in size and the average holding size is only 1.23 hectares. This is often in fragments and unirrigated. There are also those who are entirely landless, although agriculture is their main source of livelihood. They have inadequate financial resources to purchase and often depend on leasing in small plots, on insecure terms, for short periods, sometimes only for one season. Hence, many face insecurity of tenure and the growing threat of land alienation and pressure from urbanisation, industrialisation and powerful interest.

6. Why does the land reform prove to be slow?

(a) Because of the disparity in power structure
(b) Because of the power of the government
(c) Because states have different laws
(d) Because of the scarcity of land in the country

⊙ (**a**) As per the passage land reforms are very slow due to disparity in power structure and also 'land ceiling law' has not been implemented successfully.

7. Which of the following statements is/are correct?

1. Land ceiling laws have proved to be unsatisfactory.
2. The democratic structure of the government cannot provide solution to the problem of land reforms.
3. The owners of land have abundant natural resources.
4. Identified land for distribution has not been distributed due to court cases against it.

Select the correct answer using the codes given below

(a) 1 and 4   (b) Only 1
(c) 3 and 4   (d) 2 and 4

⊙ (**a**) Statement 1 and 4 are correct. Land ceiling laws have proved to be unsatisfactory and land which has been identified for distribution has court cases or litigations so it could not be distributed.

8. One of the reasons of selling off the lands by the allottees is that the lands were

(a) unproductive and barren
(b) salty, not getting water
(c) fertile, but uncultivable
(d with the powerful people

⊙ (**a**) Land alloted to landless household was unproductive and barren, so they sell off the unproductive land in the absence of resources.

9. Which word/group of words in the passage means 'lawsuit'?

(a) Amendments   (b) Litigations
(c) Illegal possession
(d) Fragments

⊙ (**b**) Litigations also means 'Law suit'. Both words means 'a claim or dispute brought to a law court for adjudication'.

10. According to the author, what is the primary source of livelihood of majority of India's population?

(a) Industry   (b) Forest
(c) Agriculture   (d) None

⊙ (**c**) The primary source of livelihood of majority of India's population is 'agriculture'.

11. "There are also those who are entirely landless, although agriculture is their main source of livelihood" means

(a) they do not have money to buy lands
(b) they have sold off their lands to others
(c) most of them are agriculture labourers
(d) they are migrant labourers from other places

⊘ *(c)* The given statement means that although some farmers are totally dependent on agriculture for livelihood but they do not have enough money to buy lands.

PASSAGE 3

Despite downsizings, workers' overall job satisfaction actually improved between 1988 and 1994. Some reasons given were improved work flow, better cooperation between departments, and increased fairness in supervision. Many firms today rely on attitude surveys to monitor how employees feel about working in their firms.

The use of employee attitude surveys had grown since 1944 when the National Industrial Conference Board "had difficulty finding fifty companies that had conducted opinion surveys". Today, most companies are aware of the need for employees' anonymity the impact of both the design of the questions and their sequence, the importance of effective communication, including knowing the purpose of the survey before it is taken and getting feedback to the employees after it is completed. Computerisation of surveys can provide anonymity, if there is no audit trail to the user, especially for short answers that are entered rather than written or typed on an identifiable machine.

Survey software packages are available that generate questions for a number of standard topics and can be customised by modifying existing questions or by adding questions. If the survey is computerised, reports can be generated with ease to provide snapshots of a given period of time, trend analysis and breakdowns according to various demographics. You may be interested in responses by age, sex, job categories, departments, division, functions or geography.

The survey can be conducted by placing microcomputers in several locations convenient for employees' use. Employees are advised where the computers will be, for how long, and when the data will be collected (for instance, daily at 5:00 p.m. for three weeks). The screens should

not be viewable to supervisors or passers-by. While there may be some risk that employees will take the survey more than once, there are comparable risks with other methods too.

Managers may be interested in knowing how they are perceived by their peers and subordinates. Packages are available that can be customised, which allow the manager to complete a self-assessment tool used to compare self-perceptions to the anonymous opinions of others. This comparison may assist in the development of a more effective manager.

12. Which one of the following is not the reason for improved job satisfaction of employees?
   (a) Improved work flow
   (b) Better cooperation between departments
   (c) Supervisors fairness
   (d) Increased remuneration

⊘ *(d)* No where in the passage it has been mentioned that increased remuneration is reason for improved job satisfaction.

13. Companies feel that it is necessary to
   (a) maintain anonymity of the employees and to have effective design and sequence of questions and effective communication
   (b) maintain the fairness of the managers to be part of the survey
   (c) conduct surveys from their employees
   (d) maintain anonymity of the employees and not to have effective design and sequence of questions and effective communication

⊘ *(c)* Many companies felt that it is necessary to conduct surveys from their employees.

14. One major benefit of using survey software packages is
   (a) reports can be generated easily
   (b) privacy of a person is exposed to the supervisors
   (c) employees would like to take up the test on computer
   (d) employer can get to know the information immediately

⊘ *(a)* If companies use survey software packages, they can generate reports easily, can provide snapshots of a given period of time, trend analysis and breakdowns according to various demographics.

15. Which word in the passage means 'tendency'?
   (a) Trend   (b) Breakdowns
   (c) Convenient   (d) Perceptions

⊘ *(a)* 'Trend' also means 'tendency'. Both words means 'an inclination or likelihood'.

16. "The screens should not be viewable to supervisors or passers by." Why?
   (a) To maintain the secrecy of a person
   (b) The main problem is to enable everyone to participate
   (c) The manager has to be fair enough
   (d) To maintain the problems faced by women in job market

⊘ *(a)* The screens should not be viewable to supervisors or passers by in order to keep the surveys secret.

17. What does the word 'customised' means here?
   (a) Adapted
   (b) Take as it is
   (c) Fixed
   (d) Mass produced

⊘ *(a)* The word 'customise' also means 'adapted'. Both word means 'to modify according to a customer's individual requirements'.

2019 (I)

PASSAGE 4

From 1600 to 1757 the East India Company's role in India was that of a trading corporation which brought goods or precious metals into India and exchanged them for Indian goods like textiles and spices, which it sold abroad. Its profits came primarily from the sale of Indian goods abroad. Naturally, it tried constantly to open new markets for Indian goods in Britain and other countries.

Thereby, it increased the export of Indian manufacturers and thus encouraged their production. This is the reason why Indian rulers tolerated and even encouraged the establishment of the Company's factories in India. But, from the very beginning, the British manufacturers were jealous of the popularity that India textiles enjoyed in Britain.

All of a sudden, dress fashions changed and light cotton textiles began to replace the coarse woolens of the English. Before, the author of the famous novel, Robinson Crusoe, complained that Indian cloth had "crept into houses, our closets and bed chambers curtains, cushions, chairs and at last beds themselves were nothing but calicos or India stuffs".

The British manufacturers put pressure on their government, to restrict and prohibit the sale of Indian goods in England. By 1720, laws had been passed forbidding the wear or use of printed or dyed cotton cloth. In 1760 a lady had to pay a fine of 200 for possessing an imported handkerchief ! Moreover, heavy duties were imposed on the import of plain cloth. Other European countries, except Holland, also either prohibited the import of Indian cloth or imposed heavy import duties. In spite of these laws, however, Indian silk and cotton textiles still held their own in foreign markets, until the middle of the eighteenth century when the English textile industry began to develop on the basis of new and advanced technology.

18. The East India Company was encouraging the export of Indian manufacturers because
   (a) it was a philanthropic trading corporation
   (b) it wanted Indian manufacturers to prosper in trade and commerce
   (c) it profited from the sale of Indian goods in foreign markets
   (d) it feared Indian Kings who would not permit them trade in India

   ⊙ (c) East India Company was encouraging the export of Indian goods as it got huge profits by the sale of Indian goods in foreign markets.

19. The people of England used Indian cloths because
   (a) they loved foreign and imported clothes
   (b) the Indian textile was light cotton
   (c) the Indian cloths were cheaper
   (d) the Indian cloths could be easily transported

   ⊙ (b) The British people used Indian clothes because the clothes were light cotton and of breathable fabric.

20. What did the British manufacturer do to compete with the Indian manufacturers?
   (a) They pressurised the government to levy heavy duties on export of Indian clothes
   (b) They pressurised the government to levy heavy duties on import of Indian clothes
   (c) They requested people to change their fashion preferences
   (d) They lowered the prices of the Britain made textile

   ⊙ (b) The British manufacturers were jealous of Indian manufacturers and they pressurised the British Government to levy heavy duties on import of Indian clothes.

21. Which source is cited by the author to argue that Indian textile was in huge demand in 18th century England?
   (a) The archival source
   (b) The scientific source
   (c) The journalistic source
   (d) The literary source

   ⊙ (d) The literary source, novel 'Robinson Crusoe' is cited by the author to argue that Indian textile was in huge demand in 18th century England.

22. "New and advanced technology" in the paragraph refers to
   (a) the French Revolution
   (b) the Glorious Revolution of England
   (c) the Industrial Revolution
   (d) the Beginning of Colonialism

   ⊙ (c) New and Advanced technology in the paragraph refers to the Industrial Revolution.

PASSAGE 5

Zimbabwe's prolonged political crisis reached the boiling point earlier this month when President Robert Mugabe dismissed the Vice-President, Emmerson Mnangagwa. A battle to succeed the 93-years-old liberation hero-turned. President had already been brewing within the ruling Zimbabwe African National Union-Patriotic Front (Zanu-PF), with the old guard backing Mr Mnangagwa, himself a freedom fighter and 'Generation 40', a grouping of younger leaders supporting Mr Mugabe's 52-years-old wife, Grace. Ms Mugabe, known for her extravagant lifestyle and interfering ways, has

been vocal in recent months about her political ambitions. 'Mr Mugabe was seen to have endorsed her when on November 6 he dismissed Mr Mnangagwa. But Mr Mugabe, who has ruled Zimbabwe since its independence in 1980, erred on two counts: he underestimated the deep connections Mr Mnangagwa has within the establishment and overestimated his own power in a system he has helped shape. In the good old days, Mr Mugabe was able to rule with an iron grip. But those days are gone. Age and health problems have weakened his hold on power, while there is a groundswell of anger among the public over economic mismanagement. So, when he turned against a man long seen by the establishment as his successor, Mr Mugabe left little doubt that he was acting from a position of political, weakness. This gave the security forces the confidence to turn against him and make it clear they didn't want a Mugabe dynasty. The military doesn't want to call its action a coup detat, for obvious reasons.

A coup would attract international condemnation, even sanctions. But it is certain that the army chief, Gen Constantino Chiwenga, is in charge, His plan, as it emerges, is to force Mr Mugabe to resign and install a transitional government, perhaps under Mr Mnangagwa, until elections are held.

23. In the paragraph, who has been called liberation hero?
   (a) Constantino Chiwenga
   (b) Emmerson Mnangagwa
   (c) Robert Mugabe
   (d) Army Chief

   ⊙ (c) As stated in the passage 93-years-old Robert Mugabe. the President of Zimbabwe has been called a liberation hero.

24. Mrs Mugabe is supported by
   (a) Mr Mnangagwa
   (b) Mr Mugabe
   (c) Generation 40
   (d) Zanu-PF

   ⊙ (c) As stated in the passage Mrs Mugabe was supported by Generation 40, a group of younger leaders.

25. Mr Mugabe's political weakness became apparent when

(a) he endorsed his wife
(b) he turned against the army
(c) he suffered from health issues
(d) he dismissed Mr Mnangagwa

⊘ *(d)* Mr Mugabe's political weakness became apparent when he dismissed Mr Mnangagwa, who was the Vice-President of Zimbabwe.

26. The secuirty forces of Zimbabwe staged a coup against the President because

(a) they wanted Mrs Mugabe as the President
(b) they were aware of Mugabe's failing wealth
(c) they disliked Mugabe's extravagant lifestyle
(d) they did not want a Mugabe dynasty

⊘ *(d)* The security forces of Zimbabwe staged a coup against the President because they did not want a Mugabe's dynasty.

27. Why does the military not want to call it a coup d'etat?

(a) Because coup is immoral
(b) Because coup is illegal
(c) Because coup would lead to international censure and sanctions
(d) Because it would make the public revolt

⊘ *(c)* The military does not want to call it a coup d'etat as coup would lead to international censure and sanctions.

PASSAGE 6

Over-eating is one of the most wonderful practices among those who think that they can afford it. In fact, authorities say that nearly all who can get as much as they desire, over-eat to their disadvantage. This class of people could save a great more food then they can save by missing one meal per week and at the same time they could improve their health. A heavy meal at night, the so-called 'dinner', is the fashion with many and often is taken shortly before retiring. It is unnecessary and could be forgone, not only once a week but daily without loss of strength. From three to five hours are needed to digest food. While sleeping, this food not being required to give energy for work, is in many cases converted

into excess fat, giving rise to over-weight. The evening meal should be light, taken three or four hours before retiring. This prevents over-eating, conserves energy and reduces the cost of food.

28. Why should those who over-eat refrain from doing so?

(a) Because over-eating leads to loss of wealth
(b) Because over-eating is bad for health
(c) Because over-eating conserves food
(d) Because over-eating is immoral and unhealthy

⊘ *(b)* Over-eating should be refrained as it is bad for health and a waste of food.

29. Over-eating is more prevalent among

(a) the rich   (b) the poor
(c) everybody   (d) the bourgeoisie

⊘ *(a)* Actually over-eating is more common among those who can afford the food.

30. The writer is asking the readers

(a) to skip the heavy dinner and take light evening meal instead
(b) to stop eating anything at night
(c) to take food only during the day
(d) to eat food before the sunset

⊘ *(a)* The writer is asking the readers to skip the heavy dinner just before retiring.They should, instead take light evening meals.

31. What is the most appropriate time for having evening meal?

(a) An hour after the sunset
(b) Three or four hours before sleeping
(c) Before the sunset
(d) Just before sleeping

⊘ *(b)* Evening meal, ideally, should be taken three or four hours before sleeping.

32. According to the passage, how many times a day should we have food?

(a) Three times
(b) Two times
(c) Once
(d) Has not been specified

⊘ *(d)* It has not been specified in the passage as how many times a day should we have food?

33. According to the passage, people over-eat

(a) because they can afford to
(b) because they are hungry
(c) because they have to work more
(d) because they have to conserve energy

⊘ *(a)* According to the passage, people over eat because they can afford and can get as much as they desire generally over-eat the food.

PASSAGE 7

Much has been said of the common ground of religious unity. I am not going just now to venture my own theory. But if anyone here hopes that this unity will come by the triumph of anyone of the religions and the destruction of the others, to him I say, "Brother, yours' is an impossible hope." Do I wish that the Christian would become Hindu? God forbid. Do I wish that the Hindu or Buddhist would become Christian? God forbid.

The seed is put in the ground and earth and air and water are placed around it. Does the seed become the earth, or the air, or the water? No. It becomes a plant.

It develops after the law of its own growth, assimilates the air, the earth and the water, converts them into plant substance and grows into a plant.

Similar is the case with religion. The Christian is not to become a Hindu or a Buddhist, nor a Hindu or a Buddhist to become a Christian. But each must assimilate the sprit of the others and yet preserve his individuality and grow according to his own law of growth.

If the Parliament of Religions has shown anything to the world, it is this: it has proved to the world that holiness, purity and charity are not the exclusive possessions of any church in the world and that every system has produced men and women of the most exalted character.

In the face of this evidence, if anybody dreams of the exclusive survival of his own religion and the destruction of the others, I pity him from the bottom of my heart and point out to him that upon the banner of every religion will soon be written in spite of resistance: 'Help and not fight,' 'Assimilation and not Destruction,' 'Harmony and Peace and not Dissension.'

34. According to the author of the passage, people should
   (a) change their religions
   (b) follow their religions and persuade others to follow it
   (c) follow their own religions and respect other religions
   (d) disrespect other religions

⊙ *(c)* According to the passage, people should follow their own religions and respect other religions also.

35. The Parliament of Religions is
   (a) a Christian organisation
   (b) a Buddhist organisation
   (c) a Hindu organisation
   (d) a platform for discussion about every religion of the world

⊙ *(d)* It is a platform for discussion about every religion of the world.

36. What does the author think about those who dream about the exclusive survival of their own religions and the destruction of the others?
   (a) He hates them
   (b) He desires to imprison them
   (c) He pities them
   (d) He praises them

⊙ *(c)* There is nothing like 'My Religions' only. The author takes a pity on those people who dream about the exclusive survival of their own religions and the destruction of the others. All religions are same and all basics of any religion are also the same.

37. According to the passage, what is 'impossible hope'?
   (a) One day, all the people of the world will follow only one religion
   (b) One day, there will be no religion
   (c) Purity and charity are the exclusive possessions
   (d) Banner of every religion will soon be written

⊙ *(a)* According to the passage, the impossible hope is that one day, all the people of the world will follow only one religion.

2018 (II)

PASSAGE 8

Daily consumption of a certain form of curcumin improved memory and mood in people with mild, age-related memory loss. The research examined the effects of an easily absorbed curcumin supplement on memory performance in people without dementia, as well as curcumin's potential impact on the microscopic plaques and tangled in the brains of people with Alzheimer's disease.

Found in turmeric, curcumin has previously been shown to have anti-inflammatory and antioxidant properties in laboratory studies. It has also been suggested as a possible reason that senior citizens in India, where curcumin is a dietary staple, have a lower prevalence of Alzheimer's disease and better cognitive performance.

38. Which of the following statements are true?
   1. Senior citizens in India have high level of Alzheimer's disease because of consumption of turmeric.
   2. Senior citizens in India do not, have high prevalence of Alzheimer's because of consumption of turmeric.
   3. Consumption of turmeric enhances cognitive performance.
   4. Curcumin is an antioxidant.
   Select the correct answer using the codes given below
   (a) 2, 3 and 4   (b) 1,3. and 4
   (c) 1 and 4   (d) 1 and 3

⊙ *(a)* Statement 2, 3 and 4 are true as per the passage.

39. Curcumin has positive effect on people
   (a) without dementia
   (b) with Alzheimer's disease
   (c) without dementia and with Alzheimer's disease
   (d) with dementia and with Alzheimer's disease

⊙ *(c)* As stated in the passage curcumin has positive effect on people without dementia and also on people suffering from Alzheimer's disease.

40. Which word in the passage means 'earlier'?
   (a) Performance   (b) Absorbed
   (c) Properties   (d) Previously

⊙ *(d)* 'Previously' means earlier or in the time gone by.

41. Eating turmeric
   (a) will reduce the chance of getting Alzheimer's disease
   (b) will increase curcumin
   (c) will enhance dementia
   (d) will reduce chance of getting cancer

⊙ *(a)* As inferred from the passage, consumption of turmeric can reduce the chance of getting Alzheimer's disease as it contains as antioxidant called curcumin.

42. .... of a disease in a region depends on the food habits too.
   (a) Dominance   (b) Prevalence
   (c) Affection   (d) Death

⊙ *(b)* Prevalence is the best option for this sentence. The word means widespread presence or a condition which is quite common.

PASSAGE 9

Mr. Rowland Hill. when a young man was walking through the lake district, when he one day saw the postman deliver a letter to a woman at a cottage door. The woman turned it over and examined it and then returned it, saying she could not pay the postage, which was a shilling. Hearing that the letter was from her brother. Mr. Hill paid the postage, in spite of the manifest unwillingness of the woman. As soon as the postman was out of sight, she showed Mr. Hill how his money had been wasted, as far as she was concerned. The sheet was blank. There was an agreement between her brother and herself that as long as all went well with him, he should send a blank sheet in this way once a quarter and she thus had tidings of him without expense of postage.

43. The story uses irony as a technique because
   (a) the woman returned her own brother's letter without opening It
   (b) the woman broke the agreement of receiving blank letters to convey well being of her brother
   (c) Mr. Hill accepted the letter addressed to the woman
   (d) in the modern times a brother has no time to write a letter to his own sister

⊙ *(a)* Woman returned her own brother's letter without opening it.

44. The woman returned the letter to the postman because
   (a) she could not pay the postage
   (b) the letter was not addressed to her
   (c) she already knew the contents of the letter
   (d) she hated the person who wrote the letter

(c) The woman returned the letter to the postman because she already knew the contents of the letter.

45. Mr. Hill paid the postage because

(a) the letter was from her brother
(b) the woman was his relative
(c) the letter was addressed to him
(d) he wanted to be kind to her

(d) Mr. Hill paid the postage because he wanted to be kind to the woman as letter was from her brother.

46. The envelope contained

(a) a currency note
(b) two written sheets
(c) no sheet at all
(d) a blank sheet

(d) As mentioned in the passage, the envelope contained a blank sheet only.

47. The woman and her brother had agreed that

(a) the letter with no postage meant good news
(b) the blank sheet meant being well
(c) the blank sheet meant bad news
(d) the letter with no postage meant unimportant news

(b) There was an agreement between the woman and her brother that the blank sheet meant all was well with him.

PASSAGE 10

In good many cases unnecessary timidity makes the trouble worse than it needs to be. Public opinion is always more tyrannical towards those who obviously fear it than towards those who feel indifferent to it.

A dog will bark more loudly and bite more easily when people are afraid of it than when they treat him with contempt and the human herd has something of this same characteristic. If you show that you are afraid of them, you give promise of good hunting, whereas if you show indifference, they begin to doubt their own power and therefore, tend to let you alone.

48. If we are afraid of public opinion, the attitude of the people towards us is

(a) sympathetic   (b) indifferent
(c) admiration   (d) ruthless

(d) According to the passage if we are afraid of public opinion, the altitude of the people towards us is ruthless or tyrannical.

49. The statement, "A dog will bark more loudly and bite more easily when people are afraid of him, than when they treat him with contempt ...." implies that

(a) barking dogs seldom bite
(b) we should not be afraid of dogs
(c) it we are afraid of others, they will leave us alone
(d) if we are afraid of people, they will try to scare us more

(d) This statement implies that if we are afraid of people, they will try to scare us more.

50. The author compares men with dogs in respect of

(a) attacking others without any reason
(b) attacking others when they are weak
(c) barking and biting
(d) faithfulness to the master

(b) People as well as dogs try to attack others when they are weak or afraid of them.

51. 'You give promise of good hunting' means

(a) you are vulnerable
(b) you are challenging
(c) you are indomitable
(d) you are confused

(a) The statement 'you give promise of good hunting' means that you are vulnerable which means exposed to the possibility of being attacked or harmed either physically or emotionally.

PASSAGE 11

We live in a curious age. We are offered glimpses of a world civilisation slowly emerging, e.g., the UN special agencies dedicated to health and education. But along with these are sights and sounds that suggest that the whole civilisation is rapidly being destroyed.

Two official policies clash and instantly embassies are attacked by howling mobs of students, at once defying law, custom and usage.

And that this may not be merely so many hot-headed lads escaping all control and may itself be part of the policy of the political parties, that is, mob antics as additional propaganda to deceive world opinion, makes the situation even worse.

Parties have always been dishonest, but now it seems as if power-mania is ready to destroy those civilities that make international relations possible.

There is something even worse. What inspires these students to burn cars and books is not their political enthusiasm but a frensied delight in destruction, an urge towards violent demolition.

52. The author calls our age curious because

(a) it is an age of science and scientists are curious by nature
(b) it is witnessing the emergence of a world civilisation
(c) it is witnessing incidents that threaten to shake the very foundations of civilisation
(d) it is an age of contradictions consisting of constructive and destructive activities

(d) The author says that this modern age is curious because it is an age of contradictions consisting of constructive and destructive activities.

53. It is deplorable to witness mob attacks on embassies following a clash of policies of two official policy makers because

(a) students should not take part in politics, but should concentrate on their studies
(b) they may result in the loss of lives of young and promising students
(c) they are overlooked by the policy planners themselves
(d) they are indicative of the complete failure of the government in controlling the rebellious students

(c) As remarked or mentioned in the passage, the attacks by students are overlooked by the policy planners or policy makers themselves.

54. One aspect of the mob indulging in violence and arson is that they

(a) destroy very costly things like vehicles
(b) destroy very valuable artifacts and books
(c) get a mad delight in destruction for the sake of destruction only
(d) are motivated by certain political ideology to resort to destruction

(c) A worrying aspect of mob attack is that they get a mad delight in destruction for the sake of destruction only.

55. In the passage, the word 'demolition' has the meaning as the word.
(a) defying   (b) antics
(c) destruction   (d) urge

⊘ *(c)* Destruction or knocking down.

2018 (I)

PASSAGE 12

Over-population is the most pressing of India's numerous and multifaceted problems. In fact, it has caused equally complex problems such as poverty, under-nourishment, unemployment and excessive fragmentation of land. Indisputably, this country has been facing a population explosion of crisis dimensions. It has largely diluted the fruits of the remarkable economic progress that the nation has made during the last four decades or so. The entire battle against poverty is thwarted by the rapid increase in the population. The tragedy is that while over-population accentuates poverty, the country's stark poverty itself is in many areas a major cause of over-population.

56. What is the irony behind the over-population of India?
(a) Over-population gives birth to poverty, which (poverty) itself is the cause of over-population
(b) Under nourishment and unemployment are outcomes of flawed economic progress
(c) Fragmentation of land is leading to over-population
(d) Fruits of the remarkable economic progress are trickling down to the poor

⊘ *(a)* Over-population gives birth to poverty, which (poverty) itself is the cause of over-population.

57. What is the general tone of the passage?
(a) Funny/humorous
(b) Sombre
(c) Didactic
(d) Tragic

⊘ *(b)* The passage conveys a feeling of deep seriousness and sadness. Hence, the tone of the passage is somber.

58. What in the author's view, severely affects the economic growth of our country?
(a) Poverty   (b) Illiteracy
(c) Over population (d) None of these

⊘ *(c)* Over-population severely affects the economic growth of our country.

59. What according to the author, is the biggest reason behind over-population?
(a) Under-nourishment
(b) Unemployment
(c) Excessive fragmentation of land
(d) Poverty

⊘ *(d)* According to the author, poverty is the biggest reason behind over-population.

60. "It has largely diluted the fruits of the remarkable economic progress". Find antonym of the underlined word.
(a) Coalesced   (b) Compounded
(c) Cheapened   (d) Consolidated

⊘ *(d)* Consolidated will be the appropriate antonym of diluted as used in the sentence. Here diluted means weakened while consolidated means strengthened.

PASSAGE 13

To eat and not be eaten-that's the imperative of a caterpillar's existence. The leaf roller reduces its risks of being picked off by predators by silking together a temporary shelter in which to feed and rest. Adopting a different line of defense, the jelly slug extrudes a sticky translucent coating that may foul the mouth-parts of marauding ants. For its part, the aquatic larva, by its watery element, fashions a portable hideout from fragments of aquatic leaves. Cutting a serpentine trail as it feeds on tender young levels, the minute citrus leaf miner spends its entire larval life inside its host plant, thus keeping its appetising body safely under wraps.

61. Which varieties of caterpillars 'build' shelters to protect themselves?
(a) Leaf roller and aquatic larva
(b) Leaf roller and jelly slug
(c) Jelly slug and aquatic larva
(d) Jelly slug and citrus leaf miner

⊘ *(a)* Leaf roller and aquatic larva built shelters to protect themselves.

62. Which one of the following caterpillars produces a sticky covering?
(a) Leaf roller   (b) Jelly slug
(c) Aquatic larva (d) Citrus leaf miner

⊘ *(b)* Jelly slug produces a sticky covering.

63. Which one of 'the following pairs of words in the passage describes enemies of the caterpillar?
(a) Serpentine and host
(b) Predator and marauding ants
(c) Serpentine and marauding
(d) Predator and host

⊘ *(b)* Predator and marauding ants are the enemies of caterpillar.

64. Which one of the following makes itself unpalatable?
(a) Leaf roller   (b) Jelly slug
(c) Aquatic larva (d) Leaf miner

⊘ *(b)* Jelly slug extrudes a sticky coating which makes itself unpalatable.

65. The main idea of the passage is that caterpillars
(a) like to eat a lot
(b) have to protect themselves while feeding
(c) are good to eat
(d) are not good to eat

⊘ *(b)* The main idea of the passage is that caterpillars have to protect themselves while feeding.

PASSAGE 14

I have always opposed the idea of dividing the world into the Orient and the Occident. It is however, the tremendous industrial growth that has made the West what it is.

I think the difference, say, between India and Europe in the 12th or 13th century would not have been very great.

Difference has been intensified by this process of industrialisation which has promoted material well-being tremendously and which is destroying the life of the mind, which is in a process of deterioration, chiefly because the environment that has been created by it does not give time or opportunity to individuals to think.

If the life of the mind is not encouraged, then inevitably civilisation collapses.

66. The words 'the Orient and the Occident' mean

(a) the West and the East respectively
(b) the East and the West respectively
(c) the North and the South respectively
(d) the South and the North respectively

⊙ *(b)* The words 'the orient and the occident' mean the 'East and the West respectively.'

67. The author believes that the difference between India and Europe in the 12th or 13th century was not very great because

(a) Indians and Europeans mixed freely
(b) Indians imitated the European way of living
(c) Europeans imitated the Indian way of living
(d) Industrialisation had not yet taken place

⊙ *(d)* The author believes that the difference between India and Europe in the 12th or 13th century was not very great because industrialisation had not yet taken place.

68. In the opinion of the author, industrialisation is

(a) an absolute blessing
(b) an absolute curse
(c) neither a blessing nor a curse
(d) more of a curse than a blessing

⊙ *(d)* In the opinion of the author, industrialisation is more of a curse than a blessing as it has destroyed the life of mind and men does not get time to think.

69. The author says that the mental life of the world is in a process of deterioration because the modern generation is

(a) endowed with low mental powers
(b) too lazy to exert its mental powers
(c) taught that physicial activities are more important than mental
(d) brought up in an environment unfavourable to the growth of the mental life

⊙ *(d)* The author has said that because modern generation is brought up in an environment unfavourable to the growth of the mental life. So it is under deterioration.

70. The title that best expresses the central idea of the passage is

(a) difference between the Occident and the Orient
(b) impact of industrialisation on our civilisation
(c) advantages of industrialisation
(d) disadvantages of industrialisation

⊙ *(b)* The best suitable title of the passage would be 'Impact of industrialisation on our civilisation'.

PASSAGE 15

In Delhi, it was forbidden by the law, at one time, to take a dog into a public vehicle. One day a lady, accompanied by a pet dog, entered a bus. Wishing to evade the law, she placed her tiny dog in her dress pocket.

It so happened that the person next to this lady was a pick-pocket and during the journey he carefully placed his hand into her pocket in search of her purse. Great was the horror to find instead a pair of sharp teeth inserted into his fingers. His exclamation of pain and surprise drew the attention of other passengers to him.

71. Once the law in Delhi did not permit the people to

(a) carry dogs into private vehicles
(b) board a bus without ticket
(c) carry dogs into a public vehicle
(d) carry animals with them

⊙ *(c)* Once the law in Delhi did not permit the people to carry dogs into a public vehicle.

72. In order to evade the law, the lady

(a) hid the dog under seat
(b) got off the bus
(c) gave the dog to a fellow passenger
(d) put the dog in her pocket

⊙ *(d)* In order to evade the law, the lady put the dog in her pocket.

73. The pick-pocket travelling with the lady

(a) reported the matter to the conductor
(b) put his hand in her pocket
(c) took out the dog
(d) asked the lady to get off

⊙ *(b)* The pick-pocket travelling with the lady put his hand in her pocket.

74. Which one of the following correctly expresses the meaning of 'wishing to evade the law'?

(a) Wish to avoid following the law
(b) Desire to follow the law blindly
(c) Reluctance to break the law
(d) Wish to change the law

⊙ *(a)* The expression 'wishing to evade the law' means 'wish to avoid following the law'.

75. Why did the pick-pocket exclaim with pain?

(a) He was hit by the lady
(b) He was caught by the fellow-passengers
(c) He was bitten by the dog
(d) He fell of the bus

⊙ *(c)* The pick-pocket exclaimed with pain because he was bitten by a dog.

2017 (II)

PASSAGE 16

For many years, ship captains navigating the waters of Antarctica have been intrigued by sightings of emerald icebergs. Scientists have now explained their mystery. Their icebergs are turned upside down. Icebergs are blocks of ice that have broken off huge slabs of frozen snow called ice shelves. Their green appearance results from seawater that has frozen at the bottom over hundreds of years. The frozen sea water has dissolved organic matter which gives it a yellow tone and the fresh water 'ice shelf' above has a blue tinge. When the iceberg turns upside done, it appears green through the visual mix of yellow with the blue from below.

76. What is the meaning of 'intrigued'?

(a) Surprised   (b) Fascinated
(c) Muffled   (d) Repulsed

⊙ *(b)* Intrigued means arouse the curiosity or interest of; fascinate.

77. What are ice shelves?

(a) They are huge pieces of frozen snow.
(b) They are frozen sea water
(c) They are pieces of ice which look like shelves
(d) They are huge pieces of ice which are very old

⊙ *(a)* Ice shelves are huge pieces of frozen snow.

78. What are icebergs?

(a) Huge chunks of ice floating on water
(b) Frozen sea water
(c) Green ice
(d) Green yellow water below and blue above

⊗ *(a)* Icebergs are huge chunks of ice floating on water, which have broken from ice shelves.

79. When the iceberg turns upside down, it appears

(a) green   (b) yellow
(c) blue   (d) white

⊗ *(a)* When the iceberg turns upside down, it appears green.

PASSAGE 17

In its simple form, science has helped man to protect himself from Nature and to overcome natural obstacles to movement. But with the advance of science, a situation has arisen in which Nature need to be protected from man. He has used Nature's own gifts, not only of metal but even the human brain, to attack Nature. Forests are being destroyed not only to satisfy the need but to provide luxuries. The evil effects of deforestation are already making themselves clearly felt by climatic changes and soil erosion. Man has at last begun to learn that he has to protect if he wants Nature to protect him.

80. The use of science in its simple form has helped man to

(a) do such things as building shelter and make carts, boats, etc.
(b) make bombs and missiles
(c) build factories using machinery
(d) make planes

⊗ *(a)* The use of science in its simple form has helped man to do such things as building shelter and make carts, boats, etc.

81. Nature now needs to be protected from man because

(a) nature has become weak
(b) man is rapidly destroying Nature
(c) man is cruel to animals
(d) man has become irrational

⊗ *(b)* Nature now needs to be protected from man because man is rapidly destroying Nature.

82. Forests are being destroyed in order to

(a) provide land for agriculture
(b) provide wood for fuel
(c) kill dangerous animals
(d) provide necessities as well as needless comforts and pleasures

⊗ *(d)* Forests are being destroyed in order to provide necessities as well as needless comforts and pleasures.

83. The evil effect of destroying Nature instead of using it is seen in

(a) the fall in production of our factories
(b) the fall in our standard of living
(c) the unfavourable changes in climate
(d) the frequent occurrence of epidemics

⊗ *(c)* The evil effect of destroying Nature instead of using it is seen in the unfavourable changes in climate.

84. Climatic changes and soil erosion are results of

(a) scientific developments
(b) nuclear explosion
(c) natural calamity
(d) deforestation

⊗ *(d)* Climate changes and soil erosion are results of deforestation.

PASSAGE 18

According to the civil laws of most countries, obedience is no longer the duty of a wife, every woman has the political right to vote, but these liberties remain theoretical as long as she does not have economic freedom. A woman supported by a man is not liberated from the male. It is through gainful employment that woman has traveled most of the distance that separated her from the male, and nothing else can guarantee her liberty in practice.

I once heard a maidservant declare, while cleaning the stone floor of a hotel lobby, "I never asked anybody for anything; I succeeded all by myself." She was as proud of her self-sufficiency as a Rockefeller, Ford or Birla. However, the mere combination of the right to vote and a job does not mean complete liberation: working, today, is not a liberty.

A recent study of women workers in a car factory shows that they would prefer to stay in the home rather than work in the factory. The majority of women do not escape from the traditional feminine world.

Their jobs at the factory do not relieve them of housekeeping burdens; they get from neither society nor their husbands, the assistance they need to become in concrete fact the equals of men.

85. Which of the following helps women?

(a) The right to vote
(b) Civil liberties
(c) A job
(d) Wealthy husbands

⊗ *(b)* Civil liberties help women.

86. Why does the writer talk about the maidservant in the hotel lobby?

(a) The servants of today will one day be freed from their rich masters
(b) A servant can become as rich as Rockefeller or Birla
(c) Even with a low paid job women can achieve equality
(d) Economic independence is necessary for women's liberation

⊗ *(d)* The writer talks about the maidservant in the hotel lobby because Economic independence is necessary for women's liberation.

87. In which paragraph does the writer say that it is revealed that some woman would not like to work in the factory?

(a) In paragraph four
(b) In paragraph three
(c) In paragraph two
(d) In paragraph one

⊗ *(a)* In paragraph four the writer says that it is revealed that some women would not like to work in the factory.

88. 'These liberties' in the first paragraph refer to

(a) The right to vote, not to obey and right to a job
(b) The right to vote and not to obey
(c) The rights of servants to disobey their master and the right of the master to punish them
(d) Women's right to vote and earn money

⊗ *(b)* These liberties in the first paragraph refer to the right to vote and not to obey.

PASSAGE 19

During the past three generations, the diseases affecting Western societies have undergone dramatic changes. Polio, diphtheria, tuberculosis, commonly known as TB, are vanishing; one injection of an antibiotic often cures deadly diseases such as pneumonia or syphilis, and so many mass killers have come under control that two-thirds of all death is now

associated with the diseases of old age. Those who die young are more often than not victims of accidents, violence, or suicide.

These changes in health status are generally equated with the decrease in suffering and attributed to more or better medical care. Almost everyone believes that at least one of his friends would not be alive and well except for the skill of a doctor.

But there is, in fact, no evidence of any direct relationship between this change in the pattern or nature of sickness on the one hand and the so-called progress of medicine on the other hand.

These changes are the results of political technological changes. They are not related to the activities that require the preparation and status of doctors or the costly equipment in which doctors take pride.

In addition, an increase in the number of new diseases in the last fifteen years are themselves the result of medical intervention. They are doctor-made or iatrogenic.

89. In the Western societies, the occurrences of polio, diphtheria, and tuberculosis has

(a) increased
(b) completely stopped
(c) decreased
(d) continued without changes

⊘ *(c)* In the Western societies, the occurrences of polio, diphtheria, and tuberculosis has decreased.

90. More death are now associated with old age than in the past because

(a) iatrogenic diseases are spreading faster now
(b) deadly diseases affecting the young have been well controlled
(c) Accidents, violence and suicide that killed many youths in the past are now under control
(d) political and technological changes now take better care of the young than the old

⊘ *(b)* More death are now associated with old age than in the past because deadly diseases affecting the young have been well controlled.

91. The writer probably is arguing for

(a) stopping the practice of Western medicines completely
(b) stopping the use of costly equipment and medicines
(c) rethinking about the successes and failures of the Western medicines
(d) giving greater attention to new, iatrogenic diseases than to the old diseases such as polio, diphtheria and pneumonia

⊘ *(c)* The writer probably is arguing for rethinking about the successes and failures of the Western medicines.

PASSAGE 20

Poverty is a complex problem. It is far more than an economic condition. We measure it usually in terms of income but forget that poverty embraces a whole range of circumstances, including lack of access to information and to basic services like nutritional diet, health care, and education.

It results in a loss of cultural identity and destroys traditional knowledge. Poor people become marginalised and suffer from exploitation and loss of human dignity.

92. Which of the following sentences comes close to the meaning of the sentence, "Poverty embraces a whole range of circumstances"?

(a) There are lot of angles to poverty
(b) There are several section in the society which are poor
(c) There are several types of poverty
(d) Poverty is solely an economic issue

⊘ *(a)* The sentence "There are lot of angles to poverty" has the same meaning as "Poverty embraces a whole range of circumstances."

93. What way do you think 'lack of access to information' affects poor people?

(a) They don't get information about how to improve their conditions
(b) They didn't get newspapers to read at all
(c) They can't go to school and read books
(d) They don't get information about schemes of getting ric

⊘ *(a)* 'Lack of access to information' affects poor people as they don't get information about how to improve their conditions.

94. What do you think 'cultural identity' is important?

(a) A sense of cultural identity gives people self-respect and confidence
(b) Cultural identity defines the character of poor people
(c) It is important to have cultural identity to get jobs
(d) It is useful to have cultural identity because it brings your success

⊘ *(a)* A sense of cultural identity gives people self-respect and confidence so 'cultural identity' is important.

95. Which of the following sentences comes closest to the sentence" "Poor people become marginalised"?

(a) They are not given any benefit of any government schemes
(b) They are ignored by the rich people
(c) They are the most ignored elements of the society
(d) They are the most disposed elements of the society

⊘ *(c)* Statement 'They are the most ignored elements of the society' has the similar meaning to the sentence 'Poor people become marginalised'.

96. What do you think is the tone of the passage?

(a) Objective but querulous
(b) Descriptive and impassioned
(c) Argumentative and critical
(d) Objective and critical

⊘ *(d)* The tone of the passage is objective and critical.

2017 (I)

PASSAGE 21

When Jonathan (the seagull) came, it was well after dark, and he floated in moonlight on the surface of the ocean. His wings were ragged bars of lead, but the weight of failure was even heavier on his back. He wished, feebly, that the weight would be just enough to drag him gently down to the bottom, and end it all. But soon he came back to normal. He pushed wearily away from the dark water and flew towards the land, grateful for what he had learned about work-saving low-altitude flying.

97. The word 'wearily' means
    (a) tireless   (b) exhausted
    (c) sadly   (d) unconscious

⊘ *(b)* 'Wearily' means with extreme tiredness or exhausted.

98. The seagull suffered because
    (a) he had tried to do something that other seagulls had not done
    (b) probably he had been attacked by a stronger bird
    (c) probably he had been attacked by some strong creature in the sea
    (d) he had swooned and fallen into the water

⊘ *(d)* It can be inferred from the passage that the seagull had fainted while flying and fallen into the water.

99. 'His wings were ragged bars of lead' means that
    (a) his wings damaged and supported by bars of lead
    (b) his wings were damaged and therefore very heavy
    (c) he had rags and bars of lead on his wings
    (d) his wings were broken like pieces of lead

⊘ *(b)* 'His wings were ragged bars of lead' means that his wings were damaged and therefore very heavy. They felt as if they were made of lead, a very heavy metal.

100. The lesson that he had learnt that day was about
    (a) not fighting with stronger birds
    (b) flying carrying bars of lead on his wings
    (c) diving too deep into the sea
    (d) flying at low altitudes

⊘ *(d)* The line '.................. what he had learned about, work saving low-altitude flying' provides the answer.

PASSAGE 22

Vacationing on a motorcycle, you see things in a way that is completely different from any other. In a car, you are always in a compartment, and because you are used to it you do not realise that through that car window everything you see is just more TV. You are a passive observer and it is all moving by you boringly in a frame. On a motorcycle, however, the frame is gone. You are completely in contact with it all. You are in the scene, not just watching it anymore, and the sense of presence is overwhelming.

101. The writer likes travelling on the motorcycle. What is the most likely reason for this?
    (a) The motorcycle has no windows
    (b) The motorcycle does not go as fast as a car
    (c) As the traveller is used to cars, travelling by motorcycle is a change
    (d) Travelling by motorcycle, the writer feels that he is part of the scenery

⊘ *(d)* The answer can be found in the line you are in the scene, not just watching it anymore ....' .

102. Which of the following statements is closest to the truth?
    (a) The writer does not like TV as it gives a narrow view of things
    (b) The writer likes TV but he does not like watching it from car windows
    (c) The writer does not like TV because the picture is in a frame
    (d) The writer does not like TV because the programmes are boring

⊘ *(c)* The answer can be found in the line 'You are a passive observer and it is all moving by you boringly in a frame'.

103. "In a car you are always in a compartment, and because you are used to it, you do not realise that ...." In this sentence, 'it' refers to
    (a) travelling in a car
    (b) always being in a compartment, e.g. one's room, office
    (c) seeing the scenery through the window frame
    (d) seeing so much TV at home

⊘ *(a)* Here, 'it' refers to travelling in a car.

104. In the last sentence, the writer talks of a 'sense of presence'. He is referring to the presence of
    (a) his own self as part of the scene
    (b) the time that is now passing
    (c) the scene and the beauty
    (d) senses with which one feels

⊘ *(a)* Here, the writer is referring to the presence of his own self as a part of the scene.

105. The word 'overwhelming' means
    (a) very strong
    (b) unavoidable
    (c) interesting
    (d) humourous

⊘ *(a)* 'Overwhelming' as used in the passage means very strong.

PASSAGE 23

I was lying down in a dark, lonely compartment of the speeding train, trying to sleep. But, quite unusually, sleep eluded me. A vague uneasiness gripped me. It was pitch dark outside.

A few points of light flashed by as we sped through a small station and in the dim light I thought I saw a hand gripping the bars of my window.

Once again the train was swallowed up by the impenetrable darkness. My heart pounded. My mouth was parched. I could not get up.

I do not know how long I remained thus before the train began to slow down. The reassuring bright lights of the station we were entering revealed no intruder. I breathed again.

106. The narrator could not sleep because
    (a) he usually found it difficult to fall asleep
    (b) he could not find a place to lie down
    (c) he was disturbed by some unspecified thoughts
    (d) the people near him were disturbing him

⊘ *(c)* The line 'A vague uneasiness gripped me' gives the answer.

107. In the dim light he saw
    (a) someone trying to climb into the train
    (b) someone clinging to the bars of the window
    (c) someone was attempting to steal his bag
    (d) someone standing outside the window

⊘ *(b)* The line '............... in the dim light I thought I saw a hand gripping the bars of my window' provides the answer.

108. Which of the following words best describes the condition of the traveller?
    (a) Cautious
    (b) Imaginative
    (c) Observant
    (d) Nervous

⊘ *(d)* The lines 'My heart pounded', 'My mouth was parched' and the narrator's inability to sleep show that he was nervous and frightened.

PASSAGE 24

I was abruptly awakened by a noisy scuffle. The sun, a mere fringe over the horizon, immediately chased away the grey half-darkness. I was too sleepy to notice what was happening. Yuri was rolling over on the ground. I ran up to him but was struck dumb. With his right hand he was holding a cobra by the neck. Two sharp fangs showed from its jaws. The battle was over in a few minutes. A hollow hissing and convulsive jerks were then only reminders of a just-ended tussle. The catcher half-opened the lid of the box and calmly put the quarry in.

109. When the writer saw Yuri holding a cobra by the neck, he was 'struck dumb'. This means that he was

(a) extremely delighted
(b) very much helpless
(c) rather surprised
(d) absolutely shocked

⊙ *(d)* The expression 'struck dumb' means to be unable to speak because of great surprise or shock.

110. From the passage, Yuri appears to be a man who is

(a) calm and courageous
(b) cunning and crafty
(c) noisy and dangerous
(d) active and jumpy

⊙ *(a)* Yuri's calm and courageous nature is reflected in the passage.

111. With reference to the passage, the following assumptions have been made:

1. The incident took place early in the morning.
2. Yuri threw the snake away.

Which of these assumptions is/are correct?

(a) Only 1   (b) Only 2
(c) Both of these   (d) Neither 1 nor 2

⊙ *(a)* The lines 'The sun ...chased away the grey half-darkness' and 'I was too sleepy to notice what was happening' give the answer.

PASSAGE 25

Urbanisation and industrialisation have often resulted in whole areas of forests being cleared to gain new land and to obtain timber for the various building projects. Large areas of fields and forests have disappeared to make way for concrete jungles, many of which are fitted with huge plants and chimney stacks. Industrial growth has necessitated the increased demand for fuel oil to run the machines and in doing so produces industrial gases and fumes, which belch through the chimney and pollute the atmosphere. The most evident elements in the contamination of the atmosphere are dust, sulphur dioxide, carbon monoxide and nitrous oxide.

112. The writer expresses the belief that

(a) there is plenty of scope for further industrialisation
(b) unplanned growth of industry has done more harm than good
(c) the change from rural to urban growth is a change for the better
(d) the timber obtained from the forests has been beneficially used

⊙ *(b)* The writer expresses the belief that unplanned growth of industry has done more harm than good.

113. The effect on forest areas produced by the activity described in the first sentence is called

(a) devastation   (b) deforestation
(c) disfiguration   (d) devaluation

⊙ *(b)* 'Deforestation' refers to clearing of forest areas to gain new land and obtain timber for the various building projects.

114. The results of industrial development, according to the writer, are

(a) urbanisation
(b) no shortage of fuel oil
(c) greater availability of domestic gas
(d) greater fuel consumption and pollution

⊙ *(d)* The line 'Industrial growth has necessitated the increased demand for fuel oil .... pollute the atmosphere' gives the answer.

115. The phrase 'concrete jungle' in the paragraph refers to the factories and houses built as a result of urbanisation and industrialisation.

This phrase suggests that the author

(a) regrets that fields and forests have been replaced by city buildings
(b) believes that too much cement has been used in building factories
(c) disapproves of modern industrial expansion
(d) would like to go back to life in the jungle

⊙ *(c)* The given phrase suggests that author disapproves modern industrial expansion.

PASSAGE 26

I must say a word about the Eiffel Tower. I do not know what purpose it serves today. But I then heard it greatly disparaged as well as praised. I remember that Tolstoy was the chief among those who disparaged it. He said that the Eiffel Tower was a monument of man's folly, not of his wisdom. Tobacco, he argued, was the worst of all intoxicants, in as much as a man addicted to it was tempted to commit crimes, which a drunkard never dared to do; liquor made a man mad, but tobacco clouded his intellect and made him build castles in the air. The Eiffel Tower was one of the creations of a man under such influence. There is no art about the Eiffel Tower. In no way can it be said to have contributed to the real beauty of the Exhibition. Men flocked to see it and ascended it as it was a novelty and of unique dimensions. It was the toy of the Exhibition. So long as we are children, we are attracted by toys, and the Tower was a good demonstration of the fact that we are children attracted by trinkets. That may be claimed to be the purpose served by the Eiffel Tower.

116. Why did Tolstoy disparage Eiffel Tower?

1. Man was foolish to build it.
2. Huge man-made structures did not appeal to him.

Which of the statements given above is/are correct?

(a) Only 1   (b) 1 and 2
(c) 1 and 3   (d) 2 and 3

⊙ *(a)* According to Tolstoy making of Eiffel Tower was a foolish thing.

117. Why did Tolstoy believe that tobacco was the worst of all intoxicants?

(a) Man lost his intellectual abilities under the influence of tobacco
(b) Tobacco kept man in a state of inebriation
(c) People who commit crimes are invariably addicted to tobacco
(d) Statements (a) and (b) above are correct in this context

⊙ (**a**) According to Tolstoy Tobacco influenced a man's intellectual abilities.

118. Why did men flock to the Eiffel Tower?

(a) Men were attracted to the castles built in the air
(b) Men lost their wisdom under the influence of intoxicants
(c) Men were attracted to childish things
(d) Men were attracted to things of no value

⊙ (**c**) Men flocked to the Eiffel Tower as it was something new and of unique dimensions.

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PASSAGE 27

One of the most important things to notice about the power of art is the way in which great works continue to exert their influence through the ages. Scientific discoveries, which are of major importance at the time, when they are made, are superseded. Thus, Newton's theory of gravitation has been superseded by Einstein's theory of relativity. Hence, the work of great scientists has value in stages on the way to a goal, which supersedes them.

Broadly speaking, the achievements of generals, politicians, and statesmen have an importance only in their own time. Hence, these people and their acts, great as they may have been are like milestones which mankind passes on its way to something else. But with works of art it is not so.

The place which they occupy in the estimation of succeeding ages and the power, which they exercise over men's spirits are as great as they were in the age, which produced them; indeed, their power tends to increase with time, as they came to be better understood.

119. The power of art can be judged through

(a) its influence on a few individuals
(b) its influence on the people over the years
(c) the greatness of great artists
(d) the opinions of great thinkers

⊙ (**b**) The passage very clearly talks about the power of art and how it has exerted its influence through the ages. Hence, option (b) is the correct answer.

120. The statement "Newton's theory of gravitation has been superseded by Einstein's theory of relativity" suggests that

(a) the theory of relativity has nothing to do with the theory of gravitation
(b) the theory of relativity is new in comparison to the theory of gravitation
(c) the theory of relativity is an improvement over the theory of gravitation
(d) the theory of relativity has suppressed the theory of gravitation

⊙ (**d**) The given statement suggests that the theory of gravitation has been replaced by the theory of relativity. Hence, option (d) is the correct answer.

121. The achievements of generals, politicians and statesmen have been compared to milestones by the author because

(a) they are inscribed on the milestones
(b) they have contemporary relevance
(c) they have topical and historical interest
(d) they are strong and lasting stones

⊙ (**b**) According to the passage, the achievements of these people had importance only in their own time. Like milestones, people just passes through them to something else. Hence, option (b) is the correct answer.

122. How is a work of art different from the work of a scientist?

(a) A work of art is as permanent as the work of a scientist
(b) The influence of a work of art increases from age to age unlike the work of a scientist which diminishes in course of time
(c) A work of art has no material value like the work of a scientist
(d) A work of art is an expression of creative power while the work of a scientist is not

⊙ (**b**) The last few lines of the passage clearly suggests that the power of art increase with time and is better understood by people. Hence, option (b) is the correct answer.

PASSAGE 28

Most disputes about whether or not men are stronger than women are meaningless because the word 'strong' may mean many things.

Most men can surpass most women in lifting heavy weights, in striking an object, in running, jumping or doing heavy physical labour. But most women live longer than most men, they have a better chance of resisting disease, they can beat men at operations requiring finger dexterity and the ability to work accurately under monotonous conditions. So, it would be legitimate to argue that women are stronger than men. The truth is that each gender can surpass the other in certain kinds of activities. To say that one is stronger than the other is to indulge in futile arguments.

123. Which one of the following statements best reflects the main contention of the author?

(a) In most cases, men are stronger than women
(b) Since women are healthier than men they are also stronger
(c) In some activities, men are stronger than women and in some others women are stronger than men
(d) Men and women are equally strong

⊙ (**c**) The passage talks about how each gender can surpass the other in certain kinds of activities. Hence, option (c) is the correct answer.

124. The author says that any dispute about whether or not men are stronger than women is meaningless, because

(a) it is an already established fact that men are stronger than women
(b) the word 'stronger' can be interpreted in various ways
(c) it is difficult to assess the comparative strength of men and women
(d) it is a dispute that might harm the man-woman relationship in our society

⊙ (**b**) The author very clearly mentions that the word 'strong' may mean many things. Hence, option (b) is the correct answer.

125. The author says, it would be legitimate to argue that women are stronger than men, because

(a) the author believes in the superior strength of women
(b) the author is not committed to any opinion
(c) in some of the activities women do give an impression that they are stronger than men
(d) in fact women are inferior to men in every respect

⊙ *(c)* The author, in the passage, talks about how in certain activities women are stronger than men. They live longer than most men, can beat them at operations requiring finger dexterity, work accurately under monotonous conditions, etc. Hence, option (c) is the correct answer.

126. From the passage, which of the following statements is most likely to be correct?

(a) Women live longer than men because they can resist diseases better than men

(b) Monotonous living conditions make women stronger than men

(c) All women are incapable of running, jumping and doing physical labour because they are not strong

(d) Statistically speaking, most women live longer than most men

⊙ *(d)* The author give many instances where women are stronger than men. These instances are based on statistics. Hence, option (d) is the correct answer.

PASSAGE 29

In national no less than in individual life there are no watertight compartments. No sharp lines can be drawn to mark off the political from the moral, the social from the economic regions of life. Politicians often talk as though one has only to introduce certain political and economic changes for paradise to descend on Earth, forgetful of the fact that the efficiency of an institution depends on the way it is worked, which itself is determined by the character and wisdom of the men who work it.

127. Which one of the following statements most clearly suggests the central theme of the passage?

(a) Political and economic changes can solve all the problems facing the nation

(b) There is no difference between the political, moral, social and economic regions of life

(c) It is not the institutions that are important but the character and wisdom of the people who manage them

(d) National progress depends solely on the efficient running of our institutions

⊙ *(c)* The passage clearly suggests that the efficiency of the institution depends on the way it is worked and the character and wisdom of the men who work it. Hence, option (c) is the correct answer.

128. Which one of the following phrases best helps to bring out the precise contextual meaning of 'watertight compartments'?

(a) Activities of life unaffected by public opinion

(b) Spheres of life where no liberty of opinion is tolerated

(c) Ways of life peculiar to each nation and each section of society

(d) Spheres of life which are independent and unconnected

⊙ *(a)* The contextual meaning of the phrase 'watertight compartments' is the 'activities of life unaffected by public opinion'.

129. Which one of the following statements most correctly reflects the attitude of the author towards politicians' opinions?

(a) The author totally disbelieves what the politicians say

(b) The author believes what the politicians say

(c) The author is sceptical about the claims of the politicians

(d) The author thinks that the opinions of the politicians are contradictory

⊙ *(d)* The author says that the politicians often talk about introducing certain political and economic changes. However, the author contradicts their view as the efficiency of an institution depends upon other factors as well. Hence, option (d) is the correct answer.

130. Which one of the following statements most correctly indicates the implication of the phrase 'paradise to descend on Earth'?

(a) A world of perfect economic, political and social well-being

(b) A world ruled by religious persons

(c) A world of total liberty and equality

(d) A world in which nobody needs to labour

⊙ *(a)* In order to make Earth a paradise to live in, everything from political, moral, social and economic well being should be in perfect sync with one another. Hence, option (a) is the correct answer.

PASSAGE 30

Just as some men like to play football or cricket, so some men like to climb mountains. This is often very difficult to do, for mountains are not just big hills. Paths are usually very steep. Some mountain sides are straight up and down, so that it may take many hours to

climb as little as one hundred feet. There is always the danger that you may fall off and be killed or injured. Men talk about conquering a mountain.

It is a wonderful feeling to reach the top of a mountain after climbing for hours and may be even for days.

You look down and see the whole country below you. You feel God-like. Two Italian prisoners of war escaped from a prison camp in Kenya during the war.

They did not try to get back to their own country, for they knew that was impossible. Instead they climbed to the top of Mount Kenya, and then they came down again and gave themselves up. They had wanted to get that feeling of freedom that one has, after climbing a difficult mountain.

131. Some men like to climb mountains because

(a) they do not like to play football or cricket

(b) they know the trick of climbing

(c) they want to have a wonderful feeling

(d) they like to face danger

⊙ *(c)* In the passage, men talk about the wonderful feeling that they experience after reaching the top of mountain after climbing for hours and sometimes even days. Hence, option (c) is the correct answer.

132. To climb a mountain is often difficult because

(a) mountains are big hills

(b) it consumes more time

(c) prisoners often escape from camps and settle there

(d) paths are steep and uneven

⊙ *(d)* It is difficult to climb mountains as paths are usually very steep. Moreover, some mountain sides are straight up and down. Hence, option (d) is the correct answer.

133. It is a wonderful feeling …… 'It' refers to

(a) the steep path

(b) the prisoner

(c) the mountain

(d) mountaineering

⊙ *(c)* 'It' here refers to the act of climbing the mountain. Hence, option (c) is the correct answer.

134. Two Italian prisoners escaped the camp and climbed to the top of Mount Kenya to
(a) escape to Italy
(b) come down and give up
(c) gain fame as mountaineers
(d) get the feeling of freedom

⊙ *(d)* The two prisoners knew that they could not get back to their country. Hence, they climbed the top of the mountain to get that feeling of freedom that one has, after climbing a difficult mountain. Hence, option (d) is the correct answer.

PASSAGE 31

Most of the people who appear most often and most gloriously in the history books are great conquerors and generals and soldiers, whereas the people, who really helped civilisation forward are often never mentioned at all. We do not know, who first set a broken leg, or launched a seaworthy boat, or calculated the length of the year, or manoeuvred a field; but we know all about the killers and destroyers. People think a great deal of them, so much so that on all the highest pillars in the great cities of the world you will find the figure of a conqueror or a general or a soldier. And I think most people believed that the greatest countries are those that have beaten in battle the greatest number of other countries and ruled over them as conquerors.

135. People, who are glorified often in history books are those
(a) who contributed to the public health
(b) who contributed to the technical knowledge of man
(c) who made calendars
(d) who fought and won wars

⊙ *(d)* The author says that most of the people, who appear most often and most gloriously in the history books are great conquerors, generals and soldiers. Hence, option (d) is the correct answer.

136. The words "the people who really helped civilisation forward" suggest that conquerors, generals and soldiers
(a) contributed a great deal to civilisation
(b) contributed only towards civilisation
(c) were least interested in the progress of civilisation
(d) contributed little to civilisation

⊙ *(d)* The conquerors, generals and soldiers, contributed more to the destruction and killing and less to the civilisation. Hence, option (d) is the correct answer.

137. We will find the figure of a conqueror or a general or a soldier on all the highest pillars in great cities because
(a) they sacrificed their lives for the benefit of humanity
(b) people have exaggerated notions about their achievements
(c) they had a deep concern for the welfare of humanity
(d) they built most cities

⊙ *(b)* The author points out in the passage that people think a great deal of the conquerors, generals or soldiers. Hence, option (b) is the correct answer.

138. The passage implies that the greatest countries are those that
(a) have conquered many countries and ruled over them
(b) are very large in their size
(c) have the largest population
(d) are civilised

⊙ *(a)* According to the author, most people believe that the greatest countries are those, who have defeated other countries in battle and ruled over them. Hence, option (a) is the correct answer.

2016 (I)

PASSAGE 32

To avoid the various foolish opinions to which mankind is prone, no superhuman brain is required. A few simple rules will keep you, not from all errors, but from silly errors.

If the matter is one that can be settled by observation, make the observation yourself. Aristotle could have avoided the mistake of thinking that women have fewer teeth than men, by the simple device of asking Mrs Aristotle to keep her mouth open while he counted. Thinking that you know, when in fact you do not, is a bad mistake to which we are all prone. I believe myself that hedgehogs eat black beetles, because I have been told that they do; but if I were writing a book on the habits of hedgehogs, I should not commit myself until I had seen one enjoying this diet.

Aristotle, however, was less cautious. Ancient and medieval writers knew all about unicorns and salamanders; not one of them thought it necessary to avoid dogmatic statements about them because he had never seen one of them.

139. The writer believes that
(a) most people could avoid making foolish mistakes if they were clever
(b) through observation we could avoid making many mistakes
(c) Aristotle made many mistakes because he was not observant
(d) all errors are caused by our own error in thinking

⊙ *(b)* The writer believes that through observation we could avoid making many mistakes because a few simple rules will keep us away not from all errors, but from silly errors.

140. With reference to the passage, which one of the following is the correct statement?
(a) Aristotle was able to avoid the mistake of thinking that women have fewer teeth than men
(b) Aristotle thought women have fewer teeth than men
(c) Aristotle proved that women have fewer teeth by counting his wife's teeth
(d) Aristotle may have thought that women have fewer teeth because he never had a wife

⊙ *(b)* Aristotle thought women have fewer teeth than men which can be inferred from he fourth line of the passage.

141. The writer says that if he was writing a book on hedgehogs,
(a) he would maintain that they eat black beetles because he had been told so
(b) he would first observe their eating habits
(c) he would think it unnecessary to verify that they ate black beetles
(d) he would make the statement that they ate black beetles and later verify it

⊙ *(b)* The writer says that if he was writing a book on hedgehogs, he would first observe their eating habits, which is clearly mentioned in the line where he states "I should not commit myself until I had seen one enjoying this diet."

142. The writer is of the opinion that
- (a) unicorns and salamanders were observed by ancient and medieval writers but were unknown to modern writers
- (b) ancient and medieval writers wrote authoritatively about unicorns and salamanders though they had never seen them
- (c) unicorns and salamanders do not exist
- (d) only those who had observed the habits of unicorns and salamanders wrote about them

⊙ (**b**) The writer is of the opinion that ancient and medieval writers wrote authoritatively about unicorns and salamanders though they had never seen them, which is clearly mentioned in the last lines of the passage.

143. A 'dogmatic statement' in the context means a statement which is
- (a) convincing
- (b) proved
- (c) unquestionable
- (d) doubtful

⊙ (**c**) 'Dogmatic statement' means a statement which is 'unquestionable'. A dogmatic belief connects with the faith of a society and people are reluctant to hear anything against that.

PASSAGE 33

Since I had nothing better to do, I decided to go to the market to buy a few handkerchiefs, the old ones had done vanishing trick. On the way I met an old friend of mine and I took him to a nearby restaurant for tea and snacks. Afterwards, I went to the shop and selected a dozen handkerchiefs.

I pulled out my purse to make the payment and discovered that it was empty; I then realised that it was not my purse. It was a different purse altogether. How that happened is still a source of wonder to me and I refuse to believe that it was the work of my good old friend, for it was his purse that I held in my hand.

144. The man could not buy the handkerchiefs because
- (a) he did not like the handkerchiefs
- (b) his friend did not allow him to buy them
- (c) the shop did not have any handkerchiefs
- (d) he had no money in the purse

⊙ (**d**) The man could not buy the handkerchiefs because he had no money in the purse. It is clearly stated in the fourth line of the passage.

145. When he tried to take out the purse, he discovered that
- (a) it was not there
- (b) it was lost
- (c) it was a new purse
- (d) it was his friend's purse

⊙ (**d**) In the last two lines, it is clearly written that "when he tried to take out the purse, he discovered that it was his friend's purse."

PASSAGE 34

A profound terror, increased still by the darkness, the silence and his waking images, froze his heart within him.

He almost felt his hair stand on end, when by straining his eyes to their utmost, he perceived through the shadows two faint yellow lights.

At first, he attributed these lights to the reflection of his own pupils, but soon the vivid brilliance of the night aided him gradually to distinguish the objects around him in the cave, and he beheld a huge animal lying but two steps from him.

146. The opening of the passage suggests that
- (a) darkness, silence and waking images added to his already being in profound terror
- (b) a profound terror increased the waking images in his frozen heart
- (c) the person was frightened by darkness and silence
- (d) a profound terror was caused in him by the silence and darkness of the night

⊙ (**a**) It is clearly stated in the first line of the passage that the profound terror is Increased due to darkness, silence and waking images.

147. When he perceived through the shadows two faint lights,
- (a) he experienced a great strain
- (b) he felt his hair stand upright
- (c) his eyes felt strained to their utmost
- (d) his pupils dilated

⊙ (**c**) When the writer's eyes felt strained to their utmost, he perceived through the shadows two faint lights.

148. The person in the story
- (a) imagined that he saw an animal
- (b) could not recognise the animal
- (c) saw the animal by chance
- (d) expected to see the animal

⊙ (**a**) The person imagined that he saw an animal.

PASSAGE 35

We are tempted to assume that technological progress is real progress and that material success is the criterion of civilisation.

If the Eastern people become fascinated by machines and techniques and use them, as Western nations do, to build huge industrial organisations and large military establishments, they will get involved in power politics and drift into the danger of death.

Scientific and technological civilisation brings great opportunities and great rewards, but also great risks and temptations.

Science and technology are neither good nor bad. They are not to be tabooed but tamed and assigned their proper place. They become dangerous only if they become idols.

149. According to the author, people think that real progress lies in
- (a) material success and technological growth
- (b) imitating Western nations
- (c) having large industries and political power
- (d) taking risks and facing temptations

⊙ (**a**) According to the author, people think hat real progress lies in material success and technological growth because people become fascinated by machines and techniques they use.

150. According to the author, science and technology should be
- (a) tabooed and eliminated from life
- (b) used in a controlled and careful manner
- (c) encouraged and liberally used
- (d) made compulsory in education

⊙ (**b**) According to the author science and technology should be used in a controlled and careful manner as they are not to be tabooed and eliminated.

151. From the passage, one gathers that the Eastern people must
- (a) appreciate scientific achievements
- (b) build huge industrial organisations
- (c) avoid being controlled by machines and techniques of industrial production
- (d) be fascinated by machines

(>) *(c)* Eastern people are fascinated by machines and techniques and they have build huge industrial organisations, but it is suggested with this passage that they must avoid being controlled by machines and techniques of industrial production.

152. According to the author, science and technology are
- (a) totally harmless
- (b) extremely dangerous
- (c) to be treated as idols
- (d) useful, if they are not worshipped blindly

(>) *(d)* According to the author, science and technology are useful, if they are not worshipped blindly, which is clearly mentioned in the last line "They become dangerous only if they become idols."

PASSAGE 36

It is not luck but labour that makes men, Luck, says an American writer, is ever waiting for something to turn up; labour with keen eyes and strong will always turns up something. Luck lies in bed and wishes the postman would bring him news of a legacy; labour turns out at six and with busy pen and ringing hammer lays the foundation, of competence. Luck whines, labour watches. Luck relies on chance; labour on character. Luck slips downwards to self-indulgence; labour stride upwards and aspires to independence. The conviction, therefore, is extending that diligence is the mother of good luck; in other words, that a man's success in life will be proportionate to his efforts, to his industry, to his attention to small things.

153. Which one of the following statements sums up the meaning of the passage?
- (a) Luck waits without exertion but labour exerts without waiting
- (b) Luck waits and complains without working while labour achieves success although it complains
- (c) Luck often ends in defeat but labour produces luck
- (d) Luck is self-indulgent but labour is selfless

(>) *(d)* It can be inferred from the passage that luck is self-indulgent but labour is selfless, as labour strides upwards and aspires to independence.

154. Which one of the following statements is true about the passage?
- (a) Luck is necessary for success
- (b) Success depends on hard work and attention to details
- (c) Expectation of good luck always meets with disappointment
- (d) Success is exactly proportionate to hard work only

(>) *(b)* Success always depends on hard work and attention to details of small things.

155. ".......... labour turns out at six and with busy pen and ringing hammer lays the foundation of competence." This statement means
- (a) hard work of all kinds makes people efficient and skilled
- (b) the labour lays the foundation of the building
- (c) the writer and the labourer are the true eyes of the society
- (d) there is no worker who works so hard as the labourer who begins his day at six in the morning

(>) *(a)* The statement means hard work of all kinds makes people efficient and skilled. Other options are meaningless in their term.

PASSAGE 37

The avowed purpose of the exact sciences is to establish complete intellectual control over experience in terms of precise rules which can be formally set out and empirically tested. Could that ideal be fully achieved, all truth and all error could henceforth be ascribed to an exact theory of the universe, while we who accept this theory would be relieved of any occasion for exercising our personal judgement. We should only have to follow the rules faithfully.

Classical mechanics approaches this ideal so closely that it is often thought to have achieved it. But this leaves out of account the element of personal judgement involved in applying the formulae of mechanics to the facts of experience.

156. The purpose of the exact sciences is to
- (a) form opinions about our experience
- (b) formulate principles which will help us to exercise our personal judgement
- (c) assert our intellectual superiority
- (d) make formal and testable rules which can help verify experience

(>) *(b)* The purpose of exact sciences is to formulate principles which will help us to exercise our personal judgement.

157. An exact theory of the universe is
- (a) not desirable
- (b) improbable
- (c) possible
- (d) yet to be made

(>) *(b)* An exact theory of the universe is 'improbable', means all truth and error are not likely to be true.

158. In exact sciences,
- (a) personal judgements are set aside in favour of a mechanical theory
- (b) one does not find answers to all questions and problems
- (c) one reposes faith in actual experience
- (d) one interprets the universe according to one's wish

(>) *(a)* In exact sciences, we would be relieved of any occasion for exercising our personal judgement. So, option (a) is correct.

159. Classical mechanics
- (a) has formulated precise rules based on experience
- (b) has gained intellectual control over the world
- (c) has formulated an exact theory of the universe
- (d) just falls short of achieving intellectual control over experience

(>) *(a)* Classical mechanics has formulated precise rules based on experience as it is said in the passage that "We should only have to follow the rules faithfully and classical mechanics approaches this ideal so closely".

2015 (II)

PASSAGE 38

Much rhapsodical nonsense has been written about the 'Mona Lisa' and her enigmatic smile, and there have been endless speculations as to her character and the meaning of

her expression. It is all beside the mark. The truth is that the 'Mona Lisa' is a study of modeling. Leonardo da Vinci had discovered that the expression of smiling is much more a matter of modeling of the cheek and of the forms below the eye than of the change in the line of the lips. It interested him to produce a smile wholly by these delicate changes of surface; hence the mysterious expression.

160. The word 'rhapsodical' as used in the passage means

(a) plain (b) unreadable
(c) enthusiastic (d) uniformed

⊙ *(c)* 'Rhapsodical' means 'enthusiastic' in the passage. e.g. Even when she is most rhapsodical, her speech never loses its ease and gentleness of tone.

161. 'Mona Lisa' is the name of

(a) a beautiful woman who made history in ancient Rome
(b) a famous painting
(c) the artist's mistress
(d) a rt technique

⊙ *(b)* 'Mona Lisa' is the name of a famous painting.

162. The truth about the 'Mona Lisa' is that it is a study in

(a) feminine psychology
(b) facial expression
(c) feminine form
(d) modeling

⊙ *(d)* 'Mona Lisa' is a study in modeling.

163. The painter was able to produce that strange smile on Mona Lisa's face by

(a) delicate changes on the surface of cheeks below the eyes
(b) using bright colours
(c) using a painting knife
(d) looking constantly at a smiling model while painting

⊙ *(a)* It is easily understood by reading the last two lines of the passage that the painter discovered the smile on Mona Lisa's face by 'delicate changes on the surface of cheeks below the eyes'.

164. The author of the above passage has examined 'Mona Lisa' from

(a) an idealistic angle
(b) an imaginary point of view
(c) a purely artistic angle
(d) a scientific and realistic standpoint

⊙ *(c)* The passage clearly shows the artistic angle of the author.

PASSAGE 39

It is possible to give wedding presents, birthday and Christmas presents, without any thought of affection at all, they can be ordered by postcard; but the unbirthday present demands the nicest care.

It is therefore the best of all and it is the only kind to which the golden rule of present-giving imperatively applies the golden rule which insists that you must never give to another person anything that you would not rather keep: nothing that does not cost you a pang to part from.

It would be better if this rule governed the choice also of those other three varieties of gifts, but they can be less exacting.

165. The author says that wedding, birthday and Christmas presents

(a) are always indicators of the giver's affection
(b) may not always be given with any thought of affection
(c) are given only to flatter the recipient
(d) are given only to fulfil an obligation

⊙ *(b)* 'May not always be given with any thought of affection' is correct as it is clearly indicated in the first line of the passage.

166. 'They can, be ordered by postcard' means that

(a) the present may only be a postcard
(b) the present would be an expensive one
(c) the choice does not involve much care
(d) the present would not be worth giving

⊙ *(c)* This statement means that 'the choice does not involve much care'.

167. The 'unbirthday' present is the best of all because

(a) it cannot be ordered by postcard
(b) it means giving expensive presents
(c) its choice needs the utmost care
(d) other occasions are better than birthdays for giving presents

⊙ *(c)* Its choice needs the utmost care.

168. A 'golden rule' is a rule which

(a) brings profit
(b) is very important
(c) is very difficult
(d) is very easy

⊙ *(b)* A 'golden rule' is a rule which 'is very important,' which can be inferred from the passage.

169. The writer is of the view that one should give a present that

(a) one would like to possess onesee
(b) one would like to get rid of
(c) cannot be ordered by mail
(d) is highly expensive and attractive

⊙ *(a)* It is clearly understood from the passage that you must never give to another person anything that you would not rather keep. So, option (a) is correct.

PASSAGE 40

People project their mental processes into their handwriting. They subconsciously shape and organise their letters, words and lines in ways that directly reflect their personalities.

This explains why no two handwritings are or even can be alike; the medium is just too personal. Everyday observation confirms the link between handwriting and personality, at least in an elementary way. Precise people construct their words with care, slowly and exactly; dynamic people dash them off.

Flamboyant people boldly cover half a page with a few words and a signature, Whose size fittingly reflects their expansive sense of self. Most of us have made such observations. But it takes a practiced eye to discern the scores of variations and interpret the subtle interplay of forces at work in any given handwriting. In fact in Europe, handwriting analysis known as graphology, now enjoys scientific acceptance and common use.

170. If you are a showy and colourful person, your handwriting is likely to be

(a) neat and slow
(b) dashing and careless
(c) bold and large
(d) legible but small

⊙ *(c)* If you are a showy and colourful person, your handwriting is likely to be bold and large, as showy and colourful person means someone who is flamboyant.

171. Graphology is

(a) the study of graphs
(b) the analysis of handwriting
(c) a special branch of phonetics
(d) a graphical description of handwriting

⊘ *(b)* Graphology is the 'analysis of handwriting,' which is clearly mentioned in the last line of the passage.

172. Handwriting analysis is

(a) not useful to us
(b) an elementary study
(e) an imprecise science
(d) means of studying personality

⊘ *(d)* Handwriting analysis is a 'means of studying personality,' which can be easily inferred from the passage.

173. According to the author, people are

(a) not conscious of what they write
(b) aggressive in the nature of their writing
(c) not conscious of the way they write
(d) not used to personal writing

⊘ *(b)* According to the author, people are bit 'aggressive in the nature of their writing.'

174. The fact that handwriting is related to personality

(a) has been noticed by most people
(b) is appreciated by dynamic people
(c) is restricted to persons who write carefully
(d) is known only to graphologists

⊘ *(d)* The fact that handwriting is related to personality 'is known only to graphologists' as it is mentioned indirectly in the eighth line of the passage.

PASSAGE 41

The simplest method of welding two pieces of metal together is known as pressure welding. The ends of metal are heated to a white heat-for iron, the welding temperature should be about 1300°C in a flame. At this temperature the metal becomes plastic. The ends are then pressed or hammered together and the joint is smoothed off. Care must be taken to ensure that the surfaces are thoroughly cleaned first, for dirt will weaken the weld. Moreover, the heating of iron or steel to a high temperature cause oxidation, and a film of oxide is formed on the heated surfaces.

For this reason, a flux is applied to the heated metal. At welding heat, the flux melts, and the oxide particles are dissolved in it together with any other impurities which may be present.

The metal surfaces are pressed together, and the flux is squeezed out from the centre of the weld. A number of different types of weld may be used, but for fairly thick bars of metals, a vee-shaped weld should normally be employed. It is rather stronger than the ordinary butt weld.

175. The simplest way of welding two pieces of metal together is

(a) heating the metal
(b) holding it in a flame
(c) coating the metal with plastic
(d) hammering heated pieces

⊘ *(d)* The simplest way of welding two pieces of metal together is 'hammering heated pieces.' In the fourth line of the passage, it is clearly mentioned that the ends are then pressed or hammered together.

176. Unless the surfaces are cleaned first,

(a) the metal will not take white heat
(b) the resulting weld will be weak
(c) the joint will be rough
(d) the metal will be less plastic

⊘ *(b)* Unless the surfaces are cleaned first, 'the resulting weld will be weak.' As mentioned in the passage that care must be taken to ensure that the surfaces are thoroughly cleaned first.

177. When iron is heated to about 1300 degree centigrade,

(a) flames turn from white to blue
(b) chemical reaction starts
(c) oxide film is found on its surfaces
(d) it turns into steel

⊘ *(c)* When iron is heated to about 1300 degree centigrade, oxide film is found on its surfaces because heating an iron or steel to a high temperature cause oxidation.

178. The flux is used to

(a) make the metal plastic
(b) cool the heated metal
(c) cover up any dirt
(d) dissolve oxide and other impurities

⊘ *(d)* The flux is used to dissolve oxide and other impurities. At welding heat, the flux melts and the oxide particles are dissolved in it together with any other impurities which may be present.

179. For fairly thick bars of metals

(a) a vee-shaped weld should be used
(b) an ordinary butt weld should be used
(c) a number of different types of weld may be used
(d) a pressure weld may be used

⊘ *(a)* For fairly thick bars of metals, a vee-shaped weld should be used, is early mentioned in the last lines of the passage.

2015 (I)

PASSAGE 42

A little man beside me was turning over the pages of a magazine quickly and nervously. Opposite me, there was a young mother who was trying to restrain her son from making a noise. The boy had obviously grown weary of waiting. he had placed an ashtray on the floor and was making aeroplane noises as he waved a pencil in his hands. Near him, an old man was fast asleep, snoring quickly to himself and the boy's mother was afraid that sooner or later her son would wake the gentleman up.

180. The noise was made by the

(a) old man   (b) aeroplane
(c) little man   (d) boy

⊘ *(d)* The noise is made by the boy.

181. The person who was the least disturbed was the

(a) observer   (b) son
(c) old man   (d) little man

⊘ *(c)* 'Fast asleep old man' suggests that he was least disturbed.

182. The factor common to all the people was that they were all

(a) watching a film
(b) waiting for something
(c) looking at the little boy's playfulness
(d) reading magazine

⊘ *(b)* Everybody was waiting for something there. It was a common thing.

183. Among those, present the one who appeared to be the most bored was the

(a) child   (b) little man
(c) old man   (d) mother

⊘ *(b)* The little man was most bored because he was turning the pages of the magazine nervously.

PASSAGE 43

A man had two blacksmiths for his neighbours. Their names was Pengu and Shengu. The man was greatly troubled by the noise of their hammers. He decided to talk to them. The next day, he called both of them and offered 100 each, if they found new huts for themselves. They took the money and agreed to find new huts for themselves. The next morning, he woke up again to the sound of their hammers. He went out to see why the blacksmiths hadn't found new huts and he discovered that Pengu and Shengu had kept their promise. They had exchanged their huts.

184. The man was troubled because
 (a) the blacksmiths always fought with each others
 (b) the blacksmiths' hammers made a lot of noise
 (c) he was afraid of blacksmiths
 (d) the blacksmiths did not do their work properly

⊙ *(b)* The blacksmiths' hammers made a lot of noise.

185. The man gave them money because
 (a) the blacksmiths were poor
 (b) the blacksmiths had asked him for money
 (e) he did not want them to make a noise
 (d) he wanted them to find new huts

⊙ *(d)* Money was given to the blacksmiths to find new huts for themselves.

186. The man went out of his house because
 (a) he wanted to fight with the blacksmiths
 (b) he wanted to ask the blacksmiths to stop the noise
 (c) he wanted to find out why they hadn't found new huts
 (d) he wanted his money back from the blacksmiths

⊙ *(c)* The man wanted to know why the blacksmiths hadn't found new huts.

187. The man came to know that
 (a) the blacksmiths were not in their huts
 (b) the blacksmiths had exchanged huts
 (c) the blacksmiths were going away
 (d) the blacksmiths had not kept their promise

⊙ *(b)* They had exchanged their huts.

PASSAGE 44

The tigress was a mile away and the ground between her and us was densely wooded, scattered over with great rocks and cut up by a number of deep ravines, but she could cover the distance well within the half-hour—if she wanted to.

The question I had to decide was, whether or not I should try to call her. If I called and she heard me, and came while it was still daylight and gave me a chance to shoot her, all would be well; on the other hand, if she came and did not give me a shot, some of us would not reach camp, for we had nearly two miles to go and the path the whole way ran through heavy jungle.

188. According to the author,
 (a) the tigress wanted to cover the distance within the half-hour
 (b) the tigress did not wish to cover the distance within the half-hour
 (c) the tigress actually covered the distance within the half-hour
 (d) there was a possibility of the tigress covering the distance within the half-hour

⊙ *(d)* There was a possibility of the tigress covering the distance within the half-hour.

189. The author says, "Some of us would not reach camp", because
 (a) it was two miles away
 (b) the tigress would kill some of them
 (c) the path is not suitable for walking
 (d) the ground was scattered over with great rocks

⊙ *(c)* The path to the camp is not suitable for walking as it is running through heavy jungle.

190. The author found it difficult to decide the question because
 (a) he was afraid
 (b) the tigress was only a mile away
 (c) the ground between them was densely wooded
 (d) there was uncertainty about the reaction of the tigress to his call

⊙ *(d)* The author found it difficult to decide the question as 'there was uncertainty about the reaction of the tigress to his call.'

191. The time available to the author for shooting the tigress was
 (a) the whole day (b) one night
 (c) a few hours (d) 30 minutes

⊙ *(a)* Possible during the daylight, hence option (a) is suitable usage.

192. When the author says 'all would be well', he means
 (a) that they would be able to hide themselves in the heavy jungle
 (b) that the tigress would run away to the deep ravines
 (c) that they would be able to shoot her down without difficulty
 (d) that they would be able to return in daylight

⊙ *(c)* When the author said 'all would be well' he meant that they would be able to shoot her down without difficulty.

PASSAGE 45

After lunch, I felt at a loose end and roamed about the little flat. It suited us well enough when mother was with me, but now I was by myself, it was too large and I'd moved the dining room table into my bedroom.

That was now, the only room I used; it had all the furniture I needed; a brass bedstead, a dressing table, some cane chairs whose seats had more or less caved in, a wardrobe with a tarnished mirror.

The rest of the flat was never used, so I didn't trouble to look after it.

193. The flat did not really suit him any more because
 (a) the rooms were too small
 (b) he was living on his own now
 (c) his mother needed too much rooms
 (d) the flat itself was too little

⊙ *(b)* He was living on his own now.

194. He did not look after the rest of the flat because
 (a) he did not use it
 (b) the bedroom was much too large
 (c) he needed only the brass bedstead
 (d) he had too much furniture

⊙ *(a)* He didn't use it.

195. "............. now I was by myself, it was too large". The word it here refers to the
 (a) dining room table
 (b) dining room
 (c) bedroom
 (d) flat

⊙ *(d)* Here, 'it' refers to 'the flat'.

196. From the passage, we learn that the writer was

(a) scared of living alone in the flat
(b) dissatisfied with the flat
(c) satisfied with the space in his bedroom
(d) an eccentric person

⊙ *(c)* From the passage, we learn that the writer was satisfied with the space in his bedroom.

197. "After lunch I felt at a loose end" means

(a) he had nothing specific to do
(b) had a rope with a loose end
(c) had much work to do
(d) had a feeling of anxiety

⊙ *(a)* 'Feeling at a loose end' means 'feeling bored' or 'have nothing specific to do'. Hence, option (a) is correct.

PASSAGE 46

The overwhelming vote given by the greater part of the public has so far been in favour of films which pass the time easily and satisfy that part of our imagination which depends on the more obvious kind of daydreams.

We make up for what we secretly regard as our deficiencies by watching the stimulating adventures of the other people who are stronger, more effective, or more beautiful than we are.

The conventional stars act out our daydreams for us in a constant succession of exciting situations set in the open spaces, in the jungles or in the underworld of great cities which abounds in crime and violence.

We would not dare to be in such situations but the situations are very exciting to watch since our youth is being spent in day-to-day routine of school, office or home.

198. According to the passage, most of us prefer films which

(a) overwhelm our imagination
(b) depict our times
(c) fulfill our secret wishes
(d) appeal to our reason

⊙ *(a)* As per the passage, most of us prefer films which overwhelm our imagination. It is clear from the first sentence of the passage.

199. By watching thrilling adventures in films, we make up for the

(a) effectiveness of our desires
(b) shortcomings in our life
(c) stimulation of our everyday life
(d) fluence which we don't have

⊙ *(b)* Shortcomings in our life.

200. Film stars present situations

(a) which are familiar to us, the city dwellers
(b) which we have seen only in jungles
(c) which we meet everyday at work
(d) which excite us

⊙ *(d)* Which excite us. The stars act in constant succession of exciting situations.

201. Whether we admit it to ourselves or not, we are aware that we are

(a) weak and plain
(b) both powerful and handsome
(c) as strong as film heroes
(d) more beautiful than film stars

⊙ *(a)* We are weak and plain, even if we admit it or not. second sentence of the passage talks about the 'deficiencies' which supports it.

202. The daily life of students, office-goers and housewives is

(a) full of new adventures
(b) the same dull repetition
(c) stimulating to their imagination
(d) very exciting to them

⊙ *(b)* The daily life of students, office-goers and housewives is the same dull repetition.

2014 (II)

PASSAGE 47

During the summer I was introduced to the game of cricket, and I felt my inherent foreignness for the first time. The ball is far too hard for my taste. Even during my last games at the school, angry spectators would shout, 'Butter fingers!' But I smiled. Everyone knew in their hearts that I was going to drop the ball anyway, and nobody expected me to be able to play the game.

203. The author first played cricket

(a) as a child in his own country
(b) when he was a school boy
(c) when he was a tourist
(d) when he returned home after his studies

⊙ *(b)* The author first played cricket when he was a school boy.

204. "felt my inherent foreignness" means

(a) felt very strange
(b) felt very interested and excited
(c) enjoyed learning new games
(d) felt my superiority over others

⊙ *(a)* 'Felt my inherent foreignness' means 'strange' or 'unknown'. Hence, option (a) is correct.

205. Spectators would shout 'Butter fingers' when the author was playing because

(a) he liked butter
(b) his fingers were like those of a lady
(c) he often dropped the ball
(d) he as very good at the game

⊙ *(c)* Spectators would shout 'Butter Fingers' when the author was playing because the ball slipped from his hands and dropped.

206. 'Spectator' means

(a) glasses   (b) onlookeu
(c) watchman   (d) player

⊙ *(b)* Spectator means a person watching an event i.e., an onlooker.

PASSAGE 48

How can you improve your reading speed? By taking off the brakes. You wouldn't think of driving a car with the brake on. Yet as a reader you probably have several brakes slowing you down.

One very common brake is regressing- looking back every now and then at something already read. It is like stepping backwards every few metres as you walk—hardly the way to move ahead quickly. Regression may arise from a lack of confidence, vocabulary deficiency, or actually missing a word or phrase.

It makes a long sentence seem even more complex as the eyes frequently regress. Eye movement photographs of 12000 readers in America showed that university students regress an average of 15 times in reading only 100 words.

The average student of class four was found to look back 20 times. In short, regression consumes one-sixth of your precious reading time. Release this brake and enjoy a spurt in reading speed.

207. In the context of the passage, what does 'regression' means?

    (a) Lack of desire to improve the reading speed

    (b) Looking back at what is already read

    (c) Lack of proper understanding of what one reads

    (d) Comparing the reading speed of school and university students

  ⊙ (**b**) 'Regression' means looking back every now and then at what is already read.

208. In order to be a good reader you should

    (a) regress whenever necessary

    (b) be like a careful driver

    (c) not look back frequently while reading

    (d) test your vocabulary frequently

  ⊙ (**c**) In order to be a good reader you should not look back frequently while reading.

209. According to the author reading with regression is like

    (a) driving with poor quality brakes

    (b) stepping backwards while walking

    (c) using several brakes in order to slow down

    (d) making sudden spurts in reading speed

  ⊙ (**b**) The author mentions in the fourth line of the passage that reading with regression is like stepping backwards while walking.

PASSAGE 49

Even in the most primitive societies the great majority of people satisfy a large part of their material needs by exchanging goods and services. Very few people indeed can make for themselves everything they need-all their food, their clothes, their housing, their tools.

Ever since men started living in communities, they have been satisfying their needs by means of specialisation and exchange, increasingly each individual has concentrated on what he can do best and has produced more of the special goods or services in which he has concentrated, than he can consume himself. The surplus he has exchanged with other members of the community, acquiring, in exchange the things he needs that others have produced.

210. Very few people can satisfy their needs today by

    (a) providing things for themselves

    (b) exchanging goods and services

    (c) concentrating on what they can do best

    (d) individual specialisation

  ⊙ (**a**) Very few people can satisfy their needs today by providing things for themselves, as stated in the second line of the passage.

211. Exchange of goods becomes possible only when

    (a) there is no specialisation

    (b) goods are produced in surplus

    (c) primitive societies become modern

    (d) individuals make things for themselves

  ⊙ (**b**) Exchange of goods becomes possible only when goods are produced in surplus.

212. Specialisation and exchange began when men started

    (a) big industries

    (b) concentrating on their work

    (c) producing things for individual use

    (d) living in communities

  ⊙ (**d**) Specialisation and exchange began hen men started living in communities.

213. Exchange of goods and services becomes necessary because

    (a) man is a social being

    (b) reciprocity is the law of life

    (c) trade and commerce are means of progress

    (d) we cannot produce everything we need ourselves

  ⊙ (**d**) Exchange of goods and services becomes necessary because we cannot produce everything we need ourselves.

PASSAGE 50

Soil scientists have shown that the soil teems with millions of living things. many of them useful, others harmful. The living things which are useful include earthworms and various kinds of bacteria. Earthworms loosen the soil and so enable air and water to enter it. Bacteria, which are microscopic living things breakdown dead plants and animals and make humus, or take nitrogen from the air and change it into substances that plants use.

The living things that do harm include other bacteria and fungi

which cause diseases. Other harmful things are pests such as wire worms which feed on the roots of grass and other plants. While the farmer can usually keep weeds in check by careful cultivation, this alone may not protect his crops from insects, pests and diseases. Now-a-days, however, he is much better able to control these enemies. He may plant specially resistant types of seeds or he may keep the pests and diseases in check with chemicals. With better seeds farmers have been able to increase their crop yields. They can grow crops that ripen more quickly and have a stronger resistance to disease, frost or drought.

214. Scientists who study soil believe that

    (a) all insects and bacteria are harmful

    (b) only microscopic living things are useful

    (c) only earthworms are useful

    (d) not all worms and bacteria are harmful

  ⊙ (**d**) Soil scientists believe that not all worms and bacteria are harmful.

215. The living things that do harm

    (a) break down plants and animals

    (b) use up the nitrogen from the air

    (c) cause diseases in the plants

    (d) loosen up the soil from air and water

  ⊙ (**c**) The living things that do harm cause disease in the plants, as stated in the fifth line of the passage.

216. Farmers are always careful

    (a) to control insects and fungi that attack plants

    (b) to encourage pests in the soil

    (c) to eliminate all bacteria from the soil

    (d) to foster all kinds of worms in the earth

  ⊙ (**a**) Farmers are always careful to control insects, fungi and bacteria that attack plants.

217. Now-a-days, it is possible to reduce the loss caused by pests and harmful bacteria

    (a) with the use of chemical fertilisers

    (b) through the development of resistant seeds

    (c) by using weeds as killers

    (d) by controlling earthworms

  ⊙ (**b**) Now-a-days, it is possible to reduce the loss caused by pests and harmful bacteria with resistant types of seeds.

218. The farmers today can also select seeds
(a) of slow ripening variety
(b) resistant to frost and drought
(c) for economy in costs
(d) of lower resistance to disease

⊗ (**b**) The farmers today can also select seeds resistant to frost and drought, as stated in the last line of the passage.

2014 (I)

PASSAGE 51

Those responsible for teaching young people have resorted to a variety of means to make their pupils learn. The earliest of these was the threat of punishment. This meant that the pupil who was slow, careless or inattentive risked either physical chastisement or the loss of some expected privilege. Learning was thus associated with fear. At a later period, pupils were encouraged to learn in the hope of some kind of reward. This often took the form of marks awarded for work done and sometimes of prizes given at the end of the year to the best scholar. Such a system appealed to the competitive spirit, but was just as depressing as the older system for the slow pupil.

In the 19th century sprang up a new type of teacher, convinced that learning was worthwhile for its own sake and that the young pupil's principal stimulus should neither be anxiety to avoid a penalty nor ambition to win a reward, but sheer desire to learn. Interest, direct or indirect, became the keyword of instruction.

219. The educational system which caused fear in the second mind was based on
(a) rewards   (b) labour
(c) punishment   (d) competition

⊗ (**c**) Punishment

220. The system based on rewards satisfied all except
(a) the slow pupil
(b) the very intelligent pupil
(c) the laborious pupil
(d) the casual pupil

⊗ (**a**) Option (a) is the correct answer.

221. The system which appealed to the competitive spirit in the pupils was largely based on
(a) punishment
(b) marks
(c) chastisement
(d) cash prizes

⊗ (**b**) Option (b) is the right answer. Rewards took the form of marks and it appealed to the competitive spirit.

PASSAGE 52

On a surface which is free from obstacles, such as a clear road or a path, only two or three species of snakes can hope to catch up with a human being, even if they are foolish to try.

A snake seems to move very fast but its movements are deceptive.

In spite of the swift, wave-like motions of its body, the snake crawls along the ground at no more than the speed of man's walk.

It may, however, have an advantage inside a jungle, where the progress of a man is obstructed by thorny bushes.

But in such places, the footsteps of a man are usually more than enough to warn snakes to keep away.

Although they have no ears of the usual kind, they can feel slight vibrations of the ground through their bodies, and thus get an early warning of danger.

222. The snake has an advantage over men inside a jungle, because there
(a) it can crawl faster
(b) it gets advance warning
(c) man's movement is obstructed
(d) it is ark inside a jungle

⊗ (**c**) Option (c) is the correct option. Inside a jungle, a man's movement is obstructed by thorny bushes.

223. What helps the snakes to receive advance warning is their sensitivity to
(a) obstacles in the path
(b) smell of other beings
(c) sounds made by other beings
(d) movements of other beings

⊗ (**d**) Option (d) is the right answer. It is mentioned in the passage that the footsteps of a man are a warning to the snakes.

PASSAGE 53

This rule of always trying to do things as well as one can do them has an important bearing upon the problem of ambition. No man or woman should be without ambition, which is the inspiration of activity. But if one allows ambition to drive one to attempt things which are beyond one's own personal capacity, then unhappiness will result. If one imagines that one can do everything better than other people, then envy and jealousy, those twin monsters, will come to sadden one's days. But if one concentrates one's attention upon developing one's own special capacities, the things one is best at, then one does not worry over much if other people are more successful.

224. Which one of the following alternatives brings out the meaning of 'to have a bearing upon' clearly?
(a) To have an effect on
(b) To carry the weight on oneself
(c) To put up with
(d) To decrease friction

⊗ (**a**) Option (a) is the correct choice. In this context, 'bearing' means 'effect'.

225. Which one of the following statements is correct?
(a) There is a close relationship between ambition and activity
(b) Ambition and activity belong to two different areas
(c) Ambition is useless
(d) Activity is responsible for ambition

⊗ (**a**) Option (a) is the correct option. It is mentioned in the passage that, 'No man or woman should be without ambition, which is the inspiration of activity'.

226. The statement 'if one allows ambition to drive one to attempt things which are beyond one's own personal capacity, then unhappiness will result,' means that
(a) one must always try to do less than one's capacity
(b) one must always try to do more than one's capacity
(c) ambition must be consistent with one's capacity
(d) there should be no ambition at all

⊗ (**c**) Option (c) is the right choice as is clear from the line, 'But if one concentrates .... more successful.

227. Which one of the following statements best reflects the underlying tone of the passage?

(a) One must do everything as well as one can

(b) One must try to be better than others

(c) One must continuously worry about others

(d) One must try beyond one's capacity to get results

⊙ **(a)** Option (a) is the correct answer.

228. Which one of the following statements can be assumed to be true?

(a) It is good to imagine oneself better than others

(b) One should not imagine oneself always to be better than others

(c) All persons have equal capacity

(d) One should have more ambition than others

⊙ **(b)** Option (b) is the right answer.

PASSAGE 54

An earthquake comes like a thief in the night, without warning. It was necessary, therefore to invent instruments that neither slumbered nor slept. Some devices were quite simple.

One, for instance, consisted of rods of various lengths and thicknesses which would stand up on end like ninepins. When a shock came it shook the rigid table upon which these stood.

If it were gentle, only the more unstable rods fell. If it were severe, they all fell. Thus, the rods by falling and by the direction in which they fell, recorded for the slumbering scientist, the strength of

a shock that was too weak to waken him and the direction from which it came.

But, instruments far more delicate than that were needed if any really serious advance was to be made.

The ideal to be aimed at was to devise an instrument that could record with a pen on paper the movements, of the ground or of the table, as the quake passed by.

While I write my pen moves but the paper keeps still. With practice, no doubt, I could, in time, learn to write by holding the pen still while the paper moved.

That sounds a silly suggestion, but that was precisely the idea adopted in some of the early instruments (seismometers) for recording earthquake waves.

But when table, penholder and paper are all moving how is it possible to write legibly? The key to a solution of that problem lay in an everyday observation.

Why does a person standing in a bus or train tend to fall when a sudden start is made?

It is because his feet move on, but his head stays still.

229. The passage says that early instruments for measuring earthquakes were

(a) faulty in design

(b) expensive

(c) not sturdy

(d) not sensitive enough

⊙ **(d)** Option (d) is the correct option.

230. Why was it necessary to invent instruments to observe an earthquake?

(a) Because an earthquake comes like a thief in the night

(b) To make people alert about earthquakes during their conscious as well as unconscious hours

(c) To prove that we are technically advanced

(d) To experiment with the control of man over nature

⊙ **(a)** Option (a) is the correct answer.

231. A simple device which consisted of rods that stood up on end like ninepins was replaced by a more sophisticated one because it failed

(a) to measure a gentle earthquake

(b) to measure a severe earthquake

(c) to record the direction of the earthquake

(d) to record the facts with a pen on paper

⊙ **(d)** Option (d) is the correct choice.

232. The everyday observation referred to in the passage relates to

(a) a moving bus or train

(b) the sudden start of a bus

(c) the tendency of a standing person to fall when a bus or train moves suddenly

(d) people standing in a bus or train

⊙ **(c)** Option (c) is the right answer.

233. The early seismometers adopted the idea that in order to record the earthquake, it is

(a) the pen that should move just as it moves when we write on paper

(b) the pen that should stay still and the paper should move

(c) both pen and paper that should move

(d) neither pen nor paper that should move

⊙ **(b)** Option (b) is the correct option.

SENTENCE IMPROVEMENT

2017 (I)

Directions (Q. Nos. 1-152) *Look at the underlined part of each sentence. Below each sentence are given three possible substitutions for the underlined part. If one of them [(a), (b), or (c)] is better than the underlined part, indicate your response against the corresponding letter. If none of the substitutions improves the sentence, indicate (d) as your response. i.e. No improvement.*

1. Go North-East across the mountains till you <u>will reach</u> an island.

(a) reached   (b) reach
(c) have reached   (d) No improvement

⊙ (*b*) 'Reach' is the correct substitution for the underlined part as the sentence is in simple present tense. So, 'will reach' should not be used here.

2. It is hard these days to <u>cope with</u> the rising prices.

(a) Cope by   (b) Cope up with
(c) to be coped with (d) No improvement

⊙ (*d*) The given sentence is correct as 'cope with' is the correct expression.

3. He took a <u>demand</u> of hundred rupees from me.

(a) debt   (b) demanding
(c) advance   (d) No improvement

⊙ (*d*) No improvement is required in this sentence.

4. <u>From the last</u> five days it has been raining torrentially.

(a) Since the last   (b) For the last
(c) Since last   (d) No improvement

⊙ (*b*) 'For the last' is the correct expression for the given underlined part as 'for' is used to denote a period of time while 'since' used to denote point of time.

5. The teacher, along with her three children, <u>were taken</u> to hospital.

(a) was taken   (b) had taken
(c) has being taken (d) No improvement

⊙ (*a*) 'Was taken' is the correct usage for the given underlined part as word joined to a singular subject by 'with' takes a singular verb.

6. The Prime Minister had <u>wide-ranging</u> discussions on the international situation.

(a) widely-ranged   (b) wide-range
(c) wide-ranged   (d) No improvement

⊙ (*d*) 'Wide-ranging' is the correct expression that means covering an extensive range. So, the sentence did not require any improvement.

7. The man disappeared after he <u>was rescuing</u> a boy from drowning.

(a) was rescued
(b) has been rescued
(c) had rescued
(d) No improvement

⊙ (*c*) The sentence is in past perfect tense so 'had rescued' will be used in place of the underlined part, to improve the given sentence.

8. I shall be obliged if you could <u>grant</u> me an interview.

(a) give   (b) allow
(c) permit   (d) No improvement

⊙ (*a*) 'Give' should be used with 'interview'. 'Grant' is used for 'Leave'. So, 'Give' should be used in place of 'grant' to improve the given sentence.

9. By 8.00 in the morning he <u>wrote</u> four letters to his friends.

(a) had written   (b) had been writing
(c) was writing   (d) No improvement

⊙ (*a*) 'The action writing the four letters had been completed before 8.00, so 'had written' will be the correct improvement for the given sentence. (Past Perfect Tense).

10. But for one witness the accused <u>ought to have</u> been sent to jail.

(a) would have   (b) had
(c) should have   (d) No improvement

⊙ (*a*) 'Would have' is the correct expression as we are talking about a hypothesis or something imagined here.

11. He is now looking <u>about</u> a job.

(a) for   (b) after
(c) into   (d) No improvement

⊙ (*a*) 'Looking for' is the correct phrasal verb that mean to hope to get something that you want or need. So, 'for' is the correct improvement.

12. He did not abide <u>with</u> my decision.

(a) to   (b) by
(c) for   (d) No improvement

⊙ (*b*) 'Abide by' is the correct expression which means to act in accord with. So, option (b) 'by' is the correct improvement.

13. I <u>was living</u> in Chennai for ten years when I was a child.

(a) had lived
(b) lived
(c) had been living
(d) No improvement

⊙ (*b*) The sentence is in simple past tense so 'lived' will be used in place of underlined part.

14. I didn't feel like going out yesterday, but on account of my son's illness I <u>had</u> to the doctor.
(a) have　　　(b) might have
(c) ought　　　(d) No improvement

➤ *(d)* The sentence is absolutely correct. No improvement is required.

15. Your services are dispensed <u>for</u>.
(a) from　　　(b) with
(c) off　　　(d) No improvement

➤ *(b)* According to the given sentence, 'with' something because you no longer want is used need them.

16. I didn't go to office because I <u>was</u> ill.
(a) felt　　　(b) had become
(c) had felt　　　(d) No improvement

➤ *(d)* 'I was ill' is the correct usage. No improvement is required.

17. The angry neighbours never <u>passed from</u> each other without making rude remarks.
(a) passed on　　　(b) passed against
(c) passed　　　(d) No improvement

➤ *(c)* No phrasal verb will be used here, 'passed' (to go past or across) will be used here to improve the given sentence.

18. The chairman with the other member of the board <u>are touring</u> Europe these days.
(a) have been on touring
(b) is touring
(c) have toured
(d) No improvement

➤ *(b)* 'is touring' is the correct usage as Chairman is singular noun. When two nouns are joined with 'with, and, or' then the verb should be used according to former noun.

19. Mahatma Gandhi is <u>called as the Father of the Nation</u>.
(a) called Father of the Nation
(b) called the Father of the Nation
(c) Father of the Nation
(d) No improvement

➤ *(b)* 'called the Father of the Nation' will be used as Mahatma Gandhi was given the name 'the Father of the Nation'.

20. Poor Tom <u>laid</u> in the shade of a tree before he could walk further.
(a) lied　　　(b) lain
(c) lay　　　(d) No improvement

➤ *(c)* The sentence is in simple present tense, so verb 'lay' will be used in place of 'laid' to improve the sentence.

21. You must <u>accustom yourself with</u> new ideas.
(a) accustomed with
(b) accustom to
(c) accustom yourself to
(d) No improvement

➤ *(c)* 'accustom yourself to' is the correct expression that means to get familiar with something so that you no longer find it strange.

22. This telephone number <u>is not existing</u>.
(a) does not exist
(b) has not been existing
(c) has had no existence
(d) No improvement

➤ *(a)* 'does not exist' is the correct expression to be used here as the sentence is negative and belongs to Present Indefinite tense.

23. <u>Suppose if</u> you are selected, will you give us a treat?
(a) Supposing if
(b) If suppose
(c) If
(d) No improvement

➤ *(c)* In the given sentence, 'suppose' and 'if' cannot be used together as both are used to depict condition and using both together becomes superfluous. Hence, option (c) is the correct answer we should remove 'suppose' from them.

24. I <u>would rather have</u> a noble enemy than a mean friend.
(a) would more have
(b) would have
(c) will have
(d) No improvement

➤ *(d)* The sentence is absolutely correct. No improvement is required.

25. He decided to take the help of a guide lest he <u>may</u> miss the way.
(a) should　　　(b) will
(c) might　　　(d) No improvement

➤ *(a)* The modal verb 'should' is used to express purpose after 'lest'. Hence, the use of 'may' in the sentence is incorrect and option (a) is the correct answer.

26. He wanted my permission <u>to taking part in</u> sports.
(a) to take part in
(b) for to take part in
(c) for to taking part in
(d) No improvement

➤ *(a)* Purpose is shown by the use of to V_1, hence, 'to take part in' is suitable usage.

27. We are doing this <u>in the interest of the poors</u>.
(a) in the interests of the poors
(b) in the interests of the poor
(c) for the interests of the poor
(d) No improvement

➤ *(b)* The plural form of poor is poor not poors. Secondly, according to subject-verb concord, interest should be substituted with interests. Hence, option (b) is the correct answer.

28. He reached <u>his destination</u> at night.
(a) destination
(b) at his destination
(c) on his destination
(d) No improvement

➤ *(d)* The sentence is absolutely correct. No improvement is required.

29. One is often pleased <u>with himself</u>.
(a) with one's self　　(b) with themselves
(c) with oneself　　(d) No improvement

➤ *(c)* When the subject is pronoun 'one', then the possessive pronoun 'oneself' is used. So, option (c) is the correct improvement.

30. Unless you <u>are you very</u> careful, you will run into debt.
(a) are very　　　(b) will be very
(c) may be　　　(d) No improvement

➤ *(a)* The given sentence begins with the conjunction 'unless', which is used instead of 'if …… not', hence, the sentence should be used without 'not'. Therefore, option (a) is the correct answer.

31. I <u>am living</u> in Bombay for the last ten years.
(a) had lived　　　(b) have been living
(c) lived　　　(d) No improvement

➤ *(b)* The given sentence denotes an action, which began in the past and is still continuing. Hence, Present Perfect Continuous tense should be used. Therefore, option (b) is the correct improvement.

32. This scooter is not as efficient as it used to be; <u>instead</u> it is still a very useful machine.
(a) similarly　　　(b) furthermore
(c) nevertheless　　(d) No improvement

➤ *(c)* In the given sentence, the scooter was not efficient, however it was still useful. Therefore, 'instead' should be substituted with 'nevertheless', which means 'in spite of that'. Hence, option (c) is the correct improvement.

33. The teacher as well as his wife <u>were invited</u>.

(a) was invited
(b) were also invited
(c) were being invited
(d) No improvement

⊙ *(a)* Words that are joined to a singular subject by 'as well as', etc. are parenthetical in nature. These verbs should therefore be put in the singular form. Hence, option (a) is the correct improvement.

34. I wish I <u>can help</u> you.

(a) may help
(b) could have helped
(c) could helped
(d) No improvement

⊙ *(c)* The given sentence denotes a possibility under certain conditions. Hence, option (c) is the correct improvement.

35. My brother is looking forward <u>to meeting</u> his employer tomorrow.

(a) to meet
(b) for meeting
(c) that he may meet
(d) No improvement

⊙ *(a)* With infinitive 'to' we use first form of verb. So, option (a) is the correct improvement.

36. My father has given his <u>ascent</u> for my long tour.

(a) accent   (b) approof
(c) assent   (d) No improvement

⊙ *(c)* In the given sentence, the underlined word ascent means a climb or walk to the summit of a mountain or hill, which is not appropriate according to the given context. So, the word 'assent' is the correct improvement as it means approval, sanation etc. Hence, option (c) is the correct answer.

37. Heavy work <u>has been thrusted</u> on me.

(a) has been thrust
(b) has thrusted
(c) has thrust down
(d) No improvement

⊙ *(d)* The given sentence is absolutely correct. No improvement is required here.

38. No sooner <u>had he completed</u> his first novel than he fell seriously ill.

(a) he had completed
(b) could he completed
(c) he completed
(d) No improvement

⊙ *(d)* The given sentence is absolutely correct.

39. There is many a slip between <u>the cup and lip</u>.

(a) cup and lip
(b) cups and lips
(c) the cup and the lip
(d) No improvement

⊙ *(c)* The given sentence is a very ancient proverb, which means that there is a time gap between the occurrence of two events and anything can occurrence of two events and anything can happen in this time gap, and things can change even at the last moment. Hence, according to this proverb, the cup and the lip is the correct improvement of the given underlined part.

40 . We can go out whenever we choose to, <u>isn't it</u>?

(a) can't we   (b) are we not
(c) don't we   (d) No improvement

⊙ *(a)* The given sentence expresses an ability as well as possibility. Also, tag takes the same verb as the question has. Hence, 'can't we' is the correct improvement.

41. He was too conscientious in the discharge of his duties <u>that he could not serve</u> that exploiter for long.

(a) that he would not serve
(b) for serving
(c) to serve
(d) No improvement

⊙ *(d)* The given sentence is absolutely correct.

42. Decide one way or the other; you can't <u>be sitting on the fence</u> forever.

(a) be seated on the fence
(b) be sitting and fencing
(c) be dancing on the fence
(d) No improvement

⊙ *(d)* The given sentence is absolutely correct.

43. Raman wants <u>to dispose off</u> his house.

(a) to dispose of
(b) the disposal off
(c) the disposal off of
(d) No improvement

⊙ *(a)* Here Ram wants to get rid of his house by giving or selling it to someone else. Hence, 'to dispose of' is the correct improvement.

44. I <u>regret for</u> using objectionable words against a man so mighty.

(a) repent for   (b) sorry for
(c) regret   (d) No improvement

⊙ *(c)* In the given sentence, 'regret for' needs to be substituted with 'regret' as regret should not followed by any preposition. Hence, option (c) is the correct improvement.

45. Ramesh <u>is working</u> in this factory for the past three months.

(a) has been working
(b) has been worked
(c) had worked
(d) No improvement

⊙ *(a)* The given sentence denotes an action, which began in the past and is still continuing. Hence, Present Perfect Continuous tense should be used here. Therefore, option (a) is the correct improvement.

46. <u>I am waiting for</u> three-quarters of an hour.

(a) I am waiting since
(b) I have waited since
(c) I have been waiting for
(d) No improvement

⊙ *(c)* The given sentence denotes an action which began in the past and is still continuing. Hence, Present Perfect Continuous tense should be used. Therefore, option (c) is the correct improvement.

47. The book is <u>the more interesting</u> of the three.

(a) the interesting
(b) the most interesting
(c) most interesting
(d) No improvement

⊙ *(b)* Here, the superlative degree of the adjective denotes the highest degree of the quality and is used when more than two things are compared. Hence, option (b) is the correct improvement.

2016 (I)

48. The police accused him <u>for</u> theft.

(a) with   (b) in
(c) of   (d) No improvement

⊙ *(c)* The word 'Accuse' is always followed by preposition 'of'. Hence, option (c) is the correct improvement.

49. He wanted <u>that I left</u> immediately.

(a) I may leave   (b) me to leave
(c) I leave   (d) No improvement

⊙ *(b)* In the given underlined part, there is a wrong use of pronoun case. Use 'me to leave' to improve the given underline part.

50. This is to certify that I know Mr J Mathews since 1970.
(a) am knowing
(b) had known
(c) have known
(d) No improvement

⊘ **(c)** To improve the given sentence, 'have known' in place of 'know' as verbs of perception are not used progressively.

51. They took away everything that belonged to him.
(a) that had been belonging
(b) that belong
(c) that has been belonging
(d) No improvement

⊘ **(d)** The given sentence is absolutely correct.

52. It was the mother of the girl of whose voice I had recognised.
(a) whose voice
(b) the voice of who
(c) voice whose
(d) No improvement

⊘ **(a)** 'Of' is not be used before 'whose' here. So, use only 'whose voice', to improve the given sentence.

53. The Executive Council is consisted of ten members.
(a) consists of   (b) comprises of
(c) constituted of (d) No improvement

⊘ **(a)** In the sentence, there is a wrong usage of passive voice. Hence, the correct use is 'consists of' to improve the given underlined part.

54. The maid was laying the table for dinner.
(a) setting up   (b) lying
(c) sorting out (d) No improvement

⊘ **(d)** The sentence is absolutely correct.

55. We have so arranged the matters and one of us is always on duty.
(a) that one of us
(b) so that one of us
(c) such that one of us
(d) No improvement

⊘ **(c)** 'Such that one of us' the suitable clause here according to the given context. Hence, option (c) is the correct improvement.

56. Hardly had we got into the forest when it began to rain.
(a) Hardly we got
(b) We had hardly got
(c) We had got hard
(d) No improvement

⊘ **(d)** The sentence is absolutely correct.

57. Each time he felt tired he lied down.
(a) lies   (b) lays
(c) lay   (d) No improvement

⊘ **(c)** 'Lay' is appropriate for the given underlined part as 'lied' is used with helping verb. Hence, option (c) is the correct improvement.

58. Though it was raining, but I went out.
(a) buy yet I   (b) I
(c) however I   (d) No improvement

⊘ **(b)** Use only 'I' in place of 'but I' to improve the given sentence as with preposition 'though', 'but' is not used.

59. There is no change of success unless you do not work hard.
(a) unless you work
(b) until your working
(c) until you do not work
(d) No improvement

⊘ **(a)** Unless is itself negative so use of 'not' is superfluous. So, 'unless you work' is the correct improvement for the given sentence.

60. She has grown too old to do little work.
(a) some   (b) any
(c) a little (d) No improvement

⊘ **(b)** Use 'any' in place of 'little' to show the negativity in a complete manner. Rest of the options are of positive sense.

61. No one enjoys to deceive his family.
(a) deceiving   (b) for deceiving
(c) deceive   (d) No improvement

⊘ **(a)** 'Deceiving' is the correct improvement because after the verb of perception, gerund is used without preposition.

62. Have you ever saw the flower of a pumpkin plant?
(a) see   (b) seeing
(c) seen   (d) No improvement

⊘ **(c)** The sentence is in Present Perfect tense, so third form of verb will be used here i.e. seen.

63. It is an ancient historical place and it once belongs to the Pandavas.
(a) belonged   (b) belonging
(c) belong   (d) No improvement

⊘ **(a)** Here, sentence is all about past moment, so past form of verb will be used i.e. 'belonged' in place of 'belongs'.

64. Since we were knowing the correct route, we did not worry at all.
(a) knew   (b) have known
(c) know   (d) No improvement

⊘ **(a)** 'Knew' is most suitable here instead of 'were knowing' to improve the given sentence.

65. Our country can progress when only people work hard.
(a) when people only work hard
(b) when people work hard only
(c) only when people work hard
(d) No improvement

⊘ **(c)** Use of 'only when' shows the condition. So, 'only when people work hard' is the correct improvement.

66. Wake me up when father will come.
(a) comes   (b) will have come
(c) came   (d) No improvement

⊘ **(a)** To improve the given sentence, option (a) 'comes' is used in place of 'will come' because the sentence is in Present Tense.

67. Do take an umbrella with you lest you not do get wet.
(a) lest you should get wet
(b) lest you should not get wet
(c) lest you might not get wet
(d) No improvement

⊘ **(a)** 'Should' is always used with 'lest'. Hence, the correct use is 'lest you should get wet' to improve the given sentence.

2015 (II)

68. It's ten o'clock already. It's high time you went home.
(a) you had gone   (b) you were going
(c) you had been   (d) No improvement

⊘ **(d)** The sentence is absolutely correct.

69. The students are playing volley-ball since 8 AM.
(a) were playing
(b) have playing
(c) have been playing
(d) No improvement

⊘ **(c)** To improve the given sentence, 'have been playing', will be used when time reference is given in place of 'are playing'.

70. Our plans for the trip fell down because we had no money.
(a) off   (b) out
(c) through   (d) No improvement

⊙ *(c)* Here, 'through' should be used that makes a phrase 'fell through' which gives the proper context in the given sentence. 'fell through' means to fail to happen that something planned.

71. None of these groups <u>has reported</u> accurately on the prevailing situation.

(a) have reported   (b) was reported
(c) has reporting   (d) No improvement

⊙ *(d)* The sentence is absolutely correct.

72. Among the athletes undergoing training Ramesh was easily <u>the better</u>.

(a) best   (b) better
(c) the best   (d) No improvement

⊙ *(c)* Here, superlative degree 'The best' takes definite article 'the'. So, option (c) is the correct improvement for the given underlined part.

73. The Earth moves around the Sun, <u>isn't it</u>?

(a) wasn't it?   (b) hasn't it
(c) doesn't it?   (d) No improvement

⊙ *(c)* Here, 'doesn't it' should be used in place of 'isn't it'. As the structure of the negative is 'aux + not + sub + ?'

74. Supposing <u>if he is arrested</u> what will he do?

(a) if he will be arrested
(b) he is arrested
(c) if he was arrested
(d) No improvement

⊙ *(b)* 'Supposing' and 'if' both the words are used to show condition. So, both are not used in a sentence. Therefore, option (b) 'he is arrested' is the correct improvement for the given underlined part according to the given context.

75. My students <u>have been interesting</u> in learning French.

(a) have been interested
(b) are being interesting
(c) have also interesting
(d) No improvement

⊙ *(a)* 'Have been interested' gives the correct sense and also it is the appropriate replacement in this sentence.

76. Hardly <u>I had fallen</u> asleep, when the bell rang.

(a) I was fallen   (b) had I fallen
(c) I fell asleep   (d) No improvement

⊙ *(b)* 'Had I fallen' is the correct replacement as we should use the correct form of inversion.

77. These days, Radha finds it difficult to make <u>both her ends meet</u>.

(a) both ends meet
(b) both the ends meet
(c) ends meet
(d) No improvement

⊙ *(a)* 'Both ends meet' is a phrase. Therefore, there could not be any change in its form. Hence, option (a) is the correct improvement for the given sentence.

78. My mother always asks us to <u>close the fan</u> when we leave the room.

(a) on the fan
(b) off the fans
(c) turn off the fan
(d) No improvement

⊙ *(c)* Here, 'turn off the fan' is the most suitable. To close/switch off an electrical appliance, we should use 'turn off'. Hence, option (c) is the correct improvement for the given underlined part.

79. If she does not get <u>more high salary</u>, she will resign.

(a) more higher salary
(b) high salaries
(c) a higher salary
(d) No improvement

⊙ *(c)* To improve the given underlined part, 'a higher salary' is suitable here to establish a comparison.

80. The parents should not <u>discriminate from</u> the girl child.

(a) discriminate between
(b) discriminate against
(c) discriminate at
(d) No improvement

⊙ *(b)* Here, 'discriminate against' is the correct improvement as 'discriminate' is followed by preposition 'against' not 'from'.

81. Shakespeare's play 'Macbeth' is <u>another of his greatest</u> works.

(a) one of his greatest
(b) best of his greatest
(c) greatest of his
(d) No improvement

⊙ *(a)* To indicate some great work, 'one of' is the appropriate one. So, 'one of his greatest' is the correct phrase here to be used.

82. Some schools required children to wear <u>black leather expensive shoes</u>.

(a) black expensive leather shoes
(b) expensive leather black shoes
(c) expensive black leather shoes
(d) No improvement

⊙ *(c)* 'Expensive black leather shoes' is the correct order for adjectives qualifying the noun 'shoes', as per the rule of order of adjectives.

83. It is a good thing <u>for him should recognise his faults</u>.

(a) that he to recognise his faults
(b) him recognising his faults
(c) for him to recognise his faults
(d) No improvement

⊙ *(c)* 'For him to recognise his faults' is the correct phrase to be used here to improve the given underlined part.

84. Some boys speak their mother-tongue <u>among one another</u>.

(a) between them
(b) among themselves
(c) with them
(d) No improvement

⊙ *(b)* 'Among' is used for more than two nouns/pronouns. So, 'among themselves' is the correct improvement for the given underlined part, to make the sentence grammatically correct.

85. <u>Prior than</u> taking any decisions he always consults his lawyer.

(a) Prior to   (b) Previous to
(c) Prior as   (d) No improvement

⊙ *(a)* 'Prior' is followed by preposition 'to'. So, option (a) 'Prior to' is the correct improvement for the given underlined part, to make the sentence grammatically correct.

86. He does not know what <u>the</u> university is.

(a) an   (b) a
(c) one   (d) No improvement

⊙ *(b)* University is not specified. So, 'a' should be used in place of 'the' to improve the given sentence.

87. The Prime Minister called <u>on</u> the President.

(a) by   (b) in
(c) to   (d) No improvement

⊙ *(d)* The given sentence is absolutely correct.

88. No sooner did we reach the railway station <u>when</u> it began to rain.

(a) than   (b) and
(c) while   (d) No improvement

⊙ *(a)* 'No sooner' agrees with 'than'. So, option (a) is the correct improvement.

89. Well-bred children always <u>listen to</u> their parents' advice.
(a) here   (b) agree
(c) obey   (d) No improvement

⊙ *(d)* The given sentence is absolutely correct.

90. We had not met since then, <u>neither did I wish</u> to meet him now.
(a) never did I wish
(b) nor did I wish
(c) did not I wish
(d) No improvement

⊙ *(b)* 'Nor did I wish' should be used in place of 'neither did I wish' express agreement with negative subject (we had not met). 'Neither' is used as subject only.

91. <u>Even she had</u> taken a taxi, she would have been late.
(a) Even if she had
(b) Although she had
(c) As if she had
(d) No improvement

⊙ *(a)* 'Even if she had' should be used to improve the given underlined part as to specify the condition involved in the sentence.

92. He felt sure of <u>his success</u>, though he was beginning to get worried.
(a) his succeed
(b) his successes
(c) being succeeded
(d) No improvement

⊙ *(d)* The sentence is absolutely correct and no improvement is required here.

2015 (I)

93. We need honest workers, not people of <u>redoubtable</u> integrity.
(a) doubting   (b) doubtful
(c) doubtless   (d) No improvement

⊙ *(b)* Here, 'Redoubtable' is not suitable to use. Using 'doubtful', which is an adjective, best describes the character of person. Hence, option (b) is the correct improvement.

94. I expect every player here to be conversant <u>at</u> the rules of game.
(a) on   (b) about
(c) with   (d) No improvement

⊙ *(c)* 'Conversant' is followed by either 'with' or 'in'. There is no 'in' in the options. Hence, 'with' is the suitable improvement.

95. There is no <u>alternate</u>, so we must leave now.
(a) alerting   (b) alternative
(c) alternation   (d) No improvement

⊙ *(b)* 'Altering' means 'to change or modify or refashion', so it is not proper to use here. 'Alternation' is the 'repeated rotation' and it also does not stick with the theme of the sentence. But, using 'alternative', which means 'a choice or an option' is proper usage according to the given sentence. Hence, option (b) is the correct improvement.

96. If I <u>were</u> you, I would do it at once.
(a) was   (b) am
(c) would be   (d) No improvement

⊙ *(d)* The sentence is absolutely correct and no improvement is required here.

97. They set a strong guard, lest anyone <u>could</u> escape.
(a) would   (b) might
(c) should   (d) No improvement

⊙ *(c)* 'Should' is always used with 'lest'. Hence, option (c) is the correct improvement of the given sentence.

98. The matter called <u>up</u> an explanation of his conduct.
(a) out   (b) in
(c) for   (d) No improvement

⊙ *(c)* See the various phrasal verbs
Called up — To start
Called out — To challenge/To shout
Called in — To seek explanation
Called for — To be a requisite/necessity
Obviously, 'called for' makes compliance with the theme of the sentence. Hence, option (c) is the correct replacement.

99. The accused <u>refused</u> having murdered anybody.
(a) disagreed   (b) denied
(c) declaimed   (d) No improvement

⊙ *(b)* 'Refused' is used in the general sense. 'Disagreed' is used to show the difference in opinion. For accusation, 'deny' should be used. Hence, option (b) is the correct improvement.

100. We cannot trust a man who plays <u>false and loose</u> with others.
(a) false or loose
(b) fast or loose
(c) fast and loose
(d) No improvement

⊙ *(c)* 'Fast and loose' is an idiom which means 'dishonest' and hence, there can't be any change in its structure.

101. He is still in vigorous health although he is on the <u>right</u> side of sixty.
(a) wrong   (b) left
(c) negative   (d) No improvement

⊙ *(a)* 'Wrong side of sixty' gives the sense of being in a critical age. Also, the sentence suggests that there is contradiction with the use of 'although'. Hence, option (a) is the correct improvement for the given sentence.

102. <u>Any</u> English are known for their practical instincts.
(a) Some   (b) Many
(c) The   (d) No improvement

⊙ *(c)* When a noun is specified for its special quality/attribute, then use of definite article 'the' is appropriate. Hence, option (c) is the correct improvement.

103. Fifty miles <u>are</u> a long distance to walk.
(a) is   (b) become
(c) be   (d) No improvement

⊙ *(a)* When a plural number/amount is shown as a whole, then we use singular verb with it as per subject-verb agreement. Hence, 'is' is proper use for the given sentence.

104. Economics today <u>were</u> not what it was a century ago.
(a) are   (b) was
(c) is   (d) No improvement

⊙ *(c)* Some nouns like Economics, Mathematics, Politics, News, etc. seems plural but actually they are singular. So, with them singular verb is used in the same tense. Hence, 'is' should be used in place of 'were' to improve the given sentence.

105. Hearing the news of the accident, he <u>broke</u>.
(a) broke down
(b) broke up
(c) broke out
(d) No improvement

⊙ *(a)* See the following phrasal verbs :
Break down—To stop working.
Break up—To end a relation
Break out—To start something
The sentence has mentioned the news of accident which is always painful, so using of 'broke down' is most suitable.

106. The speaker asked the audience to bear <u>upon</u> him for a few minutes more.
(a) on   (b) with
(c) for   (d) No improvement

⊘ (**b**) See the following phrasal verbs :

Bear upon—To show concern

Bear with—To show concern

Bear with—To tolerate

Bear for—No meaning

The speaker wants the audience 'to tolerate' him to sometime. Hence, here it is suitable to use 'bear with'.

107. Those men as are false to their friends should be avoided.

(a) The men   (b) Men

(c) Such men   (d) No Improvement

⊘ (**a**) 'Those' an 'such' are inappropriate to use because both need the nouns to be stated previously. There is no mention of this so these are not appropriate. Using 'men' only doesn't specify what kind of 'men' are being talked about. Hence, 'The men' is suitable usage here.

108. Many people find it difficult to make both hands meet.

(a) both accounts

(b) both hands to mouth

(c) both ends meet

(d) No improvement

⊘ (**c**) Here, in the given sentence, 'both ends meet' is the correct improvement in the place of 'hands meet', 'Hands meet' is meaning less. 'To make both ends meet' is an idiom which means 'to earn enough to keep the life going on properly'. Which is also appropriate according to the given context.

109. Young children are not physically capable to carry these loads.

(a) have to carry these loads

(b) of carrying these loads

(c) carry these loads

(d) No improvement

⊘ (**b**) 'Capable' is followed by preposition 'of' and hence, 'capable of carrying these loads' is suitable replacement to improve the given sentence.

110. I enjoyed the ballet by a troupe of Russian dancers.

(a) troop   (b) trouper

(c) trooper   (d) No improvement

⊘ (**d**) The sentence is absolutely correct and no improvement is required here.

111. The secretary threatened to resign his post.

(a) from his post   (b) to his post

(c) for his post   (d) No improvement

⊘ (**a**) Here, 'to resign from his post' is the correct replacement for the given sentence, as the word 'resign' followed by preposition 'from'.

112. By the time he arrived, everybody had gone home.

(a) when he arrived

(b) at which he arrived

(c) by which he arrive

(d) No improvement

⊘ (**d**) The sentence is correct and no improvement is required here.

2014 (II)

113. I never have and probably never will write good letters.

(a) I never have written

(b) I never have wrote

(c) I never have been writing

(d) No improvement

⊘ (**a**) 'When two clauses are joined by a linker which is coordinate, then the different tenses take their respective structure. So, 'have written' is appropriate improvement with 'will write' as both are joined by 'and'.

114. I think his feet are bigger than any boy in town.

(a) his feet are bigger than many boys in town

(b) his feet are bigger than no boys in town

(c) his feet are bigger than any other boys in town

(d) No improvement

⊘ (**c**) When an inclusive comparison is employed, then the noun or pronoun is exclude which is the main comparison element. Here, the feet of the boy has been compared to that of the feet of others. So, ''his feet are bigger than any other boys in town'' is appropriate to used in the given sentence.

115. I haven't studied for this examination.

(a) Hardly I have studied

(b) I have hardly studied

(c) Not hardly I have studied

(d) No improvement

⊘ (**b**) Here, wrong usage of inversion to show negativity. Therefore, I have hardly studied for this examination is appropriate improvement for the given sentence.

116. As you look across the street, lighted windows can be seen.

(a) you saw lighted windows

(b) lighted windows may be seen

(c) you can see lighted windows

(d) No improvement

⊘ (**c**) Clauses which are separated by comma or semi-colon should take same form of voice to the end of the sentence. So, 'you can see lighted windows' is the correct improvement for the given underlined part of the sentence.

117. Her sister is a nurse and she intends to be one too.

(a) this is the profession she intends

(b) her intention is the same profession

(c) she intending to be a nurse too

(d) No improvement

⊘ (**d**) The sentence is absolutely correct and no improvement is required here.

118. He asked for the cup of tea.

(a) some cup of tea

(b) cup of tea

(c) a cup of tea

(d) No improvement

⊘ (**c**) As 'the cup' is not specified, so use of 'the' is not suitable here. So, 'a cup of tea' is appropriate to use in the given sentence.

119. Several people saw the thief snatch her gold chain.

(a) people have seen

(b) people were seeing

(c) people must see

(d) No improvement

⊘ (**a**) If the time reference is not specified for being of near Past, then Present Perfect is used. Therefore, 'have seen' is appropriate improvement according to the given sentence.

120. We shall not wait for anyone who will arrive late.

(a) who arrives late (b) who arrived late

(c) who shall arrive (d) No improvement

⊘ (**a**) Correct syntax for a possible condition is

Sub + Shall/Will + V_1 + Relative Pronoun + V_1 + s/es

So, 'who arrives late' is the correct improvement for the given question.

121. We had a hard time in the war.

(a) from the war   (b) since the war

(c) during the war   (d) No improvement

⊘ (**c**) A time reference related to noun is shown by 'during'. So, option (c) is the correct improvement for the given sentence.

122. He aimed a blow on me.

(a) at me   (b) to me

(c) against me   (d) No improvement

⊘ (**a**) The word 'blow' is followed by preposition 'at'. So, 'at me', should be used in place of 'on me'.

123. He waited for her <u>by dinner time</u>.
   (a) at dinner time   (b) till dinner time
   (c) one dinner time   (d) No improvement

   ⊙ **(b)** When a certain time reference is to be shown then 'till' is used. So, 'till dinner time' is the correct improvement for the given sentence.

124. He does not have the <u>last</u> idea of it.
   (a) little   (b) less
   (c) least   (d) No improvement

   ⊙ **(c)** Extreme of the negativity is shown by the use of 'least' not 'last'.

125. Born of poor, illiterate farm workers, Lincoln <u>rose to become</u> the President of the USA.
   (a) raised to become
   (b) arose to become
   (c) risen to become
   (d) No improvement

   ⊙ **(d)** The sentence is absolutely correct and no correction is required hre

126. Gopal is two years older <u>than his brother</u>.
   (a) than own brother
   (b) to his brother
   (c) by his brother
   (d) No improvement

   ⊙ **(d)** The sentence is absolutely correct and no correction is required here.

127. The editor regretted that he <u>was inable</u> to make use of the article.
   (a) was disabled   (b) was unable
   (c) was enabled   (d) No improvement

   ⊙ **(b)** Here, 'Inable' is a wrong usage. The correct usage is 'unable' to improve the given sentence.

128. He walked softly lest <u>he may wake</u> the baby.
   (a) he would wake   (b) he waked
   (c) he should wake   (d) No improvement

   ⊙ **(c)** 'Lest' is always followed by 'should'. So, option (c) is appropriate here, to improve the given sentence.

129. I look forward <u>to meet you</u> in Delhi.
   (a) to meeting you   (b) to meet with you
   (c) at meeting you   (d) No improvement

   ⊙ **(a)** Use V_1 + ing with the phrase 'look forward to'. So, 'to meeting you' is the correct improvement for the given sentence.

130. I do not know <u>where has he gone</u>.
   (a) where had he gone
   (b) where he has gone
   (c) when has he gone
   (d) No improvement

   ⊙ **(b)** The given sentence is in Indirect speech. So, to improve the given underlined part, 'where he has gone' is the correct improvement. In indirect speech, relation pronoun (he) is used after connector (where).

131. The teacher taught the students that <u>the Moon goes around the Earth</u>.
   (a) the Moon went around the Earth
   (b) the Moon is going around the Earth
   (c) the Moon his gone around the Earth
   (d) No improvement

   ⊙ **(d)** The sentence is absolutely correct and no improvement is required here.

132. This is the boy <u>that I talked to you about</u>.
   (a) who I talked to you about
   (b) whom I talked to you about
   (c) which I talked to you about
   (d) No improvement

   ⊙ **(b)** We use 'whom' when an object is to be referred in the sentence. So, option (b) is the correct improvement to improve the given sentence.

2014 (I)

133. There <u>is</u> no rain in our village for the last six months.
   (a) has been   (b) was
   (c) had been   (d) No improvement

   ⊙ **(a)** The given sentence is in Present Perfect Continuous Tense, so 'has been' should be used in place of underlined part 'is' to improve the given sentence.

134. The police investigated <u>into the matter</u>.
   (a) with the matter   (b) at the matter
   (c) the matter   (d) No improvement

   ⊙ **(c)** Investigation itself refers to look into. So, 'into' is superfluous here. Hence, only 'the matter' should be used here.

135. Ramachandra Murthy and his family is in Guyana <u>from</u> 1985.
   (a) since   (b) about
   (c) on   (d) No improvement

   ⊙ **(a)** For a point of time, 'since' should be used instead of 'from' to improve the given sentence.

136. I <u>am living</u> in this town since 1980.
   (a) was living
   (b) shall live
   (c) have been living
   (d) No improvement

   ⊙ **(c)** The given sentence is in Present Perfect Continuous Tense. So, 'have been living' should be used in place of given underlined part to improve the sentence.

137. If I <u>was you</u> I should tell him the truth.
   (a) am you   (b) were you
   (c) had been you (d) No improvement

   ⊙ **(b)** 'Were' is used after any subject in the if clause instead of 'was'. So, option (b) is the correct improvement.

138. He is better than <u>any boy</u> in the class.
   (a) any boys   (b) all the boys
   (c) any other boy (d) No improvement

   ⊙ **(c)** When a comparison is instituted by means of a comparative followed by than, the thing compared must always excluded from the class of things with which it is compared by using other or some such words. Hence, 'any other boy' is the correct improvement in place of 'any boy'.

139. Anil ought not <u>to tell</u> me your secret, but he did.
   (a) to be telling   (b) tell
   (c) to have told   (d) No improvement

   ⊙ **(c)** To express the likelihood of something happening or expectation 'ought to + have + past participle of main verb' should be used. So, 'to have told' is the correct improvement for the given sentence.

140. <u>If I were him</u> I would have not accepted the offer.
   (a) If I was him   (b) If I were he
   (c) If I had he   (d) No improvement

   ⊙ **(b)** In sentence expressing some imaginary wish, supposition then the verb (were) used in plural form and pronoun should be used in the subjective case (he) not objective case (him).

141. What the nation needs <u>is people of character</u>.
   (a) are the people of character
   (b) are people of character
   (c) is a people of character
   (d) No improvement

   ⊙ **(d)** The sentence is absolutely correct and no improvement is required here.

142. We now come to the important question of where this great swarm of galaxies <u>have come from</u>.
   (a) have come
   (b) has come from
   (c) are coming from
   (d) No improvement

⊘ *(b)* The singular form 'has' is used after swarm of galaxies (which is singular) in place of 'have' to improve the given sentence.

143. <u>Fewer rainfall means less traffic accidents</u>, according to the experts' report on highway safety.

(a) Less rainfall means fewer traffic accidents
(b) Less rainfall means less traffic accidents
(c) Fewer rainfall means fewer traffic accidents
(d) No improvement

⊘ *(b)* 'Less rainfall means less traffic accidents', is the correct improvement according to the given sentence.

144. <u>I never saw</u> you at the party yesterday.

(a) have not seen   (b) did not see
(c) had never seen   (d) No improvement

⊘ *(b)* I 'did not see' will be used in place of 'I never saw' as the sentence is in Past Indefinite Tense.

145. Ajeet is a <u>bigger</u> scholar than his brother.

(a) better   (b) smaller
(c) superior   (d) No improvement

⊘ *(a)* When comparison is made between two peoples or things than comparative degree should be used. So, 'better' will be used in place of 'bigger' to improve the given sentence. 'Bigger' is used in respect to size of things not for peoples.

146. I did not wait for him because he <u>went out</u> before I arrived.

(a) has gone out   (b) had gone out
(c) had been out   (d) No improvement

⊘ *(b)* Here, 'had gone out' is the correct improvement. Past Perfect Tense is used in such sentences in one clause.

147. Whenever I saw him, he <u>has been reading</u> the same novel.

(a) had been reading
(b) read
(c) was reading
(d) No improvement

⊘ *(c)* The given sentence belongs to Past Continuous Tense. So. 'was reading' should be used to improve the given sentence.

148. Since, the beginning of the term, we <u>are spending</u> a lot of time on poetry.

(a) spent   (b) will spend
(c) have spent   (d) No improvement

⊘ *(c)* Present Perfect tense is used after since in such sentence. So, 'have spent' is the correct improvement for the given underlined part.

149. Your sister cooks well, isn't <u>she</u>?

(a) isn't it?   (b) doesn't she?
(c) doesn't it   (d) No improvement

⊘ *(b)* The pattern of such sentence is auxiliary + not + subject. So, 'doesn't she' is the correct question tag to be used in place of 'isn't she' to improve the given sentence.

150. Dicken's novels, <u>like many writers</u>, are largely autobiographical.

(a) like those of many other writers
(b) like so many others
(c) like many other novelists
(d) No improvement

⊘ *(a)* In the case of comparison of exclusion is shown by the use of 'other'. So, 'like those of many other writers' should be used in place of 'like many writers' to improve the given sentence.

151. <u>She was as pretty as</u>, if not prettier than, any other girl at the party.

(a) She was very pretty
(b) She was pretty
(c) She was the prettiest
(d) No improvement

⊘ *(d)* The sentence is absolutely correct and no improvement is required here.

152. <u>Never I have</u> seen such breathtaking scenery!

(a) Never have I
(b) Ever I have
(c) I cannot ever
(d) No improvement

⊘ *(a)* The given underlined part has a wrong usage of inversion form. Inversion means just putting the verb before the subject. So, the sentence is in Present Perfect Tense and the correct form of inversion is 'never have I'. Therefore, option (a) is its correct improvement.

IDIOMS AND PHRASES

Directions (Q. Nos. 1-45) Given below are some idioms/phrases followed by four alternative meanings to each. Choose the response (a), (b), (c) or (d) which is the most appropriate meaning.

2019 (II)

1. Dirt cheap
- (a) Extremely cheap
- (b) Extremely costly
- (c) Very cheap person
- (d) Very cheap item

⊙ (**a**) Idiom 'Dirt cheap' means 'very inexpensive'. So, option (a) 'extremely cheap' express its correct meaning.

2. A shrinking violet
- (a) A lean person
- (b) A shy person
- (c) A happy person
- (d) A sad person

⊙ (**b**) Idiom 'A shrinking violet' means 'an extremely shy person'. So, option (b) 'a shy person' express its correct meaning.

3. Gordian knot
- (a) Undoable job
- (b) A difficult problem
- (c) A different problem
- (d) Doable job

⊙ (**b**) Idiom 'Gordian knot' means 'an extremely difficult problem'. So, option (b) express the correct meaning of given idiom.

4. Fall in a heap
- (a) To be at the mercy of someone else
- (b) To be thinking about someone
- (c) To lose control of one's own feelings
- (d) To be in control of one's own feelings

⊙ (**c**) The idiom 'Fall in a heap' means 'to lose control of one's own feelings'. So, option (c) express the correct meaning of given idiom.

5. Have a conniption fit
- (a) To be very angry
- (b) To be very happy
- (c) To be very sad
- (d) To be a jubilant person

⊙ (**a**) The idiom 'Have a conniption fit' means 'to become unreasonably angry or upset'. So, option (a) express the correct meaning of given idiom.

6. Be in seventh heaven
- (a) To be extremely happy
- (b) To be extremely upset
- (c) To be extremely adventurous
- (d) To be extremely silent

⊙ (**a**) The idiom 'Be in seventh heaven' means 'to be extremely happy'. So, option (a) is the correct answer of given idioms.

7. Hand in glove
- (a) Working separately
- (b) Working together
- (c) Working for someone
- (d) Not willing to work

⊙ (**b**) The idiom 'Hand in glove' means 'working together'. So, option (b) express the correct meaning of given idiom.

8. Nip in the bud
- (a) Prevent a small problem before it becomes severe
- (b) Prevent the big problems
- (c) Make it severe
- (d) Beating the problem

⊙ (**a**) The idiom 'Nip in the bud' means 'prevent a small problem before it becomes severe'. So, option (a) express the correct meaning of given idiom.

9. Like a shag on a rock
- (a) Completely alone
- (b) Completely idle
- (c) Complete silence
- (d) Complete happy

⊙ (**a**) Idiom 'Like a shag on a rock' means 'completely alone or isolated'. So, option (a) express the correct meaning of given idiom.

10. A pearl of wisdom
- (a) An important piece of news
- (b) An important person
- (c) An important thing for life
- (d) An important piece of advice

⊙ (**d**) Idiom 'A pearl of wisdom' means 'an important piece of advice'. So, option (d) is the correct choice.

2019 (I)

11. A match made in heaven
- (a) a marriage that is solemnised formally
- (b) a marriage that is unsuccessful
- (c) a marriage that is likely to be happy and successful
- (d) a marriage of convenience

⊙ (**c**) The idiom 'A match made in heaven' means 'a very successful marriage as both partners are compatible with each other'. So, option (c) express the correct meaning of given idiom.

12. A culture vulture

(a) someone who is very keen to experience art and literature
(b) someone who wants to defend ancient culture
(c) someone who is ashamed of one's own culture
(d) someone who looks at her/his culture critically

⊙ (*a*) Idiom 'A culture vulture' means 'a person who is very keen to experience art and literature'. So, option (a) express the correct meaning of given idiom.

13. A death blow

(a) To be nearly dead
(b) to be deeply afraid of death
(c) to beat someone to death
(d) an action or event which causes something to end or fail

⊙ (*d*) The idiom 'A death blow' means 'an action or event which causes something to end or fail'. So, option (d) express the correct meaning of given idiom.

14. The jewel in the crown

(a) someone who has many skills
(b) something that one wants
(c) the most valuable thing in a group of things
(d) the jewel in the crown of the king

⊙ (*c*) Idiom 'The jewel in the crown' means 'the most valuable thing in a group of similar things'. So, option (c) express the correct meaning of given idiom.

15. To live in a fool's paradise

(a) to live a life that is dishonest
(b) to be happy because you will not accept how bad a situation really is
(c) to believe that things you want will happen
(d) to enjoy yourself by spending a lot of money

⊙ (*b*) Idiom 'To live in a fool's paradise' means 'to be happy because one do not know or will not accept how bad a situation really is'. So, option (b) express the correct meaning of given idiom.

16. A rotten apple

(a) to remove something which is rotten
(b) one bad person in a group of good people
(c) a loving and kind person
(d) a disorganised person with bad habits

⊙ (*b*) The idiom 'A rotten apple' means 'one bad person in a group of good people'. So, option (b) express the correct meaning of given idiom.

17. To vote with your feet

(a) to show that you do not support something
(b) to replace something important

(c) to change something you must do
(d) to express a particular opinion

⊙ (*a*) Idiom 'To vote with your feet' means 'to show that you do not support something'. So, option (a) express the correct meaning of given idiom.

18. Verbal diarrhea

(a) to be sick
(b) to talk to much
(c) to be in a difficult situation
(d) to be a good orator

⊙ (*b*) The idiom 'Verbal diarrhea' means 'to talk to much'. So, option (b) express the correct meaning of given idiom.

19. To sail close to the wind

(a) to pretend to be something that you are not
(b) to be in some unpleasant situation
(c) to be destroyed by a belief
(d) to do something that is dangerous

⊙ (*d*) The idiom 'To sail close to the wind' means 'to do something that is dangerous or that may be illegal or improper'. So, option (d) express the correct meaning of given idiom.

20. A double entendre

(a) to look at someone or something twice
(b) a situation in which you cannot succeed
(c) a word which has two meanings
(d) something that causes both advantages and problems

⊙ (*c*) The idiom 'A double entendre' means 'a word or phrase that has two meanings'. So, option (c) express the correct meaning of given idiom.

21. To cut your own throat

(a) to stop doing something
(b) to do something because you are angry
(c) to behave in a relaxed manner
(d) to allow someone to do something

⊙ (*b*) The idiom 'To cut you own throat' means 'to do something which may cause problem for oneself'. So, option (b) express the correct meaning of given idiom.

22. Cook the books

(a) to record false information in the accounts of an organisation
(b) to do something that spoils someone's plan
(c) to tell a false story
(d) to be very angry

⊙ (*a*) The idiom 'Cook the books' means 'to record false information in the accounts of an organisation'. So, option (a) express the correct meaning of given idiom.

23. Change your tune

(a) to listen to good music
(b) to do things that you are not willing to
(c) to change your opinion completely because it will bring you an advantage
(d) to pretend to be very friendly

⊙ (*c*) The idiom 'Change your tune' means 'to change one's opinion completely as it will bring you an advantage'. So, option (c) express the correct meaning of given idiom.

24. Blue blood

(a) to swallow poison
(b) to be overly interested in someone
(c) to suddenly become jealous
(d) to belong to a family of the highest social class

⊙ (*d*) The idiom 'Blue blood' means 'a member of a wealthy upper class family or ancestry'. So, option (d) express the correct meaning of given idiom.

25. Cut the crap

(a) an impolite way of telling someone to stop saying things that are not true
(b) to stop needing someone else to look after you
(c) to talk about something important
(d) to upset someone by criticising them

⊙ (*a*) The idiom 'Cut the crap' means 'a rude way of telling someone to stop saying things that are not true or not important'. So, option (a) express the correct meaning of given idiom.

2018 (II)

26. He makes decision <u>on the fly</u>.

(a) He decides quickly without any seriousness
(b) He decides with all seriousness
(c) He decides non-chalantly
(d) He is unwilling to decide

⊙ (*a*) The phrase 'On the fly' means 'to do something quickly without planing or thinking about it in advance'. So, option (a) is the correct choice.

27. Follow suit

(a) Following someone's suit
(b) Suiting to someone
(c) Doing the same as someone else has just done
(d) Doing the same kind of mistake

⊙ (*c*) Idiom 'Follow suit' means 'doing the same thing that someone else has just done'. So, option (c) express the correct meaning of given idiom.

28. Close shave

(a) Shaving very closely
(b) Miraculous escape
(c) Saving someone from danger
(d) Easy escape

(b) The idiom 'Close shave' means 'miraculous escape'. The expression is used to describe a situation where one avoids something dangerous.

29. At the crossroads

(a) At important point of a decision
(b) At an important point of journey
(c) At the important road of a journey
(d) At an important stage or decision

(a) The idiom 'At the crossroads' means 'at important point of a decision'. So, option (a) express the correct meaning of given idiom.

30. A pearl of wisdom

(a) A wise man
(b) An important piece of order
(c) An important piece of pearl
(d) An important piece of advice

(d) Idiom 'A pearl of wisdom' means 'an important or valuable piece of advice'. So, option (d) express the correct meaning of given idiom.

2018 (I)

31. A hot potato

(a) A dish to relish when it is hot
(b) A very important person in a gathering
(c) An issue which is disputed and catching the attention of people
(d) A way of thinking what someone is thinking

(c) Idiom 'A hot potato' means 'an issue which is disputed and catches the attention of people'. So, option (c) is the correct choice.

32. You snooze, you lose

(a) Don't take it lightly
(b) Don't be over enthusiastic
(c) Don't hesitate to do it
(d) Don't be pessimistic

(a) Idiom 'You snooze, you lose' means 'if you do not pay attention and do something quickly, someone else will do it instead of you'.

Hence, option (a) 'Don't take it lightly'. Correctly express the meaning of given idiom.

33. I don't buy it

(a) I don't believe it
(b) I have no money
(c) I summarise it
(d) I don't need it

(a) The phrase 'I don't buy it' means 'to be not convinced'. Hence, option (a) 'I don't believe it' is the correct response for it.

34. My two cents

(a) My money   (b) My opinion
(c) My decision   (d) My explanation

(b) The expression 'My two cents' means 'to give or share your opinion'. Hence, option (b) 'My opinion' correctly express the meaning of given idiom.

35. Out of the blue

(a) Undoubtedly   (b) Unexpectedly
(c) Unbelievably   (d) Unconcerned

(b) The phrase 'Out of the blue' means 'unexpectedly'. So option (b) is the correct choice.

36. What a small world?

(a) What a coincidence?
(b) What a challenging task?
(c) What a narrow space?
(d) What a beautiful place?

(a) The phrase 'What a small world' is used to express surprise at meeting an acquaintance or discovering a personal connection in a distant place'. Hence, option (a) 'What a coincidence' is the correct response for it.

37. Down the road

(a) In future
(b) In the past
(c) At present
(d) No particular time

(a) The phrase 'Down the road' means 'in future'. So, option (a) is the correct choice.

38. Raising eyebrows

(a) To show surprise
(b) Criticise
(c) Support
(d) Instruct

(a) The phrase 'Raising eyebrows' means 'to cause surprise or shock'. So, option (a) express the correct meaning of given phrase.

39. Step up the plate

(a) Take control
(b) Take a job
(c) Take a responsibility
(d) Take an opportunity

(c) The phrase 'Step up the plate' means 'to accept a challenge or responsibility for something'. So, option (c) express the correct meaning of given phrase.

40. The holy grail

(a) The pious place of worship
(b) An important object or goal
(c) A very important place
(d) Someone's destination of life

(b) Idiom 'The holy grail' means 'an object or goal that is sought after for its great significance'. So, option (b) is the correct answer.

41. You scratch my back, I'll scratch yours

(a) Mutual favour
(b) Mutual understanding
(c) Mutual respect
(d) Mutual disliking

(a) The idiom 'You scratch my back, I'll scratch yours' means 'one person helps another on condition that second person will help him in return'.

Hence, option (a) 'mutual favour' is the correct response for it.

42. At the drop of a hat

(a) Without any hesitation
(b) When attempt fails and it's time to start all over
(c) To future a loss with mockery
(d) Judging other's intentions too much

(a) The idiom 'At the drop of a hat' means 'freely or without any hesitation.' So, option (a) is the correct choice.

43. Ball is in your court

(a) Be happy at the dance/ball room
(b) It's up to you to make the decision
(c) A very powerful person
(d) Not speaking directly about an issue

(b) The idiom 'Ball is in your court' means 'it is time for someone to deal with a problem or make a decision'. Hence, option (b) 'It's up to you to make the decision' is the correct choice.

44. Best of both worlds

(a) A happy person who is the best with all
(b) All the advantages
(c) To take on a task that is way too big
(d) Someone whom everybody likes

(b) The idiom 'Best of both worlds' means 'all the advantages'. So, option (b) is the correct choice.

45. Costs an arm and a leg

(a) Severe punishment to someone
(b) Too much consciousness about one's body
(c) Two difficult alternatives
(d) Something very expensive

(d) The idiom 'Costs an arm and a leg' means 'something very expensive'. So, option (d) is the correct choice.

CLOZE TEST

2019 (II)

Directions (Q. Nos. 1-19) Each of the following passage in this section has some blank spaces with four words or groups of words given. Select whichever word or group of words you consider most appropriate for the blank space and indicate your response on the Answer Sheet accordingly.

PASSAGE 1

The founders of the Indian Republic .... **1.** (a) had   the farsightedness and the courage to
(b) has
(c) has had
(d) were

commit .... **2.** (a) them   to two major innovations of historical significance in nation-building and social
(b) themselves
(c) the people
(d) built

engineering : first, to .... **3.** (a) build   a democratic and civil ...... **4.** (a) libertarian   society among
(b) building   (b) liberation
(c) constructing   (c) liberating
(d) built   (d) liberty

illiterate people and, second, to undertake economic development .... **5.** (a) with a democratic political
(b) within a
(c) for the
(d) without a

structure, Hitherto, in all societies in which an economic takeoff or an early industrial and agricultural ....

6. (a) breakthrough   had occurred, effective democracy, especially from the working people, had been extremely
(b) breakout
(c) breaking
(d) investment

limited. On the other hand, ... **7.** (a) with   the beginning, India was committed to .... **8.** (a) few
(b) from   (b) some
(c) within   (c) a
(d) for   (d) an

democratic and civil libertarian political order and a representative system of government ……… **9.** (a) basing
(b) basis of
(c) based
(d) function

on free and fair elections to be conducted on the basis of universal adult franchise.

⊙ Solutions (1-9)

1. (a) Here, in the given blank, 'had' is an appropriate choice as the given sentence is in Past Tense.

2. (b) Here, reflexive pronoun 'themselves' will be used as it is used for plural noun 'founders'.

3. (a) With 'to', base form of verb is used. So, option (a) 'build' (V₁) is the correct choice for the given blank.

4. (a) Here, 'Libertarian' is the correct word according to the given context as 'Libertarian' means 'a person or society who believes in free will'.

5. (b) In the given blank option (b) 'within a' is the correct choice as the word 'within' is used to indicate enclosure or containment.

6. (a) 'Break through' means 'an important development or achievement' and it is best suited for the given blank.

7. (b) In the given blank, preposition 'from' will be used. 'From' is used to show the starting point of an action.

8. (c) Article 'a' should be used before the word which starts with a consonant sound (democratic).

9. (c) The suitable word for the given blank in 'based'. 'Based on something' means 'to use particular ideas or facts to make a decision'.

PASSAGE 2

Ecology, in a very simple term, is a science that ……… **10.** (a) studies   the interdependent, mutually reactive
(b) study
(c) studying
(d) exploring

interconnected relationships ……… **11.** (a) among   the organisms and ……… **12.** (a) their   physical environment
(b) between
(c) to
(d) for
(b) its
(c) theirs
(d) all

on the one hand and among the organisms on the other hand. ……… **13.** (a) Through   the term 'ecology' was
(b) In spite of
(c) Though
(d) Because

first coined and used by the German biologist Ernst Haeckel in 1869, a few conceptual

terms ……… **14.** (a) are   already proposed to reveal relationships ……… **15.** (a) among   organisms and their
(b) were
(c) have been
(d) have
(b) those
(c) of
(d) between

environment. For example, French zoologist LG Hilaire used the term 'ethology' ……… **16.** (a) for   the study of
(b) to
(c) with
(d) in

the relations of ……… **17.** (a) the organisms within the family and society in the aggregate and in the community.
(b) a
(c) live
(d) dead

British naturalist St. George Jackson Mivart proposed the term 'hexicology' with regard to the study of the

relations ………… **18.** (a) for   living creatures to other organisms and their environment as regards the nature of
(b) of
(c) within
(d) in

the locality they frequency, the temperature and the ……… **19.** (a) amount   of light which suit them, and their
(b) focus
(c) share
(d) quality

relations to other organisms as enemies, rivals, or accidental and involuntary benefactors.

> **Solutions** (10-19)

10. (a) Here, the general fact is given so Present Indefinite Tense will be used. Hence, option (a) 'studies' is the correct choice.

11. (b) Here, Preposition 'between' will be used to fill the given blank. 'Between' is used with two persons or things or group of things.

12. (a) Here, the suitable word is 'their' to indicate the physical environment of the organisms.

13. (c) Conjunction 'though' is the appropriate choice to fill the given blank as the rest of the sentence appear to contradict.

14. (b) The given sentence is in Past Tense, so Past form 'were' will be used to fill the given blank.

15. (d) To fill the given blank, preposition 'between' is the suitable choice. 'Between' is used with two persons or things or group of things.

16. (a) Here, preposition 'for' is the correct choice to fill the given blank. 'For' is used to show the purpose of something.

17. (a) Here, article 'the' should be used to make definite or specific reference that has been already referred to.

18. (b) In the given blank preposition 'of' is the suitable choice. Preposition 'of' is used to show the possession.

19. (a) With the word 'light', option (a) 'amount' is the suitable choice in the given context.

2019 (I)

Directions (Q. Nos. 20-34) Each of the following sentences in this section has a blank space with four words or group of words given. Select whichever word or group of words you consider most appropriate for the blank space and indicate your response on the answer sheet accordingly.

PASSAGE 1

The question whether war is ever justified, and if so under what circumstances, is one which has been forcing itself .... **20.** (a) upon   the attention of all thoughtful men. On this question I find myself in the somewhat ....
　　　　　(b) on
　　　　　(c) at
　　　　　(d) over

21. (a) delightful position of holding that no single one of the combatants is justified in the present war, while not
(b) painful
(c) pleasant
(d) lovely

taking the extreme Tolstoyan view that war is under all circumstances a .... **22.** (a) duty. Opinions on such a
　　　　　　　　　　　　　　　　　　　　　　　　(b) obligation
　　　　　　　　　　　　　　　　　　　　　　　　(c) responsibility
　　　　　　　　　　　　　　　　　　　　　　　　(d) crime

subject as war are the outcome of .... **23.** (a) feeling rather than of thought : given a man's emotional.
　　　　　　　　　　　　　　　　　　(b) sentiment
　　　　　　　　　　　　　　　　　　(c) reason
　　　　　　　　　　　　　　　　　　(d) patriotism

temperament, his convictions, ... **24.** (a) however   on war in general and on any particular war which may
　　　　　　　　　　　　　　　　(b) as well as
　　　　　　　　　　　　　　　　(c) both
　　　　　　　　　　　　　　　　(d) despite

occur during his lifetime, can be .... **25.** (a) thought   with tolerable certainty. The arguments used will be mere
　　　　　　　　　　　　　　　　(b) intimated
　　　　　　　　　　　　　　　　(c) suggested
　　　　　　　　　　　　　　　　(d) held

reinforcements to convictions otherwise reached. The fundamental facts in this as in all ethical ....

26. (a) questions   are feelings; all that thought can do is to clarify and systematise the expression of those feelings
(b) answer
(c) statements
(d) experiences

and it is such clarifying and systematising of my own feelings that I wish to .... **27.** (a) engage
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(b) praise
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(c) attempt
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(d) commend

in the present article. In fact, the question of rights and wrongs of a particular war is generally ....

28. (a) considered from a juridical or quasi-juridical ……… **29.** (a) possibility.
    (b) observed   (b) formula.
    (c) transferred   (c) force.
    (d) opined   (d) standpoint

⊙ **Solutions** (20-29)

20. (a) With the word 'itself', preposition 'upon' is the suitable choice.

21. (b) In the given context, 'painful' is the appropriate word to fill the given blank.

22. (d) With respect to the word 'war', option (d) 'crime' is the appropriate choice.

23. (a) 'Feeling' is the appropriate word to fill the given blank according to given context. 'Feeling' is an emotional state or reaction.

24. (c) Here, conjunction 'both' will be used to fill the given blank as 'both …… and' is a conjunction pair used to join one statement or fact to another.

25. (c) Here, 'suggested' is the appropriate word to fill the given blank as it means 'put-forward for consideration'.

26. (a) With the word 'ethical', option (a) 'questions' is the suitable choice. 'Ethical questions' are those questions that involve consideration of conflicting moral choices and dilemmas, with several alternative solutions.

27. (c) In the given context, option (a) 'considered' is the appropriate choice.

28. (a) In the given context, 'considered' is the appropriate word to fill the given blank. 'Considered' means 'having been thought about carefully'.

29. (d) With the word 'juridical or quasi-juridical' option (d) 'stand point' is the appropriate choice. The word 'stand point' means 'a set of beliefs and ideas from which opinions and decisions are formed'.

PASSAGE 2

The Nobel Prize for Chemistry this year is a tribute to the power of ……… **30.** (a) evolution. The laureates
    (b) devolution.
    (c) revolution.
    (d) involution.

harnessed evolution and used it in the ……… **31.** (a) microscope with amazing results. Frances H Arnold, an
    (b) field
    (c) market
    (d) laboratory

American who was given one-half of the prize, used 'directed evolution' to ……… **32.** (a) inhibit variants of
    (b) synthesize
    (c) hamper
    (d) hold back

naturally occurring enzymes that could be used to ……… . **33.** (a) constitute biofuels and pharmaceuticals. The other
    (b) sink
    (c) manufacture
    (d) resolve

half went to George P Smith, also of the US and Sir Gregory P Winter, from the UK, who evolved antibodies to
………… **34.** (a) combat autoimmune diseases and even metastatic cancer through a process called phage display.
    (b) support
    (c) observe
    (d) invite

⊙ **Solutions** (30-34)

30. (a) The whole passage is about evolution and its scientific usage. So, option (a) 'evolution' is the correct word to fill the given blank. 'Evolution' is the gradual development of something over a period of time.

31. (d) Experiments are done is the laboratory to get amazing results. So, option (d) 'laboratory' is the suitable choice in the given context.

32. (b) The word 'synthesize' means 'to produce a substance by combining other substances chemically'. Hence, it is best suited for the given blank in the given context.

33. (c) 'Biofuels and pharmaceuticals' are manufactured with the help of naturally occurring enzymes. So, option (c) 'manufacture' is the suitable choice in the given context.

34. (a) In context of autoimmune diseases, 'combat' is the correct word to fill the given blank as it means 'to take action to reduce or prevent something bad or undesirable'.

2018 (II)

Directions (Q. Nos. 35-49) Each of the following sentences in this section has a blank space with four words or group of words given. Select whichever word or group of words you consider most appropriate for the blank space and indicate your response on the answer sheet accordingly.

PASSAGE 1

This cultural form ……… **35.** from Japan has a name which means 'whimsical or impromptu pictures'. It ……… **36.** in existence since the 12th century when the first ……… **37.** for this art form was seen. Since the language itself is read from right to left, the books with ……… **38.** art form follow the same pattern ……… **39.** when English translations were made, they flipped the pictures and published it. This ……… **40.** the purists as it showed left-handed Samurai, who did not exist in the original book. Hence, nowadays even English translations follow ……… **41.** right to left format. The name of this art from is Manga.

35. (a) originating   (b) originates   (c) originated   (d) organising

36. (a) had been   (b) has been   (c) was   (d) is

37. (a) instance   (b) incident   (c) accident   (d) events

38. (a) that   (b) this   (c) these   (d) which

39. (a) For   (b) Beginning   (c) During   (d) Initially

40. (a) enrage   (b) enlarged   (c) engraved   (d) enraged

41. (a) the   (b) a   (c) some   (d) same

> **Solutions** (35-41)

35. (a) As whole passage is in Present Tense, use of 'originating' is correct which means 'having a specified beginning'.

36. (b) The usage of 'since' indicates that the given sentence is in Present Perfect Continuous Tense. So, option (b) 'has been' is the suitable choice to fill the given blank.

37. (a) With the word 'First', option (a) 'instance' is the correct choice to fill the given blank. 'Instance' means 'an example or single occurrence of something.'

38. (b) Here, demonstrative pronoun 'this' will be used as it is used to point out the singular objects, here 'art form'.

39. (d) According to the given context, 'initially' is the appropriate word for the given blank as it means 'at first or at the beginning'.

40. (d) The usage of 'did' show that the given sentence is in Past Tense, so past form 'enraged' is the correct choice in the given context. 'Enraged' means 'to make very angry'.

41. (a) 'Right to left' format has already been mentioned in the passage. So, definite article 'the' is the correct choice to fill the given blank.

PASSAGE 2

So the ……… **42.** is that is the present social structure, discipline has become an important factor because we want large numbers of children ……… **43.** together and ……… **44.** Educated to be what? To be bank clerks or super salesmen, capitalists or commissars. When you are a superman ……… **45.** as/or a super governor or a subtle parliamentary debater, what have you done? You are probably very clever, full of facts. Anybody can pick up facts; but we are human beings, not factual machines, not ……… **46.** routine automations. But again, sirs, you are not interested. You are listening to me and ……… **47.** each other, you are not going to do a thing about radically changing the education system; so it will drag on ……… **48.** a monstrous revolution, which will merely be another substitution-there will be much more control because the totalitarian government knows how to shape the minds and hearts of the people, they ……… **49.** the trick.

42. (a) difficulty   (b) difficult   (c) difference   (d) different

43. (a) educated   (b) to be educated   (c) to be educating   (d) to educate

44. (a) as quick as possible   (b) as quickly as possible   (c) as possible as   (d) quickly

45. (a) of some kind   (b) of same kind   (c) of some   (d) of same

46. (a) beast   (b) bear   (c) beastly   (d) bare

47. (a) smiling for   (b) smiling to   (c) smiling with   (d) smiling at

48. (a) until there are   (b) still there is   (c) till there was   (d) till there is

49. (a) had learnt   (b) learnt   (c) have learnt   (d) had been learnt

⟩ **Solutions** (42-49)

42. (a) The word 'difficulty' is the appropriate choice in the given context. 'Difficulty' means 'a problem or situation that is difficult'.

43. (b) 'to be educated' is the correct answer to fill the blank because use of passive voice is required here.

44. (b) 'as quickly as possible' is the correct expression which means 'as soon as possible'. So, option (b) is the correct choice for the given blank.

45. (a) The correct expression for the given blank is 'of some kind'. It is used to refer to a range of items that could fit in the description.

46. (d) Use of 'bare' is appropriate for the given blank, which means here basic and simple.

47. (d) The word 'smiling' is followed by preposition 'at'. So, option (d) 'smiling at' is the correct choice for the given blank.

48. (d) Preposition 'till' is used to indicate when something (here monstrous revolution) will happen or begin and usage of article 'a' indicate that singular verb will be used with it. So, option (d) 'till there is' is the correct choice for the given blank.

49. (c) The given sentence is in Present Tense, so option (c) 'have learnt' is the correct choice for the given blank.

2018 (I)

Directions (Q. Nos. 50-64) Each of the following sentence in this section has a blank space with four words or group of words given. Select whichever words or group of words you consider most appropriate for the blank space and indicate your response.

PASSAGE-1

One of India's greatest musicians in MS Subbulakshmi, affectionately known to most people at M.S. Her singing has brought **50.** .... to millions of people not only **51.** .... all parts of India, but in **52.** .... countries around the worlds as well. **53.** .... October, 1966 Subbulakshmi was invited to **54.** .... in New York, where people of **55.** .... foreign countries listened to her music **56.** .... This was one of the greatest **57.** .... ever given to any musician. For **58.** .... together M.S. kept that international **59.** .... spell-bound with the beauty of her voice and her style of singing.

50. (a) sorrow   (b) joy   (c) boredom   (d) pain

51. (a) over   (b) on   (c) in   (d) with

52. (a) strange   (b) unknown   (c) other   (d) familiar

53. (a) Within   (b) on   (c) in   (d) by

54. (a) dance   (b) sing   (c) speak   (d) enjoy

55. (a) many   (b) few   (c) backward   (d) all

56. (a) attentively   (b) quietly   (c) indifferently   (d) boldly

57. (a) awards   (b) honours   (c) prizes   (d) recognitions

58. (a) seconds   (b) minutes   (c) hours   (d) days

59. (a) spectator   (b) audience   (c) time   (d) businessmen

⟩ **Solutions** (50-59)

50. (b) In the given context, the word 'joy' is the suitable usage as 'joy' means 'a feeling of great pleasure and happiness'.

51. (c) For the given blank preposition 'in' is the suitable choice as 'in' is used for a enclosed space or large parts of a place.

52. (c) In the given blank, option (c) 'other' is the correct choice as it is used to refer to an additional thing of the same type as one that has been already mentioned.

53. (c) For the given blank, preposition 'in' is the suitable choice as 'in' is used for months, years, centuries and long periods.

54. (b) As mentioned in the passage, M.S. Subbulakshmi was a great singer, so she must be invited to sing in New York. Hence, option (b) 'sing' is the correct choice.

55. (a) In the given blank, option (a) 'many' is the correct choice. Adjective 'many' is used with plural countable nouns (foreign countries).

56. (a) With reference to music listening, option (a) 'attentively' is the suitable usage in the given context 'Attentively' means 'while giving close attention.

57. (b) In the given context 'honours' is the correct usage as it means 'to regard with great respect'.

58. (c) For referring to a longer period, option (c) 'hours' is the correct usage. The word is used here to show the long period of music event.

59. (b) In the given context, with the word 'international' option (b) 'audience' is the correct usage. In refers to the people of foreign countries who had came to listen the melodious voice of M.S. Subbulakshmi.

PASSAGE-2

The second Anglo-Maratha War had shattered the 60. .... of the Maratha chief, but no their spirit. The 61. .... of their freedom rankled in their hearts. They made a last 62. .... attempt to regain their independence and old .... 63. in 1817. The lead in organising a united front of the Maratha chiefs was taken by Peshwa who was smarting under the 64. .... control exercised by the British Resident.

60. (a) power   (b) dignity   (c) time   (d) patience

61. (a) disappearance   (b) empowerment   (c) loss   (d) disappointment

62. (a) horrible   (b) desperate   (c) poor   (d) strong

63. (a) prestige   (b) army   (c) rebellion   (d) infantry

64. (a) pleasant   (b) satisfying   (c) rigid   (d) orthodox

> **Solutions** (60-64)

60. (a) With the word 'shattered', option (a) 'power' is the correct usage in the given context. The usage of word 'dignity' will not be correct in the given context. Other words are not relevant here.

61. (c) With the word 'freedom' option (c) 'loss' will be the correct usage as freedom can be loss or gain by any country, empire, group etc.

62. (b) With the word 'last' option (b) 'desperate' will be the appropriate choice as 'desperate attempt' is the last attempt undertaken as a last resort.

63. (a) In the given blank 'prestige' will be the correct usage in the given context as 'prestige' means 'widespread respect and admiration'.

64. (c) With the word 'control', option (c) 'rigid' will be the appropriate usage as 'Rigid Control' is strict and severe exercised by the British.

2017 (II)

Directions (Q. Nos. 65-74) Each of the following sentence in this section has a blank space with four words or group of words given. Select whichever word or group of words you consider most appropriate for the blank space and indicate your response on the Answer Sheet accordingly.

Whenever I go into a bank, I feel scared. Everybody and everything that I see there

65. .... me. As for the manager the sight **66.** .... him simply terrifies me and **67.** .... me want to runaway **68.** .... I can. As soon as I **69.** .... the door of the bank I lose my head **70.** .... when I try to do any **71.** .... I behave like an idiot. I cannot explain **72.** .... for this but that is how it **73.** .... has been that is how it is **74.** ....

65. (a) pleases   (b) frightens   (c) saddens   (d) terrifies

66. (a) of   (b) at   (c) by   (d) on

67. (a) shapes   (b) makes   (c) shields   (d) asks

68. (a) as slow as   (b) as fast as   (c) as steadily as   (d) as actively as

69. (a) open   (b) close   (c) shut   (d) see

70. (a) or   (b) and   (c) either   (d) neither

71. (a) service   (b) business   (c) deed   (d) act

72. (a) the reasons   (b) the responses   (c) the answers   (d) the causes

73. (a) always   (b) no time   (c) any time   (d) many times

74. (b) then   (b) now   (c) later   (d) after

> **Solutions** (65-74)

65. (b) The mention of word 'scared' in the previous sentence of the passage indicates that the word 'frightens' will be the correct usage for the given blank. 'Frighten' means 'to become afraid'.

66. (a) The word 'sight' is followed by preposition 'of'. 'Sight of someone' means 'to view someone for a moment'.

67. (b) In the given context, option (b) 'make' will be the appropriate choice.

68. (b) To show the ability the expression 'as fast as' will be the appropriate choice. It refers to the speed at which something is done.

69. (a) In the given context 'open' will be appropriate choice for the given blank as it is mentioned in the passage the author is afraid and wanted to get out of the bank.

70. (b) In the given blank, conjunction 'and' will be the appropriate choice as it is used to join two similar clauses.

71. (b) In the given context 'business' will be the correct usage. 'Business' refers to the activity of buying and selling of goods or services.

72. (a) With the word 'explain' option (a) 'the reasons' will be the appropriate choice in the given context as reasons are explained for an action done.

73. (a) In the given blank adverb 'always' will be used as the expression 'always has been' is used to show the time reference of an action.

74. (b) The usage of 'is' indicate that the given sentence is in Present Tense, so option (b) 'now' will be the correct choice for the given blank.

2016 (II)

Directions (Q. Nos. 75-124) In the following passage, at certain points you are given a choice of three words marked (a), (b) and (c), one of which fits the meaning of the passage. Choose the best word out of the three. Mark the letter, viz., (a), (b) or (c) relating to this word.

PASSAGE 1

Many of us believe that science is something modern, **75.** (a) if the truth is that **76.** (a) men has been using
(b) though (b) people
(c) unless (c) man

science for **77.** (a) the very long time. However, it has **78.** (a) has a greater effect on human lives in
(b) a (b) have
(c) that (c) had

the last 25 **79.** (a) and 30 years than in the hundreds of years **80.** (a) from the invention of the plough. The
(b) or (b) for
(c) either (c) since

81. (a) marvellous gifts of science have made moder life **82.** (a) dull and comfortable. But science has
(b) or (b) for
(c) either (c) since

83. (a) at the same time created new problems. One of these which may become **84.** (a) bad in the years to
(b) in (b) worse
(c) within (c) good

come, is **85.** (a) those of 'jet-lag'. With the coming of modern jets, flying at more than 900 km an hour, the
(b) this
(c) that

world **86.** (a) can become very small indeed. Today if you **87.** (a) leave New Delhi at 4.00 in the morning.
(b) become (b) will leave
(c) has become (c) would leave

you **88.** (a) will eat an early breakfast in the sky **89.** (a) at Kabul, and be in London by about 1.00 p.m.
(b) can (b) on
(c) must (c) over

⊙ **Solutions** (75-89))

75. (b) In the given blank conjunction 'though' will be used as 'though' is used to connect two contrasting ideas.

76. (c) The helping verb 'has' takes a singular noun, so, option (c) 'man' is the correct choice for the given blank.

77. (b) Article 'a' is used before the words starting with consonant sounds. So, option (b) 'a' is the correct choice for the given blank.

78. (c) With the helping verb 'has' option (c) 'had' is the correct usage as 'has had' is used to indicate an ongoing action in the past that was completed before some other action.

79. (b) For the given blank conjunction 'or' will be the correct usage as it is used to suggest that only one possibility can be realised.

80. (c) In the given blank preposition 'since' will be the correct usage as it is used with a particular point in time.

81. (a) With reference to 'gift of science', option (a) 'marvellous' will be the correct usage as 'marvellous' means 'causing great wonder'.

82. (b) Conjunction 'and' is used to join two similar ideas, so with the word 'comfortable' option (b) 'exciting' is the appropriate choice.

83. (a) In the given blank the usage of preposition 'at' will be correct as 'at the same time' is the correct phrase. Phrase 'at the same time' is used to introduce another fact or opinion that is also true in addition to the one that has already been mentioned.

84. (b) To compare the condition of problems in the upcoming years, comparative form 'worse' will be used. So, option (b) 'worse' is the suitable choice for the given blank.

85. (c) For the given blank, option (c) 'that' is the appropriate choice as 'that' is used to describe an object in the given sentence.

86. (c) To show that something has just happened or has been completed, the present perfect tense-form is used. So, option (c) 'has become' is the suitable choice.

87. (a) In conditional sentences with words like 'if', the present tense forms is used to talk about the future. So, option (a) 'leave' is the suitable choice for the given blank.

88. (b) In the given blank, modal 'can' is the appropriate choice as it is used to show possibility of an event.

89. (a) For the given blank, preposition 'at' will be the appropriate choice as preposition 'at' is used to refer a certain point. Here, 'Kabul' is the certain point of journey, so 'at' will be used with it.

PASSAGE 2

All of us known the kinds of substances that are known as metals. They are commonly distinguished from other substance by their bright and shiny surfaces. The majority of them are fairly heavy.

90. (a) Since most metals and hard and strong, they **91.** (a) can be hammered, pulled and pressed into
(b) Although   (b) cannot be
(c) When   (c) a

various shapes **92.** (a) by mean of strong machines. It is more easy to shape **93.** (a) the piece of metal after
                 (b) by meaning of   (b) that
                 (c) by means of   (c) a

it has just been **94.** (a) lightly heated because heat softens it. Very great heat **95.** (a) must need to melt a
              (b) warmly   (b) been needed
              (c) now   (c) is needed

metal to its liquid **96.** (a) flow. Metal workers always pour the liquid metal **97.** (a) out of a hollow form
                   (b) condition   (b) into
                   (c) content   (c) onto

called a mould, usually made of **98.** (a) specialist prepared moulding sand held in a box of wood or iron.
                                  (b) specified
                                  (c) specially

99. (a) Before the metal **100.** (a) has cooled the moulding boxes are broken open and the **101.** (a) liquid
(b) after   (b) have cooled   (b) solid
(c) while   (c) has been cooled   (c) soiled

metal shapes are taken out of the moulds. **102.** (a) That process is called casting. Metal objects that
                                  (b) this
                                  (c) thus it

103. (a) have been fashion by this process break more easily than those made by hammering. When
(b) have been fashioned
(c) are in fashion

104. (a) those metals are melted they can be mixed together. The mixture is called an alloy.
(b) two
(c) all

> **Solutions** (90-104)

90. (a) To fill the given blank, subordinating conjunction 'since' will be used as it joins a main clause and a subordinate clause. 'Since' is used at the beginning of the sentence to introduce or show reason.

91. (a) Modal 'can' is used to show the capability, so option (a) 'can' is the appropriate choice for the given blank.

92. (c) In the given blank, phrase 'by means of' is the correct usage in the given context. Phrase 'by means of' means 'with the help of'.

93. (c) For the given blank, article 'a' will be the correct usage as article 'a' is used before singular, countable nouns which begin with consonant sounds.

94. (a) With the word 'heated', adverb 'lightly' will be used as 'lightly heated' is the correct expression which means 'heated at a low temperature'. So, option (a) is the correct choice for the given blank.

95. (c) The given sentence is in present tense, so option (c) 'is needed' will be the correct choice for the given blank.

96. (b) With the word 'liquid', option (b) 'condition' will be the correct usage as here the word 'condition' means 'state'.

97. (b) Preposition 'into' is the correct word for the given blank, as 'into' is used to show the movement towards inside of something.

98. (c) With the verb 'prepared', adverb 'specially' will be the correct usage in the given context. 'Specially' means 'for a special purpose'.

99. (b) 'After' is the used as a conjunction to introduce a clause. So, option (b) 'after' is the correct choice for the given blank.

100. (c) The given sentence is in passive voice, so with 'has been', past participle form of verb will be used. So, option (c) 'has been coded' is the suitable choice for the given blank.

101. (b) As mentioned in the given sentence that the metal has been cooled, so in this context option (b) 'solid' is the correct choice.

102. (b) In the given blank, demonstrative pronoun 'this' will be used as 'this' is used for an action or process that has happened recently.

103. (b) The given sentence is in passive voice, so with 'have been', past participle verb form will be used. Hence, option (b) is the correct choice for the given blank.

104. (a) Here, in the given blank, usage of pronoun will be appropriate, so option (a) 'those' is the correct choice.

2016 (I)

I was engaged in many activities and I wanted a proper reconciliation between my activity and thought. Thought without

105. (a) wish is undeveloped though. Action without **106.** (a) thought is folly. Of course we **107.** (a) never   act on
(b) action   (b) wish   (b) belatedly
(c) idea   (c) idea   (c) sometimes

some impulse or **108.** (a) peaceful   urge. If suddenly you throw **109.** (a) no   brick at me and my **110.** (a) hand goes
       (b) uncontrollable   (b) an   (b) wrist
       (c) indisputable   (c) a   (c) figure

up in front to **111.** (a) stimulate   myself, it is automatic, **112.** (a) uncontrollable action and not a result **113.** (a) to
     (b) rescue   (b) instinctive   (b) in
     (c) protect   (c) impulsive   (c) of

deliberate though. Our living is **114.** (a) made   by a series of automatic **115.** (a) thoughts from morning till night.
         (b) conditioned   (b) actions
         (c) developed   (c) wishes

Anything **116.** (a) we   do outside that common range of **117.** (a) thoughts   however, has to be **118.** (a) proceeded   by some
    (b) I   (b) ideas   (b) preceded
    (c) they   (c) actions   (c) followed

measure of thinking. **119.** (a) Some more action and thought are **120.** (a) developed and integrated, the more effective
         (b) if   (b) allied
         (c) The   (c) hostile

121. (a) they   become and the happier you **122.** (a) appear. There will then be no **123.** (a) reconciliation between a
(b) thoughts   (b) develop.   (b) conflict
(c) we   (c) grow.   (c) inflict

wish to do something and **124.** (a) inability   to act.
       (b) probability
       (c) plausibility

⊙ Solutions (105-124)

105. (b) With 'undeveloped thought', option (b) 'action' will be the correct usage as 'thought without action' are not considered as useful thoughts.

106. (a) Doing an action without a prior thought is considered foolishness. So, option (a) 'though' will be the correct usage for the given blank.

107. (c) In the given blank, option (c) 'sometimes' will be the correct usage as it means 'occasionally'.

108. (b) With the word 'urge', option (b) 'uncontrollable' will be the correct usage as 'urge' is a strong desire that is difficult or impossible to control.

109. (c) In the given blank, article 'a' will be the correct usage as it is used before singular countable nouns which begin with consonant sounds.

110. (a) In the given context, option (a) 'hand' will be the correct usage as 'hand' goes up in front to protect if something is thown at someone.

111. (c) For the given blank, verb 'protect' will be the correct usage in the given context as it means 'to defend or guard from attack or injury'.

112. (b) For the given blank, option (b) 'instinctive' is the correct choice as 'instinctive action' is the action that one do without thinking or reasoning.

113. (c) When the word 'result' is used as a noun, it is followed by preposition 'of'. So, option (c) is the correct choice for the given blank.

114. (b) In the given context, option (b) 'conditioned' will be the appropriate choice as it means 'existing under or subject to'.

115. (b) To complete the given sentence, the word 'actions' will be the appropriate choice in the given context.

116. (a) The mention of 'our' in the previous sentence indicates that 'we' will be the appropriate pronoun for the given blank.

117. (c) In the given blank, option (c) 'actions' is the appropriate choice as 'range of actions' is the correct phrase.

118. (b) In the given context, 'preceded' is the correct choice as it means 'to come before in order'.

119. (c) In the blank, article 'the' will be used as the construction 'the more …… the more' is used to say that when a particular activity increases, it causes something else to change at the same time.

120. (b) Conjunction 'and' is used to join two similar ideas, so with word 'integrated', option (b) 'allied' will be the correct usage.

121. (a) The pronoun 'they' is the correct choice for the given blank in the given context.

122. (c) in the given context, option (c) 'grow' will be the correct usage as it means 'to increase in size or amount'.

123. (b) For the given blank, the word 'conflict' is the appropriate choice as it means 'a disagreement'.

124. (a) With the word 'act', noun 'inability' is the correct usage as it means 'lack of ability to do something'.

2015 (II)

PASSAGE 1

What **125.** (a) can happen to them after us? This most **126.** (a) joyous question continually torments the
(b) will   (b) distressing
(c) must   (c) distracting

parents of these **127.** (a) unethical children. So they are mainly interested in **128.** (a) providing some kind of vocational
(b) unnatural   (b) making
(c) unfortunate   (c) giving

training for them. **129.** (a) But   special schools for such children, spread all **130.** (a) above the world, lay emphasis on
(b) Yet   (b) under
(c) Hence   (c) over

vocational training. **131.** (a) However,   they are taught to make paper bags, **132.** (a) dubious wall hangings etc. This,
(b) Accordingly,   (b) simple
(c) Similarly,   (c) clumsy

of course, is quite **133.** (a) agreeable and admirable. But what about play and **134.** (a) sport.
(b) astute   (b) game.
(c) additional   (c) grounds.

> **Solutions** (125-149)

125. (b) The time of the subordinate clause is marked by the word 'after', so in the main clause future tense will be used. So, option (b) will be the correct choice.

126. (b) With the word 'torments', option (b) 'distressing' is the correct usage as 'distressing questions' are the questions that distress or upset one.

127. (c) With the word 'children', option (c) 'unfortunate' is the correct choice as it means 'unlucky'.

128. (a) With reference to training, the word 'providing' will be the appropriate choice.

129. (c) In the given blank, option (c) 'hence' will be the correct usage as 'hence' is used in a sentence to show a cause effect relationship between two parts of a sentence.

130. (c) With the word 'all', the preposition 'over' will be the correct usage as 'all over the world' is the correct phrase.

131. (b) Adverb 'accordingly' is the appropriate word to fill the given blank as it means 'in a way that is appropriate to the particular circumstances'.

132. (b) With 'wall hangings', the word 'simple' is the correct usage. Adjective 'simple' means 'plain or basic in form, nature or design.

133. (b) Conjunction 'and' is used to join two similar ideas, so with 'admirable', the word 'astute' is the suitable usage. 'Astute' is the ability to understand a situation quickly in order to take advantage from it.

134. (a) Conjunction 'and' is used to join two similar ideas, so with verb 'play', option (a) 'sport' is the correct choice.

PASSAGE 2

Galileo used mathematical calculation as well as observation of nature and was the first astronomer to use a telescope.

With an instrument of his own **135.** (a) experiment, Galileo observed Jupiter and four of **136.** (a) the Moons, the phases
(b) construction,   (b) their
(c) calculation   (c) its

of Venus and the spots on the Sun. His **137.** (a) observing and calculations confirmed that Copernicus and Kepler
(b) observations
(c) observed

were right. He saw **138.** (a) by his own eyes and made other people **139.** (a) to see too that the Earth was not the
(b) from   (b) see
(c) with   (c) seeing

fixed center of **140.** (a) an universe as Ptolemy had said. Galileo **141.** (a) instead made some important discoveries in
(b) a   (b) also
(c) the   (c) therefore

mechanics. He did not **142.** (a) as legend says drop cannon balls from the Leaning Tower of Pisa **143.** (a) having proved
(b) as stories say   (b) proving
(c) as people say   (c) to prove

that all bodies fall at the **144.** (a) same speed, but he did roll balls **145.** (a) downside a slope to show that the
(b) equal (b) down over
(c) similar (c) down

146. (a) track   a body falls is proportionate **147.** (a) to   the square of the time it takes to fall. Galileo also noticed
(b) distance (b) of
(c) path (c) with

the regular **148.** (a) swings   of the lamps in Pisa Cathedral; **149.** (a) these   gave him the idea of the pendulum, a device
(b) swinging (b) this
(c) swaying (c) those

that enabled him to make the clock a scientific instrument for the first time.

135. (b) With reference to instrument, option (b) 'construction' will be used. 'Construction' means 'process of making or building something'.

136. (c) In the given blank, possessive pronoun 'its' will be used as pronoun 'it' is used for non-living things.

137. (b) Conjunction 'and' is used to join two similar ideas, so with the word 'calculations', option (b) 'observations' will be the correct choice. 'Observations' are the recorded information that results from studying a scientific event.

138. (c) In the given blank, preposition 'with' will be used as it is used with objects, materials and physical characteristics.

139. (b) The given sentence is in present tense, so option (b) 'see' is the correct choice for the given blank.

140. (c) In the given blank, article 'the' will be used as before the word 'universe', article 'the' is used.

141. (b) In the given blank, option (b) 'also' will be used as in the given sentence some other important discoveries of Galileo is mentioned in addition to the one's already mentioned in the passage. Adverb 'also' means 'in addition'.

142. (b) In the given context, option (b) 'as stories say' is the correct choice.

143. (c) For the giving blank, 'to + infinitive' construction will be used, so option (c) 'to prove' is the correct choice for the given blank.

144. (a) In the given blank, option (a) 'same' will be used. Here, the word 'same' is used to show the identical speed at which canon balls are falling.

145. (c) With the word 'slope', option (c) 'down' will be the correct usage. The word 'down' means 'directed or moving towards a lower place or position'.

146. (b) In the given context, the word 'distance' will be the appropriate choice for the given blank as it means 'the length of space between two points'.

147. (a) Adjective 'proportionate' is followed by preposition 'to'. So, option (a) is the correct choice to fill the given blank.

148. (a) The usage of word 'regular' indicates that the given sentence is in present indefinite tense, so base form of verb with 's/es' will be used. Hence, option (a) 'swings' is the appropriate word for the given blank.

149. (b) Here, demonstrative pronoun 'this' will be used to fill the given blank as 'this' is used with singular noun (idea of the pendulum).

2015 (I)

We all like listening to the person who is good **150.** (a) on telling stories and will always be a **151.** (a) popular
(b) at (b) good
(c) by (c) necessary

member of any company. The art **152.** (a) on good story-telling covers much more than **153.** (a) describing up
(b) of (b) making
(c) at (c) showing

fabulous adventures; it includes telling **154.** (a) about   the doings of living people or **155.** (a) insignificant men and
(b) by (b) dead
(c) for (c) famous

women of the past, **156.** (a) in   your own travels and adventures and **157.** (a) experiences about the books you
(b) about (b) desires
(c) through (c) worries

have read

158. (a) either   the films you have seen. Practising **159.** (a) an   art of story-telling can be very **160.** (a) useful   too.
(b) all (b) a (b) dangerous
(c) and (c) the (c) contagious

It will help you to **161.** (a) listen   clearly and logically, to sortout **162.** (a) her   ideas to express yourself clearly and
(b) remember (b) their
(c) think (c) your

163. (a) timidly,   to gain and hold the attention **164.** (a) at   others. It will help you to **165.** (a) shake   off shyness
(b) effectively (b) on (b) lay
(c) bluntly (c) of (c) hit

and self-consciousness, and give **166.** (a) she that feeling of freedom **167.** (a) then is so important to

(b) you

(c) I

(b) what

(c) which

168. (a) success in life.

(b) victory

(c) gain

> **Solutions** (150-168)

150. (b) Adjective 'good' is followed by preposition 'at'. So, option (b) 'at' is the correct choice.

151. (a) In the given context, option (a) 'popular' is the correct choice. 'Popular' means 'liked or admired by many people'.

152. (b) 'Art' is followed by preposition 'of'. Here, 'art' means 'skill acquired by experience, study or observation'. Hence, option (b) is the correct choice.

153. (b) With the word 'up', option (b) 'making' is the suitable usage as 'making up' means 'to combine together to form something'.

154. (a) The verb 'telling' is followed by preposition 'about'. So, option (a) is the correct choice.

155. (c) Conjunction 'or' is used to connect two or more possibilities or alternatives. Here, option (c) 'famous' is the correct usage in the given context as it means 'known' and recognised by many people'.

156. (b) Here, with reference to 'travels and adventures', option (b) 'about' will be used. So, option (b) is the correct choice.

157. (a) Conjunction 'and' joins similar ideas, so with 'adventures', option (a) 'experiences' is the correct usage.

158. (c) Conjunction 'and' is used to join one clause or phrase to another similar clause. So, option (c) 'and' is the suitable choice for the given blank.

159. (c) 'Art of story-telling' has already been mentioned in the passage. So, definite article 'the' is the correct choice to fill the given blank.

160. (a) In the given blank, the word 'useful' will be the appropriate choice as practicing the art of story-telling can be useful. 'Useful' means 'capable or able to be used for practical purpose'.

161. (c) With the words, 'clearly & logically', option (c) 'think' will be the appropriate choice.

162. (c) The mention of 'you' in the given sentence indicates that possessive pronoun 'your' will be the suitable choice for the given blank.

163. (b) Conjunction 'and' joins two similar ideas, so with adverb 'clearly', the use of word 'effectively' will be correct. Adverb 'effectively' means 'in such a manner as to achieve a desired result'.

164. (c) The usage of words 'gain' and 'hold' with noun 'attention' indicates that preposition 'of' will be the appropriate choice for the given blank.

165. (b) With the word 'off', option (b) 'lay' will be the correct usage as 'lay off' is a phrasal verb which means 'to give up or stop doing something'.

166. (b) In the given blank, objective case of pronoun is to be used, so option (b) 'you' is the appropriate choice for the given blank.

167. (c) With reference to 'feeling of freedom', relative pronoun 'which' will be used. Hence, option (c) is the correct choice to fill the given blank.

168. (a) In the given blank, verb 'gain' is the correct choice in the given context. 'Gain' means 'to get something that is useful', here 'feeling of freedom'.

2014 (II)

We know that the average depth of the sea is about two and a half miles, but in few places it is very deep indeed-over six

miles. The air presses upon our bodies with a weight of about fifteen pounds to the square inch at **169.** (a) sea-water.

(b) sea-level

(c) sea-bed

We are used to this air pressure and **170.** (a) do not notice it. In the sea this **171.** (a) weight is doubled at a depth of

(b) did

(c) does

(b) volume

(c) pressure

thirty-five feet, and it **172.** (a) expands at this rate for greater depths. In the great deeps **173.** (a) off the Philippine

(b) decreases

(c) increases

(b) of

(c) on

Islands, a man would be squeezed and utterly crushed by a pressure of **174.** (a) severe tons per square inch. The

(b) several

(c) sheer

pressure near the ocean floor is **175.** (a) such great that, if you were to weigh a piece of wood and **176.** (a) measure it

(b) not

(c) so

(b) follow

(c) lower

to a great depth and then pull it. **177.** (a) up   again it would no longer float, **178.** (a) but   it would have become
        (b) off   (b) for
        (c) down   (c) when

waterlogged. All the tiny wood cells and cavities **179.** (a) should   have burst and become filled with water. We
        (b) could
        (c) would

180. (a) know   that animals live at a depth of three miles and more we wonder **181.** (a) why   this can be. The
(b) have known   (b) how
(c) are knowing   (c) what

bodies of animals down **182.** (a) here   are almost entirely filled with water, and **183.** (a) this   saves them from being
        (b) where   (b) these
        (c) there   (c) thus

crushed. However, many of **184.** (a) such   animals contain some gases as well, for **185.** (a) then   they are captured
        (b) those   (b) since
        (c) there   (c) when

in nets and drawn **186.** (a) on   the surface these gases expand so much that the animal **187.** (a) immediately explodes.Its body is
        (b) to   (b) eventually
        (c) from   (c) actually

torn to shreds as it **188.** (a) bursts
        (b) jumps
        (c) lands

> **Solutions** (169-188)

169. (b) In the given context, with preposition 'at' option (b) 'sea-level' will be the appropriate choice.
170. (a) The given sentence is in present tense and the verb to be used must be in plural form as the subject in the sentence is plural. So, option (a) 'do' is the correct choice for the given blank.
171. (c) As the whole passage discuss about the air-pressure under the sea, so with the word 'sea', option (c) 'pressure' is the appropriate choice.
172. (c) 'Increases' is the suitable word to fill the given blank as air-pressure increases at greater depths.
173. (b) Here, the word 'deeps' means 'a deep part of the sea', so preposition 'of' will be used with it. Preposition 'of' is used in the meaning of 'belonging to'.
174. (b) For the given blank, option (b) 'several' is the correct choice as 'several' is used to refer to an imprecise number of quantity (here tons).
175. (c) In the given blank, option (c) 'so' will be the appropriate usage as construction 'so + adjective + that' as a conjunction is used to introduce clauses of reason and explanation. 'So great that' means 'to such a great extent'.
176. (a) As the whole passage discuss about air-pressure, so option (a) 'measure' will be the correct choice for the given blank.
177. (a) With the word 'pull' option (a) 'up' is the correct usage as 'pull something up' means 'to raise or lift something upward'.
178. (b) In the given blank, 'for' will be used as a conjunction which means the same as 'because'.
179. (b) For the given blank, modal 'could' will be the appropriate usage as the construct 'could + have' is used to discuss about the past possibilities.
180. (a) The given sentence is a general fact, so present indefinite tense will be used. Hence, option (a) 'know' is the correct usage.
181. (b) In the given blank, adverb 'how' will be the appropriate usage in the given context.
182. (c) With the word 'down', option (c) 'there' is the correct usage. So, option (c) is the suitable choice for the given blank.
183. (a) To indicate the process that is just discussed, option (a) 'this' will be used. Hence, option (a) is the correct choice for the given blank.
184. (b) To mention the persons, animals or things that are far to the speaker option (b) 'those' is used. So, 'those' is the suitable word to fill in the given blank.
185. (c) In the given blank, option (c) 'when' will be the appropriate choice as it means 'at the time that'.
186. (b) With the word 'surface', preposition 'to' is the correct usage. So, option (b) 'to' is the correct choice for the given blank.
187. (a) In the given context, option (a) 'immediately' is the appropriate choice. 'Immediately' means 'at once or instantly'.
188. (a) For the given blank, 'burst' is the appropriate word in the given context as it means 'to break open or appart suddenly'.

2014 (I)

PASSAGE 5

One of the most interesting new books published recently is 'Spaceship' by Professor EC Walker. Our Earth he says **189.** (a) is like a spaceship, and all the 400 million people **190.** (a) over Earth are passengers on it. And
(b) have been   (b) on
(c) will be   (c) upon

we are heading **191.** (a) about a disaster. The levels of atmospheric pollution **192.** (a) increasing in the cities and
(b) to   (b) arriving
(c) towards   (c) coming

industrial areas of the world could in time change the weather patterns of the Earth, raising the temperature

193. (a) in the whole planet. If this rose a few **194.** (a) degrees   the deserts of the world would expand to double their
(b) of   (b) steps
(c) for   (c) miles

size. The polar ice caps would start melting. If the polar ice caps melted, the **195.** (a) water level all over the world
(b) ice
(c) sea

would rise **196.** (a) in about 60 m. Professor Walker's **197.** (a) idea is not at all about gloom and doom. He admits
(b) by   (b) thought
(c) to   (c) book

that the **198.** (a) ideas   he describes could take thousands of years.
(b) solutions
(c) changes

> **Solutions** (189-198)

189. (a) The given sentence is in present tense and no time reference is mentioned in it, so option (a) 'is' the suitable choice for the given blank.

190. (a) Preposition 'on' is the appropriate choice for the given blank as 'on' is used to point the position a top a surface.

191. (c) With the word 'heading', preposition 'towards' is the appropriate usage. Preposition 'towards' means 'in the direction of'.

192. (a) With reference to the levels of atmospheric pollution, option (a) 'increasing' is the correct usage. 'Increasing' means 'becoming greater in size, amount or degree'.

193. (b) In the given blank, preposition 'of' will be used as preposition 'of' is used to indicate reference.

194. (a) In relation to the temperature, option (a) 'degrees' is the appropriate usage.

195. (c) With the word level, option (c) 'sea' is the appropriate usage in the given context. 'Sea level' is the average height of sea where it meets the land.

196. (b) To fill the given blank, preposition 'by' is appropriate choice as 'by' is used to talk about measurements (here 60 m) and increase and decrease in amount.

197. (c) As the passage is about the book named 'Spaceship' written by Professor EC Walker, so option (c) 'book' is the appropriate choice for the given blank.

198. (c) With reference to 'thousands of years', option (c) 'change' is the appropriate usage in the given context.

SENTENCE COMPLETION

Directions (Q. Nos. 1-74) *Each of the following sentences in this section has a blank space and four words or group of words are given after the sentence. Select the word or group of words you consider the most appropriate for the blank space and indicate your response on the Answer sheet accordingly.*

2019 (II)

1. How we.........to ageing is a choice we must make wisely?
(a) respond   (b) absolve
(c) discharge   (d) overlook

⊙ *(a)* 'respond' is correct word to be used for the given blank as respond means to react to something.

2. Complementary medicine .... fewer risks; since it is used alongwith standard remendies, often to lessen side -effects and enhance feelings of well-being.
(a) reacts   (b) releases
(c) ejects   (d) carries

⊙ *(d)* 'carries' is appropriate word for the given blank. The word means an act of carrying something.

3. Stress many ....fertility, in man and women.
(a) engage   (b) reduce
(c) inject   (d) deduce

⊙ *(b)* 'reduce' is the aporopriate word for the blank. The word means to become diminished.

4. The football match had to be ....because of the weather.
(a) called on   (b) called off
(c) called out   (d) called over

⊙ *(b)* 'called off' is the appropriate phrase for the given blank. The phrase means to cancel or abandon something.

5. Nobody believed Ram at first but he ....to be right.
(a) came out   (b) carried out
(c) worked out   (d) turned out

⊙ *(d)* 'turned out' is the appropriate phrase for the blank as it means to happen is a particular way.

6. How are you......in your new job? Are you enjoying it?
(a) keeping on   (b) going on
(c) getting on   (d) carrying on

⊙ *(c)* 'getting on' is an appropriate phrase. for the give blank. The word means to have a good relationship.

7. We live.........a tower block. Out apartment is on the fifteenth floor.
(a) at   (b) in
(c) over   (d) above

⊙ *(b)* Here, preposition 'in' is an appropriate word for the blank, as in is used for an enclosed space.

8. You were going to apply for the job and then you decided not to so what.......?
(a) put you off   (b) put you out
(c) turned you off   (d) turned you away

⊙ *(a)* 'put you off' is the most appropriate phrase for the given blank. The phrase means to cause someone to lose interest or enthusiasm.

9. ....it was raining, he went out without a raincoat.
(a) Even   (b) Since
(c) Unless   (d) Although

⊙ *(d)* According to the given sentence, 'Although' is the most appropriate word to be used for the given blank. .

10. I parked my car in a no-parking zone, but I.........it.
(a) came up with   (b) got away with
(c) made off with   (d) got on with

⊙ *(b)* 'got away with' is the most appropriate phrase to be used for the blank. The phrase means to escape blame punishment or undesirable' consequence for an act that is wrong or mistaken.

11. My teacher was ....us for being late.
(a) annoyed at   (b) annoyed with
(c) annoyed about   (d) annoys

⊙ *(b)* 'annoyed with' is the most appropriate phrase as when we are angry with people we use 'annoyed with 'Annoyed with' means to make source slightly angry or upset.

12. Sandhya .... me from the top of the house.
(a) shouted to   (b) shouted at
(c) shouted on   (d) shouted

⊙ *(b)* With verb 'shouted', preposition to be used is 'at'. So option b 'shouted at' is correct here as we shout at some or the other person.

13. Ravi has the habit of ....a headache.
(a) complaining   (b) complain
(c) complaining to   (d) complaining of

⊙ *(d)* 'Complaining of' is the most sutiable option. When we speak about illnesses, we use 'complaining of'.

14. I always want to go alone for a ride, but my mother.........going with my brother.
(a) insists   (b) insists on
(c) insists in   (d) insisted

⊙ *(a)* 'insists' is an appropriate option. 'insist means to say firmly or demand forcefully. There is need to use any prepositional with 'insist'.

15. The new student fund it difficult to ....with his classmates.
(a) get along   (b) get among
(c) get well   (d) get up

⊙ (*a*) 'get along' is the phrase verb which should be appropriate in the given blank. 'Get along' means to have a friendly relationship with other which is correct according to the context.

16. The visiting Diplomat.......the Prime Minister.
(a) Called in   (b) called at
(c) called on   (d) called upon

⊙ (*c*) 'called on' is the appropriate phrasal verb to fill in the bank 'called on' means to ask someone to do something.

17. ....sincere, the would have got the prize.
(a) Had he been   (b) Has he been
(c) Would he have been
(d) He is

⊙ (*a*) From the given options 'had he been' is the most suitable one. The sentence is 'conditional' so here, use of past perfect is required.

18. Ten years.........for me to live in a foreign country.
(a) are a long time   (b) is a long time
(c) has a long time   (d) of time

⊙ (*b*) Ten years is singular noun, so we will use 'is a long time' to fill the given blank.

19. If I ....you, I ....love to accept the offer.
(a) was......will   (b) was ....would
(c) were..... would   (d) were.......will

⊙ (*c*) Use of 'were' and 'would is required in the given conditional type sentence.

20. My sister asked me ....willing to go abroad for my studies.
(a) if I were   (b) if I could be
(c) whether I should be
(d) whether I will

⊙ (*a*) 'if I were' seems to be the only correct option because the sentence shows assumption.

21. In the face of the overwhelming mass of evidence against him, we cannot.......him of the crime.
(a) punish   (b) absolve
(c) release   (d) ignore

⊙ (*b*) 'absolve' is the appropriate word to be filled in the blank to make the sentence meaningful. Absolve means declare someone free from guilt, obligation or punishment.

22. I hope that the rain will.......for our picnic tomorrow.
(a) keep off   (b) put off
(c) set back   (d) stay out

⊙ (*d*) 'stay out' is the appropriate word to be filled in the blank to makes the sentence meaningfully complete. Hence, stay out means to not come.

23. After the marathon, some of the competitors felt completely........
(a) cut up   (b) done in
(c) done out   (d) run out

⊙ (*b*) 'Done in' means extremely tired. Hence, it is the appropriate choice to be filled in the sentence.

24. Scarcely.......... the teacher entered the class when he heard the noise.
(a) did   (b) has   (c) had (d) will have

⊙ (*c*) 'had' will be used in the blank as the principal clause is in past indefinite so the subordinate clause will be in past. perfect tense.

25. I do not think he will ever ....the shock of his wife's death.
(a) get by   (b) get off
(c) get through   (d) get over

⊙ (*d*) 'get over' means 'to recover from' which fits in the blank appropriately to make the sentence meaningful.

26. It is no use is crying over ....
(a) spoiled milk   (b) spirited milk
(c) split milk   (d) spilt milk

⊙ (*d*) 'Cry over spilt milk' is the correct phrasal expression, which means to express regret over something which can not be changed.

27. You must go to the station now, your brother........go just yet as his train leaves after three hours.
(a) shouldn't   (b) mustn't
(c) wouldn't   (d) needn't

⊙ (*d*) 'needn't' is the appropriate modal verb to be filled in the given blank. As needn't express the speakers authority or advice (Here, advice)

28. Every rash driver becomes a ....killer.
(a) sure   (b) reckless
(c) potential   (d) powerful

⊙ (*c*) 'potential' means likely or probable which fits in the meaning of the given sentence.

29. The country owes a deep debt of ......for the freedom fighters.
(a) patriotism   (b) sincerity
(c) remembrance   (d) gratitude .

⊙ (*d*) 'gratitude' means thankful which fits in the blank to make the sentence meaningfully correct.

30. The whole lot of young men were very enthusiastic but your friend alone was.......

(a) quarrelsome   (b) complaining
(c) a wet blanket   (d) sleepy

⊙ (*c*) 'a wet blanket' is the appropriate Indian to be filled in the sentence which means a person who spoils other people's fun by failing to join in with of by disapproving of their activities.

31. With the less rapid expansion of the economy, we should make....... progress toward stable price levels.
(a) detailed   (b) substantial
(c) definite   (d) infinite

⊙ (*b*) 'substantial' means concerning the essentials or basic of something Hence, it is appropriate choice to be filled.

32. At times he gets very angry, and then no one can.........him.
(a) prevent   (b) humour
(c) mollify   (d) satisfy

⊙ (*c*) 'mollify' is the correct word to be used for the given blank. Mollify means to oppose the anger or anxiety of or to calm down someone.

33. Many people today have fallen into utter confusion of values with the result that they cannot ....the good from the bad.
(a) divide   (b) differentiate
(c) see   (d) alter

⊙ (*b*) According to the given context, differentiate is the most suitable word for the given blank. 'Differentiate' means to make out the difference.

34. If Mohan.........at 5 a.m., he would not have missed the train.
(a) started   (b) had started
(c) would start   (d) has started

⊙ (*b*) When would is used in if clause had IIIrd form of verb should be used so, here 'had started' is the correct words to fill the given blank.

35. His property was divided.........his daughters and sons.
(a) between   (b) among
(c) from   (d) with

⊙ (*a*) Here, the property divides only between daughters and sons i.e two so, 'between' is the most appropriate word for the given blank because for two between is used and for more than two among is used.

36. His persistence in his misdemeanours has lowered him in the.........of everyone who knows him.
(a) eyes   (b) estimation
(c) estimate   (d) esteern

⊙ (*a*) 'eyes' is the appropriate word which fits in the blank to make the sentence meaningfully correct.

37. The clouds of suspicion will clear ....soon.
(a) up   (b) away
(c) off   (d) by

⊙ **(a)** According to the given sentence, 'up' is the appropriate word to fill in the blank as 'clear up' means to solve or explain something .

38. The teachers said that they were no longer prepared to.........the way of the new Headmaster.
(a) put over with   (b) put on with
(c) put up with   (d) put up to

⊙ **(c)** 'Put up with' is the appropriate phrase for the given blank, to make the sentence meaningful. 'Put up with' means talerate, endure or support etc.

39. ....the construction of new housing units at the rate of one every month, there is still a shortage of accomodation.
(a) Through   (b) Despite
(c) By   (d) For

⊙ **(b)** Here, 'despite' is the most appropriate word to fill the given blank and make the sentence meaningful. Despite means without being affected by or inspite of.

40. Democracy required the equal right of all to the development of such capacity for good as nature has.........them with.
(a) presented   (b) endowed
(c) fortified   (d) replenished

⊙ **(b)** 'endowed' is correct word to be used for the given blank as it means provide with a quality, ability or asset.

2017 (I)

Directions (Q. Nos. 41-74) *In this section, each of the following sentences has a blank space and four words are given below it. Select the word or group of words you consider most appropriate for the blank space and indicate your response.*

41. In this University, there is no ……… for awarding scholarships on the basis of merit in examination alone.
(a) precedent   (b) opportunity
(c) chance   (d) possibility

⊙ **(a)** 'precedent' is the most appropriate word to be used for the given blank. The word precedent means an earlier event or action that is regarded as an example.

42. Can you pay ……… all these articles?
(a) out   (b) of   (c) for   (d) off

⊙ **(c)** Preposition 'for' is suitable for the given blank. As, 'out', 'of', or 'off' cannot used with 'pay'.

43. He may not come, but we'll get ready in case he ……… .
(a) may   (b) will   (c) shall   (d) does

⊙ **(d)** 'does' is the appropriate choice to be filled in the given blank. Do/Does is used in present tense for interrogation.

44. He is quite ………; you can never count on him in matters of secrecy.
(a) unjust   (b) unbearable
(c) inefficient   (d) unreliable

⊙ **(d)** 'unreliable' is the appropriate word to be filled in the blank to make the sentence meaningful. Unreliable means not able to be trusted or believed.

45. The Governor will …… the oath of office to the thirty-five new ministers at 9:30 p.m. tomorrow.
(a) confer   (b) present
(c) execute   (d) administer

⊙ **(d)** The word 'administer' is the appropriate choice to be filled in the sentence which means to control the operation or arrangement of something.

46. Most of the students have forgotten to bring their certificates; they will be ……… by the principal for this reason.
(a) reproached   (b) abused
(c) accused   (d) reprimanded

⊙ **(d)** 'reprimanded' is the appropriate choice to be filled in the sentence. The word reprimanded means someone in authority speaks to you in an angry way because you have done something wrong and it is best suited according to the sentence.

47. The consequences of economic growth have now ……… to the lowest level.
(a) draw   (b) slipped
(c) percolated   (d) crept

⊙ **(d)** According to the context of the given sentence, 'crept' is the appropriate word to fill the blank as it means move very slowly or inexorably.

48. Mrs. Ramsay did not know whether Miss Jane knew ………
(a) swimming   (b) to swim
(c) how to swim   (d) how to swimming

⊙ **(c)** For the given blank, option (c) 'how to swim' is the correct choice as 'knew how to' means 'have the ability to'.

49. He ……… the role of the organisation in creating environmental awareness among the people.
(a) collaborated   (b) commanded
(c) contrasted   (d) commended

⊙ **(d)** 'commended' is the appropriate word to be filled in the blank to make the sentence meaningful. 'Commended' means to formally praise someone or something.

50. We should give everyone training in citizenship but we have ……… this aspect till now.
(a) denied   (b) neglected
(c) refused   (d) disallowed

⊙ **(b)** Here, according to the given context, 'neglected' is the appropriate word to make the sentence meaningful. Neglected means ignoring.

51. The mounting pressure was so overwhelming that he ultimately ……… to her wish.
(a) yielded in   (b) gave in
(c) cowed in   (d) agreed in

⊙ **(b)** 'gave in' is the appropriate phrase to make the given sentence meaningful. 'gave in' means admit defeat or cease fighting or arguing.

52. Authority ……… when it is not supported by the moral purity of its user.
(a) prevails   (b) entails
(c) crumbles   (d) waits

⊙ **(c)** Here, the word 'crumbles' (break or fall apart into small fragments) best suited to the given context.

53. In a developing country like India, some industries will have to be brought within public ……… and control, for otherwise rapid growth of the economy may be impossible.
(a) perspective   (b) hegemony
(c) observation   (d) ownership

⊙ **(d)** Here, 'ownership' is the correct word to fill the given blank. 'ownership' means shows the effect of public administration.

54. Gandhiji conceived of the idea of channelising the powerful currents of the united mass movement so as to give the utmost impetus to the national ……… for independence.
(a) struggle   (b) conflict
(c) onslaught   (d) march

⊙ **(a)** 'struggle' is the appropriate word, to make the sentence meaningful.

55. Because of his .... habits, he could not save much money.
(a) extravagant　　(b) frugal
(c) unsavoury　　(d) bad

⊙ *(a)* The word 'extravagant' (lacking restraint in spending money or using resources) is best suited in the given context.

56. Socrates was .... of spreading discontent among young men of Athens and of trying to destroy their faith in the old Gods.
(a) rebuked　　(b) disparaged
(c) accused　　(d) demonised

⊙ *(c)* Here, 'accused' (a person or group of people who are charged with or on a trial for a crime) is the best suited word for the given context.

57. The robbers fell ...... amongst themselves over the sharing of the loot.
(a) out　(b) through　(c) off　(d) across

⊙ *(a)* Hurry Fell 'out' is the appropriate usage. Fell out means to have a quarrel.

58. A really sophisticated person would never be .... enough to think that he is always right.
(a) reverent　　(b) naive
(c) articulate　　(d) humble

⊙ *(b)* Here, 'naive' (of a person or action showing a lack of experience or wisdom) is the appropriate usage for the given blank.

59. Speeding and blocking are traffic offences which lead to .... accidents.
(a) troublesome　　(b) final
(c) great　　(d) gruesome

⊙ *(d)* According to the given sentence, 'gruesome' is the most suitable word. 'Gruesome' means causing repulsion or horror or unpleasant.

60. Creative people are often .... with their own uniqueness.
(a) obsessed　　(b) deranged
(c) unbalanced　　(d) dissatisfied

⊙ *(d)* Here, the word 'dissatisfied' (not content or happy with something) makes the sentence meaningful.

61. We must not .... the real and important advances science has made.
(a) oppose　　(b) question
(c) ignore　　(d) doubt

⊙ *(c)* 'ignore' is correct choice here, according to the given context. 'Question' and 'Doubt' an out of context here. Oppose is used to disagree with somebody's belief.

62. These trousers are too long, ... the length please.
(a) diminish　　(b) lessen
(c) curtail　　(d) reduce

⊙ *(d)* Here, 'reduce' is the correct usage with context to 'length'.

63. "What did you think of the film?" "......, I didn't like it very much."
(a) To be honest　　(b) Being honest
(c) To be fair　　(d) In honesty

⊙ *(a)* 'To be honest' is the correct phrase to be used in the given blank and also make the sentence meaningful.

64. He .... in this school since 2010.
(a) studied
(b) was studying
(c) has been studying
(d) has studied

⊙ *(c)* 'has been studying' will show the time reference as the sentence is in Present Perfect Continuous.

65. "His parents died when he was young." "I think that's why he has ...... problems."
(a) to many　　(b) so many
(c) any more　　(d) much more

⊙ *(b)* 'so many' is the correct usage according to the given context.

66. .... if he is willing to fit in with the plans of the group.
(a) There is no objection to him joining the party
(b) There is no objection on his joining the party
(c) There is no objection to his joining the party
(d) There was no objection for his joining the party

⊙ *(c)* 'There is no objection to his joining the party' is the right usage to make the sentence appropriate and meaningful.

67. Having secured the highest marks in the class, ...
(a) the college had offered him a scholarship
(b) he was offered a scholarship by the college
(c) a scholarship was offered him by the college
(d) a college scholarship has been offered to him

⊙ *(b)* As the given sentence is in Passive Voice, so 'he was offered a scholarship by the college' is the right usage.

68. After they .... lunch, the boys ran outside.
(a) have eaten　　(b) had eaten
(c) were eating　　(d) would eat

⊙ *(b)* 'had eaten' will be correct usage in the context of the sentence as the sentence is in past tense.

69. As he was .... and had saved enough money, his family escaped misery when he died suddenly.
(a) prudent　　(b) preparatory
(c) persistent　　(d) providential

⊙ *(a)* 'prudent' is the correct word to be used for the given blank. Prudent means sensible and careful, and its best suited in the given context.

70. Some mysteries remain in desert research: especially relating to why some regions, once fertile, are now ....
(a) blossoming　　(b) cultivable
(c) barren　　(d) irrigated

⊙ *(c)* 'barren' is the appropriate word to be filled in the blank to make the sentence meaningfully complete.

2014 (I)

71. It is necessary to .... that adequate standards are maintained.
(a) insure　　(b) influence
(c) ensure　　(d) control

⊙ *(c)* The correct answer is option (c). 'Ensure' means make certain, so it is the correct word to fit in the sentence.

72. Many of the city's narrow streets have been ....
(a) distinguished
(b) widened
(c) doubled
(d) rehabilitated

⊙ *(b)* The right answer is (b) because the streets were narrow and hence, could be 'widened'.

73. Only the Chairman ...... to the proposal to build more houses.
(a) aboided　　(b) admitted
(c) prevented　　(d) objected

⊙ *(d)* Option (d) is the right option as the preposition 'to' is there, so we have meaningful word i.e. 'objected to'.

74. He hoped to bring the ...... to a satisfactory conclusion.
(a) quarrel　　(b) negotiations
(c) conflicts　　(d) concession

⊙ *(b)* Option (b) is the correct choice because 'negotiations' are brought to a conclusion not conflicts, quarrels and concession.

37

MISCELLANEOUS

Directions (Q. Nos. 1-7) *In this section, a word is spelled in four different ways. You are to identify the one which is correct. Choose the alternative bearing the correct spelling from (a), (b), (c) and (d).*

1. (a) Accommodate   (b) Acomodate
     (c) Accomdate   (d) Acomodait

⊙ *(a)* 'Accommodate' is the correct spelling and it means to make an adjustment to suit a particular purpose.

2. (a) Recommand   (b) Reccommed
     (c) Recommend   (d) Reccomand

⊙ *(c)* 'Recommend' is the correct spelling. The word means to advocate or to suggest that a particular person will be suitable for a job.

3. (a) Argyument   (b) Argument
     (c) Arguement   (d) Argyooment

⊙ *(b)* 'Argument' is the correct spelling. The word means a set of reasons given in support of an idea.

4. (a) Decisive   (b) Desisive
     (c) Descisive   (d) Desicive

⊙ *(a)* 'Decisive' is the correct spelling. The word means able to make decisions quickly.

5. (a) Aggressive   (b) Agresive
     (c) Agressive   (d) Aggresive

⊙ *(a)* 'Aggressive' is the correct spelling. The world means behaving or done in a determined and forceful way.

6. (a) Assassination
     (b) Asassination
     (c) Asasination
     (d) Assasination

⊙ *(a)* 'Assassination' is the correct spelling. The word means the act of killing a prominent person for either political or other reason.

7. (a) Embarassment   (b) Embbarasment
     (c) Embresement   (d) Embarrassment

⊙ *(d)* 'Embarrassment' is the correct spelling. The word means a feeling of self-consciousness, shame or awkwardness.

Directions (Q. Nos. 8-17) *Given below are a few sentences. Identify the part of speech of the underlined word. Choose the response (a), (b), (c), or (d) which is the most appropriate answer.*

8. <u>Rita</u> <u>eats</u> her dinner quicky.
     (a) Verb   (b) Preposition
     (c) Adjective   (d) Adverb

⊙ *(a)* 'Eats' is a verb as it show action.

9. He thought the movie ended <u>abruptly</u>.
     (a) Noun   (b) Adverb
     (c) Verb   (d) Adjective

⊙ *(b)* 'Abruptly' is an adverb, which is modifying the verb 'ended' in the sentence.

10. I will meet you <u>in</u> the third week of August.
     (a) Pronoun   (b) Verb
     (c) Preposition   (d) Noun

⊙ *(c)* 'In' is a simple preposition and used to describe a location, time or place is used as preposition.

11. Jasmines <u>and</u> roses are my favourite flowers.
     (a) Verb   (b) Preposition
     (c) Conjunction   (d) Interjection

⊙ *(c)* 'And' is a conjunction as it joins two subjects.

12. She <u>truthfully</u> answered the detective's questions.
     (a) Verb   (b) Adjective
     (c) Noun   (d) Adverb

⊙ *(d)* Here, the word 'truthfully' is an adverb which is modifying the verb 'answered'.

13. <u>Hurrah</u>! We won the game!
     (a) Interjection   (b) Conjunction
     (c) Noun   (d) Pronoun

⊙ *(a)* The underlined word 'hurrah' is an Interjection or exclamation. In this part of speech, different words show different emotions.

14. The son writes <u>meaningless</u> letters to his father.
     (a) Adverb   (b) Verb
     (c) Pronoun   (d) Adjective

⊙ *(d)* The word meaningless is an 'adjective' that telling more about the noun (letters).

15. The secretary <u>himself</u> visited the affected families.
     (a) Verb   (b) Noun
     (c) Adverb   (d) Pronoun

⊙ *(d)* The word 'himself' is possessive pronoun, used for noun 'secretary'.

16. The children were walking, <u>through</u> the forest.
     (a) Verb   (b) Adverb
     (c) Adjective   (d) Preposition

⊙ *(d)* Here, 'through' is preposition. 'Through' is a simple preposition and can be used with respect to 'by' means of or from one side to another.

17. The Presiding Officer walked <u>slowly</u> to the dais.
     (a) Adverb   (b) Adjective
     (c) Verb   (d) Noun

⊙ *(a)* Slowly is an 'adverb' that modifying the verb 'walked'.

Directions (Q. Nos. 18-23) *Each item in this section has a direct statement followed by its reported form in indirect speech. Select the correct statement in indirect speech and mark it in the answer sheet accordingly.*

18. The captain said to his soldiers, ''Move forward and face the target now.''
(a) The captain ordered his soldiers to move forward and face the target
(b) The captain informed his soldiers that they should move forward and face the target now
(c) The captain asked his soldiers to move forward and face the target then
(d) The captain told his soldiers that they move forward and face the target immediately

⊙ (*a*) The correct sentence (Imperative type) In indirect speech. Here, principle verb is 'ordered' which is correct as a captain orders to his soldiers.

19. Vivek said to his friend, ''Could you please turn off the switch ?''
(a) Vivek told his friend to turn off the switch
(b) Vivek asked his friend to please turn off the switch
(c) Vivek requested his friend to turn off the switch
(d) Vivek told his friend that he should turn off the switch

⊙ (*c*) As the sentence in direct speech is a type of request so, option (c) is the correct statement in indirect speech of the given sentence.

20. The manager said to his colleagues , ''We have received a serious threat to our business now and we need to act to face it.''
(a) The manager told his colleagues that they had received a serious threat to our business then and they needed to act to face it
(b) The manager told his colleagues that they received a serious threat to their business then and they needed to act to face it
(c) The manager said his colleagues that they had received a serious threat to our business then and they needed to act to face it
(d) The manager told his colleagues that they had received a serious threat to their business at that time and they needed to act face it

⊙ (*d*) As the given sentence is in past tense 'have received' will change to 'had received' and 'need' will be changed to 'needed'. Hence, option (d) is the correct answer.

21. Romila said to Rahim, ''Where were your ideas when we faced the troubles last week?''
(a) Romila asked Rahim where his ideas had been when they had faced the trouble the week before
(b) Romila asked Rahim where his ideas had been when they faced the trouble the last week
(c) Romila requested Rahim where his ideas had been when they faced the trouble the week before
(d) Romila told Rahim where his ideas where when they faced the trouble the week before

⊙ (*a*) As sentence is interrogative type, the correct statement in indirect speech with proper tense used in option (a).

22. The actor, said to his co-star, Sarita, ''Will you go with me for a cup of tea in the evening today?''
(a) The actor said to his co-star if she would go for a cup of tea with him in evening today
(b) The actor told his co-star, Sarita if she would go with him for a cup of tea in evening that day
(c) The actor requests his co-star, Sarita if she would go with him for a cup of tea in that evening that day
(d) The actor asked his co-star, Sarita if she would go with him for a cup of tea in the evening that day

⊙ (*d*) As sentence is interrogative type, the correct statement in indirect speech with proper syntax used in option (d).

23. The preacher said to the crowd, ''The Sun rises everyday for all of us without any expectations in return.''
(a) The preacher told the crowd that the Sun rose everyday for all of them without any expectations in return
(b) The preacher told the crowed that the Sun rises everyday for all of us without any expectations in return
(c) The preacher told the crowd that the Sun has risen everyday for all of them without any expectations in return
(d) The preacher told the crowd that the Sun rises everyday for all of them without any expectations in return

⊙ (*d*) The give sentence is a universal truth. So, the correct statement in indirect speech is used in option (d). Hence, option (d) is its correct answer.

Directions (Q. Nos. 24-28) *Each item in this section has a sentence in active voice followed by four sentences one of which is the correct passive voice statement of the same. Select the correct one and mark it in the answer sheet accordingly.*

24. The Members of the Parliament elect their group leader either by consensus or by voice vote.
(a) The group leader is elected by the Members of the Parliament either by consensus or by voice vote
(b) The group leader was elected by the Members of the Parliament either by consensus or by voice vote
(c) The group leader has been elected by the Members of the Parliament either by consensus or by voice vote
(d) The Members of the Parliament are elected by their group leader either by consensus of by voice vote

⊙ (*a*) The given sentence is in simple present tense. So, the correct statement in indirect speech with proper tense used in option (a).

25. All the examinees have answered one particular question in the long answer writing section.
(a) One particular question is answered by all the examinees in the long answer writing section
(b) One particular question was answered by all the examinees in the long answer writing section
(c) All the examinees answered one particular question in the long answer writing section
(d) One particular question has been answered by all the examinees in the long answer writing section

⊙ (*d*) The given sentence is in present perfect tense. So, the correct statement in indirect speech, with proper tense, used in option (d).

26. The writer who passed away recently has authored a dozen novels and a number of poetry collections.
(a) A dozen novels and a number of poetry collections have been authored by the writer who passed away recently
(b) A dozen novels and a number of poetry collections has been authored by the writer who passed away recently

(c) A dozen novels and a number of poetry collections were authored by the writer who passed away recently

(d) A dozen novels and a number of poetry collections had been authored by the writer who passed away recently

⊙ (**a**) Options (a) is the correct sentence in passive voice as the sentence is in present perfect tense.

27. Shut the door.

(a) Shut the door
(b) Let the door be shut
(c) The door be shut
(d) The door is shut

⊙ (**b**) Option (b) is the correct sentence in passive voice as the sentence is imperative. An imperative sentence in passive voice has the following structure Let +object + be + past participle.

28. India won freedom with the blood and sweat of hundreds and thousands of Indians.

(a) India had won freedom with the blood and sweat of hundreds and thousands of Indians

(b) Freedom had been won by India with the blood and sweat of hundreds and thousands of Indians

(c) Freedom was won by India with the blood and sweat of hundreds and thousands of Indians

(d) Freedom was won by hundreds and thousands of Indians with their blood and sweat

⊙ (**c**) Freedom was won by India with the blood and sweat of hundreds and thousands of Indians,' is the correct passive voice of the given sentence. As the given sentence is in past tense so was + V$_3$+by+object should be used.

Directions (Q. Nos. 29-34) *For the expression which has been underlined in each of the following sentences, choose the response (a), (b), (c) or (d) which most nearly expresses its meaning.*

29. The institution decided to given Mrs. Roy's job to her son not because she was a social worker, but because she had <u>died in harness</u>.

(a) die after retirement
(b) died before retirement

(c) died while riding a horse
(d) died for a great cause of die while still at work

⊙ (**b**) 'Died in harness' means. 'Died before retirement'.

30. You ambition should be <u>in consonance with</u> your capabilities.

(a) parallel to
(b) in accordance with
(c) in harmony with
(d) in tune with

⊙ (**b**) 'In consonance with' means in proportion or in accordance with. So, option (b) is its correct answer.

31. I could not go up in life <u>for want of</u> proper guidance.

(a) for lack of
(b) for need of
(c) for the desire of
(d) for the necessity of

⊙ (**a**) 'For lack of' means to lack something that you really need. So, 'for lack of' is the correct answer.

32. Though he was arrogant, I could not <u>dispense with</u> his services.

(a) terminate   (b) align with
(c) claim   (d) disregard with

⊙ (**a**) It you dispense with something. You stop using it or get rid of it completely especially, you, no longer need it. So, 'terminate' is its correct answer.

33. In spite of his work, he was <u>made a scapegoat for</u> the failure of the project.

(a) freed from any responsibility for
(b) suspected of causing
(c) blamed without reason for
(d) was severely punished for

⊙ (**c**) Scapegoat for 'Something' means that people blame them publicly though it was not their fault. So, option (c) is its correct answer.

34. If food supply fails <u>to keep pace with</u> the population, civilisation will collapse.

(a) to grow along with
(b) to walk side by side
(c) to gain momentum
(d) to move at the same speed as

⊙ (**d**) 'To keep pace with' means to go or make progress as the same speed as someone or something else. So, option (d) is its correct answer.

2015 (I)

Directions (Q. Nos. 35-39) *For the expression which has been underlined in each of the following sentences, choose the response (a), (b), (c) or (d) which most nearly expresses its meaning.*

35. Moralists are usually <u>persons who abstain from alcoholic drinks</u>.

(a) Teetotallers   (b) Ascetics
(c) Pedants   (d) Celibates

⊙ (**a**) 'Teetotallers' is a person who never drinks alcohol.

36. The chairman is quick to find fault and <u>is hard to please</u>.

(a) Frivolous   (b) Facetious
(c) Fastidious   (d) Ferocious

⊙ (**c**) Fastidious is one who hard to please or characterised by excessive care or delicacy.

37. Scriptural injunctions should not be <u>opposed or treated with contempt</u>.

(a) Flouted   (b) Flounced
(c) Floundered   (d) Flaunted

⊙ (**a**) 'Flouted' means openly disregard (a rule, law or convention). So, it expresses the most nearly hearing to the underlined expression.

38. <u>A fortress on a commanding height for defense of a city</u> is called

(a) Citadel
(b) Metropolis
(c) Megapolis
(d) Headquarters

⊙ (**a**) 'Citadel' is a fortress that commands a city.

39. <u>Nostalgia</u> is

(a) Anxiety about future
(b) Feeling of insecurity
(c) Longing for a period in the past
(d) An allergy to certain foods

⊙ (**c**) A longing for a period in the past is Nostalgia.

2019 (II)

1. A car undergoes a uniform circular motion. The acceleration of the car is
(a) zero
(b) a non-zero constant
(c) non-zero but not a constant
(d) None of the above

⊙ **(c)** Circular motion is a movement of an object along the circumference of a circle or rotation along a circular path. It can be uniform with constant angular rate of rotation and constant speed or non-uniform with a changing rate of rotation.

Since, the object's velocity vector is constantly changing direction, the moving object is undergoing acceleration by a centripetal force in the direction of the centre of rotation without this acceleration, the object would move in a straight line, according to Newton's laws of motion.

Hence, the acceleration of the car is a non-zero but not a constant.

2. An echo is heard after 5 s of the production of sound which moves with a speed of 340 m/s. What is the distance of the mountain from the source of sound which produced the echo?
(a) 0.085 km   (b) 0.85 km
(c) 0.17 km   (d) 1.7 km

⊙ **(b)** Given, speed of sound = 340 m/s
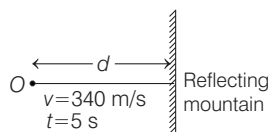
Let the distance of the mountain from the source of sound is d.

To heard echo after 5 s, sound will travel $2d$ distance. Since Echo is repection of sound which is reflected from any surface.

∴ Speed = $\dfrac{\text{Distance}}{\text{Time}}$ ⇒ $340 = \dfrac{2d}{5}$

⇒ $d = 170 \times 5 = 850$ m
          = 0.85 km

3. A 100 W electric bulb is used for 10 h/day. How many units of energy are consumed in 30 days?
(a) 1 unit   (b) 10 units
(c) 30 units   (d) 300 units

⊙ **(c)** Given, power of electric bulb = 100W

Duration used each day = 10h

Number of days = 30

Total energy consumed by the electric bulb = Power × Duration

= 100 × 10 h/day × 30 days

= 30000 = 30 kWh

So, energy consume is 30 units.

4. Rutherford's α-particle scattering experiment on thin gold foil was responsible for the discovery of
(a) electron   (b) proton
(c) atomic nucleus (d) neutron

⊙ **(c)** Rutherford's α-particle scattering experiment leads to the discovery of atomic nucleus. He proposed that, there is a positively charged spherical centre in an atom called nucleus.

5. Magnification is
(a) actual size of specimen/observed size
(b) observed size of specimen/actual size
(c) actual size of specimen-observed size
(d) observed size of specimen actual size

⊙ **(b)** The ratio of the observed size of specimen by a spherical mirror to the size of the actual, is called the **linear magnification** by the spherical mirror, it is denoted by m.

i.e. $m = \dfrac{I}{O}$

where, I = observed size of specimen and O = actual size of the object.

6. Rate of evaporation increases with
(a) an increase of surface area
(b) an increase in humidity
(c) a decrease in wind speed
(d) a decrease of temperature

⊙ **(a)** The evaporation is a surface phenomenon. The rate of evaporation increases on increasing the surface area of the liquid.

A substance that has a larger surface area will evaporate faster, as there are more surface molecules that are able to escape.

7. If an object is at rest, then the time (X-axis) *versus* distance (Y-axis) graph
(a) is vertical
(b) is horizontal
(c) has 45° positive slope
(d) has 45° negative slope

⊙ **(b)** If an object is at rest, then the time-distance graph is as below
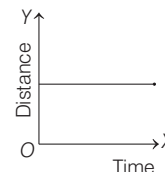
Hence, graph is horizontal.

8. If the speed of a moving magnet inside a coil increases, the electric current in the coil
(a) increases
(b) decreases
(c) reverses
(d) remains the same

⊚ *(a)* If the speed of a moving magnet inside a coil increases, the electric current in the coil increases. Whenever, a magnetic field and an electric conductor move relative to one another, so the conductor crosses lines of force in the magnetic field.

Hence, the current produced by electromagnetic induction is greater.

9. The frequency (in Hz) of a note that is one octave higher than 500 Hz is

(a) 375   (b) 750   (c) 1000   (d) 2000

⊚ *(c)* An octave or perfect octave is the interval between one musical pitch and another with double its frequency.

Hence, option (c) is correct.

10. Soap solution used for cleaning purpose appears cloudy. This is due to the fact that soap micelles can

(a) refract light   (b) scatter light
(c) diffract light   (d) polarise light

⊚ *(b)* Soap solution used for cleaning purpose. When soap is mixed in water, a colloidal solution is formed. The soap solution has soap micelles which are an aggregate of soap molecules.

These micelles are large and they scatter light. That is why the soap solution appears cloudy.

11. People prefer to wear cotton clothes in summer season. This is due to the fact that cotton clothes are

(a) good absorbers of water
(b) good conveyors of heat
(c) good radiators of heat
(d) good absorbers of heat

⊚ *(a)* People prefer to wear cotton clothes in summer season to keep them cool and comfortable.

In summer, we sweat more, cotton being a good absorber of water helps in absorbing the sweat and exposes it to the atmosphere for evaporation.

So, we can say that cotton clothes are good absorbers of water.

2019 (I)

12. Two identical solid pieces, one of gold and other of silver, when immersed completely in water exhibit equal weights. When weighed in air (given that, density of gold is greater than that of silver),

(a) the gold piece will weigh more
(b) the silver piece will weigh more
(c) Both silver and gold pieces weigh equal
(d) weighing will depend on their masses

⊚ *(c)* Since, gold is more denser than silver. But it is given that both pieces have identical and equal weight in water, it means both have equal volume and mass. (May be gold piece hollow inside.)

(As we know, force of gravity is determined by mass and buoyant force is determined by volume)

So, both silver and gold pieces weight equal in air.

13. If the wavelengths corresponding to ultraviolet, visible and infrared radiations are given as $\lambda_{ultraviolet}$, $\lambda_{visible}$ and $\lambda_{infrared}$ respectively, then which one of the following gives the correct relationship among these wavelengths?

(a) $\lambda_{ultraviolet} < \lambda_{infrared} < \lambda_{visible}$
(b) $\lambda_{ultraviolet} > \lambda_{visible} > \lambda_{infrared}$
(c) $\lambda_{ultraviolet} > \lambda_{infrared} > \lambda_{visible}$
(d) $\lambda_{ultraviolet} < \lambda_{visible} < \lambda_{infrared}$

⊚ *(d)* As we know that, infrared light has a lower frequency than visible light and visible light has a lower frequency than ultraviolet light.

i.e. $\nu_{ultraviolet} > \nu_{visible} > \nu_{infrared}$

Since, wavelength of a light is inversely proportional to its frequency, therefore

$$\lambda_{ultraviolet} < \lambda_{visible} < \lambda_{infrared}$$

14. An electron and a proton starting from rest get accelerated through potential difference of 100 kV. The final speeds of the electron and the proton are v_e and v_p, respectively. Which one of the following relation is correct?

(a) $v_e > v_p$
(b) $v_e < v_p$
(c) $v_e = v_p$
(d) Cannot be determined

⊚ *(a)* As we know that,

$$KE = \frac{1}{2}mv^2 = qV$$

For proton and electron, the relation of charge and mass are $q_p = -q_e$

and $m_p = m_e \cdot 1840$

$$v \propto \sqrt{\frac{2qV}{m}}$$

$$\Rightarrow \qquad v \propto \sqrt{\frac{1}{m}}$$

Here, we can see that mass of proton is very high than mass of electron, so $v_e > v_p$.

15. If two vectors **A** and **B** are at an angle $\theta \neq 0°$, then

(a) $|\mathbf{A}| + |\mathbf{B}| = |\mathbf{A} + \mathbf{B}|$
(b) $|\mathbf{A}| + |\mathbf{B}| > |\mathbf{A} + \mathbf{B}|$
(c) $|\mathbf{A}| + |\mathbf{B}| < |\mathbf{A} + \mathbf{B}|$
(d) $|\mathbf{A}| + |\mathbf{B}| = |\mathbf{A} - \mathbf{B}|$

⊚ *(b)* Since, any one side of a triangle is less than the sum of the other two sides individually, so for any two vectors **A** and **B**,

$$|\mathbf{A} + \mathbf{B}| \leq |\mathbf{A}| + |\mathbf{B}|$$

If $\theta \neq 0$, then

$$|\mathbf{A}| + |\mathbf{B}| > |\mathbf{A} + \mathbf{B}|.$$

16. The Hooke's law is valid for

(a) only proportional region of the stress-strain curve
(b) entire stress-strain curve
(c) entire elastic region of the stress-strain curve
(d) elastic as well as plastic region of the stress-strain curve

⊚ *(a)* Hooke's law is valid for only proportional region of the stress-strain curve.

∵ Hooke's law → stress ∝ strain

2018 (II)

17. A particle moves with uniform acceleration along a straight line from rest. The percentage increase in displacement during 6th compared to that in 5th is about

(a) 11%   (b) 22%
(c) 33%   (d) 44%

⊚ *(b)* The particle is moving with uniform acceleration along a straight line from rest.

Displacement during 6th second,

$$\mathbf{s}_{6th} = \mathbf{u} + \frac{1}{2}\mathbf{a}(2n - 1)$$

∵ $n = 6$

$$\mathbf{s}_{6th} = \mathbf{u} + \frac{1}{2}\mathbf{a}(12 - 1)$$

Given, $\mathbf{u} = 0$

So, $\mathbf{s}_{6th} = \mathbf{a}\dfrac{11}{2}$

In 5th second $= \dfrac{1}{2}\mathbf{a}(10 - 1) = \dfrac{9\mathbf{a}}{2}$

$$= \frac{\mathbf{s}_{6th} - \mathbf{s}_{5th}}{\mathbf{s}_{5th}}$$

$$= \frac{\dfrac{11\mathbf{a}}{2} - \dfrac{9\mathbf{a}}{2}}{\dfrac{9\mathbf{a}}{2}} = \frac{2}{9}$$

Percentage change in displacement

$$= \frac{2}{9} \times 100$$

$$= 22.22 \simeq 22\%$$

18. If two miscible liquids of same volume but different densities ρ_1 and ρ_2 are mixed, then the density of the mixture is given by

(a) $\dfrac{\rho_1 + \rho_2}{2}$ (b) $\dfrac{2\rho_1\rho_2}{\rho_1 + \rho_2}$

(c) $\dfrac{2\rho_1\rho_2}{\rho_1 - \rho_2}$ (d) $\dfrac{\rho_1\rho_2}{\rho_1 + \rho_2}$

⊘ **(b)** Density of liquid $A = \rho_1$

Density of liquid $B = \rho_2$

We assume the mass of liquid A or $B = m$

Volume of liquid, $A = \dfrac{m}{\rho_1}$

$$\left[\because \text{Volume} = \dfrac{\text{Mass}}{\text{Density}} \right]$$

Volume of liquid, $B = \dfrac{m}{\rho_2}$

Total volume of the mixture $= \dfrac{m}{\rho_1} + \dfrac{m}{\rho_2}$

Total mass $= m + m = 2m$

Hence, density of mixture $= \dfrac{\text{total mass}}{\text{total volume}}$

$$= \dfrac{2m}{\left(\dfrac{m}{\rho_1} + \dfrac{m}{\rho_2} \right)} = \dfrac{2m}{m \left(\dfrac{1}{\rho_1} + \dfrac{1}{\rho_2} \right)}$$

$$= \dfrac{2}{\left(\dfrac{1}{\rho_1} + \dfrac{1}{\rho_2} \right)} = \dfrac{2}{\left(\dfrac{\rho_2 + \rho_1}{\rho_1\rho_2} \right)}$$

Density of mixture $= \dfrac{2\rho_1\rho_2}{\rho_1 + \rho_2}$

19. The position vector of a particle is $\mathbf{r} = 2t^2\hat{\mathbf{x}} + 3t\hat{\mathbf{y}} + 4\hat{\mathbf{z}}$

Then, the instantaneous velocity $\mathbf{v}$ and acceleration $\mathbf{a}$ respectively lie

(a) on xy-plane and along z-direction
(b) on yz-plane and along x-direction
(c) on yz-plane and along y-direction
(d) on xy-plane and along x-direction

⊘ **(d)** $\mathbf{r} = 2t^2\hat{\mathbf{x}} + 3t\hat{\mathbf{y}} + 4\hat{\mathbf{z}}$

On differentiating both sides, we get
$$\dfrac{d\mathbf{r}}{dt} = \dfrac{d}{dt}(2t^2\hat{\mathbf{x}} + 3t\hat{\mathbf{y}} + 4\hat{\mathbf{z}})$$

Instantaneous velocity, $\mathbf{v} = 4t\hat{\mathbf{x}} + 3\hat{\mathbf{y}}$
Hence, in istantaneous velocity lie on xy-plane.

Instantaneous acceleration, $\mathbf{a} = \dfrac{d\mathbf{v}}{dt}$

$$= \dfrac{d}{dt}(4t\hat{\mathbf{x}} + 3\hat{\mathbf{y}}) = 4\hat{\mathbf{x}}$$

Hence, acceleration lie along x-direction.

20. Two persons are holding a rope of negligible mass horizontally. A 20 kg mass is attached to the rope at the mid-point, as a result, the rope deviates from the horizontal direction. The tension required to completely straighten the rope is
($g = 10$ m/s^2)

(a) 200 N   (b) 20 N
(c) 10 N   (d) infinitely large

⊘ **(a)** Given, $m = 20$ kg
Tension required to completely straighten the rope.
From Newton's second law of motion,

$$F = ma$$
$$F = 20 \times 10$$
($\because$ acceleration a due to gravity
$g = 10$ m/s^2)
$$= 200 \text{ N}$$

21. Which one of the following does not convert electrical energy into light energy?

(a) A candle
(b) A light emitting diode
(c) A laser
(d) A television set

⊘ **(a)** Burning of a candle is a chemical as well as physical change in which chemical energy is converted into heat and light energy.

A light emitting diode, a laser, a television set convert electrical energy into light energy.

22. The visible portion of the electromagnetic spectrum is

(a) infrared   (b) radio wave
(c) microwave   (d) light

⊘ **(d)** The visible portion of the electromagnetic spectrum is light. Visible rays are the most familiar form of electromagnetic waves.

It is the part of the spectrum that is detected by human eyes. It runs from about 4×10^{14} Hz to 7×10^{14} Hz or a wavelength of about 700-400 nm.

Infrared, radio waves, microwaves, etc., are not visible portion of electromagnetic spectrum.

23. When a convex lens produces a real image of an object, the minimum distance between the object and image is equal to

(a) the focal length of the convex lens
(b) twice the focal length of the convex lens
(c) four times the focal length of the convex lens
(d) one-half of the focal length of the convex lens

⊘ **(c)** Let s be the distance of object and image, u be the object distance and f be the focal length of the lens.
Then, the lens formula,

$$\dfrac{1}{u} + \dfrac{1}{s - u} = \dfrac{1}{f}$$

$\Rightarrow$ $f(s - u) + fu - u(s - u) = 0$
$\Rightarrow$ $fs - fu + fu - su + u^2 = 0$
$\Rightarrow$ $fs - su + u^2 = 0$
$\Rightarrow$ $u^2 = (u - f)s$

or $s = \dfrac{u^2}{u - f}$

On differentiating,

$$\dfrac{ds}{du} = \dfrac{(u - f)(2u) - u^2}{(u - f)^2}$$

$$= \dfrac{(u^2 - 2uf)}{(u - f)^2} = \dfrac{u(u - 2f)}{(u - f)^2}$$

$\dfrac{ds}{du} = 0$, when $u (u - 2f) = 0$

$\Rightarrow$ $u = 0$
For real image, $u = 2f$

When $u < 2f, \dfrac{ds}{du} < 0$.

When $u > 2f, \dfrac{ds}{du} > 0$

$u = 2f$ is therefore a minimum. The object and image distances for minimum separation are both $2f$, giving separation $4f$.

24. The direction of magnetic field at any location on the earth's surface is commonly specified in terms of

(a) field declination
(b) field inclination
(c) Both field declination and field inclination
(d) horizontal component of the field

⊘ **(d)** The direction of magnetic field on the earth's surface is termed as horizontal component of the field.

At a place, it is defined as the component of earth's magnetic field along the horizontal in the magnetic meridian. Its value is different at different places.

Field declination is the acute angle between magnetic meridian and geographical meridian at a place.

Inclination is the angle which resultant earth's magnetic field at a place makes with the horizontal surface.

25. A circuit has a fuse having a rating of 5 A. What is the maximum number of 100 W-220 V bulbs that can be safely connected in parallel in the circuit?

(a) 20   (b) 15   (c) 11   (d) 10

⊘ **(c)** Given, $P = 100$ W, (power of 1 bulb)
$$V = 220 \text{ V and } I = 5 \text{ A}.$$

Let x be the maximum number of bulbs that can be safely connected in parallel circuit.

Potential difference, $V = 220$ V

$\therefore$ $\qquad P = VI$

$\qquad 100 \times x = 220 \times 5$

$\Rightarrow \qquad x = \dfrac{220 \times 5}{100} = 11$

26. In which of the following, heat loss is primarily not due to convection?

(a) Boiling water
(b) Land and sea breeze
(c) Circulation of air around blast furnace
(d) Heating of glass surface of a bulb due to current in filament

⊙ **(d)** Convection is the process of heat transfer of the bulk movement of molecules within fluids such as gases and liquids.

In this process, the heat transfers is by the actual motion of matter. It happens in liquid and gases.

Boiling water, land and sea breeze, circulation of air around blast furnace, etc., are the example of convection. Whereas heating of glass surface of a bulb due to current in filament occurs due to conduction of heat.

2018 (I)

27. Which of the following represents a relation for 'heat lost = heat gained'?

(a) Principle of thermal equilibrium
(b) Principle of colours
(c) Principle of calorimetry
(d) Principle of vaporisation

⊙ **(c)** 'Heat Lost=Heat gained' represents the relation of principle of calorimetry.

According to this principle, if two substances of different temperatures are brought in contact with each other, then heat flows from the substance at higher temperatures to the substances at lower temperatures, till their temperature become equal (equilibrium state).

This principle is based on the law of conservation of energy.

28. Two metallic wires made from copper have same length but the radius of wire 1 is half of that of wire 2. The resistance of wire 1 is R. If both the wires are joined together in series, the total resistance becomes

(a) $2R$

(b) $\dfrac{R}{2}$

(c) $\dfrac{5}{4}R$

(d) $\dfrac{3}{4}R$

⊙ **(c)** As, $R = \rho \cdot \dfrac{l}{A}$ and $A = \pi r^2$

$\therefore \qquad R = \rho \dfrac{l}{\pi r^2}$

Let r is radius of first wire.

$\therefore \qquad R_1 = \rho \dfrac{l}{\pi r^2} = R$

For second wire, radius $= 2r$

$\therefore \qquad R_2 = \rho \dfrac{l}{4\pi r^2} = \dfrac{R}{4}$

From question, both the wires are joined together in series, the total resistance becomes

$\qquad R_{eq} = R_1 + R_2$

$\qquad = R + \dfrac{R}{4} = \dfrac{5}{4}R$

29. When the sun is near the horizon during the morning or evening, it appears reddish. The phenomenon that is responsible for this observation is

(a) reflection of light
(b) refraction of light
(c) dispersion of light
(d) scattering of light

⊙ **(d)** When the sun is near the horizon during the morning or evening, it appears reddish due to the scattering of light from the sun near the horizon. It passes through thicker layers of air and covers larger distance in the atmosphere before reaching our eyes. Near the horizon, most of the blue light and shorter wavelengths are scattered away.

30. A wire of copper having length l and area of cross-section A is taken and a current I is flown through it. The power dissipated in the wire is P. If we take an aluminium wire having same dimensions and pass the same current through it, the power dissipated will be

(a) P

(b) $< P$

(c) $> P$

(d) $2P$

⊙ **(c)** $\therefore R = \rho \cdot \dfrac{l}{A}$

where, ρ is a constant called resistivity or specific resistivity.

Power $P = I^2 \cdot R = I^2 \cdot \rho \dfrac{l}{A}$

So, $\quad P \propto \rho$

$\therefore \quad \dfrac{P_{Cu}}{P_{Al}} = \dfrac{\rho_{Cu}}{\rho_{Al}}, \ \rho_{Cu} < \rho_{Al}$

$\therefore \quad P_{Al} > P$ (power)

31. The pressure of a fluid varies with depth h as $p = p_0 + \rho g h$, where ρ is the fluid density. This expression is associated with

(a) Pascal's law
(b) Newton's law
(c) Bernoulli's principle
(d) Archimedes' principle

⊙ **(a)** Pascal's law

$\qquad p_{absolute} = p_{gauge} + p_{atmospheric}$

$\qquad p = p_0 + \rho g h$

i.e. Pressure of fluid varies with depth h can expressed by above equation.

32. Why is argon gas used along with tungsten wire in an electric bulb?

(a) To increase the life of the bulb
(b) To reduce the consumption of electricity
(c) To make the emitted light coloured
(d) To reduce the cost of the bulb

⊙ **(a)** Argon being an inert gas used in electric bulb to increase the life of the bulb. It prevents the tungsten filaments from descend too quickly.

33. Which one of the following is the correct relation between the Kelvin temperature T and the Celsius temperature t_C?

(a) These are two independent temperature scales
(b) $T = t_C$
(c) $T = t_C - 273.15$
(d) $T = t_C + 273.15$

⊙ **(d)** To change a temperature from Kelvin scale to the Celsius scale, you have to subtract 273.15 from the given temperature and to convert a temperature from Celsius scale to the Kelvin scale, you have to add 273.15 to the given temperature.

Hence, the correct relation is

$\qquad T = t_C + 273.15$

34. Sound waves cannot travel through a

(a) copper wire placed in air
(b) silver slab placed in air
(c) glass prism placed in water
(d) wooden hollow pipe placed in vacuum

⊙ **(d)** Sound waves cannot travel in vacuum, it need a material medium to propagate. Hence, it cannot passes through the wooden hollow pipe placed in vacuum.

35. Which one of the following is the value of 1 nanometre?

(a) 10^{-7} cm

(b) 10^{-6} cm

(c) 10^{-4} cm

(d) 10^{-3} cm

⊙ *(a)* 1 nanometre = 10^{-9} metre

$\quad\quad\quad\quad = 1 \times 10^{-7}$ centimetre.

Its unit of length.

36. Consider the following statements.

1. There is no net moment on a body which is in equilibrium.
2. The momentum of a body is always conserved.
3. The kinetic energy of an object is always conserved.

Which of the statement(s) given above is/are correct?

(a) All of these   (b) 2 and 3
(c) 1 and 2   (d) Only 1

⊙ *(c)* Kinetic energy is the energy possessed by an object due to its motion. The kinetic energy of an object increases with its speed. The only kinetic energy of an object cannot be conserved but the sum of kinetic and potential energies is conserved. The momentum of a body is always conserved due to conservation of momentum.

When a body is in equilibrium, there is no net moment present in it.

Hence, option (c) is correct.

37. Working of safety fuses depends upon

1. magnetic effect of the current
2. chemical effect of the current
3. magnitude of the current
4. heating effect of the current

Select the correct answer using the code given below.

(a) All of these   (b) 1, 2 and 3
(c) 3 and 4   (d) Only 4

⊙ *(c)* Working of safety fuses depends upon magnitude of the current and heating effect of the current.

Hence, option (c) is correct.

2017 (II)

38. An electron and a proton starting from rest are accelerated through a potential difference of 1000 V. Which one of the following statements in this regard is correct?

(a) The kinetic energy of both the particles will be different.
(b) The speed of the electron will be higher than that of the proton.
(c) The speed of the proton will be higher than that of the electron.
(d) The speed of the electron and the proton will be equal.

⊙ *(b)* After starting from rest, kinetic energy of electron,

$$K_e = e(1000) = \frac{1}{2} m_e v_e^2$$

Kinetic energy of proton,

$$K_p = e(1000) = \frac{1}{2} m_p v_p^2$$

$\therefore \quad\quad K_e = K_p$

$\Rightarrow \quad m_e v_e^2 = m_p v_p^2$

$\Rightarrow \quad \dfrac{v_p}{v_e} = \sqrt{\dfrac{m_e}{m_p}} < 1 \quad\quad [\because m_p > m_e]$

$\Rightarrow \quad\quad v_p < v_e$

Therefore, speed of the electron will be higher than that of the proton.

39. Two wires are made having same length l and area of cross-section A. Wire 1 is made of copper and wire 2 is made of aluminium. It is given that the electrical conductivity of copper is more than that of aluminium. In this context, which one of the following statements is correct?

(a) The resistance of wire 1 will be higher than that of wire 2.
(b) The resistance of wire 2 will be higher than that of wire 1.
(c) The resistance of both the wires will be the same.
(d) If same current is flown through both the wires, the power dissipated in both the wires will be the same.

⊙ *(b)* Resistance of wire,

$$R = \rho \frac{l}{A}$$

where, ρ = resistivity, l = length and A = area of cross-section.

Resistance of aluminium wire ,

$$R_{Al} = \rho_{Al} \frac{l}{A}$$

Resistance of copper wire,

$$R_{Cu} = \rho_{Cu} \frac{l}{A} \Rightarrow \frac{R_{Al}}{R_{Cu}} = \frac{\rho_{Al}}{\rho_{Cu}}$$

As conductivity $\sigma = \dfrac{1}{\text{Resistivity}}$

Given, $\quad \sigma_{Cu} > \sigma_{Al} \Rightarrow \rho_{Cu} < \rho_{Al}$

$\therefore \quad\quad \dfrac{R_{Al}}{R_{Cu}} > 1$

$\Rightarrow \quad\quad R_{Al} > R_{Cu}$

$\Rightarrow \quad\quad R_2 > R_1$

Hence, the resistance of wire 2 will be higher than that of wire 1.

40. A ray of light is incident on a plane mirror at an angle of 40° with respect to surface normal. When it gets reflected from the mirror, it undergoes a deviation of

(a) 40°   (b) 100°

(c) 90°   (d) 80°

⊙ *(b)* A ray of light is incident on a plane mirror as shown in figure.
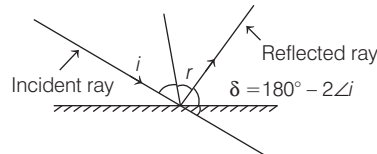
$\therefore \quad\quad \angle i = \angle r = 40°$

Therefore, deviation,

$\quad\quad \delta = 180° - 2\angle i$

$\quad\quad\quad = 180° - 2 \times 40°$

$\quad\quad\quad = 180° - 80° = 100°$

41. Infrared, visible and ultraviolet radiations/light have different properties. Which one of the following statements related to these radiations/light is not correct?

(a) The wavelength of infrared is more than that of ultraviolet radiation.
(b) The wavelength of ultraviolet is smaller than that of visible light.
(c) The photon energy of visible light is more than that of infrared light.
(d) The photon energy of ultraviolet is less than that of visible light.

⊙ *(c)* Wavelength of visible light lies in the range of 400 nm to 700 nm. Wavelength of a infrared light lies in the range of 10^3 nm to 10^6 nm. As energy is inversely proportional to the wavelength. Hence, photon energy of visible light is less than that of infrared light.

42. After using for some time, big transformers get heated up. This is due to the fact that

1. current produces heat in the transformers.
2. hysteresis loss occurs in the transformers.
3. liquid used for cooling gets heated.

Select the correct answer using the codes given below.

(a) Only 1   (b) 2 and 3
(c) 1 and 2   (d) 1, 2 and 3

⊙ *(c)* The transformers get heated up due to the following reasons :

(i) The current flowing through the wire of resistance (R) produces a heat $(I^2 R)$.

(ii) The magnetisation of the core produces heat due to hysteresis loss.

Transformer oil or insulating oil that, is stable at high temperatures and has excellent electrical insulating properties are used as coolant.

43. A person is standing on a frictionless horizontal ground. How can he move by a certain distance on this ground?

(a) By sneezing
(b) By jumping
(c) By running
(d) By rolling

⊙ **(a)** A person is standing on a frictionless horizontal ground can move by a certain distance on this ground due to reaction caused by sneezing.

The person cannot run, jump or roll on the frictionless surface.

44. Joule-Thomson process is extremely useful and economical for attaining low temperature. The process can be categorised as

(a) isobaric process
(b) isoenthalpic process
(c) adiabatic process
(d) isochoric process

⊙ **(c)** In Joule-Thomson process, the temperature remains low. Thus, heat content of the process can be taken as constant. Therefore, the process can be categorised as **adiabatic** process.

45. Ultrasonic waves are produced by making use of

(a) ferromagnetic material
(b) ferrimagnetic material
(c) piezoelectric material
(d) pyroelectrical material

⊙ **(c) Piezoelectric effect** is used in the production of ultrasonic sound waves. Therefore, piezoelectric material, i.e. compound of sodium or potassium can be utilised for the production of ultrasonic waves.

46. A person throws an object on a horizontal frictionless plane surface. It is noticed that, there are two forces acting on this object – (i) gravitational pull and (ii) normal reaction of the surface. According to the third law of motion, the net resultant force is zero. Which one of the following can be said for the motion of the objects ?

(a) The object will move with acceleration.
(b) The object will move with deceleration.
(c) The object will move with constant speed but varying direction.
(d) The object will move with constant velocity.

⊙ **(d)** Two forces acting on the object are gravitational pull of the earth and the normal reaction of the surface. These forces are equal in magnitude and opposite in directions.
Thus, net force on the object is zero and the object will move with constant velocity.

47. Consider the following statements :

1. The chain reaction process is used in nuclear bombs to release a vast amount of energy, but in nuclear reactors, there is no chain reaction.
2. In a nuclear reactor, the reaction is controlled, while in nuclear bombs, the reaction is uncontrolled.
3. In a nuclear reactor, all operating reactors are 'critical', while there is no question of 'critically' in case of a nuclear bomb.
4. Nuclear reactors do not use moderators, while nuclear bombs use them.

Which of the above statements about operational principles of a nuclear reactor and a nuclear bomb is/are correct?

(a) 1 and 3
(b) 2 and 3
(c) 4 only
(d) 1 and 4

⊙ **(b)** Chain reaction is the principle of nuclear reactors, while uncontrolled chain reaction is the principle of atom bomb.

In nuclear reactor, the reaction is controlled by control material like as cadmium rod or moderator.

In a nuclear reactor, all operating reactors are critical, while there is no question of critically in case of a nuclear bomb.

Hence, statements 2 are 3 are correct.

2017 (I)

48. When a piece of pure silicon is doped with aluminium, then

(a) the conductivity of the doped silicon piece will remain the same
(b) the doped silicon piece will become n-type
(c) the doped silicon piece will become p-type
(d) the resistivity of the doped silicon piece will increase

⊙ **(c)** The aluminium atom has three electrons in its outer shell, which is one

less than needed to form valence bonds with four nearby silicon atoms.

So, one covalent bond with Si-atom is left incomplete due to deficiency of one electron because of this a p-type semiconductor is formed.

This type of semiconductor, hence formed by doping of **trivalent impurity** atoms, i.e. Al is known as p-type semiconductor.

49. Suppose voltage V is applied across a resistance R. The power dissipated in the resistance is P. Now, the same voltage V is applied across a parallel combination of three equal resistors each of resistance R. Then, the power dissipated in the second case will be

(a) P
(b) $3P$
(c) $P/3$
(d) $2P/3$

⊙ **(b)** For parallel combinations,

$$1/R_{eq} = 1/R + 1/R + 1/R = 3/R$$
$$R_{eq} = R/3$$
$$\text{Power, } P = \frac{V^2}{R_{eq}} = 3\frac{V^2}{R} = 3P$$
$$\left[\because \text{Power, } P = \frac{V^2}{R} \right]$$

50. Which one of the following is not a semiconductor?

(a) Silicon
(b) Germanium
(c) Quartz
(d) Gallium arsenide

⊙ **(c)** A semiconductor means a solid substance that allows heat or electricity to pass through it in particular conditions. Here, Si, Ge, GaAs (Gallium arsenide) are semiconductors

while quartz is the second most abundant mineral in earth's continental crust, after feldspar. Its crystal structure is a continuous framework of SiO_4 (silicon- oxygen tetrahedra) with each oxygen being shared between two tetrahedra, giving the overall chemical formula of SiO_2.

51. A parallel plate capacitor, with air in between the plates, has capacitance C. Now, the space between the two plates of the capacitor is filled with a dielectric of dielectric constant 7. Then, the value of the capacitance will become

(a) C
(b) $C/7$
(c) $7C$
(d) $14C$

⊙ **(c)** The following equation is used to measure the capacitance C of a capacitor,

$$C = Q/V \text{ and } C = \frac{\varepsilon_0 KA}{d}$$

where, K = dielectric constant,
A = area of each plate
and d = distance between the plates.

For air, $K = 1$

$\Rightarrow$ Capacitance, $C = \dfrac{\varepsilon_0 A}{d}$ ...(i)

If the space between the two plates of the capacitor is filled with a dielectric of dielectric constant, $K = 7$, then

Capacitance, $C' = \dfrac{7\varepsilon_0 A}{d}$

$\Rightarrow C' = 7C$ [$\because$ using Eq. (i)]

52. For which one of the following does the centre of mass lie outside the body?
(a) A fountain pen   (b) A cricket ball
(c) A ring   (d) A book

$\odot$ *(c)* The centre of mass of a rigid body is a point at a fixed position with respect to the body, where whole mass of the body is supposed to be concentrated. For a ring, the centre of mass lies at the geometrical centre, where there is no matter, so it lies outside.

53. Consider the electromagnetic radiations having wavelengths 200 nm, 500 nm and 1000 nm. Which of the following wavelength(s) can make visual sensation to a human eye?
(a) 200 nm and 500 nm
(b) 500 nm and 1000 nm
(c) 500 nm
(d) 200 nm and 1000 nm

$\odot$ *(c)* Visible light is the light that we can see and helps us to see things around us. The range of visible wavelengths is 400 to 700 nm. So, wavelength 500 nm lies in visible region.

54. A copper wire of radius r and length l has a resistance of R. A second copper wire with radius $2r$ and length l is taken and the two wires are joined in a parallel combination. The resultant resistance of the parallel combination of the two wires will be

(a) $5R$ (b) $\dfrac{5}{4}R$

(c) $\dfrac{4}{5}R$ (d) $\dfrac{R}{5}$

$\odot$ *(d)* Resistance of wire is given by

$R = \rho \dfrac{l}{\pi r^2}$

where, ρ = resistivity of the wire,
l = length of the wire
and r = radius of the wire.

So, for the first wire,

$R_1 \propto \dfrac{1}{r^2}$ $\left[\because R_1 = \rho \dfrac{l}{\pi r^2} = R \right]$ ...(i)

Resistance of second wire is given by

$R_2 = \rho \dfrac{l}{\pi (2r)^2}$

i.e, $R_2 \propto \dfrac{1}{4r^2}$ ...(ii)

Dividing Eq. (ii) by Eq. (i), we get

$\Rightarrow \dfrac{R_2}{R_1} = \dfrac{1/4r^2}{1/r^2} = \dfrac{1}{4}$

$\Rightarrow R_2 = \dfrac{R_1}{4}$ ...(iii)

When the 2 wires are connected in parallel, the equivalent resistance is

$\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$

$\Rightarrow \dfrac{1}{R_{eq}} = \dfrac{R_2 + R_1}{R_1 R_2}$

$\Rightarrow R_{eq} = \dfrac{R_1 \times R_2}{R_1 + R_2} = \dfrac{R \times R/4}{R + R/4} = \dfrac{R}{5}$

($\because$ using Eq. (iii) and $R_1 = R$)

55. A parallel plate capacitor of capacitance C_1 is made using two gold plates. Another parallel plate capacitor of capacitance C_2 is made using two aluminium plates with same plate separation and all the four plates are of same area. If ρ_g and ρ_a are respectively the electrical resistivities of gold and aluminium, then which one of the following relations is correct?

(a) $C_1 > C_2$ (b) $C_2 > C_1$

(c) $C_1 \rho_g = C_2 \rho_a$ (d) $C_1 = C_2$

$\odot$ *(d)* Capacitance of parallel plate capacitor is given by, $C = \dfrac{\varepsilon_0 A}{d}$

where, ε_0 = permittivity of free space,
A = area of cross-section of the plates
and d = distance of separation between the plates.

$A_1 = A_2$ and $d_1 = d_2$ [given]

$\Rightarrow C_1 = C_2$

Therefore, the capacitance of parallel plate capacitor does not depends on the material of the plate.

56. A photon of X-ray has energy of 1 keV. A photon of visible radiation has energy of 3 eV. In this context, which one of the following statement(s) is/are not correct?
(a) The wavelength of X-ray photon is less than the wavelength of visible radiation photon.

(b) Both the photons have different energies.
(c) The speeds of both the photons in vacuum are different.
(d) The frequency of X-ray photon is higher than the frequency of visible radiation photon.

$\odot$ *(c)* In physics, electromagnetic radiation (EM radiation or EMR) refers to the waves (or their quanta, photons) of the electromagnetic field, propagating (radiating) through space carrying electromagnetic radiant energy.

Electromagnetic radiation consists of electromagnetic waves, which are synchronised oscillations of electric and magnetic fields that propagate at the speed of light through a vacuum. Hence, speeds of a photon of energy 1 keV and another photon of energy 3eV are same in vacuum. Frequency of X-ray photon is higher than any other photon.

Hence, option (c) is incorrect.

57. The optical phenomenon that is primarily responsible for the observation of rainbow on a rainy day is
(a) diffraction   (b) interference
(c) dispersion   (d) reflection

$\odot$ *(c)* One of nature's most splendid masterpieces is the rainbow. A rainbow is an excellent demonstration of the dispersion of light and one more piece of evidence that visible light is composed of a spectrum of wavelengths, each associated with a distinct colour.

Hence, option (c) is correct.

58. Which one of the following statement(s) is/are not correct?
(a) The cathode rays originate from cathode and proceed towards the anode in a cathode ray discharge tube.
(b) The television picture tubes are nothing but cathode ray tubes.
(c) The cathode rays themselves are not visible.
(d) The characteristics of cathode rays depend upon the nature of the gas present in the cathode ray tube.

$\odot$ *(d)* Cathode ray tube is a vacuum tube that contains one or more electron guns and a phosphorescent screen and is used to display images. It modulates, accelerates and defects electron beam on to the screen to create the images. The characteristics of cathode rays does not depend upon the nature of the gas present in the cathode ray tube. Since, it is consist of accelerated electron.

59. In total internal reflection, the light travels from

(a) rarer to denser medium and it occurs with no loss of intensity
(b) denser to rarer medium and it occurs with no loss of intensity
(c) rarer to denser medium and it occurs with loss of intensity
(d) denser to rarer medium and it occurs with loss of intensity

⊙ **(d)** In total internal reflection, light travels from an optically denser medium to a rarer medium at the interface. It is partly reflected back into the same medium and partly refracted back to the second medium. The intensity of the reflected and refracted rays do not remain constant but reflection occurs with loss of intensity.

60. The energy of a photon, whose momentum is 10 MeV/c, where c is the speed of light, is given by

(a) 10 MeV (b) 100 MeV
(c) 1 MeV (d) 0.1 MeV

⊙ **(a)** Momentum of the photon is given by
$$p = 10 \text{ MeV}/c$$
∴ Energy of photon,
$$E = pc = \left(\frac{10 \text{ MeV}}{c}\right)c = 10 \text{ MeV}$$

61. Light travels in a straight line (rectilinear propagation of light). This statement does hold, if the medium of travel for light is

(a) of variable refractive index
(b) made up of slabs of different refractive indice
(c) homogeneous and transparent
(d) inhomogeneous and transparent

⊙ **(c)** Rectilinear propagation means that, light travels in a straight line. Formation of shadows and eclipses are the direct consequences of rectilinear propagation. In a homogeneous and transparent, medium light travels in a straight line and this is known as rectilinear propagation of light.
Hence, option (c) is correct.

62. The spring constant of a spring depends on its

(a) length only
(b) material only
(c) length and its diameter
(d) thickness, its diameter and its material

⊙ **(d)** The spring constant of a spring depends on material of the spring. It also depends upon thickness, length as well as its diameter.
Hence, option (d) is correct.

63. The pressure exerted by a 760 mm column of mercury at 0°C is known as

(a) 1 pascal (b) 1 atm
(c) 1 bar (d) 1 poise

⊙ **(b)** The value of atmospheric pressure on the surface of earth at sea level, is called one atmosphere (1 atm) and is nearly equal to $1.013 \times 10^5 \text{ N/m}^2$.
Atmospheric pressure is also called barometer pressure. One atm is the pressure exerted by a 760 mm column of mercury at 0°C.

64. Which one of the following statement(s) is/are not correct?

(a) The response of the ear to sound of increasing intensity is approximately logarithmic.
(b) The sensitivity of the human ear does not vary with the frequency of the sound.
(c) When two or more waves traverse the same medium, the displacement of any element of the medium is the algebraic sum of the displacements due to each wave.
(d) Longitudinal waves can travel in all media; solids, liquids and gases.

⊙ **(b)** The sensitivity of the human ear depends upon the frequency of sound. It is most sensitive in the frequency range 20 Hz to 20000 Hz.
Hence, option (b) is correct.

65. In a bi-polar junction transistor,

(a) all the three regions (the emitter, the base and the collector) have equal concentrations of impurity
(b) the emitter has the least concentration of impurity
(c) the collector has the least concentration of impurity
(d) the base has the least concentration of impurity

⊙ **(d)** A junction transistor is three-terminal semiconductor device consisting of two p-n junctions formed by placing a thin layer of doped semiconductor (p-type or n-type) between two thick similar layers of opposite type.
A transistor has three doped regions forming two p-n junctions between them. Hence, in a bi-polar junction transistor, the base has the least concentration of impurity.

2016 (I)

66. The rate of change of momentum of a body is equal to the resultant

(a) energy (b) power (c) force (d) impulse

⊙ **(c)** According to the statement of Newton's second law, $F_{ext} = \dfrac{d\mathbf{p}}{dt} = m\mathbf{a}$
where,
$\mathbf{F}_{ext}$ = resultant force on the body,
$\dfrac{d\mathbf{p}}{dt}$ = rate of change of momentum,
m = mass of the body
and $\mathbf{a}$ = acceleration of the body.
Therefore, the rate of change of momentum of a body is equal to the resultant force acting on the body.
Hence, option (c) is correct.

67. The SI unit of mechanical energy is

(a) joule
(b) watt
(c) newton-second
(d) joule-second

⊙ **(a)** The sum of kinetic energy and potential energy is called mechanical energy,
i.e.   ME = KE + PE
So, SI unit of mechanical energy is joule.

68. Two systems are said to be in thermal equilibrium, if and only if

(a) there can be a heat flow between them even, if they are at different temperatures
(b) there cannot be a heat flow between them even, if they are at different temperatures
(c) there is no heat flow between them
(d) their temperatures are slightly different

⊙ **(c)** Two systems are said to be in thermal equilibrium, if there is no flow of heat between them when they are brought into thermal contact. If there is a temperature difference between them, then the flow of heat will be there, till it reaches to the same temperature.
Hence, option (c) is correct.

69. Which one of the following statements is correct? The velocity of sound

(a) does not depend upon the nature of media
(b) is maximum in gases and minimum in liquids
(c) is maximum in solids and minimum in liquids
(d) is maximum in solids and minimum in gases

⊙ **(d)** The velocity of sound depends upon the nature of medium. The speeds of sound in air, water and steel at 0°C are

Medium	Speed (m/s)
Air	331
Water	1450
Steel	5000

Therefore, velocity of sound is maximum in solids and minimum in gases.

70. Which one of the following statements is not correct?

(a) Sound waves in gases are longitudinal in nature.
(b) Sound waves having frequency below 20 Hz are known as ultrasonic waves.
(c) Sound waves having higher amplitudes are louder.
(d) Sound waves with high audible frequencies are sharp.

⊙ (*b*) Sound waves of frequency less than 20 Hz is known as infrasonic sound or infrasound.

Sound waves of frequency greater than 20 kHz is known as ultrasonic sound or ultrasound.

Sound waves are longitudinal waves. Higher amplitude sound waves are louder, whereas high frequency sound waves are sharp.

71. A myopic person has a power of – 1.25 D. What is the focal length and nature of his lens?

(a) 50 cm and convex lens
(b) 80 cm and convex lens
(c) 50 cm and concave lens
(d) – 80 cm and concave lens

⊙ (*d*) Power of lens, $P = \dfrac{1}{f}$

Here, $P = -1.25$ D

∴ $P = \dfrac{1}{f} \Rightarrow f = \dfrac{1}{P} = \dfrac{-1}{1.25} = \dfrac{-4}{5}$ m

⇒ $f = -\dfrac{4}{5} \times 100$ cm $= -80$ cm

or $f = -80$ cm

Since, focal length of the lens is negative, so the lens is concave in nature.

72. Which one of the following statements about bar magnet is correct?

(a) The pole strength of the North pole of a bar magnet is larger than that of the South pole.
(b) When a piece of bar magnet is bisected perpendicular to its axis, the North and South poles get separated.
(c) When a piece of bar magnet is bisected perpendicular to its axis, two new bar magnets are formed.

(d) The poles of a bar magnet are unequal in magnitude and opposite in nature.

⊙ (*c*) Bar magnet has equal and opposite magnitude at their poles. When a bar magnet is bisected perpendicular to its axis, it always create a new bar magnet. The poles of bar magnet can never be separated to each other.

73. A person rings, a metallic bell near a strong concrete wall. He hears the echo after 0.3 s. If the sound moves with a speed of 340 m/s, how far is the wall from him?

(a) 102 m   (b) 11 m
(c) 51 m   (d) 30 m

⊙ (*c*) The sound that is heard after the first ring is due to reflection of sound at the surface of wall is called **echo**.

Total distance travelled by sound in going to the surface and back
= Speed × Time

So, the distance of the wall (surface) from the sound source

$= \dfrac{1}{2} \times$ Speed × Time

$= \dfrac{1}{2} \times 340 \times 0.3 = 51$ m

Hence, option (c) is correct.

2015 (II)

74. A body is falling freely under the action of gravity alone in vacuum. Which one of the following remains constant during the fall?

(a) Potential energy
(b) Kinetic energy
(c) Total linear momentum
(d) Total mechanical energy

⊙ (*d*) During the free fall of a body under the action of gravity of earth, total mechanical energy always remains constant.

Total mechanical energy = Kinetic energy + Potential energy

$\dfrac{1}{2}mv^2 + mgh =$ constant

75. X-rays are

(a) deflected by an electric field but not by a magnetic field
(b) deflected by a magnetic field but not by an electric field
(c) deflected by both a magnetic field and an electric field
(d) not deflected by an electric field and a magnetic field

⊙ (*d*) Since, X-ray is a high energy photons, which don't carry any charge. So, it is not deflected by an electric field and a magnetic field.

76. The focal length of the lens of a normal human eye is about

(a) 25 cm (b) 1 m (c) 2.5 mm (d) 2.5 cm

⊙ (*d*) The focal length or the distance from the corner of the retina of a normal relaxed eye is about 1.7 cm and 2.3 cm. So, the nearest value of the given option is 2.5 cm.

77. Which one of the following physical quantities is the same for molecules of all gases at a given temperature?

(a) Speed   (b) Mass
(c) Kinetic energy (d) Momentum

⊙ (*c*) According to kinetic theory of gases, for molecules of all gases at a given temperature have the same average kinetic energy.

78. Newton's laws of motion do not hold good for objects

(a) at rest
(b) moving slowly
(c) moving with high velocity
(d) moving with velocity comparable to velocity of light

⊙ (*d*) Newton's laws of motion do not hold good for objects moving with velocity comparable to velocity of light as there is a change in mass of body.

79. Which one of the following statements is not correct?

(a) Weight of a body is different on different planets.
(b) Mass of a body on the earth, on the moon and in empty space is the same.
(c) Weightlessness of a body occurs when the gravitational forces acting on it is counter-balanced.
(d) Weight and mass of a body are equal at sea level on the surface of the earth.

⊙ (*d*) Weight and mass of a body are not equal at sea level on the surface of the earth, because mass is the total content of the body and weight is the force of attraction by which centre of earth attract any mass.

Hence, option (d) is correct.

80. A brick is thrown vertically from an aircraft flying 2 km above the earth. The brick will fall with a

(a) constant speed
(b) constant velocity
(c) constant acceleration

(d) constant speed for sometime, then with constant acceleration as it nears the earth

⊙ *(c)* During free fall of a body, the physical quantity which remains constant is acceleration due to gravity *g* of the earth, which remains constant in magnitude and directed towards the centre of earth.

81. The outside rear view mirror of modern automobiles is marked with warning 'objects in mirror are closer than they appear'. Such mirrors are

(a) plane mirrors
(b) concave mirrors with very large focal lengths
(c) concave mirrors with very small focal lengths
(d) convex mirrors

⊙ *(d)* The outside rear view mirror of modern automobiles are made up of convex mirror. So that, it can give wider field of view. Since, this type of mirror forms diminished, virtual image in between focus and pole of the mirror and smaller appearing objects seem farther away than they actually are. So, it is written that 'objects in the mirror are closer than they appear'.

2015 (I)

82. In respect of the difference of the gravitational force from electric and magnetic forces, which one of the following statements is true?

(a) Gravitational force is stronger than the other two.
(b) Gravitational force is attractive only, whereas the electric and the magnetic forces are attractive as well as repulsive.
(c) Gravitational force has a very short range.
(d) Gravitational force is a long range force, while the other two are short range forces.

⊙ *(b)* As we know that, gravitational force is always attractive in nature and given by

$$\frac{Gm_1m_2}{r^2}$$

where, G = gravitational constant.

whereas electric force may be attractive or repulsive depending upon the nature of charge. Similarly, magnetic force is also attractive or repulsive depending on the nature of poles of the magnet.

83. Creation of something from nothing is against the law of

(a) constant proportions
(b) conservation of mass-energy
(c) multiple proportions
(d) conservation of momentum

⊙ *(b)* Every object in the universe possess mass. If there is no mass, then object does not exist. Also, as per law of conservation of energy, energy can neither be created nor be destroyed.

It can only be transferred from one form to another.

Hence, creating of something from nothing is against conservation of mass-energy.

84. An electron and a proton are circulating with same speed in circular paths of equal radius. Which one among the following will happen, if the mass of a proton is about 2000 times that of an electron?

(a) The centripetal force required by the electron is about 2000 times more than that required by the proton
(b) The centripetal force required by the proton is about 2000 times more than that required by the electron
(c) No centripetal force is required for any charged particle
(d) Equal centripetal force acts on both the particles as they rotate in the same circular path

⊙ *(b)* According to question, $m_p = 2000m_e$

Centripetal force for electron, $F_e = \dfrac{m_e v^2}{r}$

Centripetal force for proton,

$$F_p = \frac{m_p v^2}{r} \Rightarrow \frac{F_e}{F_p} = \frac{m_e}{m_p}$$

So, $\dfrac{F_e}{F_p} = \dfrac{m_e}{2000 m_e} \Rightarrow F_p = 2000 F_e$

85. An object is raised to a height of 3 m from the ground. It is then allowed to fall on to a table 1 m high from ground level. In this context, which one among the following statements is correct?

(a) Its potential energy decreases by two-third of its original value of total energy.
(b) Its potential energy decreases by one-third of its original value of total energy.
(c) Its kinetic energy increases by two-third, while potential energy increases by one-third.
(d) Its kinetic energy increases by one-third, while potential energy decreases by one-third.

⊙ *(b)* When object reaches the height of 3 m, then potential energy, $U_1 = mgh_1$
$= 3mg$ $(\because h_1 = 3\,\text{m})$
Kinetic energy, $K_1 = 0$
When object reaches the height of 1 m from ground, then potential energy,
$U_2 = mgh_2 = mg$ $(\because h_2 = 1\,\text{m})$
Kinetic energy, $K_2 = 0$
Thus, the potential energy has decreased by one-third.
In both cases, kinetic energy is zero.
So, it is not needed to be considered.
Hence, option (b) is correct.

86. Two pieces of conductor of same material and of equal length are connected in series with a cell. One of the two pieces has cross-sectional area double that of the other. Which one of the following statements is correct in this regard?

(a) The thicker one will allow stronger current to pass through it.
(b) The thinner one would allow stronger current to pass through it.
(c) Same amount of electric current would pass through both the pieces producing more heat in the thicker one.
(d) Same amount of electric current would pass through both the pieces producing more heat in the thinner one.

⊙ *(a)* As we know that, resistance, $R = \dfrac{\rho l}{A}$

Since, ρ and l are same further wire.

So, $R \propto \dfrac{1}{A}$

As resistance is inversely proportional to the area of cross-section, so the thicker wire has lesser resistance and in turn allow stronger current.

Hence, option (a) is correct.

87. The horizontal wind circulation near the earth's surface is due to the

1. pressure gradient
2. frictional force
3. coriolis force

Select the correct answer using the codes given below.

(a) Only 1   (b) 2 and 3
(c) 1 and 3   (d) All of these

⊙ *(d)* If the earth were stationary and had uniform surface, air would flow directly from high pressure to low pressure areas. Because none of these condition exist the direction and speed of wind are controlled by a number of factors.

These are pressure gradient, the coriolis effect, the centripetal acceleration and frictional force. Hence, option (d) is correct.

88. A wire bound standard resistor uses manganin or constantan. It is because
(a) these alloys are cheap and easily available
(b) they have high resistivity
(c) they have low resistivity
(d) they have resistivity which almost remains unchanged with temperature

⊙ **(d)** A wire bound standard resistor uses manganin or constantan because they have resistivity which is almost remaining unchanged with temperature.

89. Statement I When a gun is fired, i.e. it pushes back with much less velocity than the velocity of the bullet.

Statement II Velocity of the recoiling gun is less because the gun is much heavier than bullet.

According to the principle of conservation of momentum when the gun is fired, momentum of gun and bullet system remains constant.

Codes
(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true but statement II is not the correct explanation of statement I
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true

⊙ **(a)** According to principle of conservation, when a bullet is fired from a gun, the gun exerts a force on the bullet in the forward direction.

This is the action force. The bullet also exerts an equal force on the gun in the backward direction.

This is the reaction force. Due to the large mass of the gun, it moves only, little distance backward by giving a jerk at the shoulder of the gun man.

The backward movement of the gun is called the recoil of the gun.

Heavier mass of gun has lesser velocity of recoil. Hence, code given in option (a) is correct.

90. In an observation, α-particles, β-particles and γ-rays have same energies. Their penetrating power in a given medium in increasing order will be
(a) α, β, γ (b) β, γ, α (c) α, γ, β (d) β, α, γ

⊙ **(a)** The penetrating power is inversely proportional to mass and charge. Higher the mass and charge lesser will be penetrating power. α-particles contain higher mass and charge than β-particle. So, the correct order of penetrating power is $\alpha < \beta < \gamma$

91. A person standing 1 m in front of a plane mirror approaches the mirror by 40 cm. The new distance between the person and his image in the plane mirror is
(a) 60 cm (b) 1.2 m (c) 1.4 m (d) 2 m

⊙ **(b)** When the person approaches the mirror by 40 cm.
Then, the new distance of the person from the mirror is
$x = 100 \text{ cm} - 40 \text{ cm} = 60 \text{ cm}$
∴ Distance between the person and his image is
$d = 2x = 2 \times 60 = 120 \text{ cm} = 1.2 \text{ m}$

92. Electricity is produced through dry cell from
(a) chemical energy
(b) thermal energy
(c) mechanical energy
(d) nuclear energy

⊙ **(a)** In a dry cell, chemical energy is converted into electrical energy. Electrons are generated due to chemical reaction inside a dry cell that is responsible for the flow of current.

2014 (II)

93. The upper and lower portions in common type of bi-focal lenses are respectively
(a) concave and convex
(b) convex and concave
(c) Both concave of different focal lengths
(d) Both convex of different focal lengths

⊙ **(a)** A bi-focal lens consists of both **concave** and **convex** lenses. The upper portion consists of a concave lens which facilitates the distinct vision while the lower part is convex lens which facilitates the nearby vision.

94. Tungsten is used for the construction of filament in electric bulb because of its
(a) high specific resistance
(b) low specific resistance
(c) high light emitting power
(d) high melting point

⊙ **(d)** Tungsten is uniquely suitable for using as a filament in electric bulbs because of its high melting point (3695 K), so that it can withstand larger temperature without melting.

95. Inactive nitrogen and argon gases are usually used in electric bulbs in order to
(a) increase the intensity of light emitted
(b) increase the life of the filament
(c) make the emitted light coloured
(d) make the production of bulb economical

⊙ **(b)** Inactive nitrogen and argon gases are usually used in electric bulbs in order to increase the life of the filament. As the gases, chamber cannot be filled with air that contain oxygen because it will cause the filament to burn, *i.e.* react with oxygen.

96. In the phenomenon of dispersion of light, the light wave of shortest wavelength is
(a) accelerated and refracted the most
(b) slowed down and refracted the most
(c) accelerated and refracted the least
(d) slowed down and refracted the least

⊙ **(b)** White light constitutes of seven colours. Wavelength of violet coloured light is least and wavelength of red is maximum. In this given diagram shown below, violet light refracted the most, while red light least.

Refractive index of material of the prism will be maximum for violet coloured light and it will be minimum for red coloured light because refractive index is inversely proportional to the wavelength of light.

Higher the refractive index of a material lesser will be the speed of light in this material. Therefore, violet light of shortest wavelength will have least speed that is retarded.

97. An oscilloscope is an instrument which allows us to see waves produced by
(a) visible light   (b) X-rays
(c) sound   (d) gamma rays

(c) An oscilloscope is an instrument which allows us to see sound waves which are longitudinal waves in nature.

98. The distance-time graph for an object is shown below. Which one of the following statements holds true for this object?
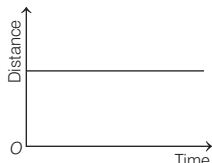
(a) The object is moving with uniform speed.
(b) The object is at rest.
(c) The object is having non-linear motion.
(d) The object is moving with non-uniform speed.

(b) As the graph is parallel to time axis, therefore the object is at rest because position remains unchanged.

If the object is moving with uniform speed, then the graph is given by
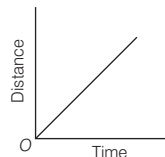
If the object is moving with non-linear motion, then the graph is given by
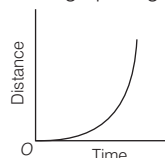
If the object is moving with non-uniform motion, then the graph may be given by
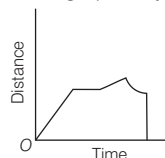
Hence, option (b) is correct.

99. For a harmonic oscillator, the graph between momentum p and displacement q would come out as

(a) a straight line   (b) a parabola
(c) a circle   (d) an ellipse

(d) For a harmonic oscillator, velocity is maximum at mean position and minimum at extreme points. Also, velocity varies non-uniformly between mean position and extreme position. This leads to an elliptical graph between velocity and displacement.

Therefore, momentum and displacement graph will also be elliptical.

2014 (I)

100. The position, relative size and nature of the image formed by a concave lens for an object placed at infinity are respectively

(a) at focus, diminished and virtual
(b) at focus, diminished and real
(c) between focus and optical centre, diminished and virtual
(d) between focus and optical centre, magnified and real

(a) We know that, lens formula,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} + \frac{1}{(-\infty)} = \frac{1}{f}$$

$$\Rightarrow \quad v = f$$

The ray diagram shows formation of image at the focus
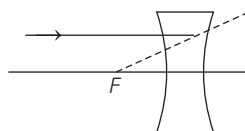
As $\quad u \to \infty, m = \left(\dfrac{v}{u}\right) \to 0$

Therefore, image will be virtual and diminished.

101. No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be

(a) either plane or convex
(b) plane only
(c) concave only
(d) convex only

(a) Image formed by a plane mirror and a convex mirror is always erect, irrespective of position of object.

102. A mobile phone charger is

(a) an inverter
(b) a UPS
(c) a step-down transformer
(d) a step-up transformer

(c) A mobile phone charger is basically a step-down transformer. It converts high voltage of home supply to low voltage.

103. Two layers of a cloth of equal thickness provide warmer covering than a single layer of cloth with double the thickness. Why?

(a) Because of the air encapsulated between two layers
(b) Since effective thickness of two layers is more
(c) Fabric of the cloth plays the role
(d) Weaving of the cloth plays the role

(a) Two layers of a cloth are warmer because air trapped between the layers acts as thermal insulator.

104. In cricket match, while catching a fast moving ball, a fielder in the ground gradually pulls his hands backwards with the moving ball to reduce the velocity to zero. The act represents

(a) Newton's first law of motion
(b) Newton's second law of motion
(c) Newton's third law of motion
(d) Law of conservation of energy

(b) We know that, from Newton's second law, $\mathbf{F}_{ext} = \dfrac{d\mathbf{p}}{dt}$

When dt is more $\mathbf{F}_{ext}$ will be less.

By gradually pulling hand backwards duration (dt) of change in momentum increases, therefore force decreases.

105. When an incandescent electric bulb glows

(a) the electric energy is completely converted into light
(b) the electric energy is partly converted into light energy and partly into heat energy
(c) the light energy is converted into electric energy
(d) the electric energy is converted into magnetic energy

(b) An incandescent electric bulb is an electric light with a wire filament heated to a high temperature. By passing an electric current through it, untill it glows with visible light. These bulbs convert less than 5% of the energy into visible light. The remaining energy is converted into heat.

106. You are asked to jog in a circular track of radius 35 m. Right one complete round on the circular track, your displacement and distance covered by you respectively

(a) zero and 220 m   (b) 220 m and zero
(c) zero and 110 m   (d) 110 m and 220 m

(a) During jogging on a circular track, in complete round initial and final positions are same, therefore displacement is zero.
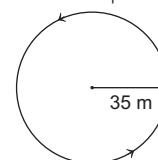
Distance travelled by you $= 2\pi r$

$= 2 \times \dfrac{22}{7} \times 35 = 70 \times \dfrac{22}{7} = 220$ m

2019 (II)

1. Bose-Einstein condensate is a
(a) solid state of matter
(b) fifth state of matter
(c) plasma
(d) state of condensed matter

⊙ *(b)* Bose-Einstein Condensate (BEC) is a fifth state of matter. The BEC is formed by working a gas of extremely low density, about one- hundred tons and the density of normal air to super low temperatures. Other states of matter : Solid, liquid, gas and plasma.

2. The rate of evaporation of liquid does not depend upon
(a) temperature
(b) its surface area exposed to the atmosphere
(c) its mass
(d) humidity

⊙ *(c)* The rate of evaporation of liquid does not depend upon its mass, because it is a surface phenomenon.
Factors affecting evaporation are:
• An increase in surface area
• An increase in temperature
• Humidity

3. Rutherford's alpha particle scattering experiment on thin gold foil was responsible for the discovery of
(a) electron   (b) proton
(c) atomic nucleus (d) neutron

⊙ *(c)* Rutherford's alpha particle scattering experiment leads to the discovery of atomic nucleus. He proposed that, there is a positively charged spherical centre in an atom, called nucleus.

4. Consider the following statements :
1. Particles of matter intermix on their own.

2. Particles of matter have force acting between them.

Which of the statements given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(c)* Particles of matter intermix on their own. Particles of matter attract each other. The force of attraction, responsible for keeping them close is inter-molecular force of attraction.
Hence, statement 1 and 2 both are correct.

5. Rate of evaporation increases with
(a) an increase of surface area
(b) an increase in humidity
(c) a decrease in wind speed
(d) a decrease of temperature

⊙ *(a)* The rate of evaporation increases on increasing the surface area of the liquid. If the surface area is increased, the rate of evaporation increases.

6. Consider the following statements about mixture :
1. A substance can be separated into other kinds of matter by any physical process.
2. Dissolved sodium chloride can be separated from water by the physical process of evaporation.

Which of the statements given above is/are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ *(b)* In order to separate the components of mixture, single or a combination of methods are used to separation of mixture can be done by both physical and chemical process. So, statement 1 is incorrect.

Dissolved sodium chloride can be separated from water by evaporation. This method is used to separate a volatile component from a non-volatile component of a mixture.
So, statement 2 is correct.

7. Which one of the following option is incorrect?
(a) Elements are defined by the number of protons they possess.
(b) Isobars are atoms having the same atomic number, but different mass number.
(c) The mass number of an atom is equal to the number of nucleons in its nucleus.
(d) Valency is the combining capacity of an atom.

⊙ *(b)* Atoms of different elements with different atomic numbers, but same mass number are known as isobars.
Hence, option (b) is in correct.

8. Which one of the following is mono atomic?
(a) Hydrogen   (b) Sulphur
(c) Phosphorus   (d) Helium

⊙ *(d)*

Elements	Atomicity
• Hydrogen	Diatomic
• Sulphur	Polyatomic
• Phosphorus	Tetra atomic
• Helium	Mono atomic

Hence, helium is mono atomic among given options.

9. In graphite, each carbon atom is bonded to three other carbon atoms
(a) forming a three-dimensional structure
(b) in the same plane giving a hexagonal array
(c) in the same plane giving a square array
(d) in the same plane giving a pentagonal array

⊘ **(b)** In graphite, each carbon atom is bonded to three other carbon atoms in the same plane given a hexagonal array. The fourth electron of each carbon atom is free.

10. Employing chromatography, one cannot separate

(a) radioisotopes
(b) colours from a dye
(c) pigments from a natural colour
(d) drugs from blood

⊘ **(a)** Chromatography is the technique for the separation of those solvents, that dissolve in the same solvent.

Radioisotopes cannot be dissolve in the same solvent to separate it.

11. Consider the following statements :

''Atomic number of an element is a more fundamental property than its atomic mass.'' Who among the following scientists has made the above statement?

(a) Dmitri Mendeleev
(b) Henry Moseley
(c) JJ Thomson
(d) Ernest Rutherford

⊘ **(b)** Given statement was stated by Henry Moseley. Mendeleev's periodic table was, therefore accordingly modified.

2019 (I)

12. Very small insoluble particles in a liquid may be separated from it by using

(a) crystallisation
(b) fractional distillation
(c) centrifugation
(d) decantation

⊘ **(d)** There are some mixtures which contain insoluble solid particles suspended in a liquid. The solid particles which are insoluble in a liquid can be separated by using **decantation** method.

13. In which of the following, functional group isomerism is not possible?

(a) Alcohols   (b) Aldehydes
(c) Alkyl halides   (d) Cyanides

⊘ **(c)** In alkyl halides, functional group isomerism is not possible. Rest of all options show functional group isomerism.

14. Which one of the following statements is not correct?

(a) Fischer projection represents the molecule in an eclipsed conformation.

(b) Newman projection can be represented in eclipsed, staggered and skew conformations.
(c) Fischer projection of the molecule is its most stable conformation.
(d) In Sawhorse projections the lines are inclined at an angle of 120° to each other.

⊘ **(c)** Statement is given in option (c) is correct. Correct statements is Fischer projection always depicts, the molecule in eclipsed form, hence it is most stable conformation.

15. The monomer/monomers used for the synthesis of nylon 6 is/are

(a) hexamethylenediamine and adipic acid
(b) caprolactam
(c) urea and formaldehyde
(d) phenol and formaldehyde

⊘ **(b)** Nylon 6 is only made from one kind of monomer, a monomer is called caprolactam.

Caprolactam
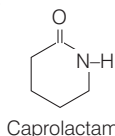
16. When hot water is placed into an empty water bottle, the bottle keeps its shape and does not soften. What type of plastic is the water bottle made from ?

(a) Thermoplastic   (b) PVC
(c) Polyurethane   (d) Thermosetting

⊘ **(d)** Water bottle made from thermosetting plastics. Thermosetting plastic is a polymer that irreversibly becomes rigid when heated. Also known as thermoset, thermosetting polymer.

17. Which of the following is/are state function/functions?

1. $q + W$ 2. q
3. W 4. $H - TS$

Select the correct answer using the codes given below.

(a) 1 and 4   (b) 1, 2 and 4
(c) 2, 3 and 4   (d) Only 1

⊘ **(a)** Internal energy $(\Delta E) = q + W$.

It is a state function because it is independent of the path.

• Gibbs energy $(G) = H - TS$

It is also a state function because it is independent of the path.

Heat (q) and work (W) are not state functions being path dependent.

18. For a certain reaction,
$\Delta G^- = -45$ kJ/mol and
$\Delta H^- = -90$ kJ/mol at 0°C.

What is the minimum temperature at which the reaction will become spontaneous, assuming that ΔH^- and ΔS^- are independent of temperature?

(a) 273 K (b) 298 K (c) 546 K (d) 596 K

⊘ **(a)** $\because \Delta G = \Delta H - T\Delta S$ and ΔH and ΔS are independent of temperature,

Also, given, $\Delta G^{-\theta} = (-)$ve at 273 K,

Thus, reaction is spontaneous at 273 K.

Hence, (a) is the correct option.

19. The PCl_5 molecule has trigonal bipyramidal structure. Therefore, the hybridisation of p-orbitals should be

(a) sp^2 (b) sp^3 (c) dsp^2 (d) dsp^3

⊘ **(d)** Phosphorus has five electrons in valence orbitals, which can hybridised and give five hybrid orbitals, *viz.* Three p-orbitals one each of s-and d-orbitals.

Thus, hybridisation of P in PCl_5 is sp^3d.

20. For an ideal gas, which one of the following statements does not hold true?

(a) The speed of all gas molecules is same.
(b) The kinetic energies of all gas molecules are not same.
(c) The potential energy of the gas molecules is zero.
(d) There is no interactive force between the molecules.

⊘ **(a)** Statement (a) is incorrect, because an ideal gas consist of a very large number of molecules which are in a state of continuous, rapid and random motion.

They move in all direction with different speeds, ranging from zero to infinity, this is a postulate of an ideal gas.

2018 (II)

21. Two reactants in a flask at room temperature are producing bubbles of a gas that turn limewater milky. The reactants could be

(a) zinc and hydrochloric acid
(b) magnesium carbonate and hydrochloric acid
(c) methane and oxygen
(d) copper and dilute hydrochloric acid

⊘ **(b)** When magnesium carbonate $(MgCO_3)$ reacts with hydrochloric acid (HCl), the product will be magnesium chloride $(MgCl_2)$, water (H_2O) and carbon dioxide (CO_2).

$MgCO_3(s) + 2HCl(aq) \longrightarrow MgCl_2(aq)$
$+ H_2O(l) + CO_2(g)\uparrow$
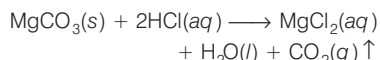
Above two reactants when taken in a flask at room temperature, they will produce bubbles of CO_2 (carbon dioxide) gas.

After that, CO_2 reacts with lime water to form calcium carbonate ($CaCO_3$), which is white and does not dissolve in water. Thus, causing the lime water turns milky.

[Lime water $\rightarrow$ Lime water is the common name for a diluted solution of calcium hydroxide ($Ca(OH)_2$). It is clear and colourless.]

$Ca(OH)_2(aq) + CO_2(g) \longrightarrow CaCO_3(s)$
$+ H_2O(l)$
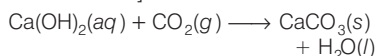
22. How many moles of CO can be obtained by reacting 2.0 moles of CH_4 with 2.0 moles of O_2 according to the equation given below?

$$CH_4(g) + \frac{1}{2}O_2 \longrightarrow CO + 2H_2$$
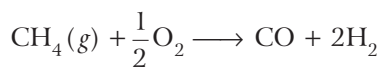
(a) 2.0   (b) 0.5
(c) 2.5   (d) 4.0

⊙ **(a)** **Step I** To find the limiting reagent,

$CH_4(g) + \frac{1}{2}O_2 \longrightarrow CO + 2H_2$

$1 \quad : \quad \frac{1}{2} \qquad 1 \quad : \quad 2$
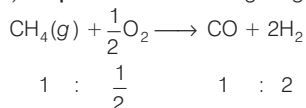
As per balanced equation,

For $\frac{1}{2}$ mole of O_2 we need
$= 1$ mole of CH_4

∴ For 2 moles of O_2 (given) we need
$= 4$ moles of CH_4

But we have given only 2 moles of CH_4, thus CH_4 is limiting reagent.
Thus,

Step II Quantity of CO is obtained
∵ 1 mole of CH_4 give 1 mole of CO
∴ 2 moles of CH_4 give $= 2$ moles of CO
Hence, 2 moles of CO will be produced.

23. Reaction between which of the following two reactants will produce hydrogen gas?

(a) Magnesium and hydrochloric acid
(b) Copper and dilute nitric acid
(c) Calcium carbonate and hydrochloric acid
(d) Zinc and nitric acid

⊙ **(a)** (i) Reaction between magnesium and hydrochloric acid

$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq)$
$+ H_2(g)\uparrow$
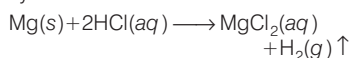
When magnesium reacts with hydrochloric acid, they produce hydrogen (H_2) gas.

(ii) Reaction between copper and dilute nitric acid

$3Cu + 8HNO_3(dilute) \longrightarrow$
$3Cu(NO_3)_2 + 2NO + 4H_2O$
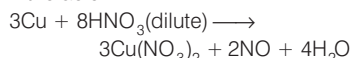
When copper reacts with dil. nitric acid, they cannot produce hydrogen (H_2) gas.

(iii) Reaction between calcium carbonate and hydrochloric acid

$CaCO_3 + HCl \longrightarrow CaCl_2$
$+ CO_2 + H_2O$
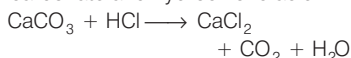
Calcium carbonate reacts with hydrochloric acid which cannot produce hydrogen (H_2) gas.

(iv) Reaction between zinc and nitric acid

$Zn + 4HNO_3 \longrightarrow Zn(NO_3)_2$
$+ 2H_2O + 2NO_2$
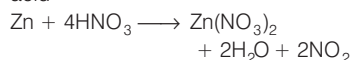
When zinc reacts with nitric acid, they also cannot produce hydrogen (H_2) gas.

Note Nitric acid is an oxidising agent which produces oxides of nitrogen on reacting with metal. It do not produces hydrogen gas.

24. Which of the following characteristics is common to hydrogen, nitrogen, oxygen and carbon dioxide ?

(a) They are all diatomic.
(b) They are all gases at room temperature
(c) They are all coloured
(d) They all have same reactivity

⊙ **(b)** H_2, N_2, O_2 and CO_2 are all gases at room temperature.
H_2, N_2 and O_2 are diatomic but CO_2 is triatomic. They all are colourless gases and they all have different reactivity.

25. The compound $C_7H_7NO_2$ has

(a) 17 atoms in a molecule of the compound
(b) equal molecules of C and H by mass
(c) twice the mass of oxygen atoms compared to nitrogen atoms
(d) twice the mass of nitrogen atoms compared to hydrogen atoms

⊙ **(a)** $C_7H_7NO_2$

Number of carbon atoms $= 7$
Number of hydrogen atoms $= 7$
Number of nitrogen atoms $= 1$
Number of oxygen atoms $= 2$
An oxygen molecule O_2 contains 2 oxygen atoms. Total number of molecules $= 7 + 7 + 1 + 2 = 17$. So, 17 atoms are present in a molecule of the compound.

26. Which of the following is the general formula for saturated hydrocarbons ?

(a) C_nH_{2n+2} (b) C_nH_{2n-2}
(c) C_nH_{2n+1} (d) C_nH_{2n-1}

⊙ **(a)** Alkanes are saturated hydrocarbons. This means that they contain only carbon and hydrogen atoms bonded by single bonds only.
• The general formula for an alkane is C_nH_{2n+2}.
• In this formula, $n = $ number of carbon.

27. The equivalent weight of $Ba(OH)_2$ is (given, atomic weight of Ba is 137.3)

(a) 85.7   (b) 137.3 (c) 154.3 (d) 171.3

⊙ **(a)** The equivalent weight is that weight which will furnish 1 mole of H^+ or 1 mole of OH^- ions.

$Ba(OH)_2 = Ba^{2+} + 2OH^-$
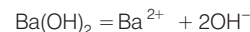
One mole of $Ba(OH)_2$ furnishes 2 moles of OH^- (2 equivalents).

$Ba(OH)_2 = $ molar mass
$1(137.3) + 2(16) + 2(1) = 171.3$ gm/mol

$Ba(OH)_2 = $ equivalent weight $= \dfrac{171.3}{2}$

$= 85.7$ g/eq

28. Which one of the following nitrogen oxides has the highest oxidation state on nitrogen?

(a) NO   (b) NO_2 (c) N_2O (d) N_2O_5

⊙ **(d)** Oxidation state of oxygen $= -2$

Oxidation state of nitrogen $= x$

(a) NO $= x + (-2) = 0$; $x - 2 = 0$;
$x = +2$
Where, oxidation state of nitrogen is $+2$.

(b) NO_2; $x + 2(-2) = 0$; $x - 4 = 0$;
$x = +4$
In above compound, oxidation state of nitrogen is $+4$.

(c) N_2O; $2x - 2 = 0$; $2x - 2, x = \dfrac{2}{2} = 1$
Where, oxidation state of nitrogen is $+1$.

(d) N_2O_5; $2x + 5(-2) = 0$;
$2x - 10 = 0$ $x = \dfrac{10}{2} = 5$
In this compound, oxidation state of nitrogen is $+5$, which is the highest oxidation state of nitrogen.

29. Which one of the following is not true for the form of carbon known as diamond ?

(a) It is harder than graphite.
(b) It contains the same percentage of carbon as graphite.
(c) It is a better electric conductor than graphite.
(d) It has different carbon to carbon distance in all directions.

⊙ **(c)** (i) **Diamond** → It has a crystalline lattice.

In diamond, each carbon atom undergoes sp^3 hybridisation and linked to four other carbon atoms.

The structure extends in space and produces a rigid three-dimensional network of carbon atom.

In this structure, directional covalent bonds are present throughout the lattice.

There are no free electrons, in the structure of diamond. Therefore, it is a very poor electric conductor.

(ii) **Graphite**

Graphite has layered structure.

Its layers are held by van der Waals' forces.

Each layer is composed of planar hexagonal rings of carbon atoms.

Electrons are mobile in graphite, therefore graphite conducts electricity.

It is a good electric conductor than diamond.

30. In which one of the following reactions, the maximum quantity of H_2 gas is produced by the decomposition of 1 g of compound by H_2O, O_2?

(a) $CH_4 + H_2O \longrightarrow CO + 3H_2$

(b) $CO_4 + H_2O \longrightarrow CO_2 + H_2$

(c) $CH_4 + \dfrac{1}{2}O_2 \longrightarrow CO + 2H_2$

(d) $C_{12}H_{24} + 6O_2 \longrightarrow 12CO + 12H_2$

⊙ **(a)** $n = \dfrac{w}{m}$

where, n = number of moles

w = given mass

m = atomic mass

(i) $CH_4 + H_2O \longrightarrow CO + 3H_2$

$(12 + 4 = 16) g + 1g \longrightarrow 6 g$

∵ 16 g will produce = 6 g of H_2

∴ 1 g will produce

$= \dfrac{6}{16} = 0.375$ g of H_2

(ii) $CO + H_2O \longrightarrow CO_2 + H_2$

$(12 + 16 = 28) g + 1g \longrightarrow 2 g$

28 g will produce = 2 g of H_2

1 g will produce

$= \dfrac{2}{28} = 0.0714$ g of H_2

(iii) $CH_4 + \dfrac{1}{2}O_2 \longrightarrow CO + 2H_2$

$(12 + 4 = 16) g + 1g \longrightarrow$

$4 g$ of H_2

∴ 16 g will produce = 4 g of H_2

∴ 1 g will produce

$= \dfrac{4}{16} = 0.25$ g of H_2

(iv) $C_{12}H_{24} + 6O_2 \longrightarrow 12CO + 12H_2$

$(144 + 24 = 168) g + 1 g \rightarrow 24 g$ of H_2

168 g will be produced = 24 g of H_2

∴ 1 g will be produced

$= \dfrac{24}{168} = 0.142$ g of H_2

31. Which one of the following can extinguish fire more quickly?

(a) Cold water (b) Boiling water
(c) Hot water (d) Ice

⊙ **(b)** Boiling water can extinguish fire more quickly because the process of fire extinguishing involves absorption of heat.

Absorption of heat in converting hot water to steam is more than the heat absorbed in heating cold water to the boiling temperature.

Hence, boiling water can extinguish fire more quickly than ice, cold water and hot water.

2018 (I)

32. Bright light is found to emit from photographer's flashgun. Thus brightness is due to the presence of which one of the following noble gases?

(a) Argon (b) Xenon
(c) Neon (d) Helium

⊙ **(b)** Xenon is used in high intensity photographic flash gun. Xenon can produce a brighter whiter light than other noble gases and tend to have a longer life span.

33. Which one of the following is not a characteristic of a compound?

(a) Composition is variable.
(b) All particles of compound are of only one type.
(c) Particles of compound have two or more elements.
(d) Its constituents cannot be separated by simple physical methods.

⊙ **(b)** A compound is a substance composed of two or more elements, chemically combined with one another in a fixed proportion.

34. Which of the following substances cause temporary hardness in water?

1. $Mg(HCO_3)_2$ 2. $Ca(HCO_3)_2$
3. $CaCl_2$ 4. $MgSO_4$

Select the correct answer using the codes given below.

(a) 3 and 4 (b) 2 and 3
(c) 1 and 4 (d) 1 and 2

⊙ **(d)** Temporary hardness in water is due to the presence magnesium and calcium hydrogen carbonates [$Mg(HCO_3)$ and $Ca(HCO_3)]_2$. It can be removed by boiling and Clark's method.

35. Which one of the following elements will be an isobar of calcium, if the atomic number of calcium is 20 and its mass number is 40?

(a) Element with 20 protons and 18 neutrons
(b) Element with 18 protons and 19 neutrons
(c) Element with 20 protons and 19 neutrons
(d) Element with 18 protons and 22 neutrons

⊙ **(d)** Atoms of different elements having same mass number (A) but different atomic number (Z) are termed as isobars. Element with 18 protons and 22 neutrons is isobaric with calcium as both of them have same mass number.

Mass number of calcium = 40

Mass number of element = number of protons + number of neutrons

= 18 + 22 = 40

36. Which one of the following elements is used as a timekeeper in atomic clocks ?

(a) Potassium (b) Caesium
(c) Calcium (d) Magnesium

⊙ **(b)** Caesium is used as a timekeeper in atomic clocks. The caesium atomic clocks are very accurate. In principle, they provide portable standard. The national standard of time interval 'second' as well as the frequency is maintained through four caesium atomic clocks.

37. Which one of the following gases dissolves in water to give acidic solution?

(a) Carbon dioxide (b) Oxygen
(c) Nitrogen (d) Hydrogen

⊙ **(a)** Carbon dioxide dissolve in water to form acidic solution. Aqueous solution of carbon dioxide is called carbonic acid (H_2CO_3).

38. Consider the following chemical reaction,

$a\text{Fe}_2O_3(s) + b\text{CO}(g) \rightarrow c\text{Fe}(s)$

$+ d\text{CO}_2$
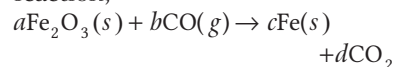
In the balanced chemical equation of the above, which of the following will be the values of the coefficients a, b, c and d respectively?

(a) 3, 2, 3, 1   (b) 1, 3, 2, 3
(c) 2, 3, 3, 1   (d) 3, 3, 2, 1

⊙ **(b)** A balanced chemical equation involves equal number of atoms of each element an both sides. The balanced chemical equation is given below and its coefficients a,b,c,d are 1,3,2,3.

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

2017 (II)

39. Pearl is a hard object produced within the soft tissues of a mollusk. Which one of the following is the main constituent of pearl?

(a) Calcium carbonate
(b) Calcium oxide
(c) Calcium nitrate
(d) Calcium sulphate

⊙ **(a)** The soft tissue of mollusc animal accumulate $CaCO_3$ which makes the pearl in them.

40. In the reaction between hydrogen sulphate ion and water

$$HSO_4^- + H_2O \longrightarrow H_3O^+ + SO_4^{2-}$$

the water acts as

(a) an acid   (b) a base
(c) a salt   (d) an inert medium

⊙ **(b)** In the given reaction the water acts as a base. A base is a substance which can accept protons or any chemical compound that yields hydroxide ions (OH^-) in solution.

It is also commonly referred to as any substance that can react with an acid to decrease or neutralise its acidity to form salts and promote certain chemical reactions.

41. How many hydrogen atoms are contained in 1.50 g of glucose $(C_6H_{12}O_6)$?

(a) 3.01×10^{22} (b) 1.20×10^{23}
(c) 2.40×10^{23} (d) 6.02×10^{22}

⊙ **(d)** Given mass = 1.5 g

molar mass of glucose = 180.16 g/mol

Moles of glucose $= -\dfrac{1.50}{180.16}$

$= 0.0083$ mol

There are 6 moles of carbon for each glucose, 12 hydrogen and 6 oxygen.

Number of hydrogen atoms in glucose $(C_6H_{12}O_6) = 0.0083 \times 12$ moles of hydrogen = 0.099 mole

hydrogen = 1 mole glucose

Now, 0.099 mole of hydrogen

$$\times \frac{6.023 \times 10^{23}}{1 \text{ mole}} = 6.02 \times 10^{22}$$

atoms of hydrogen.

42. The paste of a white material in water is used to maintain a fractured bone fixed in place. The white material used is called

(a) bleaching powder
(b) Plaster of Paris
(c) powder of zinc oxide
(d) lime powder

⊙ **(b)** The white material is Plaster of Paris. It is calcium sulphate hemihydrate $\left(CaSO_4 \cdot \dfrac{1}{2}H_2O\right)$. It is used for setting fractured bones. When mined with water, it takes up the water of crystallisation and sets into a hard mass.

43. Which one of the following types of glasses is used for making optical instruments?

(a) Pyrex glass   (b) Soft glass
(c) Hard glass   (d) Flint glass

⊙ **(c)** Optical instrument are made up of hard glass. It is also known as potash glass. It is prepared by passing a mixture of potassium carbonate and silica. As its name indicates, it is very hard and have high melting point.

44. What are the main constituents of biogas?

(a) Methane and sulphur dioxide
(b) Methane and carbon dioxide
(c) Methane , hydrogen and nitric oxide
(d) Methane and nitric oxide

⊙ **(b)** Biogas is a type of biofuel that is naturally produced from the decomposition of organic waste. When organic matter, such as food scraps and animal waste, break down in an anaerobic environment (an environment absent of oxygen) they release a blend of gases, primarily methane and carbon dioxide.

Because this decomposition happens in an anaerobic environment, the process of producing biogas is also known as anaerobic digestion.

Biogas Composition

- Methane - 50-74%, CO_2 - 25-50%
- Nitrogen - 0-10%, Hydrogen - 0-1%
- Hydrogen sulphide - 0-3%, oxygen - 0-2%

Hence, option (b) is correct answer.

45. One carbon credit is accepted as equivalent to

(a) 100 kg of carbon
(b) 100 kg of carbon dioxide
(c) 1000 kg of carbon
(d) 1000 kg of carbon dioxide

⊙ **(d)** Carbon credit is a generic term for any tradable certificate or permit representing the right to emit one tonne of carbon dioxide or the mass of another greenhouse gas with a carbon dioxide equivalent to one tonne of carbon dioxide.

46. An emulsion consists of

(a) one liquid and one solid
(b) one liquid and one gas
(c) two liquids
(d) two solids

⊙ **(c)** An emulsion is a dispersion of finely divided droplets in another liquid. Thus, these are liquid-liquid 'colloidal systems. Generally, one of two liquids is water and the other, which is immiscible with water, is designated as oil.

47. Which one of the following radioactive substances enters/enter the human body through food chain and causes/cause many physiological disorders ?

(a) Strontium – 90   (b) Iodine – 131
(c) Cesium – 137   (d) All of these

⊙ **(d)** Strontium-90, iodine-131 and cesium-137, all three are radioactive substances that enters the human body through food chain and causes many physiological disorders in all form of individuals involved in food chain.

48. Desalination of sea water is done by using reverse osmosis. The pressure applied to the solution is

(a) larger than osmotic pressure
(b) smaller than osmotic pressure
(c) equal to osmotic pressure
(d) equal to atmospheric pressure

⊙ **(a)** When a pressure, more than the osmotic pressure is applied to the solution, the solvent may pass from solution into the solvent through the semi-permeable membrane. This type of osmosis is known as reverse osmosis. Reverse osmosis is used for the desalination of sea water.

Hence, option (a) is true.

49. Which one of the following polymers does not contain glucose units ?

(a) Glycogen   (b) Starch
(c) Cellulose   (d) Rubber

(d) A polymer is a large molecule, or macromolecule, composed of many repeated subunits. Because of their broad range of properties, both synthetic and natural polymers play essential ubiquitous role in everyday life. All the polymers except rubber contain glucose units.

50. Tincture of iodine is an antiseptic for fresh wounds. It is a dilute solution of elemental iodine, which does not contain

(a) water
(b) acetone
(c) alcohol
(d) potassium iodide

> (b) Tincture of iodine, iodine tincture or weak iodine solution is an antiseptic.

It is usually 2-7% elemental iodine, along with potassium iodide or sodium iodide, dissolved in a mixture of ethanol and water. Tincture solutions are characterised by the presence of alcohol.

2017 (I)

51. Which one of the following is a physical change ?

(a) Burning of coal
(b) Burning of wood
(c) Heating of a platinum crucible
(d) Heating of potassium chlorate

> (c) Heating of a platinum crucible is a physical change. In a physical change, a substance undergoes a change in its physical properties such as shape, size, colour etc.

Physical changes are used to separate mixtures into their component compounds, but cannot be used to separate compounds into chemical elements or simpler compounds. In such a change no new substance is formed.

Examples of physical properties include melting, transition to a gas, change of strength, change of durability, changes to crystal form, textural change, shape, size, colour, volume and density.

52. The pH value of a sample of multiple-distilled water is

(a) zero
(b) 14
(c) very near to zero
(d) very near to 7

> (d) Distilled water has a neutral pH that is neither alkaline nor acidic. This is because the number of hydroxyl ions and hydrogen ions in pure water is balanced. Pure water has a pH of 7.0 at 25°C.

As temperature increases, pH decreases. But, that does not mean that the water has become acidic. Here, the point at which pH is neutral drop. It is still neutral because the hydrogen ions and the hydroxyl ions in the water are still balanced.

53. Which one of the following is the most characteristic property of an element?

(a) Density
(b) Boiling point
(c) Mass number
(d) Atomic number

> (d) The most important characteristic of a chemical element is its atomic number. It is equal to the number of protons in the nucleus of an atom of the element, and it is also equal to the number of electrons in the atom.

The atomic number is the most important factor that determines the chemical properties of an element.

54. There are two elements-calcium (atomic number 20) and argon (atomic number 18). The mass number of both the elements is 40. They are therefore known as

(a) isotones
(b) isochores
(c) isobars
(d) isotopes

> (c) Isobars are atoms (nuclides) of different chemical elements that have same number of nucleons or mass number but different-atomic number such as ^{40}Ca, ^{40}Ar.

55. 'Plum pudding model' for an atom was proposed by

(a) Antoine Lavoisier
(b) Robert Boyle
(c) Ernest Rutherford
(d) JJ Thomson

> (d) JJ Thomson, who discovered the electron in 1897, proposed the Plum pudding model of the atom in 1904 before the discovery of the atomic nucleus in order to include the electron in the atomic model.

He proposed that an atom consists of a positively charged sphere and the electrons are embedded into it.

56. What is the number of atoms in 46 g of sodium-23 (N = Avogadro constant)?

(a) $\dfrac{N}{2}$
(b) N
(c) $2N$
(d) $23N$

> (c) Avogadro's number is a very important relationship in stoichiometric calculations : 1 mole = 6.022×10^{23} atoms, molecules, protons, etc.

To convert moles into atoms, multiply the molar amount by Avogadro's number.

To convert atoms into moles, divide the amount of atom by Avogadro's number (or multiply by its reciprocal).

Here, 1g of Na = 23 g.

then number of atom in 46 g of
$^{23}Na = 46 \cdot \dfrac{N}{23} = 2N$

57. What is the maximum number of states of matter ?

(a) Three
(b) Four
(c) Five
(d) Variable

> (c) There are five states of matter-solids, liquids, gases, plasma and Bose-Einstein condensates. They exist due to difference in structures of each state and in densities of the particles.

58. The chemical properties of an element depend upon

(a) the number of isotopes of the element
(b) the mass number of the element
(c) the total number of neutrons in the element
(d) the number of electrons in the outermost shell of the element

> (d) The chemical properties of an element depend upon the number of electrons in the outermost shell of the element because they participate in bond formation and dissociation.

59. The molecular mass of sulphuric acid is 98. If 49 g of the acid is dissolved in water to make one litre of solution, what will be the strength of the acid?

(a) Two normal
(b) One normal
(c) 0.5 normal
(d) Four normal

> (b) Normality is a way of expressing the concentration of solution. It is defined as the concentration expressed as the number of equivalent weights of solute per litre of solution.

• Here, equivalent weight of H_2SO_4 is $98/2 = 49$.

• So, normality of solution is 1.

Hence, the strength of 49 g of acid dissolved in water to make one litre of solution is 1N.

2016 (II)

60. Which one of the following is not an allotrope of carbon?

(a) Coal
(b) Diamond
(c) Graphite
(d) Graphene

⊘ *(d)* Allotropy is the property of some chemical elements to exist in two or more different forms, or allotropes, when found in nature.

There are several allotropes of carbon, such as; coal, diamond, graphite, amorphous carbon, fullerenes and nanotubes, glassy carbon and carbon nanofoam.

61. In paper manufacturing, degumming of the raw material is done using

(a) sulphuric acid
(b) bleaching powder
(c) caustic soda
(d) nitric acid

⊘ *(b)* For degumming of the raw material in paper manufacturing industries bleaching powder is used.

The two main raw materials required for the manufacture of bleaching powder are high grade lime and chlorine.

Bleaching powder, also known as chlorinated lime, is a yellowish white powder easily soluble in water.

The major use of bleaching powder is in paper industry, textile industry and oil industry. It is also used in all chemical industry where bleaching is required.

62. Dolomite powder is applied in some agricultural lands. The purpose of applying it is to

(a) increase the pH of the soil
(b) lower the pH of the soil
(c) increase the phosphorus content of the soil
(d) increase the nitrogen content of the soil

⊘ *(a)* Dolomite is used in agriculture to raise the pH of overly acidic soil and provide nutrients for plants. Dolomite is an example of an agricultural lime, or crushed stone, applied to the soil with beneficial properties for healthy plant growth.

Dolomite contains calcium carbonate and magnesium carbonate, two basic pH raising ingredients that counter act the acids in soil and peat. It gradually dissolves into the soil, neutralising acidity from further watering and fertilising.

Dolomite also helps plants absorb nutrients more effectively. However, dolomite can harm plants if used in the wrong soil type or if used in excess. Mineral content testing and pH testing are both recommended before choosing dolomite over other agricultural limes.

63. Which one of the following element does not form solid hydrogen carbonate?

(a) Sodium
(b) Potassium
(c) Caesium
(d) Lithium

⊘ *(d)* Lithium hydrogen carbonate does not exist in solid form because lithium hydrogen carbonate ($LiHCO_3$) is found in solution form. Lithium is a chemical element with the symbol Li and atomic number 3. It is a soft, silver-white metal belonging to the alkali metal group of chemical elements.

64. Liquids and gases never show

(a) diamagnetic property
(b) paramagnetic property
(c) ferromagnetic property
(d) electromagnetic property

⊘ *(c)* Ferromagnetism is the basic mechanism by which certain materials, such as iron are attracted to magnets. Only a few substances are ferromagnetic.

The common ones are iron, nickel, cobalt and most of their alloys, some compounds of rare earth metals, and a few naturally occurring minerals, such as lodestone. Thus, liquids and gases never show the ferromagnetic property.

65. In the gamma decay of a nucleus,

(a) the mass number of the nucleus changes whereas its atomic number does not change
(b) the mass number of the nucleus does not change whereas its atomic number changes
(c) both the mass number and the atomic number of the nucleus change
(d) neither the mass number nor the atomic number of the nucleus changes

⊘ *(d)* In gamma decay, a nucleus changes from a higher energy state to a lower energy state through the emission of electromagnetic radiation. The number of protons and neutrons in the nucleus remain unchanged in this process, so the parent and atoms are the same chemical elements.

66. The pressure exerted by a 760 mm column of mercury at $0\,°C$ is known as

(a) 1 pascal
(b) 1 atmosphere
(c) 1 bar
(d) 1 poise

⊘ *(b)* Atmospheric pressure is also called barometric pressure. It is the pressure exerted by the weight of air in the atmosphere of the Earth. In most circumstances, atmospheric pressure is closely approximated by the hydrostatic pressure caused by the weight of air above the measurement point.

Low pressure area have less atmospheric mass above their location. High pressure area have more atmospheric mass above their location.

67. Which one of the following statements is correct?

(a) The oxidation number for hydrogen is always zero.
(b) The oxidation number for hydrogen is always +1.
(c) The oxidation number for hydrogen is always −1.
(d) Hydrogen can have more than one oxidation number.

⊘ *(d)* Hydrogen has two possible oxidation numbers +1 and −1. It has an oxidation number +1, when it is bonded to non-metals. For the compound hydrochloric acid, hydrogen is bonded to chlorine, a non-metal, so the oxidation number of hydrogen is +1.

Hydrogen has an oxidation number of −1, when it is bonded to a metal. For the compound sodium hydride, hydrogen is bonded to sodium, which is a metal, so the oxidation number is −1.

68. In case of a standard hydrogen electrode

(a) absolute electrode potential is not zero
(b) absolute electrode potential is zero
(c) both absolute and standard electrode potential values are zero
(d) electrode potential is zero only at 25°C

⊘ *(d)* The standard hydrogen electrode is a redox electrode, which forms the basis of the thermodynamic scale of oxidation-reduction potentials. Its absolute electrode potential is estimated to be 4.44 V at 25°C.

To form a basis for comparison with all other electrode reactions, hydrogen standard electrode potential ($E°$) is declared to be zero volts at all temperature. The concentration of both reduced and oxidised form is maintained at unity. It implies that the pressure of hydrogen gas is 1 bar and the activity of hydrogen ions in the solution is unity.

2016 (I)

69. After a hot sunny day, people sprinkle water on the roof-top because

(a) water helps air around the roof-top to absorb the heat instantly
(b) water has lower specific heat capacity
(c) water is easily available
(d) water has large latent heat of vaporisation

⊙ *(a)* People sprinkle water on the roof because when this water gets evaporated they take up some of the heat from the roof for the process of evaporation. As some of the heat gets released, the roof becomes cooler making the rooms also cool.

70. The handle of pressure cookers is made of plastic because it should be made non-conductor of heat. The plastic used there is the first man-made plastic, which is

(a) polythene   (b) terylene
(c) nylon   (d) bakelite

⊙ *(d)* Bakelite is a type of plastic (i.e. polythene) once moulded, does not melt in the presence of heat. It is used for making electrical appliances, handles of crockery, etc.

71. Methyl isocyanate gas, which was involved in the disaster in Bhopal in December, 1984, was used in the Union Carbide Factory for production of

(a) dyes   (b) detergents
(c) explosives   (d) pesticides

⊙ *(d)* Methyl Isocyanate (MIC) gas was used as a precursor for the formation of pesticides in UCIL (Bhopal). The toxic substance made its way into and around the towns located near the plant.

72. 'German silver' is used to make decorative articles, coinage metal, ornaments etc. The name is given because

(a) it is an alloy of copper and contains silver as one of its components
(b) Germans were the first to use silver
(c) its appearance is like silver
(d) it is an alloy of silver

⊙ *(c)* German silver is an alloy of copper, zinc and nickel. It is called so as it appears like silver.

73. Vitamin-B_{12} deficiency causes pernicious anaemia. Animals cannot synthesise vitamin-B_{12}. Humans must obtain all their vitamin-B_{12} from their diet. The complexing metal ion in vitamin-B_{12} is

(a) Mg^{2+} (magnesium ion)
(b) Fe^{2+} (iron ion)
(c) Co^{3+} (cobalt ion)
(d) Zn^{2+} (zinc ion)

⊙ *(c)* Vitamin-B_{12} is also called as **cobalamin** and contain Co^{3+} ion. Its deficiency in diet causes **pernicious anaemia**. It is an autoimmune disorder

that can lead to serious complications. It occurs when the body cannot absorb enough vitamin B-12.

74. A piece of ice, 100 g in mass is kept at 0°C. The amount of heat it requires to melt at 0°C is (take latent heat of melting of ice to be 333.6 J/g)

(a) 750.6 J   (b) 83.4 J
(c) 33360 J   (d) 3.336 J

⊙ *(c)* Latent heat is the amount of heat required per unit mass during the change of phase of a substance.
SI unit Jkg^{-1}

Latent heat $(L) = \dfrac{\text{Quantity of heat } (Q)}{\text{Mass } (m)}$

Here, $m = 100$ g of ice
     $L = 333.6$ J/g
So, amount of heat $(Q) = m \times L$
        $= 100 \times 333.6$
        $Q = 33360$ J

75. Which one of the following is an example of chemical change?

(a) Burning of paper
(b) Magnetisation of soft iron
(c) Dissolution of cane sugar in water
(d) Preparation of ice cubes from water

⊙ *(a)* Chemical change involves change in chemical composition of matter.

During magnetisation of iron, dissolution of sugar in water and preparation of ice from water, the chemical compositions do not alter hence they are physical change. While burning of paper results in formation of carbon dioxide and water vapours, which have new chemical composition, hence it is called chemical change.

76. Which of the following statement(s) is/are correct?

1. Acid rain reacts with buildings made from limestone.
2. Burning of sulphur containing coal can contribute to acid rain.
3. Eutrophication is an effective measure to control pollution.

Select the correct answer using the codes given below.

(a) 1 and 2   (b) 2 and 3
(c) Only 1   (d) All of these

⊙ *(a)* Acid rain causes decomposition of limestone.

$CaCO_3 + H_2SO_4 \longrightarrow CaSO_4$
$\qquad\qquad\qquad + CO_2\uparrow + H_2O$

• Burning of sulphur along with coal results in formation of oxides of sulphur as

$S + O_2 \longrightarrow SO_2$

$\Rightarrow \quad SO_2 + \dfrac{1}{2}O_2 \longrightarrow SO_3$

When sulphur trioxide (SO_3) reacts with water (of clouds) it forms acid, hence causes acid rain.

$SO_3 + H_2O \longrightarrow H_2SO_4$

• Eutrophication is the excessive increase of nutrients in an ecosystem (like ponds) which results abnormal growth of population of dependent organism (like algal bloom in pond). Hence, it can cause pollution instead of controlling it.

Hence statement 1, 2 are correct and statements 3 is incorrect

77. Which one of the following statements is not correct?

(a) Hydrogen is an element
(b) Hydrogen is the lightest element
(c) Hydrogen has no isotopes
(d) Hydrogen and oxygen form an explosive mixture

⊙ *(c)* Hydrogen has three known isotopes namely protium, deuterium and tritium.

78. Which one of the following statements is not correct?

(a) Atoms of different elements may have same mass numbers
(b) Atoms of an element may have different mass numbers
(c) All the atoms of an element have same number of protons
(d) All the atoms of an element will always have same number of neutrons

⊙ *(d)* Two atoms are said to belongs to an element when they have same number of protons.

But they can have different number of neutrons. e.g. the isotopes of an element have same number of protons, but different number of neutrons.

Hence statements given option (d) is incorrect.

79. The synthetic rubber has replaced natural rubber for domestic and industrial purposes. Which one of the following is the main reason behind that?

(a) Natural rubber is unable to meet the growing demand of different industries
(b) Natural rubber is grown in tropical countries only
(c) Raw materials for synthetic rubber are easily available
(d) Natural rubber is not durable

⊙ *(c)* Natural rubber is made from the latex of rubber tree found in the hot, damp

forests of South-East Asia, Africa and South America. But during second World War the United States, which essentially needed rubber for its growing industries, was cut off from all sources of natural rubber.

Hence, it developed synthetic rubber plant which is a product of petroleum refining and styrene, to sustain its industries. Thus, easy availability of raw materials from products of petroleum refining industries lead to growth of synthetic rubber.

2015 (II)

80. Which of the following statements with regard to Portland cement are correct?

1. Silica imparts strength to cement.
2. Alumina makes the cement quick setting.
3. Excess of lime increases the strength of cement.
4. Calcium sulphate decreases the initial setting time of cement.

Select the correct answer using the codes given below.

(a) 2 and 4   (b) 1 and 3
(c) 1, 2 and 4   (d) 1 and 2

⊙ (**d**) Functions of ingredients of cement are as follows:

- **Silica** (SiO_2) It imparts strength to the cement due to the formation of dicalcium and tricalcium silicates.

- **Alumina** (Al_2O_3) It imparts quick setting property to the cement. It acts as a flux and it lowers the clinkering temperature.

Hence, statement 1 and 2 are correct regaring portland cement.

81. Red phosphorus is used in the manufacture of safety matches. This is due to the fact that

(a) it shows phosphorescence
(b) at ordinary temperature, it is less reactive than other varieties of phosphorus
(c) it cannot be converted to white phosphorus on heating
(d) it does not react with halogen on heating

⊙ (**b**) Red phosphorus is a relatively stable allotrope of phosphorus at room temperature. Its ignition temperature (543 K) is much higher than that of white phosphorus (303 K). As a result, it does not catch fire easily.

82. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Exponent)	List II (Law)
A. John Dalton	1. Law of definite proportion by volume
B. Joseph Proust	2. Law of multiple proportion
C. Antoine Lavoisier	3. Law of definite proportion by weight
D. Joseph Louis Gay Lussac	4. Law of conservation of mass

Codes

	A	B	C	D
(a)	2	3	4	1
(b)	2	4	3	1
(c)	1	4	3	2
(d)	1	3	4	2

⊙ (**a**) Law of definite proportion by volume was propounded by Joseph Louis Gay Lussac and is applicable for gases.

- Law of multiple proportion was propounded by John Dalton in 1803.
- Law of definite proportion by weight was propounded by Joseph Proust.
- Law of conservation of mass was propounded by Antoine Lavoisier.

83. Which one of the following statements is not correct?

(a) Water starts boiling when its vapour pressure becomes equal to atmospheric pressure
(b) Water is known as universal solvent
(c) Permanent hardness of water is due to presence of $MgCl_2$, $CaCl_2$, $MgSO_4$ and $CaSO_4$
(d) Density of ice is greater than that of water

⊙ (**d**) The density of ice is less than that of water and thats why, ice floats on water. The ice structure takes up more volume than the liquid water molecules, hence ice is less dense than liquid water.

Hence, statements (d) is not correct.

84. Which one of the following is not true for diamond?

(a) Each carbon atom is linked to four other carbon atoms
(b) Three-dimensional network structure of carbon atoms is formed
(c) It is used as an abrasive for sharpening hard tools
(d) It can be used as a lubricant

⊙ (**d**) Diamond is used as an abrasive for sharpening hard tools. Graphite is used as a dry lubricant in machines running at

high temperature, where oil cannot be used as a lubricant.

85. The atomic theory of matter was first proposed by

(a) John Dalton   (b) Rutherford
(c) J.J. Thomson   (d) Niels Bohr

⊙ (**a**) The atomic theory of matter was first proposed by an English chemist, John Dalton. The theory said that all matter is made of atoms. Atoms are indivisible and indestructible. All atoms of a given element are identical in mass and properties. Compounds are formed by a combination of two or more different kinds of atoms.

86. Which one of the following is a non-renewable resource?

(a) Solar energy   (b) Coal
(c) Water   (d) Fisheries

⊙ (**b**) Natural resources such as coal, petroleum and natural gas take thousands of years to form naturally and cannot be replaced as fast as they are being consumed. That is why, it is a non-renewable resource. While natural resources such as solar energy, water and fisheries are renewable resources.

2015 (I)

87. Which one among the following fuels is used in gas welding?

(a) LPG   (b) Ethylene
(c) Methane   (d) Acetylene

⊙ (**d**) Acetylene is a fuel used in gas welding. It is used to weld and cut the metals that have a temperature of 3300°C of a flame.

88. Match List I with List II and select the correct answer using the codes given below the lists:

List I (Air pollution)	List II (Effect)
A. Chlorofluoro-carbon	1. Acid rain
B. Sulphur dioxide	2. Depletion in ozone layer in the atmosphere
C. Lead compound	3. Harmful for human nervous system
D. Carbon dioxide	4. Topmost contribution to greenhouse effect

Codes

	A	B	C	D
(a)	4	3	1	2
(b)	4	1	3	2
(c)	2	1	3	4
(d)	2	3	1	4

(**c**) The correct matching is A → 2, B → 1, C → 3, D → 4.
- Chlorofluorocarbon (DFCs) is responsible for depletion in ozone layer.
- Acid rain is caused by a chemical reaction that begins, when compounds like sulphur dioxide and nitrogen oxide are released into the air.
- Lead compound is harmful for human nervous system.
- The primary greenhouse gases in earth's atmosphere are water vapour, carbon dioxide, methane and nitrous oxide.

89. Which one among following metals is prominently used in mobile phone batteries?
(a) Copper   (b) Zinc
(c) Nickel   (d) Lithium

(**d**) Lithium metal is used in mobile phone batteries. Nickel-cadmium batteries are used in the portable electronics and toys whereas, zinc-carbon batteries are used in the electrical appliances. These are non-rechargeable batteries.

90. Which one of the following is the most appropriate and correct practice from the point of view of a healthy environment?
(a) Burning of plastic wastes to keep the environment clean
(b) Burning of dry and fallen leaves in a garden or field
(c) Treatment of domestic sewage before its release
(d) Use of chemical fertilisers in agricultural fields

(**c**) Burning of plastic wastes and burning of dry and fallen leaves in a garden field both creates air pollution. Use of chemical fertilisers in agricultural field creates soil pollution and other harmful effect on environment. Treatment of domestic sewage before its release is the best practice in respect of healthy environment.

91. Who among the following proposed that atom is indivisible?
(a) Dalton   (b) Berzelius
(c) Rutherford   (d) Avogadro

(**a**) Modern atomic theory was given by **Dalton** that states "All matter is made up of atoms and atoms are indivisible".

Berzelius is known as father of modern chemistry. He determined the exact elementary constituents of large number of compounds.

Rutherford discovered the nucleus of an atom in 1911. While **Avogadro** is best known for his hypothesis that equal volumes of different gases contain an equal number of molecules, provided they are at the same temperature and pressure.

92. How many elements are there in the 5th period of modern periodic table?
(a) 2   (b) 8   (c) 18   (d) 36

(**c**) There are a total of 18 elements in the 5th period of modern periodic table.

Trend of number of elements in the modern periodic table:

1st period	–	2
2nd period	–	8
3rd period	–	8
4th period	–	18
5th period	–	18
6th period	–	32
7th period	–	Incomplete

93. Which one among the following is used in making lead pencils?
(a) Charcoal   (b) Graphite
(c) Coke   (d) Carbon black

(**b**) Graphite is used to make lead pencils. The graphite is an allotropic form of carbon that consists of atoms of carbon that possesses a kind of hybridisation in a way that three strong bonds are forming a equilateral triangle in the same plane and a weaker bond perpendicular to that plane.

This allows that carbon arranges in "parallel" sheets that slide on each other giving the graphite a high lubricant performance.

94. Sodium metal should be stored in
(a) alcohol   (b) kerosene oil
(c) water   (d) hydrochloric acid

(**b**) Sodium metal is highly reactive due to high electropositive character. Hence, it is stored in kerosene oil, which provides it an inert atmosphere. When sodium metal come in contact with water, it reacts violently.

95. When hard water is evaporated completely the white solid remains in the container. It may be due to the presence of
1. carbonates of Ca and Mg
2. sulphates of Ca and Mg
3. chlorides of Ca and Mg

Select the correct answer using the codes given below.
(a) 1 and 2   (b) 1 and 3
(c) Only 3   (d) All of these

(**d**) Presence of calcium, magnesium and iron salt in the form of hydrogen carbonate, chloride and sulphate in water makes hard water.

When this type of water get evaporated, then these salts remains as a white solid in the container.

96. Which one among the following compounds has same equivalent weight and molecular weight?
(a) H_2SO_4 (b) $CaCl_2$
(c) Na_2SO_4 (d) NaCl

(**d**) NaCl has same equivalent and molecular weight, because the valence factor for NaCl is one. Hence, $E_{NaCl} = M_{NaCl}$.

97. A metallic plate sticks firmly on the mouth of a water vessel made from another metal. By the way of heating, one can detach the plate from the vessel. This is because heat expands
(a) the vessel only
(b) both the vessel and the plate equally
(c) the vessel more than the plate
(d) the vessel and contracts the plate

(**c**) Since, vessel expands more than the plate, so one can detach the plate by the way of heating.

2014 (II)

98. Bagasse, a by-product of sugar manufacturing industry, is used for the production of
(a) glass   (b) paper
(c) rubber   (d) cement

(**b**) Bagasse is the fibrous matter that remains after sugarcane stacks are crushed to extract their juice. It is used as a biofuel and as a substitute for wood in many tropical and subtropical countries for the production of pulp, paper, board etc.

99. The main constituent of gobar gas or bio gas is
(a) ethane   (b) methane
(c) propane   (d) acetylene

(**b**) Gobar gas or bio gas is a mixture of gases produced by the breakdown of organic matter in the absence of oxygen. It is primarily composed of methane (CH_4), carbon dioxide (CO_2) and may also have small amounts of hydrogen sulphide (H_2S), moisture and siloxanes. Hence, option (b) is true.

100. Which of the following is a good lubricant?

(a) Diamond powder
(b) Graphite powder
(c) Molten carbon
(d) Alloy of carbon and iron

⊙ *(b)* A graphite crystal consists of layers of carbon atoms, in which each carbon atom is joined to three other carbon atoms by strong covalent bonds to form flat hexagonal rings. The various layers of carbon atoms are held together by weak van der Waals' forces. Due to these weak forces, these layers can slide over one another. This makes the graphite soft and slippery to touch.

Hence, due to the sheet like structure, graphite is a comparatively soft substance.

101. In tritium (T), the number of protons (p) and neutrons (n) respectively are

(a) 1 and 1
(b) 1 and 2
(c) 1 and 3
(d) 2 and 1

⊙ *(b)* Tritium is very heavy hydrogen isotope of mass number 3. It is represented as $_1^3H$. In tritium, number of protons (p) is 1 and number of neutrons (n) are $(3 - 1 = 2)$.

102. When carbon dioxide is passed through lime water, the solution turns milky, but on prolonged passage, the solution turns clear. This is because

(a) the calcium carbonate formed initially is converted to soluble calcium bicarbonate on passage of more carbon dioxide
(b) the reaction is reversible and lime water is regenerated
(c) the calcium bicarbonate formed initially is converted to soluble calcium carbonate on passage of more carbon dioxide
(d) the initially formed insoluble compound is soluble in carbonic acid

⊙ *(a)* When carbon dioxide (CO_2) is passed through lime water, the lime water turns milky due to the formation of a white precipitate of calcium carbonate.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

If excess of CO_2 is passed through lime water, then the white precipitate formed first dissolves due to the formation of calcium bicarbonate and the solution becomes clear again.

$$CaCO_3 + CO_2 + H_2O \longrightarrow Ca(HCO_3)_2$$

103. The form of carbon known as graphite

(a) is harder than diamond
(b) contains a higher percentage of carbon than diamond
(c) is a better electrical conductor than diamond
(d) has equal carbon-to-carbon distances in all directions

⊙ *(c)* The two common allotropes of carbon are diamond and graphite. Graphite is a good conductor of electricity whereas diamond is a non-conductor of electricity.

In a graphite crystal, each carbon atom is joined to only three other carbon atoms by covalent bonds. The fourth valence electron of each carbon atom is 'free' to move, which is responsible for the conduction of electricity.

Where as in a diamond crystal, each carbon atom is linked to four other carbon atoms by strong covalent bonds.

104. Which one among the following is an example of chemical change?

(a) The melting of an ice cube
(b) The boiling of gasoline
(c) The frying of an egg
(d) Attraction of an iron nail to a magnet

⊙ *(c)* The change which affects the composition as well as chemical properties of matter and result in the formation of a new substance is called a chemical change.

Chemical changes are generally irreversible. So, the frying of an egg is a chemical change.

105. Which of the following is not correct about baking soda?

(a) It is used in soda-acid fire extinguisher
(b) It is added for faster cooking
(c) It is a corrosive base
(d) It neutralises excess acid in the stomach

⊙ *(c)* Baking soda ($NaHCO_3$) is a mild, non-corrosive base. It is used as an antacid in medicine to remove acidity of the stomach. It is also used for faster cooking and in soda acid fire extinguisher.

106. Chromium oxide in paints makes the colour of paint

(a) green   (b) white
(c) red   (d) blue

⊙ *(a)* Chromium oxide, cuprous oxide and cobalt oxide in paints make the colour of paint green, red and blue respectively.

107. Carbon or graphite rods are used in atomic reactors as moderators for sustained nuclear chain reaction through nuclear fission process. In this process

(a) the neutrons are made fast
(b) the protons are made fast
(c) the neutrons are made slow
(d) the protons are made slow

⊙ *(c)* The substances, such as carbon or graphite are used to slow down, fast moving neutron because of the following:

• It has low atomic weight.
• It does not absorb neutron.
• It should undergo elastic collisions with neutrons and reduce their velocity.

108. **Statement I** During indigestion, milk of magnesia is taken to get rid of pain in the stomach.
Statement II Milk of magnesia is a base and it neutralises the excess acid in the stomach.

Codes
(a) Both the statements are individually true and Statement II is the correct explanation of Statement I
(b) Both the statements are individually true but Statement II is not the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

⊙ *(a)* Milk of magnesia or magnesium hydroxide is an inorganic compound. During indigestion, milk of magnesia is taken to get rid of pain in the stomach. It is used as an antacid to relieve indigestion, sour stomach and heart burn.

Hence, option (a) is true.

109. The distribution of electrons into different orbits of an atom, as suggested by Bohr, is

(a) 2 electrons in the *K*-orbit, 6 electrons in the *L*-orbit and 18 electrons in the *M*-orbit
(b) 2 electrons in the *K*-orbit, 8 electrons in the *L*-orbit and 32 electrons in the *M*-orbit
(c) 2 electrons in the *K*-orbit, 8 electrons in the *L*-orbit and 18 electrons in the *M*-orbit
(d) 2 electrons in the *K*-orbit, 8 electrons in the *L*-orbit and 16 electrons in the *M*-orbit

⊙ *(c)* According to Bohr, the distribution of electrons into different orbits of an atom is given by $2n^2$, where, n is number of orbits.

For *K*-orbit, $n = 1$

∴ 2 electrons

For *L*-orbit, $n = 2$

∴ 8 electrons

For *M*-orbit, $n = 3$

∴ 18 electrons

2014 (I)

110. Date of manufacture of food items fried in oil should be checked before buying because oils become rancid due to

(a) oxidation
(b) reduction
(c) hydrogenation
(d) decrease in viscosity

⊙ *(a)* Oil become rancid due to oxidation. It react with food in presence of oxygen and become rancid. Rancid oil is a major source of destructive free radicals in our diet.

111. Which of the following solutions will not change the colour of blue litmus paper to red?

1. Acid solution
2. Base solution
3. Common salt solution

Select the correct answer using the codes given below.

(a) 1 and 3   (b) 2 and 3
(c) Only 1   (d) Only 2

⊙ *(b)* The litmus paper turns red in acidic solution and blue in basic solution. The neutral solution does not affect the litmus paper.

Thus, only acidic solution can change the colour of blue litmus paper to red.

112. Nitric oxide pollution can lead to all of the following, except

(a) leaf spotting in plants
(b) bronchitis related respiratory problems in human
(c) production of corrosive gases through photochemical reaction
(d) silicosis in human

⊙ *(d)* Silicosis in human is a lung disease which occurs due to inhalation of silica-dust.

113. Addition of ethylene dibromide to petrol

(a) increases the octane number of fuel
(b) helps elimination of lead oxide
(c) removes the sulphur compound in petrol
(d) serves as a substitute of tetraethyl lead

⊙ *(d)* Ethylene dibromide is added to petrol in place of tetraethyl lead to save the environment from lead pollution.

114. **Statement I** Clay layers are poor aquifers.

Statement II The inter-particle space of clay minerals is the least.

Codes

(a) Both the statements are individually true and Statement II is the correct explanation of Statement I
(b) Both the statements are individually true but Statement II is not the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

⊙ *(a)* An aquifer is an underground layer of water bearing rocks. Water bearing rocks are permeable, i.e. they have opening that liquids allows and gases to pass through. But clay layers are poor aquifers.

Clay minerals are dense, impermeable material and act as an 'aquiteral',

i.e. a layer of material that is almost impenetrable to water. Through groundwater might more through such material, it will do so very slowly.

115. Which of the following are the two main constituents of granite?

(a) Iron and silica
(b) Iron and silver
(c) Silica and aluminium
(d) Iron oxide and potassium

⊙ *(c)* Silica and aluminium are the two main constituents of granite. Granite contains 72.04% of silica and 14.42% of aluminium in the form of (Al_2O_3).

116. A metal screw top on a glass bottle, which appears to be stuck could be opened by using the fact that

(a) the metal expands more than the glass when both are heated
(b) the metal and glass expand identically when heated
(c) the metal shrinks when heated
(d) Both metal and glass shrink when cooled

⊙ *(a)* Both metal and glass expand when heated. Glass being a non-metal does not have free electrons and hence, have poor thermal conductivity.

Thermal conductivity of metals is very high. Therefore, metal expands more than non-metals due to temperature change.

117. Iron sheet kept in moist air covered with rust. Rust is

(a) an element
(b) a compound
(c) a mixture of iron and dust
(d) a mixture of iron, oxygen and water

⊙ *(b)* Iron forms hydrated iron oxide (rust) when kept open in moist air.

$$4Fe + \underbrace{2O_2 + xH_2O}_{\text{From air}} \longrightarrow$$
$$\underset{\substack{\text{Hydrated iron oxide (rust)}\\\text{(a compound)}}}{2Fe_2O_3 \cdot xH_2O}$$
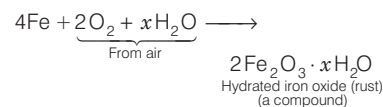
118. Which one of the following gases is supporter of combustion?

(a) Hydrogen
(b) Nitrogen
(c) Carbon dioxide
(d) Oxygen

⊙ *(d)* Combustion is supported by oxygen because combustion is an oxidation process and this cannot occur without the presence of oxygen, but oxygen is not combustible.

So, oxygen is a key reactant in the process of combustion.

BIOLOGY

1. Food chain is
- (a) relationship between autotrophic organisms
- (b) exchange of genetic material between two organisms
- (c) passage of food (and thus energy) from one organism to another
- (d) modern entrepreneur establishment providing food outlets

⊘ *(c)* Food chain is the linear sequence of transfer of matter and energy in the form of food from organism to organism.

It begins from the producer organisms, i.e. plants, and ends with decomposer species like bacteria, fungi, etc.

2. Which one of the following is active transport?
- (a) It is the movement of a substance against a diffusion gradient with the use of energy from respiration
- (b) It is the movement of a substance against a diffusion gradient without the use of energy
- (c) It is the movement of a substance against a diffusion gradient with the use of energy from photosynthesis
- (d) It is the movement of a substance along a diffusion gradient with the use of energy from respiration

⊘ *(a)* Active transport is the movement of molecules across a membrane, from a region of their lower concentration to a region of their higher concentration, i.e. aganist the diffusion or concentration gradient.

Active transport always requires cellular energy to achieve this movement.

3. Chlorophyll in photosynthetic prokaryotic bacteria is associated with
- (a) plastids
- (b) membranous vesicles
- (c) nucleoids
- (d) chromosomes

⊘ *(b)* Chlorophyll in photosynthetic prokaryotic bacteria is associated with membranous vesicles.

These organisms lack membrane bound organelles (such as chloroplast).

They have infoldings of the plasma membrane present in the scattered form in cytoplasm for attachment of chlorophyll. These carryout photosynthesis.

4. Which of the following organisms is responsible for sleeping-sickness?
- (a) *Leishmania*
- (b) *Trypanosoma*
- (c) *Ascaris*
- (d) *Helicobacter*

⊘ *(b) Trypanosoma* is responsible for sleeping-sickness. It is a vector borne disease, transmitted to humans by the tse-tse fly.

Its symptoms include, fever, headache, joint pains and poor mental and physical coordination.

5. Which one of the following body parts/organs of the human body does not have smooth muscles?
- (a) Ureters
- (b) Iris of eye
- (c) Bronchi of lungs
- (d) Biceps

⊘ *(d)* Amongst the options that are given, 'biceps' does not have smooth muscles. Smooth muscles are involuntary muscles as their functioning cannot be directly controlled by our own will.

The muscle present in the biceps as well as triceps are called skeletal or striated or voluntary muscles. We can control the movements of these muscles.

6. Which one of the following cell organelles is known as 'suicidal bags' of a cell?
- (a) Lysosomes
- (b) Plastids
- (c) Endoplasmic reticulum
- (d) Mitochondria

⊘ *(a)* Lysosomes are the cell organelles which are known as 'suicidal bags' of a cell. They contain powerful hydrolytic enzymes which are capable of breaking down all organic material present inside the cell.

During the disturbance in cellular metabolism or when the cell gets damaged, lysosomes may burst and the enzymes digest their own cell. Therefore, they are also known as suicidal bags of a cell.

7. Which one of the following is the correct sequential phase in the successional development of vegetation community in a habitat?
- (a) Migration, reaction, stabilisation and nudation
- (b) Migration, stabilisation, reaction and nudation
- (c) Nudation, migration, reaction and stabilisation
- (d) Reaction, migration, stabilisation and nudation

⊘ *(c)* The successional development of vegetation community in a habit at depends on many factors. In the begining an area is bare, with time there begins migration of people to that area.

This is followed by reaction of people to changing environment condition and lastly people try to stabilise in a given area with certain set of climatic condition. Therefore, the correct sequence is nudation, migration, reaction and stabilisation.

8. Which one of the following acids is also known as vitamin-C?

(a) Methanoic acid　(b) Ascorbic acid
(c) Lactic acid　　　(d) Tartaric acid

⊙ *(b)* Vitamin-C is known as ascorbic acid. It is found in all citrus fruits. It's deficiency in diet comes scurvy.

9. Which one of the following is not found in animal cells?

(a) Free ribosomes　(b) Mitochondria
(c) Nucleolus　　　(d) Cell wall

⊙ *(d)* Animal cell does not possess cell wall. It is present in the plant cells, outside the plasma membrane as a rigid outer covering. It maintains the shape of the cell and protects it. Cell wall is also present in fungi, algae and bacteria.

10. *Marsilea,* fern and horse-tail are examples of which one of the following plant groups?

(a) Pteridophyta　　(b) Bryophyta
(c) Gymnosperms　(d) Angiosperms

⊙ *(a) Marsilea,* fern and horse-tail are examples of division–Pteridophyta of plant kingdom. In this group, the plant body is differentiated into roots, stem and leaves and has specialised tissue for the conduction of water and other substances from one part of the plant body to another.

2019 (I)

11. Which one of the following functions is not carried out by smooth endoplasmic reticulum?

(a) Transport of materials
(b) Synthesis of lipid
(c) Synthesis of protein
(d) Synthesis of steroid hormone

⊙ *(c)* Endoplasmic reticulum has two types–Smooth Endoplasmic Reticulum (SER) and Rough Endoplasmic Reticulum (RER). SER have smooth surface due to lack of ribosomes. Thus, they do not help in protein synthesis unlike RER which contain ribosomes (the site of protein synthesis).

SER help in synthesis of steroid hormones and lipids. They also form vesicles for the transportation of materials.

12. Which one of the following cell organelles mainly functions as storehouse of digestive enzymes?

(a) Desmosome
(b) Ribosome
(c) Lysosome
(d) Vacuoles

⊙ *(c)* Lysosomes are called storehouse of digestive enzymes. These are single membrane bound cell organelles which contain various digestive or hydrolytic enzymes.

Due to the presence of hydrolytic enzymes these are also called as suicidal bags of cell. These enzymes take part in hydrolysis of extracellular materials.

13. Which one of the following tissues is responsible for increase of girth in the stem of a plant?

(a) Tracheid
(b) Pericycle
(c) Intercalary meristem
(d) Lateral meristem

⊙ *(d)* The lateral meristem tissues are responsible for increase of girth in the stem of a plant. This tissue is present along the side of organs, e.g. vascular cambium and cork cambium, which are responsible for the secondary growth of plants. Due to this secondary growth the girth of stems and roots increases.

14. Which one of the following organisms is dependent on saprophytic mode of nutrition?

(a) *Agaricus*　　　(b) *Ulothrix*
(c) *Riccia*　　　　(d) *Cladophora*

⊙ *(a) Agaricus* is an organism which is dependant on saprophytic mode of nutrition. They obtain their nutrition from dead and decaying organic matter.

Rest organisms, i.e. *Ulothrix, Riccia* and *Cladophora* have autotrophic mode of nutrition.

15. Which one of the following statements regarding histone proteins is correct?

(a) Histones are proteins that are present in mitochondrial membrane
(b) Histones are proteins that are present in nucleus in association with DNA
(c) Histones are proteins associated with lipids in the cytosol
(d) Histones are proteins associated with carbohydrates in the cytosol

⊙ *(b)* Statement in option (b) regarding histone protein is correct. These are protein that are present in nucleus in association with DNA.

16. Which one of the following statements regarding haemoglobin is correct?

(a) Haemoglobin present in RBCs can carry only oxygen, but not carbon dioxide
(b) Haemoglobin of RBC can carry both oxygen and carbon dioxide
(c) Haemoglobin of RBCs can carry only carbon dioxide
(d) Haemoglobin is only used for blood clotting and not for carrying gases

⊙ *(b)* Haemoglobin of RBCs can carry both oxygen and carbon dioxide and it not used for clotting of blood. Hence, option (b) is the correct answer.

17. Which one of the following is the correct sequence of passage of light in a compound microscope?

(a) Condenser–Objective lens–Eye piece–Body tube
(b) Objective lens–Condenser–Body tube–Eye piece
(c) Condenser–Objective lens–Body tube–Eye piece
(d) Eye piece–Objective lens–Body tube–Mirror

⊙ *(c)* The correct sequence of passage of light in a compound microscope is condenser–Objective lens–Body tube-Eye piece.

Compound microscope is a common light microscope usually used in labs of schools and colleges. In this type of microscope, light reflected by mirror goes to condenser which condense light on object. From here, light goes to objective lens, body tube and eye piece, respectively.

18. Which one of the following statements is correct?

(a) Urea is produced in liver
(b) Urea is produced in blood
(c) Urea is produced from digestion of starch
(d) Urea is produced in lung and kidney

⊙ *(a)* The statement given in option (a) is correct, i.e. urea is produced in liver. As a result of metabolism of nitrogenous compounds (amino acids, proteins, nucleic acids), ammonia is produced. It combines with CO_2 through ornithine cycle and forms urea.

19. Which one of the following has a bilateral symmetry in its body organisation?

(a) *Asterias*　　　(b) *Sea anemone*
(c) *Nereis*　　　　(d) *Echinus*

⊙ *(c) Nereis* is a member of phylum–Annelida, which has bilateral symmetry in its body organisation.

In bilateral symmetry, a lengthwise vertical plane divided the animals into two equal and opposite halves. Sea anemone of phylum–Cnidaria and *Asterias* and *Echinus* of phylum–Echinodermata have radial symmetry.

20. Which one of the following pairs of animals is warm- blooded?

(a) Crocodile and ostrich
(b) Hagfish and dogfish
(c) Tortoise and ostrich
(d) Peacock and camel

⊙ (*d*) Peacock and camel are warm-blooded animals. These animals regulate their body temperature in any kind of environment. On the other hand, crocodile, hagfish, dogfish, tortoise are cold-blooded animals.

2018 (II)

21. Which of the following is/are the main absorbing organ/organs of plants?

(a) Root only
(b) Leaf only
(c) Root and leaf
(d) Root, leaf and bark

⊙ (*a*) Roots are the main absorbing organ in plants. This underground part of plant, which absorbs water and soluble mineral salts from soil.

22. Which of the following is not a primary function of a green leaf?

(a) Manufacture of food
(b) Interchange of gases
(c) Evaporation of water
(d) Conduction of food and water

⊙ (*d*) Conduction of food and water is not the primary function of a green leaf. Manufacture of food by photosynthesis, gaseous interchange by stomata and evaporation of water (Transpiration) are primary functions of leaves.

Conduction of water and food is done by vascular tissues. Conduction of water occurs *via* xylem and conduction of food occurs *via* phloem.

23. Which one of the following denotes a 'true' fruit?

(a) When only the thalamus of the flower grows and develops into a fruit
(b) When only the receptacle of the flower develops into a fruit
(c) When fruit originates only from the calyx of a flower
(d) When only the ovary of the flower grows into a fruit

⊙ (*d*) True fruit develops from the ovary of flower after fertilisation, while false or pseudo fruit develops from other parts of flower, i.e. the edible part of apple is fleshy receptacle.

24. In which one of the following physiological processes, excess water escapes in the form of droplets from a plant?

(a) Transpiration   (b) Guttation
(c) Secretion   (d) Excretion

⊙ (*b*) Guttation is special physiological process in which excess water escapes in the form of liquid droplets from the tips and margins of leaves. It occurs during night or early morning, when there is high atmospheric humidity and rate of transpiration is lower than the rate of water absorption.

25. If the xylem of a plant is mechanically blocked, which of the following functions of the plant will be affected?

(a) Transport of water only
(b) Transport of water and solutes
(c) Transport of solutes only
(d) Transport of gases

⊙ (*b*) Xylem is responsible for transportation of water and solutes (soluble mineral ions). Thus, its blocking will affect transportation of water and solutes.

26. Which one of the following agents does not contribute to propagation of plants through seed dispersal?

(a) Wind (b) Fungus (c) Animal (d) Water

⊙ (*b*) Fungus does not contribute to propagation of plants through seed dispersal, other factors are helpful in seed dispersal. The dislocation of seeds from their parental plants by different mediums is known as seed dispersal. The seeds of *Calotropis*, *Rafflesia* and lotus are dispersed by wind, elephant and water, respectively.

27. Which one of the following features is an indication for modification of stem of a plant?

(a) Presence of 'eye' on potato
(b) 'Scale' found in onion
(c) 'Tendril' found in pea
(d) 'Hair' present in carrot

⊙ (*a*) Presence of eye on potato is an indication for modification of stem of a plant. Potato is a modified stem, known as tuber. The eye of potato is a very small axillary bud, which contains small internodes and nodes. It can give rise to a new plant *via* asexual reproduction.

The tendrils of pea and scales of onion are modification of leaves, while hairs on carrot are part of root.

28. Which of the following roles is/are played by epididymis, vas deferens, seminal vesicles and prostate in male reproductive system of human?

(a) Spermatogenesis and maturation of sperms
(b) Maturation and motility of sperms
(c) Spermatogenesis and motility of sperms
(d) Motility of sperms only

⊙ (*b*) Epididymis, vas deferens, seminal vesicles and prostate in male reproductive system of human are involved in maturation and motility of sperms. Spermatogenesis occurs in testes, which is a process of formation of sperms.

29. Which one of the following is the special type of milk produced by a lactating mother, essential for the development of immune response of newborn baby in human?

(a) Breast milk produced after a month of childbirth
(b) Transitional milk
(c) Colostrum
(d) Mineralised milk

⊙ (*c*) Colostrum is a type of milk produced by a lactating mother essential for development of immune response of newborn baby in human. It is the first yellow and thick milk produced by a lactating mother. It contains IgA antibodies in abundance, which are essential for the development of immune response against many diseases in a newborn baby.

30. Which one of the following statements explains higher mutation rate and faster evolution found in RNA virus?

(a) RNA is relatively unstable compared to DNA
(b) Virus can multiply only within the living cell of a host
(c) Metabolic processes are absent in virus
(d) Virus can remain latent for a long period

⊙ (*a*) RNA is relatively unstable compared to DNA, which explains higher mutation rate and faster evolution found in RNA virus. The main reasons of unstability of RNA are presence of 2OH group in ribose sugar makes RNA more labile and degradable because it is highly reactive group and single strand structure.

2018 (I)

Directions (Q.Nos. 31-32) *The following consist of two statements, statement I and statement II. Examine these two statements carefully and select the correct answer using the options given below.*

Codes
(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true, but statement II is not the correct explanation of statement I
(c) Statement I is true, but statement II is false
(d) Statement I is false, but statement II is true

31. **Statement I** A person may suffer from tuberculosis if she/he frequently visits crowded place.

Statement II Bacteria of tuberculosis spread through droplets by sneezing or coughing.

⊘ *(a)* Both the statements are individually true and statement II is the correct explanation of statement I.

A person may suffer from tuberculosis if she /he frequently visits crowded place because the bacteria of tuberculosis *(Mycobacterium tuberculosis)* spreads through the droplets by sneezing or coughing by diseased/ affected person.

32. **Statement I** Bioaccumulation is a process of progressive accumulation of heavy metals and pesticides in an organism.

Statement II Large fishes of the pond are found to have higher concentration of pesticides than planktons of the same pond.

⊘ *(b)* Both the statements are individually true, but statement II is not the correct explanation of statement I.
'Bioaccumulation is the accumulation of substances, such as metals and pesticides in an organism.

Bioaccumulation occurs when an organism absorbs a substance at a rate faster than that at which the substance is lost by catabolism and excretion. Fishes have higher bioaccumulation than planktons due to their larger size and food requirement along with their large adipose tissues which deposit and accumulate metals and pesticides.

33. Which one of the following is a true fish as per the biological system of classification?
(a) Silverfish
(b) Jellyfish
(c) Cuttle fish
(d) Flying fish

⊘ *(d)* Flying fish is a true fish as per the biological system of classification.

It is a marine fish, which belongs to order– Beloniformes and class–Pisces.

Other fishes are not true fishes. Silver fish is an arthropod, jellyfish and cuttle fish are the animals, which belong to class–Cnidaria.

34. In which one of the following types of connective tissue in animals does fat get stored?
(a) Adipocyte
(b) Chondrocyte
(c) Osteocyte
(d) Reticulocyte

⊘ *(a)* The excess fat in the body gets stored in the adipocytes of the body tissue named adipose. It is found under the skin. This is made up of fat cells.

35. Which one of the following pairs about organ/part that helps in locomotion is not correctly matched?
(a) *Euglena* : Flagellum
(b) *Paramecium* : Cilia
(c) *Nereis* : Pseudopodia
(d) Starfish : Tube feet

⊘ *(c)* The miss matched pair is *Nereis*–pseudopodia as, it does not have pseudopodia. It has lateral appandages for its movements. Other pairs are correctly matched.

36. Lysosome is formed from which of the following cell organelles?
(a) Nucleus
(b) Endoplasmic reticulum
(c) Golgi bodies
(d) Ribosomes

⊘ *(c)* The lysosomes take their origin from Golgi bodies. These contain hydrolytic enzymes which digest and clean cellular debris.

37. A protein is synthesised in the endoplasmic reticulum bound ribosomes and it targets to the inner thylakoid space of chloroplast. How many double-layered membrane layers it has to pass to reach its destination?
(a) 2 (b) 3 (c) 4 (d) 5

⊘ *(c)* The protein molecules synthesised on ribosomes get processed inside the endoplasmic reticulum which is a double membrane structure.

It reaches to thylakoid by crossing the double membranes of chloroplast.
So, it crosses four membranes in total to reach thylakoid structure.

38. Which one of the following statements about lymph is correct?
(a) Lymph is formed due to leakage of blood through capillaries
(b) Lymph contains blood cells such as RBCs
(c) Lymph is also circulated by the blood circulating heart
(d) Lymph only transports hormones

⊘ *(a)* Statement (a) about lymph is correct. Other statements can be corrected as

lymph is a colourless fluid containing specialised lymphocytes, not RBCs. It circulates throughout the lymphatic system. Lymph is also an important carrier for nutrients, hormones, etc.

39. Which of the following classes of animals has/have three -chambered heart?
(a) Pisces and Amphibia
(b) Amphibia and Reptilia
(c) Reptilia only
(d) Amphibia only

⊘ *(b)* All amphibians and few reptiles have three-chambered heart. They have two auricles and one ventricle and only mixed blood flows through the heart. Whereas, Pisces have two-chambered heart.

40. Accumulation of which one of the following in the muscles of sprinters leads to cramp?
(a) Lactic acid
(b) Ethanol
(c) Pyruvic acid
(d) Glucose

⊘ *(a)* Accumulation of lactic acid in the muscle of sprinters leads to cramp. This occurs under conditions of high energy demand, rapid fluctuations of the energy requirement and insufficient supply of O_2. This leads to cramps or muscle fatigue due to the accumulation of lactic acid during anaerobic respiration.

41. Which one of the following elements is involved in the control of water content of the blood?
(a) Potassium
(b) Lithium
(c) Rubidium
(d) Caesium

⊘ *(a)* Potassium ions are the most abundant cations within tissue fluids. These activate many enzymes, participate in the oxidation of glucose to produce ATP. In blood plasma, potassium level is only 5 mmolL^{-1} within the red blood cells. These concentrations change to 105 m mol (K^+).

42. Which one of the following gases dissolves in water to give acidic solution?

(a) Carbon dioxide
(b) Oxygen
(c) Nitrogen
(d) Hydrogen

⊙ (*a*) Carbon dioxide dissolve in water to form acidic solution. Aqueous solution of carbon dioxide forms carbonic acid (H_2CO_3).

43. Which one of the following elements is essential for the formation of chlorophyll in green plants?

(a) Calcium   (b) Iron
(c) Magnesium   (d) Potassium

⊙ (*c*) Magnesium element is essential for the formation of chlorophyll in green plants. It is the main pigment for the absorption of light in plants is chlorophyll which contains magnesium ion.

2017 (II)

44. Which one of the following proteins gives lustrous shiny appearance to silk fibre?

(a) Fibrin   (b) Sericin
(c) Collagen   (d) Nectin

⊙ (*a*) Fibrin protein constitute 80% of the silk fibre which gives it lustrous shiny appearance. It is produced by cocoon of silkworm.

45. Blue baby syndrome is caused by the contamination of

(a) nitrite (NO_2^-)   (b) sulphite (SO_3^{2-})
(c) nitrate (NO_3^-)   (d) sulphate (SO_4^{2-})

⊙ (*a*) Nitrite gets accumulated in water bodies due to excessive use of nitrogen fertiliser. It causes blue baby syndrome. It hiders with transport of O_2.

46. Match List I with List II and select the correct answer using the code given below.

List I (Cell organelles)		List II (Functions)
A. Mitochondria	1.	Photosynthesis
B. Chloroplast	2.	Protein synthesis
C. Ribosomes	3.	Intracellular diagestion
D. Lysosomes	4.	ATP formation

Codes

	A	B	C	D			A	B	C	D
(a)	3	1	2	4		(b)	3	2	1	4
(c)	4	1	2	3		(d)	4	2	1	3

⊙ (*c*) The most prominent roles of mitochondria are to produce the energy currency of the cell, i.e. ATP. The main role of chloroplasts is to conduct photosynthesis. Ribosomes are a cell organelles that makes protein.

Inside a cell, numerous organelles function to remove wastes. One of the key organelles involved in digestion and waste removal is the lysosome.

47. Human insulin molecule is composed of one α-chain having 21 amino acids and one β-chain having 30 amino acids. How many functional insulin genes occur in adult humans?

(a) One   (b) Two   (c) Three   (d) Four

⊙ (*b*) One gene makes one polypeptide, so two chain of insulin protein will be synthesised by two genes.

48. A biological community in its environment such as a pond, an ocean, a forest, even an aquarium is known as

(a) biome
(b) community
(c) abiotic environment
(d) ecosystem

⊙ (*a*) A biological community in its environment such as a pond, an ocean, a forest, even an aquarium all together form a biome.

49. The foul smell of urine of a healthy man having healthy food, when spilled on floor, is mainly due to the bacterial decomposition of

(a) urea into sulphur dioxide
(b) sugar into carbon dioxide
(c) lipids into methane
(d) urea into ammonia

⊙ (*d*) Urea is degraded by bacteria into ammonia, so it causes foul smell when accumulated at one place.

50. Desalination of sea water is done by using reverse osmosis. The pressure applied to the solution is

(a) larger than osmotic pressure
(b) smaller than osmotic pressure
(c) equal to osmotic pressure
(d) equal to atmospheric pressure

⊙ (*a*) When a pressure, more than the osmotic pressure is applied to the solution, the solvent may pass from solution into the solvent through the semi-permeable membrane. This type of osmosis is known as reverse osmosis. Reverse osmosis is used for the desalination of sea water.

51. **Statement I** Skin cancer is generally caused by the ultraviolet radiation.

Statement II Stratosphere allows ultraviolet radiation to enter the earth from the sun.

Codes
(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true, but statement II is not the correct explanation of statement I
(c) Statement I is true, but statement II is false
(d) Statement I is false, but statement II is true

⊙ (*b*) Both the statements are individually true, but statement II is not the correct explanation of statement I.

Exposure to UV radiation is the main factor that causes skin cells to become cancerous cells.

Almost all skin cancers are caused by too much UV radiation from the sun or other sources such as solaria (Solariums, Sunbeds and Sun lamps).

Skin cancer develops in the cells in the epidermis-the top or outer layer of the skin. The UV rays reaches the earth from the sun through stratosphere.

52. Which one of the following radioactive substances enters/enter the human body through food chain and causes/cause many physiological disorders?

(a) Strontium-90   (b) Iodine-131
(c) Cesium-137   (d) All of these

⊙ (*d*) Strontium-90, iodine-131 and cesium-137, all three are radioactive substances that enter the human body through food chain and cause many physiological disorders in all form of individuals involved in food chain.

2017 (I)

53. Polynucleotide chain of DNA contains

(a) a nitrogenous base, deoxyribose sugar and phosphate group
(b) a nitrogenous base, ribose sugar and phosphate group
(c) deoxyribose sugar, ribose sugar and phosphate group
(d) a nitrogenous base and phosphate group only

⊙ (*a*) Polynucleotide chain of DNA contains a nitrogenous base, deoxyribose sugar and a phosphate group.

Polynucleotides are two DNA strands as they are composed of simple monomer units called nucleotides.

54. The process of copying genetic information from one strand of DNA into RNA is termed as

(a) translation   (b) transcription
(c) replication   (d) mutation

(*b*) The process of copying genetic information from one strand of DNA into RNA is termed as transcription. It is the first step of gene expression, in which a particular segment of DNA is copied into RNA (especially *m*RNA) by the enzyme RNA polymerase.

Both DNA and RNA are nucleic acids, which use base pairs of nucleotides as a complementary language. It consists of three steps–initiation, elongation and termination.

55. AIDS is caused by the Human Immunodeficiency Virus (HIV). The transmission of HIV infection generally occurs through

(a) eating contaminated food and water
(b) transfusion of contaminated blood and blood products
(c) inhaling polluted air
(d) shaking hand with infected person

(*b*) The transmission of HIV infection generally occurs through transfusion of contaminated blood, blood products, donated semen or organ of infected person. It can also be transmitted from infected mother to her child before birth or quite possibly by breast-fed milk.

56. The cell growth and differentiation are highly controlled and regulated in human body but in cancer cells

(a) there is breakdown of these regulatory mechanisms leading to formation of benign and malignant tumours
(b) controlled cell division and over production of genetic material occur
(c) RNA is mutated and produced in less amount
(d) DNA is mutated and produced in less amount

(*a*) The cell growth and differentiation are highly controlled and regulated in human body, but in cancer cells there is breakdown of these regulatory mechanisms leading to the formation of benign and malignant tumours.

This abnormal and uncontrolled division of cells destroy surrounding tissues and causes cancer. Cancer cells do not remain confined to one part of the body and penetrate to adjoining tissues and disrupt their functions.

57. Most viruses that infect plants possess

(a) single-stranded DNA
(b) single-stranded RNA
(c) double-stranded DNA and RNA
(d) double-stranded RNA

(*b*) Most viruses that infect plants possess single-stranded RNA. Like all other viruses, plant viruses are also obligate intracellular parasites that do not have the molecular machinery to replicate without a host. Plant viruses are pathogenic to higher plants, e.g. Tobacco Mosaic Virus (TMV).

58. Syngamy results in formation of

(a) haploid zygote
(b) diploid zygote
(c) non-motile male gametes
(d) motile male gametes

(*b*) Syngamy results in formation of diploid zygote. It is also called fertilisation. It involves the complete and permanent fusion of two haploid gametes to form a zygote. It is the most common mode of sexual reproduction in higher plants and animals.

59. Bleeding of gums, falling of teeth, fragile bones and delayed wound healing occur due to the deficiency of which one of the following vitamins?

(a) Vitamin – C   (b) Vitamin – K
(c) Vitamin – D   (d) Vitamin – B

(*a*) The given symptoms are due to the deficiency of vitamin-C. It is also called as ascorbic acid. It cannot be made by human body and so is an essential component of our diet.

Vitamin-C is needed to make a substance called collagen, which is required for the health and repair of various tissues in the body, including skin, bone, cartilage, blood vessel walls, teeth, ligaments and tendons.

60. Kwashiorkor disease in children is caused by

(a) sufficient carbohydrates, but less fats in diet
(b) sufficient carbohydrates and fats but deficient proteins in diet
(c) sufficient vitamins, but deficient fats in diet
(d) sufficient fats, but deficient vitamins in diet

(*b*) Kwashiorkor disease in children is caused by sufficient carbohydrates and fats, but deficiency of protein in diet. It is a form of severe protein-energy malnutrition characterised by oedema, irritability, ulcerating dermatoses, and an

enlarged liver with fatty infiltrates. It is a result of sufficient calorie intake, but with insufficient protein consumption.

61. The mammalian heart is myogenic and it is regulated by nerves. The heartbeat originates from

(a) sino-atrial node
(b) QRS wave
(c) T wave
(d) hepatic portal system

(*a*) The mammalian heart is myogenic and is regulated by nerves. The heartbeat in this originates from sino-atrial (SA) node. The impulse starts in SA node, which is a small bundle of specialised cells located in the right atrium.

The electrical activity spreads through the walls of the atria and causes them to contract. This forces blood into the ventricles. The SA node sets the rate and rhythm of the heartbeat. It is also called natural pacemaker of heart.

62. The plant growth regulators are small, simple molecules of diverse chemical composition. They are

(a) carbohydrates, fats and proteins
(b) indole compounds, adenine derivatives, carotenoids and terpenes
(c) fatty acids, glucose and vitamins
(d) vitamin-C, vitamin-D and glucose

(*b*) The plant growth regulators are small, simple molecules of diverse chemical composition. They are indole compounds, adenine derivatives, carotenoids and terpenes.

These are also known as plant exogenous hormones. These are synthetic substances that are similar to natural plant hormones. They are used to regulate the growth of plants and are important measures to ensure agricultural production.

2016 (II)

63. Which one of the following gases is released mostly from landfills in urban areas?

(a) Nitrogen   (b) Hydrogen
(c) Methane   (d) Oxygen

(*c*) Methane gas is released from land fills in urban areas. Landfill gas is a complex mixture of different gases created by the action of microorganisms within a landfill. This gas is approximately 40%-60% methane, with the remainder being mostly carbon dioxide.

64. The HIV virus weakens the immunity of a person because it destroys

(a) mast cells　　(b) platelets
(c) erythrocytes　(d) lymphocytes

⊘ (**d**) HIV virus weakens the immunity of a person because it destroys lymphocytes. Human Immunodeficiency Virus (HIV) causes Acquired Immuno Deficiency Syndrome (AIDS).

The virus attacks a specific type of immune system cell in the body, known as CD_4 helper lymphocyte cells. HIV destroys these cells, making it harder for the body to fight off other infections.

65. Which one of the following air pollutants combines with the haemoglobin of human blood and reduces its oxygen carrying capacity, leading to suffocation and may cause even death?

(a) Chlorofluorocarbon
(b) Fly ash
(c) Carbon monoxide
(d) Sulphur dioxide

⊘ (**c**) Carbon monoxide is the air pollutant which combines with the haemoglobin of human blood. It reduces the oxygen-carrying capacity of the blood, which leads to suffocation and may cause even death. Carbon monoxide is produced from incomplete burning of fuels, such as petrol and diesel. It is a poisonous gas.

66. An irregular mode of reproduction resulting in the development of an embryo without fertilisation is called

1. Parthenogenesis
2. Apogamy
3. Sporophytic budding

Which of the statement(s) given above is/are correct?

(a) Only 1
(b) Only 2
(c) 2 and 3
(d) All of the above

⊘ (**d**) **Parthenogenesis** It is a natural form of asexual reproduction in which growth and development of individual occur without fertilisation of eggs.

Apogamy It is the development of sporophytes without gametes and syngamy (fertilisation) from vegetative cells of the gametophyte.

Sporophytic Budding (Adventive embryony) In this, an embryo develops directly from a diploid cell other than egg (from nucellus and integument), e.g. *Citrus, Opuntia*.

67. Deficiency of fluoride leads to which one of the following health problems?

(a) Tooth caries
(b) Mottling of tooth
(c) Bending of bones
(d) Stiffening of joints

⊘ (**a**) Deficiency of fluoride or fluorine may cause dental caries or tooth decay, which means breaking down of dental tissues. Possibly, it may lead to osteoporosis (a bone disorder, which leads to a decrease in bone mass and an increase in bone fragility).

However, due to a lack of fluoride in the diet, there are anti-osteoporotic functional food ingredients that can help in decrease the risk of osteoporosis fractures.

68. Excessive use of which of the following fertilisers may be responsible for the presence of a toxic substance in groundwater?

(a) Nitrogen
(b) Only phosphate
(c) Only potassium
(d) Phosphate and potassium

⊘ (**a**) Excessive use of nitrogen fertiliser including manure may be responsible for the presence of toxic substance in groundwater.

High application rates of nitrogen containing fertilisers combined with the water, leads to increased runoff of chemicals into surface water as well as their leaching into groundwater, thereby causing groundwater pollution.

69. Which one of the following is most sensitive to environmental change?

(a) Amphibian　(b) Reptile
(c) Mammal　　(d) Insect

⊘ (**a**) Amphibians are most sensitive to environmental changes. It is because the egg shell of these animals does not have hard covering as it is found as reptiles and Aves.

Their egg are covered with jelly-like substances. If any change occur in the environment like dryness dehydration, it affects the egg and thus their reproduction gets affected.

70. Which one of the following hormones is essential for the uptake of glucose by cells in the human body?

(a) GH　　　(b) TSH
(c) Insulin　(d) Cortisol

⊘ (**c**) Insuline is the hormone which is essential for the uptake of glucose by cells in the human body.

The body manufactures insulin in the pancreas and the hormone is secreted by the beta (β) cells. The beta cells of the pancreas are perfectly designed as 'fuel sensors' stimulated by glucose.

71. Which of the following cells do not contain nucleus?

1. Root hair cells
2. Red blood cells
3. Platelets
4. Monocytes

Select the correct answer using the code given below

(a) Only 1　　(b) 2 and 3
(c) 1, 2 and 4　(d) 2, 3 and 4

⊘ (**b**) Option (b) is correct that RBCs and platelets do not contain nucleus.

The Red Blood Cells (RBCs) upon maturity looses its nucleus in order to increase its cellular surface area for gaseous exchange. Likewise platelets are also non-nucleated fragments of cytoplasm.

72. Biological catalysts are protein molecules which

1. speed up a chemical reaction.
2. remain unchanged after reaction.
3. function optimally at 37 °C.
4. do not have an enzymatic activity.

Which of the statement(s) given above is/are correct?

(a) Only 1　　(b) 1, 2 and 3
(c) 2 and 3　　(d) 1, 3 and 4

⊘ (**b**) Biological catalysts are enzymes and soluble protein molecules that can speed up chemical reactions in cells.

These reactions includes respiration, photosynthesis and making new proteins. They remain unchanged after reaction and work efficiently at optimum temperature, i.e. 37°C.

73. 'Altitude sickness' is caused at high altitude due to

(a) high partial pressure of oxygen
(b) low partial pressure of oxygen
(c) low level of haemoglobin
(d) high partial pressure of carbon dioxide

⊘ (**b**) Altitude sickness is caused at high altitude due to low partial pressure of oxygen.

There are three types of altitude sickness, i.e. acute altitude or mountain sickness, high altitude pulmonary oedema and high altitude cerebral oedema.

2016 (I)

74. Which one of the following is considered as 'good cholesterol' with reference to individuals facing the risk of cardio-vascular diseases and hypertension?

(a) High Density Lipoprotein (HDL)
(b) Low Density Lipoprotein (LDL)
(c) Triglyceride
(d) Fatty acids

⊙ *(a)* HDL is also known as 'good cholesterol' present in our body because they can transport fat molecules out of artery walls and help in reducing the cardio-vascular diseases.

75. Which of the following pairs of vitamin and disease is/are correctly matched?

1. Vitamin-A   :   Rickets
2. Vitamin-B₁ :   Beri-beri
3. Vitamin-C   :   Scurvy

Select the correct answer using the codes given below:

(a) Only 2
(b) 2 and 3
(c) 1 and 3
(d) 1, 2 and 3

⊙ *(b)* Deficiency of vitamin-B₁ causes

beri-beri disease, which affects peripheral nervous system and cardio vascular system.

Deficiency of vitamin-C causes scurvy. Vitamin-C helps in synthesis of collagen fibre. Bleeding gums are caused due to its deficiency.

Deficiency of vitamin-A causes night-blindness whereas rickets is caused due to the deficiency of vitamin-D.

76. The germplasm is required for the propagation of plants and animals. Germplasm is the

1. genetic resources
2. seeds or tissues for breeding
3. egg and sperm repository
4. a germ cell's determining zone

Select the correct answer using the codes given below:

(a) Only 1   (b) 1, 2 and 3
(c) 2 and 3   (d) 2 and 4

⊙ *(c)* The germplasm includes the collection of genetic resources for further breeding or research programmes in plants and animals. It is a collection of seeds and tissues in case of plants, egg and sperms in case of animals.

77. Dengue virus is known to cause low platelet count in blood of patient by

1. interfering in the process of platelet production in bone marrow.
2. infecting endothelial cells.
3. binding with platelets.
4. accumulating platelets in intestine.

Select the correct answer using the codes given below:

(a) 1 and 2
(b) 1 and 3
(c) 3 and 4
(d) 1, 2 and 3

⊙ *(d)* The platelet count in dengue fever decreases because virus infects vascular endothelial cells, suppresses the platelet production in bone marrow and also gets attached to the platelet cells individually.

78. Plants contain a variety of sterols like stigmasterol, ergosterol, sitosterol, etc., which very closely resemble cholesterol. These plant sterols are referred as

(a) phytosterols   (b) calciferols
(c) ergocalciferols (d) lumisterols

⊙ *(a)* All sterols derived from plants are referred as phytosterols. Vitamin-D is also known as calciferol or ergocalciferol. It is important for absorption of calcium from stomach.

Ergocalciferol is used to treat hypoparathyroidism. Lumisterol is a stereoisomer of ergosterol. It is produced when sterol is exposed to ultraviolet radiations.

79. In Artificial Insemination (AI) process, which of the following is/are introduced into the uterus of the female?

(a) Only egg
(b) Fertilised egg
(c) Only sperms
(d) Egg and sperm

⊙ *(c)* In artificial insemination, only the sperms are introduced in the female genital track to induce fertilisation process.

80. Genetically Modified (GM) crops contain modified genetic material due to

1. introduction of new DNA
2. removal of existing DNA
3. introduction of RNA
4. introduction of new traits

Select the correct answer using the codes given below:

(a) 1 and 2   (b) 1, 2 and 3
(c) 3 and 4   (d) 1, 2 and 4

⊙ *(d)* Genetically modified crops contain segments of foreign DNA that bring a new trait in the existing genome of the organism. It might involve the removal of some part of existing DNA too. It does not involve introduction of RNA.

81. Which one of the following vitamins has a role in blood clotting?

(a) Vitamin-A   (b) Vitamin-B
(c) Vitamin-D   (d) Vitamin-K

⊙ *(d)* Vitamin-K is involved in the blood clotting phenomenon. It induces the production of certain protein molecules, which act as precursors for blood clotting enzymes.

Vitamin-A is required for synthesis of visual pigments such as rhodopsin and iodopsin, essential for reproduction and have anticancerous property.

Vitamin-D is synthesised in skin by UV rays of light. It is important for bone and teeth. Vitamin-B is a complex of many vitamins, soluble in water.

82. Glucose is a source of energy. Which one of the following types of molecule is glucose?

(a) Carbohydrate   (b) Protein
(c) Fat   (d) Nucleic acid

⊙ *(a)* Carbohydrates are an energy containing plant products. These include monosaccharides like glucose molecules. Glucose is first used in respiration for release of energy.

Glucose polymerise to form glycogen (energy reserve in animals), cellulose (structural component of cell wall), starch (energy reserve in plants). Proteins are building blocks of the body.

They are essential for growth, repair and reproduction. Fat acts as reserve fuel of body. It produces 2.25 times more energy as compare to carbohydrates.

83. The living content of cell is called protoplasm. It is composed of

(a) only cytoplasm
(b) cytoplasm and nucleoplasm
(c) only nucleoplasm
(d) cytoplasm, nucleoplasm and other organelles

⊙ *(d)* Protoplasm is the total living content of a cell that is surrounded by plasma membrane. It is composed of cytoplasm, nucleoplasm and other organelles.

84. Which one of the following hormones contains peptide chain?
(a) Oxytocin (b) Corticotrophin
(c) Insulin (d) Cortisone

⊙ (**c**) Insulin hormone is made up of two polypeptide chains. These are joined by disulphide bonds.

2015 (II)

85. Penicillin inhibits synthesis of bacterial
(a) cell wall (b) protein
(c) RNA (d) DNA

⊙ (**a**) Penicillin is an antibiotic, which kills bacteria by inhibiting the synthesis of cell wall. Specifically the cross linking of bacterial cell wall mucosaccharide chains is prevented.

86. Most antibiotics target bacterial parasites interfering with various factors of growth or metabolism such as
1. synthesis of cell wall.
2. bacterial protein synthesis.
3. synthesis of nuclear membrane.
4. mitochondria function.

Select the correct answer using the codes given below:
(a) 1, 2 and 3 (b) 1 and 4
(c) 2 and 3 (d) 1 and 2

⊙ (**a**) Most antibiotics kill bacterial parasites by inhibiting synthesis of cell wall, nuclear membrane and protein.

87. Which of the following is not gaseous air pollutant?
(a) Oxides of sulphur
(b) Oxides of nitrogen
(c) Hydrocarbon
(d) Smoke

⊙ (**d**) The gaseous air pollutants are primary concern in urban areas include sulphur dioxide, nitrogen dioxide and carbon monoxide. These are emitted directly into the air from fossil fuels, whereas, smoke is a collection of tiny solid, liquid and gas particles.

88. Genetic screening is
(a) analysis of DNA to check the presence of a particular gene in a person
(b) analysis of gene in a population
(c) pedigree analysis
(d) screening of infertility in parents

⊙ (**a**) The genetic screening is meant to check particular gene (faulty gene) in a person by the analysis of DNA of a person.

89. Who among the following is considered as the 'father of genetic engineering'?
(a) Philip Drinker
(b) Paul Berg
(c) Thomas Addison
(d) Alpheus S Packard Jr

⊙ (**b**) Paul Berg is considered as the 'father of genetic engineering'.
He developed the technique to join DNA segments of two different organisms in 1973.

90. Which of the following cause(s) for variation in the genetic material of progeny?
1. Sexual reproduction
2. Asexual reproduction
3. Mutations
4. Epigenetic changes

Select the correct answer using the codes given below:
(a) Only 2 (b) 1, 2 and 3
(c) 1, 3 and 4 (d) 1 and 3

⊙ (**d**) The causes for variation in the genetic material of progeny are both mutation and sexual reproduction.
During sexual reproduction meiosis occurs in which crossing over takes place where exchange of chromosomal segments occurs and random mating of male and female gametes occurs. That is why new variations generated during sexual reproduction.
During asexual reproduction no meiosis and mating of gametes occurs so little changes may occur due to the mutation which occurs randomly and suddenly.
Epigenetic is the study of change in gene expression that does not involve change to the underlying DNA sequence. It is a change in phenotype with a change in genotype.

91. Cobalt is associated with
(a) growth hormone
(b) vitamin-B_{12}
(c) haemoglobin
(d) intestinal enzymes

⊙ (**b**) Cobalt is associated with the molecular structure of vitamin-B_{12}. That is why it is also known as cyanocobalamin. Growth hormones do not contain cobalt, but they are peptide in nature. Haemoglobin contains iron as a haeme pigment. Intestinal enzymes are proteins in nature.

92. Absorption of water in the human body can be found in
1. renal tubule in kidney.
2. hepatic cells in liver.
3. large intestine.
4. pancreatic duct.

Select the correct answer using the codes given below:
(a) 1, 2 and 3 (b) 1 and 3
(c) 2 and 4 (d) Only 3

⊙ (**b**) The absorption of water takes place only in the large intestine of alimentary canal and renal tubule of kidney. Hepatic cells of liver are phagocytic in nature and pancreatic duct carries pancreatic juice.

93. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Geological Time-Scale)	List II (Life forms)
A. Pleistocene	1. Mammals
B. Paleocene	2. Human genus
C. Permian	3. Invertebrates
D. Cambrian	4. Frogs

Codes

	A	B	C	D
(a)	2	1	4	3
(b)	2	4	1	3
(c)	3	4	1	2
(d)	3	1	4	2

⊙ (**a**) The evolution of human genus took place during the Pleistocene, the time period that spanned from 1.8 to 11700 million years ago.
Mammals had first appeared in the late Triassic 240 million years ago at about the same time as dinosaurs. During the period of Paleocene, lasted from about 66-56 million years ago, mammals occupied a larger part of the vacant ecological niches.
Permian is a geological period extends from 299 to 241 million years ago, in which frogs appeared first time.
Cambrian period is the first geological time period of the Paleozoic era, lasted from 541 to 485.4 million years ago during which period invertebrate evolved and developed.

94. Measles is a disease caused by
(a) bacteria (b) virus
(c) protozoan (d) worm

⊙ (**b**) Measles is caused by the virus (paramyxovirus), which is highly contagious. It is spread through dropped transmission from the nose, throat and

mouth of someone, who is infected with the virus.

Bacteria cause many diseases as typhoid, cholera, tuberculosis by many species. Protozoans cause, sleeping-sickness, kala-azar, amoebiasis and diarrhea. Worm leads to ascariasis, elephantiasis, guinea worm diseases.

95. Neutrophils and lymphocytes originate from
(a) kidney tubule   (b) spleen
(c) bone marrow   (d) lymph node

⊙ *(c)* All white blood cells including lymphocytes and neutrophils are originate from bone marrow. Lymph nodes are sites where WBCs remain accumulated and they fight with bacteria, virus and other foreign agents. In the spleen RBCs are destroyed and in kidney tubule selective reabsorption occurs, finally urine is formed.

96. The mandate of the scheme entitled 'Directly Observed Treatment, Short-Course (DOTS)' launched by WHO is to ensure that
(a) doctors treat patients with medicine for a short duration
(b) doctors do not start treatment without a trial
(c) patients complete their course of drug
(d) patients voluntarily take vaccines

⊙ *(c)* The DOTS strategy ensures that infectious TB patients are diagnosed and treated effectively till cure, by ensuring availability of the full course of drugs and a system for monitoring patient compliance to the treatment. Other three options are not correct in relation to DOTS.

2015 (I)

97. In human digestive system, the process of digestion starts in
(a) oesophagus   (b) buccal cavity
(c) duodenum   (d) stomach

⊙ *(b)* In human digestive system, the process of digestion starts in mouth or buccal cavity where salivary amylase (enzyme present in saliva) breakdown starch into dextrin and maltose.

In oesophagus no digestion of food occurs. In stomach gastric juice is secreted releasing propepsinogen and prorennin converting into pepsin and rennin which digest protein, in the presence of hydrochloric acid.

In the duodenum bile, pancreatic juice and intestinal juice is secreted, which release different enzymes for digestion of incompletely digested protein, carbohydrate and fat.

98. Which one among the following is a micronutrient present in soil for various crops?
(a) Calcium   (b) Manganese
(c) Magnesium   (d) Potassium

⊙ *(b)* Manganese is one of the micronutrients that is derived from soil and is needed in small amounts.

It functions with enzyme systems involved in breakdown of carbohydrates and nitrogen metabolism.

Calcium (Ca) element is an important component of middle lamella in cell wall. It is also required for cell division, cell enlargement and translocation of carbohydrate.

Magnesium (Mg) is a component of chlorophyll. It is important in synthesis of fat and respiration. It binds two subunits of ribosomes. Potassium (K) is important for K^+/Na^+ pump essential for maintaining normal gradient during active transport. It also plays important role in opening and closing of stomata. It is helpful in maintaining turgidity of cell.

99. Which one of the following diseases in humans can spread through air?
(a) Dengue   (b) Tuberculosis
(c) HIV/AIDS   (d) Goitre

⊙ *(b)* Tuberculosis is the disease caused by bacterium *Mycobacterium tuberculosis*. It spreads through the air through coughing, sneezing by infected person, etc.

Dengue spread by female *Aedes aegypti* mosquito transmitting arbovirus. HIV spread through injection, blood transfusion and sexual contacts.

100. Which one of the following statements regarding water cycle is correct?
(a) Transpiration by plants does not contribute to cloud formation
(b) Only evaporation of surface water of rivers and oceans is responsible for cloud formation
(c) Rainfall does not contribute in maintenance of underground water level
(d) Underground water may also be connected to surface water

⊙ *(d)* The water cycle or hydrological cycle is a continuous cycle where water evaporates, travels into the air and becomes part of a cloud, falls down to

the earth as precipitation and then evaporates again. This repeats again and again in a never-ending cycle.

Water keeps moving and changing from a solid to a liquid to a gas, over and over again. Precipitation creates runoff that travels over the ground surface and helps to fill lakes and rivers.

It also percolates or moves downward through openings in the soil to replenish aquifers under the ground.

101. Which one among the following structures or cells is not present in connective tissues?
(a) Chondrocytes   (b) Axon
(c) Collagen fibre   (d) Lymphocytes

⊙ *(b)* Axon is the structure that is not present in connective tissue. It is a part of nervous tissue that forms a long, slender projection of a nerve cell or neuron and conducts electrical impulses away from neuron's cell body.

On the other hand connective tissue consists of blood, lymph, cartilage, fibres (like collagen fibres), ground substance and cells (like lymphocytes and chondrocytes).

102. The word 'vaccination' has been derived from a Latin word which relates to
(a) pig   (b) horse (c) cow   (d) dog

⊙ *(c)* The word 'vaccine' comes from the Latin word *vaccinus* which means 'pertaining to cows'. The first vaccine was based on the relatively mild cowpox virus, which infected cow and people associated with them.

This vaccine protected people against smallpox virus. Pig, horse and dog are not connected to the origin of vaccine word.

103. Which one among the following statements is correct?
(a) Prokaryotic cells possess nucleus
(b) Cell membrane is present in both plant and animal cells
(c) Mitochondria and chromoplasts are not found in eukaryotic cells
(d) Ribosomes are present in eukaryotic cell only

⊙ *(b)* Cell membrane is present in both plant and animal cells whereas cell wall is absent in animal cells.

Prokaryotic cells does not possess a well-defined nucleus. The DNA exists freely in the cytoplasm as a closed loop.

Mitochondria and chromoplasts are found in eukaryotic cells. Ribosomes are present in both prokaryotic and eukaryotic cells. They aid in protein synthesis.

104. Which one among the following statements is not true for mammals?

(a) They possess hair on the body
(b) Some of them lay eggs
(c) Their heart is three-chambered
(d) Some are aquatic

⊙ *(c)* All the statements are true about mammals except (c). The heart of the mammals is four-chambered with two auricles and two ventricles that prevent mixing of oxygenated and deoxygenated blood. Double circulation is the characteristic feature of mammalian heart.

105. Which of the following statement(s) is/are correct?

1. Professor Kamal Bawa was conferred with the MIDORI Prize (2014) for biodiversity for his research on climate change in the Himalayas.

2. MIDORI Prize is an annual international prize given to an individual for outstanding contribution to the conservation and sustainable use of biodiversity at global, regional or local levels.

Select the correct answer using the codes given below:

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(c)* Kamal Bawa, a professor of biology at the University of Massachusetts, has received the 2014 MIDORI Prize in Biodiversity.

Bawa has received the MIDORI Prize in recognition of his research on the ecology and sustainable use of tropical forests.

The MIDORI Prize for Biodiversity was established in 2010 at the occasion of the 20th anniversary of the AEON Environmental Foundation, which coincided with the celebration of the International Year of Biodiversity.

2014 (II)

106. Match List I with List II and select the correct answer using the codes given below the lists:

List I (Animals)		List II (Phyla)	
A.	*Ascaris*	1.	Mammalia
B.	Malarial parasite	2.	Arthropoda
C.	Housefly	3.	Nematoda
D.	Cow	4.	Protozoa

Codes

	A	B	C	D
(a)	3	4	2	1
(b)	3	2	4	1
(c)	1	2	4	3
(d)	1	4	2	3

⊙ *(a)* The correct matching is

Animals	Phylum
Ascaris	Nematoda
Malarial parasite	Protozoa
Housefly	Arthropoda
Cow	Mammalia

107. Which one among the following pairs is not correctly matched?

(a) Sandal wood plant   Partial root parasite
(b) *Cuscuta*   Parasite
(c) *Nepenthes*   Carnivorous
(d) Mushrooms   Autotroph

⊙ *(d)* Mushrooms are heterotrophs because they get their food from decomposition of organic matter and consume nutrients from the soil.

Sandal wood plant is a partial root parasite whose roots draw some nourishment from the roots of other trees. *Cuscuta* (has no chlorophyll) parasitises on wild and cultivated plants like alfalfa and potatoes.

Nepenthes (pitcher plant) is a carnivorous, insectivorous plant which attracts and kills their prey to gain nitrogen and phosphorus minerals to supplement their nutrient requirements.

108. Which one among the following cattle breed produces highest amount of milk?

(a) Brown Swiss
(b) Holstein
(c) Dutch belted
(d) Blaarkop

⊙ *(b)* Holstein Friesians are a breed of cattle known today as the world's highest production dairy animals.

They give on an average of about 7330 litres of milk/year. While on the other hand Brown Swiss produces the second largest quantity of milk per annum. Blaarkop produces 6000 litres of milk on an average and Dutch belted breed supplies about 12000-15000 pounds of milk per lactation period.

109. Which one among the following is the generic name of the causal organism of elephantiasis?

(a) *Filaria*
(b) *Microfilariae*
(c) *Wuchereria bancrofti*
(d) *Culex pipiens*

⊙ *(c)* Elephantiasis is a chronic disease whose causal organism is *Wuchereria bancrofti*, a human parasitic roundworm.

The disease usually spreads through bite of *Culex pipiens* which further develops in mosquito and change into *Microfilariae* and it reaches to man.

Finally it reaches the lymphatic vessels of the lower limbs where lymphatic fluid accumulate leading to swelling of affected organ.

Filariasis is a parasitic disease transmitted by blood feeding arthropods mainly black flies and mosquitoes.

110. Which one among the following statements is not correct?

(a) Pulses are rich in proteins
(b) Milk is a rich source of vitamin-A
(c) Cereals are very poor source of carbohydrates
(d) Vegetables are rich source of minerals

⊙ *(c)* Statement given in option (c) is not correct. Cereals are rich source of carbohydrates, i.e. they contain 80% of them.

Milk is a rich source of thiamin, riboflavin and vitamin-B_{12} and it also contains a good amount of vitamin-A. Vegetables are rich source of both vitamins and minerals while, pulses are considered as the richest source of proteins.

111. Which of the statements given below are correct?

1. A person having blood group-A can donate blood to persons having blood group-A and blood group-AB.
2. A person having blood group-AB can donate blood to persons having blood groups-A, B, AB or O.
3. A person with blood group-O can donate blood to persons having any blood group.
4. A person with blood group-O can receive blood from the person of any of the blood groups.

Select the correct answer using the codes given below:

(a) 1, 2, 3 and 4   (b) 1 and 2
(c) 3 and 4   (d) 1 and 3

⊙ *(d)* A person having blood group-A ($I^A I^A$ or $I^A i$) can donate blood to persons having blood group-A ($I^A I^A$ or $I^A i$) or AB ($I^A I^B$) as no antibodies will be raised in the acceptor against the antigen present in the donor's blood.

A person having blood group-O ($I^O I^O$) can donate blood to persons with blood group-A, B and AB as it will raise antibodies against antigen A and B present in donor's blood group.

However the person with blood group-AB can receive blood from any person irrespective of the type of blood group present, is therefore called a 'Universal recipient'.

A person with blood group-O contains no antigen and hence can donate blood to acceptor having any blood group. Therefore, person with blood group-O is called as 'Universal donor'.

A person with blood group-O cannot receive blood from donor having variant blood groups as his body will raise antibodies against any antigen (I^A or I^B) present in the donor's blood. Hence, this statement is false and he can accept blood only from the person having blood group-O.

112. Which one among the following is the correct pathway for the elimination of urine?

(a) Kidneys, Ureters, Bladder, Urethra
(b) Kidneys, Urethra, Bladder, Ureters
(c) Urethra, Ureters, Bladder, Kidneys
(d) Bladder, Ureters, Kidneys, Urethra

⊘ *(a)* The correct pathway for the elimination of urine is
Kidneys → Ureters → Urinary Bladder → Urethra

Kidneys are main excretory organs where urine formation occurs. Ureters are tube-like structures emerging from hilum of kidneys.

Urinary bladder is a sac-like structure where urine is stored. Through urethra urine is discharged outside.

113. Which of the following parts are found in both plant and animal cells?

(a) Cell membrane, chloroplast, vacuole
(b) Cell wall, nucleus, vacuole
(c) Cell membrane, cytoplasm, nucleus
(d) Cell wall, chloroplast, cytoplasm

⊘ *(c)* Cell membrane, cytoplasm and nucleus are the components or parts that are common to both plant and animal cells, whereas cell wall and chloroplast are strictly confined to plant cell only.

Prominent vacuole is present in plant cell whereas animal cell contains multiple small vacuoles.

114. Which of the following statements is/are correct?

1. Coronary artery supplies blood to heart muscles.

2. Pulmonary vein supplies blood to lungs.
3. Hepatic artery supplies blood to kidneys.
4. Renal vein supplies blood to kidneys.

Select the correct answer using the codes given below:

(a) Only 1   (b) 1 and 2
(c) 2 and 4   (d) 1, 3 and 4

⊘ *(a)* Only statement 1 is correct, rest are incorrect. Pulmonary veins deliver oxygenated blood from lungs to heart. Common hepatic artery supplies blood to the liver, pylorus, duodenum and pancreas. Renal vein carries the blood, filtered by kidney to the heart.

2014 (I)

115. Which of the following does not possess a specialised conducting tissue for transport of water and other substances in plants?

(a) *Marchantia*   (b) *Marsilea*
(c) *Cycas*   (d) Fern

⊘ *(a)* *Marchantia* belongs to group bryophytes. In bryophytes plants absorb water through general body surface. Bryophytes are amphibians of plant kingdom. They grow near water or in moist and shady places. They cannot complete their life cycle without water, but they lack conducting tissues. In bryophytes, xylem and phloem are present.

Marsilea and fern belong to group pteridophytes which have xylem tissue for transport of water. *Cycas* belongs to gymnosperms which also have xylem, but vessels are absent.

116. Which of the following structures of a plant is responsible for transpiration?

(a) Xylem (b) Root (c) Stomata (d) Bark

⊘ *(c)* Stomata is a tiny opening or pore that is responsible for transpiration. Air containing carbon dioxide and oxygen enter the plant through these openings where it is used in photosynthesis and respiration. Also, water vapour gets into the atmosphere through these pores in a process called transpiratioin.

Some times small pores lenticels are also present. Xylem is responsible for conduction of water. Root absorbs water from soil and barks are dead covering in older plants.

117. People suffering from 'anorexia nervosa'

(a) develop paralysis
(b) show poor reflex
(c) cannot speak properly
(d) eat very little and fear gaining weight

⊘ *(d)* Anorexia nervosa is an eating disorder characterised by immoderate food restriction, inappropriate eating habits or rituals, obsession with having a thin figure, and an irrational fear of weight gain, as well as a distorted body self-perception.

118. Which of the following statements is/are correct regarding fats?

1. Fats are needed for the formation of cell membrane.
2. Fats help the body to absorb calcium from food.
3. Fats are required to repair damaged tissue.
4. Body cannot release energy in fats as quickly as the energy in carbohydrates.

Select the correct answer using the codes given below:

(a) 1 and 4   (b) Only 1
(c) 2 and 4   (d) 3 and 4

⊘ *(a)* Fats are needed for the formation of cell membrane. Fats are present in the form of phospholipid.

Phospholipid are the same as triglycerides except that
one of the three fatty acid units is replaced by a molecule that contains phosphorus.

Body cannot release energy in fats as quickly as the energy released in carbohydrates because fat first will have oxidise into carbohydrate in the form of acetyl Co-A for releasing energy.

Vitamin-D is essential for absorption of calcium (Ca) and proteins are required for repairing of damaged tissue of the body.

119. Among the following animals, choose the one having three pairs of legs.

(a) Spider   (b) Scorpion
(c) Bug   (d) Mite

⊘ *(c)* Among the given options bug has only three pairs of legs. All the insects in phylum–Arthropoda have three pairs of leg. In given option only bug belongs to class–Insecta. Others have four pairs of legs belong to other class–Arachnida.

120. Which of the following statement(s) is/are correct?

1. Amnion contains fluid.
2. Ultrasound scan can detect the sex of an embryo.

Select the correct answer using the codes given below:

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ (**c**) Both the statements (1) and (2) are correct. Amnion is a membrane, filled with fluid, closely covers the embryo which protects it from shock.

The sex of the embryo may be determined by ultrasound as early as 11 weeks gestation.

121. Deficiency of which of the following elements is responsible for weakening of bones?

1. Calcium
2. Phosphorus
3. Nitrogen
4. Carbon

Select the correct answer using the codes given below:

(a) 1 and 2
(c) 1, 2 and 3
(b) Only 1
(d) Only 4

⊙ (**a**) Deficiency of calcium and phosphorus is responsible for weakening of bone because bone is made up of calcium and phosphate both.

Deficiency of nitrogen and carbon may affect proteins content leading to stunted body growth which may lead to protein energy disorder such as marasmus in childhood stage.

122. In a forest, animals like voles and wood lice feed on plant roots and barks, respectively. Among the other carnivores, foxes, shrews and owls are present in that forest. Following predictions are made by a group of observers who have visited the forest.

1. If the roots of the tree develop a disease, then voles and foxes will starve and not the owls.
2. Population of voles is dependent on wood lice population through food web.
3. If owl population declines, it will indirectly affect wood lice population.
4. If barks of tree are affected due to a disease, then reduction of wood lice will affect the shrew population forcing owls to eat more voles.

Which of the above prediction(s) is/are correct?

(a) 1, 2, and 4
(b) Only 3
(c) 1 and 2
(d) Only 2

⊙ (**b**) If owl population declines, it will indirectly affect wood lice population because if owl population will decline the population of wood lice increases because owl is not available to eat the wood lice population.

Hence option (b) is correct.

123. Match the following.

List I (Glands)		List II (Hormones)
A.	Pancreas	1.	Cortisol
B.	Pituitary	2.	Vitamin-D
C.	Adrenal	3.	Thyroid stimulating hormone
D.	Kidneys	4.	Glucagon

Codes

	A	B	C	D
(a)	4	3	1	2
(b)	4	1	3	2
(c)	2	1	3	4
(d)	2	3	1	4

⊙ (**a**) The correct matching is

List I (Glands)	List II (Hormones)
Pancreas	Glucagon
Pituitary	Thyroid stimulating hormone
Adrenal	Cortisol
Kidneys	Vitamin-D

124. Which one of the following elements is present in green pigment of leaf?

(a) Magnesium
(b) Phosphorus
(c) Iron
(d) Calcium

⊙ (**a**) Magnesium is present in green pigment of leaf. The green pigment of leaf is chlorophyll molecule. Chlorophyll is chemically a tetrapyrrole structure in which Mg^{++} is present in the centre.

Phosphorus is an important component of nucleic acid, component of cell membrane. Iron is associated with electron transport chain in photosynthesis and respiration.

It is essential for chlorophyll synthesis. Calcium is present in middle lamella of cell wall in the form of calcium pectate. Calcium stimulates development of root hairs. It plays an important role in apical meristems and mitosis.

125. Two strands of DNA are held together by

(a) hydrogen bonds
(b) covalent bonds
(c) electrostatic force
(d) van der Waals' forces

⊙ (**a**) Two strands of DNA are held together by hydrogen bond. H-bond is formed between the bases of two strands. adenine pair with thymine by two H-bonds and guanine pair with cytosine by three H-bonds.

Covalent bond is present between phosphoric acid and sugar in the form of phosphodiester bond.

Electrostatic force and van der Waal's forces do not present in DNA.

2019 (II)

1. What was the Dutt-Bradley Thesis?

(a) The Working Committee of the Indian National Congress decided that Congress should play a crucial role in realising the independence of India

(b) The Socialist Party decided to play foremost part in anti-imperialist struggle

(c) Revolutionary socialist Batukeshwar Dutt put forth a ten-point plan to work for the success of anti-imperialist front

(d) It was a Communist Party document, according to which the National Congress could play a great part and a foremost part in realising the anti-imperialist people's front

⊗ *(d)* Dutt-Bradley Thesis was a Communist Party document, according to which the National Congress could play a great part and a foremost part in realising the anti-imperialist people's front.

The Anti-imperialistic people's front in India written by Rajni Palme Dutt and Ben Bradley, popularly known as the Dutt-Bradley Thesis.

Anti-imperialist people are opposed to colonialism, colonial empires, hegemony, imperialism and the territorial expansion of a counter beyond its established borders.

Hence, option (d) is the correct answer.

2. The Khuntkatti tenure was prevalent in which one of the following regions of India during the British Colonial Rule?

(a) Bundelkhand

(b) Karnataka

(c) Chota Nagpur

(d) Madras Presidency

⊗ *(c)* Tribal people in Chota Nagpur area, which is present day in Jharkhand,

practised Khuntkatti Tenure (system) (joint holding tribal lineages) till mid-19th century.

3. Who among the following started the Indian Agriculture Service?

(a) Lord Curzon   (b) William Bentinck

(c) Lord Minto   (d) Lord Rippon

⊗ *(c)* The Indian Agriculture Service was started in 1906 under the All India Board of Agriculture. It was during the viceroyalty of Lord Minto. However, the training of staff could not be taken out due to lack of funds and primary aim remained as merely education.

4. Chandimangal was composed in which one of the following languages during the 16th century CE?

(a) Sanskrit   (b) Tamil

(c) Bengali   (d) Oriya

⊗ *(c)* The Chandimangal is an important subgenre of Mangal Kavya, the most significant genre of medieval Bengali literature.

The text belonging to this subgenre praise Chandi or Abhaya, primarily a folk goddess, but subsequently identified with puranic goddess Chandi.

This identification was probably completed a few centuries before the earliest composition of the Chandimangal Kavya.

5. In December, 1962, which Soviet leader declared that China was responsible for the Sino-Indian War of 1962?

(a) Khrushchev   (b) Bulganin

(c) Suslov   (d) Malenkov

⊗ *(a)* The Sino-Indian War, also known as the Indo-China war and Sino-Indian border conflict, was a war between China and India that occurred in 1962. On 2nd October, Soviet leader Nikita Khrushchev declared that China was responsible for the Sino-Indian War of 1962.

6. Who were the Nayanars?

(a) Those who were immersed in devotion to Vishnu

(b) Those who were devotees of Buddha

(c) Leaders who were devotees of Shiva

(d) Leaders who were devotees of Basveshwara

⊗ *(c)* Nayanars were a group of 63 saints in the 6th to 8th century who were devoted to the Hindu God Shiva in Tamil Nadu.

They along with the Alwars, influenced the Bhakti movement in Tamil. The names of the Nayanars were first compiled by Sundarar.

7. Who among the following Mughal emperors was a follower of the Naqshbandiyya leader, Khwaja Ubaydullah Ahrar?

(a) Babur   (b) Humayun

(c) Akbar   (d) Jahangir

⊗ *(a)* Mughal emperor Babur was the follower of Khwaja Ubaydullah Ahrar, a member of Naqshbandi Sufi order.

This order was introduced in India by Khwaja Baqi Billah from the beginning the mystics of this order stressed on : the observance of the shariat and denounced all innovations or biddat.

8. Consider the following statements:

1. According to Mahavamsa, Ashoka turned to the Buddha's dhamma when his nephew Nigrodha preached the doctrine to him.

2. Divyavadana ascribes Ashoka being drawn to the Buddha's teaching to the influence of Ashokavandana Samudra, a merchant-turned monk.

3. Dipavamsa speaks of Samudra, the 12 year old son of a merchant, as the key figure in Ashoka's coming under the influence of the Buddhist dhamma.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) 1 and 2   (d) 1 and 3

⊙ **(a)** According to Mahavamsa, Ashoka turned to the Budha's dhamma when his nephew Nigrodha preached the doctrine to him.

Divyavadana ascribes Ashoka being drawn to the Budha's teaching to the influence of Upagupta (a Buddhist monk).

Dipavamsa refers to three visits to the Sri Lanka by the Buddha, the places being Kelaniya, Deegavapi Raja Maha Viharaya. The Dipavamsa lauds the Theravada as a great banyan tree.

Hence, statements 2 and 3 are incorrect and statement 1 is correct.

9. Who is the author of the 16th century Sanskrit text, the *Vraja Bhakti Vilasa* which focuses on the Braj region in North India?

(a) Todar Mal   (b) Narayana Bhatta
(c) Chaitanya   (d) Rupa Goswami

⊙ **(b)** Narayana Bhatta Goswami was Brahmin born in South India. Later, he came to Vraja and took initiation from Krishna Das Brahmachari. He wrote the 16th Century Sanskrit text Vraja Bhakti Vilasa which focuses on the Braj region in North India.

Directions (Q. Nos. 10-13) *The following items consists of two statements, Statement I and Statement II. Examine these two statements carefully and select the correct answer using the codes given below.*

Codes
(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true, but statement II is not the correct explanation of statement I
(c) Statement I is true, but statement II is false
(d) Statement I is false, but statement II is true

10. **Statement I** The Greek travellers were most impressed by the fertility of India's soil and the energy and ability of her cultivators.

Statement II Ancient India knew the use of manure.

⊙ **(a)** Ancient India knew the use of manure. Because of this Greek travellers were most impressed by the fertility of India's soil and the energy and ability of India's cultivators.

From Maurya period to Gupta period, the arrival of Greeks in India is common. Greek travellers visited India and impressed by India's natural beauty in terms of plants, animals, minerals.

Hence, both the statements are correct and statement II is correct explanation of statements I.

11. **Statement I** Non-cooperation began in Punjab with the student movement inspired by Lala Lajpat Rai in January 1921.

Statement II The Sikh dominaed central Punjab countryside was stirred by the powerful Akali upsurge.

⊙ **(d)** Non-cooperation movement was started to demand Swaraj from Britishers. The main goal is not cooperate with British government and to create barriers in their daily work. Gandhiji started non-cooperation movement on 1st August, 1920 and ended till Febraury, 1922.

The Sikh dominated central Punjab countryside was stirred by the powerful Akali upsurge. Hence, statement I is false, but statement II is true.

12. **Statement I** The Oudh Kisan Sabha established in 1920 failed to bring under its wing any Kisan Sabhas.

Statement II The Oudh Kisan Sabha asked the Kisans to refuse to till Bedakhli land, not to offer hari and begar.

⊙ **(d)** In 1917, Jawaharlal Nehru, Madan Mohan Malviya and Gauri Shankar Mishra etc. established Uttar Pradesh Farmers Organisation, but due to Khilafat Movement, there were disputes among farmers leaders.

This resulted in creation of Awadh farmers organisation in 1920 under Ramchandra. Awadh farmers were asked to refuse to till Bedakhli land by Kisan organisations.

The Oudh Kisan Sabha established in 1920 was not failed to bring any Kisan Sabha under its wing. Hence, statement I is false, but statement II is true.

13. **Statement I** The united provinces during non-cooperation became one of the strongest bases of the Congress.

Statement II The literary outcrop of non-cooperation in Bengal was quite meagre compared to the days of the Swadeshi agitation.

⊙ **(b)** Non-cooperation movement started under the guidance of Mahatma Gandhi. As Swadeshi agitation began due to Partition of Bengal, many people from Bengal participated in the movement, but the literary outcrop of non-cooperation in Bengal was quite meagre.

Hence, both the statements are correct.

14. Who were Alvars?

(a) Those who immersed in devotion to Vishnu
(b) Devotees of Shiva
(c) Those who worshipped abstract form of God
(d) Devotees of Shakti

⊙ **(a)** The Alvars, were Tamil Poets–Saints of South India who favour support Net Bhakti to the Hindu God Vishnu or his Avatar Krishna in their songs of longing, ecstasy and service.

They believe especially in Vaishnavism, which regards Vishnu or Krishna as the Supreme Being.

2019 (I)

15. Henry T Colebrooke was a Professor of Sanskrit in which one of the following institutions?

(a) Fort William College
(b) Serampore Mission
(c) Kashi Vidyapith
(d) Asiatic Society

⊙ **(a)** Henry Thomas Colebrooke was a Sanskrit scholar and orientalist. He was appointed to a writership in India during that time he learnt Sanskrit.

He was a Professor of Sanskrit at college of Fort William College in 1805. He was elected as President of the Asiatic Society of Calcutta. He also translated two treatises, the Mitacshara of Vijnaneshwara and the Dayabhaga of Jimutavahana in English.

16. The Deccan Agriculturalists' Relief Act of 1879 was enacted with which one of the following objectives?

(a) Restore lands to the dispossessed peasants
(b) Ensure financial assistance to peasants during social and religious occasions
(c) Restrict the sale of land for indebtedness to outsiders
(d) Give legal aid to insolvent peasants

⊙ **(d)** Deccan Agriculturalists Relief Act in 1879 was enacted with the objective to give legal aid to insolvent peasants.

In Deccan region of Maharashtra, money lenders from Gujarat exploited peasants, usurped their land.

This led to large scale riots in 1875.

17. The Damin-i-Koh was created by the British government to settle which one of the following communities?

(a) Santhal   (b) Mundas
(c) Oraons   (d) Saoras

◉ *(a)* Damin-i-Koh was the name given to the forested hilly areas of Rajmahal hills (Present day Jharkhand), inhabited by Santhal tribe. The Britishers intruded in their areas and interfered in their socio-economic life, thus, restricting their movement in forest.

All atrocities on Santhal's resulted into large scale rebellion in 1855. Later, Santhal Pargana was constituted by the Britishers.

18. The Limitation Law, which was passed by the British in 1859, addressed which one of the following issues?

(a) Loan bonds would not have any legal validity
(b) Loan bonds signed between moneylender and ryots would have validity only for three years
(c) Land bonds could not be executed by moneylenders
(d) Loan bonds would have validity for ten years

◉ *(b)* The Limitation Law was passed by the British in 1859 with an objective that loan bond signed between money lenders and ryots would have validity only for three years.

It took final shape when government of India enacted Limitation Act in 1963.

19. Who among the following was known during the days of the Revolt of 1857, as 'Danka Shah'?

(a) Shah Mal
(b) Maulvi Ahmadullah Shah
(c) Nana Sahib
(d) Tantia Tope

◉ *(b)* Maulvi Ahmadullah Shah was known as 'Danka Shah', was one of the leading figures of the great Revolt of 1857.

He gave tough fight to the Britishers in the Awadh region of Uttar Pradesh, even liberated Faizabad from British rule.

He was symbol of Hindu-Muslim unity and fought until his death with the hand of British agent in 1858.

20. The Summary Settlement of 1856 was based on which one of the following assumptions?

(a) The Talukdars were the rightful owners of the land
(b) The Talukdars were interlopers with no permanent stakes in the land
(c) The Talukdars could evict the peasants from the lands
(d) The Talukdars would take a portion of the revenue which flowed to the State

◉ *(b)* The Settlement Act of 1856 was introduced under the guidance of Lord Dalhousie in Awadh region, this settlement was not in favour of Talukdar as it gave priority to village Zamindar.

As a result of this act, Talukdars were left as a interlopers with no permanent stake in the land.

21. Who designed the Bombay Secretariat in the 1870s?

(a) Henry St Clair Wilkins
(b) Sir Cowasjee Jehangir Readymoney
(c) Purushottamdas Thakurdas
(d) Nusserwanji Tata

◉ *(a)* The Bombay Secretariat was completed in 1874 and designed by Captain Henry St Clair Wilkins in the Venetian Gothic style.

With its arcaded verandahs and huge gable over the West facade, it was a monument to the civic pride of Bombay's British rulers.

22. Who was the founder of Mahakali Pathshala in Calcutta?

(a) Her Holiness Mataji Maharani Tapaswini
(b) Sister Nivedita
(c) Madame Blavatsky
(d) Sarojini Naidu

◉ *(a)* Mataji Maharani Tapaswini founded Mahakali Pathshala in Calcutta in 1893 to foster women education.

23. Which European ruler had observed, "Bear in mind that the commerce of India is the commerce of the world … he who can exclusively command it is the dictator of Europe"?

(a) Queen Victoria
(b) Peter the Great of Russia
(c) Napoleon Bonaparte
(d) Gustav II Adolf

◉ *(b)* Peter the great was a Russian Czar (emperor) in the late 17th century. He was best known for his extensive reforms

in an attempt to establish Russia as a great nation.

As India was one of the main centres of the world trade and industry, Peter observed, "Bear in mind that the commerce of India is the commerce of the world."

24. Which European traveller had observed, "A Hindu woman can go anywhere alone, even in the most crowded places and she needs never fear the impertinent looks and jokes of idle loungers"?

(a) Francois Bernier
(b) Jean-Baptiste Tavernier
(c) Thomas Roe
(d) Abbe JA Dubois

◉ *(d)* Abbe Jean Antoine Dubois was a French Catholic missionary in India. He was an indologist and authored the book 'Hindu Manners, Custom and Ceremonies'. In his book, he wrote about position of women in the society.

He had observed that a Hindu woman can go anywhere alone, even in the most crowded places and she needs never fear the impertinent looks and jokes of idle loungers. He was called as 'Dadda Swami' by the local people.

25. Which Indian social theorist had argued that the idea of a homogenised Hinduism was constructed through the 'cultural arrogance of post-enlightenment Europe?'

(a) Ashis Nandy   (b) Partha Chatterjee
(c) TK Oommen   (d) Rajni Kothari

◉ *(a)* Ashis Nandy is an Indian political psychologist, social theorist and critic. He has given theoretical criticism of European colonialism, development, modernity and secularism.

According to him, "the idea homogenised Hinduism emnates from the cultural arrogance of post-enlightenment Europe."

26. Which one of the following developments took place because of the Kansas-Nebraska Act of 1854?

(a) The Missouri Compromise was repealed and people of Kansas and Nebraska were allowed to determine whether they should own slaves or not
(b) The Act did not permit the territories the right to vote over the question of slavery

(c) The voice of the majority in regard to the issue of slavery was muzzled

(d) The Federal Government had the sole authority to decide on slavery

⊙ (**a**) The Kansas-Nebraska Act was passed by the US Congress in 1854. It allowed people in the territories of Kansas and Nebraska to decide for themselves whether or not allow slavery with in their borders.

This act repealed the Missouri compromise of 1820 which prohibited slavery.

27. In 1921, during which one of the following tours, Gandhiji shaved his head and began wearing loincloth in order to identify with the poor?

(a) Ahmedabad   (b) Champaran
(c) Chauri Chaura   (d) South India

⊙ (**d**) Gandhiji was on journey down to South India (Madurai) in 1921.

He asked the people to wear Khadi, but they replied that they are too poor, cannot afford Khadi clothes, after this incident Gandhiji decided to shave his head and began wearing loincloth in order to identify with the poor.

28. Simla was founded as a hill station to use as strategic place for billeting troops, guarding frontier and launching campaign during the course of

(a) Anglo-Maratha War
(b) Anglo-Burmese War
(c) Anglo-Gurkha War
(d) Anglo-Afghan War

⊙ (**c**) Simla was founded as a hill station by the Britisher during Anglo-Gurkha or Anglo-Nepalese war fought between 1814-16.

The war ended with the signing of the treaty of Sugauli in 1816. The strategic location of Simla is decided.

29. Which politician in British India had opposed to a Pakistan that would mean ''Muslim Raj here and Hindu Raj elsewhere''?

(a) Khan Abdul Ghaffar Khan
(b) Sikandar Hayat Khan
(c) Maulana Abul Kalam Azad
(d) Rafi Ahmed Kidwai

⊙ (**b**) Premier of Punjab Sir Sikandar Hayat Khan predicted to told the Punjab Legislative Assembly.

On 11th March, 1941 ''We do not ask for freedom that there may be Muslim Raj here and Hindu Raj elsewhere.'' If that is what Pakistan means I will have nothing to do with it.

30. Match List I with List II and select the correct answer using the codes given below.

	List I (Author)		List II (Book)
A.	Sekhar Bandyopadhyay	1.	*Jawaharlal Nehru : A Biography, Vol-I, 1889-1947*
B.	Sarvepalli Gopal	2.	*From Plassey to Partition : A History of Modern India*
C.	David Hardiman	3.	*The Ascendancy of the Congress in Uttar Pradesh, 1926-1934*
d.	Gyanendra Pandey	4.	*Gandhi in His Time and Ours*

Codes

	A	B	C	D		A	B	C	D
(a)	2	4	1	3	(b)	2	1	4	3
(c)	3	1	4	2	(d)	3	4	1	2

⊙ (**b**)

Sekhar Bandyopadhyay	*From Plassey to Partition: A History of Modern India*
Sarvepalli Gopal	*Jawaharlal Nehru : A Biography, Vol-I, 1889-1947*
David Hardiman	*Gandhi in His Time and Ours*
Gyanendra Pandey	*The Ascendancy of the Congress in Uttar Pradesh, 1926 - 1934*

2018 (II)

31. The Harappan site at Kot Diji is close to which one of the following major sites of that civilisation?

(a) Harappa   (b) Mohenjo-daro
(c) Lothal   (d) Kalibangan

⊙ (**b**) Kot Diji is located in the vicinity of several other important historic sites. It is close to the site of East of Mohenjo-daro, a group of mounds that contains the remains of what was one largest city of the Indus civilisation.

32. The story *Gandatindu Jataka* was written in which language?

(a) Sanskrit   (b) Telugu
(c) Tamil   (d) Pali

⊙ (**d**) The Jatakas were written in Pali around the middle of the first Millennium CE.

One story known as the Gandatindu Jataka describes the plight of the subjects of a wicked king. These included elderly women and men,

cultivators, herders, village boys and even animals.

When the king went in disguise to find out what his subjects thought about him, each one of them cursed him for their miseries. To escape from this situation, people abandoned their village and went to live in the forest.

33. According to the Tamil Sangam texts, who among the following were the large landowners?

(a) Gahapatis   (b) Uzhavars
(c) Adimais   (d) Vellalars

⊙ (**d**) The large landowners were known as the Vellalars according to the Tamil Sangam. The cultivators were known as the Uzhavar and it was the Kadaisiyar who were the slaves.

One can get the details of the life style of that period while going through the Jataka stories. Vellalars were, originally an elite caste of Tamil agricultural landlords in Tamil Nadu, Kerala states in India and in neighbouring Sri Lanka.

34. According to the *Manusmriti*, women can acquire wealth through which of the following means?

(a) Purchase   (b Investment
(c) Token of affection (d) Inheritance

⊙ (**c**) The Manusmriti is also known as 'Manav Dharma Shastra', is the early work on 'Brahminical Dharma in Hinduism'.

According to Manusmriti, the inherited property of parents would be distributed equally among all the sons. Women could not demand their share in these ancestral properties.

The women had the right over the gifts given to her during her marriage. It was called the Stridhana or woman's wealth. This wealth could be inherited by her children later.

According to the Manusmriti, women can acquire wealth through Token of affection.

35. The dialogue on Varna between King Avantiputta and Kachchana, a disciple of Buddha, appears in which one of the following Buddhist texts?

(a) Majjhima Nikaya
(b) Samyutta Nikaya
(c) Anguttara Nikaya
(d) Ambattha Sutta

⊙ (**a**) The story, based on a Buddhist text in Pali known as the 'Majjhima Nikaya', is part of a dialogue between a king named Avantiputta and a disciple of the Buddha named Kachchana. It reveals Buddhist attitudes towards varna.

36. In the first century AD, which among the following was not a major item of Indian exports to Rome?

(a) Pepper   (b) Spikenard
(c) Tortoise shell   (d) Nutmeg

⊙ *(d)* Romans liked pepper so much, it was called Yavanpriya. They also imported medicinal plants, ivory, muslin textile, precious stones, sandalwood, indigo.

Roman paid back with gold, silver and wine . Tortoise shell (Nutmeg) was not a major item of Indian exports to Rome.

37. Who among the following European travellers never returned to Europe and settled down in India?

(a) Duarte Barbosa   (b) Manucci
(c) Tavernier   (d) Bernier

⊙ *(b)* Niccolao Manucci (19th April, 1638–1717) was an Italian writer and traveller. He wrote a memoir about the Indian subcontinent during the Mughal era.

His records have been a source of history about Shah Jahan, Aurangzeb, Dara Shikoh, Shah Alam, Raja Jai Singh and Kirat Singh.

He spent his entire life in India. Italian doctor Manucci, never returned to Europe, and settled down in India.

38. The class of Amar Nayakas in Vijayanagara is a reference to which of the following?

(a) Village Chieftains
(b) Senior Civil Servants
(c) Tributary Chiefs
(d) Military Commanders

⊙ *(d)* The Amara Nayaka system was a major political innovation of the Vijayanagara Empire. Nayakas were military chiefs usually maintained law and order in their areas of control.

They maintained forests and kept armed supporters. They used to control and expand fertile land and agricultural settlements.

39. The important source for Akbar's reign, Tarikh-i-Akbari was written by which one of the following Persian language scholars?

(a) Arif Qandahari
(b) Bayazid Bayat
(c) Abdul Qadir Badauni
(d) Nizamuddin Ahmad

⊙ *(a)* Tarikh-i-Akbari, also known as Tarikh-i-Qandahari, or Muzaffar Nama, the first chronicle of Emperor Akbar's reign is unanimously important source of

information on the 16th century history of India; particularly the formative years of his career. It was written by Arif Qandahari.

Though the major pre-occupation of modern scholars has been with Abul Fazl's Akbar Nama and Badauni's Muntakhab-ut-Tawarikh, it supplements in many ways of the former's works while Farishta in his Gulshan-i-Ibrahimi and Nihawandi in his Maasir-i-Rahimi explicitly acknowledge their indebtedness to it.

40. The aristocrat Muqarrab Khan was a great favourite of which Mughal Emperor?

(a) Akbar   (b) Jahangir
(c) Farrukhsiyar   (d) Shah Alam

⊙ *(b)* Muqarrab Khan was favourite of Mughal emperor Jahangir. Muqarrab Khan of Golconda (titled Khan-Zaman Fateh Jung) was the most experienced commander in Golconda, during the reign of Abul Hasan Qutub Shah.

Muqarrab Khan is known to have been an ally of Afzal Khan and defended Golconda's Southern realms against Maratha raids.

Aurangzeb sent the Golconda noble Muqarrab Khan to hunt down and kill Shambhaji. Later in 1687, Aurangzeb ordered Mu'azzam (Shah Alam) to march against the sultanate of Golconda.

41. Who was the first Nawab Wazir of Awadh in the 18th century?

(a) Nawab Safdarjung
(b) Nawab Saadat Ali Khan
(c) Nawab Shuja-ud-Daula
(d) Nawab Saadat Khan

⊙ *(b)* Saadat Khan Burhanul Mulk or Saadat Ali Khan was appointed Nawab in 1722 and established his court in Faizabad near Lucknow.

He took advantage of a weakening Mughal Empire in Delhi to lay the foundation of the Awadh dynasty.

42. According to the French traveller Tavernier, the majority of houses in Varanasi during the 17th century were made of

(a) brick and mud   (b) stone and thatch
(c) wood and stone   (d) brick and stone

⊙ *(a)* In 1665, the French traveller Jean Baptiste Tavernier described the architectural beauty of the Vindu Madhava temple on the side of the Ganges.

According to him, the majority of houses in Varanasi during the 17th century were made of brick and mud.

43. The College of Fort William was established by which one of the following Governor-Generals?

(a) Warren Hastings
(b) Lord Cornwallis
(c) Richard Wellesley
(d) William Bentinck

⊙ *(c)* Fort William College (also called the College of Fort William) was an academy and learning centre of Oriental studies established by Lord Wellesley in 1800, by the then Governor-General of British India.

Fort William College aimed at training British officials in Indian languages and, in the process, fostered the development of languages such as Bengali and Urdu.

44. The economic historian, who has used the data collected by Buchanan Hamilton to support the thesis of de-industrialisation in the 19th century India, is

(a) Tirthankar Roy
(b) Amiya Kumar Bagchi
(c) Sabyasachi Bhattacharya
(d) Irfan Habib

⊙ *(b)* Amiya Kumar Bagchi examined evidence on handloom spinning and other traditional industry in Gangetic Bihar, an area of Eastern India, collected between 1809 and 1813 by the East India Company surveyor Dr. Francis Buchanan Hamilton.

Bagchi compared Hamilton's data with the 1901 Census estimates of the population dependent on industry for the same area.

45. Tea growing in India in the 19th century was made possible by

(a) Joseph Banks
(b) James Cook
(c) Robert Fortune
(d) Robert Owen

⊙ *(c)* Robert Fortune (1812-80) was a Scottish botanist, plant hunter and traveller. He is best known for stealing tea plants from China in the employment of the British East India Company.

46. Subhas Chandra Bose started the 'Azad Hind Radio' in which of the following countries?

(a) Japan   (b) Austria
(c) Germany   (d) Malaysia

⊙ *(c)* Azad Hind Radio was a propaganda radio service that was started under the leadership of Netaji Subhas Chandra Bose in Germany in 1942 to encourage Indians to fight for freedom.

47. Which political party formally accepted the Cabinet Mission Plan on 6th June, 1946, which had rejected the demand for a sovereign Pakistan?

(a) The Hindu Mahasabha
(b) The Congress
(c) The Muslim League
(d) The Unionist Party

⊙ **(c)** Cabinet Mission of 1946 came to India with an aim to discuss the transfer of power from the British Government to the Indian leadership, with the aim of preserving India's unity and granting it independence.

The Cabinet Mission Plan of 1946 proposed that there shall be a Union of India which was to be empowered to deal with the defense, foreign affairs and communication.

The Muslim League first approved the plan. But when Congress declared that it could change the scheme through its majority in the Constituent Assembly, they rejected the plan.

48. The elected President of the All India Kisan Sabha, which met in Vijayawada (1944), was

(a) Sahajananda Saraswati
(b) Vinoba Bhave
(c) Achyut Rao Patwardhan
(d) Narendra Dev

⊙ **(a)** Swami Sahajanand Saraswati was the elected President of All India Kisan Sabha at Vijayawada, Andhra Pradesh in 1944. It was the Eighth Conference of All India Kisan Sabha.

Swami Sahajanand fist started the Kisan Sabha Movement in Bihar. He was instrumental in forming All India Kisan Sabha in 1936 and became its first President.

The Kisan Sabha movement had started in Bihar under the leadership of Swami Sahajanand Saraswati.

49. Who took over the 'Eka Movement' started by the Congress in Awadh during 1921-1922?

(a) Bhagwan Ahir
(b) Madari Pasi
(c) Baba Ramchandra
(d) Shah Naeem Ata

⊙ **(b)** Eka Movement or Unity Movement is a Peasant Movement which surfaced in Hardoi, Bahraich and Sitapur (Uttar Pradesh) during the end of 1921 by Madari Pasi, an offshoot of Non-cooperation Movement.

50. Which organisation was started at the Haridwar Kumbh Mela in 1915?

(a) Sanatan Dharma Sabha
(b) Dev Samaj
(c) Brahmin Sabha
(d) Hindu Mahasabha

⊙ **(d)** The first All India Hindu Mahasabha Conference was organised at Haridwar in 1915 during Kumbh Mela.

Hindu Mahasabha was founded in 1915 by Madan Mohan Malviya. It worked with Arya Samaj and other Hindu organisations. It was directly linked with Rashtriya Swayam Sevak Sangh founded in 1925 at Nagpur by K. B Hedgewar.

2018 (I)

51. Who deciphered the Brahmi and Kharosthi scripts?

(a) Piyadassi
(b) Colin Mackenzie
(c) Alexander Conningham
(d) James Prinsep

⊙ **(d)** James Prinsep was an English scholar, orientalist and antiquary. He was the founding editor of the Journal Asiatic Society of Bengal and is best remembered for deciphering the Kharosthi and Brahmi scripts of ancient India.

These scripts were used significantly at the time of Ashoka for spreading his Dhamma.

52. Which of the following is/are the feature(s) of the Brahmadeya Grants during 600 – 1200 AD?

1. Their creation meant a renunciation of actual or potential sources of revenue by the state.
2. These grants could vary from a small plot to several villages.
3. Most grants were made in unsettled areas.

Select the correct answer using the codes given below

(a) Only 1   (b) 2 and 3
(c) 1 and 2   (d) All of these

⊙ **(d)** Brahmadeya (given to Brahmin) was tax free land gift either in form of single plot or whole villages donated to Brahmans in the early Medieval (600-1200 AD) India.

As per many inscriptions like Uttarmerur during Chola large scale land was expanded under agriculture and irrigation. This can be attributed to the Brahmadeya land grants. Hence, all three statements are right.

53. Who is the author of Manimekalai?

(a) Kovalan   (b) Sathanar
(c) Ilango Adigal   (d) Tirutakkatevar

⊙ **(b)** Manimekalai was written by the poet Chithalai Sathanar. It is one of the five great epics of Tamil literature. According to later Tamil literary tradition, its story is a sequel to another of the five great epics, Silappadikaram, and tells the story of the daughter of Kovalan and Madhavi, who became a Buddhist Bikkuni.

54. Which of the following statements about the Elephanta Island is correct?

(a) It was given its name by the British after a large elephant structure located there
(b) It contains one large cave
(c) It is well-known for a spectacular carving of Vishnu described in the Vishnudharmottara Purana
(d) It is associated with the Pashupata sect

⊙ **(d)** The historic Elephanta Island is inspired from the Pashupata Shaivism literature corpus of Hinduism composed by the 5th-century. Hence, option (d) is correct.

The Elephanta island and its resident caves received the name 'Elephanta' from Portuguese invaders after the discovery of a black stone sculpture of an elephant on the island. The island has two groups of rock-cut caves.

The larger group of caves, which consists of five caves on the Western hill of the island, is well known for its Hindu sculptures. The collections of cave temples are predominantly dedicated to the Hindu God Shiva.

55. Which of the following statements about Sir Syed Ahmed Khan is/are correct?

1. He argued that India was a federation of ethnic communities based on common descent.
2. His philosophy was very similar to that of the Indian National Congress.
3. He imagined India as a Nation State based on individual citizen's rights.
4. The curriculum at the Mohammedan Anglo-Oriental College blended Muslim theology and European empiricism.

Select the correct answer using the codes given below

(a) Only 1   (b) 2 and 3
(c) Only 3   (d) 1 and 4

(d) Sir Syed Ahmed Khan was a renowned Muslim reformer of the 19th century.

He thought that Congress was mainly a Hindu body which worked for the protection of the rights of the Hindus. His views were different from Congress. He once propounded the theory of common descent of Hindus and Muslims in the land of Ganga.

However, in the later half of his life, he said that the interests of both Muslims and Hindus are different.

In his works, he enlightened how the Islamic faith could go with advanced scientific and political ideas of his time.

It was reflected in the curriculum at Mohammedan Anglo-Oriental College which was a blend of Muslim teachings and Western education.

56. Consider the following statement: "A sound body means one which bends itself to the spirit and is always a ready instrument at its service." The above statement is attributed to
(a) Sardar Patel   (b) Winston Churchill
(c) Mahatma Gandhi
(d) Baden-Powell

(c) According to Gandhiji, "a sound body means one which bends itself to the spirit. This body is always ready to work at the commands given by the spirit."

A sound body is made in the cornfields or farms where one performs physical work.

57. Who among the following was the founder of Phoenix Settlement?
(a) Mahatma Gandhi
(b) BR Ambedkar
(c) Rabindranath Tagore
(d) Swami Vivekananda

(a) Phoenix is an Indian suburb, North-West of central Durban in South Africa. It was established as a township by the apartheid government in 1976, but it has a long history of Indian occupation.

It is associated with the Phoenix Settlement, built by Mahatma Gandhi in Natal Province South Africa.

Phoenix Settlement was mainly a cooperative community established in 1904.

58. Name the platform used for ritual purposes by the kings of the Vijayanagara Empire.
(a) Mahanavami Dibba
(b) Lotus Maha
(c) Hazara Rama
(d) Virupaksha

(a) The Mahanavami Dibba, is the platform used for ritual purposes by the rings of the Vijayanagara Empire.

59. The idea of 'Farr-i-Izadi', on which the Mughal kingship was based, was first developed by which one of the following Sufi saints?
(a) Shihabuddin Suhrawardi
(b) Nizamuddin Auliya
(c) Ibn al-Arabi
(d) Bayazid Bistami

(a) Abul Fazl placed Mughal kingship as the highest position in the hierarchy of objects receiving light emanating from God (Farr-i-Izadi).

He was inspired by a famous Iranian Sufi, Shihabuddin Suhrawardi (1191) who first developed this idea. According to this idea, there was a hierarchy in which the Divine Light was transmitted to the king, who then became the source of spiritual guidance for his subject.

60. Which Buddhist text contains an account of the Mauryan emperor Ashoka?
(a) Vinaya Pitaka
(b) Sutta Pitaka
(c) Abhidhamma Pitaka
(d) Mahavamsa

(d) Mahavamsa contains an account of the Mauryan emperor Ashoka.

The contents of the Mahavamsa can be broadly divided into four categories
(i) The Buddha's Visits to Ceylon
(ii) Chronicles of Kings of Ceylon
(iii) History of the Buddhist Sangha
(iv) Chronicles of Ceylon

61. Which one of the following statements about Buddhist Stupas in India is not correct?
(a) Ashoka played an important role in popularising the Stupa cult
(b) They were repositories of relics of Buddha and other monks
(c) They were located in rural areas
(d) They were located close to trade routes

(c) A stupa is a mound-like or hemispherical structure containing relics that is used as a place of meditation.

Buddhist sources claim that during the 3rd century BCE, the Mauryan Emperor Ashoka the Great ordered these eight stupas to be opened, further distributed the relics of the Buddha into 84,000 portions, and had stupas built over them all over the expanding Buddhist world.

They were located on trade routes in order to propagate Buddhism. However, there was no evidence of them being located in rural areas. Hence, stupas were located in rural areas is incorrect.

Hence, option (c) is not correct.

62. Verses ascribed to poet-saint Kabir have been compiled in which of the following traditions?
1. *Bijak* in Varanasi
2. *Kabir Granthawali* in Rajasthan
3. *Adi Granth Sahib*
Select the correct answer using the codes given below
(a) 1 and 2   (b) Only 3
(c) 2 and 3   (d) All of these

(d) Kabir was a 15th century Indian mystic poet and saint, whose writings influenced Hinduism's Bhakti movement and his verses are found in Sikhism's scripture Guru Granth Sahib.

His early life was in a Muslim family, but he was strongly influenced by his teacher, the Hindu Bhakti leader Ramananda. Literary works with compositions attributed to Kabir include Kabir Bijak, Kabir Parachai, Sakhi Granth, Adi Granth Sahib and Kabir Granthawali (Rajasthan). Hence, all the statements are true.

63. Which of the following statements about the usage of the term 'barbarian' is/are correct?
1. It is derived from the Greek word 'barbaros' which means a non-Greek.
2. Romans used the term for the Germanic tribes, the Gauls and the Huns.
Select the correct answer using the codes given below.
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

(c) The term 'Barbarian' originated from the Greek (barbaros) which in turn originated from the incomprehensible languages of early Anatolian nations that were heard by the Greeks as 'bar..bar.'

In Ancient Greece, the Greeks used the term towards those who didn't speak Greek and follow classical Greek customs. In Ancient Rome, the Romans used the term towards non-Romans such as the Germanics, Celts, Gauls, Iberians, Thracians, Illyrians, Berbers, Parthians, and Sarmatians.

Hence, both the statements are correct.

64. Which one of the following statements is not correct?
(a) Al-Biruni identifies the Sufi doctrine of divine love as self-annihilation with parallel passages from *Bhagawad Gita*
(b) According to Al-Biruni, Sufi theories of Soul were similar to those in Patanjali's Yoga Sutra

(c) The Hatha Yogic treatise Amrita Kunda had lasting impact on Sufism

(d) Hujwiri's conversation with the Yogis shows that he was impressed with their theory of the division of the human body

⊙ *(d)* Hujwiri was known as Datta Ganj Baksh. Hujwiri comments that before he settled in Lahore some sufis believed in theories that he calls brahmanical.

According to Hujwiri, they wrongly believed the 'annihilation (fand)' signifies loss of essence and destruction of the personality and that subsistence indicates the subsistence of God in man. Hence, option (d) is not correct.

65. Consider the following statement "So much is wrung from the peasants, that even dry bread is scarcely left to fill their stomachs." Who among the following European travellers had made the above statement about the condition of peasantry in the Mughal Empire?

(a) Francisco Pelsaert
(b) Francois Bernier
(c) Jean-Baptiste Tavernier
(d) Niccolao Manucci

⊙ *(a)* Francisco Pelsaert was a Dutch merchant who worked for the Dutch East India Company. He explained about the conditions of farmers and agriculture in the Mughal era. He said that the Mughal period was marked by agriculture stagnation if not slump. The per capita yield was declining and the average man in Mughal period probably had less to eat than before.

66. What is the name of the literary genre developed by the Khojas who are a branch of the Ismaili sect?

(a) Ginan
(b) Ziyarat
(c) Raag
(d) Shahada

⊙ *(a)* 'Ginan' is the name to the literary genre developed by the Khojas who are a branch of the Ismaili sect.
The Khojas are a group of diverse people who converted to Islam in South Asia.
The word 'Khoja' derives from Khwaja, a Persian honorific title of pious individuals from Central Asia, South Asia and the Middle East. Ginans are devotional hymns or poems recited by Shia Ismaili Muslims (Khojas).

67. Who was/were the 10th century composers of the Nalayira Divya Prabandham?

(a) Alvars
(b) Nayanars
(c) Appar
(d) Sambandar

⊙ *(a)* The Nalayira Divya Prabandham is a collection of 4,000 Tamil verses (Naalayiram in Tamil means 'four thousand') composed by the 12 Alvars. It was compiled in its present form by Nathamuni during the 9th – 10th centuries.

68. Around twelfth century, Sufi Silsilas began to crystallise in different parts of the Islamic world to signify

1. continuous link between the master and disciple
2. unbroken spiritual genealogy to the Prophet Muhammad
3. the transmission of spiritual power and blessings to devotees

Which of the statement(s) given above is/are correct?
(a) 1 and 2
(b) Only 2
(c) 1 and 3
(d) All of these

⊙ *(d)* 'Silsila' is an Arabic word meaning chain, link, connection often used in various senses of lineage. In particular, it may be translated as 'spiritual genealogy' where one Sufi Master transfers his khilfat to his spiritual descendant.

The origins of Sufism can be traced to the lifetime of the Prophet Muhammad, whose teachings attracted a group of scholars who came to be called 'Ahle Suffe', the People of Suffe, from their practice of sitting at the platform of the mosque of the Prophet in Medina.

They engaged themselves in discussions concerning the reality of 'Being', and in search of the inner path and devoted themselves to spiritual purification and meditation. These individuals were the founders of Sufism.

Four important Silsilas are: Chishti Silsila, Kadri Silsila and Soharvardi Silsila and Nakshbandi Silsila.
Hence, all the statements are correct.

69. In the 10th Mandala of the Rigveda, which one of the following hymns reflects upon the marriage ceremonies?

(a) Surya Sukta
(b) Purusha Sukta
(c) Dana Stuits
(d) Urna Sutra

⊙ *(b)* Purusha Sukta is hymn of the Rigveda, dedicated to the purusha the 'cosmic being.' It is also found in the Shukla Yajurveda Vajasena Samhita (31) some scholars state that certain verses of Purusha Sukta are later interpolation of the Rigveda.

70. Which of the following statements about the Non-Cooperation Movement is/are correct?

1. It was marked by significant participation of peasants from Karnataka.
2. It was marked by non-brahmin lower caste participation in Madras and Maharashtra.
3. It was marked by the lack of labour unrest in places like Assam, Bengal and Madras.
4. It was badly shaken by the Chauri Chaura incident in 1922 after which Gandhiji decided to continue with the movement on a much smaller scale.

Select the correct answer using the codes given below.
(a) Only 1
(b) 1, 2 and 4
(c) 2 and 3
(d) Only 2

⊙ *(d)* In September 1920, at a special session in Calcutta, the Congress approved a Non- cooperation Movement under leadership of Gandhiji. Most of the South Indian states participated in it except Karnataka. In Assam, strike in tea plantation, steamer services and Assam Bengal Railways has been organised. There were some non-Brahmin lower-caste participation in Madras and Maharashtra. The movement was withdrawn in 1922 by Mahatma Gandhi with Chauri Chaura incident in which violent mob burnt a police station in United province. Hence, only statement (2) is correct.

2017 (II)

71. **Statement I** The early Aryans, who were essentially pastoral, did not develop any political structure which could measure up to a state in either ancient or modern sense.

Statement II Kingship was the same as tribal chief ship; the term Rajan being used for tribal chief who was primarily a military leader and who ruled over his people and not over any specified area.

(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true, but statement II is not the correct explanation of statement I

(c) Statement I is true, but statement II is false

(d) Statement I is false, but statement II is true

▷ **(a)** The early Aryans were divided into tribes or Janas. The chief of the tribe was called Rajan. He was selected by the tribe and he ruled according to the wishes of his tribesmen.

He fought wars (not for acquiring territories but for protecting and acquiring cattle especially cows) and prayed for the welfare of his tribe. The people offered voluntary tributes called bali to the Rajan.

Hence, both the statements are individually true and statement II is the correct explanation of statement I.

72. Which one of the following peasant struggles was an outcome of British opium policy ?

(a) Phulaguri Dhawa [1861]
(b) Birsaite Ulgulan [1899- 1900]
(c) Pabna Revolt [1873]
(d) Maratha Peasant Uprising [1875]

▷ **(a)** The Phulaguri Dhawa was the first ever peasant movement in the content of Indian Freedom Movement.

Phulaguri Dhawa uprising of 1861. (Assam) was triggered by a ban imposed on opium cultivation and a proposed taxation on betel leaf and nut by British officials. A number of British officials and policemen were killed by peasants and their bodies were thrown into the Kolong river.

Birsaite Ulgulan of 1899-1900 was started in region South of Ranchi under leadership of Birsa Munda against British and local Zamindars. Pabna Revolt (1873) was a peasant movement against the zomindars of tusufshahi pargana in Bengal. Maratha peasant uprising of 1875 was against increasing agrarian distress.

73. Which one of the following combinations of year and event concerning the French Revolution is correctly matched?

(a) 1789 : Napoleonic Code
(b) 1791 : Tennis Court Oath
(c) 1792 : National Convention
(d) 1804 : New Constitution of France

▷ **(c)** National convention was the first Government of the French Revolution. Created after great insurrection of 10th August, 1792, it was the first French government organised as a republic abandoning monarchy altogether. Napolean code was established in 1904.

While tennis Court Oath was taken on 20th June, 1789. New Constitution of France was created by National Assembly in 1791.

74. Due to which of the following factors, the Industrial Revolution took place in England in the eighteenth century?

1. The discovery of coal and iron deposits
2. The discovery of steam power
3. The introduction of railways
4. The regular supply of raw materials

Select the correct answer using the codes given below

(a) 1 and 2   (b) 2, 3 and 4
(c) 1 and 3   (d) 1, 2, 3 and 4

▷ **(d)** The Industrial Revolution was the transition to new manufacturing process in the period from about 1760 to sometime between 1820 and 1840. Following factors were responsible for the Industrial Revolution that took place in England.

   (i) The discovery of coal and iron deposits
   (ii) The discovery of steam power
   (iii) The introduction of railways
   (iv) The regular supply of raw materials, same other factors were also responsible for this.

75. Consider the following

1. Tughlaqabad Fort
2. Bara Gumbad in Lodhi Garden
3. Qutub Minar
4. Fatehpur Sikri

Which one of the following is the correct chronological order of building the above monuments?

(a) 3, 1, 4, 2   (b) 3, 1, 2, 4
(c) 1, 3, 2, 4   (d) 1, 3, 4, 2

▷ **(b)** **Qutub Minar** was built in 1193 by Qutub-ud-din Aibak. It is a 73 m tall tapering tower of five stories situated in Delhi.

Tughlaqabad Fort (1321) was built by Ghiyas-ud-din Tughlaq of Delhi Sultanate. **Bara Gumbad** (1490) was constructed by Sikandar Lodhi and is believed to be the earliest full dome of any building in Delhi.

Fatehpur Sikri was founded as the capital of Mughal Empire in 1571 by Emperor Akbar.

76. With regard to nature of Mughal State, who among the following scholars argued that "the peculiar feature of the State in Mughal India was that it served not merely as the protective arm

of the exploiting classes, but was itself the principal instrument of exploitation"?

(a) Irfan Habib   (b) Satish Chandra
(c) Athar Ali   (d) J F Richards

▷ **(a)** Irfan Habib in his book, the partition of memory, insists that …
''the peculiar feature of the state in Mughal India was that it served not merely as the protective arm of the exploiting classes, but was itself the principal instrument of exploitation''.

77. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Type of Land)	List II (Meaning)
A. Urvara	1. Land watered by a river
B. Maru	2. Fertile land
C. Nadimatrika	3. Land watered by rain
D. Devamatrika	4. Desert land

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	4	3	(b)	3	4	1	2
(c)	3	1	4	2	(d)	2	4	1	3

▷ **(d)** Urvara   → Fertile land
Maru   → Desert land
Nadimatrika → Land watered by a river
Devamatrika→ Land watered by rain

78. Who was the editor of the journal *Indian Social Reformer* that was started in 1890?

(a) KT Telang
(b) Veeresalingam
(c) NG Chandavarkar
(d) KN Natarajan

▷ **(d)** The Indian Social Reformer was founded in Madras in 1890 by Kamakashi Natarajan, an associate of the great compaigning Journalist and founder of the Hindu, G. Subramaniam Iyer.

79. Which twelfth century Sanskrit scholar was first responsible for the compilation of 'Nibandhas' or digests of epic and Puranic texts?

(a) Harsha   (b) Govindachandra
(c) Lakshmidhara   (d) Kalidasa

▷ **(c)** The twelfth century sanskrit scholar who was responsible for the compilation of nibandhas and puranic texts is Lakshmidhara.

The compilation of nibandhas is called Kalptaru and has themes from various Hindu aspects such as the puranas dharnia literature and vedas in one volume.

80. Which river is praised in the fifth century Tamil epic, Silappadikaram?
(a) Cauvery   (b) Godavari
(c) Saraswati   (d) Ganges

⊙ *(a)* Silappadikaram is the earliest among the available Tamil epics written by Prince Ilange Adigal, it describes the love story of Kannagi and Kovalan. Silappadikaram says that Kovalan and Kannagi walked along the river Cauvery up to capital Uraiyur.

81. Which one of the following statements about the Harappan Culture is not correct ?
(a) It witnessed the first cities in the subcontinent
(b) It marks the first use of script, written from right to left
(c) It marks the earliest known use of iron as a medium for the art of sculpting
(d) It marks the earliest known use of stone as a medium for the art of sculpting

⊙ *(c)* The people of the valley discovered new techniques of building with metals that were mined or imported, and from this successfully produced lead, copper, tin and bronze. They never have accessed to iron mines and hence never produced iron. So they did not use iron as a medium for the art of sculpting. So option (a), (b) and (d) are correct.

82. Harshacharita has references to various presents sent by a ruler named Bhaskara to Harshavardhana. Bhaskara belonged to
(a) Haryanka Dynasty of Magadha
(b) Varman Dynasty of Assam
(c) Nanda Dynasty of North India
(d) None of the above

⊙ *(b)* Bhaskara also known by the name of Bhaskaravarman belonged to the Varman dynasty of Assam. Bhaskaravarman is known for his alliance with Harshavardhana against Shashanka.

He issued the Nidhanpur copper plate grant from his camp at Karnasuvarna and it moved into his control for a short period.

83. Which of the following was/were founded by Raja Ram Mohan Roy?
1. Atmiya Sabha
2. Brahmo Samaj
3. Prarthana Samaj
4. Arya Samaj

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) Only 2
(c) 1 and 2 only   (d) 1, 3 and 4

⊙ *(c)* Raja Rammohan Roy founded the Atmiya Sabha and the Brahmo Samaj. Arya Samaj was founded by Swami Dayanand Saraswati and Prarthana Samaj was founded by Dr Atmaram Pandurang.

Hence, option (c) is the correct answer.

84. Which one of the following statements about the Gupta period in Indian history is not correct?
(a) Sanskrit language and literature, after centuries of evolution, reached what has been described as a level of classical excellence through royal patronage
(b) The status of women was redefined. They were entitled to formal education and hence there were women teachers, philosophers and doctors. Early marriage was prohibited by law and they were given the right to property
(c) Decentralisation of administrative authority was impacted by increased grants of land and villages with fiscal and administrative immunities to priests and temples
(d) Land grants paved the way for feudal developments and emergence of selfdom in India, resulting in the depression of the peasantry

⊙ *(b)* The condition of women in the Gupta Empire period slowly deteriorated.

The women were given secondary position in the Gupta Empire society and the life of a woman in Gupta period was confined within the restrictions imposed upon her by the male members of the family.

Hence, the statement (b) is incorrect as it talks about improved position of women in the society which was not the scenario.

2017 (I)

85. Consider the following statements about the different meanings of 'Swaraj' as articulated by Mahatma Gandhi:
1. Swaraj is intimately linked with Ahimsa (non-violence) and Satyagraha (adherence to truth).

2. Swaraj has two senses-one political and one beyond the realm of politics.
3. Swaraj is something that requires time and patience to acquire.
4. With determination, Swaraj could be obtained easily and quickly.

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) 1 and 2
(c) 3 and 4   (d) 1, 2 and 3

⊙ *(d)* Swaraj movement was initiated by Mahatma Gandhi which focuses on self-rule or self-governance and is intimately linked with Ahimsa (non-violence) and Satyagraha (adherence to truth). Moreover, it referred to Gandhi's concept Indian independence from British rule.

The movement had two meanings, political and non-political.

It was political in the sense that it opposed being ruled by foreigners, and non-political in the sense that every person has right to be ruled by himself or herself.

Swaraj is a virtue which needs time and patience to achieve and cannot be obtained easily and quickly.

Hence, all statements are correct except statement 4.

86. What was/were the formative influence(s) on the philosophy of Mahatma Gandhi?
1. Gandhiji was influenced by the 18th Century Pranami sect that advocated the unity of faiths.
2. Gandhiji was influenced by the theosophists.
3. Gandhiji was an admirer of the writings of Romantics like Wordsworth.

Select the correct answer using the codes given below.
(a) 1 and 2   (b) 2 and 3
(c) 1, 2 and 3   (d) Only 1

⊙ *(c)* It was through theosophy that Gandhiji was induced to study his own heritage. Theosophy is the brotherhood of man.

Gandhiji's mother Putlibai belonged to the Pranami sect, which talked about Hindu-Muslim unity.

Gandhiji was influenced by this 18th century Pranami Sect that advocated the Unity of faiths. Philosophy of Mahatma Gandhi was also influenced by the writings of Romantics like Wordsworth.

Hence, statements 1, 2 and 3 correct.

The Salt March was not impressed upon the British the urgent need to devolve more power to India.

87. Which of the following statements about the Shiromani Gurudwara Prabandhak Committee (SGPC) are correct?

1. It began as the political wing of the Singh Sabhas in the late 19th century.
2. It was formed in 1920 as part of the upcoming Akali movement.
3. It was founded to reclaim control of the Sikh shrines from the government manipulated loyalist committees.
4. It formed the Akali Dal to coordinate groups (Jathas) to reclaim control of the shrines.

Select the correct answer using the codes given below

(a) 1, 3 and 4   (b) 2, 3 and 4
(c) 2 and 4   (d) 2 and 3

⊗ *(b)* Shiromani Gurudwara Prabandhak Committee (SGPC) was formed under Akali movement of 1920 also known as Gurudwara Reform Movement. It was formed to free Sikh historic Gurudwara from Mahants who were supported by the British rule. Akali Dal was formed on 14th December, 1920 as a task force of the Shiromani Gurudwara Prabhandhak Committee to coordinate groups (Jathas) to reclaim control of the shrines.

88. Which of the following statements with regard to the speech of Mahatma Gandhi at the opening of the Banaras Hindu University are correct?

1. He charged the Indian elite with a lack of concern for the labouring poor.
2. He asserted that our salvation can come only through the farmers.
3. He highlighted the plight of the untouchables.
4. He promised to take up the cause of the mill owners of Ahmedabad.

Select the correct answer using the code given below

(a) 1, 2, 3 and 4   (b) 1 and 2
(c) 1, 2 and 3   (d) 3 and 4

⊗ *(b)* Our salvation can only come through the farmer. Neither the lawyers, nor the doctors, nor the rich landlords are going to secure it.

For two years Gandhiji had travelled extensively and had talked at different places. He now, wanted some work connected with labour.

His interest first centred in the problem of indentured labour, the system under which poor, ignorant labourers were enticed away India to work in the British colonies. Hence, option (b) is true.

89. Match List I with List II and select the correct answer using the code given below the list.

List I (Act /Event)		List II (Year)
A. Rowlatt Act	1.	1922
B. Salt March	2.	1931
C. Chauri Chaura Incident	3.	1930
D. Second Round Table Conference	4.	1919

Codes

	A	B	C	D		A	B	C	D
(a)	4	3	1	2	(b)	3	1	4	2
(c)	4	3	2	1	(d)	3	4	2	1

⊗ *(a)* Option (a) is the correct matching of given lists

Rowlatt Act was passed by Imperial Legislative Council in Delhi on 18th March, 1919.

Salt March (Dandi March) or Salt Satyagaraha was initiated by Mahatma Gandhi on 12th March, 1930.

The **Chauri Chaura** incident took place at Chauri Chaura in Gorakhpur district on 5th February, 1922.

The **Second Round Table Conference** was held to discuss the constitutional reform on 7th September, 1931.

90. Consider the following statements about the Salt March:

1. The Salt March was deliberately ignored by the European media.
2. The Salt March was widely covered by the American and European press.
3. The Salt March was the first nationalist activity in which women participated in large numbers.
4. The Salt March impressed upon the British the urgent need to devolve more power to Indians.

Which of the statements given above are correct?

(a) 1, 2 and 4   (b) 2, 3 and 4
(c) 3 and 4   (d) 2 and 3

⊗ *(d)* The Salt March or Salt Satyagraha was an act of nonviolent civil disobedience in colonial India led by Mohandas Karamchand Gandhi.

The movement was widely covered by Indian, European and American newspapers and also saw the participation of large number of women.

The event shook the British, and for the first time, they realised the power of women. Hence, only statements 2 and 3 are correct.

91. In the elections to the provincial legislatures in 1937 in British India

1. only about 10 to 12 per cent of the population had the right to vote
2. the untouchables had no right to vote
3. the Congress won an absolute majority in five out of eleven provinces
4. the Muslim League won more than 80% of the seats reserved for Muslims

Select the correct answer using the codes given below

(a) 1, 3 and 4   (b) 1 and 4
(c) 1 and 3   (d) 2, 3 and 4

⊗ *(c)* In the elections to the provincial legislatures in 1937, the Congress won absolute majority in 5 provinces viz.

Madras, United Provinces, Central Provinces, Bihar and Odisha, Bombay, Assam and North-West Frontier Province. It emerged at the largest political party and formed the governments. Hence, the statement 3 is correct.

The Government of India Act 1935 had increased the number of enfranchised people. Approximately 10 to 12 per cent of the population had voting rights that included women and untouchables (lower castes) too. Further, the Act provided for a limited adult franchise based on property qualifications such as land ownership and rent.

Thus, statement 1 is correct whereas statement 2 is incorrect.

The Muslim League captured around 25 per cent of the seats reserved for Muslims. Hence, the statement 4 is incorrect.

92. Which of the following statement(s) about the social base of the Arya Samaj in British India is/are correct?

1. It was located mainly in Punjab and Western Uttar Pradesh.
2. It mainly comprised the trading castes.
3. It was much more limited than that of the Brahmo Samaj.

Select the correct answer using the codes given below

(a) 1 and 2　　　　(b) 2 and 3
(c) Only 1　　　　　(d) 1, 2 and 3

⊘ **(c)** Arya Samaj is an Indian Hindu Reform Movement that promotes values and practices based on the belief in the infalible authority of the Vedas.

Arya Samaj was established in Bombay on 7th April, 1875. By 1873, it became more than just a regional movement based in Punjab and Western Uttar Pradesh.

93. During the mid 19th century Industrial Revolution, the average life span of workers in Manchester was

(a) 17 years　　　　(b) 30 years
(c) 55 years　　　　(d) 62 years

⊘ **(a)** In a British Government study, an average life span was 17 years for a working-class person in one city, 38 years for a rural area worker.

Coal miner's life span was shortened 10 years shorter than that of other workers because of harsh conditions.

94. George Washington was made the Commander-in-Chief of the American forces

(a) in December 1773, after the Boston Tea Party
(b) at the First Continental Congress in September, 1774
(c) at the Second Continental Congress in 1775
(d) by the Continental Congress at the Declaration of Independence on 4th July, 1776

⊘ **(c)** On 3rd July, 1775, Washington officially took command of the poorly trained and under-supplied Continental Army.

After 6 years of struggle and despite frequent setbacks, Washington managed to lead the army to key victories and Great Britain eventually surrendered in 1781.

Due largely to his military fame and humble personality, Americans overwhelmingly elected Washington their first President in 1789.

95. Alexander Kerensky was

(a) the head of the Provisional government in Russia before the October Revolution
(b) a close confident of Lenin, with whose help the Czar was dethroned
(c) the head of the Czar's army
(d) the advisor of Joseph Stalin

⊘ **(a)** Alexander Kerensky led, the Provisional government of Russian between July 1917 to November 1917.

Kerensky belonged to the Socialist Revolutionaries, the Petrograd Soviet and was a member of the Duma.

He was therefore, seen as a solid representative of the working class and in July, 1917 became the Prime Minister of the Provisional government.

96. **Statement I** The passing of the Coercive Acts made reconciliation between Britain and her American colonies virtually impossible.

Statement II The British Parliament, having issued the Stamp Act in 1765, repealed it later.

Codes

(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true but statement II is not the correct explanation of statement I
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true.

⊘ **(b)** The Stamp Act was passed by the British Parliament on 22nd March, 1765.

The new tax was imposed on all American colonies and required them to pay a tax on every piece of printed paper they used.

Ship's papers, legal documents, licenses, newspapers, other publications, and even playing cards were taxed.

Hence, both statements are individually true and statement II is not correct explanation of statement I.

97. The Ryotwari experiment in land revenue was started by

(a) Henry Dundas
(b) Alexander Reed
(c) David Ricardo
(d) Mountstuart Elphinstone

⊘ **(b)** The Ryotwari System of assessment of land revenue was started by Alexander Reed and Thomas Munro in Madras, Berar, Bombay and Assam, which covered about 52% of the cultivable land.

2016 (II)

98. Match the following.

List I (Historians)	List II (Books)
A. Sumit Sarkar	1. The Rise and Growth of Economic Nationalism in India
B. Shahid Amin	2. A Rule of Property for Bengal
C. Ranajit Guha	3. The Swadeshi Movement in Bengal, 1903-1908
D. Bipan Chandra	4. Event, Metaphor, Memory-Chauri Chaura, 1922-1992

Codes

	A	B	C	D			A	B	C	D
(a)	3	4	2	1		(b)	3	2	4	1
(c)	1	2	4	3		(d)	1	4	2	3

⊘ **(a) Sumit Sarkar** is an Indian historian of modern India. He is the author of 'The Swadeshi Movement in Bengal', 1903-1908.

Shahid Amin is the author of 'Event, Metaphor, Memory–Chauri Chaura, 1922-1992'. A Professor of History at Delhi University, Amin was a Visiting Fellow at Stanford, Princeton and Berlin.

Ranajit Guha is a historian of South Asia, who was greatly influential in the subaltern studies group, and was the editor of several of the group's early anthologies.

He is the author of 'A Rule of Property for Bengal' an essay on the idea of permanent settlement.

Bipan Chandra was professor of modern history at Jawaharlal Nehru University and specialised on the Indian Independence Movement.

He authored several books, including 'The Rise and Growth of Economic Nationalism in India'.

99. What form of Shiva is most prominent in the Brihadeshvara temple built by the Chola dynasty?

(a) Harihara　　　　(b) Bhairava
(c) Rudra　　　　　(d) Tripurantaka

⊘ **(d)** Brihadeshvara temple is also known as Thanjavur Perya Kovil or Rajarajeshwara temple, Rajarajeswaram, is dedicated to Tripurantaka form of Shiva and located in Thanjavur in Tamil Nadu.

It is one of the largest temples in India and is an example of Tamil architecture during the Chola period.

It is built by Rajaraja Chola I and completed in AD 1010. The temple is part of the UNESCO World Heritage Site, known as the Great Living Chola temple.

100. Which of the following statements about the philosopher Shankara is/are correct?

1. Shankara espoused a form of Vedanta called Advaita.
2. He elaborated on the philosophy of Gaudapada.
3. Shankara tried to demonstrate that the Upanishads and Brahmasutras contain a unified, systematic philosophy.
4. Shankara founded the Amanaya Mathas.

Select the correct answer using the codes given below

(a) 1 and 2
(b) 1, 2 and 3
(c) 3 and 4
(d) Only 4

⊙ *(b)* Adi Shankara was a philosopher and theologian, who consolidated the doctrine of Advaita Vedanta. He elaborated on the philosophy of Gaudapada.

He demonstrated that the Upanishads and Brahmasutras containing a unified, systematic philosophy.

Adi Shankara is believed to be the organiser of the Dashanami monastic order and unified the Shanmata tradition of worship. Hence, options (b) is correct.

101. Which of the following statement(s) about the Deccan Riots of 1875 is/are true?

1. The Deccan riots resulted in protection for peasants through the Deccan Agriculturalists Relief Act of 1879.
2. The riots did not spread to the whole of Maharashtra because of prompt suppression by the British.
3. The British were unable to contain the riots and they spread throughout Maharashtra.
4. The cotton boom in the Deccan that had been caused by the artificial demand generated by the American Civil War caused the impoverishment of the peasants.

Select the correct answer using the codes given below.

(a) Only 1
(b) 1 and 3
(c) 2 and 4
(d) 1, 2 and 4

⊙ *(d)* In May and June, 1875, the peasants of Maharashtra in some parts of Pune, Satara and Nagar districts revolted against increasing agrarian distress.

The Deccan revolt of 1875 targeted conditions of debt peonage to moneylenders. The sole purpose of the rioters was to obtain and destroy the bond, decrease and other documents in the possession of the moneylenders.

The Deccan riots resulted in protection for peasants through the Deccan Agriculturalists Relief Act of 1879.

The riots did not spread to the whole of Maharashtra because of prompt suppression by the British.

The cotton boom in the Deccan that had been caused by the artificial demand generated by the American civil war caused the impoverishment of the peasants.

Hence, statement 1, 2 and 4 are correct and statement 3 is incorrect.

102. Why are the Gypsies regarded as of Indian origin?

1. They follow Indian religious practices.
2. Their language, called Romani, is an Indo-Aryan language.
3. They believe that they came from India.
4. Epigraphic evidence locates their original home in Uttar Pradesh.

Select the correct answer using the codes given below.

(a) 1 and 4
(b) Only 2
(c) 1, 2 and 4
(d) 2 and 3

⊙ *(d)* Gypsies is the term used to refer the Romani people who are regarded as Indo-Aryan ethnic group originating from the Northern Indian subcontinent. Their language, Romani is an indo-Aryan language.

Gypsies have long believed they have origins in India, citing common Sanskrit words in their languages and photographs of darker-skinned ancestors in South Asian clothes.

Their ancestry is traced back to Rajasthan, Haryana, and Punjab regions of modern-day India. Hence, statement 2 and 3 are correct.

103. The term *Upari* refers to which one of the following?

(a) A category of proprietary tenure under the Mughal rule
(b) A category of tenancy tenure under the Maratha rule

(c) A soldier in the Maratha army
(d) A village headman in the Mughal period

⊙ *(b)* Under the farming system of Maratha, the major tenure by which the land was mostly held under the Maratha Government were Miras, Watan, Inam, Saranjam and Upari.

The Upari tenure was a tenancy tenure. The land holders had no proprietary right on the land.

104. The 'water frame' of Richard Arkwright was a device for

(a) producing a new type of painting
(b) irrigating fields for rice cultivation
(c) producing strong threads of yarn
(d) the faster movement of steamships

⊙ *(c)* The water frame is the name given to a water-powered spinning frame, which was an easy way to create cotton thread.

The first time, the machine was used in 1768. It was able to spin 128 threads of yarn at a time, which was the easiest and fastest method than never before.

It was developed by Richard Arkwright, who patented the technology in 1769.

105. The epic, *Silappadikaram* refers to the

(a) story of Rama
(b) Jaina elements in the storyline
(c) culture of Sri Lankan Buddhists
(d) cult of Shakti worship

⊙ *(b) Silappadikaram* is one of the five great epics of Tamil literature, was composed by poet named Ilanga around 1800 years ago.

The *Silappadikaram* also refers to Vedic rituals and mentions various Gods, such as Indra, Shiva, Vishnu and Murugan and several Goddesses including Durga.

106. *Rakshasa* type of marriage is

(a) marriage by purchase
(b) marriage by capture
(c) marriage by giving dowry
(d) marriage by seduction

⊙ *(b)* Rakshasa marriage is the marriage by capturing the bride forcibly. The groom will fight a battle with the bride's family, overcome them and carry the bride away to convince her to marry him.

107. Consider the following statement(s) about Harappan cities:

1. Roads were not always absolutely straight and did not always cross one another at right angles.
2. A striking feature is the uniformity in the average size

of the bricks for houses and for city walls.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ **(b)** The remarkable thing about the arrangement of the roads that were always straight and did always cross one another at right angles. Hence, (b) is the correct answer.

Indus Valley Civilisation was mainly an urban culture sustained by surplus agricultural production and commerce.

The latter include trade with summer in Southern Mesopotamia. Both Mohenjodaro and Harappa are characterised as having differentiated living quarters, flat rooked.

Brick size was same in almost every Harappan city. Brick houses are fortified administrative or religious centres.

Directions (Q. Nos. 108-110) *The following three items consist of two statements, statement I and statement II. Examine these two statements carefully and select the correct answer using the codes given below.*

Codes
(a) Both the statements are true and statement II is the correct explanation of statement I
(b) Both the statements are true, but statement II is not the correct explanation of statement I
(c) statement I is true, but statement II is false
(d) Statement I is false, but statement II is true

108. **Statement I** The *Pahi-okashta* peasants were non-resident cultivators cultivating lands on a contractual basis.

Statement II The *Pahi-okashta* peasants worked under the temptation of favourable terms of revenue or the compulsion of economic distress.

⊙ **(a)** The *Khud-kashta* were residents of the village in which they held their lands.

The *Pahi-okashta* were non-resident cultivators, who belonged to some other village, they worked elsewhere on contractual basis. People became *Pahi-okashta* either out of choice or out of compulsion.

When terms of revenue in a distant village were more favourable, peasants moved to other village. Hence, both statements are true and statement II is the correct explaination of statement I.

109. **Statement I** The Zamindars were an exploitative class in Mughal India.

Statement II The Zamindars often received the support of the peasantry in a large number of agrarian uprisings in North India in the 17th century.

⊙ **(b)** The Zamindars in Mughal rule was not of much utility due to better ties with neighbouring regions.

They defied the Mughals in frequent uprisings, which hastened the decline of Mughal power.

In response, the Mughals tried to strengthen the Jagirdars and therefore, the revenue administration against the local potentates.

In absence of strong centre, the Jagirdars started defying the centre and found alliances with the local potentates further eroding the Mughal power. Hence, both statements are true.

110. **Statement I** King Ashoka abolished capital punishment and disbanded his army.

Statement II After Kalinga War, Ashoka was remorseful and became a Buddhist.

⊙ **(d)** After the accession to the throne, Ashoka fought only one major war called the Kalinga War.

The war caused great suffering to the Brahmana priests and Buddhist monks.

This in turn brought upon Ashoka much grief and remorse. He therefore abandoned the policy of physical occupation in favour of one of cultural conquest.

In other words, Bherighosha was replaced with Dhammaghosha.

Statement I is incorrect becuase king Ashoka never disbanded his army.

111. Which of the following Gods are also known as *Lokapalas* or the Guardians of the Universe?

(a) Yama, Indra, Varuna and Kubera
(b) Indra, Varuna, Skanda and Kubera
(c) Indra, Varuna, Yama and Brahma
(d) Yama, Shiva, Kubera and Indra

⊙ **(a)** The earliest epigraphical reference to the Brahminical Lokapalas is found in the Nanaghat inscription of Queen Nayanika of Satavahana dynasty, who seems to have flourished about the close of the 1st century BC.

It is interesting to note that salutations are offered in this record to the four Lokapalas, *viz*, Yama, Varuna, Kubera and Vasava (Indra).

2016 (I)

112. Consider the following statements:

1. In Hind Swaraj, Mahatma Gandhi formulates a conception of good life for the individual as well as the society.
2. Hind Swaraj was the outcome of the experience of Gandhi's prolonged struggle against Colonial Raj in India.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ **(a)** Hind Swaraj is a book written by Mohandas K. Gandhi in 1909. In it he expresses his views on Swaraj, modern civilisation, mechanisation etc.

The book was banned in 1910 by the British government in India as a seditious text. Gandhi wrote this book in his native language, Gujarati, while traveling from London to South Africa.

In the book Gandhi gives a diagnosis for the problems of humanity in modern times, the causes, and his remedy.

He also formulates a conception of good life for individual as well as society in the book.

Hence, Statement 1 is correct. However, Hind Swaraj was not the outcome of the experience of Gandhi's prolonged struggle against Colonial Raj in India since it was written before his arrival in India in 1915.Thus, Statement 2 is incorrect.

113. Who among the following archaeologists was the first to identify similarities between a pre-Harappan culture and the mature Harappan culture?

(a) Amalananda Ghosh
(b) Rakhaldas Bannerjee
(c) Daya Ram Sahni
(d) Sir John Marshall

⊙ **(a)** In 1965, Amalananda Ghosh was the first archaeologist to identify similarities between pre-Harappan culture and post Harappan culture.

He compared the two culture during his research on Sothi culture in present Rajasthan.

114. Which one of the following is the common element between the Kailasanatha temple at Ellora and the Shore temple at Mamallapuram?

(a) Both are examples of Nagara architecture.
(b) Both are carved out from solid rocks.

(c) Both are Gupta period temples.

(d) Both were built under the patronage of Pallava Kings.

⊙ *(b)* Kailasanatha temple at Ellora is one of the largest rock-cut temples, built by Rashtrakuta King Krishna I.

Shore temple at Mamallapuram is a structural temple built with blocks of granite by Narasimha Varman II of Pallava dynasty.

Hence, Kailasanatha temple at Ellora and the Shore temple at Mamallapuram are carved out from solid rocks.

115. Which of the following is/are not depicted in the Rajput paintings?

1. The stories of Krishna
2. Ragas and Raginis
3. The deeds of Hamza
4. The deeds of Babur

Select the correct answer using the codes given below

(a) 1, 2 and 3

(b) 2, 3 and 4

(c) 3 and 4

(d) Only 4

⊙ *(c)* Rajput paintings are also called Rajasthani painting.

Subject related to Sri Ram Charit, Divine love of Radha and Krishna, Barahamasa, Raagmala paintings and those based on Geet-Govinda are treasures of Rajput paintings. Hence, option (c) is correct.

116. Which one among the following was not an attribute of Samudragupta described in *Prayag Prashasti*?

(a) Sharp and polished intellect

(b) Accomplished sculptor

(c) Fine musical performances

(d) Poetical talent of a genius

⊙ *(b)* *Prayag Prashasti* is also known as Allahabad pillar inscription.

Harisena was the court poet of Samudragupta, who mentioned the achievements of Samudragupta in the *Prayag Prashasti*.

Hence, all features of Prayag Prashasti are true, such as sharp and polished intellect fine musical performances, Poetical talent of a genius.

117. Kamandaka's *Nitisara* is a contribution to

(a) Logic and Philosophy

(b) Mathematics

(c) Political morality

(d) Grammar

⊙ *(c)* Kamandaka's *'Nitisara'* is Sanskrit text on political morality. Its creator's name is Kamandaki or Kamandak.

In reality this text is rendering essential principles laid down by Kautilya's Arthashastra.

It is in the form of verses. Its language is very simple. Hence, option (c) is the correct answer.

118. The followers of Gorakhnath were called

(a) Jogis (b) Nath-Panthis

(c) Tantriks (d) Sanyasis

⊙ *(a)* The followers of Goraknath were called 'Jogis'. The main region of this group is in Eastern India and Nepal. It is a form of Hinduism and worshipped Lord Shiva.

119. What were the 12 states of the Sikh confederacy called?

(a) Misl (b) Gurmata

(c) Sardari (d) Rakhi

⊙ *(a)* 'Misl' is a term used for the 12 states of the Sikh confederacy. Which originated in the 18th century history of the Sikhs to describe a unit or brigade of Sikh warriors. And the territory acquired by it in the course of its campaign of conquest following the weakening of the Mughal authority.

Ranjit Singh was leader of one of such misl before he united all of them. And conquered some move to became the Maharaja of 'Punjab'.

120. Which one among the following statements about the coins of the Gupta rulers is correct?

(a) The obverse and reverse, both, had only the king's portrait and date.

(b) The obverse and reverse, both, had only an image of a deity and date.

(c) The obverse generally had king's portrait and reverse had an image of a deity or a motif.

(d) The obverse generally had king's portrait and reverse always had a date.

⊙ *(c)* Gupta age is referred to as the 'Golden Age' of ancient India and was perhaps the most prosperous era in the Indian History. Gupta rulers issued large number of gold coins which are called as dinars. Which contains portrait of king on one side and image of a deity or a motif in reverse side.

121. The *Agrahara* in early India was

(a) the name of a village or land granted to Brahmins

(b) the garland of flowers of Agar

(c) the grant of land to officers and soldiers

(d) land of village settled by Vaishya farmers

⊙ *(a)* Agrahara is a type of land grants given to Brahmin by the royal kings and this land is exempted from all kinds of taxes.

122. Which of the following statement(s) about the Vijayanagara empire is/are true?

1. The kings claimed to rule on behalf of the God Virupaksha.

2. Rulers used the title 'Hindu Suratrana' to indicate their close links with Gods.

3. All royal orders were signed in Kannada, Sanskrit and Tamil.

4. Royal portrait sculpture was now displayed in temples.

Select the correct answer using the codes given below:

(a) Only 4 (b) 1 and 2

(c) 1, 2 and 3 (d) 1, 2 and 4

⊙ *(d)* The Vijayanagara Empire was based in the Deccan Plateau region in South India. It was established in 1336 by Harihara I and his brother Bukka Raya I of Sangama Dynasty.

The Vijayanagara kings claimed to rule on behalf of the God Virupaksha.

All royal orders were signed "Shri Virupaksha", usually in the Kannada script.

Rulers also indicated their close links with the Gods by using the title "Hindu Suratrana" that meant Hindu Sultan.

Further, royal portrait sculpture was displayed in temples. Hence, statements 1, 2 and 4 are correct and statement 3 is incorrect.

123. *Iqta* in medieval India meant

(a) land assigned to religious personnel for spiritual purposes

(b) land revenue from different territorial units assigned to army officers

(c) charity for educational and cultural activities

(d) the rights of the Zamindar

⊙ (b) Iqta was Islamic practice of tax farming that was introduced by Iltutmish in Delhi Sultanate. It was basically grant of revenue from territory in lieu of salary. This grant was not hereditary.

124. Which one of the following books was not illustrated with paintings in Akbar's court?

(a) Hamzanama (b) Razmnama

(c) Baburnama (d) Tarikh-i-Alfi

⊙ *(c)* Tuzuk-i-Baburi (or Baburnama) was the autobiography of Babur. It was not illustrated with paintings in Akbars court.

Baburnama During the reign of Akbar, Tujuk-i-Babri was completely translated to Persian by a Mughal courtier. Abdul Rahim Khan-e-Khana named it Baburnama.

Hamzanama Narrates the legendary exploits of Amir Hamza (an uncle of the prophet Muhammad). Akbar commissioned his court workshop to create an illustrated manuscript of the Hamzanama.

Razmnama is the Persian translation of one of the great Hindu epics of India, the Mahabharata.

Tarikh-i-Alfi 'History of a thousand year' was written for the Mughal Emperor Akbar.

125. Which kingdom did the temple of Hazara Rama belong to?

(a) Avadh   (b) Travancore
(c) Vijayanagara   (d) Ahom

⊘ (*c*) Hazara Rama belonged to the Vijayanagara kingdom. Other important temples of Vijayanagara empire were

(i) Vithalswami temple at Hampi.
(ii) Tadapatri and Parvati temples at Chidambaram.
(iii) Varadraja and Ekambarnath temples at Kanchipuram.

126. Consider the following statements about votive inscriptions in the 2nd century BC:

1. They record gifts made to religious institutions.
2. They tell us about the idea of transference of the meritorious results of the action of one person to another person.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ (*a*) Votive inscription denotes votive offerings to a deity by one or more persons.

They may express gratitude for victory in a battle or for a merchant ship that has returned safely home.

They record gifts made to religious institutions.

127. Consider the following statements:

1. Abhinavagupta wrote a comprehensive treatise called the *Tantraloka* which systematically presents the teachings of the *Kula* and *Trika* systems.

2. The *Samaraichchakaha* by Haribhadra Suri written in Gujarat around the 8th century is technically not a tantric work but is saturated with tantric ideas and practices.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ (*a*) Abhinavagupta was a philosopher, mystic and aesthetician from Kashmir. His most important work was Tantraloka, a synthesis of all the Trika system.

Abhinavaguptas most important work on the philosophy of art is Abhinavabharati – a long and complex commentary on Natya Shastra of Bharata Muni. Hence, Statement 1 is correct.

Aacharya Haribhadra Suri was a Svetambara mendicant Jain leader and author. With his writings, he established Sanskrit as the language of Jain study.

Samaraiccakaha is a narrative which outlines the effects of 'karma' in a story about the enmity of its characters which endures over several reincarnations. Hence, Statement 2 is incorrect.

128. Consider the following statements :

1. The inscriptions on the pillar at Rummindei give vivid details of Ashoka's *Dhamma*.

2. The Nigalisagar inscription records the fact of Ashoka having visited the Konagamana stupa.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ (*b*) Rummindei Pillar Inscription provides details of Ashoka's visit to Lumbini.

The Lumbini Pillar Edict recorded that sometime after the twentieth year of his reign, Ashoka travelled to the Buddha's birthplace and personally made offerings.

He then had a stone pillar set up and reduced the taxes of the people in that area. Hence, statement 1 is incorrect.

Nigalisagar Pillar Inscription was originally located at Kapilvastu.

The Ashoka inscription engraved on the pillar in Brahmi script and Pali language attests the fact that Emperor Ashoka enlarged the Kanaka muni Buddha's stupa, worshiped it and erected a stone

pillar for Kanaka muni Buddha on the occasion of the twentieth year of his coronation. Hence, statement 2 is correct.

129. Consider the following statements:

1. The province of Assam was created in the year 1911.
2. Eleven districts comprising Assam were separated from the Lieutenant Governorship of Bengal and established as an independent administration under a Chief Commissioner in the year 1874.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ (*c*) The province of Assam was created in 1911 by the probation of Eastern Bengal and Assam.

The Assam territory was first separated from Bengal in 1874 as the 'North-East Frontier'.

Eleven districts comprising Assam were separated from the Lieutenant Governorship of Bengal and established as an independent administration under a Chief Commissioner in the year 1874. Hence, both the statements are true.

130. Which of the following statement(s) is/are true?

1. Faxian's *Gaoseng Faxian Zhuan* was the earliest first-hand Chinese account of Buddhist sites and practices in India.
2. Faxian was only 25 years old at the time of writing the text.
3. Faxian's main aim in coming to India was to obtain and take back texts containing monastic rules.

Select the correct answer using the codes given below:

(a) 1, 2 and 3   (b) Only 2
(c) 1 and 3   (d) Only 3

⊘ (*c*) Faxian (Fa-Hien) was Chinese Buddhist monk who travelled by foot from China to India.

Visited India in the early 5th century, during the reign of Chandragupta-II.

Faxian's Gaoseng Faxian Zhuan was the earliest first hand Chinese account of Buddhist sites and practices in India.

Its main aim in coming to India was to obtain and take back texts containing monastic rule. Hence, statement 1 and 3 are true.

2015 (II)

131. Consider the following statements about Alauddin Khilji's market policy

1. He placed markets under the control of a high officer called 'Shahna' for strictly controlling the shopkeepers and prices.

2. In order to ensure a regular supply of cheap foodgrains, he ordered the land revenue from Doab region to be paid directly to the state.

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(c)* Alauddin Khilji took various steps to control the prices. He exercised supervisions over the market.

He fixed the prices of all the commodities from top to bottom. Market officers called 'Shahna' were appointed to keep a check on the prices.

The defaulters were heavily punished. Land revenue was fixed and the grain was stored in government granaries.

He was the first monarch who insisted that in the Doab, land revenue would be assessed on the basis of measurement of the land under cultivation.

132. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Term)		List II (Meaning)
A.	Mihrab	1. Stepped pulpit
B.	Mimbar	2. Direction towards the Kaba for prayer
C.	Khutba	3. Arch
D.	Kibla	4. Sermon

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	4	3	(b)	2	4	1	3
(c)	3	1	4	2	(d)	3	4	1	2

⊙ *(c)* Mihrab means arch, i.e. an ornamental indentation in the wall of a mosque which marks the direction of the qiblah.

Mimbar means stepped pulpit, i.e. a short flight of steps, used as a platform by a preacher in a mosque.

Khutba means sermon preached by an imam in a mosque.

Kibla means direction towards the Kaba for prayer in Mecca.

133. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Person)		List II (Work)
A.	Uddanda	1. Sudhanidhi
B.	Suyana	2. Mallikamaruta
C.	Yadavaprakaasa	3. Malatimadhava
D.	Bhavabhuti	4. Vaijayanti

Codes

	A	B	C	D
(a)	2	1	4	3
(b)	3	4	1	2
(c)	2	4	1	3
(d)	3	1	4	2

⊙ *(a)* Uddanda Shastri was a famous author from Tamil Nadu in medieval India. He authored Kokila Sandesa and Mallika Maruta.

Suyana famous work is Sudhanidhi. Yadava Prakaasa was an Advaita scholar and a contemporary of Vaishnava Acharya Ramanuja.

He was one of the teachers of Ramanuja during the latter's early years in Kanchi. Vaijayantikosa is a lexicon written by Yadava Prakaasa.

Bhavabhuti was an 8th-century scholar of India noted for his plays and poetry, written in Sanskrit.

His famous works include, Mahaviracharita, Malatimadhava and Uttararamacarita. Malatimadhava is a play based on the romance of Malati and Madhava.

134. The *Rihla* was written in

(a) Arabic in the 14th century by Ibn Battuta
(b) Persian in the 15th century by Abdur Razzaq
(c) Persian in the 13th century by Ibn Battuta
(d) Italian in the 13th century by Marco Polo

⊙ *(a)* The Rihla was written in Arabic in the 14th century by Ibn Battuta.

Ibn Battuta (1304-1369) a Morocco born, Berber Muslim scholar and traveller.

He is known for his extensive travels, accounts of which were published in the Rihla.

135. Which of the following statement(s) about the formation of the Indian National Congress is/are true?

1. The Indian National Congress was formed at a national convention held in Calcutta in December 1885 under the presidency of Motilal Nehru.

2. The Safety Valve Theory regarding the formation of the Indian National Congress emerged from a biography of AO Hume written by William Wedderburn.

3. An early decision was that the President would be from the same region where the session was to be held.

4. WC Bannerjee was the first President of the Indian National Congress.

Select the correct answer using the codes given below:
(a) 1, 2 and 4   (b) 2 and 3
(c) 2 and 4   (d) 1 and 3

⊙ *(c)* The Indian National Congress was formed by AO Hume at Gokuldas Tejpal Sanskrit College in Bombay on 28th December, 1885 and Womesh Chandra Bannerjee of Calcutta was elected as President.

Motilal Nehru served to Congress President in 1919 and 1928. The Safety Valve Theory regarding the formation of INC emerged from a biography of AO Hume written by William Wedderburn. Hence, statements 2 and 4 are true.

136. Which of the following statement(s) about Jyotirao Phule's Satyashodhak Samaj Movement in Maharashtra is/are true?

1. The Satyashodhak Samaj was set-up in 1873.

2. Phule argued that Brahmins were the progeny of 'alien' Aryans.

3. Phule's focus on the Kunbi peasantry in the 1880s and 1890s led to a privileging of Maratha identity.

Select the correct answer using the codes given below:
(a) 1 and 2   (b) Only 2
(c) 1 and 3   (d) 1, 2 and 3

⊙ *(d)* The Satyashodhak Samaj was founded by Mahatma Jyotirao Phule on 24th September, 1873. Phule argued that Brahmins were the progeny of 'alien' Aryans.

His focus on Kunbi peasantry in the 1880s and 1890s led to a privileging of Maratha identity. Hence, all the above statements about Satyashodhak Samaj are ture.

137. Which of the following statement(s) about Maulvi Ahmadullah Shah, who played an important part in the Revolt of 1857 is/are correct?

1. He was popularly known as Danka Shah or the Maulvi with a drum.
2. He fought in the famous Battle of Chinhat.
3. He was killed by British troops under the command of Henry Lawrence.

Select the correct answer using the codes given below:
(a) Only 1   (b) 1 and 3
(c) 2 and 3   (d) 1 and 2

⊙ *(d)* Maulvi Ahmadullah Shah was popularly known as Danka Shah or the Maulvi with a drum or Maulvi of Faizabad.

He fought in the famous Battle of Chinhat, in which the British forces under Henry Lawrence were defeated in 1857. Hence, statements 1 and 2 are correct.

138. In ancient India, the 'Yaudheyas' were

(a) a sect of the Buddhism
(b) a sect of the Jainism
(c) a republican tribe
(d) vassals of the Cholas

⊙ *(c)* Yaudheyas had an ancient tribal confederation who lived in the area between the Indus river and the Ganges river. They find mention in Panini's Ashtadhyayi and Ganapatha.
There are other references to them, namely in Mahabharata, Mahamayuri, Brihatsamhita, Puranas, Chandrasekhar's and Kashika.

139. Borobudur is the site of

(a) a huge temple of Vishnu and Shiva in Java, built in the AD 12th century
(b) an enormous Stupa in Java, built in the AD 8th century
(c) a magnificent palace of a Chola King in Tamil Nadu
(d) a Jain monastery in Gujarat

⊙ *(b)* Borobudur, a famous Buddhist temple, located in Central Java.
It was built in three tiers : a pyramidal base with five concentric square terraces, the trunk of a cone with three circular platforms and at the top, a monumental stupa.

140. Which of the following statement(s) about the Hastings Plan of 1772 is/are correct?

1. Each district was to have a civil and a criminal court.

2. The Judges were helped by native assessors who were skilled in Hindu and Islamic laws.
3. The Sadar Diwani Adalat was mainly meant to settle mercantile cases exceeding ₹ 10000 in value.
4. These courts did not put into place any procedural improvements.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 3 and 4
(c) 2 and 4   (d) Only 2

⊙ *(a)* Following are the provisions of the Hastings Plan of 1772:
• Each district was to have a civil and criminal court.
• The judges were helped by native assessors who were skilled in Hindu and Islamic laws.
• A Mofussil Diwani Adalat was established in each district to decide civil cases only especially mercantile cases upto the monetary value of ₹ 500. The Sadar Diwani Adalat heard appeals from the Mofussil Diwani Adalat of cases valuing over ₹ 500.
• There were a codified set of rules for court procedure to be followed in court for the improvements.

Hence, option (a) is the correct answer.

141. Who among the following was not a painter at Akbar's Court?

(a) Daswanth
(b) Abdus Samad
(c) Kalyan Das
(d) Basawan

⊙ *(c)* Daswanth, Mukand, Basawan, Jagan, Madhu, Mahesh, Kesu Lal, Ram, Tara, Sanwla, Khem Karan, Haribansh, Mir Sayyid Ali and Abdus Samad were famous painters in the Court of Akbar. Kalyan Das was court artist of Mughal Emperor Muhammad Shah.

142. After the death of Shivaji, there was a fight for succession between

(a) Shambhaji and the widow of Shivaji
(b) Shambhaji and Bajirao
(c) Rajaram and Shambhaji
(d) None of the above

⊙ *(c)* After the death of Shivaji, there was a fight for succession between Rajaram and Shambhaji.
Shambhaji marched to fort Raigad. Raigad fell without much resistance to Shambhaji. Soyrabai was imprisoned by Shambhaji on charges of plotting against him and also poisoning the late king. Both she and her son Rajaram were imprisoned.

143. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Author)		List II (Work)
A. Somadeva	1.	*Malavikagnimitra*
B. Kalidasa	2.	*Kathasaritsagara*
C. Bhasa	3.	*Chaurapanchasika*
D. Bilhana	4.	*Svapnavasavadatta*

Codes
   A B C D
(a) 2 1 4 3   (b) 3 4 1 2
(c) 2 4 1 3   (d) 3 1 4 2

⊙ *(a)* Somadeva, Kashmiri Brahmin of the Saiva sect and Sanskrit writer who authors *Kathasaritsagara* (ocean of rivers of stories).
Kalidasa, the greatest poet and dramatist in the Sanskrit language, wrote *Malavikagnimitra*, and *Vikramovasiyan*.
Bhasa authored the play *Svapnavasavadatta*.
Bilhana was an 11th century Kashmir poet, who wrote *Chaurapanchasika* (the love thief), an Indian love poem.

144. Patanjali was

(a) a philosopher of the 'Yogachara' school
(b) the author of a book on Ayurveda
(c) a philosopher of the 'Madhyamika' school
(d) the author of a commentary on Panini's Sanskrit grammar

⊙ *(d)* Patanjali was a great grammarian and his Mahabhashya or Great Commentary on Panini's grammar is still read and acknowledged.

145. Match List I with List II and select the correct answer using the codes given below the lists.

List I (King)		List II (Region)
A. Shashanka	1.	Assam
B. Kharavela	2.	Maharashtra
C. Simuka	3.	Odisha
D. Bhaskara Varman	4.	Bengal

Codes
   A B C D   A B C D
(a) 4 2 3 1   (b) 1 3 2 4
(c) 4 3 2 1   (d) 1 2 3 4

⊙ *(c)* Shashanka was the first important king of ancient Bengal and the development of the Bengali Calendar is often attributed to him.
Kharavela was the best-known king of the Mahameghavahana dynasty of Odisha.

Simuka was the founder of Satavahana dynasty in Maharashtra.

Bhaskara Varman was the last and most illustrious king of the Varman dynasty of Kamarupa kingdom in Assam.

2015 (I)

146. Which of the following characteristic(s) describes the nature of religion according to the Rig Veda?

1. Rig Vedic religion can be described as naturalistic polytheism.
2. There are striking similarities between the Rig Vedic religion and the ideas in the Iranian Avesta.
3. Vedic sacrifices were conducted in the house of the priest who was called *yajaman*.
4. Vedic sacrifices were of two kinds — those conducted by the householder and those that required ritual specialists.

Select the correct answer using the codes given below:
(a) Only 3   (b) 1 and 2
(c) 1, 2 and 4   (d) All of these

⊙ *(c)* Rig Veda reflects a naturalistic polytheism—a belief in many God who personified natural phenomenon.

The Rig Veda reflects the belief and practices of a religions aristocracy and its patrons and there are several striking similarities with ideas reflected in the Iranian Avesta.

The sacrifices were of two kinds. The first kind of sacrifices were those in which certain hymns and verses of Rig Veda were used as benedictions and prayers at birth, marriage and other occasions of daily life.

These simple sacrifices were performed by everyone. The second kind of ceremonial worship was so elaborate that seven classes of priest were required.

Hence, statements 1, 2 and 4 correctly describes the nature of religion according to the Rig Veda.

147. Which of the following statement(s) about Mahatma Gandhi's South African experiences (1893-1914) is/are true?

1. Muslim merchants were actively involved in Gandhian political movements in South Africa.
2. In 1906, Gandhi led a campaign in Cape Town against the ordinance on compulsory registration and passes for Indians.
3. Gandhi began his political career with struggles against the imposition of excessive taxes on Indians in Cape Town.

Select the correct answer using the codes given below:
(a) Only 1   (b) Only 3
(c) 1 and 2   (d) All of the above

⊙ *(a)* Only statement-1 is correct about Mahatma Gandhi's South African experiences (1893-1914). Muslim merchants were actively involved in Gandhian political movements in South Africa.

Statement-2 and Statement-3 are incorrect as, in 1906, Gandhi led a campaign in Johannesburg against the ordinance on compulsory registration and passes for Indian.

148. Which of the following sets of newspapers reflected the concerns of educated Indian Muslims during the Khilafat Movement?

(a) Comrade and Hamdard
(b) Comrade and Hindustan Times
(c) Zamindar and Muslim Voice
(d) Comrade, Hamdard, Zamindar and Al Hilal

⊙ *(d)* The Comrade was a weekly English-language newspaper, whereas, Hamdard was an Urdu daily.

Both of these newspapers were published by Maulana Mohammad Ali. Zamindar was a newspaper in Urdu language.

It was published by Maulana Zafar Ali Khan, who was a poet, intellectual, writer and a Muslim nationalist. Al Hilal was a weekly Urdu language newspaper established by Maulana Abul Kalam Azad in 1912.

149. Which of the following statement(s) is/are correct?

1. The Marxist theory repudiates the idea of the atomised and alienated individual.
2. Marxism upholds the idea of the natural rights of men and individuals.

Select the correct answer using the codes given below:
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(a)* Marxism is a method of socio-economic analysis, originating in mid 19th century works of German philosophers Karl Marx.

The Marxist theory believed that alienation is a systematic result of capatalism. Karl Marx also analysis the idea of atomisation.

The idea of natural right is based on a political theory of Karl Marx.

It analyses class relations and societal conflict using a materialist interpretation of historical development and a dialectical view of social transformation.

150. Which would be the most appropriate description concerning the Punjab Naujawan Bharat Sabha?

It aspired to
(a) do political work among youth, peasants and workers
(b) spread the philosophy of revolution among students
(c) initiate discussions regarding anti-imperialism among workers
(d) help the formation of a Trade Union Movement in Punjab

⊙ *(a)* Naujawan Bharat Sabha (Youth Society of India) was an association of Indian youth that sought to foment revolution against the British Raj by gathering together worker, peasant and youth. The organisation was founded by Bhagat Singh in March, 1926.

151. Which empire did Nicolo de Conti, Abdur Razzaq, Afanasy Nikitin and Fernao Nuniz visit?

(a) The empire of Kannauj
(b) Vijayanagara empire
(c) Hoysala empire
(d) Rashtrakuta empire

⊙ *(b)* Famous Travellers to Vijayanagara Kingdom were Nicolo de Conti, Abdur Razzaq, Afanasy Nikitin and Fernao Nuniz visited the Vijayanagara Empire. Nicolo Conti was an Italian traveller.

He visited Vijayanagara empire during the reign of Devaraya-I (theTuluva dynasty ruler). He gave a comprehensive account of the Hindu kingdom of Vijayanagara.

Abdur Razzaq was a Persian, timurid chronicler and a scholar who visited the Vijayanagara Kingdom at the time of Dev Raya II. Afanasy Nikitin was a first Russian traveller and merchant who visited India.

He described the conditions of the Bahamani kingdom under Muhammad III in his Voyage to India.

Fernao Nuniz was a Portuguese traveller, chronicler and horse trader who visited India during reign of Achyutaraya and spent three years in Vijayanagara.

152. Match List I with List II and select the correct answer using the codes given below the lists:

List I (Editor)	List II (Journal/Newspaper)
A. SA Dange	1. Labour-Kisan Gazette
B. Muzaffar Ahmed	2. Inquilab
C. Ghulam Hussain	3. Navayug
D. M. Singaravelu	4. The Socialist

Codes

	A	B	C	D
(a)	4	3	2	1
(b)	4	2	3	1
(c)	1	2	3	4
(d)	1	3	2	4

⊗ (*a*) Option (a) is the correct match. **SA Dange** was a founding member of the Communist Party of India (CPI) and leader of Indian Trade Union Movement. He was the founder of 'socialist', the 1st socialist weekly in India.

Muzaffar Ahmed noted Bengali politician, journalist and communist activist, popularly known as 'Kakababu'. In 1920, along with Kazi Nazrul Islam he started 'Navayug'.

Ghulam Hussain editor of Urdu weekly 'Inquilab' (Revolution).

M. Singaravelu Communist leader and editor of Labour-Kisan Gazette.

153. Which of the following was/were connected primarily to the communist ideology?

1. Kirti Kisan Party
2. Labour Swaraj Party

Select the correct answer using the codes given below:
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊗ (*c*) The Ghadar Party in 1925 established a Workers and Peasant Party (Kirti Kisan Party) in the Punjab. Its organ, the Kirti, a purely communistic production, was subsidised by the Ghadar Party in America.

The Kirti Kisan Party was a counter part in India of the Ghadar Party organisation in America and it professed communist creed.

Labour Swaraj Party of the **Indian National Congress** was founded in Bengal on 1st November, 1925. The founding leaders of the party were Kazi

Nazrul Islam, Hemanta Kumar Sarkar, Qutubuddin Ahmed and Shamsuddin Hussain.

At the All Bengal Praja Conference, held at Krishnagar on 6th February, 1926. A resolution was moved by Faizuddin Hussain Sahib of Mymensingh for the creation of a workers-peasants party.

All open communist activities were carried out through Workers and Peasants Parties.

Hence, both the statements are correct.

154. The interest of the British Government of India in Afghanistan in the 19th century came about in order to

(a) make use of the natural resources of Afghanistan
(b) ensure that the Russian empire did not have an influence over Afghanistan
(c) increase the reach of the British Empire
(d) establish a monopoly over the markets of Afghanistan

⊗ (*b*) In the 1830s, the British Empire was firmly entrenched in India, but by 1837 Lord Palmerston and John Hobhouse, fearing the instability of Afghanistan, Sindh.

And the increasing power of the Sikh kingdom to the North-West, raised the spectre of a possible Russian invasion of India through Afghanistan.

The Russian empire was slowly extending its domain into Central Asia, and this was seen as an encroachment to South that might prove fatal for the British Company Rule in India.

155. Which of the following features of the State of Arcot in 18th century South India are correct?

1. The founders of the dynasty that ruled Arcot were Daud Khan Panni and Saadatullah Khan.
2. Arcot became the site of a protracted struggle between the English and Dutch East India Companies from the 1740s.
3. Decentralisation was a key feature of the State of Arcot in the 18th century.
4. The other major State to emerge in South India at this time was Mysore.

Select the correct answer using the codes given below:
(a) 1 and 2   (b) 1, 2 and 4
(c) 3 and 4   (d) 2 and 4

⊗ (*b*) Daud Khan Panni, a Mughal Commander and Saadatullah Khan were the founder of dynasty that ruled Arcot in 18th century. During this time, Mysore also emerged as a major state under Haider Ali and his successor Tipu Sultan. From 1740s onward Arcot became the site of protracted rivalry between the English and Dutch East India companies. State of Arcot was a monarchy that was highly centralised. Hence statement 3 is not correct.

156. Which of the following statement(s) about the musical culture in 18th and 19th centuries North India is/are not correct?

1. The period was marked by the growing eminence of Sadarang Neamat Khan who introduced the khyal form.
2. A large number of musicians move out of regional centres to Delhi where they hoped they would receive more employment and patronage.
3. The period was marked by the formation of specific region based *gharanas*.

Select the correct answer using the codes given below:
(a) Only 1   (b) 2 and 3
(c) Only 2   (d) All of these

⊗ (*c*) With decline in material fortune of Mughal empire in 18th and 19th century, a huge number of musicians migrated towards the regional courts in search of Patronage. In the context of vocal music, Khayal gayaki of Sadarang Niamat Khan flourished in the regional courts. Migration and movement of artistes between courts allows musicians to interact across family lineages which get formalised in different gharanas. Hence, statement 2 is not correct.

157. Which of the following statement(s) about the musical culture in 18th and 19th centuries South India is/are correct?

1. Musical developments were spearheaded by the Arcot court.
2. Tanjavur replaced Madras as the cultural capital of classical music in the second half of the 19th century.
3. Three great composers, Tyagaraja, Dikshitar and Syama Sastri experimented with the kriti from to set the foundations for modern Carnatic music.

Select the correct answer using the codes given below:
(a) 1 and 3   (b) Only 2
(c) Only 3   (d) All of these

⊙ *(c)* Musical developments were not spearheaded by Arcot Court. The city of Madras was founded in 1639, Madras replaced Thanjavur as the cultural capital of South India.

The contemporaries Tyagaraja (1759-1847), Muthuswami Dikshitar, (1776-1827).

And Syama Sastri, (1762-1827) are regarded as the Trinity of Carnatic music because of the quality of Syama Sastri's compositions, the varieties of compositions of Muthuswami Dikshitar, and Tyagaraja's prolific output in composing kritis.

158. Which of the following statement(s) about visual culture in 18th and early 19th century North India is/are correct?

1. Painters from Patna and Murshidabad flocked to Calcutta and produced water colours in the English mode.
2. Landscape and portraiture became extremely important at this time.
3. The artists Zayan-al-Din, Bhawani Das and Ram Das were adopted by the English East India Company to produce albums of India birds and animals.
4. While Indians were influenced by European artistic styles, Europeans artists did not visit regional courts.

Select the correct answer using the codes given below:
(a) 1, 2 and 3   (b) 2 and 3
(c) 1, 3 and 4   (d) Only 4

⊙ *(a)* Company Painting water colours were prominent, painters from Patna, Murshidabad and from other places flocked to Calcutta.

Landscape and portraiture became extremely important at that time. The three Indian artist Zayan-al-Din, Bhawani Das and Ram Das came from Patna, where they had been trained in the Mughal painting technique.

They produced album of Indian birds and mammals painted on large sheet of European.

Hence, statements 1, 2 and 3 are incorrect.

159. Which of the following statements about the social reformer, Raja Ram Mohan Roy, is false?

(a) Ram Mohan Roy belonged to the gentry class whose power has been diminished because of the imposition of the Permanent Settlement
(b) He studied both Vedantic Monism and Christian Unitarianism
(c) He translated the Upanishads into Bengali
(d) His first organisation was the Atmiya Sabha, founded in Calcutta in 1815

⊙ *(a)* Raja Ram Mohan Roy is known as the 'Maker of Modern India'. He was the founder of the Brahmo Samaj, one of the first Indian socio-religious reform movements.

He played a major role in abolishing the role of Sati. Raja Ram Mohan Roy was a great scholar and an independent thinker.

He advocated the study of English, Science, Western Medicine and Technology. He was given the title 'Raja' by the Mughal Emperor, Akbar II.

By the age of fifteen, Raja Ram Mohan Roy had learnt Bangla, Persian, Arabic and Sanskrit and Vedas. His first organisation was the Atmiya Sabha, founded in Calcutta in 1815.

He was also a great scholar who translated many books, religious and philosophical work and scriptures into Bengali and also translated Vedic scriptures into English.

160. Which of the following characteristic(s) about the state of Travancore in 18th century Kerala is/are correct?

1. Travancore was ruled by Martanda Varma from 1729 to 1758.
2. Travancore built a strong army and defeated the Dutch in 1741.
3. Travancore was an important centre of learning.

Select the correct answer using the codes given below:
(a) Only 1   (b) Only 2
(c) 1 and 2   (d) All of these

⊙ *(d)* Travancore was ruled by Martanda Varma from 1729 to 1758.

He was the only Indian king to beat the European armed force at the 1741 Battle of Colachel against the Dutch.

He then adopted a European mode of discipline in his army and expanded the Venad domain into adjoining regions.

He organised a substantial standing army, reduced the power of the Nair aristocracy (on which rulers of Kerala had been dependent militarily) and fortified the northern limits of his kingdom at the Travancore line.

Travancore under Maharaja Martanda Varma was one of the few kingdoms in India determined to consolidate their power by the use of maritime means. Travancore was an important centre of learning.

Hence, all the above statements are true.

161. Upari refers to which one of the following?

(a) A form of Marathi poetry that emerged during the Maratha period
(b) A category of tenancy tenure held under the Maratha regime
(c) A court official during Maratha rule
(d) A group of peasants who repelled against their oppressive landlords under Maratha rule

⊙ *(b)* Upari refers to a category of tenancy tenure held under the Maratha regime. Under this system the cultivator was taken land from landlords for farming purposes.

The village Patil had the right to distribute land among cultivators. The farmers were paying some parts of produced commodities as rent.

The farmers were not enjoying ownership right of land.

162. Which of the following is/are the characteristic(s) of the Sannyasi and Fakir uprisings?

1. These uprisings refer to a series of skirmishes between the English East India Company and a group of Sannyasis and Fakirs.
2. One reason for the uprising was the ban on free movement of the Sannyasis along pilgrimage routes.
3. In the course of the uprisings in 1773, Warren Hastings issued a proclamation banishing all Sannyasis from Bengal and Bihar.
4. Are contemporaneous with the Non- Cooperation Movement.

Select the correct answer using the codes given below:
(a) Only 1   (b) 1 and 3
(c) 1, 2 and 3   (d) 2 and 4

⊙ *(c)* The Sannyasi and Fakir uprising took place in Bengal in the late 18th century.

To the British these ascetic were looters and must be stopped from collecting money that belonged to the Company and possibly from even entering the province. When the Company's forces tried to prevent the Sannyasis and Fakirs from entering the province, fierce clashes was ensued.

Hence, statements 1, 2 and 3 are true about characteristics of Sannyasi and Fakir uprising.

2014 (II)

163. Which of the statements given below about the Mughal rule in India is false?

(a) Peasant communities were a united and homogeneous group.
(b) There was an abundance of food grain.
(c) The state encouraged those crops that brought in more revenue.
(d) Most regions produced two crops in a year.

⊙ (*a*) Maintaining the Mughal lifestyle meant higher taxes from which the tax-payers derived no benefit. Little money was invested in agricultural or technological development.

Economic prosperity was regarded as a threat to the security of the state and so was discouraged. Mughal state encouraged those crops that brought in more revenue.

Indian peasantry in the Mughal Empire was highly stratified and there was considerable difference is the size of holdings, produce and resource of peasants with in same locality.

164. The Ghadar party, formed in the USA, was determined to start a revolt in India. Which among the following provinces did the party choose to begin its armed revolt?

(a) Punjab (b) Bengal
(c) United Provinces (d) Bihar

⊙ (*a*) The Ghadar Party was an organisation founded by Punjabi Indians, in the USA and Canada with the aim to gaining India's independence from British rule.

Key members included Lala Har Dayal, Sohan Singh Bhakna, Kartar Singh Sarabha and Ras Bihari Bose.

Many of its most prominent activities were forced into exile to Canada and the USA.

It ceased to play an active role in Indian politics after 1919.

165. The ruins of the Vijayanagara at Hampi were brought to light in 1800 by

(a) Colonel Colin Mackenzie
(b) Sir John Shore
(c) Andrew Fraser (d) John Marshall

⊙ (*a*) Colonel Colin Mackenzie was Scottish army officer in the British East India Company and was a Collector of antiquities and an Orientalist.

His collections consisting of thousands of manuscripts, inscriptions, translation, coins and paintings brought to light not only ruins of Vijayanagara empire but also other forbidden kingdoms.

166. Consider the following statements about colonial economy of Vietnam (Indo-China):

1. The colonial economy in Vietnam was primarily based on rice cultivation and rubber plantations.
2. All the rubber plantations in Vietnam were owned and controlled by a small Vietnamese elite.
3. Indentured Vietnamese labour was widely used in the rubber plantations.
4. Indentured labourers worked on the basis of contracts that did not specify any rights of labourers but gave immense power to the employers.

Which of the statement(s) given above is/are correct?
(a) 1, 3 and 4 (b) 1 and 4
(c) 2 and 3 (d) Only 1

⊙ (*a*) The colonial economy in Vietnam was primarily based on rice cultivation and rubber plantations owned by the French and a small Vietnamese elite.

Indentured labour was widely used in the rubber plantations. Labourers worked on the basis of contracts that did not specify any rights of labourers but gave immense power to employers. Hence from all the above it is clear that statements 1, 3 and 4 are true.

167. Which of the four linguistic regions in South India remained unaffected by the Non-Cooperation Movement (1921-22)?

(a) Kerala (b) Tamil Nadu
(c) Andhra Pradesh (d) Karnataka

⊙ (*d*) Of the four linguistic regions of South India, three were effectively brought into the movement, while Karnataka remained unaffected.

168. Which of the following statement(s) about the penetration of English into Bengal is/are correct?

1. Job Charnock arrived in Sutanati in August, 1690 and laid the foundation of Calcutta which later became the heart of the British Indian empire.
2. The French East India Company built a fort near the Fort William in Calcutta.

Select the correct answer using the codes given below:
(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2

⊙ (*a*) Job Charnock arrived at Sutanati in August, 1690 and founded new city (i.e. Kalikata, Calcutta) by merging other two villages Gobindapur and Sutanati.

Some historians regarded this attempt of Charnock as the penetration of English into Bengal. French East India company built Fort in Chandernagore.

169. Which of the following statement(s) is/are correct?

1. Early Buddhist literature is generally composed of the canonical text.
2. The Buddhist schools classify their canonical literature as only the Pitakas.

Select the correct answer using the codes given below:
(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2

⊙ (*d*) Buddhist texts can be categorised in a number of ways. The Western terms 'scripture' and 'canonical' are applied to Buddhism in consistent ways by Western scholars : for instance — one authority refers to "scriptures and other canonical texts" while another says that scriptures can be categorised into canonical, commentarial and pseudo-canonical.

Canonical texts comprise three different kind of texts– the Sutras, Vinaya, and Abhidharma. Hence option (d) is the correct answer.

Directions (Q. Nos. 170-173) *The following items consist of two statements, Statement* I *and Statement* II. *You are to examine these two statements carefully and select the answers to these items using the code given below*

Codes
(a) Both the statements are individually true and statement II is the correct of statement I.

(b) Both the statements are individually true, but statement II is not the correct explanation of statement I.

(c) Statement I is true, but statement II is false.

(d) Statement I is false, but statement II is true.

170. **Statement I** The 12th century witnessed the emergence of a new movement in Karnataka led by a Brahmana named Basavanna.

Statement II The Lingayats worshipped Shiva in his manifestation as a Linga.

⊛ *(b)* Basavanna was an Indian social reformer in Karnataka. He fought against the practice of the caste system which discriminated against people based on their birth and other rituals in Hinduism.

Lingayats propounded a primarily monotheistic conception of divinity through the worship of Lord Shiva in the form of linga.

Hence, both the statements are individually true , but statement II is not the correct explanation of statements I.

171. **Statement I** Ram Mohan Roy in his famous work *Gift to Monotheism* put forward weighty arguments against belief in many Gods and for the worship of a single God.

Statement II Ram Mohan Roy in his *Precepts of Jesus* tried to separate the moral and philosophic message of the New Testament.

⊛ *(b)* In 1804, Roy published 'Tuhfat-ul Mahwahhiddin' (A Gift to Monotheists), a tract in Persian criticising existing religions as based upon irrationality, deception, intolerance and other means of unjust social control.

In 1820, Roy wrote a book about Jesus emphasising Christ's moral and ethical sayings. In the *'Precepts of Jesus',* Roy omitted theological passages and miracle stories. Hence, both the statements are individually true but statement II is not correct explanation of statement I.

172. **Statement I** The Bethune School, founded in Calcutta in 1849 was the first fruit of the powerful movement for women's education that arose in the 1840s and 1850s.

Statement II The first step in giving modern education to girls was undertaken by Vidyasagar in 1800.

⊛ *(c)* The Bethune School (now Bethune College) is a women's college in India. It was founded as a school in 1849 by John Elliot Drinkwater Bethune in Calcutta.

In 1879, it developed into the first women's college in India after whom it is named as Bethune College.

Ishwar Chandra Vidyasagar was a social reformer who fought for the social upliftment of women especially widow remarriage. Hence, statement I is true, statement II is false.

173. **Statement I** The annexation of Awadh by Lord Dalhousie in 1856 adversely affected the financial conditions of the sepoys.

Statement II The sepoys had to pay higher taxes on the land where their family members stayed in Awadh.

⊛ *(a)* The annexation of Awadh by Lord Dalhousie in 1856 adversely affected the financial conditions of the Sepoys.

After the annexation of Awadh, many sepoys were disquieted from both losing their perquisites, as landed gentry.

After the annexation of Awadh by Lord Dalhousie in 1856 many sepoys were disquieted from losing their perquisites as landed gentry in the Awadh courts and from the anticipation of any increased land-revenue payments that the annexation might bring about.

Hence, the statements are individually true and statement II is the correct explanation of statement I.

174. Marco Polo's trip to India (AD 1271) earned much fame in Europe on account of

(a) his having discovered a safe route to India

(b) his having established amicable relations with many Kings of India

(c) his account of commercial, religious and social conditions in the East

(d) All of the above

⊛ *(c)* Marco Polo's trip to India (AD 1271) earned much fame in Europe on account of his work on commercial, religious and social conditions in the East.

2014 (I)

175. Consider the following statements from Kalhana's *Rajatarangini*

1. The common people ate rice and *Utpala-saka* (a wild vegetable of bitter taste).

2. Harsha introduced into Kashmir a general dress befitting a king which included a long coat.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2

(c) Both 1 and 2   (d) Neither 1 nor 2

⊛ *(c) Rajatarangini* is a metrical historical chronicle of kings of Kashmir written in Sanskrit by Kalhana in 12th century CE describing social life of Kashmir.

King Harsha is known to introduce a general dress befitting a king which include a long coat. Hence, both the statements are correct.

176. Match the following

List I (Text)		List II (Author)	
A.	Kitab-al-Hind	1.	Ibn Battuta
B.	Rehla	2.	Al-Biruni
C.	Humayun Nama	3.	Lahori
D.	Badshah Nama	4.	Gulbadan Begum

Codes

	A	B	C	D		A	B	C	D
(a)	2	4	1	3	(b)	3	1	4	2
(c)	3	4	1	2	(d)	2	1	4	3

⊛ *(d)* **Kitab-al-Hind** was written by Al-Biruni, it accounts for his observations on Indian conditions, system of knowledge, social norms and religion of India.

Rehla or Rihla (meaning Journey) is an account of journey made by Ibn Battuta, it is only source of Ibn Battuta's adventures.

Humayun Nama, the account of life of Humayun was written by his half-sister Gulbadan Begum.

Badshah Nama or Padshahnama was written by traveller/historian Abdul Hamid Lahori during the reign of Shah Jahan.

177. Which one of the following was a temple built by the Chola Kings?

(a) Brihadiswara Temple, Tanjavur

(b) Meenakshi Temple, Madurai

(c) Srirangam Temple, Thiruchirapalli

(d) Durga Temple, Aihole

⊛ *(a)* Brihadiswara Temple at Tanjavur dedicated to Lord Shiva was built by Chola Kings, Rajaraja Chola I being the founder of it.

Meenakshi Temple, Madurai dedicated to Parvati (known as Meenakshi) was built between 1623 and 1655.

Srirangam Temple, Thiruchirapalli is dedicated to Ranganatha (form of Hindu deity Vishnu). Durga Temple at Aihole was built between 7th and 8th centuries by the dynasty of the Chalukyas.

178. Consider the following statements concerning the initial phase of the Industrial Revolution in England.

1. England was fortunate in that coal and iron ore were plentifully available to be used in industry.
2. Until the 18th century, there was a scarcity of usable iron.

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ *(c)* The iron industry in England took off after 1760 since iron ore and coal were both present in England.

Abraham Derby, in 1709, inverted a way of smelting iron using coke so good quality iron got available in England in 18th century. Before this, it was imported from other countries.

179. Match the following

List I (Temple)		List II (Town)	
A. Kailasanathar	1.	Bhuvneshwar
B. Lingaraj	2.	Khajuraho
C. Kandariya Mahadev	3.	Mount Abu
D. Dilwara	4.	Kanchipuram

Codes

	A	B	C	D		A	B	C	D
(a)	4	2	1	3	(b)	4	1	2	3
(c)	3	1	2	4	(d)	3	2	1	4

⊘ *(b)* Kaliasanathar Temple is located in Kanchipuram and is built in Dravidian architectural style and is dedicated to God Shiva.

Lingaraj Temple is located in Bhuvneshwar and is dedicated to Haryana (a form of Shiva).

Kandariya Mahadeva Temples are largest medieval period temples located in Khajuraho.

Dilwara Temple built by Chalukyas between AD 11th and 13th centuries are located near Mount Abu.

180. Which among the following was the reason of the resignations of the Indian Ministers in all the provinces in the year 1939?

(a) The Governors refused to act as constitutional heads
(b) The Centre did not provide the required financial help to provinces
(c) The Governor-General converted Indian administration from federal to unitary one because of the beginning of the World War II
(d) India was declared a party to the World War II without the consent of the provincial government

⊘ *(d)* Viceroy Linlithgow declared India at war against Germany in 1939 without prior consultation of Indians.

Congress reacted strongly to this by resigning in all the provinces. Hence, India was declared a party to the World War II without the consent of the provincial government.

181. Who among the following was not associated with the activities of the Theosophical Society?

(a) Madame HP Blavatsky
(b) Mr AO Hume
(c) Col HS Olcott
(d) Mrs Annie Besant

⊘ *(b)* In 1875, Madame HP Blavatsky, Col HS Olcott and WQ Judge established Theosophical society in New York.

Annie Besant joined Theosophical society in 1889 and represented it at World Parliament of Religions in Chicago in 1893.

Mr AO Hume is regarded as the founding father of Indian National Congress.

182. The Society of Jesus, whose followers were called Jesuits, was set-up by

(a) Martin Luther   (b) Ulrich Zwingli
(c) Erasmus   (d) Ignatius Loyola

⊘ *(d)* Ignatius Loyola along with six others formed 'company of Jesus' in 1534, which later came to known as the society of Jesus. Jesuits work in education, intellectual research and cultural pursuits.

183. Consider the following statements about the First Session of the Indian National Congress

1. It was held in Bombay in 1885.
2. Surendranath Bannerji could not attend the session due to the simultaneous session of the Indian National Conference.

Which of the statement(s) given above is/are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊘ *(c)* The first session of Indian National Congress (INC) was held in Bombay in 1885 which was to be earlier organised in Pune.

Surendra Nath Bannerjee could not attend the session due to simultaneous session of the Indian National Association. Hence, both the statements are true.

184. Consider the following statements

1. BG Tilak founded the Home Rule League in April 1916, in Maharashtra.
2. NC Kelkar was not associated with Home Rule Movement.

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ *(a)* The Home Rule League was founded by Annie Besant on 9th October, 1916 in Madras while, the Indian Home Rule League was founded by BG Tilak in Poona on 23rd April, 1916.

NC Kelkar was the seretary of the India Home Rule League while Joseph Baktista was the President.

185. Consider the following statements about Syed Ahmed Khan, the founder of Muhammadan Anglo-Oriental College, Aligarh

1. He was a staunch supporter of Indian National Congress.
2. Muhammadan Anglo-Oriental College was set-up with the objective of promoting learning of Islamic education among the Muslims.

Which of the statement(s) given above is/are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊘ *(d)* Syed Ahmad Khan founded the Muhammadan Anglo-Oriental College (today Aligarh Muslim University) in 1875 with the aim of promoting social and economic development of Indian Muslims.

He denounced nationalist organisations such as the Indian National Congress, instead forming organisations to promote Muslim unity and pro-British attitudes and activities. Hence, both the statements are incorrect.

186. The social ideals of Mahatma Gandhi were first put forth in

(a) Hind Swaraj
(b) An Authobiography—The Story of My Experiments with Truth
(c) History of the Satyagraha in South Africa
(d) The Bhagavad Geeta According to Gandhi

⊘ *(a)* The 3-recurrent themes in Hind Swaraj were colonial imperialism, industrial capitalism and rationalist materialism. History of the Satyagraha in

South Africa accounts for the struggle of Indians for social justice in South Africa.

Bhagavad Geeta according to Gandhi addresses the issues related to the spiritual lives of common people.

187. The only inscribed stone portrait of Emperor Ashoka has been found at

(a) Sanchi
(b) Amaravati
(c) Kanaganahalli
(d) Ajanta

⊘ *(c)* The only inscribed stone portrait of Emperor Ashoka has been found at Kanaganahalli. This is situated near Bhima River in Gulbarg district of Karnataka.

188. Which one of the following statements about Rig Veda is not correct?

(a) Deities were worshipped through prayer and sacrificial rituals
(b) The Gods are presented as powerful, who could be made to intervene in the world of men *via* the performance of sacrifices
(c) The Gods were supposed to partake of the offerings as they were consumed by the fire
(d) The sacrifices were performed in the temples

⊘ *(d)* Prayers and sacrificial rituals were performed during Rig Veda period and these were not associated with temples.

Gods are presented as powerful, who could be made to intervene in the world of men *via* the performance of sacrifices.

Gods were supposed to partake of the offerings as they were consumed by the fire.

189. Consider the following statements

1. Battle of Buxar provided the key to the English to establish their rule in India.
2. The Treaty of Allahabad, concluded in 1765, enabled the British to establish their rule in Bengal.

Which of the statement(s) given above is/are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊘ *(c)* Battle of Buxar was fought on 23rd October, 1764, between British East India Company and Mughal King Shah Alam II.

After defeat, Shah Alam II signed the Treaty of Allahabad which gave 'Diwani Rights' to company and helped in establishment of English Rule-in-Bengal. Hence, both the above statements are correct. Hence, option (c) is the correct answer.

190. Which one of the following statements about ancient Indian Mahajanapadas is correct?

(a) All Mahajanapadas were oligarchies where power was exercised by a group of people
(b) All Mahajanapadas were located in Eastern India
(c) No army was maintained by the Mahajanapadas
(d) Buddhist and Jaina texts list sixteen Mahajanapadas

⊘ *(d)* Buddhist text 'Anguttara Nikaya' and Jaina text 'Bhagavati Sutra' provide list of 16 Mahajanapadas.

Mahajanapadas were of two types : Monarchial states ruled by kings and Republics ruled by a group of people.

191. Consider the following statements regarding Indian Feudalism in the early medieval period

1. The revenue assignments were called *Bhoga*.
2. The hereditary chiefs neither collected revenues nor assumed administrative powers.

Which of the statement(s) given above is/are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊘ *(a)* In early medieval period, the revenue assignments were called 'Bhoga' which included tax of fruits, wood, food grain, etc,. to the king. The collection of taxes in villages was done by hereditary chiefs.

192. The Fourth Buddhist Council was held in Kashmir under the leadership of

(a) Bindusara
(b) Ashoka
(c) Kunal
(d) Kanishka

⊘ *(d)*

Buddhist Council	Place	Chaired by	Patronage of
1st (400 BC)	Rajgriha (sattapani cave)	Mahakashyapa	Ajatshatru
2nd (383 BC)	Vaishali	Sabakami	Kalasoka
3rd (250 BC)	Pataliputra	Moggaliputta Tissa	Ashoka
4th (72 AD)	Kundalvana, Kashmir	Vasumitra	Kanishka

193. The University of Nalanda was set-up by which Gupta ruler?

(a) Kumaragupta II
(b) Kumaragupta I
(c) Chandragupta II
(d) Samudragupta

⊘ *(b)* Kumaragupta I became a Gupta king in AD 415. University of Nalanda was set-up during his rule. This university of Nalanda is called Oxford of Mahayan Buddhism.

194. Consider the following statements about Sher Shah's administration

1. He divided his empire into *Sarkars,* which were further subdivided into *Parganas.*
2. The *Sarkars* and the *Parganas* were directly administered by Sher Shah without the help of any other officials.

Which of the statement(s) given above is/are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊘ *(a)* Sher Shah divided his empire into 47 Sarkars. Each Sarkar was divided into smaller units called Parganas.

A civilian was to be the head of entire province and was given a small army. Two-important officials of Sarkar were Munsif-i- Munsifan and Shigdar-i-Shigdaran.

Important officials of Parganas were Shigdar, Amin, treasure, Munsiff, etc.

The Sarkars and the Parganas were not directly administered by Sher Shah. It were administrered by important officials such as Amin, Shigdar etc. Hence, statement I is true and statement II is false.

GEOGRAPHY

2019 (II)

1. Which one of the following is the most noticeable characteristic of the mediterranean climate?

(a) Limited geographical extent
(b) Dry summer
(c) Dry winter
(d) Moderate temperature

⊘ (*b*) Mediterranean climate is characterised by dry summer, mild and wet winters. The climate receive its name from the mediterranean basin, where this climate type is most common.

Climate zones are located along the Western sides of continents, between 30° and 45° North and South of the equator.

2. Which one of the following rivers takes a 'U' turn at Namcha Barwa and enters India?

(a) Ganga
(b) Tista
(c) Barak
(d) Brahmaputra

⊘ (*d*) Brahmaputra originates on the Angsi Glacier located on the Northern side of the Himalayas as Yarlung Tsangpo river and flows in Southern Tibet to break through the Himalayas in great Gorges.

Tsangpo (Brahmaputra) enters India after taking a 'U' turn at Namcha Barwa and flows in Arunachal Pradesh where it is known as 'Dihang' or 'Siang' rivers.

3. Which one of the following Indian States has no international boundary?

(a) Bihar
(b) Chhattisgarh
(c) Uttarakhand
(d) Meghalaya

⊘ (*b*) India is the 7th largest country in the world and it is the only country in the Indian subcontinent to share its land frontiers with every member country of the subcontinent .

Afghanistan, Bhutan, Bangladesh, China, Myanmar, Nepal and Pakistan are bordering countries of India. Chhattisgarh do not have any international boundary.

4. Which one of the following Indian cities is not located on a river bank?

(a) Agra
(b) Bhagalpur
(c) Bhopal
(d) Kanpur

⊘ (*c*) Agra is a city in the State of Uttar Pradesh in India situated on the banks of river Yamuna.

Bhagalpur is one of the important city of the State of Bihar. It is situated on the banks of the river Ganga.

Kanpur is situated in State of Uttar Pradesh, it is situated on Ganga river. Hence, Bhopal is not situated on a river bank.

5. Where are Jhumri Telaiya and Mandar Hills situated?

(a) Jharkhand
(b) Bihar
(c) Assam
(d) West Bengal

⊘ (***) Jhumri Telaiya is a city in Koderma district of Jharkhand (India). Geographically, it is located in the Damodar River valley. The city is known for Mica Production and Telaiya dam. The dam was constructed on River Barakar by the Damodar Valley Corporation (DVC) and opened in the year 1953. It is a part of Damodar Valley Project.

Mandar Hill is a small mountain situated in Banka district under Bhagalpur division of state of Bihar. This hill has many references in Hindu mythology as Mandarachal Parvat.

As per references found from Puranas and Mahabharata this hill was used for 'Samudra Manthan'.

6. Which one of the following is not correct regarding South India?

(a) Diurnal range of temperature is less
(b) Annual range of temperature is less
(c) Temperature is high throughout the year
(d) Extreme climatic conditions are found

⊘ (*d*) South Indian regions have a tropical climate with the monsoons playing a major part. Diurnal range of temperature is less in South India.

Annual range of temperature is also due to proximity to equator. Temperature is high throughout the year. Climatic conditions are not extreme here as they are in Northern part of India.

Hence, option (d) is not correct.

7. Which one of the following regions is an important supplier of citrus fruits?

(a) Equatorial region
(b) Mediterranean region
(c) Desert region
(d) Sub-humid region

⊘ (*b*) Citrus fruits are the highest value fruit crop in terms of international trade. They are produced all over the world. Mediterranean region is an important supplier of citrus fruits.

Oranges account for the majority of citrus production, but the industry also sees significant quantities of grape fruits, pomelos, lemons.

8. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Ethnic Territorial Segment)		List II (Related Occupational Pattern)	
A.	Maruta Makkal	1.	Pastoralists
B.	Kuravan Makkal	2.	Fishing people
C.	Mullai Makkal	3.	Ploughmen
D.	Neytal Makkal	4.	Hill people

Codes

	A	B	C	D		A	B	C	D
(a)	3	1	4	2	(b)	2	1	4	3
(c)	3	4	1	2	(d)	2	4	1	3

⊘ (*c*) According to Tamil literature, the basic unit of ethnic identification in Dravidian culture was 'Nadu' and these were divided into **five** types on the basis of natural sub-region.

The ethnic territorial segments are

Maruta Makkal	Ploughmen inhabiting fertile land.
Kuravan Makkal	Hill people who leave the forest to work in Panai.
Mullai Makkal	Pastoralist.
Neytal Makkal	Fishing people living in coastal villages.

Palai Makkal   People of dry plains

9. Which one of the following is not geographical requirement for cultivation of cotton?

(a) Temperature reaching 25°C or more in summer.
(b) Moderate to light rainfall.
(c) Medium laom soil with good drainage.
(d) A growing period of at least 100 frost free days.

⊘ (*d*) Cultivation of cotton requires a growing period of atleast 200 frost free days, and not just 100 frost free days.

Other requirements for cotton cultivation include, temperature reaching 25°C or more in summer, moderate to light rainfall (55-100 cm), medium loam soil with good drainage and high water retention capacity.

Rainfall during harvesting season is harmful for its production. India is the largest producer of cotton in the world.

10. Which one of the following statements regarding temperate coniferous forest biome is not correct?

(a) They are characterised by very little undergrowth.
(b) They have a growing period of 50 to 100 days in a year.
(c) There is low variation in annual temperature.
(d) There is high range in spatial distribution of annual precipitation.

⊘ (*c*) Temperate coniferous forest are found in areas with cool winters, warm summers and abundant rainfall. Trees like spruce, pine and cedar grows here, but they have little undergrowth.

They have a growing period of 50 to 100 days in a year. Rainfall is abundant but there is high range in spatial distribution of annual precipitation. Thus, option (a), (b) and (d) are correct.

These areas have moderate temperature but experiences seasonal changes and considerable valuation.

Temperate coniferous forest biome has high (and not low) variation in annual temperature. It ranges from an average of –40°C in winters to 10°C in summers.

Hence, option (c) is not correct.

11. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Peak)		List II (Name of Hill)
A. Anamudi	1.	Nilgiri
B. Doddabetta	2.	Satpura
C. Dhupgarh	3.	Aravalli
D. Guru Shikhar	4.	Annamalai

Codes

	A	B	C	D
(a)	3	2	1	4
(b)	3	1	2	4
(c)	4	1	2	3
(d)	4	2	1	3

⊘ (*c*) **Anamudi** is the highest peak in the Western Ghats in India. It is located at junction of Cardamom hills, Annamalai hills and Palani hills.

Doddabetta is the highest peak in the Nilgiri mountains, situated in Nilgiris distric of TamilNadu.

Dhupgarh is highest point on the Satpura mountains, situated in Panchmaehi, Madhya Pradesh.

Guru Shikhar, a peak in Rajasthan is the highest point of the Aravalli range. Hence, option (c) is correct.

12. Coral reefs are not found in which one of the following regions?

(a) Lakshadweep Islands
(b) Gulf of Kutch
(c) Gulf of Mannar
(d) Gulf of Cambay

⊘ (*d*) In India, coral reefs are found in Andaman and Nicobar Islands, Gulf of Kutch, Gulf of Mannar, Lakshadweep Islands, Gulf of Khambat etc. It is not found in Gulf of Cambay.

Hence, option (d) is not correct.

13. In which one of the following states is jute not significantly cultivated?

(a) Assam
(b) West Bengal
(c) Odisha
(d) Andhra Pradesh

⊘ (*d*) The cultivation of jute is mainly confined to the Eastern region of the country. The jute crop is grown in nearly 83 districts of West Bengal, Assam, Odisha, Bihar, Uttar Pradesh, Tripura and Meghalaya.

Jute is not cultivated in Andhra Pradesh significantly.

Hence, option (d) is not correct.

14. Name the site that gives us valuable information about India's maritime links on the Coromandel coast.

(a) Bharukachchha
(b) Karur
(c) Arikamedu
(d) Anuradhapura

⊘ (*c*) Arikamedu gives us valuable information about India's maritime links on Coromandel coast. It is situated in South India's Puducherry.

Arikamedu was an important port of Chola Kingdom. It also helps in trade with Roman people.

15. Where are the largest quantity of cichlids found in India?

(a) Backwaters of Kerala
(b) Sunderbans
(c) Narmada
(d) Godavari

⊘ (*d*) Cichlids are fish from the family cichlidae in the order *cichlid forums*. They are the largest verteberate families in the world.

They are found mostly in Africa and South America. They are foundless in brackish and saltwater habitats.

They are largest in number in the Godavari river of Indian subcontinent.

16. What is Inter-cropping?

(a) It is the time period between two cropping seasons.
(b) It is growing two or more crops in random mixture.
(c) It is growing two or more crops in definite row patterns.
(d) It is growing of different crops on a piece of land in a pre-planned succession.

⊘ (*c*) Inter-cropping is growing two or more crops simultaneously on the same field in a definite pattern. A few rows of one crop alternate with a few rows of a second crop, for example Soyabean + Maize.

The crops are selected such their nutrient requirements are different. This ensures maximum utilisation of nutrients supplied and both the cultivations give better returns.

17. The term 'soil impoverishment' relates to which one of the following?

(a) Soil erosion
(b) Soil deposition
(c) Soil getting very deficient in plant nutrients
(d) Soil getting enriched with plant nutrients

> (*c*) The term 'soil impoverishment' relates to soil getting very deficient in plant nutrients.

Soil gets impoverished due to reasons like : over-grazing mono-cropping, leaching, erosion, land use charge etc.

An impoverished soil leads to increase in input cost of crop cultivation in the form of fertilizers cost, pesticide cost, etc.

Soil erosion refers to removal of top fertile layers of the soil. Erosion may be due to natural reasons (like : river erosion, glacial erosion etc.) or anthropogenic factor (like : mining activities, urbanisation, etc). Usually, soil erosion leads to soil impoverishment.

18. Which one of the following is the correct sequential phase in the successional development of vegetation community in a habitat?

(a) Migration, Reaction, Stabilisation and Nudation
(b) Migration, Stabilisation, Reaction and Nudation
(c) Nudation, Migration, Reaction and Stabilisation
(d) Reaction, Migration, Stabilisation and Nudation

> (*c*) The correct sequential phase is the successional development of vegetation community in a habitat is

Nudation, Migration, Reaction and Stabalisation. Successional development of vegetation community is the process of change in the species structure of vegetation community over time.

The sequential stages of this development include,

Nudation Process of succession begins with the formation of a bare area.

Migration The seeds or spores of the species reach the bare area through the agency of air, water or wind.

Competition and Reaction As the number of a species increase, the competition for space and nutrition is started among them (both inter and intraspecific competition).

Individuals also modify the environment which leads to reaction. This reaction leads to arrival of new species and extinction of previous ones.

Stabilisation Eventually a stage is reached when the final terminal community becomes more or less stabilised for a longer period of time and it can maintain itself in equilibrium with the climate of that area.

19. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Soil Type)		List II (Major Characteristic)
A. Oxisols	1.	Very rich in organic matter
B. Vertisols	2.	Soil lacking horizons
C. Histosols	3.	Very old and highly weathered
D. Entisols	4.	Rich in clay content and highly basic

Codes

	A	B	C	D
(a)	3	1	4	2
(b)	3	4	1	2
(c)	2	1	4	3
(d)	2	4	1	3

> (*a*) **Oxisols** are very old soil and they are highly weathered.

Vertisols are very rich in organic matter.

Histosols are rich in clay content and highly basic.

Entisols are soils which lack horizons.

20. Which one of the following mountains separates Black Sea and Caspian Sea?

(a) Urals
(b) Caucasus
(c) Carpathians
(d) Balkan mountains

> (*b*) The Caucasus mountains are a mountain system at the intersection of Europe and Asia stretching between Black sea and Caspian sea. It is home to mount Elbrus, highest peak in Europe.

It includes greater Caucasus in the North and lesser Caucasus in the South.

21. Rains caused by thunderstorms during the hot weather season (mid-March to mid-June) in Karnataka are called

(a) Kalbaisakhi
(b) Mango showers
(c) Loo
(d) Cherry blossoms

> (*b*) These pre-monsoon rains are as called 'Mango Showers'. Mango showers are common in state of Kerala, Karnataka, Maharashtra and some part of Tamil Nadu.

These showers arrive generally in late April and May and are usually very difficult to predict.

2019 (I)

22. Which one among the following stars is nearest to the Earth?

(a) Sirius
(b) Arcturus
(c) Spica
(d) Proxima Centauri

> (*d*) The nearest star to the Earth is Sun followed by the Proxima Centauri.

Proxima Centauri is part of the star system known as 'Alpha Centauri'.

23. Which of the following planets of our solar system has least mass?

(a) Neptune (b) Jupiter
(c) Mars (d) Mercury

> (*d*) Mercury is the smallest and closest planet to Sun. It has the least mass in the solar system. The planet with the highest mass is Jupiter.

24. Which one of the following States of India is not covered by flood forecasting stations set-up by the Central Water Commission?

(a) Rajasthan
(b) Jammu and Kashmir
(c) Tripura
(d) Himachal Pradesh

> (*d*) Central Water Commission is the nodal organisation for flood forecasting in the country. CWC comes under Ministry of Water Resource, River Development and Ganga Rejuvenation.

It is the modal agency for flood forecasting in India.

Except Himachal Pradesh all other mentioned states are covered by flood forecasting stations setup by the CWC.

Hence, option (d) is not correct.

25. The city of Cartagena, which is famous for Protocol on Biosafety, is located in

(a) Colombia (b) Venezuela
(c) Brazil (d) Guyana

> (*a*) Cartagena Protocol on Biosafety is an international treaty that seeks to protect biodiversity from the potential risks posed by Genetically Modified Organisms (GMO).

It was singed on 15th May, 2000 in Cartagena which is in Colombia.

26. Which among the following countries of South America does the Tropic of Capricorn not pass through?

(a) Chile
(b) Bolivia
(c) Paraguay
(d) Brazil

⊙ (**b**) The Tropic of Capricorn is an imaginary line of latitude at 23.5° South of the equator. This latitude runs through following countries: Namibia, Botswana, South Africa, Mozambique Madagascar , Australia, Chile, Argentina, Paraguay and Brazil. It does not pass through Bolivia.

Hence, option (b) is not correct.

27. Which one of the following is not correct about Sargasso Sea?

(a) It is characterised with anti-cyclonic circulation of ocean currents.
(b) It records the highest salinity in Atlantic ocean.
(c) It is located West of Gulf stream and East of Canary current.
(d) It confined in gyre of calm and motionless water.

⊙ (**a**) Sargasso sea is the calm centre of the anti-cylonic gyre in the North Atlantic, comprising a large eddy of surface water, the boundaries of which are demarcated by major current systems such as the Gulf Stream, Canaries current, and North Atlantic Drift.

The Sargasso sea is a large, warm (18° C), saline region which is characterised by an abundance of floating brown seaweed (*Sargassum*).

Hence, option (a) is not correct.

28. Match List I with List II and select the correct answer using the codes given below the lists.

List I (City)		List II (Product)
A. Detroit (USA)	1.	Motarcar
B. Antwerp (Belgium)	2.	Diamond Cutting
C. Tokyo (Japan)	3.	Steel
D. Harbin (China)	4.	Ship Building

Codes

	A	B	C	D		A	B	C	D
(a)	3	4	2	1	(b)	3	2	4	1
(c)	1	4	2	3	(d)	1	2	4	3

⊙ (**d**)

City	Product
Detroit (USA)	Motarcar
Antwerp (Belgium)	Diamond Cutting
Tokyo (Japan)	Ship Building
Harbin (China)	Steel

29. Which one of the following is not situated on Varanasi-Kanyakumari National Highway?

(a) Satna
(b) Rewa
(c) Katni
(d) Jabalpur

⊙ (**a**) The Varanasi-Kanyakumari National highway is Part of NH-44. Major cities such as Rewa, Katni, Jabalpur, Hyderabad, Bengaluru etc. are located on this highway.

Satna does not lie on this Highway.

30. Which one of the following methods is not suitable for urban rainwater harvesting?

(a) Rooftop recharge pit
(b) Recharge wells
(c) Gully plug
(d) Recharge trench

⊙ (**c**) Except Gully plug, all the others such as Rooftop recharge pit, Recharge wells and Recharge trench are viable in urban rainwater harvesting.

Gully plugs or Checkdams are mainly built to prevent erosion and to settle sediments and pollutant.

31. If one plots the tank irrigation in India and superimposes it with map of well irrigation, one may find that the two are negatively related. Which of the following statements explain the phenomenon?

1. Tank irrigation predates well irrigation.
2. Tank irrigation is in the areas with impervious surface layers.
3. Well irrigation requires sufficient groundwater reserves.
4. Other forms of irrigation are not available.

Select the correct answer using the codes given below

(a) 1, 2 and 3
(b) 2 and 3
(c) 3 and 4
(d) 1 and 4

⊙ (**b**) The tank irrigation is more in the rocky plateau area of the country, where the rainfall is not even and highly seasonal and the rocks are impervious.

The Eastern Madhya Pradesh, Chhattisgarh, Odisha, Tamil Nadu and some parts of Andhra Pradesh have areas under tank irrigation.

On the other hand, well irrigation is most common in alluvial plains of the country except the desert of Rajasthan.

Plains of UP, Bihar, Gujarat, Karnataka and Tamil Nadu are the states which are mostly under well irrigation. These areas have large ground water reserves.

Thus, only statements 2 and 3 correctly explains this phenomenon.

32. What is a constellation?

(a) A particular pattern of equidistant stars from the Earth in the sky.
(b) A particular pattern of stars that may not be equidistant from the Earth in the sky.
(c) A particular pattern of planets of our solar system in the sky.
(d) A particular pattern of stars, planets and satellites in the sky due to their position in the space.

⊙ (**b**) A constellation is a group of stars usually in a recognisable shape or pattern.

In 1922, the International Astronomical Union (IAU) formally accepted the modern list of 88 constellations.

33. Which one of the following river valleys of India is under the influence of intensive gully erosion?

(a) Kosi
(b) Chambal
(c) Damodar
(d) Brahmaputra

⊙ (**b**) Chambal river valley is under the influence of intensive gully erosion. Chambal forms ravines or badlands due to intensive gully erosion.

It occurs when water is channeled across unprotected land and washes away the soil along drainage lines. Chambal rises from Mhow district in Vindhya Ranges and it is a chief tributary of Yamuna river.

34. Which one of the following may be the true characteristic of cyclones?

(a) Temperate cyclones move from West to East with Westerlies whereas tropical cyclones follow trade winds.
(b) The front side of cyclone is known as the 'eye of cyclone'.
(c) Cyclones possess a centre of high pressure surrounded by closed isobars.
(d) Hurricanes are well-known tropical cyclones which develop over mid-latitudes.

⊙ (**a**) Temperate cyclones are cyclones of mid-latitudes and hence are primarily under influence of permanent winds of mid-latitudes, i.e Westerlies.

Their movement is therefore Eastwards of their origin with average velocity of 32 km per hour in summers and 48 km per hour in winters.

Normally, tropical cyclones move from East to West under the influence of trade winds because trade winds are permanent winds of tropical latitudes.

The general direction is therefore Westwards from their origin. They advance with varying velocities. Weak

cyclones move at the speed of about 32 km per hour while hurricanes attain the velocity of 180 km per hour or more.

Hence, option (a) is correct.

35. The headquarters of the International Tropical Timber Organisation is located at
(a) New Delhi   (b) Yokohama
(c) Madrid   (d) Jakarta

⊙ (**b**) The International Tropical Timber Organisation was established in 1986 with a objective to conserve and manage tropical forests resources.

Its headquarter is located at Yokohama (Japan).

36. Atmospheric conditions are well-governed by humidity. Which one among the following may best define humidity?
(a) Form of suspended water droplets caused by condensation.
(b) Deposition of atmospheric moisture.
(c) Almost microscopically small drops of water condensed from and suspended in air.
(d) The moisture content of the atmosphere at a particular time and place.

⊙ (**d**) Humidity refers to the moisture content of the atmosphere at a particular time and place. It is measured in either relative terms (relative humidity) or absolute terms (absolute humidity).

It is relative humidity which indicate the likelihood of precipitation.

Fog is a form of suspended water droplets caused by condensation.

Fog can be considered a type of cloud at very low altitude. It reduces visibility and is a hazard.

Almost microscopically small drops of water condensed from and suspended in air is initial stage of cloud formation. When these droplets combine together, clouds are formed.

37. The Shompens are the vulnerable tribal group of
(a) Jharkhand
(b) Odisha
(c) West Bengal
(d) Andaman and Nicobar Islands

⊙ (**d**) The Shompens are inhabitant of Andaman and Nicobar Islands. Many more tribes live on this island such as the Great Andamanes, Onge, Jarawa and Sentinelese.

38. Which one of the following cities was not included in the list of smart cities in India?
(a) Silvassa   (b) Jorhat
(c) Itanagar   (d) Kavaratti

⊙ (**b**) The smart city mission was launched by Government of India to develop smart cities in country.

Silvassa and Kavaratti is included in the list of smart cities. Itanagar (Arunachal Pradesh) was also included as a special case in Smart City Mission in August, 2017.

Shillong became 100th city, added to the smart city mission. Jorhat (Assam) is not included among the smart cities.

39. Find the correct arrangement of the following urban agglomerations in descending order as per their population size according to Census 2011.
(a) Delhi–Mumbai–Kolkata–Chennai
(b) Mumbai–Delhi–Kolkata–Chennai
(c) Mumbai–Kolkata–Delhi–Chennai
(d) Kolkata–Chennai–Mumbai–Delhi

⊙ (**b**) According to the Census of 2011 Mumbai is the most populated urban agglomerations followed by Delhi, Kolkata and Chennai.

There are total 53 million plus cities in India as per Census of 2011. Least populated among them is Kota.

40. Match List I with List II and select the correct answer using the codes given below the lists.

List I		List II	
(Type of Lake)		(Example)	
A.	Tectonic	1.	Lonar Lake
B.	Crater	2.	Gangabal Lake
C.	Glacial	3.	Purbasthali Lake
D.	Fluvial	4.	Bhimtal Lake

Codes

	A	B	C	D		A	B	C	D
(a)	4	1	2	3	(b)	4	2	1	3
(c)	3	1	2	4	(d)	3	2	1	4

⊙ (**a**)

Type of Lake	Example
Tectonic	Bhimtal Lake (Uttarakhand)
Crater	Lonar Lake (Maharashtra)
Glacial	Gangabal Lake (Jammu and Kashmir)
Fluvial	Purbasthali Lake (W. Bengal)

41. The Andaman group of islands and the Nicobar group of islands are separated by which one of the following latitudes?
(a) 8° N latitude   (b) 10° N latitude
(c) 12° N latitude   (d) 13° N latitude

⊙ (**b**) The Andaman and Nicobar group are situated in Bay of Bengal. The Islands are an extension of Arakan mountain ranges. Both the group are separated by 10°N latitude.

The Saddle peak is highest peak and India's only active volcano on these Islands. Barren island is also located in Andaman sea.

42. Daman Ganga Reservoir Project with about 115 km of minor canals and distributaries is located in
(a) NCT
(b) Dadra and Nagar Haveli
(c) Puducherry
(d) Goa

⊙ (**b**) The Daman Ganga Reservoir Project is located in Dadra and Nagar Haveli.

The Daman Ganga (also known as Daman river) flows through Maharashtra, Gujarat, Daman and Diu and Dadra and Nagar Haveli.

43. Consider the following statements relating to Coal India Limited:

1. It is designated as a 'Maha Ratna' company under the Ministry of Coal.
2. It is the single largest coal producing company in the world.
3. The Headquarters of Coal India Limited is located at Ranchi (Jharkhand).

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) 1, 2 and 3

⊙ (**b**) Coal India Limited is a public sector company under the Ministry of Coal.

Its salient features are
(i) It is designated as a 'Maha Ratna' company under the Ministry of coal.
(ii) It is the single largest coal producing company in the world. Thus statements 1 and 2 are correct.
(iii) Coal India is headquartered at Kolkata, West Bengal.
Thus, statement 3 is incorrect.

2018 (II)

44. Which one of the following is the correct ascending sequence of states in terms of their population density as per Census 2011?
(a) Arunachal Pradesh–Sikkim–Mizoram– Himachal Pradesh
(b) Arunachal Pradesh–Mizoram–Sikkim– Himachal Pradesh

(c) Mizoram–Arunachal Pradesh–Himachal Pradesh–Sikkim
(d) Arunachal Pradesh–Himachal Pradesh–Sikkim–Mizoram

⊙ (**b**) The correct ascending sequence of states in terms of their population density as per Census 2011 is
  (i) Arunachal Pradesh–17 People/sq. km
  (ii) Mizoram–52 People/sq. kim
  (iii) Sikkim–86 People/sq. km
  (iv) Himachal Pradesh–123 People/sq. km.
Hence, option (b) is correct.

45. The rate of population growth during 2001-2011 decade declined over the previous decade (1991-2001) in all of the following states, except
(a) Tamil Nadu   (b) Kerala
(c) Goa   (d) Andhra Pradesh

⊙ (**a**) The rate of population growth during 2001-2011 decade and previous decade (1991-2001) in the given states is stated below

State	Population growth (2001-11)	Population growth (1991- 2001)
1. Tamil Nadu	15.60	11.19
2. Kerala	4.9	9.42
3. Goa	8.2	14.89
4. Andhra Pradesh	11.0	14.59

Thus, decadal growth rate of Tamil Nadu has declined from the decade 1991-2001 to 2001-2011.

46. Which one of the following statements with regard to growth of coral reefs is not correct?
(a) Coral can grow abundantly in fresh water.
(b) It requires warm water between 23°C-25°C.
(c) It requires shallow saltwater, not deeper than 50 m.
(d) It requires plenty of sunlight to aid photosynthesis.

⊙ (**a**) The formation of coral reefs only occurs in saline water of oceans, where temperature is between 23°-25°C.
They do not exist below 50 m due to the requirement of plenty of sunlight for photosynthesis.
Hence, options (a) is incorrect.

47. Which one of the following states has more than two major ports?
(a) Maharashtra   (b) West Bengal
(c) Odisha   (d) Tamil Nadu

⊙ (**d**) Tamil Nadu has more than two major ports i.e., Chennai Port, Tuticorin Port and Ennore Port. Maharashtra has two major ports i.e., Jawaharlal Nehru Port Trust and Mumbai Port. Both West Bengal and Odisha have one major port namely, Haldiya and Paradip port respectively.

48. Which one of the following places does not fall on Leeward slope?
(a) Pune   (b) Bengaluru
(c) Leh   (d) Mangaluru

⊙ (**d**) Leeward slope is the part of a mountain that does not face the wind i.e. the slope opposite the windward slope.
Mangaluru does not fall on Leeward slope. Mangaluru is situated on the West coast of India and is bounded by the Arabian Sea to its West and the Western Ghats to its East.
Mangaluru experiences moderate to gusty winds during day time and gentle winds at night.

49. South Arcot and Ramanathapuram receive over 50 percent of their annual rainfall from which one of the following?
(a) South-West monsoon
(b) North-East monsoon
(c) Bay of Bengal branch of summer monsoon
(d) Western disturbances

⊙ (**b**) South Arcot and Ramanthapuram located in Tamil Nadu receives rainfall in the winter season due to North-East trade winds. The normal annual rainfall of the region is about 945 mm (37.2 in) of which 48% is through the North-East monsoon and 32% through the South-West monsoon.
Hence, option (b) is correct.

50. The Eight Degree Channel separates which of the following?
(a) India from Sri Lanka
(b) Lakshadweep from Maldives
(c) Andaman from Nicobar Islands
(d) Indira Point from Indonesia

⊙ (**b**) Lakshadweep Islands are separated from Maldives by Eight Degree Channel. Minicoy is separated from rest of the Lakshadweep by Nine Degree Channel. Ten Degree Channel separates Andaman from Nicobar islands.

51. Match List I with List II and select the correct answer using the codes given below the lists

List I (Classification of Town)	List II (Example)
A. Industrial Town	1. Vishakhapatnam
B. Transport Town	2. Bhilai
C. Mining Town	3. Singrauli
D. Garrison Cantonment Town	4. Ambala

Codes

	A	B	C	D
(a)	2	1	3	4
(b)	2	3	1	4
(c)	4	3	1	2
(d)	4	1	3	2

⊙ (**a**) Industrial Town-Bhilai, Chhattisgarh Transport Town- Vishakhapatnam (Andhra Pradesh).
Mining Town-Singrauli (Madhya Pradesh), Garrison Cantonment Town-Ambala (Haryana).

52. Which of the following statements with regard to the land use situation in India is/are correct?
1. There has been a tremendous decline in area under forest in recent years.
2. The rate of increase in land use in recent years is the highest in case of area under non-agricultural use.
3. Land use such as barren and wasteland, area under pastures and tree crops have experienced decline in the recent years.

Select the correct answer using the codes given below
(a) Only 1
(b) 1 and 2
(c) 2 and 3
(d) 1, 2 and 3

⊙ (**c**) India's tree and forest cover has registered an increase of 1% or 8,021 sq. km in two years since 2015, according to the latest assessment by the government. Land devoted to non-agricultural use has increased three times since independence.
Whereas, Land use under barren and wasteland and area under pastures and tree crops have declined significantly.
Thus, statement 2 and 3 are correct.

53. Which one of the following was not a part of the strategies followed by the Government of India to increase foodgrain production in India immediately after independence?
(a) Intensification of cropping over already cultivated land.
(b) Increasing cultivable area by bringing cultivable and fallow land under plough.
(c) Using High Yielding Varieties (HYV) seeds.
(d) Switching over from cash crops to food crops.

⊘ (**c**) Use of High Yielding Varieties (HYV) seeds were not a part of strategies followed by Government of India to increase foodgrain production in India immediately after independence.

HYV seeds were not used in India till beginning of Green Revolution.

54. Which one of the following is a West-flowing river?

(a) Mahanadi   (b) Godavari
(c) Krishna   (d Narmada

⊘ (**d**) Narmada is the largest West-flowing river of the Peninsular India.

Narmada flows Westwards through a rift valley between the Vindhyan Range on the North and the Satpura Range on the South.

55. Khasi language is included in

(a) Munda branch of Austro-Asiatic sub-family.
(b) Mon-Khmer branch of Austro-Asiatic sub-family.
(c) North Assam branch of Sino-Tibetan family.
(d) Assam-Myanmari branch of Sino-Tibetan family.

⊘ (**b**) The Austroasiatic language, also known as 'Mon-Khmer'. Khasi is an Austro-Asiatic language spoken primarily in Meghalaya state in India by the Khasi people.

It is also spoken by a sizable population in Assam and Bangladesh.

Khasi is part of the Austro-Asiatic language family and is related to Cambodian and Mon languages of South-East Asia and the Munda branch of that family which is spoken in East-Central India.

56. Which one among the following is not a tributary of river Luni?

(a) Khari   (b) Sukri
(c) Jawai   (d) Banas

⊘ (**d**) Major tributaries of Luni river are the Sukri, Mithri, Bandi, Khari, Jawai, Guhiya and Sagi on the left bank and the Jojari river on the right bank.

The Luni river begins near Ajmer in the Pushkar valley of the Western Aravalli Range at an elevation of about 550 m.

The Banas is a river in Rajasthan in the Western India. It is a tributary of the Chambal river.

57. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Major Dam)		List II (State)
A. Cheruthoni Dam	1.	Madhya Pradesh
B. Indira Sagar Dam	2.	Tamil Nadu
C. Krishnaraja Sagar Dam	3.	Karnataka
D. Mettur Dam	4.	Kerala

Codes
     A   B   C   D
(a) 2   1   3   4
(b) 2   3   1   4
(c) 4   3   1   2
(d) 4   1   3   2

⊘ (**d**) **The Cheruthoni Dam**, located in Idukki district, Kerala, India is a 138m tall concrete gravity dam.

The Indira Sagar Dam is a multipurpose project of Madhya Pradesh on the Narmada river.

Krishnaraja Sagar Dam, popularly known as 'KRS', is a lake and the dam that creates it. They are close to settlement of Krishnaraja Sagar in the Indian state of Karnataka.

The Mettur Dam is the largest in Tamil Nadu located across the river Cauvery.

58. Which one among the following Union Territories of India shares the shortest length of National Highways?

(a) Chandigarh
(b) Delhi
(c) Daman and Diu
(d) Dadra and Nagar Haveli

⊘ (**a**) Length of National Highway in Chandigarh is 15km, in Delhi is 80km, in Daman and Diu is 22 km and in Dadar and Nagar Haveli is 31km.

59. Which one among the following passes links Lhasa with Ladakh?

(a) Lanak La   (b) Burzil
(c) Babusar   (d) Khyber

⊘ (**a**) Lanak La is a well-established frontier point between Ladakh and Tibet. It is on the South-Eastern boundary of the Aksai Chin region that is controlled by China. It connects Lhasa to Ladakh.

60. Statement I Agriculture in India still accounts for a substantial share in total employment.

Statement II There has been no decline in volatility of agricultural growth in India.

Codes
(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true, but statement II is not the correct explanation of statement I
(c) Statement I is true, but statement II is false
(d) Statement I is false, but statement II is true

⊘ (**c**) The Indian economy has moved decisively to a higher path of growth. In Agriculture's share of total employment has declined.

It is still a dominant source of employment, and presently it accounts for 52 per cent of the country's total labour force.

The declining trend in agricultural growth has emerged as a major concern for researchers and policymakers but volatility in agriculture has declined significantly in India.

Thus, statement I is correct and II is incorrect.

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Directions (Q. Nos. 62-66) *The following consist of two statements, statement I and statement II. Examine these two statements carefully and select the correct answer using the options are given below.*

Codes
(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true, but statement II is not the correct explanation of statement I
(c) Statement I is true, but statement II is false
(d) Statement I is false, but statement II is true

61. Statement I By far the most common topographic form in a Karst terrain is the sinkhole.

Statement II Topographically, a sinkhole is a depression that varies in depth from less than a meter to few hundred meters.

⊗ (**b**) The statement I and II are correct, but statement II is not the correct explanation of statement I.

Karst topography is usually formed in a region of plentiful rainfall where bedrock consists of carbonate rich rock, such as limestone, gypsum, or dolomite, that is easily dissolved.

Sinkhole, which is a depression with varying depth and width is considered most fundamental feature of Karst topography.

Though, there is no absolute reason for it being the most common topographic form, but studies show that it is most common because it is both the initial as well as the final feature of a Karst terrain.

Various Karst cycle of erosions begin with a sinkhole (of dolines) and finally ends with collapse of caves to form sinkholes.

62. Statement I Incised meanders are formed in the mature stage of a river.

Statement II Incised meanders are characterised by rejuvenation and upliftment of land.

⊗ (**d**) Incised meander is a river meander which has been cut abnormally deeply into the landscape because upliftment of the land and has led to renewed downward erosion by the river.

This type of meander occurs in the young stage of river.

Therefore, only statement II is correct.

63. Statement I Portions of glacial troughs may exhibit remarkably flat floors.

Statement II The falt floor in a glacial trough is produced by uniform glacial erosion.

⊗ (**a**) Glaciated valleys are trough like and U-shaped with broad floors and relatively smooth and steep sides. The U-shaped valleys are carved out by glaciers which have receded or disappeared.

The valley may contain littered debris or debris shaped as moraines with swampy appearance. Very deep glacial troughs filled with sea water and making up share lines (in high latitudes) are called fjords/fiords.

Trough tend to have flat valley floors and steep, straights sides. They are formed by glacial erosion.

Hence, both the statements are correct and statements II is the correct explanation of statement I.

64. Statement I In Tundra climate, biodiversity is comparatively less.

Statement II Tundra climate has less reproductive warm period.

⊗ (**b**) Species richness is generally lower in the Arctic than at lower latitudes, and richness also tends to decline from the low to high Arctic.

However, patterns of species richness vary spatially and include significant patchiness.

Further, there are differences among taxonomic groups, with certain groups being most diverse in the Arctic.

Hence, both statements are individually true, but statement II is not the correct explanation of statement I.

65. Statement I Tides are the rise and fall of sea levels caused by the combined effects of the gravitational forces exerted by the Moon, Sun and the rotation of the Earth.

Statement II The Earth rotates from West to East.

⊗ (**b**) Tides are rise and fall of sea levels caused by the combined effect of the gravitational forces exerted by the Moon and the Sun and the rotation of the Earth because the Earth rotates once in about 24 hours with respect to the Sun.

The tidal range is not constant but changes depending on where the Sun and Moon are.

Hence, both the statements are individually correct but statement II is not the correct explanation of statement I.

66. Which one of the following places of India experiences highest atmospheric pressure during winter?

(a) Jaisalmer   (b) Leh
(c) Chennai   (d) Guwahati

⊗ (**b**) High air pressure prevails over large parts of North-West India due to low temperatures coupled with divergence induced by the ridge of the sub-tropical jet stream.

Pressure is comparatively lower as we move towards South of India in winters. Leh is present closest to this high pressure area followed by Guwahati, Jaisalmer and Chennai.

Hence, (b) is the right option.

67. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Hypothesis/Theory)		List II (Propounder)	
A.	Planetesimal Hypothesis	1.	Kober
B.	Thermal Contraction Theory	2.	Chamberlin
C.	Geosynclinal Orogen Theory	3.	Daly
D.	Hypothesis of Sliding Continent	4.	Jeffrey

Codes

	A	B	C	D		A	B	C	D
(a)	2	4	1	3	(b)	2	1	4	3
(c)	3	1	4	2	(d)	3	4	1	2

⊗ (**a**) **The Chamberlin–Moulton Planetesimal Hypothesis** states that planets form out of cosmic dust particles that collide and stick to form larger and larger bodies.

Thermal Contraction Theory or **Jeffrey's Theory** is based on the history of the contraction of the Earth.

According to Jeffrey the Earth began to shrink because of contraction caused by gradual cooling of the Earth due to loss of heat through radiation from the very beginning of its origin.

Kober Attempted to explain the origin of the mountains on the basis of his geosynclinal theory.

Daly's Hypothesis is based mainly on the idea that mountain building was due to the downhill movement of the continents.

68. Which one of the following is not an exclusive right of the concerned coastal nations over Exclusive Economic Zone (EEZ)?

(a) Survey and exploitation of mineral resources of ocean deposits.
(b) Exploitation of marine water energy and marine organisms including fishing.
(c) Conservation and management of marine resources.
(d) Navigation of ships and laying down submarine cables.

⊗ (**d**) According to Article 58 of United Nations Convention on the Law of the Sea (UNCLOS), 1982, Navigation of ships and laying down submarine cables over.

Exclusive Economic Zone (EEZ) is not an exclusive right of concerned coastal nations. Rather, this right is available to

all the states whether coastal or land locked.

Rest of the rights given above are exclusive rights of the concerned coastal nations over EEZ under Article 56 of UNCLOS.

UNCLOS is an international treaty which aims to set legal status of the territorial sea, of the air space over the territorial sea and of its bed and subsoil.

69. In which one of the following groups of states in India is the Integrated Coastal Zone Management (ICZM) project being implemented as a pilot investment?

(a) Gujarat, Kerala and Goa
(b) Kerala, Karnataka and Andhra Pradesh
(c) Gujarat, Odisha and West Bengal
(d) Maharashtra, Andhra Pradesh and Tamil Nadu

⊘ (**c**) The Integrated Coastal Zone Management (ICZM) Project aided by World Bank is focusing on improving the water availability for the population, to contribute towards increased understanding and acceptance of the need to protect, conserve and manage coastal natural resources etc.

Under this project, coastal zones would be developed and pilot projects would be implemented in specific geographical areas. Focus would be on three selected states Gujarat (Gulf of Kutch), Odisha (Paradip Chilika lake) and West Bengal (sagar dweep).

70. Which of the following statements about the National Water Academy (NWA) is/are correct?

1. The primary objective of the NWA is to function as Centre of Excellence in training for in service engineers from Central and State organisations on various aspects of water resource planning.

2. The NWA is located in New Delhi.

Select the correct answer using the codes given below
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊘ (**a**) National Water Academy (NWA) (earlier named as Central Training Unit) was set up Central Water Commission in the year 1988. It imparts training to the in-service engineers of various Central/State organisations involved in the Development and Management of Water Resources (MOWR).

Now, it is functioning under full funding from budget of Ministry of Water Resources (MOWR), River Development and Ganga Rejuvenation.

It is located at Pune, Maharashtra.

Thus, only statements (1) is correct and statement (2) is incorrect.

71. Which one of the following Indian States has the highest percentage of Scheduled Tribe population to its total population?
(a) Mizoram   (b) Nagaland
(c) Meghalaya   (d) Arunachal Pradesh

⊘ (**a**) According to the data of National Commission for Scheduled Tribes of India population of Schedule Tribe in India is 8.2% of the total population.

The state with highest percentage of Schedule Tribe population is Mizoram with 94.5% and the state with lowest percentage of Schedule Tribe population is Goa (0.04%).

UT with highest proportion of Scheduled Tribes is Lakshadweep (94.5%) and UT with lowest proportion of Scheduled Tribes is Andaman and Nicobar Islands (8.3%).

72. Extrusive volcanoes are not found in, which one of the following mountains?
(a) Alaska   (b) Rocky
(c) Andes   (d) Himalayas

⊘ (**d**) When volcanic activity takes place above ground, and hot molten magma is released onto the landscape, the volcanic activity is extrusive, meaning it is on the exterior, or outside of the Earth. Magma that comes out is known as lava.

This type of volcano is found in the region of subduction i.e. when there is a collision between a heavy and light plate like oceanic and continental plates.

In the above options, extrusive volcanoes are not found in Himalayas because they are formed due to the collision of two continental plates i.e. Eurasian and Indo-Australian plates, the other mentioned mountains are formed with the collision or subduction of oceanic and continental plates.

73. Which one of the following crops is not cultivated in Karewas, the lacustrine deposits of sand, clay, loam, silt and boulders?
(a) Saffron   (b) Almond
(c) Walnut   (d) Ling nut

⊘ (**d**) Saffron, almond, walnut crops are cultivated in Karewas. Ling nut is not cultivated in Karewas.

Indians often translate this nut as Singhara or water chestnut.

Ling nut grows throughout the East India, West Bengal, Jharkhand and Bihar. Ling nut is a food crop.

74. Consider the following tributaries of river Ganga
1. Gandak   2. Kosi
3. Ghaghara   4. Gomti

Which one of the following is the correct order of the above rivers from East to West?
(a) 3, 4, 1, 2   (b) 2, 1, 3, 4
(c) 2, 3, 1, 4   (d) 1, 2, 4, 3

⊘ (**b**) The correct order of the tributaries of river Ganga from East to West is Kosi, Gandak, Ghaghara and Gomti.

This order can be understood from the places where these tributaries meet river Ganga, Kosi joins Ganga near Katihar (Bihar), Gandak near Hajipur (Patna), Ghaghara near Revelganj (Bihar) and Gomti near Varanasi (UP).

These cities are from East to West location.

75. Where is Hambantota Port located?
(a) Iran   (b) Sri Lanka
(c) Japan   (d) Pakistan

⊘ (**b**) The Hambantota Port is a maritime port in Hambantota, Sri Lanka. It is built inland and operated by the Sri Lanka Ports Authority. It has been funded by the EXIM Bank of the People's Republic of China.

This port is regarded as one of the port of the string of pearls theory of China which was developed to encircle India in its own backyard.

76. The projects under Coastal Berth Scheme of the flagship Sagarmala Programme are distributed over how many states?
(a) Eight   (b) Ten
(c) Twelve   (d) Fourteen

⊘ (**a**) The Coastal Berth Scheme aims to provide financial support to ports or state governments for creation of infrastructure for movement of cargo and passengers by sea or national waterways.

The admissible financial assistance under the scheme from Central Government is 50% of total cost of project.

The projects under Coastal Berth Scheme are distributed over eight states with highest number of projects in Maharashtra.

The other states are Andhra Pradesh, Goa, Karnataka, Kerala and Tamil Nadu, Gujarat and West Bengal.

77. Which of the following National Parks of India are declared as World Heritage by UNESCO?

1. Keoladeo National Park
2. Sundarbans National Park
3. Kaziranga National Park
4. Ranthambore National Park

Select the correct answer using the codes given below

(a) 1 and 2
(b) 1, 2 and 3
(c) 3 and 4
(d) All of these

⊗ (**b**) A UNESCO World Heritage Site is a place that is listed by the United Nations Educational, Scientific and Cultural Organisation as of special cultural or physical significance.

Natural World Heritage Sites in India
(As on July, 2016)

Name of World Heritage Site	State Location	Year of Notification
Great Himalayan National Park Conservation Area	Himachal Pradesh	2014
Western Ghats	Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala	2012
Nanda Devi and Valley of Flowers National Parks	Uttarakhand	1988
Sundarbans National Park	West Bengal	1987
Kaziranga National Park	Assam	1985
Keoladeo National Park	Rajasthan	1985
Manas Wildlife Sanctuary	Assam	1985

Hence, option (b) is correct.

78. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Railway Zone)	List II (Headquarters)
A. North Central	1. Allahabad
B. North Eastern	2. Jabalpur
C. West Central	3. Gorakhpur
D. South Central	4. Secunderabad

Codes

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     A  B  C  D
(a)  4  3  2  1
(b)  4  2  3  1
(c)  1  2  3  4
(d)  1  3  2  4
```

⊗ (**d**) Names of the railway zones are listed below

Zonal Headquarters	Divisions
Central Railway	Mumbai CST
Eastern Railway	Kolkata
Northern Railway	New Delhi
North-Eastern Railway	Gorakhpur (U.P)
North-East Frontier Railway	Malegaon (Guwahati)
Southern Railway	Chennai
South Central Railway	Secunderabad
South-Eastern Railway	Kolkata
Western Railway	Churchgate (Mumbai)
East Central Railway	Hajipur (Bihar)
East Coast Railway	Bhubaneswar
North Central Railway	Allahabad (UP)
North Western Railway	Jaipur
South-East Central Railway	Bilaspur (Chhattisgarh)
South Western Railway	Hubli (Karnataka)
West Central Railway	Jabalpur (M.P)

Hence, option (d) is correct.

2017 (II)

79. Which one of the following tribal groups is dominantly found in the 'blue mountains'?

(a) Lambadas
(b) Gonds
(c) Jarawas
(d) Todas

⊗ (**d**) Nilgiri in English are called as 'Blue Mountains'. The Nilgiri Hills are part of a larger mountain chain known as the 'Western Ghats'. Toda Tribe is the most ancient tribe of Nilgiri Hills of Tamil Nadu in Southern India.

80. Who among the following geographers is related to 'primate city' concept?

(a) August Losch
(b) Mark Jefferson
(c) Griffith Taylor
(d) W Christaller

⊗ (**b**) Geographer Mark Jefferson developed the law of the primate city to explain the phenomenon of huge cities in 1939.

According to him "A country's leading city is always disproportionately large and exceptionally expressive of national capacity and feeling."

The primate city in commonly at least twice as large as the next largest city and more than twice as significant.

81. Which one of the following island is the largest?

(a) Borneo
(b) Madagascar
(c) New Guinea
(d) Sumatra

⊗ (**c**) Among the following islands, New Guinea is the largest island with an area of $7,86,000 \text{ km}^2$.

While Borneo ($7,43,330 \text{km}^2$), Madagascar ($5,87,041 \text{ km}^2$) and Sumatra ($4,73,481 \text{ km}^2$) are at second, third and fourth position respectively.

82. Arrange the following Tiger Reserves of India from North to South

1. Dudhwa
2. Panna
3. Pench
4. Indravati

Select the correct answer using the codes given below

(a) 4, 3, 2, 1
(b) 2, 1, 4, 3
(c) 1, 2, 3, 4
(d) 1, 3, 2, 4

⊗ (**c**) Dudhwa is in North-Eastern Uttar Pradesh
Panna is in North-Eastern Madhya Pradesh
Pench is in Central-Southern Madhya Pradesh
Indravati is in Southern Chhattisgarh
Hence, option (c) is correct.

83. The phenomenon of 'demographic dividend' of a country relates to

(a) a sharp decline in total population
(b) an increase in working age population
(c) a decline in infant mortality rate
(d) an increase in sex ratio

⊗ (**b**) Demographic dividend is a phenomenon which occurs when the proportion of working population out of the total population is high.

According to the UN population fund, it means that economic growth potential resulting from shifts in a population's age structure, mainly when the share of the working-age population (15 to 64) is larger than the share of non-working age population.

Hence, option (b) is correct.

Directions (Q. Nos. 85 and 86) *The following consist of two statements, statement I and statement II. Examine these two statements carefully and select the correct answer using the codes given below.*

Codes

(a) Both the statements are individually true and statement II is the correct explanation of statement I

(b) Both the statements are individually true, but statement II is not the correct explanation of statement I

(c) Statement I is true, but statement II is false

(d) Statement I is false, but statement II is true

84. **Statement I** The interior part of Maharashtra does not receive adequate rain in the summer season.

Statement II The interior part of Maharashtra lies in the rain shadow area of the Western Ghats.

⊙ (**a**) A rain shadow area is a patch of land that has been forced to remain dry because mountain ranges block most of the rain bearing winds.

In case of interiors of Maharashtra most of the rain bearing South-West monsoon winds are blocked by the Western ghats.

As a result, interiors of Maharashtra becomes rain shadow region and does not receive adequate rain.

Hence, both the statements are correct and statement II is the correct explanation of statement I.

85. **Statement I** Global warming signifies the rise in global surface temperature.

Statement II The increase of concentration of greenhouse gases in the atmosphere causes the rise in global surface temperature.

⊙ (**a**) Global warming is the unusually rapid increase in Earth's average surface temperature over the past century primarily due to the greenhouse gases released as people burn fossil fuels.

The global average surface temperature has tremendously increased in recent years. Greenhouse gases absorbs thermal radiations emmitted by the Earth's surface.

Increase in concentration of GHGs will resoil in increased absorption of thermal radiations.

Thus will consequently led to rise in temperature.

Hence, option (a) is correct.

86. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Strait)	List II (Countries)
A. Bass Strait	1. UK and France
B. Davis Strait	2. Australia and Tasmania
C. Dover Strait	3. USA and Cuba
D. Florida Strait	4. Canada and Greenland

Codes

	A	B	C	D
(a)	2	4	1	3
(b)	2	1	4	3
(c)	3	4	1	2
(d)	3	1	4	2

⊙ (**a**) **Bass Strait,** channel separating Victoria, (Australia) from the island of Tasmania on the South. King Island and the Indian Ocean lie at its Western extremity, and the Furneaux Group is at its Eastern end. Banks Strait is the South-Eastern opening to the Tasman Sea.

Davis Strait, situated between Baffin Island (Canada) and Greenland. Some of the greatest depths in the Eastern Arctic are reached here (3660 m) in the Southern end of the strait.

Dover Strait is a narrow water passage separating England (UK) from France (South-East) and connecting the English Channel (South-West) with the North Sea (North-East). The strait was an exposed river valley, thus making England an extension of the European continent.

Florida Strait passage connecting the Gulf of Mexico (US) with the Atlantic Ocean. The US on the North and Cuba on the South, and it extends East to the Bahamas. The straits mark the area where the Florida Current, the initial part of the Gulf Stream.

Hence, options (a) is correct.

87. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Pass)	List II (Place)
A. Zoji La	1. Himachal Pradesh
B. Shipki La	2. Uttarakhand
C. Lipulekh	3. Jammu and Kashmir
D. Nathu La	4. Sikkim

Codes

	A	B	C	D		A	B	C	D
(a)	4	2	1	3	(b)	4	1	2	3
(c)	3	1	2	4	(d)	3	2	1	4

⊙ (**c**) **Zoji La** Pass is located on the Indian National Highway one between Srinagar and Leh, in the Western section of the Himalayan mountain ranges. Around 3,528 m (11, 649 ft) above the sea level it is considered to be the second highest pass in India.

Shipki La is a high mountain pass and border post on the India-China border, at an elevation of 3.930 m (12,894 ft) above the sea level. It is located in the state of Himachal Pradesh India and in Tibet (China).

Lipulekh pass is in Pithoragarh district of Uttarakhand. It connects the Kumaon

region of Uttarakhand with the old trading town of Taklakot in Tibet.

The pass is first Indian border post to be opened for trade with China in 1992.

Hence, option (c) is correct.

Nathu La is in Sikkim. This pass at 4310 m (14,450 ft). above sea level, and is one of the most important Himalayan passes in the country.

It is one of three open trading border posts between India and China and is famous for its picturesque beauty and beautiful environment. Nathu means 'listening ears' and La means 'pass' in Tibetan.

88. Match List I with List II and select the correct answer using the codes given below the lists.

List I (National Highway)	List II (Route)
A. NH – 2	1. Delhi – Jaipur – Ahmedabad – Mumbai
B. NH – 4	2. Thane – Pune – Bengaluru – Chennai
C. NH – 7	3. Delhi – Agra – Allahabad – Kolkata
D. NH – 8	4. Varanasi – Jabalpur – Nagpur – Hyderabad – Bengaluru – Madurai – Kanyakumari

Codes

	A	B	C	D		A	B	C	D
(a)	3	4	2	1	(b)	1	2	4	3
(c)	1	4	2	3	(d)	3	2	4	1

⊙ (**d**) **NH-2** has a (total length of 1465 kms) and passes through Delhi-Agra-Allahabad -Kolkata.

NH-4 (total length 230.7kms) passes through Thane-Pune-Bengaluru-Chennai.

NH-7 (total length 2369 kms) passes through Varanasi-Jabalpur - Nagpur - Hyderabad - Bengaluru - Madurai - Kanyakumari.

NH-8 (total length 1375 kms) passes through Delhi-Jaipur-Ahmedabad-Mumbai.

Hence, option (d) is the correct match.

89. 'Xeriscaping' is a concept related to

(a) landscaping related to save water

(b) landscaping related to save soil erosion

(c) weathering of rock surface

(d) All of the above

⊙ (**a**) Xeriscaping is landscaping and gardening that reduces or eliminates the need for water supplement in the form of irrigation to the crops.

This type of landscaping is related to water conservation concept.

Hence, option (a) is correct.

90. Match List I with List II and select the correct answer using the codes given below the lists.

	List I (Industrial Region)		List II (Country)
A.	Leipzig	1.	USA
B.	Detroit	2.	UK
C.	Lorraine	3.	France
D.	Cumberland	4.	Germany

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	3	4	(b)	4	3	1	2
(c)	4	1	3	2	(d)	2	3	1	4

⊘ (**c**) Leipzig → Germany
Detroit → USA
Lorraine → France
Cumberland → UK

91. Match List-I with List-II and select the correct answer using the codes given below the lists.

	List I (Mountain Range)	List II (Location in Map)
A.	Satpura	
B.	Vindhya	
C.	Aravalli	
D.	Mahadeo	

Codes

	A	B	C	D		A	B	C	D
(a)	4	2	1	3	(b)	3	1	2	4
(c)	3	2	1	4	(d)	4	1	2	3

⊘ (**c**) 1. → Aravalli   2. → Vindhya
3. → Satpura   4. → Mahadeo

92. Which of the following statements with respect to the Indian Pensinsular Plateau are correct?

1. The Deccan Plateau gradually rises from North to South.
2. The Malwa Plateau dominates the Vindhyan scraps, forming the Eastern flank of the plateau.
3. The Western Satpuras separate the Narmada and Tapi rivers.
4. The Chota Nagpur Plateau is composed of Archaean granite and gneiss rocks.

Select the correct answer using the codes given below
(a) 1, 2, 3 and 4   (b) 1, 3 and 4
(c) 2 and 3   (d) 1 and 3

⊘ (**b**) The Deccan Plateau gradually rises from North (100 m) to South (more than 1000 m).

The Malwa Plateau dominates the Vindhyan scraps, forming the Northern flank of the Plateau (and not eastern).

The Western Satpuras separate the Narmada and Tapi rivers.

The Chota Nagpur Plateau is composed of Archean granite and gneiss rocks. Hence, statements 1,3, 4 are correct. Statement (2) is in correct.

Hence, option (b) is correct option.

93. Which of the following lakes is/are situated in Ladakh?

1. Tso Kar   2. Pangong Tso
3. Tsomgo   4. Tso Moriri

Select the correct answer using the codes given below
(a) Only 1   (b) 2 and 3
(c) 1, 2 and 4   (d) 2 and 4

⊘ (**c**) The **Tso-Kar** Lake also known as 'White Lake' is one of the three high altitude salt water lakes in Ladakh.

It is known as 'White Lake' because the white salt of the water deposits all over the lake shores.

Tsomgo Lake, also known as 'Changu Lake' is a glacial lake in Sikkim. This is one of the few and beautiful high altitude lakes in India.

The lake becomes doubly attractive with the reflections of the surrounding hills on the water.

Tso Moriri or Lake Moriri or Mountain Lake, is a lake in the Ladakhi part of the Changthang Plateau in Jammu and Kashmir in Northern India.

The lake and surrounding area are protected as the Tso Moriri Wetland Conservation Reserve. The lake is at an altitude of 4,522 m. It is the largest of the high altitude lakes entirely within India and entirely within Ladakh in this Trans-Himalayan biogeographic region.

Pangong Tso is one of the largest brackish lakes in Asia. It is one of the charismatic lakes situated on the Changtang plateau in Eastern Ladakh region.

Pangong Lake is also known by the name of 'Hollow Lake' and appears as a clear symbol of nature craftsmanship.

94. Which of the following statements related to latitude are true?

1. Rainfall, temperature and vegetation vary with latitude.
2. The difference between the longest day and the shortest day increases with latitude.
3. Indira Point is located approximately at 6°45'N latitude.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 1 and 3
(c) 2 and 3   (d) 1, 2 and 3

⊘ (**d**) Latitude are parallels, otherwise known as latitude lines, are lines that run across the Earth from East to West at a constant flow.

Across latitude the intensity and the angle of sunlight varies that results in the variation of rainfall, temperature and vegetation.

The difference between the longest and the shortest day increases with latitude. At the equator, the days and the nights are almost equal and as we move closer to the poles, the length of day decreases with latitude.

Indira Point which is also the Southern-most point of India is located South of Andaman and Nicobar Islands and is at a latitude of 6° 45'N latitude.

Hence, all the given statements are correct.

95. Match List I with List II and select the correct answer using the codes given below the lists.

	List I (Lake)		List II (Type of Lake)
A.	Bhimtal	1.	Lagoon
B.	Ashtamudi	2.	Landslide
C.	Gohna	3.	Tectonic
D.	Lonar	4.	Crater

Codes

	A	B	C	D		A	B	C	D
(a)	3	1	2	4	(b)	3	2	1	4
(c)	4	2	1	3	(d)	4	1	2	3

⊘ (**a**) **Bhimtal** is an example of tectonic lake. Tectonic uplift may interfere with natural land-drainage patterns in such a way as to produce lake basins.

Ashtamudi Lake also called Ashtamudi Kayal in the Kollam District of the Indian state of Kerala, is the most visited backwater and lake in the state.

The lake is also called the gateway to the backwaters of Kerala and is well known for its houseboat and backwater resorts. It is a type of lagoon where there has been incursion of seawater in the mainland.

The **Gohna Lake** dam-burst is a flood in Garhwal Region of India in 1894 caused by a landslide induced temporary lake. Landside caused huge mass of Earth to shift down creating this lake.

Lonar Lake is a saline soda lake located at Lonar in Buldhana district, Maharashtra, India. It was created by a meteor impact during the Pleistocene Epoch and it is the only known hyper velocity impact crater in basaltic rock

anywhere on Earth. It is thereby named as Crater lake.

Hence, option (a) is correct.

96. Which of the following statements is/are correct?

1. Himalayan rivers have their origin in the snow-covered areas, hence are dry in winter season.
2. Rivers of the Peninsular Plateau have reached maturity.
3. Himalayan rivers depict all the three stages of normal cycle of erosion.

Select the correct answer using the codes given below

(a) Only 2   (b) 1 and 3
(c) 2 and 3   (d) 1, 2 and 3

⊙ (**c**) Since the Himalayan rivers are perennial rivers they have water in them all through the year.

They are fed by melting glaciers of the lofty glaciers of the Himalayas and the rains that are caused by South-West Monsoon system. Therefore, they are not dry in winter season but have river flow in them.

The rivers of the peninsular region like the Krishna, Godavari and the Kaveri are very old and senile rivers.
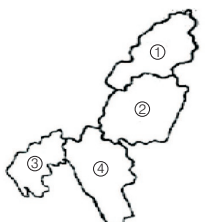
They have reached an advanced stage in their development and have no downcutting power in them.

Hence, they are said to be in their stage of maturity.

The Himalayan rivers like Ganga and Brahmaputra depicts all three cycles of erosion namely Youth, Mature and old. In the upper reaches of the river there is youth stage where are rivers follow extreme downcutting and lateral corrosion. In the mature phase, there is widening of the valleys and in the old phase there is deposition of silt.

Hence, statements 2 and 3 are correct.

97. Match List I with List II and select the correct answer using the codes given below the lists.

List I (States of North Eastern India)	List II (Location in Map)
A. Tripura	
B. Mizoram	
C. Nagaland	
D. Manipur	

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	4	3	(b)	2	4	1	3
(c)	3	1	4	2	(d)	3	4	1	2

⊙ (**d**) Tripura, Mizoram, Nagaland and Manipur are North-Eastern states. Capital of these states are as follow

(i) Tripura - Agartala
(ii) Mizoram - Aizawl
(iii) Nagaland - Kohima
(iii) Manipur - Imphal

Hence, option (d) is correct

98. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Harappan Site)	List II (Modern Name)
A. Dholavira	1. Saurashtra
B. Rakhigarhi	2. Hisar
C. Bhirrana	3. Kadir island
D. Bhogavo	4. Haryana

Codes

	A	B	C	D		A	B	C	D
(a)	1	4	2	3	(b)	1	2	4	3
(c)	3	2	4	1	(d)	3	4	2	1

⊙ (**c**) **Dholavira,** known locally as Kotada (which means large fort) is located in the North-West corner of the island of Kadir, one of the islands in the Great Rann of Kutch. Dholavira has one of the world's earliest water conservation systems ever excavated and was one of the prominent Harappan sites.

Rakhigarhi is the only place which has the remains of early, mature and late phase of Indus Valley Civilisation at the same location.

It is one of the few Harappan sites which has an unbroken history of settlement. In the year 2014, it was the largest discovered Harappan site till date which is located in Hisar district of Haryana.

Bhirrana which is considered the oldest discovered Indus Valley Civilization site, with some of the oldest mounds dating back to 7500 BCE is located in Haryana.

Bhogavo is a river in Gujarat in the region of Saurashtra. It is located in the ancient town of Lothal which was a dockyard at the time of Indus Valley Civilisation.

2017 (I)

99. In which one of the following States is Loktak Lake situated?

(a) Sikkim   (b) Himachal Pradesh
(c) Manipur   (d) Meghalaya

⊙ (**c**) Loktak Lake is the largest freshwater lake in North-East India, and is famous

for the *phumdis* (heterogeneous mass of vegetation, soil, and organic matter at various stages of decomposition) floating over it. Keibul Lamjao is the only floating national park in the world. It is located near Moirang in Manipur State, India.

100. The ratio of Gross Cropped Area to the Net Sown Area is called

(a) cropping intensity
(b) intensity of crop rotation
(c) crop productivity
(d) cropping diversity

⊙ (**a**) Gross Cropped Area (GCA) is the total area sown once as well as more than once in a particular year. When the crop is sown on a piece of land for twice, the area is counted twice in GCA.

On the other hand, Net Sown Area is the area sown with crops but is counted only once. Cropping intensity refers to raising of a number of crops from the same field during one agriculture year.

It can be expressed as, Cropping intensity = (Gross cropped area ÷ Net sown area) × 100.

101. Which one of the following is the correct sequence of occurrences of rivers from Chennai to Kolkata when travelled by road (shortest distance)?

(a) Krishna, Kaveri, Godavari, Mahanadi, Subarnarekha
(b) Krishna, Periyar, Godavari, Mahanadi, Subarnarekha
(c) Penneru, Krishna, Godavari, Mahanadi, Subarnarekha
(d) Penneru, Mahanadi, Subarnarekha, Godavari, Krishna

⊙ (**c**) Penneru, Krishna, Godavari, Mahanadi, Subarnarekha are East flowing Peninsular river.

From South to North-East Penneru-Andhra Pradesh Krishna-Karnataka Godavari-Maharashtra Mahanadi-Odisha, Subarnarekha-Jharkhand

102. Which one of the following statements with regard to volcanoes is not correct?

(a) Stratovolcanoes produce lava flows that initially follow valleys but are highly resistant to erosion.
(b) The surrounding areas can remain highlands, lava ridges or mesas.
(c) Hawaiian shield volcanoes are eroded by streams that form deeply carved valleys with steeply sloping heads.
(d) The system of streams on a dissected volcano cone is not a radial drainage pattern.

(**d**) A stratovolcano is a tall, conical volcano composed of one layer of hardened lava, tephra, and volcanic ash. These volcanoes are characterised by a steep profile and periodic explosive eruptions.

The lava that flows from them is highly viscous and cools and hardens before spreading very far.

The system of streams on a dissected volcano cone is a radial drainage pattern.

Thus, statements (d) is incorrect.

103. Which one of the following is not a biosphere reserve of India?

(a) Agasthyamalai
(b) Nokrek
(c) Great Nicobar
(d) Great Himalayan

(**d**) Great Himalayan is a national park not Biosphere reserve. It is located in Kullu region of Himachal Pradesh.

It was established in 1984. All other are Biosphere reserves of India.

104. Which one of the following statements with regard to the Indian Railways is not correct?

(a) The Indian rail network have been developed throughout the Konkan coast.
(b) There is very low density of railway lines in the Himalayan region.
(c) The North Indian Plain has a dense network of railway.
(d) At present, India has the largest railway network in the world.

(**d**) The USA has the largest railway system in the world, about 240000 km connecting 48 continental States.

This track is enough to circle the Earth five times.

Russia (154000 km) and Canada (72961 km) follow. India comes fifth with 62658 km of railroad after Canada and China.

Hence, statement (d) is incorrect.

105. Which of the following statements with regard to the Mediterranean agriculture is/are correct?

1. The Mediterranean agriculture is highly specialised commercial agriculture.
2. It is intensive subsistence agriculture dominated by wet paddy cultivation.
3. It is a primitive subsistence agriculture.
4. Viticulture is a speciality of the Mediterranean region.

Select the correct answer using the code given below
(a) Only 1 (b) 2 and 3
(c) 1 and 4 (d) 1, 3 and 4

(**c**) Mediterranean agriculture is practised in areas bordering Mediterranean Sea (especially European region).

This type of agriculture is highly specialised commercial agriculture.

It is not a subsistence type of agriculture. This agriculture is dominated by crops like wheat, barley, horticulture crops etc., and not wet paddy.

This agriculture is highly specialised (and not primitive). Viticulture or grape cultivation is a speciality of this region.

Hence, option (c) is correct.

106. Which one of the following statements with regard to the winter solstice is correct?

(a) The South Pole experiences 24 hours of darkness.
(b) It occurs on 21st June.
(c) The North Pole experiences 24 hours of darkness.
(d) The Sun is at aphelion.

(**c**) It occurs on 21st December, being the longest day of the year, also means that people in the areas South of the Antarctic Circle towards the South Pole will see the midnight Sun, It means 24 hours of daylight, during this time of the year.

For people in the Northern Hemisphere, the December solstice marks the exact opposite, the day of the year with fewest hours of daylight.

North of the Arctic Circle towards the North Pole, there is no direct sunlight at all during this time of the year.

Hence, options (c) is correct.

107. Tropical evergreen rainforest biome provides optimum environmental conditions for the growth of plants and animals. Which one among the following statements regarding this is not correct?

(a) It has heavy rainfall and high temperature throughout the year.
(b) This biome is also called mega-thermal biome.
(c) The evergreen rain forest biome extends between 10° N and 10° S latitudes.
(d) The maximum development of this biome has taken place in central and Southern California and North-Western coastal lands of Africa.

(**d**) Tropical rainforests are such rainforests that occur in the region of tropical rainforest climate where there is no dry season and it remain hot and wet.

Tropical evergreen rainforest biome prodvides optimum environmental condition for the growth of plants and animals because it experience heavy rainfall and high temeprature, and extend between 10°N and 10°S latitudes.

The biometropical rainforests are of mega thermal trye because the organisms are adapted to high temperature and wet and humid condition.

The maximum development of this biome has taken place in South America, lowland region in Africa, and the islands off the South-East Asia, Central America and parts of Australia.

108. Tsunami waves are the undersea occurrence of earthquake exceeding 7.5 on Richter scale. Which one of the following statements regarding this is not correct?

(a) It often generates strong waves
(b) The Pacific coasts are most vulnerable to Tsunami waves
(c) Tsunami waves are also called high-energy tidal waves or seismic sea waves
(d) Tsunami is a Latin word

(**d**) 'Tsunami' is a Japanese word which means 'harbour waves'. Tsunami is a series of ocean waves that sends surges of water towards coast.

It often generates strong waves which may reach a height of 100 feets near the shores. Due to presence of the 'Pacific Ring of Fire', Pacific coasts are most vulnerable to Tsunami waves.

Tsunami is are also called as high energy tidal waves or seismic waves as usually they are a result of seismic activities.

109. Which of the following statements with regard to cloudburst is/are correct?

1. It is defined as sudden localised very heavy downpour with cloud thunder and lightning.
2. It mostly occurs in the hilly areas.
3. It results into very high intensity of rainfall, i.e., 250 mm-300 mm in a couple of hours.
4. It occurs only during daytime.

Select the correct answer using the code given below
(a) 1, 2 and 3
(b) 1, 3 and 4
(c) 2 and 3
(d) Only 2

⊘ (**a**) Cloud bursts are usually localised phenomena which results in very high intensity of rainfall (250 mm-300 mm), in a couple of hours, alongwith thunder and lightning.

They may occur at any place and at any time, but are more common in hilly areas and during daytime.

Hence, Only statements (d) is incorrect.

110. Which one of the following with regard to Aridisol, one of the soil orders, is not correct?
(a) Lack of water for plants during most part of the year
(b) High organic matter
(c) Large accumulation of carbonates at depth
(d) Absence of deep wide cracks

⊘ (**b**) Aridisols are soil order is USA soil taxonomy. Aridisols form in an arid or semi arid climate. Aridisols dominate the deserts and xeric shrublands, which occupy about on third of the Earth's land surface. Aridisols have a very low concentration of organic matter, reflecting the paucity of vegetative production on these dry soils. Water deficiency is the major defining characteristic of Aridisols.

111. Which one of the following statements with regard to Jet stream, an upper level tropospheric wave, is not correct?
(a) It is narrow band of high-velocity wind.
(b) It follows the wave path near the tropopause at elevations of 8 km to 15 km.
(c) Jet streams are typically continuous over long distances.
(d) In summer, the polar front jet achieves its maximum force.

⊘ (**d**) Jet stream are phenomena of winter. It is believed that jet stream exercises an important influence on the winter weather in India.

Therefore, the polar jet stream shifts its location from winter to summer, depending on the temperature differences which cause strong pressure gradients. The greatest temperature gradients in the winter reach further South means the polar jet stream extends further South during winter months.

In the summer, temperature differences aren't as good and are in North (in Canada) so the polar jet stream is usually in North.

So, the large contrast in temperature in the winter causes the polar jet stream to be stronger in the winter months than summer.

Hence, statement (d) is not correct.

112. The Gulf Stream is a poleward flowing current in the Atlantic Ocean. Which one of the following statements with regard to this is not correct?
(a) It is similar to the Kuroshio current in the North Pacific Ocean
(b) It transports warm, tropical water towards polar region
(c) This current is a major factor in weather along the East coast of the USA
(d) The warm water of the Gulf Stream sustains the coral reefs of West Pacific Coast

⊘ (**d**) Gulf stream, like Kuroshio current, is a warm ocean current. It orginates in the Gulf of Mexico and carries warm water to the polar region through Atlantic ocean.

It flows through Eastern margins of North America. Thus impacting the climate of Western USA. So, statements (a), (b) and (c) are correct.

It has no role in sustaining the coral reefs of West Pacific coast. Kuroshio current helps in promoting the growth of planktons and coral reefs in the West pacific.

So, statement (d) is incorrect.

113. Which one of the following about sugar industry of Peninsular India is not correct?
(a) High yield per hectare of sugarcane.
(b) Higher sucrose content.
(c) Long crushing season.
(d) Most of the mills in the Peninsula are located mainly along the East coast.

⊘ (**d**) Most sugar industries are situated on the Western coast of India because of several better conditions prevailing there. These are
• The tropical climali of peninsular India results in higher yield per unit hectare of land.
• Long crushing season
• Better management under cooperative sector.

Hence, statement (d) is not correct.

114. Which one of the following ports is located on estuary?
(a) Kandala   (b) Marmagao
(c) Kolkata-Haldia   (d) Tuticorin

⊘ (**b**) Marmagao is in Goa, is located on estuary on Eastern coast of India. Delta formation and estuary formation take place mostly on Western coast and Goa is in Western coast.

Kandala is a Tidal port, Kolkata- Haldia is a riverine port, Tuticorin is a river port.

115. The fact that the planets move around the Sun, not in circles but in ellipses, was first demonstrated by
(a) Galileo
(b) Martin Luther
(c) Johannes Keppler
(d) Copernicus

⊘ (**c**) Though, copernicus was the first to observe that planets revolve around the Sun, it was Johannes Keppler who correctly defined their orbits as elliptical.

2016 (II)

116. With reference to earthquakes, which of the following statements are correct?
1. Earthquakes largely occur along the converging plate boundaries.
2. Point of origin of earthquake in lithosphere is known as focus/hypocentre.
3. Intensity of earthquake decreases with distance from the epicentre.
4. Epicentre of earthquake always remains over continents only.

Which of the statements given above are correct?
(a) 1 and 2   (b) 1, 2 and 3
(c) 2 and 3   (d) 1 and 4

⊘ (**b**) Earthquakes largely take place along convergent boundaries, where plates are moving toward each other, and sometimes one plate is subducted (sink) under another.

The location, where subduction of a plate takes place is called a **subduction zone**.

The epicenter is the point on the Earth's surface vertically above the hypocenter (or focus), where a seismic rupture begins.

However, the earthquake epicentre is typically not the point where most damage occurs. Intensity decreases with distance from the fault.

The epicentre of an earthquake may be over continents or ocean basins.

Hence, option (b) is true.

117. Which of the following pairs of Indian states and tribal population are correct?

1. Madhya Pradesh : Largest tribal population
2. Mizoram : Highest percentage of tribal population out of the total population of the State
3. Chhattisgarh : Second largest tribal population after Madhya Pradesh
4. Arunachal Pradesh : Second highest percentage of tribal population out of the total population of the State after Mizoram

Which of the statements given above are correct?
(a) 1 and 2
(b) 2 and 4
(c) 1, 2 and 3
(d) 2, 3 and 4

⊙ (**a**) The tribes in India are spread over the length and breadth of the country. They vary in strength in different states from a few hundred to several lakhs.

According to the 2011 Census, the largest number of tribal population is found in Madhya Pradesh followed by Maharashtra, Odisha, Rajasthan and Gujarat.

In Mizoram, the tribal population constitutes 95% of the total population of the State, in Nagaland 89%, in Meghalaya and Arunachal Pradesh 80% each, in Tripura 70%, and so on.

Hence, statements (3) and (4) are not correct.

118. Which one of the following is not correct in respect of Andaman and Nicobar Command?

(a) It is the first integrated theatre command in India.
(b) Its headquarters is at Port Blair.
(c) It is commanded by a three-star officer.
(d) It was set-up by the British during the Second World War.

⊙ (**d**) The Andaman and Nicobar Command is the only Tri-Service Theatre Command of the Indian Armed Forces at Port Blair in the Andaman and Nicobar Islands. It was created in 2001 to safeguard India's strategic interests in South-East Asia and the Strait of Malacca by increasing rapid deployment of military assets in the region.

The Andaman and Nicobar Command is the first and only command with rotating three-star Commanders-in-Chief from the Army, Navy and Air Force.

The command reports directly to the Chairman of the Chiefs of Staff Committee.

Hence, statement (d) is incorrect.

119. If the latitude and longitudinal extent of an Indian State/UT is 15°48′00″ N to 14°53′15″ N and 74°20′13″ E to 74°40′33″ E, then which one of the following is that State/UT?

(a) Puducherry
(b) Chandigarh
(c) Goa
(d) Delhi

⊙ (**c**) Goa lies within the latitudes 15°48′00″ N to 14°53′15″ N. The longitudinal extent of Goa is 74°20′13″ E to 74°40′33″ E. The average altitude of Goa is around 64m above sea level. Goa encompasses an area of 3702 sq km.

120. Match the following.

	List I (Railway Zones)		List II (Headquarters)
A.	North-Eastern Railway	1.	Kolkata
B.	East Central Railway	2.	Bilaspur
C.	South-East Central Railway	3.	Hajipur
D.	South-Eastern Railway	4.	Gorakhpur

Codes

	A	B	C	D		A	B	C	D
(a)	4	2	3	1	(b)	1	3	2	4
(c)	1	2	3	4	(d)	4	3	2	1

⊙ (**d**) The Headquarter of North-Eastern Railway is at Gorakhpur.

The Headquarter of East Central Railway is at Hajipur.

The Headquarter of South-East Central Railway is at Bilaspur.

The Headquarter of South-Eastern Railway is at Kolkata.

121. Which of the following statements concerning atmosphere of the Earth are correct?

1. In stratosphere, temperature increases with altitude.
2. In mesosphere, temperature decreases with altitude.
3. The lowest temperature of the atmosphere is recorded in the upper part of mesosphere.
4. Tropopause is an isothermal zone.

Which of the statements given above are correct?
(a) 1 and 2
(b) 1, 2 and 3
(c) 3 and 4
(d) All of these

⊙ (**d**) Atmosphere consists of four major layers namely, troposphere (innermost layer), stratosphere, mesosphere and exosphere (outermost layer).

In general, temperature decreases with altitude. But in stratosphere, temperature increases with height.

This happens due to presence of ozone layer in stratosphere. Above stratosphere mesosphere is present.

Here, again the temperature declines with altitude. And, resultant minimum temperature of the atmosphere is recorded in upper Mesosphere (The transition zone between mesosphere and exosphere).

Tropopause is the transition zone between troposphere and stratosphere. This zone is narrow and experiences constant temperature. Hence is an isothermal zone.

Hence, all the statements are correct.

122. Match the following.

	List I (Places)		List II (Industries)
A.	Bongaigaon	1.	Paper
B.	Koraput	2.	Machine tools
C.	Pinjore	3.	Aircraft
D.	Sirpur	4.	Petrochemical

Codes

	A	B	C	D		A	B	C	D
(a)	4	2	3	1	(b)	4	3	2	1
(c)	1	2	3	4	(d)	1	3	2	4

⊙ (**b**) **An oil refinery and petrochemical complex** is located in Bongaigaon in Assam. It is the eighth largest refinery of Indian oil.

Koraput is located in Odisha, houses the engine division of Hindustan Aeronautics Limited (HAL).

Pinjore is located in Panchkula in Haryana, is a residential township and is well-known for the Hindustan Machine Tools (HMT) factory.

Sirpur town in Mahasumund district, (Chhattisgarh) is well-known for paper manufacturing mills.

123. Which one of the following is not a tributary of the river Ganga?

(a) Son
(b) Mahananda
(c) Teesta
(d) Sharda

❯ (**c**) **Tributaries of Ganga**

From Left :	Ramganga, Gomati, Ghaghara, Gandak, Bagmati, Koshi, Mahananda, Sharda (Kali Ganga)
From Right :	Yamuna, Tamsa, Son, Punpun

Whereas, river Teesta is the right-bank tributary of the river Brahmaputra.

124. Which one of the following pairs of lakes are connected by Soo Canal?

(a) Superior and Michigan
(b) Superior and Huron
(c) Huron and Ontario
(d) Huron and Erie

❯ (**b**) The Soo Canal or Sault lake is a set of parallel lakes, which enable ships to travel between Lake Superior and the lower Great Lakes.

The Canal is located on the St. Marys River between Lake Superior and Lake Huron.

125. Match the following.

List I (Straits)		List II (Water Bodies)
A.	Strait of Hormuz	1. Java Sea
B.	Strait of Bab-el-Mandeb	2. Andaman Sea
C.	Strait of Malacca	3. Red Sea
D.	Strait of Sunda	4. Gulf of Persia

Codes

	A	B	C	D		A	B	C	D
(a)	4	2	3	1	(b)	1	3	2	4
(c)	1	2	3	4	(d)	4	3	2	1

❯ (**d**) **The Strait of Hormuz** It is situated between the Gulf of Oman and the Gulf of Persia. It provides the only sea passage from the Persian Gulf to the open ocean.

The Strait of Bab-el-Mandeb It is located between Yemen on the Arabian Peninsula Djibouti and Eritrea. It is located in Red Sea. It connects the Red Sea to the Gulf of Aden.

The Strait of Malacca It is located between the Peninsular Malaysia and the Indonesian island of Sumatra in Andaman Sea.

The Strait of Sunda It is located between the Indonesian islands of Java and Sumatra. It connects the Java Sea to the Indian Ocean and situated in Java Sea.

Hence, options (d) is correct.

126. Match the following.

List I (Ocean Currents)		List II (Countries)
A.	Agulhas current	1. Peru
B.	Humboldt current	2. South Africa
C.	Labrador current	3. Argentina
D.	Falkland current	4. Canada

Codes

	A	B	C	D		A	B	C	D
(a)	3	4	1	2	(b)	2	1	4	3
(c)	3	1	4	2	(d)	2	4	1	3

❯ (**b**) The courses of the warm **Agulhas current** blow along the East coast of South Africa. It is the Western boundary current of the South-West Indian Ocean.

The **Humboldt current** is also called the Peru current. It is a cold current and has low salinity. It flows North along the West coast of South America from the Southern tip of Chile to Northern Peru. It flows mostly in Peru.

The **Labrador current** is a cold current in the North Atlantic Ocean, which follows from the Arctic Ocean to South along the coast of Labrador and passes around New foundland. The waters of the Labrador current has cooling effect in the Canada and USA.

The **Falkland current** is a cold water current that flows northward along the Atlantic coast of Patagonia (Argentina) as far North as the mouth or the Rio de la Plata.

127. Which one of the following fishing bank is located on the coast of the United Kingdom?

(a) Great Fisher Bank - North Sea
(b) Grand Banks - North America
(c) Dogger Bank
(d) Reed Bank - South China Sea

❯ (**c**) Dogger Bank is located on the coast of the United Kingdom (England). The bank is an important fishing area, with cod and herring being caught in large numbers. Dogger Bank has been identified as an oceanic environment that exhibits high primary productivity throughout the year in the form of phytoplankton.

128. Match the following.

List I (Power Plants)		List II (States)
A.	Satpura	1. Maharashtra
B.	Dhuvaran	2. Uttarakhand
C.	Tanakpur	3. Gujarat
D.	Dabhol	4. Madhya Pradesh

Codes

	A	B	C	D		A	B	C	D
(a)	4	3	2	1	(b)	1	3	2	4
(c)	1	2	3	4	(d)	4	2	3	1

❯ (**a**) **Satpura Thermal Power** Plant is located at Sarni town in Betul district of Madhya Pradesh. The power plant is one of the coal-based power plants of Madhya Pradesh Power Generation Company Limited (MPPGCL).

Dhuvaran Thermal Power Station is an Oil and Gas power plant located at Khambhat in Anand district of Gujarat. The power plant is under ownership of State owned Gujarat State Electricity Corporation Limited.

Tanakpur Hydro Power Plant (India) is located at Banbassa in Champawat district of Uttarakhand. It is operated by National Hydro Power Corporation.

Dabhol Power Station is located at Anjanwel village in Ratnagiri district of Maharashtra.

The power station was built by the Dabhol Power Company, which was a joint venture of Enron, General Electric, Bechtel and Maharashtra Power Development Corporation.

129. Which of the following statements regarding soil is/are correct?

1. Alluvial soils are rich in nitrogen content.
2. Black soils are rich in iron and lime but deficient in nitrogen.
3. Laterite soils are rich in iron and aluminium but deficient in nitrogen and potassium.

Which of the statement(s) given above is/are correct?

(a) 1 and 2   (b) Only 3
(c) 2 and 3   (d) All of these

❯ (**c**) In the alluvial soils, the proportion of nitrogen is generally low, but potash, phosphoric acid and alkalis are adequate, while iron oxide and lime vary within a wide range.

In black soils, potash is variable (less than 0.5%) and phosphates, nitrogen and humus are also low. But a typical black soil contains 10% of alumina, 9-10% of iron oxide and 6-8% of lime and magnesium carbonates.

Almost all laterite soils are very poor in lime and magnesia and deficient in nitrogen.

Sometimes, tile phosphate content may be high, probably present in the form of iron phosphate but potash is deficient. Hence, statement 2 and 3 are correct.

130. Which one of the following is the highest altitude zoo in the world?
- (a) Cheyenne Mountain Zoo
- (b) Pandit GB Pant High Altitude Zoo
- (c) Himalayan Zoological Park, Gangtok
- (d) Padmaja Naidu Himalayan Zoological Park

(*d*) Padmaja Naidu Himalayan Zoological Park situated at an average elevation of 2134m is the highest altitude zoo in India. This is the only specialised zoo in India and is internationally recognised for its conservation breeding programmes of red panda, snow leopards, Tibetan wolf and other endangered animals species of Eastern Himalaya.

131. Match the following.

List I (Terms)		List II (Meanings)	
A.	Kurinchi	1.	Pastoral region
B.	Palai	2.	Seashore
C.	Neithal	3.	Arid region
D.	Mullai	4.	Mountainous region

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	1	3	2	4
(c)	4	3	2	1	(d)	4	2	3	1

(*c*) These terms are derived from Sangam Literature which mentions about geographical landscapes.

Kurinchi It is the name of mountainous region in South India. This name is taken from a famous flower 'Kurinji.'

Palai In classical Tamil literature, palai means Arid region. This region is considered a wasteland. People inhabiting this region are known as eyiner, maravar and kalvar.

Neithal It refers to sea-shore. The seashore affords many examples of compelling charm of Sangam poetry and the extraordinary freshness of its realism. The inhabitants were known as parathavar, nulaiyar and umanar.

Mullai It refers to the land of forest (which includes pastoral region). Mullai or Jasmine is the flower of forests. The inhabitants were known as kovalar, ayar and idaiyar.

Hence, statement (c) is correct.

132. Which one of the following statement are not correct?
- (a) Position of the Sun, Earth and Moon in a straight line of 180° angle is known as Syzygy
- (b) Syzygy conjunction causes solar eclipse
- (c) Syzygy opposition causes lunar eclipse
- (d) Syzygy conjunction occurs at the time of perihelion only

(*d*) The word 'Syzygy' is often used in reference to the Sun, Earth and either the Moon or a planet, where the latter is in opposition. Solar and lunar eclipses occur at the time of syzygy.

133. Which one of the following is not related to wind erosion?
- (a) Wind gap
- (b) Zeugen
- (c) Dreikanter
- (d) Demoiselle

(*a*) **Demoiselles** These are rock pillars which stand as resistant rocks above soft rocks as a result of differential erosion of hard and soft rocks.
Zeugen A table-shaped area of rock found in arid and semi-arid areas formed when more resistant rock is reduced at a slower rate than softer rocks around it.
Dreikanter It is a type of ventifact that typically forms in desert or periglacial environments due to the abrasive action of blowing sand. A wind gap is a gap through which a waterway once flowed that is now dry as result of stream capture.

134. Which one of the following is correct?
- (a) Guindy National Park is known for tiger reserve
- (b) Namdapha National Park is meant for lion conservation
- (c) Jaldapara is a biosphere reserve
- (d) Rann of Kutch is a Wild Ass Sanctuary

(*d*) **Guindy National Park** is a protected area in Chennai (Tamil Nadu). It is the smallest National Park of India.
Namdapha National Park is the third largest National Park in India in terms of area. It is located in the Eastern Himalayan biodiversity hotspot in Arunachal Pradesh.
Jaldapara National Park is situated at the foothills of the Eastern Himalayas in Northern-West Bengal and on the bank of river Torsa.
Indian Wild Ass Sanctuary is located in the little Rann of Kutch in Gujarat. The endangered wild ass sub-species Indian Wild Ass (Khur) (Equushemionus Khur) belonging to Asiatic Wild Ass species On ager (Equushemionus) can be spotted.
Hence, options (d) is correct.

135. Which one of the following statements concerning the natural vegetation of India is not correct?
- (a) Sal is found in moist deciduous forests
- (b) Casuarina is largely found along the coastal region of Tamil Nadu
- (c) Deodar is a coniferous species of tree
- (d) Shola forests are found mainly on the upper reaches of Himalaya

(*d*) Shola forests are tropical montane forests found in Southern Western Ghats (Nilgiri hill region) separated by rolling grasslands in high altitudes.
These forests consists of dwarf trees growing 25-30 feet. The vegetation that grows in these forests are evergreen.
The origin of shola forests has been subject to scientific debate. Usually, Shola forests and grasslands are found in a ratio of 1: 5.
Hence, option (d) is not correct.

136. Which one of the following statements concerning research centres in India is not correct?
- (a) Rajiv Gandhi Centre for Biotechnology is located at Kolkata
- (b) Central Arid Zone Research Institute is located at Jodhpur
- (c) Centre for Social Forestry and Eco-Rehabilitation is located at Allahabad
- (d) Institute of Forest Productivity is located at Ranchi

(*a*) The Rajiv Gandhi Centre for Biotechnology (RGCB) is located in capital city of Kerala i.e. Thiruvananthapuram.
In 1991 by recognising its potential, it was made a 'Grant-in-aid' institute of the Government of Kerala and renamed as Rajiv Gandhi Centre for Development of Education, Science and Technology. It was the first institute in the country to be named after Rajiv Gandhi. Hence, statement (a) is incorrect.

137. With regard to water transportation in India, which of the following statements are correct?
1. Headquarters of Central Inland Water Transport Corporation is located at Delhi.
2. Headquarters of Inland Waterways Authority of India is located at Noida.
3. National Inland Navigation Institute is located at Kolkata.
4. First National Inland Waterway was between Haldia and Allahabad.

Select the correct answer using the codes given below.
- (a) 1 and 2
- (b) 2 and 3
- (c) 2 and 4
- (d) 1, 2 and 4

(*c*) Headquarters of Central Inland Water Transport Corporation is located at Kolkata. It was established in the year

1967 as a Public Sector Undertaking under the Comparies Act, 1956.

Headquarters of Inland Waterways Authority of India (IWAI) is located at Noida, U.P. It was constituted under IWAI Act, 1985.

National Island Navigation Institute is located at Patna (Bihar). It was been setup by IWAI to develop human resoruce for Island water transport sector.

First National Inland waterway (NW-1) was between Haldia and Allahabad (1620 kms long) on Ganga-Bhagirathi-Hooghly river system.

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138. Pir Panjal range in the Himalayas is a part of

(a) Shiwalik
(b) Trans Himalaya
(c) Central Himalaya
(d) Lesser Himalaya

⊙ (**d**) Pir Panjal range of Jammu and Kashmir Himalayas is a part of Lesser or Middle Himalayas or Himachal.

The Himalayas can be divided into four Kashmir and Ladakh region, namely, Trans-Greater Himalayas or Himadri, Lesser Himalayas (Pir Panjal Ranges) and the Shiwaliks (Jammu hills).

The sceric Kashmir valley lies between the great Himalaya in the North and Pir Panjal range in the South.

Hence, option (d) is correct.

139. Consider the following statements regarding laterite soils of India

1. Laterite soils are generally red in colour.
2. Laterite soils are rich in nitrogen and potash.
3. Laterite soils are well developed in Rajasthan and Uttar Pradesh.
4. Tapioca and cashew nuts grow well in this soil.

Which of the statements given above is/are correct?

(a) Only 1
(b) 2, 3 and 4
(c) 1 and 4
(d) 1, 2 and 4

⊙ (**c**) Due to presence of iron oxides, laterite soils are generally red in colour. Laterite soils have low content of nitrogen, potash, phosphorous lime and magnesia.

They are well developed on highlands of Madhya Pradesh, Maharashtra,

Chhattisgarh, Jharkhand, Karnataka, Telangana, Andhra Pradesh, Kerala, Tamil Nadu, Meghalaya etc, (and not plains of Rajasthan and Uttar Pradesh).

Plantation crop like cashew nuts and tapioca grow well in this soil.

Hence, statements 1 and 4 are correct.

140. Consider the following map of India:
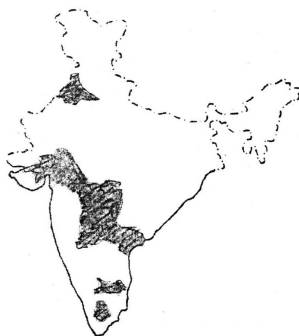
The areas marked in the map given above account for the production of which one of the following cash crops?

(a) Cotton
(b) Groundnut
(c) Sugarcane
(d) Tobacco

⊙ (**a**) This is map of India shows the cultivation area of cotton. Cotton cultivation is closely related to black soils (regur). Black soils covers most of the Deccan plateau, which includes parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh and some parts of Tamil Nadu. It has high water retaining capacity.

141. Which of the following statements regarding Mediterranean and Monsoon climate is/are correct?

1. Precipitation in Mediterranean climate is in winter while in Monsoon climate it is mostly in summer.
2. The annual range of temperature in Mediterranean climate is higher than the Monsoon climate.
3. Rainy and dry seasons are found in both the climates.

Select the correct answer using the codes given below :

(a) Only 1
(b) 2 and 3
(c) 1 and 3
(d) 1, 2 and 3

⊙ (**d**) Mediterranean climate is characteristic by shifting of wind belts.

During summers, the region is under the influence of offshora trade winds. While, during winters, it is under the influence of on shore westerlies. Thus, the region receives rain during winters.

The annual range of temperature in this climate is pretty high (more than 15ºC). In Mediterranean climate summers are quiet dry.

Monsoon climate is characterised by seasonal reversal of winds. This type of climate is best developed in the Indian Sub-continent. The region is under the influence of South-West monsoon winds during summer.

Hence, all the statements are correct.

142. With which one of the following countries, India has signed an MoU under the International Cooperation on Brahmaputra and Sutlej rivers?

(a) Pakistan
(b) China
(c) Bangladesh
(d) Nepal

⊙ (**b**) In the year 2002, Government of India had entered into a MoU with China for five years upon provision of hydrological information on Brahmaputra river during flood season by China to India.

River Sutlej rises from Mansarovar-Rakas Lake in Tibet (China) at a height of 4570m. It enters India in the state of Himachal Pradesh through Shipki La Pass.

143. Headquarters of which one among the following Railway Zones in India is situated at the highest elevation from the mean sea level?

(a) East–Central Railway
(b) South–Eastern Railway
(c) South–Western Railway
(d) West–Central Railway

⊙ (**c**)

Railway Zone	Headquarters	Height
East–Central	Hajipur	55 m
South–Eastern	Kolkata	9 m
South–Western	Hubli	671 m
West–Central	Jabalpur	412 m

144. Stalactites and stalagmites are features of

(a) glacial topography
(b) volcanic topography
(c) karst topography
(d) fluvial topography

⊙ (**c**) **Karst topography** is a named after the tripical tropography developed formed from the disolution of soluble rocks as limestone, dolomite and gypsum.

It is characteristic by underground drainage systems with sinkholes and caves subterranean drainage may limit surface water. Statacities having from the ceiling of a cave white statagmites grow from the cave floor.

145. Which one of the following is the correct sequence of the given planets in increasing order of their size (diameter)?

(a) Mars-Venus-Earth-Mercury-Uranus
(b) Mercury-Mars-Venus-Earth-Uranus
(c) Mercury-Mars-Venus-Uranus-Earth
(d) Venus-Mercury-Mars-Earth-Uranus

⊚ (**b**)

Planets	Diameter size (Thousands of km)
Mercury	4.8
Venus	12.1
Earth	12.6
Mars	6.7
Jupiter	142.4
Saturn	120
Uranus	49.6
Neptune	44.8

Therefore, correct sequence of the given planets in increasing order of their diameters is Mercury → Mars → Venus → Earth → Uranus

146. Consider the following statements:

1. Most of the coal and the ferrous group of minerals in India occur in the peninsular India, South of the Vindhyas.
2. The peninsular India once formed part of the super-continent which included Australia, Antarctica, Africa and South America.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊚ (**c**) Indian Peninsula, South of Vindhyas accounts for 98% of the Gondwana coal deposits.Further, most of the ferrous group minerals also occur in this region in the Archean rocks of Jharkhand, Odisha, M.P, Chhattisgarh, etc.

According to the plate tectonics theory,all the continents were part of single continental mass; this super-continent was named Pangea. It later broke into two large continental land masses namely, Laurasia and Gondwana land. The latter consisted of present dry India, Australia, Antarctica, South America and Africa.

Hence, both the statements are correct.

147. The Mahatma Gandhi National Marine Park is located in

(a) Pirotan Island
(b) Rameswaram
(c) Ganga Sagar Island
(d) Port Blair

⊚ (**d**) Mahatma Gandhi National Marine Park is situated at Port Blair, Andaman. The park was created in 1983, to protect marine life such as corals, nesting sea turtles. The park covers an area of 281.5 km^2 made up of 17 islands.

148. Which of the following statement(s) is/are correct?

1. The Earth is nearest to the Sun at Perihelion, which generally occurs on 3rd January.
2. The Earth is farthest away from the Sun at Perihelion, which generally occurs on 4th July.
3. The Earth is farthest away from the Sun at Aphelion, which generally occurs on 4th July.
4. The Earth is nearest to the Sun at Aphelion, which generally occurs on 3rd January.

Select the correct answer using the codes given below:

(a) Only 1   (b) 2 and 4
(c) 1 and 3   (d) 1 and 2

⊚ (**c**) Perihelion and Aphelion are the nearest and farthest points of Earth's direct orbit around the Sun, respectively. Aphelion occurs on 4th July and Perihelion occurs on 3rd January.

149. Which one of the following islands is of volcanic origin?

(a) Reunion Island
(b) Andaman and Nicobar Islands
(c) Lakshadweep Islands
(d) Maldives

⊚ (**a**) Reunion island is volcanic in origin. Andaman and Nicobar islands are part of submerged mountain in ocean. Lakshadweep islands and Maldives are coral in origin.

150. Which one of the following is the cause of long-term sea-level change?

(a) Atmospheric disturbance
(b) Change in marine water density
(c) Melting of icebergs
(d) Melting of ice sheets

⊚ (**d**) Short-term variation in sea level occurs due to waves, tides or specific flood events, such as those associated

with a winter snow melt or hurricane or other coastal strom.

Long-term variation is due to seasonal weather patterns, variation in the Earth's declination, change in coastal and ocean circulation, anthropogenic influence etc. Melting of ice sheets either due to anthropogenic cause or climate change is a long-term events resulting in sea level rise.

151. Consider the following tributaries of river Brahmaputra:

1. Lohit   2. Tista
3. Subansiri   4. Sankosh

Arrange the above rivers from West to East:

(a) 2, 4, 3, 1
(b) 2, 3, 4, 1
(c) 4, 2, 3, 1
(d) 3, 1, 2, 4

⊚ (**a**) The correct sequence of these tributaries from West to East is Tista→ Sankosh → Subansiri → Lohit. The principal tributaries of Brahmaputra joining from right are Subansiri, Manas, Torsa, Sankosh, Tista etc. Those joining from left are – Burhi-Dihing, Disang, Dhansiri and Kopili.

152. Which one of the following is the reason due to which the wind in the Southern hemisphere is deflected towards its left?

(a) Difference in the water masses of Northern and Southern hemisphere
(b) Temperature and pressure variations
(c) Inclined axis of the Earth
(d) Rotation of the Earth

⊚ (**d**) Coriolis effect generated due to rotation of Earth causes a deflection in global wind pattern. This force causes moving objects on the surface of the Earth to be deflected to the right in Northern hemisphere and to the left in Southern hemisphere.

153. The 'eye' of the cyclone has

(a) abnormally high temperature and lowest pressure
(b) abnormally low temperature and pressure
(c) clear sky and lowest temperature
(d) dense cloud cover and low pressure

⊚ (**c**) The eye of cyclone is a region of mostly calm weather. i.e. clear sky and lowest temperature. It is roughly circular area. It is surrounded by the eyewall, a ring of towering thunderstroms where the most severe weather occurs.

154. Which of the following statement(s) regarding chemical industry in India is/are correct?

1. Chemical industry is one of the oldest industries in India.
2. Dyestuff sector is one of the important segments of chemical industry.
3. Textile industry accounts for the largest consumption of dyestuffs.

Select the correct answer using the codes given below:
(a) Only 1 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

⊙ (**b**) Chemical industry made a late start in India and is still a nascent industry.
However, it still is the fourth largest set of Industries in India after textiles, iron and steel, and engineering industries.
Dyestuff sector is one of the core chemical industries in India. It is also the second highest export segment in chemical industry. Textile industry accounts for the largest consumption of dye stuffs.
Hence, statements 2 and 3 are correct.

155. Which of the following statements relating to the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 are correct?

1. The Act recognises forest rights of forest dwelling Scheduled Tribes who have been occupying the forest land before 25th October, 1980.
2. The onus of implementation of the Act lies at the level of the State/UT Governments.
3. The Act seeks to recognise and vest certain forest rights in the forest dwelling Scheduled Tribes and other traditional forest dwellers.

Select the correct answer using the codes given below:
(a) 1 and 2
(b) 2 and 3
(c) 1 and 3
(d) 1, 2 and 3

⊙ (**b**) The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Right) Act, 2006 has following provisions

(i) *A forest dweller is*
 • A person primarily residing in forests and depends on forests and forest land for livelihood.

 • The above condition have been true for 75 years or above (for other traditional forest dweller).
 • That one is member of Scheduled Tribe residing in area where they are scheduled.

(ii) The onus of implementation of the Act lies at the State /UT Governments.

(iii) The Act seeks to recognise and vest certain forest right in the forest dwelling Scheduled Tribes and other traditional forest dweller.

Hence, statement 2 and 3 are correct

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156. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Region)	List II (State)
A. Baghelkhand	1. West Bengal
B. Kuttanad	2. Madhya Pradesh
C. Saurashtra	3. Kerala
D. Rarh	4. Gujarat

Codes
	A	B	C	D		A	B	C	D
(a)	2	3	4	1	(b)	2	4	3	1
(c)	1	3	4	2	(d)	1	4	3	2

⊙ (**a**) **Baghelkhand** is a region and also a mountain range in Central India that covers North-East of Madhya Pradesh and a small area of Western Uttar Pradesh.

Kuttanad is a region covering to Alappuzha, Pathanamthitta and Kottayam districts in the state of Kerala.

Saurashtra is a region of Western India, located on the Arabian sea of Gujarat state.

Rarh is a region between the Chota Nagpur plateau on the West and the Ganges delta on the East. It is mainly co-extensive with the state of West Bengal.

157. Match List I with List Il and select the correct answer using the codes given below the lists.

List I (City)	List II (Earthquake Zone)
A. Kolkata	1. Zone V
B. Guwahati	2. Zone IV
C. Delhi	3. Zone III
D. Chennai	4. Zone II

Codes
	A	B	C	D		A	B	C	D
(a)	3	2	1	4	(b)	3	1	2	4
(c)	4	1	2	3	(d)	4	2	1	3

⊙ (**b**) Kolkata and Mumbai lie in seismic Zone III.
Guwahati and Srinagar are in the highest risk Zone V.
Delhi lies in the high risk seismic Zone IV.
Chennai lies in Zone II.

158. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Lake)	List II (Type)
A. Ashtamudi Kayal	1. Residual (Sweet water)
B. Himayat Sagar	2. Lagoon
C. Dal Lake	3. Glacial
D. Tsomgo Lake	4. Artificial (Sweet water)

Codes
	A	B	C	D		A	B	C	D
(a)	2	4	1	3	(b)	2	1	4	3
(c)	3	1	4	2	(d)	3	4	1	2

⊙ (**a**) **Ashtamudi Kayal** is the most visited backwater and Lagoon lake in the Kollam district of Kerala.
Himayat Sagar is an artificial (sweet water) lake about 20 km from Hyderabad in Telangana. It lies parallel to a larger artificial lake Osman Sagar.

Dal Lake is of residual (sweet water) type in Srinagar, Jammu and Kashmir. It is well-known for its Victorian era wooden houseboats.

Tsomgo Lake is a glacial lake in the Sikkim. The lake surface reflects different colours with change of seasons.

159. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Farming Area)	List II (State)
A. Doab	1. Assam
B. Char	2. Karnataka
C. Maidan	3. Punjab
D. Terai	4. Uttar Pradesh

Codes
	A	B	C	D		A	B	C	D
(a)	3	2	1	4	(b)	3	1	2	4
(c)	4	1	2	3	(d)	4	2	1	3

⊙ (**b**) **Doab** is farming area of Punjab.
Char is farming area of Assam.
Maidan is the farming area of Karnataka.
Terai is the farming area of Uttar Pradesh.

160. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Steel Mill)		List I (State)	
A.	Kalinganagar	1.	West Bengal
B.	Vijayanagara	2.	Tamil Nadu
C.	Salem	3.	Odisha
D.	Durgapur	4.	Karnataka

Codes

	A	B	C	D		A	B	C	D
(a)	1	4	2	3	(b)	1	2	4	3
(c)	3	4	2	1	(d)	3	2	4	1

⊙ (*c*) **Kalinganagar** steel plant of Tata Steel is in Jaipur, district of Odisha. Vijayanagara steel plant is located in Karnataka.

Salem steel plant is a unit of the Steel Authority of India (SAI), located in Tamil Nadu.

Durgapur steel plant was established in collaboration with Britain. It is located in Durgapur distict of West Bengal (1955).

161. Which one of the following is the pattern of circulation around a low pressure area in the Northern hemisphere?

(a) Counter-clockwise and away from the centre
(b) Clockwise and away from the centre
(c) Counter-clockwise and towards the centre
(d) Clockwise and towards the centre

⊙ (*c*) The pattern of circulation around a low pressure area in the Northern hemisphere is counter-clockwise and towards the centre, while in Southern hemisphere it is clockwise and away from the centre. These circulations may develop into cyclones.

The direction of circulation around a high pressure area is same as that around low pressure area but, is directed away from the centre. These circulations result in anti-cyclones.

162. Which one of the following statements about the atmosphere is correct?

(a) The atmosphere has definite upper limits, but gradually thins until it becomes imperceptible
(b) The atmosphere has no definite upper limits, but gradually thins until it becomes imperceptible
(c) The atmosphere has definite upper limits, but gradually thickens until it becomes imperceptible
(d) The atmosphere has no definite upper limits, but gradually thickens until it becomes imperceptible

⊙ (*b*) The atmosphere has no definite upper limits, but gradually thins until it becomes imperceptible. This happens because the atmosphere is held to Earth due to Earth's gravitational pull. Thus, the atmosphere is densest at the sea level (due to highest gravitational pull) and this or gets rarefied upwards gradually until it becomes imperceptible.

163. Which one of the following statement is correct?

(a) Cold fronts move at slower rate than warm fronts and therefore, cannot overtake the warm fronts
(b) Cold fronts normally move faster than warm fronts and therefore, frequently overtake the warm fronts
(c) Cold fronts move at slower rate and eventually, they are overtaken by the warm fronts
(d) Cold fronts move faster than warm fronts, but they cannot overtake the warm fronts

⊙ (*b*) Cold fronts often come with thunderstorms or other types of extreme weather. They usually move from West to East.

Cold fronts move faster than warm fronts because cold air is denser, mean there are more molecules of material in cold air than in warm air.

164. Which of the following elements are found in highest and lowest quantities respectively in the crust of the Earth?

(a) Oxygen and silicon
(b) Calcium and sodium
(c) Sodium and magnesium
(d) Oxygen and magnesium

⊙ (*d*) Oxygen and magnesium are the elements that are found in highest and lowest quantities respectively in the crust of the Earth. Crust is the outermost layer of the Earth. The most common elements in the crust of the are oxygen (46.6%), Silicon (27.7%), Aluminium (8.1%), Iron (5%), Calcium (3.6%), Potassium (2.8%), Sodium (2.6%) and Magnesium (2.1%).

165. **Statement I** The Kuroshio is a warm North-flowing ocean current on the West side of the North Pacific ocean.

Statement II Presence of a number of volcanoes at the bottom of the sea of Japan is responsible for the Kuroshio becoming warm.

Codes

(a) Both the statements are individually true and Statement II is the correct explanation of Statement I
(b) Both the statements are individually true, but Statement II is not the correct explanation of Statement I
(c) Statement I is true, but Statement II is false
(d) Statement I is false, but Statement II is true

⊙ (*c*) The Kuroshio is a North-flowing ocean current on the West side of the North Pacific ocean. It is similar to the Gulf Stream in the North Atlantic and is part of the North Pacific ocean gyre. Like the Gulf Stream, it is a strong Western boundary current.

Warm water currents are streams of warm water that move through the world ocean, carried by wind. These warm currents get heated-up in the tropics and then move toward the poles.

Hence, statement (1) is correct, but 2 is incorrect.

166. Which of the following are the major factors responsible for the monsoon type of climate in India?

1. Location
2. Thermal contrast
3. Upper air circulation
4. The Himalayan Mountains

Select the correct answer using the codes given below :

(a) 1 and 4
(b) 1, 2, 3 and 4
(c) 2, 3 and 4
(d) 1, 2 and 3

⊙ (*b*) The major factors responsible for the monsoon type of climate in India are location thermal contrast, upper air circulation, the Himalayan mountains etc.

167. Consider the following Indian states

1. Andhra Pradesh 2. Chhattisgarh
3. Tamil Nadu 4. Telangana
5. Uttarakhand

Which among the states given above are the largest and smallest respectively (in terms of geographical area)?

(a) 3 and 4
(b) 3 and 2
(c) 1 and 5
(d) 2 and 5

⊙ (*c*) According to study conducted by Ministry of Statistics and Programme implementation, the areas of states given above in descending order are; Andhra Pradesh ($162{,}970 \text{ km}^2$) > Chhattisgarh ($135{,} 192 \text{ km}^2$) > Tamil Nadu ($130{,} 060 \text{ km}^2$) > Telangana ($112{,} 077 \text{ km}^2$) > Uttarakhand (53483 km^2).

Thus, Andhra Pradesh and Uttarakhand are largest and smallest states respectively (in the terms of geographical area) when whole India is considered, Rajasthan ($342{,} 239 \text{ km}^2$) and Goa (3702 km^2) are largest and smallest states respectively.

168. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Plant)		List II (Natural Vegetation Type)
A. Ebony	1.	Moist deciduous
B. Shisham	2.	Himalayan moist
C. Walnut	3.	Alpine
D. Birch	4.	Tropical evergreen

Codes

	A	B	C	D		A	B	C	D
(a)	4	1	2	3	(b)	4	2	1	3
(c)	3	2	1	4	(d)	3	1	2	4

⊙ (**a**) **Ebony** is a tropical evergreen tree that belongs to the ebony family. **Shisham** is a tropical moist deciduous tree. The Indian rosewoods are popularly known as Shisham. **Walnut** is a Himalayan moist tree. **Birch** is a Alpine and sub-alpine tree.

169. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Climate)	List II (Characteristic)
A. Mediterranean	1. Temperature cycle is moderated by marine influence
B. Marine West Coast	2. Warm summers and cold winters with 3 months below freezing. Very large annual temperature range
C. Dry Mid-Latitude	3. Strong temperature cycle with large annual range. Warm summers to hot and cold winters to very cold
D. Moist Continental	4. Temperature range is moderate with warm to hot summers and mild winters

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	3	4	(b)	2	3	1	4
(c)	4	3	1	2	(d)	4	1	3	2

⊙ (**d**) **Mediterranean** climate is characterised by warm to hot and dry summers and mild to cool wet winters and located between about 30° and 45° latitude of North and South of the equator.
Marine West Coast climate is characterised by moderate temperature which is influenced by marine. It is

usually located along the West coast of mid-latitude continents.
Dry Mid-Latitude climate is characterised by strong temperature with large annual range and warm summers to hot and cold winters to very cold.
Moist Continental climate is characterised by warm summers and cold winters with 3 months below freezing and very large annual temperature range.

170. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Weathering Type)		List II (Landform/Process)
A. Chemical weathering	1.	Till
B. Mechanical weathering	2.	Oxidation
C. Glacial deposits	3.	Plant roots
D. Deposition by ground water	4.	Stalactite

Codes

	A	B	C	D		A	B	C	D
(a)	2	3	1	4	(b)	2	1	3	4
(c)	4	1	3	2	(d)	4	3	1	2

⊙ (**a**) **Chemical weathering** is the subsequent disintegration of rock by chemical reactions. These reaction include oxidation, hydrolysis and carbonation.
Mechanical weathering is the set of various processes of weathering that break apart rocks into particles (sediment) without change in the chemical composition of the rock.
Glacial deposits is the settling of sediment left behind by a moving glacier. The mixture of consorted sediments deposits carved by the glacier is called 'till'.
Deposition by ground water cause erosion under the surface and carries dissolved minerals in solution.

171. If a ship has to go from Chennai to Kochi, it has to go around Sri Lanka rather than crossing through the Palk Strait. Why?

(a) The Palk Strait has disputed islands and the Sri Lankan Navy does not allow the ships to cross through
(b) It is too shallow for ships to cross
(c) Shipping is prohibited through the strait due to its religious significance connected with the epic Ramayana
(d) The around Sri Lanka route is actually shorter than crossing through the Palk Strait

⊙ (**b**) If a ship has a go from Chennai to Kochi, it has to go around Sri Lanka

rather than crossing through the Palk Strait because it is too shallow for ships to cross.

172. Which of the following facts are related to Burma (Myanmar)?
 1. It shares its borders with India, China, Bangladesh and Vietnam.
 2. It is ruled by a military government.
 3. The National League for Democracy was not allowed to contest the elections held in the year 2010.
 4. Myanmar is a member of ASEAN.

Select the correct answer using the codes given below:
(a) 1 and 3   (b) 3 and 4
(c) 1, 2 and 4   (d) 1 and 2

⊙ (**b**) Myanmar shares its borders with India, China, Bangladesh, Thailand and Laos.
Military rule in the country lasted from 1962 to 2011. In 2011, the military junta was officially dissolved following a 2010 general election, and a nominally civilian government was installed.
The National League for Democracy was banned and not allowed to contest elections held in the year 2010.
Myanmar became the member of ASEAN in the year 1997 (along with Laos).

173. Which one of the following is not an example of externalities?

(a) Pollution of air by a cement factory
(b) Health hazard caused to the person due to smoking by himself/herself
(c) Smoke coming out of neighbour's vehicle
(d) Increase in land price of adjacent plots due to construction of a road by the government

⊙ (**b**) Externality is defined as a benefit or cost that is imposed on a third party who do not choose incur that cost or benefit.
In given option, the health hazard caused to the person due to smoking by himself/herself is not an example of externalities.

174. 'Rio + 20' is the short name for

(a) Millennium Development Goals
(b) United Nations Conference on Sustainable Development
(c) Earth Summit
(d) Post-2015 Development Agenda

⊙ (**b**) 'Rio+20' is the short name for United Nations Conference on Sustainable Development which took place in Rio de Janeiro, Brazil in June 2012, twenty years after the landmark 1992 Earth Summit in Rio.

2015 (I)

175. Consider the contour plot given below:

Contour in Metres
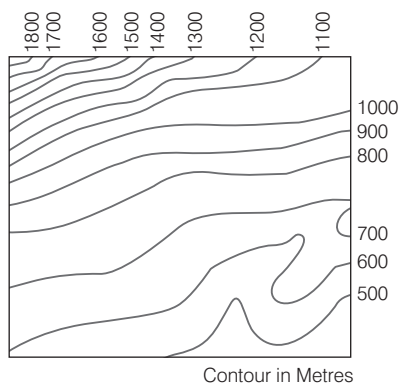
The above contours of an area indicate several relief features. Which one among the following relief features is not depicted here?

(a) Steep slope   (b) River valley
(c) Conical hill   (d) Gentle slope

⊙ (**c**) A contour is a line of constant height above mean sea level. A conical hill rises almost uniformally from the surrounding regions.

It can be shown with the help of almost concentric contour line spaced regularly. Closely placed contours indicate a steep slope. The widely spaced contours indicates a gentle slope.

176. Arrange the following tributaries of river Indus from North to South :

1. Chenab   2. Jhelum 3. Ravi
4. Sutlej
Codes
(a) 4, 3, 1, 2   (b) 2, 3, 1, 4
(c) 1, 2, 3, 4   (d) 2, 1, 3, 4

⊙ (**d**) The **Jhelum** rises in Verinag at the foot hills of Pir Panjal and flow through the Kashmir valley.

Chenab, the largest tributary of Indus in formed by two stream Chandra and Bhaga and flow through Himachal Pradesh, and Jammu and Kashmir.

Ravi rises in Kullu hills, near Rohtang Pass, of Himachal Pradesh.

Sutlej originates from the Rakas lake. It enters India through Ship Ki-La, flow through Himachal Pradesh and Punjab.

So, the sequence is

Jhelum—Chenab—Ravi—Sutlej

177. Seismic gaps are

(a) parts of plate boundaries in oceans where tsunamis occur frequently

(b) sections of plate boundaries that have ruptured repeatedly in the recent past

(c) sections of plate boundaries that have not ruptured in the recent past

(d) plate boundaries having no volcanic activity

⊙ (**c**) A seismic gap is a segment of an active fault known to produce significant earthquakes, that has not slipped in an unusually long time when compared with other segments along the same structure.

Seismic gap hypothesis states that, over long period of time, the displacement on any segment must be experienced by all the other parts of the fault.

178. In the absence of Cold Labrador Current, which one among the following would happen?

(a) There will be no North-East Atlantic fishing grounds

(b) There will be no North-West Atlantic fishing grounds

(c) There will be no fishing ground in the North Atlantic ocean

(d) Semi-arid condition of the Atlantic coast of the USA and Canada would prevail

⊙ (**b**) In the absence of Cold Labrador Current, there would be no North-West Atlantic fishing grounds.

World's most productive fishing grounds are found at places where warm and cold ocean currents meet.

One such situation is found in North-West Atlantic region where cold Labrador current meets Warm Gulf Stream. This results in formation of one of the world's most productive fishing grounds.

Similar fishing grounds are found in North-East Atlantic Ocean (due to mixing of Warm North Atlantic drift with Cold Greenland current), and near Japan coast (due to mixing of Warm Kuroshio with Cold Oyashio current.

Hence, option (b) is correct.

179. Match List I with List II and select the correct answer using the codes given below the lists:

List I (Type of Grass)		List II (Country)	
A.	Llanos	1.	Australia
B.	Prairies	2.	Venezuela
C.	Pampas	3.	USA
D.	Downs	4.	Argentina

Codes

	A	B	C	D
(a)	1	4	3	2
(b)	1	3	4	2
(c)	2	4	3	1
(d)	2	3	4	1

⊙ (**d**) **Lianos** is a vast tropical grassland plain situated to the east of Andes in Colombia and Venezuela. It is a part of Savanna biome. It is used for cattle ranching.

Prairies are ecosystems considered part of the temperate grasslands found in USA. The famous bison is a native specie of this region.

Pampas are also temperate grasslands found in Argentina. Livestock grazing and wheat growing are major economic activities of the region.

Downs are subtropical, semi-arid grasslands of Australia. Major economic activities are extensive mechanised wheat cultivation, pastoral farming, cattle ranching, etc.

Hence, option (d) is the correct match.

180. Tank irrigation is commonly found in South-Central parts of India. What could be the reason?

1. Insufficient shallow ground water.
2. Rocky plateau with impervious surface depression.
3. Undulating terrain helps in accumulation of rain water in depression or man-made tank.

Select the correct answer using the codes given below:
(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) All of these

⊙ (**d**) Tank irrigation is commonly found in South-Central parts of India due to various reasons.

First, there is insufficient availability of shallow ground water.

Secondly, the plateaus of this region are made of impervious rocks with surface depression and undulating terrain, which helps in accumulation of rain water in depression or man-made tank. Thus, tank irrigation is common in these areas.

Hence, all the statements are correct.

181. Which of the following is/are the reason(s) behind Gujarat being the leading producer of Salt in India?

1. The long length of coastline.
2. Long duration of hot and dry conditions.
3. Presence of gulf areas.

Select the correct answer using the codes given below:
(a) 1 and 2   (b) Only 2
(c) 1, 2 and 3   (d) 1 and 3

⊙ (**b**) In India, favourable conditions, such as dry and warm climate are found in Gujarat. Gujarat is the largest producers of salt in India and ranking 2nd highest export in the world. Gujarat contributes 76% to the total production, followed by Tamil Nadu (12%) and Rajasthan (8%).

Hence, statement 2 is correct.

182. If 82° 30′ East longitude (Allahabad) shows 6:00 am of Sunday (local time), what would be the local time of Florida (USA) located at 82° West longitude?

(a) 6 : 58 pm of Saturday
(b) 7 : 02 pm of Sunday
(c) 6 : 58 am of Sunday
(d) 7 : 02 am of Saturday

⊙ (**a**) When 82°30′ East longitude (Allahabad) shows 6:00 AM of Sunday (local time), the local time of Florida (USA) located at 82° West longitude would be 6:58 PM on Saturday.

183. Consider the following statements with regard to cold waves in winter season in Northern India:

1. There is lack of maritime influence.
2. Northern India is nearer to the Himalayan region.
3. Air mass comes from polar regions of Northern India.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) 2 and 3
(c) 1 and 3   (d) 1 and 2

⊙ (**d**) When the minimum temperature falls appreciably below normal in the winter months then it is called as cold waves. India's cold wave zone covers the North Indian states.

The cold waves are generally experienced during December–February. Following are the main reasons for cold waves in Northern India:

(i) Lack of maritime influence, maritime type of climate is mainly found in the region which are located near the coast line sea. In maritime type there is less of temperature variation and hence summers are cool and winters are moderate.

(ii) In the rear of snowfall activity in Himalayan region, North westerly winds may set over the region and causes inflow of cold air mass from higher latitude and for mountain regions. Hence, due to its proximity to the Himalayan region these areas experience cold waves.

Hence, statements 1 and 2 are correct. Statement 3 is not correct as the Himalayan system blocks the air masses coming from polar region.

184. Match List I with List II and select the correct answer using the codes given below the lists :

List I (Ocean Current)		List II (Coast)	
A.	Humboldt	1.	Namibia-Angola
B.	North Atlantic Drift	2.	Chile-Peru
C.	Benguela	3.	Mozambique-Madagascar
D.	Agulhas	4.	Norway-United Kingdom

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	4	3	(b)	2	4	1	3
(c)	3	4	1	2	(d)	3	1	4	2

⊙ (**b**) **Humboldt current** is a cold current of South Pacific Ocean. It flows North along he West coast of South America from Southern tip of Chile to Northern Peru. It is also known as 'Peru current'. About 18-20% world's fish catch comes from the Humboldt current region.

North Atlantic drift also known as Northern Atlantic Sea Movement and North Atlantic Current is a warm current within the Atlantic Ocean that also extends to the Gulf stream.

It splits into two major branches or reaching West of Continental Europe. One branch goes to South-East and passes North-West Africa. The other major branch continues North along the coast of Northwertern Europe like United Kingdom and its other flows along the coast of Norway as Norwegian current.

Benguela current is a cold ocean current of South Atlantic Ocean. It is one of the world's four major Eastern boundary current. It flows northward off the coast of south western Africa along the Western coast of South Africa, Namibia and Southern Angola.

Agulhas current is a warm ocean current of Indian Ocean. The Agulhas current is formed by the confluence of warm Mozambique and East Madagoscar currents, which meet South-West of Madagascar.

185. Match List I with List II and select the correct answer using the codes given below the lists :

List I (Sanctuary)		List II (State)	
A.	Sharavathi Valley	1.	Gujarat
B.	Satkosia Gorge	2.	Goa
C.	Pirotan Island	3.	Odisha
D.	Bhagwan Mahaveer	4.	Karnataka

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	3	4	(b)	4	1	3	2
(c)	4	3	1	2	(d)	2	3	1	4

⊙ (**c**) **Sharavathi Wildlife Sanctuary** is in Sagar of Shimoga District in Karnataka.

Satkosia-Gorge-Sanctuary is located in the districts of Nayagarh, Angul and Boudh in the state of Odisha.

Pirotan Island Sanctuary is located in Jamnagar district of Gujarat state.

Bhagwan Mahaveer Sanctuary and Mollem National Park is a 240 sq km protected area located in the Western Ghats of South India, in Sanguem Taluk, Goa along the Eastern border with Karnataka.

186. Which of the following statement(s) is/are correct with regard to the Living Planet Report-2014 (Species and Spaces, People and Places) released by World Wildlife Fund (WWF)?

1. The Living Planet Index (LPI), which measures more than 10000 representative populations of mammals, birds, reptiles, amphibians and fish, has declined by 52% since 1970.
2. The most dramatic regional LPI decrease occurred in Africa.

Select the correct answer using the codes given below :

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ (**a**) The Living Planet Index (LPI) is an indicator of the state of global biological diversity, based on trending in vertebrate population of species from around the world. The living planet report is published every two years by

World Wide Fund (WWF) for nature since 1998.

According to report published in 2014 population size of vertebrate species have declined by 52% over the last 40 years. This percentage has decreased due to changes in methodology to better reflect the relative size of species across biomes.

According to 2014 report, the must dramatic regional LPI decrease occurred in South America which was followed closely by Asia-Pacific region.

Hence, statement (1) is correct.

187. The Tungabhadra river provided sustenance to which empire?

(a) Chola
(b) Vijayanagara
(c) Vakataka
(d) Pandya

⊘ (**b**) Vijayanagara empire was established in 1336 by Harihara and Bukka. One of the greatest achievement of the Vijayanagara empire was irrigation and water supply network across the kingdom.

Tungabhadra was the important and only source of water for cities like Hampi Dev Ray I built the dam on this river and created a huge reservoir.

He also built a network of canals for irrigation and also ensured regular water supply for drinking from this river. Due to this river Vijayanagara rapidly developed into flourishing centre for trade and commerce.

Directions (Q. No. 189-191) The following items consist of two statements, Statement I and Statement II. You have to examine these two statements carefully and select the answers from these items using the codes given below:

Codes
(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true, but statement II is not the correct explanation of statement I
(c) Statement I is true, but statement II is false
(d) Statement I is false, but statement II is true

188. Statement I India's offshore and deep sea fish catch is very poor considering the marine potential.

Statement II Indian coast does not have many gulfs, bays, estuaries and backwaters.

⊘ (**a**) India offshore and deep sea fish catch is very poor because its coast does not have many gulfs, bays, estuaries etc. and backwaters.

189. Statement I Tides are the rise and fall of sea levels caused by the combined effects of the gravitational forces exerted by the Moon and the Sun and the rotation of the Earth.

Statement II The Earth rotates from the West towards the East once in 24 hours with respect to the Sun.

⊘ (**b**) Statement I is true as low tides and high tides are caused by the combined effect of the gravitational forces of the Moon and the Sun and rotation of the Earth.

Statement II is also correct as the Earth rotates from the West towards the East once in 24 hours. But this is not the correct explanation for the occurrence of tide.

190. Statement I Sidereal day is shorter than Solar day.

Statement II The motion of the Earth in its orbit around the Sun is termed as revolution.

⊘ (**b**) Statement I is true as a 'Solar Day' is the time from Noon-to-Noon and is, by agreement, exactly 24 hours long. But the actual rotation period of the Earth is 23 h 56 min and 4 sec and this time period is called the 'Sidereal Day'.

Statement II is also correct as revolution is the motion of the Earth in its orbit around the Sun, but this is not the correct explanation for the reason behind the shorter sidereal day.

191. The Earth without rotational movement would result into

1. no Sun-rise and Sun-set.
2. no occurrence of day and night cycle.
3. only one season.

Select the correct answer using the codes given below :
(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) All of these

⊘ (**b**) The primary effect of the Earth's rotation is the phenomenon of day and night.

The rotation of the Earth about its axis in an anti-clockwise direction (when viewed from over the North Pole) gives us the impression that the Sun rises in the East and sets in the West.

Our heavenly view, in particular that of the night sky, likewise reveals a panorama that moves from East to West.

An additional effect is that of spin or rotation placed on weather systems by what is called. 'Coriolis effect'.

192. Match List I with List II and select the correct answer using the codes given below the lists:

List I (Ocean Current)	List II (Location in Map)
A. Guinea current	
B. Oyashio current	
C. Canaries current	
D. Kuroshio current	

Codes

	A	B	C	D		A	B	C	D
(a)	4	3	1	2	(b)	2	3	1	4
(c)	2	1	3	4	(d)	4	1	3	2

⊘ (**b**) Guinea current : Guinea, West Coast of Africa

Oyashio current : East Coast of Russia

Canaries current : Canary Islands, West of Africa

Kuroshio current : East Coast of Japan

193. Arrange the following layers of atmosphere vertically from the surface of the Earth:

1. Mesosphere 2. Troposphere
3. Stratosphere 4. Thermosphere

Codes
(a) 1, 2, 3, 4   (b) 2, 1, 3, 4
(c) 2, 3, 1, 4   (d) 3, 4, 2, 1

⊘ (**c**) The atmosphere is divided into five layers. It is thickest near the surface and thins out with height until is eventually merges with space.

The atmospheric layers in sequence are as follows-

1. The **troposphere** is the first layer above the surface and contains half of the Earth's atmosphere. Weather occurs in this layer.

2. Many jet aircrafts fly in the **stratosphere** because it is very stable. Also, the ozone layer absorbs harmful rays from the Sun.

3. Meteors or rock fragments burn up in the **mesosphere**.

4. The **thermosphere** is a layer with auroras. It is also where the space shuttle orbits.

5. The **atmosphere** merges into space in the extremely thin exosphere. This is the upper limit of our atmosphere.

2014 (II)

194. Arrange the following States of India on the basis of conferring statehood (starting from the earliest)

1. Arunachal Pradesh
2. Nagaland
3. Sikkim
4. Meghalaya

Select the correct answer using the codes given below:
(a) 2, 4, 3,1   (b) 2, 1, 4, 3
(c) 4, 1, 3, 2   (d) 4, 1, 2, 3

⊘ (**a**) **Nagaland** became the 16th State of the Indian Union on 1st December,1963.

Meghalaya was previously part of Assam, but on 21st January, 1972, the districts of Khasi, Garo and Jaintia hills became the new State of Meghalaya.

Sikkim became the 22nd State of the Indian Union on 15th May, 1975 and the monarchy was abolished

Arunachal Pradesh was granted statehood on 20th February, 1987.

195. Plate tectonics is a scientific theory that describes the large scale motions of Earth's lithosphere. Which one among the following statements regarding plate tectonics is not correct?

(a) Tectonic plates are composed of oceanic lithosphere and thicker Continental lithosphere.
(b) Tectonic plates are able to move because the Earth's lithosphere has a higher strength than the underlying asthenosphere.
(c) The Earth's lithosphere is broken up into tectonic plates.
(d) Along divergent plate boundaries, subduction carries plates into the mantle.

⊘ (**d**) Plate tectonic is a scientific theory describing the large scale motion of seven large plates and the movements of a large number of smaller plates of the Earth's lithosphere.

The lithosphere is the rigid outermost shell of a planet (the crust and upper mantle), is broken into tectonic plates. Tectonic plates are composed of oceanic lithosphere and thicker continental lithosphere each topped by its own kind of crust.

Tectonic plates are able to move because the Earth's lithosphere has greater mechanical strength than the underlying asthenosphere (viscous, weak, ductile region of upper mantle of the Earth). Plato boundaries are the edges where two plates meet.

Most geologic activities, including volcanoes, earthquakes and mountain building occurs at plate boundaries.

Divergent plate boundaries are area where plate move away from each other forming either mid-oceanic ridges or rift valley. Earthquakes are common at mid-ocean ridges. A convergent plate boundary is an area where two or more lithosphere collide. When oceanic crust converges with continental crust, the denser oceanic plate plunges beneath the continental plate.

This process called subduction, occurs at the oceanic trenches. The entire region is called subduction zone. This zone has a lot of intense earthquakes and volcanic eruptions. The subducting plates cause melting in the mantle.

196. Consider the diagram given below:

```
  1012 mb        1020 mb
    A              B

       998 mb
         C
```
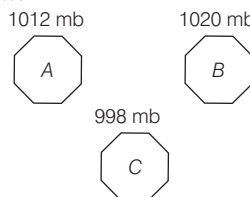
The diagram represents the pressure conditions of three different places, *viz*,. A, B and C. Which of the following is the correct direction of movement of winds?

(a) Blow from B towards A and C.
(b) Blow from C towards A and B.
(c) Blow from B to A and from A to C.
(d) Blow from B to C and C to B.

⊘ (**a**) Wind is a natural movement of any velocity especially, the Earth's air or the gas surrounding a planet in natural motion horizontally. There are mainly three factors that affect the wind direction.

They are atmospheric pressure, coriolis effect and topography. One of the prim drivers of wind direction is atmospheric pressure. Winds flow generally from high pressure to low pressure. The other factors which play an important role is the coriolis effect.

In coriolis effect, winds, though are partly shunted off almost courses between high and low pressure of the Earth by the rotation of Earth. Topography variations may affect the wind direction.

This factor does not operate exclusively of pressure influence.

In the present, question option (a) seems to be right answer when we follow the general rule of wind direction which flows from high pressure to low pressure area.

197. Consider the following statements regarding ground water in India

1. The large scale exploitation of groundwater is done with the help of tube-wells.
2. The demand for groundwater started increasing with the advent of green revolution.
3. The total replenishable ground water reserves is highest in the hilly tracts of Sikkim, Nagaland and Tripura.

Which of the statement(s) given above is/are correct?
(a) 1 and 2   (b) Only 1
(c) 2 and 3   (d) 1, 2 and 3

⊘ (**a**) India relies excessively on ground water resources, which accounts for over 60 per cent of irrigated area and 85% of drinking water supplies.

It is estimated that over 70% of India's foodgrain production now comes from irrigated agriculture in which ground water plays an important role. The large scale exploitation of groundwater is done with the help of tube-wells.

Easy availability of electricity and poor maintenance of tanks were the main reason for the growth of tube-well irrigation in India.

The green revolution technology has been one of the driving force for the groundwater use in India. The adoption of new high yielding variety seeds and the accompanying use of fertilisers provided great benefits, and the gains were the best with irrigation.

Huge investments were undertaken for surface water irrigation projects to provide irrigation water over vast areas. Electricity supply expanded in rural areas making pumping of groundwater easy and economical.

The large alluvial tracts in the India-Ganga Brahmaputra Plains extending from Punjab in went to Assam in the East alongwith coastal plains, constitutes one of the must potential groundwater reservior.

198. MONEX is associated with

(a) montreal experiment
(b) monetary experiment
(c) lunar experiment
(d) monsoon experiment

(*d*) MONEX or monsoon experiment was a part of the Global Atmospheric Research Programme (GARP) and coincided with the First GARP Global Experiment (FGGE) in 1979.

MONEX was a field project developed to provide needed information on the processes that drive the large scale monsoon in order to better predict monsoons and their impact on human life. There are two distinct monsoon system affecting India and South-East Asia so MONEX was divided into two components : summer and winter.

The main focus area of experiments were South China Sea, Bay of Bengal, Arabian sea etc.

199. Which of the following would have happened if the Himalayas did not exist?

(a) Monsoon rains would have taken place in winter months.
(b) Coastal India would have experienced Mediterranean climate.
(c) North Indian plain would have been much cooler in winter.
(d) North-Western part of India would have experienced humid condition.

(*c*) If Himalayas did not exist then North India plain would have been much cooler in winter, because they prevent the cold polar winds coming from Siberia from entering India and thus keep the country relatively warm during winter months.

200. Match List I with List II and select the correct answer using the codes given below the Lists:

List I (Phenomenon)		List II (Date)
A.	Summer Solstice	1. 21st June
B.	Winter Solstice	2. 22nd December
C.	Vernal Equinox	3. 23rd September
D.	Autumnal Equinox	4. 21st March

Codes

	A	B	C	D		A	B	C	D
(a)	1	4	2	3	(b)	1	2	4	3
(c)	3	2	4	1	(d)	3	4	2	1

(*b*) In the Northern hemisphere, the **Winter Solstice** occurs on 22nd December, when the Sun shines directly over the Tropic of Capricorn, the **Summer Solstice** occurs on 21st June, when the Sun shines directly over the Tropic of Cancer.

In the Southern hemisphere, the winter and summer solstices are reversed. On 21st March and 23rd September, the Sun shines directly overhead the Equator. So, half part of all latitudes receives sunlight.

Hence, the duration of day and night is equal everywhere. These two positions are referred to as Equinoxes means equal days and nights. 21st March, is called **Vernal Equinox** and 23rd September is called **Autumnal Equinox**.

201. Which of the following statements regarding *jhum* cultivation in India are correct?

1. It is largely practised in North-Eastern Indian States.
2. It is referred to as 'slash and burn' technique.
3. In it, the fertility of soil is exhausted in a few years.

Select the correct answer using the codes given below:
(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 2 and 3

(*d*) Jhum or Jhoom cultivation is a local name for slash and burn agriculture practiced by the tribal groups in the North-Eastern States of India like Arunachal Pradesh, Meghalaya, Mizoram and Nagaland and also in the districts of Bangladesh like Khagrachari and Sylhet.

This system involves clearing a piece of land by setting fire or clear felling and using the area for growing crops of agricultural importance such as upland rice, vegetables or fruits.

202. Arrange the following features formed by rivers in its course starting from upstream :

1. Meanders   2. Falls
3. Delta   4. Oxbow Lake

Select the correct answer using the codes given below:
(a) 2, 1, 3, 4   (b) 2, 1, 4, 3
(c) 1, 2, 3, 4   (d) 1, 4, 2, 3

(*b*) A river begins at source (or more often several sources) follows a path course and ends at a mouth or mouths. River landforms can be divided into upper, middle and lower course features. Upper course features include steep-sided V shaped valleys, interlocking spurs, rapids, gorges and waterfalls.

Waterfalls or simply falls are caused because of sudden descents or abrupt breaks in the longitudinal course of the river due to a hist of factors like variation in the relative difference in topographic reliefs, fall in the sea levels, Earth movements etc.

It may be defined as a vertical drop of water of enormous volume from a great height. Middle course river features include wider, shallower valleys, meanders and Oxbow lakes.

Meanders refer to the bends of longitudinal courses of the river. Each bend of a meander has two types of slopes of valley side. One side in concave slope and the other side is convex slope.

The neck of the meander gets narrower and narrower. Eventually, the curve grows so tight that the river cuts through the meanders neck. This separated area of water is called an oxbow lake.

Delta formation occurs at the lower course of river. A river delta is a landform created by deposition of sediment that in carried by the river as the flow leaves its mouth and enters slower moving or stagnant water.

Hence, option (b) is correct.

203. Which of the following statement(s) relating to Indian agriculture is/are correct?

1. India has the world's largest cropped area.
2. Cropping pattern is dominated by cereal crop.
3. The average size of an Indian farm holding is too small for several agricultural operations.

Select the correct answer using the codes given below:
(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) 1, 2 and 3

(*c*) India was the world's second largest cropped area (159.65 million hectares) behind USA (174.45 million hectares). More than 50% of the crops are cereal crops. The average size of an Indian farm holding is around 1.1 hectares.

This is too small for several agricultural operations (like extensive commercial agriculture).

Hence, statements 2 and 3 are correct.

204. Collision-Coalescence process of precipitation is applicable to

(a) clouds which extend beyond freezing level.
(b) those clouds which do not extend beyond the freezing level.
(c) all types of clouds.
(d) cumulonimbus cloud.

(*b*) Collision-Coalescence process of precipitation is applicable to those clouds which do not extend beyond the freezing level.

This hypothesis developed because the Bergeron process of the origin of precipitation and rainfall could not explain the mechanism of rainfall in the tropical areas where cumulus clouds

over the oceans give abundant rains when they are only 2000 m thick and the air temperature at their top is 5°C or even more.

205. Arrange the following tiger reserves of India from North to South :
1. Indravati
2. Dudhwa
3. Bandipur
4. Similipal

Select the correct answer using the codes given below:
(a) 3-4-1-2   (b) 4-2-3-1
(c) 2-4-1-3   (d) 2-1-4-3

⊙ (**c**) There are 47 tiger reserves in India which are governed by Project Tiger which is administered by the National Tiger Conservation Authority (NTCA). Additionally, the in-principle approval has been accorded by the National Tiger Conservation Authority for creation of two new tiger reserves, and the sites are : Ratapani (Madhya Pradesh) and Sunabeda (Odisha).

The tiger reserves of India from North to South site are as-Dudhwa Tiger Reserve is situated in Uttar Pradesh, Similipal Tiger Reserve is situated in Odisha, Indravati is situated in Chhattisgarh, Bandipur is situated in Karnataka.

206. The Equatorial region has no other season except summer. What could be the reason?
1. The length of day and night is more or less equal over the year.
2. The Earth's rotational velocity is maximum at the Equator.
3. The Coriolis force is zero at the Equator.

Select the correct answer using the codes given below:
(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) 1, 2 and 3

⊙ (**a**) Equatorial region has no other season except summer. This is so because the mid-day Sun is almost overhead throughout the year and there is little difference between the lengths of the day and night during the year and hence, the equatorial region receives maximum amount of insolation which causes uniformly high temperature throughout the year.

The average monthly temperature is always more than 18°C. Rotational velocity and coriolis force have no direct co-relation with the climate of equatorial region.

207. Match List I with List II and select the correct answer using the codes given below the Lists:

List I (Hill Range of Central India)	List II (Location in Map)
(a) Satpura	
(b) Mahadeo	
(c) Vindhya	
(d) Maikala	

Codes

	A	B	C	D		A	B	C	D
(a)	4	3	1	2	(b)	4	1	3	2
(c)	2	1	3	4	(d)	2	3	1	4

⊙ (**d**) **Satpura** range rises in the Eastern Gujarat and runs East through the borders of Maharashtra and Madhya Pradesh to the East till Chhattisgarh. To the North of it is **Vindhya range**. **Mahadeo** hills form the central part of Satpura range. **Maikala** range lies in Chhattisgarh and forms the Eastern part of Satpura range.

208. *Baiji* oil refinery is located at
(a) Iran
(b) Iraq
(c) South Sudan
(d) Russia

⊙ (**b**) Baiji oil refinery is located in Northern Iraq. It is located some 130 miles North of Baghdad, on the main road to Mosul.

During the 1991 Gulf War, about 80% of the oil refinery was destroyed.

It was quickly rebuilt and was back in action only a couple of months after the war's end Baiji refinery is Iraq's largest refinery and produces a third of Iraq's oil output.

Directions (Q. Nos. 210 and 211)

The following items consist of two statements, Statement I and Statement II. You are to examine these two statements carefully and select the answers to these items using the codes given below:

Codes
(a) Both the statements are individually true and Statement II is the correct explanation of Statement I.
(b) Both the statements are individually true, but Statement II is not the correct explanation of Statement I.
(c) Statement I is true, but Statement II is false.
(d) Statement I is false, but Statement II is true.

209. **Statement I** A tsunami is a series of waves in a water body caused by displacement of a large volume of water, generally an ocean or a large lake.

Statement II A tsunami can be generated when thrust faults associated with convergent or destructive plate boundaries move abruptly.

⊙ (**a**) Tsunami, also known as a 'seismic wave', is a series of wave in a water body caused by the displacement of a large volume of water, generally an ocean or a large lake.

Tsunami can be generated when thrust faults associated with convergent or destructive plate boundaries move abruptly, resulted in water displacement, owing to the vertical component of movement involved.

210. **Statement I** The Atacama is the driest among the deserts of the World.

Statement II The aridity of the Atacama is explained by its location between two mountain chains of sufficient height to prevent moisture advection from either the Pacific or the Atlantic Ocean.

⊙ (**a**) Atacama desert is the driest place in the world. Four inches of rain-every 1000 years. It is in South America stretches over some 600 miles between Peru's Southern border and Chile's Central Pacific coast.

Geographically, the aridity of the Atacama is explained by it being situated between two mountain chains (the Andes and the Chilean coastal range) of sufficient height to prevent moisture advection from either the Pacific or the Atlantic oceans.

211. Which among the following is/are correct statement(s) about Malawi?
1. Malawi is a landlocked country in South-East Africa that was formerly known as Nyasaland.
2. It has presidential system with unitary form of government.
3. Malawi's economy is highly dependent on agriculture and majority of the population is rural.

Select the correct answer using the codes given below:
(a) Only 1   (b) 2 and 3
(c) 1, 2 and 3   (d) 1 and 3

(**c**) Malawi is a land locked country in South-East Africa bordered by Zambia to the North-West, Tanzania to the North-East and Mozambique to the East, South and West.

It has presidential system with unitary form of government.

Currently Peter Mutharika is the President. Malawi is among the world's least developed and most densely populated countries. Around 85% of the population live in rural areas.

The economy is based on agriculture, and more than one-third of GDP and 90% of export revenues came from agriculture.

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212. Which of the following method(s) is/are suitable for soil conservation in hilly region?

1. Terracing and contour bunding
2. Shifting cultivation
3. Contour ploughing

Select the correct answer using the codes given below:
(a) 1 and 3   (b) Only 2
(c) Only 3   (d) All of the above

(**a**) Level terrace or contour bunding involves construction of bind passing through the points having same elevation (contour). Contour ploughing is the farming practice of ploughing and/or planting across a slope following its elevation contour lines.

Hence, option (a) is the correct answer.

213. Which one of the following is the example of subsistence farming?

(a) Shifting cultivation
(b) Commercial farming
(c) Extensive and intensive farming
(d) Organic farming

(**a**) Subsistence farming is self-sufficiency farming in which the farmers grow enough food to feed themselves and families. It is mostly practised in developing countries.

Shifting cultivation is a type/example of subsistence farming in which the farmers clear a patch of forest land by clearing and burning of trees and then crops are grown.

214. Which of the following is/are West flowing river(s) of India?

1. Mahanadi
2. Krishna
3. Narmada
4. Cauvery

Select the correct answer using the codes given below:
(a) 1, 2 and 4   (b) 2 and 3
(c) Only 3   (d) 1 and 3

(**c**) Rivers which flow from East to West direction are called West flowing rivers. Some major West flowing rivers of India are Narmada, Tapi, Luni, Indus, Jhelum, Beas, Sutlej, Mandovi, etc. Some major East flowing rivers of India are Godavari, Son, Mahanadi, Krishna, Ganga, etc.

215. A typical black hole is always specified by

(a) a (curvature) singularity
(b) a horizon
(c) either a (curvature) singularity or a horizen
(d) a charge

(**b**) A typical black hole is always specified by a horizon. Event horizon is the boundary marking the limits of a black hole. Nothing that enters a black hole can get out or can be observed from outside the event horizon likewise, any radiation generated inside the horizon can never escape beyond it.

216. Which of the following statement(s) relating to Earthquakes is/are correct?

1. The point of origin of Earthquake is called epicenter.
2. The lines joining the places which were affected Earthquake at the same point of time are called homoseismal lines.

Select the correct answer using the codes given below:
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

(**b**) The point of origin of an Earthquake is called focus or hypocenter. Epicenter is the point at ground level directly above the hypocenter.

The line on Earth's surface connecting points which are affected by Earthquake at same time are called homoseismal lines.

217. The vegetation type characterised by (i) a large expanse of grassland with scattered trees and shrubs, (ii) lying between tropical rain forest and tropical steppes and deserts and (iii) flat-topped trees, is called

(a) mid-latitude broad-leaf mixed forest
(b) temperate rain forest
(c) tropical savanna
(d) mid-latitude grassland

(**c**) Tropical Savanna vegetation type is characterised by a large expanse of grassland with scattered trees and shrubs, lying between tropical rain forest and tropical steppes and deserts, and presence of flat topped trees.

Savanna type of climate is also known as Sudan type of climate. This climate is characterised by distinct wet and dry seasons, and mean high temperature throughout the year is between 24°C-27°C.

218. On 8th November, 2013, many people died in Philippines after a super typhoon ravaged the country. What was the name of the typhoon?

(a) Haiyan   (b) Utor
(c) Phailin   (d) Nesat

(**a**) Typhoon Haiyan was a super typhoon that ravaged the Philippines on 8th November, 2013. Typhoon is the name given to tropical cyclones in the East and South-East Asia region.

They are developed in the region lying between Tropic of Cancer and Capricorn.

Typhoons are more vigorous and move with very high velocity over the oceans but become weakened while moving over land areas and ultimately die out after reaching the interior portion of the continents.

The rainfall regimes of low latitudes are mainly controlled by tropical cyclones.

219. What would be the influence on the weather conditions when in mid-winter a feeble high pressure develops over the North-Western part of India?

1. High and dry winds would blow outward from this high pressure area.
2. The Northern plain would become cold.
3. Scorching winds (locally called loo) would blow during the day time.
4. There would be torrential rains brought by thunderstorms.

Select the correct answer using the codes given below:
(a) 1 and 2   (b) 2 and 3
(c) 3 and 4   (d) All of these

(**a**) The temperature is very low in mid-winter in the North-Western part of India, which develops the high pressure and at the same time, the pressure is very low in Northern plain of India, due to which cold winds coming from

North-Western India, increase cold in Northern plains as winds blow from high-pressure area to low pressure area.

220. Which of the following is/are direct source(s) of information about the interior of the Earth?

1. Earthquake wave
2. Volcano
3. Gravitational force
4. Earth magnetism

Select the correct answer using the codes given below:

(a) 1 and 2   (b) Only 2
(c) 3 and 4   (d) All of these

⊙ (**b**) During volcano explosion, the internal material of Earth comes to the surface. By study of these material we can get information about the interior of the Earth.

221. Which one of the following is depositional landform?

(a) Stalagmite   (b) Lapis
(c) Sinkhole   (d) Cave

⊙ (**a**) Landforms produced by chemical weathering of carbonate rocks (like calcium carbonate, magnesium carbonate, etc.) by surface and sub-surface water are called Karst topography.

Stalagmites are calcareous columns of dripstones growing upward from the cave floor.

Lapies are highly ridged and rough surface of limestone lithology characterised by low ridges and pinnacles, narrow clefts and numerous solution holes.

Sinkholes are formed when chemically active rainwater dissolves limestones and other carbonate rocks along their joints, thus forming numerous holes.

Caves are the most significant landforms produced by erosional work of groundwater in limestore lithology. They are voids of large dimension below the ground surface.

222. Arrange the locations of four oil refineries of India from West to East.

(a) Koyali, Kochi, Panipat, Mathura
(b) Kochi, Koyali, Panipat, Mathura
(c) Koyali, Panipat, Kochi, Mathura
(d) Koyali, Panipat, Mathura, Kochi

⊙ (**a**) The correct sequence of given oil refineries from West to East is Koyali (Gujarat), Kochi (Kerala), Panipat (Haryana), Mathura (U.P).

Koyali refinery is located near Vadodara (Gujarat) is the second largest refinery

owned by Indian Oil Corporation Ltd. (IOCL).

Kochi refinery is located in Kerala, is the largest public sector refinery in India. It is under Bharat Petroleum Corporation Limited (BPCL).

Panipat refinery is located in Haryana, is the largest refinery owned by IOCL.

Mathura refinery is located in Uttar Pradesh. It is also owned by IOCL.

223. Which of the following statements regarding the duration of day and night is correct?

(a) Difference is least near the Equator and progressively increases away from it
(b) Difference is maximum at the Equator and progressively decreases away from it
(c) Difference is least at the Tropics and progressively increases towards the Equator and Poles
(d) Difference is maximum at the Tropics and progressively decreases towards the Equator and Poles

⊙ (**a**) The difference between duration of day and night is least near the Equator and progressively increases away from it. The tilt of the Earth's axis and its path around the Sun is the reason for this difference.

Near equator, the lengths of days and nights are almost equal throughout the year. While, towards poles length of days are very long during summers, and very short during winters.

224. Which of the following is/are the stage(s) of demographic transition?

1. High death rate and birthrate, low growth rate.
2. Rapid decline in death rate, continued low birthrate, very low growth rate.
3. Rapid decline in birthrate, continued decline in death rate.
4. Low death rate and birthrate, low growth rate.

Select the correct answer using the codes given below:

(a) Only 1
(b) 1, 2 and 3
(c) 3 and 4
(d) 1 and 4

⊙ (**d**) The demographic transition consists of four stages:

Stage I High death rate and birthrate, resulting in low growth rate of population. The society is primarily agrarian.

Stage II Birth rate continues to remain high, but there is substantial fall in death rates leading to accelerated growth of population. There is gradual attainment of economic development.

Stage III Alongwith low death rate, country also experiences the fall in the birthrate. Consequently, there is a fall in the rate of growth of population.

The country starts to experience the change in the structure of economy from purely agrarian to an industrialised one.

Stage IV This stage is characterised by low birth and death rates. As a result, population growth rate is also low. The economy of the the country is purely industrialised.

Thus, demographic transition throws light on changes in birthrate and death rate and consequently on the growth rate of population.

225. Which one of the following is a land-locked harbour?

(a) Vishakhapatnam (b) Ennore
(c) Mumbai   (d) Haldia

⊙ (**a**) Vishakhapatnam is the deppest land locked port of India. Ennore port is known for being privately developed. Mumbai port is one of the busiest on West coast. Haldia (Kolkata) is a riverine port.

226. Match the following

List I (Hydroelectric Power Station)	List II (Location in the Map)
A. Srisailam	
B. Sabarigiri	
C. Hirakud	
D. Sileru	

Codes

	A	B	C	D		A	B	C	D
(a)	3	1	4	2	(b)	3	4	1	2
(c)	2	4	1	3	(d)	2	1	4	3

⊙ (**b**) **Srisailam** Dam is constructed across the Krishna River in Kurnool District, Andhra Pradesh.

Sabarigiri Hydro Project is located at Moozhiyar, Pathanamthitta District of Kerala.

Hirakud Project is located on Mahanadi River in Sambalpur, Odisha.

Sileru Project is situated on river Sileru on the border of Andhra Pradesh and Odisha.

Geography

227. Biodiversity is richer in which region?

(a) Tropical regions
(b) Polar regions
(c) Temperate regions
(d) Oceans

(**a**) Biodiversity is richer in tropical regions because tropical environment is less reasonable, relatively more constant, get more amount of solar radiation. It remained relatively undisturbed in the part when glaciation occurred in temperate regions.

228. Match the following

List I (Irrigation/Power Project)		List II (River)
A.	Bhakra Nangal	1.	Bhagirathi
B.	Dul Hasti	2.	Mahanadi
C.	Hirakud	3.	Chandra
D.	Tehri	4.	Sutlej

Codes

	A	B	C	D		A	B	C	D
(a)	4	2	3	1	(b)	4	3	2	1
(c)	1	3	2	4	(d)	1	2	3	4

(**b**) Correct matches are

Bhakra Nangal	–	Sutlej
Dul Hasti	–	Chandra
Hirakud	–	Mahanadi
Tehri	–	Bhagirathi

Bhakra Nangal Dam is a concerete gravity dam on the Sutlej river in Bilaspur, Himachal Pradesh. In terms of quantity of water, it is the third largest reservoir in India.

It was described as 'New temple of resurgent India', by Jawaharlal Nehru. Nangal Dam is another dam in Punjab downstream of Bhakra dam.

However, sometimes both the dams together are called 'Bhakara-Nangal' Dam though they are two separate dam Dul Hasti Dam is a gravity dam situated on the Chandra river (a tributary of Chenab river) in the Kishtwar district of erstwhile Jammu and Kashmir state.

It is used for producing hydroelectric power.

Hirakud dam is bult across Mahanadi river in Odisha. It is India's largest dam

Tehri dam is the highest dam in India and one of the highest in the world. It is situated on Bhagirathi river near Tehri in Uttarakhand. It is a multipurpose rock and Earth fill embankment dam.

229. Veliconda group of low hills is a structural part of which of the following region ?

(a) Nilgiri Hills
(b) Western Ghats
(c) Eastern Ghats
(d) Cardamom Hills

(**c**) Veliconda hills is a range of mountains that form part of the Eastern Ghats. Veliconda range is located in the South-Eastern part of Andhra Pradesh.

230. Which one of the following dams is constructed across Krishna River?

(a) Ukai Dam
(b) Krishnaraja Sagar Dam
(c) Srisailam Dam
(d) Mettur Dam

(**c**) The Srisailam dam is a dam constructed across the Krishna river at Srisol Srisailam in Kurnool District of Andhra Pradesh and is the 3rd largest hydroelectric project in the country.

POLITY

1. Under which one of the following Articles of the Constitution of India, a statement of estimated receipts and expenditure of the government of India has to be laid before the Parliament in respect of every financial year?

(a) Article-110   (b) Article-111
(c) Article-112   (d) Article-113

⊘ (**c**) *Article-112 in the Constitution of India 1949 says*

The President shall in respect of every financial year cause to be laid before both the Houses of Parliament a statement of the estimated receipts and expenditure of the government of India for that year, in this Part referred to as the annual financial statement.

• Article 110 (3) of the Constitution of India categorically states that if any question arises whether a Bill is a Money Bill or not, the decision of the speakers of the house of the people thereon shall be final.

• Article 111 of the Constitution of India 'Assent to Bills' when a Bill has been passed by the Houses of Parliament, it shall be presented to the President and the President shall declare either that he assent to the Bill, or that he withholds assent there from.

• According to Article 113 of the Indian Constitution estimates expenditure from the Consolidated Fund of India in the Annual Financial Statement are to be voted the Lok Sabha.

2. Arrange the following in the chronological order of their implementation :

1. The Indian Factory Act (First)
2. The Vernacular Press Act
3. The Morley-Minto Reforms
4. The Cornwallis Code

Select the correct answer using the codes given below

(a) 4, 2, 1, 3   (b) 2, 4, 1, 3
(c) 3, 4, 1, 2   (d) 2, 1, 3, 4

⊘ (**a**) Option (a) is the correct sequence. **The Cornwallis code** is a body of legislation enacted in 1793 by the East India Company to improve the governance of its territories India.

The Vernacular Press Act (1878) was enacted by the Britishers to curtail the freedom of Indian press and prevent the expression of criticism towards British policies.

During Lord's Ripon time, the **'First Factory Act'** was adopted in 1881 to improve the service conditions of the factory workers in India. The act banned the appointment of children below the age of seven in factories. It also reduced the working hours of children.

The Morley-Minto Reforms (1909) was an act of the Parliament of the UK that brought about a limited increase in the Involvement of Indians in the governance of British India.

3. Article-371A of the Constitution of India provides special privileges to which states?

(a) Nagaland   (b) Mizoram
(c) Sikkim   (d) Manipur

⊘ (**a**) Article 371A of the Constitution of India provides special privileges to the state of Nagaland with an aim to preserve their tribal culture.

Article 371 also confers special privileges to the state of Assam, Meghalaya, Sikkim, Manipur and Arunachal Pradesh.

Article 371 gives the power to the President of India to establish separate development boards for Vidarbha, Marathwada regions of Maharashtra and the rest of the State and Saurashtra, Kutch and rest of Gujarat.

Special provisions with respect to Andhra Pradesh, Karnataka, Goa are dealt in Articles 371D and 371E, 371J, 371I respectively.

4. How many Zonal Councils were set-up vide Part-III of the States Re-organisation Act,1956?

(a) Eight   (b) Seven
(c) Six   (d) Five

⊘ (**d**) Zonal Councils are Advisory Councils and are made up of the States of India that have been grouped into five zones to foster cooperation among them.

These were set-up vide Part III of the States Reorganisation Act, 1956.

The present composition of each these Zonal Council is under Northern Zonal Council, Central Zonal Council, Eastern Zonal Council, Western Zonal Council and Southern Zonal Council. The North Eastern States are under another statutory body, the North Eastern Council.

5. Which provision of the Constitution of India provides that the President shall not be answerable to any Court in India for the exercise of powers of his office?

(a) Article-53   (b) Article-74
(c) Article-361   (d) Article-363

⊘ (**c**) **Article-361** of the Constitution of India provides that the President or the Governor of a State, shall not be answerable to any court for the exercise and performance of the powers and duties of his office or for any act done or purporting to be done by him in the exercise and performance of these powers and duties.

Article 53 Executive Power of the Union

The executive power of the union shall be vested in the President and shall be exercised by him either directly or through officers subordinate to him in accordance with this Constitution.

Article 74 of the Constitution of the Republic of India provides for a Council of Ministers which shall aid the President in the exercise of his functions.

Article 363 of the Constitution bars the jurisdiction of all courts in any dispute arising out of any agreement which was entered into or executed before the commencement of the Constitution by any ruler of an Indian state to which the Government of India was party.

6. Which law prescribes that all proceedings in the Supreme Court shall be in English language?
  (a) Article-145 of the Constitution of India
  (b) Article-348 of the Constitution of India
  (c) The Supreme Court Rules, 1966
  (d) An Act Passed by the Parliament

⊙ (**b**) Article-348 of the Constitution of India prescribes language to be used in the Supreme Court and in the High Court and for acts, bills, etc.

All proceeding in the Supreme Court and in every High Court, the authoritative texts of all bills to be introduced or amendment there to be moved in either House of Parliament or either House of State Legislature, shall be in English.

7. The total number of members in the Union Council of Ministers in India shall, not exceed
  (a) 10% of the total number of members of the Parliament
  (b) 15% of the total number of members of the Parliament
  (c) 10% of the total number of members of the Lok Sabha
  (d) 15% of the total number of members of the Lok Sabha

⊙ (**d**) The Union Council of Ministers Exercises Executive Authority in the Republic of India. It consists of senior ministers, called Cabinet Ministers, Minister of State or Deputy Ministers.

According to the Constitution of India, the total numbers of ministers in the Council of Ministers must not exceed 15% of the total numbers of member of the Lok Sabha.

8. Which one of the following states does not have a Legislative Council?
  (a) Karnataka
  (b) Telangana
  (c) Jammu and Kashmir
  (d) Arunachal Pradesh

⊙ (**d**) Legislative Council is the Upper House in those States of India that have a bicameral legislature its establishment is defined in Article-169 of the Constitution of India.

As of 2019, 7 out of 29 States have Legislative Council namely—Andhra Pradesh, Bihar, Karnataka, Maharashtra, Jammu and Kashmir, Telangana and Uttar Pradesh.

9. Which one of the following is not enumerated in the Constitution of India as a Fundamental Duty of citizens of India?
  (a) To safeguard public property
  (b) To protect and improve the natural environment
  (c) To develop the scientific temper and spirit of inquiry
  (d) To promote international peace and security

⊙ (**d**) The Fundamental Duties of citizens were added to the Constitution by the 42nd Amendment in 1976, upon the recommendation of the Swaran Singh Committee that was constituted by the government.

Under Article 51, it mentions to promote international peace and security. It is not enumerated in the Constitution of India as Fundamental Duty of Citizens of India.

10. Which one of the following conditions laid down in the Constitution of India for the issue of a writ of Quo-Warranto is not correct?
  (a) The office must be public and it must be created by a statute
  (b) The office must be a substantive one
  (c) There has been a contravention of the Constitution or a state in appointing such person to that office
  (d) The appointment is in tune with a statutory provision

⊙ (**d**) Writ of 'Quo-Warranto' in literal sense means by what authority or warrant it is issued by the court to enquire into legality of claim of a person to public office. Hence, it prevents illegal **usurpation** of public office by a person. Hence, option (d) is not correct.

11. Which of the following statements relating to the Fifth Schedule of the Constitution of India is not correct?
  (a) It relates to the special provision for administration of certain areas in the States other than Assam, Meghalaya, Tripura and Mizoram.
  (b) Tribal Advisory Councils are to be constituted to give advice under the Fifth Schedule.
  (c) The Governor is not authorised, to make regulations to prohibit or restrict the transfer of land by or among members of the Scheduled Tribes.

  (d) The Governors of the States in which there are scheduled areas have to submit reports to the President regarding the administration of such areas.

⊙ (**c**) The Fifth Schedule of the Constitution deals with the administration and control of scheduled areas and Scheduled Tribe in any State except the four States of Assam, Meghalaya, Tripura and Mizoram. It says, Tribal Advisory Councils are to be constituted to give advice under the Fifth Schedule.

The Governor is empowered to make regulations to prohibit or restrict the transfer of land by or among members of the Scheduled Tribes.

Hence, option (c) is not correct.

12. Consider the following statements:
  1. The Advocate General of a State in India is appointed by the President of India upon the recommendations of the Governor of the concerned state.
  2. As provided in the Code of Civil Procedure, High Courts have original appellate advisory jurisdiction at the state level.

Which of the statement(s) given above is/are correct?
  (a) Only 1   (b) Only 2
  (c) Both 1 and 2   (d) Neither 1 nor 2

⊙ (**d**) The Advocate General of a State in India is appointed by the Governor of a State.

A High Court is primarily a Court of Appeal. It hears appeals against the Judgements of Subordinate Courts functioning in its territorial jurisdiction. It has appellate jurisdiction in both civil and criminal matters.

Under Act 226 original appellate jurisdiction under Article 226 of Constitution, not civil procedure code. Hence, both the statements are incorrect.

13. Which one of the following forms of Constitution contains the features of both the Unitary and Federal Constitution?
  (a) Unitary   (b) Federal
  (c) Quasi-Federal   (d) Quasi-Unitary

⊙ (**c**) Quasi-Federal forms of Constitution contains the features of both the unitary and Federal Constitution.

The Constitution of India has both the unitary as well as federal features. Federal features are dual polity, written Constitution, division of powers, supremacy of the Constitution, Rigid

Constitution, independent judiciary, Bicameralism. Unitary features are strong centre, single Constitution, flexibility of the Constitution etc.

14. Which one of the following statements about the Government of India Act, 1919 is not correct?

(a) It extended the practice of communal representation

(b) It made the Central Executive responsible to the Legislature

(c) It is also known as the Montague-Chelmsford Reforms

(d) It paved the way for federalism by clearly separating the responsibilities of the Centre and the Provinces

⊚ (*d*) Government of India Act 1919, also known as Montague-Chelmsford Reforms. It extended the principle of communal representation to Sikhs, Indian Christians, Anglo-Indians and Europeans. It divided the provincial subjects into 2 parts transferred and reserved.

Transferred subjects were to be administered by the Governor with the aid of ministers responsible to the Legislative Council.

Reserved subjects were to be administered by the Governor and his Executive Council without being responsible to the Legislative Council.

Hence, option (d) is incorrect.

15. The concept of 'Four Pillar State', free from district magistracy for India was suggested by

(a) Lala Lajpat Rai

(b) Ram Manohar Lohia

(c) Raja Ram Mohan Roy

(d) Subhash Chandra Bose

⊚ (*b*) Ram Manohar Lohia believes in decentralisation of economic and political powers. So he gave the concept of Four Pillar State, which is based on the principle of division of powers.

According to him four pillar constitute four limbs of the State. They are the village, the district, the province and the centre with sovereign powers.

16. Which one among the following is not a part of the Fundamental Rights (Part III) of the Constitution of India?

(a) Prohibition of traffic in human beings and forced labour

(b) Prohibition of employment of children in factories

(c) Participation of workers in management of industries

(d) Practice any profession or to carry on any occupation, trade or business

⊚ (*c*) Participation of workers in management of industries is not a part of the Fundamental Rights (Part III) of the Constitution of India.

Participation of workers in management of industries is directive principle of State policy.

Fundamental Rights are enshrined in Part-III of the Constitution from Article-12-35. Prohibition of traffic in human beings and forced labour is Article-23.

Prohibition of employment of children in factories is Article-24. Practice any profession, or to carry on any occupation, trade business is Article 19(1)g.

17. Which of the following statements as per the Constitution of India are not correct?

1. The President tenders his resignation to the Chief Justice of India.

2. The Vice-President tenders his resignation to the President of India.

3. The Comptroller and Auditor General of India is removed from his office in the like manner as the President of India.

4. A Judge of the Supreme Court can resign his office by writing under his hand addressed to the Chief Justice of India.

Select the incorrect answer using the codes given below

(a) 1 and 2　　　(b) 2 and 3

(c) 1, 2 and 3　　(d) 1, 3 and 4

⊚ (*d*) According to Constitution of India, President can resign from his office at any time by addressing the resignation letter to the Vice-President.

The Vice-President of India can resign anytime by writting to President of India.

The Comptroller and Auditor General of India (CAG) can be removed by the President on the same grounds and in same manner as a judge of Supreme Court (not President).

A Judge of Supreme Court can resign from his office by writting to President of India.

Hence, statements 1, 3 and 4 are incorrect and statement 2 is correct.

18. Rajya Sabha has exclusive jurisdiction in

(a) creation of new states

(b) declaring a war

(c) financial emergency

(d) authorising Parliament to legislate on a subject in the state list

(*d*) Due to its federal character, the Rajya Sabha has been given two exclusive or special powers that are not enjoyed by the Lok Sabha.

(i) It can authorise the Parliament to make a law on a subject enumerated in the state list.

(ii) It can authorise the Parliament to create new all India services common to both the Centre and States.

2019 (I)

19. The Inter-State Council was set-up in 1990 on the recommendation of

(a) Punchhi Commission

(b) Sarkaria Commission

(c) Rajamannar Commission

(d) Mungerilal Commission

⊚ (*b*) Article-263 in Part XI of the Constitution provides for the establishment of an Inter-State Council for better coordination among the states and between Centre and States.

In 1990, the Inter-State Council was established on the recommendation of Sarkaria Commission (1983-87).

It consists of the following members.

(i) Prime Minister as the Chairman

(ii) Chief Minister of all the States and Union Territories

(iii) Administrators of Union Territories not having Assemblies

(iv) Governor's of States under President rule

(v) Six Central Cabinet Ministers

20. Which among the following writs is issued to quash the order of a Court or Tribunal?

(a) Mandamus　　(b) Prohibition

(c) Quo Warranto　(d) Certiorari

⊚ (*d*) Certiorari is issued to quash the order of a Court or Tribunal. There are five major types of writs Habeas Corpus, Mandamus, Prohibition, Quo Warranto and Certiorari. In India, both Supreme Court and High Court are empowered with writ jurisdiction.

Certiorari It is issued by Supreme Court and High Court to transfer a particular matter or quash the order of lower court.

Mandamus It is a command issued by a court to a public authority, lower court or tribunal to perform their duties.

Prohibition Supreme Court and High Court may prohibit lower courts who exceeds their jurisdiction are act in country to the rule of natural justice.

Quo Warranto This unit is issued to enquire into legality of the claim of a person or public office.

Habeas Corpus is used by the courts to find out if a person has been illegally detained.

21. Which among the following statements about the power to change the basic structure of the Constitution of India is/are correct?

1. It falls outside the scope of the amending powers of the Parliament.
2. It can be exercised by the people through representatives in a Constituent Assembly.
3. It falls within the constituent powers of the Parliament.

Select the correct answer using the codes given below

(a) 1 and 3   (b) 1 and 2
(c) Only 1   (d) 2 and 3

⊘ (**c**)

1. The concept of basic structure was laid down by the Supreme Court in the Keshavanand Bharti Case (1973). The basic structure doctrine states that the Constitution of India has certain basic features that cannot be altered or destroyed through amendments by the Parliament.

   Article 368 does not give absolute powers to the Parliament to amend any part of the Constitution.

   Thus, statement (1) is correct.

2. The amendment in basic structure can also not be brought via Constituent Assembly since it was dissolved in 24th January, 1950.

   Hence, statement (2)is incorrect.

3. Constituent power is the power to formulate a Constitution or to propose amendments to or revisions of the Constitution and to ratify such proposal. The Constitution of India vests constituent power upon the Parliament subject to the special procedure laid down therein. However, scope to amend the basic structure is limited.

   Hence, statement (3) is incorrect.

22. When a proclamation of emergency is in operation, the right to move a court for the enforcement of all Fundamental Rights remains suspended, except

(a) Article-20 and Article-21
(b) Article-21 and Article-22
(c) Article-19 and Article-20
(d) Article-15 and Article-16

⊘ (**a**) The President can proclam emergency under Article-352 when security of nation or a part of it is

threatened by war as external aggression or armed rebellion.

• Article-20 and Article-21 which ensure protection of life and personal liberty cannot be suspended at any cost.
• Article-22 Protection against arrest and detention in certain cases.
• Article-19 Protection of certain sights regarding freedom of speech etc.
• Article-15 Prohibition of discrimination on grounds of religion, race, caste, sex or place of birth.
• Article 16 Equality of opportunity in matters of public employment.

23. Which one of the following Articles of the Constitution of India lays down that no citizen can be denied the use of wells, tanks and bathing ghats maintained out of state funds?

(a) Article-14   (b) Article-15
(c) Article-16   (d) Article-17

⊘ (**b**) Article-15 of the Constitution abolishes untouchability and forbids its practice in any form. So, no person would be denied to use the wells, tanks and bathing ghats maintained out of state funds.

In 1955, government enacted protection of Civil Right Act to abolish untouchability from society.

24. Who amongst the following organised the All India Scheduled Castes Federation?

(a) Jyotiba Phule   (b) Periyar
(c) BR Ambedkar   (d) MK Karunanidhi

⊘ (**c**) All India Scheduled Castes Federation was founded by BR Ambedkar in 1942 to organise schedule caste people against Brahmanical ideology.

He also established Bahishkrit Hitkarni Sabha, Independent Labour Party and started weekly paper 'Mooknayak'. He was appointed as the first Law Minister of India.

25. Which one of the following is not an assumption in the law of demand?

(a) There are no changes in the taste and preferences of consumers
(b) Income of consumers remains constant
(c) Consumers are affected by demonstration effect
(d) There are no changes in the price of substitute goods

⊘ (**c**) Consumers are affected by demonstration effect, is not an assumption in the law of demand.

The law of demand is a fundamental concept of economics which states that at a higher price consumers will demand a lower quantity of goods and vice-versa.

26. Which one of the following is not a change brought about by the Indian Independence Act of 1947?

(a) The Government of India Act, 1935 was amended to provide an interim Constitution.
(b) India ceased to be a dependency.
(c) The Crown was the source of authority till new Constitution was framed.
(d) The Governor-General was the Constitutional Head of Indian Dominion.

⊘ (**b**) India ceased to be a dependency is not a charge brought about by the Indian Independence Act of 1947.

On 20th February, 1947 British PM declared that British rule will end by 30th June 1948, but on 3rd June, 1947 Mountabatten Plan was accepted by Congress which led to enaction of Indian Independence Act.

As per Act India was declared as an independent and Sovereign State from 15th August, 1947.

Hence, option (b) is correct.

27. Which one of the following is not a correct statement regarding the provision of Legislative Council in the State Legislature?

(a) The States of Bihar and Telangana have Legislative Councils
(b) The total number of members in the Legislative Council of a State shall not exceed one-third of the total number of members in the Legislative Assembly
(c) One-twelfth of all members shall be elected by electorates consisting of local bodies and authorities
(d) One-twelfth of all members shall be elected by graduates residing in the state

⊘ (**c**) The Constitution as provided autonomy to state to have unicameral and bicameral legislature, 7 out of 28 states have bicameral legislature, Legislative Assembly and Council.

The Legislative Council is the Upper House where members are indirectly elected.

The maximum strength of the council is fixed at one-third of the total strength of assembly and minimum is fixed at 40.

Manner of Election

One-third	By Local Bodies and Authorities
One-third	By Legislative Assemblies
One-twelfth	By Graduates
One twelfth	By Teachers
One-sixth	Nominated by Governor

Hence, option (c) is incorrect.

28. Which one of the following is not correct about the Panchayats as laid down in Part IX of the Constitution of India?

(a) The Chairperson of a Panchayat needs to be directly elected by people in order to exercise the right to vote in the Panchayat meetings

(b) The State Legislature has the right to decide whether or not offices of the Chairpersons in the Panchayats are reserved for SCs, STs or women

(c) Unless dissolved earlier, every Panchayat continues of a period of five years

(d) The State Legislature may by law make provisions for audit of accounts of the Panchayats

⊗ (**a**) The Part IX was inserted in Constitution through the 73rd Amendment Act.

Important Features

The Chairman of a Panchayat shall be elected in such a manner as the State Legislature determines. So statement (a) is not correct.

Rest all statements are true. It also provided one-third reservation of seats for women in State Finance Commission, State Election Commission etc.

29. Which one of the following is not correct about Administrative Tribunals?

(a) The Parliament may be law Constitute Administrative Tribunals both at the Union and State levels

(b) Tribunals may look into disputes and complaints with respect to recruitment and conditions of service of persons appointed to public services

(c) Tribunals established by a law of the Parliament can exclude the jurisdiction of all courts to allow for special leave to appeal

(d) The law establishing the Tribunals may provide for procedures including rules of evidence to be followed

⊗ (**c**) The 42nd Constitutional Amendment Act of 1976 added a new Part XIV-A entitled as 'Tribunals'. It consists of two Article-323A and 323B.

Article-323A empowers the Parliament to establish Administrative Tribunal, in 1985 the Administrative Tribunal Act was passed to establish Central Administrative Tribunal.

All the statements are true except (c), as they are not empowered to exclude the jurisdiction of all court to allow for special leave to appeal.

Article-323B gives power to both Parliament and State Legislature to establish tribunal for different disputes.

30. Which of the following statements about Alladi Krishnaswami Ayyar, as a drafting member of the Constitution of India, are correct?

1. He favoured the role of the Supreme Court in taking important decisions related to the interpretation of the Constitution of India.

2. He felt that the Supreme Court had to draw the line between liberty and social control.

3. He believed in the dominance of the executive over the judiciary.

4. He favoured a dictatorial form of governance.

Select the correct answer using the codes given below

(a) 1 and 2   (b) 1, 2 and 3
(c) 3 and 4   (d) 1, 2 and 4

⊗ (**a**) Only statement 1 and 2 are correct. Alladi Krishnaswami was eminent lawyer from Chennai, in Constituents Assembly he favoured the role of Supreme Court to interpret the Constitution when required. He also wanted that the Supreme Court had to draw the line between liberty and social control.

31. The 'Beijing Declaration' is concerned with which one of the following issues?

(a) Rights of Children
(b) Rights of Women
(c) Right to Development
(d) Reduction of Tariffs

⊗ (**b**) The 'Beijing Declaration' is concerned with the 'Right of Women', this declaration was outcome of fourth world conference on women in 1995.

It advances the goals of equality, development and peace for all women.

32. The 'Gujral Doctrine' relates to which one of the following issues?

(a) Build trust between India and its neighbours

(b) Initiate dialogue with all insurgent groups in India

(c) Undertake development activities in Naxal-dominated areas

(d) Ensure food security

⊗ (**a**) The main objective of 'Gujaral doctrine' to build trust between India and its neighbours, was initiated in 1996 by IK Gujaral, the then Finance Minister.

33. Afro-Asian solidarity as a central element of India's foreign policy was initiated by which of the following Prime Ministers?

(a) Narendra Modi
(b) IK Gujral
(c) JL Nehru
(d) Manmohan Singh

⊗ (**c**) Afro-Asian solidarity as a central element of India's foreign policy was initiated by PM Jawaharlal Nehru.

JL Nehru believed that Asia had a certain responsibility toward the people of Africa. In this regard, he followed Afro-Asian solidarity as a central element of India's foreign policy.

34. The Prime Minister's National Relief Fund is operated by which one of the following bodies?

(a) The Prime Minister's Office (PMO)

(b) The National Disaster Management Authority

(c) The Ministry of Finance

(d) The National Development Council (NDC)

⊗ (**a**) The Prime Minister's National Relief Fund (PMNRF) was established in 1948 to assist displaced person from Pakistan, now resources of PMNRD are utilised to render relief to families of those killed in natural calamities and man-made disaster. This fund is operated by the Prime Minister's Office (PMO).

35. Which one of the following statements about the provisions of the Constitution of India with regard to the State of Jammu and Kashmir is not correct. Prior to arogational of Article 370.

(a) The Directive Principles of State Policy do not apply.

(b) Article-35A gives some special rights to the permanent residents of the State with regard to employment, settlement and property.

(c) Article-19(1)(f) has been omitted.

(d) Article-368 is not applicable for the Amendment of Constitution of the State.

⊙ (**c**) The Government of India abrogated the Article 370 in August 2019, thus making all the provisions of the Indian Constitution applicable to Jammu and Kashmir.

Prior to its abrogation, Article 370 provided the State of Jammu and Kashmir, power to have a separate Constitution, a state flag and autonomy over the internal administration of the state.

According to question, option (c) is not correct.

2018 (II)

36. Which of the following statements relating to the Government of India Act, 1858 is/are correct?

1. The British Crown assumed sovereignty over India from the East India Company.
2. The British Parliament enacted the first statute for the governance of India under the direct rule of the British.
3. This Act was dominated by the principle of absolute imperial control without any population participation in the administration of the country.

Select the correct answer using the codes given below
(a) 1 and 2   (b) Only 2
(c) 1, 2 and 3   (d) 1 and 3

⊙ (**c**) The Government of India Act, 1858 was an Act of the British Parliament that transferred the government and territories of the East India Company to the British Crown.

The Company's rule over British territories in India came to an end and it was passed directly to the British government. Queen Victoria, who was the monarch of Britain, also became the sovereign of British territories in India as a result of this Act.

This act was dominated by the principle of absolute imperial control without any popular participation in administration of the country. Under this act, all the powers of Crown were exercised by Secretary of State of India and was assisted by Council of India (Council of fifteen members).

Hence, all statements are correct.

37. Which of the following statements relating to the Indian Councils Act, 1861 is/are correct?

1. The Act introduced a grain of popular element by including non-official members in the Governor-General's Executive Council.
2. The members were nominated and their functions were confined exclusively to consideration of legislative proposals placed before it by the Governor-General.
3. The Governor-General did not have effective legislative power.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 2 and 3
(c) 1, 2 and 3   (d) Only 1

⊙ (**a**) The Indian Councils Act, 1861 was passed by British Parliament on 1st August, 1861 to make substantial changes in the composition of the Governor-General council.

- The executive council of Governor-General was added a fifth finance member. For legislative purposes, the Governor-General's Council was enlarged. Now, there were to be between 6 and 12 additional members (nominated by the Governor-General).
- They were appointed for a period of 2 years. Out of these, atleast half of the additional members were to be non-official (British or Indian).
- Their functions were confined to legislative measures.
- Any bill related to public revenue or debt, military, religion or foreign affairs could not be passed without the Governor- General's assent.
- The Viceroy had the power to overrule the council, if necessary.
- The Governor-General also had the power to promulgate ordinances without the council's concurrence during emergencies.

Hence, statements 1 and 2 are correct and statement 3 is incorrect.

38. Which of the following statements relating to the historic objectives resolution, which was adopted by the constituent assembly, is/are correct?

1. The objectives resolution inspired the shaping of the Constitution through all its subsequent stages.
2. It was not just a resolution, but a declaration, a firm resolve and a pledge.
3. It provided the underlying philosophy of our Constitution.

Select the correct answer using the codes given below
(a) 1 and 2   (b) Only 1
(c) 1, 2 and 3   (d) 2 and 3

⊙ (**c**) Objectives Resolution' was the resolution moved by Jawaharlal Nehru on the 13th of December, 1946 in the 1st Session of India's Constituent Assembly, which was charged with the objective to frame India's Constitution.

It was unanimously adopted on 22nd of January, 1947. It laid down the fundamentals and philosophy of the constitutional structure.

The Constituent Assembly declared its firm resolve to proclaim India an Independent Sovereign Republic and draw up a Constitution for her governance.

Hence, all statements are correct.

39. Which of the following statements relating to the duties of the Governor is/are correct?

1. The duties of the Governor as a Constitutional Head of the State do not become the subject matter of questions or debate in the Parliament.
2. Where the Governor takes a decision independently of his Council of Ministers or where he acts as the Chief Executive of the State under President's rule, his actions are subject to scrutiny by the Parliament.

Select the correct answer using the codes given below.
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ (**b**) Since Governor is appointed by the President or Union Government. His duties as constitutional Head of the State can become the subject matter of questions or debate in the Parliament.

Even in that condition when the Governor takes a decision independently of his Council of Ministers or where he acts as the Chief Executive of the State under President rule his actions are subject to scrutiny by the Parliament.

Hence, statement 1 is incorrect and statement 2 is correct.

40. Which one of the following Articles of the Constitution of India deals with the special provision with respect to the State of Assam?

(a) Article 371A   (b) Article 371B
(c) Article 371C   (d) Article 371D

⊘ (**b**) The Article 371B of Indian Constitution has special provision with respect to the State of Assam. It is mostly related to Sixth Schedule and functioning of Legislative Assembly and Sixth Schedule.

- Article 371 A of Indian Constitution has special provision with respect to the state of Nagaland.
- Article 371 C deals with special provision with respect to Manipur.
- Article 371 D special provision with respect to the state of Andhra Pradesh.

41. Provisions of which one of the following Articles of the Constitution of India apply to the State of Jammu and Kashmir?

(a) Article 238   (b) Article 370
(c) Article 371   (d) Article 371G

⊘ (**b**) Article 370 of the Indian Constitution was an article that grants special autonomous status to the State of Jammu and Kashmir. The article was drafted in Part XXI of the Constitution, which relates to Temporary, Transitional and Special Provisions.

The Government of India abrogated the Article 370 in August 2019, thus making all the provision of the Indian Constitution applicable to Jammu and Kashmir.

42. Which one of the following Schedules to the Constitution of India provides for setting up of Autonomous District Councils?

(a) Third Schedule
(b) Fourth Schedule
(c) Fifth Schedule
(d) Sixth Schedule

⊘ (**d**) Sixth Schedule to the Constitution of India provides for setting up of Autonomous Districts Council.

The Constitution of India makes special provisions for the administration of the tribal dominated areas in four states viz. Assam, Meghalaya, Tripura and Mizoram.

As per Article 244 and sixth Schedule, these areas are called 'Tribal Areas'. The Sixth Schedule envisages establishment of Autonomous District Councils (ADCs).

43. Which one of the following regarding the tenure of the elected members of the Autonomous District Council is correct?

(a) Five years from the date of election
(b) Five years from the date appointed for the first meeting of the council after the election
(c) Six years from the date of administration of oath
(d) Six years from the date of election

⊘ (**b**) The tenure of the elected members of the Autonomous District Council is five years from the date appointed for the first meeting of the Council after the election. They are known as MDC (Member of the District Council).

The Sixth Schedule to the Constitution empowers the Governor to determine the administrative areas of the autonomous councils.

Each district council or regional council provided under the Sixth Schedule is a corporate body by name of District Council or Regional Council of (name of the district or name of the region) having perpetual succession and a common seal with the right to sue and be sued.

44. Who among the following shall cause the accounts of the Autonomous District and Regional Council Funds to be audited?

(a) The Comptroller and Auditor General of India
(b) The Chartered Accountant empanelled by the Government of India
(c) The State Government Auditors
(d) Any Chartered Accountant

⊘ (**a**) The Comptroller and Auditor General shall cause the accounts of District and Regional Councils to be audited in such manner as he may think fit, and the reports of the Comptroller and Auditor General relating to such accounts shall be submitted to the Governor who shall cause them to be laid before the council.

The Sixth Schedule of the Constitution of India also envisages audit of accounts of district and regional councils of autonomous regions by the Comptroller and Auditor General of India (CAG).

45. Who has the power of annulment or suspension of acts and resolutions of the autonomous district and regional Councils?

(a) The Governor
(b) The President
(c) The Chief Minister of the State
(d) The Prime Minister

⊘ (**a**) Governor has the power of annulment of suspension of Acts and resolutions of the autonomous district and regional council.

The Governor also has power to include any other area, exclude any area, increase, decrease, diminish these areas, unite two districts/regions, and alter the names and boundaries of these autonomous district councils.

Governors of four states viz. Assam, Meghalaya, Tripura and Mizoram are empowered to declare some tribal dominated districts/areas of these states as autonomous districts and autonomous regions by order.

No separate legislation is needed for this.

46. The audit reports of the Comptroller and Auditor General of India relating to the accounts of the Union shall be submitted to

(a) the President
(b) the Speaker of the Lok Sabha
(c) the Prime Minister
(d) the Vice-President

⊘ (**a**) Under Article 151 of Constitution, the reports of the Comptroller and Auditor-General (CAG) of India relating to the accounts of the Union shall be submitted to the President, who shall cause them to be laid before each House of Parliament.

47. Which of the following is not related to the powers of the Governor?

(a) Diplomatic and Military powers
(b) Power of appoint Advocate General
(c) Summoning, proroguing and dissolving State Legislature
(d) Power to grant pardons, reprieves, respites or remission of punishments

⊘ (**a**) Governor is the Head of the State, as President being the head of the country. He enjoys executive, legislative as well as judicial functions. Diplomatic and Military powers not related to the powers of Governor.

Following are the powers and duties performed by Governor in states are

(i) They have power to appoint Advocate General.

(ii) They can summoning, proroguing and dissolving State Legislature.

(iii) They have power to grant pardons, reprieves, respites or remission of punishments.

48. Which one of the following regarding the procedure and conduct of business in the Parliament is not correct?

(a) To discuss state matters

(b) To discuss issues of the use of police force in suppressing the Scheduled Caste and Scheduled Tribe communities

(c) To discuss issues in dealing with violent disturbances in an undertaking under the control of the Union Government

(d) To discuss issues for putting down the demands of the industrial labour

⊗ (*a*) To discuss state matters in general condition does not lie under procedure and conduct of business of Parliament. Under Article 246 of the Constitution, Parliament has right to make laws on Union list and Concurrent list of Schedule seven.

Parliament can discuss the issue of Police action against the Schedule Castes and Tribes under the Scheduled Castes and Tribes (Prevention of Atrocities) Act, 1989.

Issue of Industrial labours come under Concurrent list, so it can be discussed in Parliament. Parliament can also discuss issues in dealing with violent disturbances in an undertaking under the control of the Union Government.

49. Which of the following is not under the powers and functions of the Election Commission of India?

(a) Superintendence, direction and control of the preparation of electoral rolls

(b) Conduct of elections to the Parliament and to the Legislature of each state

(c) Conduct of election of the office of the President and the Vice-President

(d) Appointment of the Regional Commissioners to assist the Election Commission in the performance of the functions conferred on the Commission

⊗ (*d*) Appointment of the Regional Commission in the performance of the functions conferred on the Commission is not done by the Election Commission of India.

According to Article 324 of Indian Constitution, the Election Commission of India has superintendence, direction and control of the entire process for conduct of elections to Parliament and Legislature (State Legislative Assembly and State Legislative Council) of every state and to the offices of President and Vice-President of India.

50. Which one of the following criteria is not required to be qualified for appointment as Judge of the Supreme Court?

(a) At least five years as a Judge of a High Court

(b) At least ten years as an Advocate of a High Court

(c) In the opinion of the President, a distinguished jurist

(d) At least twenty years as a Sub-Judicial Magistrate

⊗ (*d*) Article 124 (3) of the Constitution prescribes that for appointment as a Judge of the Supreme Court a person must be

(i) a citizen of India,

(ii) has been a judge of any High Court for at least 5 years, or

(iii) has been an advocate in a High Court for 10 years or is in the opinion of the President a distinguished jurist.
Hence, the criteria given in option (d) is not required.

51. Which one of the following is not among the duties of the Chief Ministers?

(a) To communicate to the Governor of the State all decisions of the Council of Ministers relating to the administration of the affairs of the state and proposals for legislation

(b) To furnish information relating to the administration of the state and proposals for legislation as the Governor may call for

(c) To communicate to the President all decisions of the Council of Ministers relating to the administration of the State in the monthly report

(d) To submit for the consideration of the Council of Ministers any matter on which a decision has been taken by a Minister but has not been considered by the Council, if the governor so requires

⊗ (*c*) To communicate to the President all decisions of the Council of Ministers relating to the administration of the state in the monthly report is the duty of Prime Minister under Article 78.

Hence, option (c) is incorrect.

The Chief Minister is appointed by the Governor. Article 164 of the Constitution provides that there shall be a Council of Ministers with the Chief Minister at its hand to aid and advise the Governor.

Under Article 167 of the Constitution, it shall be the duty of the Chief Minister of each state

(i) to communicate to the Governor of the state all decisions of the Council of Ministers relating to the administration of the affairs of the state and proposals for legislation.

(ii) to furnish such information relating to the administration of the affairs of the state and proposals for legislation as the Governor may call for.

52. Which one of the following is not considered a part of the Legislature of States?

(a) The Governor
(b) The Legislative Assembly
(c) The Legislative Council
(d) The Chief Minister

⊗ (*d*) Under Article 168 of the Constitution, for every state there shall be a Legislature which shall consist of the Governor, and where there are two Houses of the Legislature of a State, one shall be known as the Legislative Council and the other as the Legislative Assembly, and where there is only one House, it shall be known as the Legislative Assembly.

Hence, Chief Minister is not the part of Legislature.

53. Which one of the following regarding the ordinance-making power of the Governor is not correct?

(a) It is not a discretionary power
(b) The Governor may withdraw the ordinance anytime
(c) The ordinance power can be exercised when the Legislature is not in session
(d) The aid and advice of Ministers is not required for declaring the ordinance

⊗ (*d*) Governor of an Indian state draws ordinance making power from Article 213 of the Constitution.

The Governor can only issue ordinances when the Legislative Assembly of a state or where there are two houses in a state both houses are not in session. Governor's ordinance-making power is not a discretionary power. This means that he can promulgate or withdraw an ordinance only on the advice of the council of ministers headed by the chief minister.

Thus option (d) is incorrect..

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54. The judgement of the Supreme Court of India in the Vishakha Case pertains to

(a) sexual harassment at the workplace
(b) sati
(c) dowry death
(d) rape

(❯) (**a**) Vishaka Guidelines against Sexual Harassment at Workplace. Guidelines and norms laid down by the Hon'ble Supreme Court in Vishaka and Others *Vs* State of Rajasthan and Others (JT 1997 (7) SC 384).

The Vishaka guidelines were superseded in 2013 by The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013.

State of Rajasthan and Union of India to enforce the Fundamental Rights of working women under Articles 14, 19 and 21 of Constitution of India.

55. Which one among the following States of India has the largest number of seats in its Legislative Assembly?

(a) West Bengal   (b) Bihar
(c) Madhya Pradesh (d) Tamil Nadu

(❯) (**a**) Among all the given options, West Bengal has the largest number of seats in its Legislative Assembly. The number of seats allotted to Legislative Assembly of any state is based on the population of that state.

The maximum number of seats are in the Legislative. Assembly of Uttar Pradesh (403) followed by West Bengal (294), Maharashtra (288), Bihar (243), Tamil Nadu (234) and Madhya Pradesh (230).

56. Which of the following statements about the ordinance making power of the Governor is/are correct?

1. It is a discretionary power.
2. The Governor himself is not competent to withdraw the ordinance at any time.

Select the correct answer using the codes given below
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

(❯) (**d**) The State Executive has temporary law-making power in emergent situations under the Constitution of India. And the Governor is the head of the State Executive. So, the ordinance making power confers on him by the Constitution itself. But this is not a discretionary power.

The ordinance making power of the Governor is coextensive with the legislative power of the State Legislature to make laws. He can promulgate ordinances only on the subjects on which the State Legislature has power to make laws under the Constitution. Hence, both the statements are incorrect.

57. Which one of the following is not an International Human Rights Treaty?

(a) International Covenant on Civil and Political Rights
(b) Convention of the Elimination of All Forms of Discrimination against Women
(c) Convention on the Rights of Persons with Disabilities
(d) Declaration on the Right to Development

(❯) (**d**) 'Declaration on the Right to Development' is not an International Human Rights Treaty.

There are seven core international human rights treaties. Each of these treaties has established a committee of experts to monitor implementation of the treaty provisions by its states parties, other than three treaties mentioned in question.

The other treaties are
(i) International Convention on the Elimination of All Forms of Racial Discrimination (ICERD)
(ii) International Covenant on Civil and Political Rights (ICCPR)
(iii) International Covenant on Economic, Social and Cultural Rights (ICESCR)
(iv) Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW)

58. In the context of elections in India, which one of the following is the correct full form of VVPAT?

(a) Voter Verifiable Poll Audit Trail
(b) Voter Verifying Paper Audit Trail
(c) Voter Verifiable Paper Audit Trail
(d) Voter Verifiable Paper Account Trail

(❯) (**c**) Voter Verifiable Paper Audit Trail (VVPAT) is a method of providing feedback to voters using a ballotless voting system.

A VVPAT is intended as an independent verification system for voting machines. It was designed to allow voters to verify that their vote was cast correctly,to detect possible election fraud or malfunction and to provide a means to audit the stored electronic results.

59. Which of the following are the functions of the National Human Rights Commission (NHRC)?

1. Inquiry at its own initiative on the violation of human rights.
2. Inquiry on a petition presented to it by a victim.
3. Visit to jails to study the condition of the inmates.
4. Undertaking and promoting research in the field of human rights.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 2, 3 and 4
(c) 1, 3 and 4   (d) All of these

(❯) (**d**) All the statements given in question come under the functions of the National Human Rights Commission (NHRC). It is formed as per the statutory provisions of Protection of Human Rights Act, 1993. It is a multi-member body consisting of Chairman and four members.

President appoints the Chairman and members of the NHRC on the recommendation of the high-powered committee headed by the Prime Minister.

Hence, all the statements are correct.

60. A person is disqualified for being chosen as, and for being, a member of either House of the Parliament if the person

1. holds any office of profit under the Government of India or the Government of any State other than an office declared by the Parliament by law not to disqualify its holder
2. is an undischarged insolvent
3. is so disqualified under the Tenth Schedule of the Constitution of India
4. is of unsound mind and stands so declared by a competent Court

Select the correct answer using the codes given below
(a) 1, 2 and 4   (b) 1, 2 and 3
(c) 3 and 4   (d) All of these

(❯) (**d**) The Constitution of India has provided (in Article 102) that a member of Parliament will be disqualified for membership if
(i) he holds any office of profit under the Union or State Government (except that of a minister or any other office exempted by Parliament).

(ii) he is of unsound mind and stands so declared by a court.

(iii) he is an undischarged insolvent.

(iv) he has ceased to be a citizen of India.

(v) he is disqualified under any other law by Parliament.

Hence, all the statements are correct.

61. According to the Election Commission of India, in order to be recognised as a 'National Party', a political party must be treated as a recognised political party in how many states?

(a) At least two states
(b) At least three states
(c) At least four states
(d) At least five states

(c) For recognition as National Party, a political party has to fulfill the following conditions:

(i) The party wins 2% of seats in the Lok Sabha (11 seats) from at least three different states.

(ii) At a General Election to Lok Sabha or Legislative Assembly, the party polls 6% of votes in four states and in addition it wins 4 Lok Sabha seats.

(iii) A party gets recognition as state party in four or more states. Both national and state parties have to fulfill these conditions for all subsequent Lok Sabha or State elections. Otherwise, they lose their status.

Hence, options (c) is correct.

62. Which one of the following is not a correct ascending order of commissioned ranks in the defence forces of India?

(a) Lieutenant, Captain, Major, Lieutenant Colonel, Colonel, Brigadier, Major General, Lieutenant General, General

(b) Flying Officer, Flight Lieutenant, Squadron Leader, Wing Commander, Group Captain, Air Commodore, Air Vice Marshal, Air Marshal, Air Chief Marshal

(c) Flying Officer, Flight Lieutenant, Squadron Leader, Group Captain, Wing Commander, Air Commodore, Air Vice Marshal, Air Marshal, Air Chief Marshal

(d) Sub Lieutenant, Lieutenant, Lieutenant Commander, Commander, Captain, Commodore, Rear Admiral, Vice Admiral, Admiral

(c) This table gives the descending order of ranks in defence forces in India

Army	Air Force	Navy
Field Marshal	Marshal of the Air Force	Admiral of the fleet
General	Air Chief Marshal	Admiral
Lt General	Air Marshal	Vice Admiral
Major General	Air Vice Marshal	Rear Admiral
Brigadier	Air Commodore	Commodore
Colonel	Group Captain	Captain
Lt Colonel	Wing Commander	Commander
Major	Squadron Leader	Lt Commander
Captain	Flight Lieutenant	Lieutenant
Lieutenant	Flying Officer	Sub Lieutenant

As per the given table option (c) is not a correct ascending order of commissioned ranks in defence forces of India.

63. Which of the following statements about Attorney General of India is/are not correct?

1. He is the first Law Officer of the Government of India.

2. He is entitled to the privileges of a Member of the Parliament.

3. He is a whole-time counsel for the government.

4. He must have the same qualifications as are required to be a judge of the Supreme Court.

Select the correct answer using the codes given below

(a) 1, 2 and 3   (b) 2 and 4
(c) Only 3   (d) Only 1

(c) Attorney General of India is not a whole time counsel for the government. Attorney General is Indian government's chief legal advisor and its primary lawyer in the Supreme Court of India.

As per Article 76(1), President of India appoints Attorney General for a term which is decided by President.

The Attorney General holds the office during the pleasure of the President. The Attorney General represents the government but is also allowed to take up private practice, provided the other party is not the state.

Attorney General has right of audience in all courts within the territory of India. He has also the right to speak and take part in proceedings of both the Houses of Parliament including joint sittings. Attorney General has all the powers and privileges that of a member of Parliament.

Hence, all the statements are correct except 3.

64. Under which one of the following Amendment Acts was Sikkim admitted into the Union of India?

(a) 35th   (b) 36th   (c) 37th (d) 38th

(b) Under the 36th Amemdment Act the state Sikkim admitted to the Union of India.

Sikkim became a state of India via the Amendment Act, 1975 on 26th April, 1975. The Sikkim State day is observed on 16th May of every year because this was the day when the first Chief Minister of Sikkim assumed office.

In 1974, the Sikkim Assembly passed a Government of Sikkim Act, 1974, which paved the way for setting up the first ever responsible government in Sikkim and sought Sikkim's representation in the political institutions of India. India also passed the 35th Amendment Act, 1974 which inserted a new Article 2A (Sikkim to be associated with Union).

65. Which one of the following statements in respect of the States of India is not correct?

(a) States in India cannot have their own Constitutions

(b) The State of Jammu and Kashmir has its own Constitution

(c) States in India do not have the right to secede from the Union of India

(d) The maximum number of members in the Council of Ministers of Delhi can be 15% of the total number of members in the Legislative Assembly

(d) The maximum number of members in the Council of Ministers of Delhi can be 10% of the total number of members in the Assembly.

Therefore, option(d) is incorrect.

India is governed by a single Constitution for the whole country. The states in India are carved for the administrative significance so, they do not have any right to secession from the Union.

66. Which one of the following Amendments to the Constitution of India has prescribed that the Council of Ministers shall not exceed 15% of total number of members of the House of the People or Legislative Assembly in the States?

(a) 91st Amendment
(b) 87th Amendment
(c) 97th Amendment
(d) 90th Amendment

⊘ (*a*) Earlier, a 'defection' by one-third of the elected members of a political party was considered a merger. The 91st Constitutional Amendment Act, 2003, changed this. So now atleast two-thirds of the members of a party have to be in favour of a 'merger' for it to have validity in the eyes of the law.

This amendment also fixed the strength of council of ministers to 15% of the total number of members of the house.

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67. In which two Indian States of the four mentioned below, it is necessary to hold certain minimum educational qualifications to be eligible to contest Panchayat Elections?

1. Punjab   2. Haryana
3. Karnakata   4. Rajasthan

Select the correct answer using the codes given below

(a) 1 and 2   (b) 2 and 4
(c) 2 and 3   (d) 1 and 4

⊘ (*b*) Haryana and Rajashtan are the states who mandate to 'fix minimum education qualification for those contesting in Panchayat Raj Institutions.

The Haryana law mandates that the minimum education qualification that to context in the Panchayat polls is class 10th pass for men, class 8th for women and class 5th pass for dalits.

In Rajasthan, candidates contesting Zila Parishad and Panchayat Samiti polls have to be *X*th pass and for Sarpanch elections class 8th pass.

68. Which of the following statements about 'delegation' is/are correct?

1. It is the abdication of responsibility.
2. It means conferring of specified authority by a lower authority to a higher one.
3. It is subject to supervision and review.
4. It is a method of dividing authority in the organisation.

Select the correct answer using the codes given below

(a) Only 3   (b) 2 and 4
(c) 3 and 4   (d) 1, 2 and 4

⊘ (*c*) The delegation of authority is an organisational process wherein, the manager divides his work among the

subordinates and gives them the responsibility to accomplish the respective tasks.

Along with the responsibility, he also shares the authority i.e., the power to take decisions with the subordinates, such that responsibilities can be completed efficiently.

Hence option (c) is correct.

69. Which of the following features were borrowed by the Constitution of India from the British Constitution?

1. Rule of Law
2. Law making Procedure
3. Independence of Judiciary
4. Parliamentary

Select the correct answer using the codes given below

(a) 1 and 2
(b) 2, 3 and 4
(c) 1 and 4
(d) 1, 2 and 4

⊘ (*d*) The Indian Constitution is unique in its contents and spirit. Though borrowed from almost every Constitution of the world, the Constitution of India has several features that distinguish it from the Constitutions of other countries. Following features have been borrowed by the British Constitution

1. Parliamentary government
2. Rule of Law
3. Legislative procedure
4. Single Citizenship
5. Cabinet system
6. Prerogative writs
7. Parliamentary privileges
8. Bicameralism

Independence of Judiciary has been taken from the Constitution of USA.

Hence option (d) is the correct answer.

70. Which one of the following Schedules of the Constitution of India has fixed the number of Members of the Rajya Sabha to be elected from each state?

(a) Fifth Schedule
(b) Third Schedule
(c) Sixth Schedule
(d) Fourth Schedule

⊘ (*d*) The Fourth schedule of the Indian Constitution contains provisions as to the allocation of seats in the council of states.

Indian Constitution originally had eight schedules. Four more schedules were added by different amendments, now

making a total 12 schedules. These are basically tables which contains additional details not mentioned in the articles.

Third Schedule Forms of Oaths or Affirmations.

Fifth Schedule Provisions as to the administration and control of scheduled areas and scheduled tribes.

Sixth Schedule Provisions as to the administration of tribal areas in (the states of Assam, Meghalaya, Tripura and Mizoram.)

71. Statement I The Communists left the All India Trade Union Congress in 1931.

Statement II By 1928, the Communists were no longer working with the mainstream national movement.

Codes

(a) Both the statements are individually true and Statement II is the correct explanation of Statement I.
(b) Both the statements are individually true but Statement II is not the correct explanation of Statement I
(c) Statement I is true, but Statement II is false
(d) Statement I is false but Statement II is true.

⊘ (*c*) The communists left the all India Trade Union Congress in 1931.

The All India Trade Union Congress was started in 1920. But from 1922, Socialist and Communist ideas started to emerge.

There were differences in the ideologies of both wings.

This led to split and NM Joshi left the All India Trade Union Congress. He founded the All India Trade Union Federation.

Hence, statement (1) is true and (2) is false.

72. The Fundamental Rights guaranteed in the Constitution of India can be suspended only by

(a) a proclamation of National Emergency
(b) an Act passed by the Parliament
(c) an amendment to the Constitution of India
(d) the judicial decisions of the Supreme Court

⊘ (*a*) During a national emergency, all the basic freedoms guaranteed by Article 19 automatically get suspended.

During emergency, President can suspend all other fundamental rights except Article 20 and Article 21. Such suspension needs parliamentary approval.

Hence, option (a) is true.

73. Which of the following statements about the 73rd and 74th Constitution Amendment Act is/are correct?

1. It makes it mandatory for all states to establish a three-tier system of Government.
2. Representatives should be directly elected for five years.
3. There should be mandatory reservation of one-third of all seats in all Panchayats at all levels for women.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 2 and 3
(c) 1, 2 and 3   (d) Only 3

⊘ (**b**) 73rd and 74th Constitution Amendments are a part of the Constitution, but many of its key provisions are not mendatory for the state government.

These amendments prescribes regular elections on every five years and election within six months of the dissolution of urban bodies and rural bodies. The election supervised by the State Election Commission.

The most revolutionary provision is the reservation of 1/3 rd of the seats for women in local bodies, alongwith the reservation of seats for scheduled castes and sceduled tribes in proportion to their regional population.

Hence, statement 1 is incorrect, statement 2 and 3 are correct.

74. A joint sitting of the Parliament is resorted to, for resolving the deadlock between two Houses of the Parliament for passing which of the following Bills?

1. Money Bill
2. Constitutional Amendment Bill
3. Ordinary Bill

Select the correct answer using the codes given below
(a) 1 and 2   (b) 2 and 3
(c) 1, 2 and 3   (d) Only 3

⊘ (**b**) Money Bills can be introduced only in Lok Sabha. Rajya Sabha cannot make amendments in a Money Bill passed by Lok Sabha and transmitted to it.

All other Bills introduced in either house of the Parliament or needs to be passed by both the houses with a simple majority.

Hence, option (b) is correct.

75. Which of the following statements is/are correct?

1. The Directive Principles of State Policy are meant for promoting social and economic democracy in India.
2. The Fundamental Rights enshrined in Part III of the Constitution of India are ordinarily subject to reasonable restrictions.
3. Secularism is one of the basic features of Constitution of any country.

Select the correct answer using the codes given below
(a) Only 1   (b) Only 2
(c) 1 and 2   (d) 1, 2 and 3

⊘ (**c**) The Directive Principles of State Policy of India are the guidelines which have been enshrined in Part IV of Indian Constitution. Directive Principles given in the Constitution are meant to promote social justice, economic welfare, foreign policy, and legal and administrative matters. Hence, statement 1 is correct.

Fundamental rights are those rights which are essential for existence and all-round development of individuals, hence, it's called as 'Fundamental' rights.

These are enshrined in Part III (Articles 12 to 35) of the Constitution of India. Accordingly under Article 19 (2), the state may make a law imposing reasonable restrictions on the exercise of the right to freedom of speech and expression. Hence, statement 2 is also correct.

A secular state is an idea pertaining to secularity, whereby a state is or purports to be officially neutral in matters of religion, supporting neither religion nor irreligion. Secularism is not the basic feature of Constitution of any country. Some of the countries has define state religion also. Hence statement 3 is not correct.

76. The President of India is elected by an Electroal College comprising of elected members of which of the following?

1. Both the Houses of the Parliament
2. The Legislative Assemblies of States
3. The Legislative Councils of States

4. The Legislative Assemblies of NCT of Delhi and Puducherry

Select the correct answer using the codes given below
(a) 1 and 2   (b) 1, 2 and 3
(c) 1, 2 and 4   (d) Only 4

⊘ (**c**) The President is elected by the members of an electoral college consisting of
(i) the elected members of both the Houses of the Parliament and
(ii) the elected members of the Legislative Assemblies of the states.
(In this article and in Article 55, 'State' includes the National Capital Territory of Puducherry).

Hence, option (c) is the correct answer.

77. Consider the following statements about the Scheduled Castes and the Scheduled Tribes under the provisions of the Constitution of India

1. State can make any special provision relating to their admission to the Government educational institutions.
2. State can make any special provision relating to their admission to the private educational institutions aided by the state.
3. State can make any special provision relating to their admission to the private educational institutions not aided by the state.
4. State can make any special provision relating to their admission to the minority educational institutions as described in Article 30.

Which of the statements given above are correct?
(a) 1 and 2   (b) 3 and 4
(c) 1, 2 and 3   (d) 1, 2, 3 and 4

⊘ (**c**) Constitution reads as follow "Nothing in this Article of sub-clause(g) of clause (1) of Article 19 shall prevent the state from making any special provision, by law, for the advancement of any socially and educationally backward classes of citizens or for Scheduled Caste or Scheduled Tribe in so far as such special provision related to their admission to educational institutions including private educational institutions, whether aided or unaided by state, other than minority educational institutions referred to in clause (1) of Article 30." Hence, all statements except statement 4 are correct.

78. Article 21 of the Constitution of India includes

1. Rights of transgenders
2. Rights of craniopagus twins
3. Rights of mentally retarded women to bear a child

Select the correct answer using the codes given below

(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) 1, 2 and 3

⊙ (**d**) Article 21 of the Indian Constitution provides that no person shall be deprived of his life or personal liberty except according to a procedure established by law. This right has been held to be the heart of the Constitution, the most organic and progressive provision in our living Constitution, the foundation of our laws. Article 21 secures two rights:

• Right to life
• Right to personal liberty

Thus, Article 21 covers the rights of transgenders, craniopagus twins and rights of mentally retarded women to bear a child.

Hence, option (d) is correct.

79. Who among the following was not a member of the Drafting Committee of the Constituent Assembly?

(a) NG Ayyangar
(b) KM Munshi
(c) BN Rau
(d) Muhammad Saadullah

⊙ (**c**) BN Rau was appointed as the constitutional adviser to the Constituent Assembly in formulating the Indian Constitution in 1946.

On 29th August, 1947, the Drafting Committee was appointed with Dr. BR Ambedkar as the Chairman along with six other members. They were Pandit Govind Ballabh Pant, KM Munshi, AK Iyer, NG Ayengar, BL Mitter, Md. Saadullah and DP Khaitari.

80. Constitutional safeguards available to Civil Servants are ensured by

(a) Article 310   (b) Article 311
(c) Article 312   (d) Article 317

⊙ (**b**) The Constitution of India through Article 311, thus protects and safe guards the rights of civil servants in Government Services against arbitrary dismissal, removal and reduction in rank. Such protection enables the civil servants to discharge their functions boldly, efficiently and effectively.

81. A writ issued to secure the release of a person found to be detained illegally is

(a) Mandamus   (b) Habeas Corpus
(c) Certiorari   (d) Prohibition

⊙ (**b**) The Indian Constitution empowers the Supreme Court to issue writs for enforcement of any of the fundamental rights conferred by part III of Indian Constitution Under Article 32.

There are five types of writs-Habeas Corpus, Mandamus, Prohibition, Certiorari and Quo warranto.

Habeas Corpus writ is issued to produce a person who has been detained, whether in prison or in private custody, before a court and to release him if such detention is found illegal.

82. Which one of the following cannot be introduced first in the Rajya Sabha?

(a) Constitutional Amendment
(b) CAG Report
(c) Annual Financial Statement
(d) Bill to alter the boundaries of any state

⊙ (**b**) The reports of the Comptroller and Auditor-General of India (CAG) relating to the accounts of the Union Shall be submitted to the President.

The President in case of the union and to the Governor in case of the state who in turn cause them to be tabled before the House.

83. The National Commission for Women was created by

(a) an amendment in the Constitution of India
(b) a decision of the Union Cabinet
(c) an Act passed by the Parliament
(d) an order of the President of India

⊙ (**c**) The National Commission for women was set up as statutory body in January, 1992 under the National Commission for Women Act, Passed by the Parliament in 1990 (Act No. 20 of 1990 of Government of India) to review the constitutional and legal safeguards for women.

84. Who among the following was the Chief Justice of India when Public Interest Litigation (PIL) was introduced in the Indian Judicial System?

(a) M Hidayatullah   (b) A S Anand
(c) A M Ahmadi   (d) P N Bhagwati

⊙ (**d**) PIL is directly filed by an individual or group of people in the Supreme Court and High courts and Judicial member.

India had to wait till 1986 when the then Chief Justice PN Bhagwati introduced Public Interest Litigation (PIL) to the Indian Judicial system. He is therefore held, alongwith Justice VR Krishna Iyer, to have pioneered judicial activism in the country.

85. Which one of the following statements regarding Uniform Civil Code as provided under Article 44 of the Constitution of India is not correct?

(a) It is Fundamental Right of every Indian citizen
(b) The State shall endeavour to secure it for citizens throughout the territory of India
(c) It is not enforceable by any Court
(d) It is not enforceable by a Court yet the Constitution requires that as a principle it should be fundamental in the governance of our country

⊙ (**a**) Article 44 of the Directive Principles sets its implementation as duty of the State to make guidelines for its effective implementation. It is not a part of fundamental rights.

Uniform civil code on the ongoing point of debate within India mandate to replace the personal laws based on the scriptures and customs of each major religious community in India with a common set of rules governing every citizen.

86. Which one of the following statements about emergency provisions under the Constitution of India is not correct?

(a) The powers of the Union Executive extend to giving directions to the states concerning the exercise of their powers.
(b) The Union Executive can issue a provision relating to reduction of salaries of employees of the State Governments.
(c) Governors have no emergency powers like the President of India.
(d) If the Governor of a State is satisfied that a situation has arisen whereby the financial stability or credit of the State is threatened, he may declare financial emergency in the State.

⊙ (**d**) The executive powers of state are vested with Governor. Unlike President of India, Governor has no such power to declare emergency in the state except under Article 356 that empowers a Governor to report the President about the failure of government in his state,

thus to take over the administration of that particular state.

Article 360 states that if the President is satisfied that a situation has arisen whereby the financial stability or the credit of India or any part is threatened, President may declare a state of emergency. During the period of such proclamation, the executive authority of the union extends to the giving of directions to nay state to observe such canons of financial propriety as may be specified in the directions.

Hence, option (a), (b) and (c) are correct, option (d) is incorrect.

2017 (I)

87. Which of the following statement(s) about the Ilbert Bill (1883) is/are correct?

1. It proposed to grant limited criminal jurisdiction to native officials.
2. It proposed to grant complete civil and criminal jurisdiction to native officials.
3. The proposed Bill generated opposition from England's European subjects in India.
4. In spite of opposition to the Bill, it was passed without any modifications.

Select the correct answer using the codes given below
(a) 1 and 2   (b) Only 2
(c) 1 and 3   (d) 3 and 4

⊙ (*c*) The bill was introduced in 1883 by Viceroy Ripon, who actually desired to abolish the racial prejudice from the Indian Penal Code. Ripon had proposed an amendment for existing laws in the country and to allow Indian judges and magistrates the jurisdiction to try British offenders in criminal cases at the District level. It was never allowed before.

So naturally, the Europeans living in India looked it as a humiliation and the introduction of the bill led to intense opposition in Britain as well as India (by the British residents). So, it was withdrawn but was reintroduced and enacted in 1884 with several amendments.

Hence, option (c) is correct.

88. Consider the following statements about the Second Five-Year Plan :

1. It was drafted under the leadership of KN Raj.

2. It proposed that industries like electricity, railways, steel, machineries and communication could be developed in the public sector.
3. The drafters found balancing industry and agriculture very difficult.
4. The drafters found balancing industry and agriculture really easy.

Which of the statement(s) given above is/are correct?
(a) Only 1   (b 1 and 2
(c) 2 and 3   (d) 3 and 4

⊙ (*c*) The Second Five-Year Plan was drafted under the leadership of PC Mahalanobis. KN Raj drafted sections of India's first Five-Year Plan. Hence, statement 1 is incorrect.

The Second Five Year Plan focused on heavy industries and followed socialist pattern of society as its goal.

Since savings and investment were growing in this period, a bulk of these industries like electricity, railways, steel, machineries and communication could be developed in the public sector. Thus, statement 2 is correct.

However, the Second Five-Year Plan had its problems as well, because industry attracted more investment than agriculture, the possibility of food shortage became adverse. So, the planners found balancing industry and agriculture really difficult.

Hence, statement 3 is also correct.

89. To be eligible to contest election under the Haryana Panchayati Raj (Amendment) Act, 2015, a candidate should

1. have a functional toilet at home
2. have payment slips of power bills
3. not be a cooperative loan defaulter
4. have studied minimum matriculation irrespective of category

Select the correct answer using the codes given below.
(a) 1, 2 and 3   (b) 1, 2 and 4
(c) 1, 2, 3 and 4   (d) 3 and 4

⊙ (*a*) The amended Haryana Panchayati Raj Act barred five categories of people from contesting Panchayat elections. These were:

1. Persons, who are charged in a criminal case for an offence that could be punished with imprisonment for not less than 10 years.

2. Those who defaulted on agriculture loans.
3. Persons with outstanding payments of electricity bills.
4. Those, who do not have the minimum specified educational qualification.
5. Those, who do not have a functional toilet at their residence.

Hence, option (a) is correct.

90. Arrange the following Commissions chronologically on the basis of their date of setting :

1. The Second Administrative Reforms Commission
2. The Eleventh Finance Commission
3. Punchhi Commission
4. Sarkaria Commission

Select the correct answer using the codes given below
(a) 4, 2, 1, 3   (b) 4, 3, 2, 1
(c) 3, 2, 4, 1   (d) 3, 4, 1, 2

⊙ (*a*) **Sarkaria Commission** was setup in June, 1983 by the Central Government of India. The Sarkaria Commission's charter was to examine the relationship and balance of power between State and Central Governments in the country and suggest changes within the framework of Constitution of India.

The **Eleventh Finance Commission** of India was appointed by the President on 3rd July, 1998 for the Period 2000-05.

Second Administrative Reforms Commission 5th August, 2005 as a committee of inquiry to prepare a detailed blueprint for revamping the public administration system.

In April, 2007, a three member commission headed by the former Chief Justice **MM Punchhi** was set-up by the UPA government to take a fresh look at relative roles and responsibilities of various levels of government and their inter-relations.

Hence, option (a) is correct.

91. Which of the following statements with regard to Panchayats in India are correct?

1. Seats in a Panchayat are filled by direct election from the territorial constituencies in the Panchayat area.
2. The Gram Sabha is the body of persons registered in the electoral rolls relating to a village within the Panchayat area.
3. The Panchayats work on the principle of constitutional autonomy.

4. The State Legislature may by law endow the Panchayats with the power and authority to enable them to function.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 2, 3 and 4
(c) 1, 2 and 4   (d) 1 and 4

⊘ (**c**) Panchayati Raj is the system of local self government in India as introduced by the Constitutional Amendment in 1992.

According to the Constitution (Seventy-Third Amendment) Act, 1992, Gram Sabha means a body consisting of persons registered in the electoral rolls relating to a village comprised within the area of Panchayat at the village level.

All the seats in a Panchayat are filled by persons chosen by direct election from territorial constituencies in the Panchayat area. Hence, statement 1 and 2 are correct.

The legislature of a State may, by law, endow the Panchayats with such powers and authority as may be necessary to enable them to function as institutions of self-government.

Hence, statement 4 is also correct.

Within the constitutional framework, 'Panchayats' is a State subject. Hence, the Panchayat does not work on the principle of constitutional autonomy. Hence, statement 3 is incorrect.

92. Which of the following statement(s) regarding Indian federal system is/are correct?

1. All States have equal representation in the Rajya Sabha.
2. Consent of a State is not required for altering its boundaries.
3. There is no dual citizenship in India.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 2 and 3
(c) 1 and 3   (d) Only 2

⊘ (**b**) Besides some federal features, the Constitution of India also has some unitary features as well. All states have no equal representation in the Rajya Sabha, because in India the states are given representation in the Rajya Sabha on the basis of population.

Hence, statement I is not correct.

Thus, the number of representatives varies from state to state, for instance, Uttar Pradesh has 31 members whereas Tripura has only 1 member.

This principle is considered as a safeguard for smaller states. States in

India also have no right to territorial integrity. The Parliament is empowered to change the area, boundaries or name of any state without their consent.

Moreover, despite dual Polity, the Constitution of India adopted the system of single citizenship. There is only Indian citizenship and no separate state citizenship.

Hence, option (b) is correct

93. Which of the following are the powers of the Supreme Court of India?

1. Original jurisdiction in a dispute between the Government of India and one or more states.
2. The power to hear appeals from the High Courts.
3. Passing decrees and orders for doing justice in any matter before it.
4. Render advice to the President of India in matters of law.

Select the correct answer using the codes given below
(a) 1, 2, 3 and 4   (b) 1, 2 and 3
(c) 1 and 2   (d) 3 and 4

⊘ (**a**) The Supreme Court of India is the highest judicial forum and final court of appeal under the Constitution of India. As the final court of appeal under the Constitution of India, it takes up appeals primarily against verdicts of the high courts of various state of the union. The law declared by the Supreme Court becomes binding on all courts within India. Hence, option (a) is correct.

94. The Twelfth Five-Year Plan focused on inclusive growth. Which of the following were considered as challenges for inclusiveness?

1. Poverty
2. Group inequality
3. Regional imbalance
4. Unemployment

Select the correct answer using the codes given below
(a) 1, 3 and 4   (b) 1, 2, 3 and 4
(c) 1, 2 and 4   (d) 2 and 3

⊘ (**a**) The inclusive growth is necessary for sustainable development and equitable distribution of wealth and prosperity.

The challenges in most important elements of inclusive growth are agriculture, poverty and employment, social sector and regional. Hence, Poverty, regional balance and unemployment are considered as challenges for inclusiveness. Group

inequality is not a challenge to inclusiveness.

Hence option (a) is correct.

95. Which of the following statements are correct about 'Saakshar Bharat' scheme?

1. It is a centrally sponsored scheme which was launched during the Eleventh Five-Year Plan.
2. The scheme applies to women in particular and disadvantaged groups in general.
3. The scheme applies to persons above the age of 10 years.
4. The scheme is anchored with Panchayati Raj Institutions and Local Self-Government.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 2, 3 and 4
(c) 1, 2 and 4   (d) 1, 3 and 4

⊘ (**c**) Saakshar Bharat scheme was launched on 8th September, 2009 during the 11th Five Year Plan, with an aim to raise literacy rate to 80%, to bridge gender gap to 10%.

The scheme is anchored with Panchayati Raj Institutions and Local Self-government to decrease regional and social disparities and to focus on women, SCs, STs, minorities and other disadvantaged groups.

It focused mainly on adult education, with emphasis on non-literates in the age group of 15-36 years. Hence, all statements are correct except statement 3.

96. Which of the following statements relating to the powers of the President of India is/are correct?

1. The executive power of the Union shall be vested in the President.
2. The executive power shall be exercised by the President only through officers subordinate to him.
3. The Supreme Command of the defence forces of the Union shall be vested in the President.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 1 and 2
(c) 1 and 3   (d) Only 3

⊘ (**a**) Article 53 of the Constitution provides that the executive power of the Union is vested in the President and he shall exercise his power either directly or through officers subordinate to him in

accordance with the provisions of the Constitution.

Supreme command of the Indian Armed Forces is vested in the President of India, although effective executive power and responsibility for national defence resides with the Cabinet of India headed by the Prime Minister. Hence, statements 1, 2 and 3 are correct.

97. Which of the following statements regarding Article-21 of the Constitution of India is/are correct?

1. Article 21 is violated when the under-trial prisoners are detained under judicial custody for an indefinite period.
2. Right to life is one of the basic human rights and not even the State has the authority to violate that right.
3. Under Article-21, the right of a woman to make reproductive choices is not a dimension of personal liberty.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 1 and 2
(c) 1 and 3   (d) Only 2

⊘ (**b**) Article 21 gets violated when the under trial prisoners are detained under judicial custody for an indefinite period.

Right to life is one of the basic human rights and not even the state has the authority to violate that right.

Hence, statement 1 and 2 is correct. Women always have the right to make reproductive choices.

Hence, statement 3 is incorrect.

98. Which of the following statement(s) is/are correct regarding Right to Education in India?

1. Free and compulsory education should be provided to all children of the age of 6 to 14 years.
2. The imperative of the provision of the Right to Education Act, 2009 is that schools must have qualified teachers and basic infrastructure.
3. There should be quality education without any discrimination on the ground of economic, social and cultural background.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 1 and 2
(c) 1 and 3   (d) Only 3

⊘ (**a**) The Right of children to free and compulsory Education Act or Right to Education Act is an act of the Parliament of India enacted on 4th August 2009. It describes the modalities of the importance of free and compulsory education for children between the age of 6 to 14 years in India under Article 21A of the Indian Constitution.

This act provides that the states will ensure that no non-teaching work is given to the teachers. The act recommends quality teachers and mandates that untrained teachers will have to upgrade themselves in 5 years. The act has listed minimum infrastructure requirements as a part of the schools and mandates the States to ensure that schools have these requirements. The schools which don't conform to the quality standards as mentioned in the Act, will upgrade themselves in 3 years or face derecognition. Hence, all the statements are correct.

99. Which one of the following statements regarding freedom to manage religious affairs as per the Constitution of India is not correct?

(a) Every religious denomination shall have the right to manage its own affairs in matters of religion except some minor communities
(b) Every religion or any section there of shall have the right to own and acquire movable and immovable property
(c) Every religious community has the right to establish and maintain institutions for religious and charitable purposes
(d) Every community has the right to manage its own affairs in matters of religion

⊘ (**a**) Article 30 of the India Constitution states the right of minorities to establish and administer educational institutions. Article 30(1) says that all minorities, whether based on religion or language, shall have the right to establish and administer educational institutions of their choice.

Further, Article 30(1A) deals with the fixation of the amount for acquisition of property of any educational institution established by minority groups.

Article 30(2) states that the government should not discriminate against any educational institution on the ground that it is under the management of a minority, whether based on religion or language, while giving aid.

Hence, all options are correct except (a), as every religious denomination including minor communities shall have right to manage its own affairs.

100. Which one of the following statements relating to protection against arrest and detention of individuals under Article-22 is not correct?

(a) No person who is arrested shall be detained in custody without being informed of the grounds for such arrest.
(b) No person shall be denied the right to consult, and be defended by, a legal practitioner of his/her choice.
(c) Every person, who is arrested and detained in custody, shall be produced before the nearest Magistrate within a period of one week of such arrest.
(d) The right to protection against arrest is not available to a person in jail pursuant to a judicial order.

⊘ (**c**) Every person, who is arrested and detained in custody shall be produced before the nearest Magistrate within a period of twenty four hours of such arrest excluding the time necessary for the journey from the place of arrest to the court of the Magistrate and no such person shall be detained in custody beyond the said period without the authority of a Magistrate.

Hence, option (c) is not correct.

101. Which one of the following intellectual property rights is protected without making any registration?

(a) Copyright
(b) Patent
(c) Industrial design
(d) Trademark

⊘ (**a**) Acquisition of copyright is automatic and it does not require any formality. Copyright comes into existence as soon as a work is created and no formality is required to be completed for acquiring copyright.

However, certificate of registration of copyright and the entries made therein serve as prima facie evidence in a court of law with reference to dispute relating to ownership of copyright.

102. The Most Favoured Nation (MFN) clause under WTO regime is based on the principle of

(a) non-discrimination between nations
(b) discrimination between nations
(c) differential treatment between locals and foreigners
(d) uniform tariff across commodities

⊙ (**a**) Most-Favoured-Nation (MFN) clause mentions that under the WTO agreements other people should be treated equally. Countries cannot normally discriminate between their trading partners, grant someone a special favour (such as a lower customs duty rate for one of their products) and you have to do the same for all other WTO members.

Hence, option (a) is correct.

103. The rank of Captain of the Indian Navy is equivalent to which one of the following?

(a) Captain of the Indian Army
(b) Group Captain in the Indian Airforce
(c) Lieutenant Colonel of the Indian Army
(d) Wing Commander of the Indian Airforce

⊙ (**b**) India uses the midshipman rank in its navy, and all future officers carry the rank upon entering the Indian Naval Academy. The rank of captain of the Indian Navy is equivalent to group captain in the Indian Airforce.

104. Which one of the following statements is correct in relation to the Indian Airforce?

(a) It has bases in many friendly countries.
(b) It does not carry out joint exercises with any country.
(c) It has a separate Maintenance Command.
(d) No officer has ever been elevated to the rank Marshal of the Indian Airforce.

⊙ (**c**) Maintenance Command is a command of the Indian Air Force. It was raised as Maintenance Group at Chakeri in Kanpur in 1950. In 1955, it was designated as Maintenance Command. Hence, only option (c) is correct.

105. Statement I The Poona Pact provided for 151 reserved seats for the Scheduled Castes to be elected by a joint, not separate, electorate.

Statement II Dr. BR Ambedkar withdrew from active politics for

almost a decade when the Communal Award was revoked.

Codes
(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true but statement II is not the correct explanation of statement I
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true

⊙ (**c**) The Poona Pact was an agreement between Dr. Babasaheb Ambedkar and Mahatma Gandhi which was signed on 24th September, 1932 at Yerwada Central Jail in Pune, India, which asserted that there will be a single Hindu electorate, with scheduled 151 castes having 151 seats reserved within it, so the representation of these classes was based on the standards of joint electorates and reserved seats.

The Communal Award was made by the British Prime Minister Ramsay MacDonald on 16th August, 1932 which allowed separate electorates in India, and it was supported by Ambedkar. Hence, statement I is true, but statement II is false.

106. Which one of the following statements about the All India Depressed Classes Association is not correct?

(a) The All India Depressed Classes Association was formed in Nagpur with MC Rajah as its first elected President.
(b) The All India Depressed Classes Association was not attended by Dr. BR Ambedkar in 1926.
(c) Ambedkar resigned from the All India Depressed Classes Association and formed his own All India Depressed Classes Congress in 1930.
(d) The All India Depressed Classes Association favoured Ambedkar's demand for separate electorate for the depressed classes.

⊙ (**c**) Dr. BR Ambedkar never resigned from All India Depressed class association. So, option (c) is incorrect.

In the 1930s, Dr. Ambedkar was now in the midst of his career; this was the central and perhaps most controversy-filled decade of his whole complex life.

Dr. B.R Ambedkar founded depressed classes association in 1930. He also became the First President of All India Depressed Classes Congress in the same year.

107. Which one of the following statements about the Justice Party is not correct?

(a) It clamoured for the same kind of separate communal representation for the Non-Brahmins as had been granted to the Muslims by the Morley-Minto Reforms.
(b) It was patronised mainly by richer landowning and urban middle class Non-Brahmins.
(c) It succeeded in getting the provision for 28 reserved seats for the Non-Brahmins in the Montagu-Chelmsford Reforms.
(d) It supported the call given by the Congress to boycott elections in 1920.

⊙ (**d**) The Justice Party was a political party in the Madras Presidency of British India. It was founded by T. M. Nair and P. Theagaraya Chetty in 1916.

Communal division between Brahmins and non Brahmins began in the presidency during the late-19th and early 20th century, mainly due to caste prejudices and disproportionate Brahminical representation in government jobs.

The Justice Party's foundation marked the culmination of several efforts to establish an organisation to represent the non-Brahmins in Madras. Founders of Justice Party thought that Congress was mainly Brahmin party, so, it started opposing Congress.

Hence, option (d) is incorrect.

108. Which one of the following statements relating to cultural and educational rights in India is not correct?

(a) Every section of the citizens has the right to conserve its language, script or culture.
(b) No citizen shall be denied admission into any educational institution maintained by the State or receiving aid out of State funds on grounds of religion, race or language.
(c) The State shall, in granting aid educational institutions, discriminate against any educational institution on the ground that it is under the management of a majority community.
(d) All minorities, whether based on religion or language, shall have the right to establish and administer educational insitutions of their choice.

⊙ (**c**) The Indian Constitution guarantees Cultural and Educational Rights under Articles 29 and 30. Under Article 29, this

article seeks to protect the interests of the minority communities. This article confers the freedom to all citizens, residing in different parts of the land, to conserve their distinct languages, scripts or cultures state shall not impose upon it any culture other than the community's own culture.

This article further assures that no citizen shall be denied admission into any state run or state-aided educational institution on grounds only of religion, race, caste, language or any of them. And under Article 30, It provides that all minority communities—religion or linguistic, have the right to establish and administer educational institutions of their choice. In granting aid to educational institutions, the state shall not discriminate on the grounds of religion or language.

Hence, option (c) is incorrect.

109. Which one of the following statements relating to the Directive Principles of State Policy is not correct?

(a) The provisions contained in Part IV of the Constitution of India shall not be enforceable by any Court.

(b) The Directive Principles of State Policy are fundamental in the governance of the country.

(c) It shall be the duty of the State to apply the Directive Principles in making laws.

(d) The Directive Principles are directed in making India an advanced capitalist country of the world.

⊙ (*d*) The Directive Principles of State Policy are enumerated in Part IV of the Constitution from Articles 36 to 51. The Directive Principles are non-justiciable in nature, that is, they are not legally enforceable by the courts for their violation.

DPSP doesn't seek to advance India as a capitalist country.

Hence, statement (d) is incorrect.

110. Which one of the following statements is not correct regarding the Office of the Vice-President of India?

(a) The Vice-President is elected by an electoral college consisting of the elected members of both the Houses of the Parliament.

(b) The Vice-President is elected in accordance with the system of proportional representation by means of single transferable vote.

(c) The Vice-President shall not be a member of either house of the

Parliament or of a House of the Legislature of any State.

(d) The Vice-President of India shall be ex-officio chairman of the Council of States and shall not hold any office of profit.

⊙ (*a*) The Vice-President is elected by an electoral college consisting of both elected and nominated members of both Houses of Parliament. Hence, option (a) is not correct.

The Vice-President in accordance with the system of proportional representation by means of the single transferable vote and the voting in such election is by secret ballot. The Vice-President is not a member of either House of Parliament or of a House of a Legislature of any state. The Vice-President of India is also Ex-officio Chairman of the Rajya Sabha or Council of States.

111. Which one of the following constitutional authorities inquires and decides in case of doubts and disputes arising out of election of the President and Vice-President of India?

(a) The Supreme Court of India
(b) The Election Commission of India
(c) The Parliamentary Committee
(d) The High Court of Delhi

⊙ (*a*) The Supreme Court of India is the highest judicial forum and final court of appeal under the Constitution of India, As the final court of appeal of the country. It takes up appeals primarily against verdicts of the highest authority including, the state, union, President and Vice-President of India.

2016 (II)

112. The basic structure doctrine with regard to the Constitution of India relates to

1. the power of judicial review.
2. the judgement in Kesavananda Bharati case (1973).
3. the constraints on Article-368 of the Constitution of India.
4. the judgement in Golaknath case (1967).

Which of the statement(s) given above is/are correct?

(a) 1, 2 and 3   (b) 2 and 4
(c) 1 and 3   (d) All of these

⊙ (*a*) The basic structure doctrine was given in the landmark decision of Kesavananda Bharati v. State of Kerala

(1973). The basic structure doctrine states that the Constitution of India has certain basic features that cannot be altered or destroyed through amendments by the Parliament. The Supreme Court can undertake judicial review for such amendments. Hence, statement 1 and 2 are correct.

The Supreme Court declared that Article 368 did not enable Parliament to alter the basic structure or framework of the Constitution and Parliament could not use its amending powers under Article 368 alter the basic structure of the Constitution. Thus, statement 3 is correct.

The Golaknath Case of 1967 relates to the power of the Parliament to curtail the Fundamental Rights provided in the Constitution. Hence, the basic structure doctrine does not relate to Golaknath case.

Hence, statement 4 is incorrect.

113. Which of the following fundamental rights as enshrined in the Constitution of India belong only to the citizens?

1. Article-19 (Protection of right to freedom of speech)
2. Article-21 (Protection of life and personal liberty)
3. Article-15 (Prohibition of discrimination)
4. Article-16 (Equality of opportunity)

Select the correct answer using the codes given below

(a) 1, 2 and 3   (b) 2, 3 and 4
(c) 1, 3 and 4   (d) 1 and 4

⊙ (*c*) There are certain fundamental rights, such as those in Articles–15, 17, 18, 23 and 24 that are also available against private individuals.

Further, certain fundamental rights including those under Articles–14, 20, 21 and 25 apply to persons of any nationality upon Indian soil, while others, such as those under Articles–15, 16, 19 and 30 are applicable only to citizens of India.

Hence, option (c) is correct.

114. A citizen of India will lose his or her citizenship if he or she

1. renounces Indian citizenship.
2. voluntarily acquires the citizenship of another country.
3. marries a citizen of another country.
4. criticises the government.

Which of the statement(s) given above is/are correct?

(a) 1, 2 and 3
(b) 2, 3 and 4
(c) 1 and 2
(d) 1 and 4

⊙ (**c**) The Citizenship Act, 1955, prescribes three ways of losing citizenship whether acquired under the Act or prior to it under the Constitution, like, renunciation, termination and deprivation.

By Renunciation Any citizen of India of full age and capacity can make a declaration renouncing his Indian citizenship. Upon the registration or that declaration, that person ceases to be a citizen of India.

By Termination When an Indian citizen voluntarily (consciously, knowingly and without duress, undue influence or compulsion) acquires the citizenship of another country, his Indian citizenship automatically terminates.

Hence, option (c) is correct.

115. Which one of the following statements is not correct with respect to protection of individuals being tried for offences?

(a) A confession can never be used as evidence against the accused
(b) The accused must have violated an existing law
(c) An accused cannot be tried and punished for the same offence again
(d) The quantum of punishment must be provided in law as it existed on the date of commission of an offence

⊙ (**a**) Article-20 of the Constitution grants protection against arbitrary and excessive punishment to an accused person whether a citizen or a foreigner or legal person like a company or a corporation. It contains three provisions in that direction

No Ex-post-facto Law No person shall be convicted of any offence except for violation of a law in force at the time of the commission of the Act nor subjected to a penalty greater than that prescribed by the law in force at the time of the commission of the Act.

No Double Jeopardy No person shall be prosecuted and punished for the same offence more than once.

No Self-incrimination No person accused of any offence shall be compelled to be a witness against himself.

Hence, option (a) is not correct.

116. Which one of the following statements is not correct with respect to Article-32 of the Constitution of India?

(a) It provides remedies to citizens for the enforcement of fundamental rights
(b) It is a part of fundamental rights
(c) The Supreme Court cannot refuse a writ petition under Article-32 on the ground of delay
(d) Protection under Article-32 also applies to the enforcement of ordinary law which has nothing to do with the fundamental rights

⊙ (**d**) Article 32 provides the right to Constitutional remedies which means that a person has right to move to Supreme Court (and high courts also) for getting his fundamental rights protected. While Supreme Court has power to issue writs under Article 32, High Courts have been given same powers under Article 226. Article 32 provides remedies to citizens for the enforcement of fundamental rights. It is a part of fundamental rights. The Supreme Court cannot refuse a writ petition under Article 32 on the ground of delay.

Protection under Article 32 also applies to the enforcement of ordinary law which has nothing to do with the fundamental rights. Protection under Article 32 applies only to the fundamental rights as provided by the Constitution. Hence option (d) is incorrect.

All the options are correct except (d).

117. Which one of the following writs is issued by the Supreme Court to secure the freedom of a person upon unlawful arrest?

(a) Habeas Corpus   (b) Mandamus
(c) Certiorari   (d) Quo Warranto

⊙ (**a**) Writ of Habeas Corpus secures the freedom of a person upon unlawful arrest. The literally means of the Writ is 'to have the body of'. It is an order issued by the court to a person, who has detained another person, to produce the body of the latter before it.

118. According to the provisons of the Constitution of India, which one of the following is not a Fundamental Duty?

(a) To respect the National Flag
(b) To defend the country
(c) To provide education to one's child
(d) To promote village and cottage industries DPSP

⊙ (**d**) According to the provision of Constitution of India. To promote village and cottage industries DPSP is not a

fundamental duty. Fundamental duties are enshrined in Article-51A of Part-I VA of the Constitution. According to Article-5IA, it shall be the duty of every citizen of India

• to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem.
• to uphold and protect the sovereignty, unity and integrity of India.
• to defend the country and render national service when called upon to do so.
• to provide opportunities for education to his child or ward between the age of six and fourteen years.

119. Under Article-352 of the Constitution of India, an emergency can be declared, if security of any part of India is threatened by

1. war
2. external aggression
3. armed rebellion
4. internal disturbance

Select the correct answer using the codes given below

(a) 1, 2 and 3   (b) 2, 3 and 4
(c) 3 and 4   (d) 1 and 2

⊙ (**a**) Under Article-352, the President can declare a National Emergency when the security of India or a part of it is threatened by war or external aggression or armed rebellion. When a National Emergency is declared on the ground of 'war' or 'external aggression', it is known as 'External Emergency'. On the other hand, when it is declared on the ground of 'armed rebellion', it is known as 'Internal Emergency'.

It may be noted that the President can declare a National Emergency even before the actual occurrence of war or external aggression or armed rebellion, if he is satisfied that there is an imminent danger.

Hence, option (a) is correct.

120. Which one of the following statements is not true of the protection of women from Domestic Violence Act, 2005?

(a) This Act provides civil remedies to protect a woman subjected to domestic violence
(b) Only women can make a complaint under this legislation
(c) Relief may be sought only against the husband or a male live-in partner with whom the woman has lived in a domestic relationship
(d) The Act includes not just wives, but also women in marriage-like relationships

⊗ (**b**) The protection of women from Domestic Violence Act, 2005, is enacted to protect women from domestic violence and came into force from 26th October, 2006.

The Act seeks to definition of an aggrieved person is equally wide and covers not just the wife but a woman, who is the sexual partner of the male irrespective of whether she is his legal wife or not.

The daughter, mother, sister, child (male or female), widowed relative, in fact, any woman residing in the household, who is related in some way to the respondent, is also covered by the Act.

Hence, option (b) is incorrect.

121. Who is the Chairman of the Chiefs of Staff Committee?

(a) The Chief of Army Staff
(b) The Chief of Naval Staff
(c) The Chief of Air Staff
(d) The member who has been longest on the Committee

⊗ (**c**) The Chief of Air Staff is the chairman of the chiefs of Staff Committee.

The Chairman of the Chiefs of Staff Committee was the position of hierarchy in the Indian Armed Forces.

The senior-most Chief of Staff was appointed to serve as a Chairman until he retired. Chief of the Air Staff, Arup Raha was the Chairman of the Chiefs of Staff Committee in 2016. The last Chairman was the Chief of the Army Staff General Bipin Rawat.

The position ceased to exist with the creation of the Chief of Defence Staff. General Bipin Rawat is also the first Chief of Defence Staff of India.

122. Jammu and Kashmir Rifles is

(a) an infantry regiment of the Indian Army
(b) a battalion of the Rashtriya Rifles
(c) the name of the Armed Police of the State of Jammu and Kashmir
(d) a paramilitary force under the Ministry of Home Affairs

⊗ (**a**) The Jammu and Kashmir Rifles is an infantry regiment of the Indian Army. Earlier, the regiment was known as Jammu and Kashmir State Forces and was the only former Princely State Forces of India. In 1963, the designation was changed to Jammu and Kashmir Rifles.

123. Which one of the following is correct?

(a) Infantry Regiment is also known as the Mechanised Infantry Regiment
(b) Corps of Electrical and Mechanical Engineers is subsumed in the Corps of Engineers

(c) Army Medical Corps and Army Dental Corps are two divisions of the Army Service Corps
(d) Army has its own Corps of Air Defence

⊗ (**a**) The Infantry Regiment is also known as the Mechanised Infantry Regiment of the Indian Army. Though its aggregate size, it is closer to that or a full mechanised division with 26 mechanised battalions.

Indian Army Corps of Electronics and Mechanical Engineers are an arms and service branch of Indian Army having varied responsibilities of design, development, trial, inspection and refit of weapon systems and equipment.

Hence, option (a) is correct.

124. Which one of the following is not one of the Commands of the Indian Army?

(a) South-Western Command
(b) North-Eastern Command
(c) Central Command
(d) Army Training Command (ARTRAC)

⊗ (**b**) North-Eastern Command is not one of the commands of the Indian Army.

The Indian Army is divided into six operational commands and one training command each headed by a Limited General.

Command	Location
Northern Command	Udhampur (J & K)
Western Command	Chandigarh
Central Command	Lucknow
Eastern Command	Kolkata
Southern Command	Pune
Western-Southern Command	Jaipur
Training Command	Shimla

125. Which one of the following statements is correct?

(a) The rank of Second Lieutenant has been abolished
(b) The Chief of Army Staff carries the rank of Field Marshal
(c) All officers posted to Andaman and Nicobar Islands wear the ranks of the Indian Navy
(d) The rank of Major General is higher than the rank of Lieutenant General

⊗ (**a**) Second Lieutenant (called under-lieutenant in some countries) is a junior commissioned officer military rank in many armed forces. But, in India, the rank of Second Lieutenant is no longer in use. Now, all new officers are commissioned as lieutenants.

India has a Field Marshal rank, but it is mostly ceremonial.

At present, there are no Field Marshals in the army organisational structure and it has been conferred on only two officers in the past, the late Field Marshal Sam Manekshaw and the late Field Marshal KM Cariappa.

Hence, option (a) is correct.

126. Which one of the following is not an Air Defence Missile system?

(a) Akash   (b) Trishul
(c) Tatra   (d) Astra

⊗ (**c**) Tatra is not an Air Defence Missile system. It is a Czech manufacturer producing vehicles in Koprivnice. It is owned by Tatra Trucks Company, based in Ostrava. It is the third oldest company producing cars.

127. The first Tejas squadron of Indian Air Force consists of

(a) 20 aircrafts with 4 in reserve
(b) 100 aircrafts with 10 in reserve
(c) 20 aircrafts with no reserve
(d) 25 aircrafts with 5 in reserve

⊗ (**a**) The first Tejas squadron will consist of 20 aircrafts in total with 4 in reserve. The Indian Air Force Planning to induct 20 LAC under the initial operational clearance and 20 more would be inducted at a later stage.

128. Which of the following are constitutional provisions and laws for the protection of the rights of the Scheduled Castes in India?

1. Article-17 of the Constitution of India.
2. The Protection of Civil Rights Act, 1955.
3. The Scheduled Castes and the Scheduled Tribes (Prevention of Atrocities) Act, 1989.

Which of the statement(s) given above is/are correct?

(a) 1 and 3   (b) 1 and 2
(c) 2 and 3   (d) All of these

⊗ (**d**) T*he constitutional provisions and laws for the protection of rights of the Scheduled Castes in India are following*

• Article-17 in the Constitution of India 1949 talks for the abolition of untouchability and its practice in any form is forbidden. The accordance of any disability arising out of untouchability shall be an offence punishable in accordance with law.

- To achieve the objective of Article-17 of the Indian Constitution, the Government of India enacted the Protection of Civil Right Act, 1955, but it was inadequate to check these atrocities and continuing the gross indignity and offences against Scheduled Caste, therefore, the Parliament of India passed the Scheduled Caste and Scheduled Tribe (Prevention of Atrocities) Act, 1989 to prevent the offences of atrocities against the members of Scheduled Castes and Tribes.

Therefore all the statements are true.

Hence, option (d) is correct.

129. Which one of the following is not the powers of the Supreme Court?

(a) The Supreme Court has original and exclusive jurisdiction in inter-governmental disputes

(b) The Supreme Court has advisory jurisdiction on a question of law or fact which may be referred to it by the President of India

(c) The Supreme Court has the power to review its own judgement or order

(d) The Supreme Court has the exclusive power to issue writs to protect the fundamental rights of the people

⊙ (**d**) As a Federal Constitution of the Union of India, Supreme Court has original and exclusive jurisdiction in inter-governmental dispute or any dispute between different units of the Indian federation.

The Constitution under Article-143 authorises the President to seek the opinion of Supreme Court in two categories of matters.

(i) On any question of law.

(ii) On any dispute arises out of any per-Constitution treaties, agreements, covenant, sanad etc. Judicial review is the power of Supreme Court to examine the constitutionality of legislative enactment. Supreme Court may also review its own judgement or order.

The Supreme Court is the guarantor and defender of fundamental rights of the citizen.

In this regard, Supreme Court has original jurisdiction in the sense that an aggrieved citizen can directly go to the Supreme Court, not necessarily by way of appeal. However, the writ jurisdiction of Supreme Court is not exclusive because High Court also empowered of issue writ jurisdiction.

Hence, option (d) is incorrect.

130. The Sixth Schedule of the Constitution of India pertains to the administration of tribal areas in which of the following States?

(a) Assam, Meghalaya, Tripura and Mizoram

(b) Meghalaya, Tripura, Manipur and Mizoram

(c) Assam, Manipur, Meghalaya and Tripura

(d) Manipur, Meghalaya, Tripura and Arunachal Pradesh

⊙ (**a**) The Constitution of India makes special provisions for the administration of the tribal dominated areas in four states *viz.* Assam, Meghalaya, Tripura and Mizoram. As per Article-244 and 6th Schedule, these are called tribal areas, which are technically different from the scheduled area under the Fifth Schedule.

131. Which one of the following statements with regard to the Ninth Schedule of the Constitution of India is not correct?

(a) It was inserted by the Constitution (First Amendment) Act, 1951

(b) The acts and regulations specified in the Ninth Schedule shall become void on the ground that it violates a Fundamental Right in Part III of the Constitution

(c) The Supreme Court has the power of judicial review of an act included in the Ninth Schedule on the doctrine of basic structure

(d) The appropriate legislature can repeal or amend an act specified in the Ninth Schedule

⊙ (**b**) Ninth Schedule says that the article mentioned in this are immune from judicial review. It is for the larger good of the society, the government cannot be challenged in the court for his actions.

Ninth Schedule was added to the Constitution by First Constitutional Amendment, 1951. In a landmark ruling on 11th January, 2007, the Supreme Court ruled that all laws (including those in the Ninth Schedule) would be open to judicial review, if they violated the basic structure of the Constitution.

Hence, option (b) is not correct.

132. Which of the following statement(s) with regard to the conduct of elections in India is/are not correct?

1. The responsibility for the preparation of the electoral rolls is vested in the Election Commission of India.

2. The Model Code of Conduct comes into existence as soon as

the date of the election is announced.

3. The laws relating to delimitation of constituencies are made by the Election Commission of India.

4. No election shall be called in question except by an election petition.

Select the correct answer using the codes given below

(a) Only 3   (b) 1, 2 and 4

(c) 1, 2 and 3   (d) Only 4

⊙ (**a**) The Election Commission is responsible for the conduction of election in India. It issues model code of conduct for all political parties and candidates to conduct election in free and fair manner.

The commission can issue an order for prohibition of publication and disseminating of results of opinion polls to present influencing the voting trends in the electorate.

The delimitation commission of India empowered to redraw the constituencies of various Assembly and Lok Sabha election, based on recent census.

All the statements are correct except 3. Hence, option (a) is incorrect.

133. Which one of the following statements with regard to the National Commission for Scheduled Tribes is not correct?

(a) The Union and every State Government shall consult the commission on all major policy matters affecting Scheduled Tribes

(b) All the reports of the commission and its recommendations shall be laid only before Lok Sabha

(c) The commission, while investigating any matter, has all the powers of a Civil Court

(d) The commission has the power to regulate its own procedures

⊙ (**b**) The National Commission for Scheduled Tribe is included in Article-338A of the Constitution through 89th Constitutional Amendment.

This commission was constituted on 19th February, 2004 to look after the Scheduled Tribes and safeguard the rights provided to them by the Constitution of India. The commission presents an annual report to the President. The President places all such reports before the Parliament.

Hence, option (b) is incorrect

134. The right to form associations and unions is a right
(a) guaranteed to everybody
(b) to freedom guaranteed to citizens only
(c) to equality before law
(d) to life and personal liberty

⊙ (**b**) Article-19(1)(c) of the Constitution of India guarantees the right 'to form associations and union to every citizen of the country'. Article-9(4) states that the State may impose reasonable restrictions on this right in the interest of public order, morality, sovereignty and integrity of India.

135. Some Indian territories were transferred in 2015 to Bangladesh by following which procedure?
(a) By an agreement between the Government of India and the Government of Bangladesh
(b) By a legislation passed by the Parliament amending First Schedule to the Constitution of India
(c) By amending First Schedule to the Constitution of India by exercising amending power of the Parliament
(d) By amending First Schedule to the Constitution of India by exercising amending power of the Parliament and ratification by 16 State Legislatures

⊙ (**c**) Some Indian territories were transferred in 2015 to Bangladesh by amending First Schedule to the Constitution of India by exercising amending power of the Parliament.

The 119th Constitutional Amendment Bill, 2013 sought to ratify the land boundary agreement between India and Bangladesh. After passing of the bill, it became 100th Constitutional Amendment.

136. Which among the following Acts were repealed by Article-395 of the Constitution of India?
1. The Government of India Act, 1935
2. The Indian Independence Act, 1947
3. The Abolition of Privy Council Jurisdiction Act, 1949
4. The Government of India Act, 1919

Which of the statement(s) given above is/are correct?
(a) 1 and 2 (b) 1 and 3
(c) 1, 2 and 3 (d) All of these

⊙ (**a**) Article-395 in the Constitution of India 1949 repeals the Indian

Independence Act, 1947 and the Government of India Act, 1935.

The abolition of Privy Council Jurisdiction Act, 1949 was not included in this and are hereby repealed First Schedule, Article-1 and 4(1), the State name and territories.

Hence, option (a) is correct.

137. On 26th November, 1949, which of the following provisions of the Constitution of India came into effect?
1. Citizenship 2. Elections
3. Provisional Parliament
4. Fundamental Rights

Select the correct answer using the codes given below
(a) 2, 3 and 4 (b) 1, 2 and 3
(c) 1 and 3 (d) 1 and 2

⊙ (**b**) The Constitution came into force on 26th January, 1950. Some provisions relating to citizenship, elections, provisional Parliament, temporary and transitional provisions are given immediate effect on 26th November, 1949.

The Article, which came into force on 26th November, 1949 included Articles–5, 6, 8, 9, 60, 324, 366, 372, 388, 391, 392 and 393. Out of them, citizenship was most important and had to immediately come into force to constitutionally handle the refugee crisis due to partition of India.

Hence, option (b) is correct.

138. Which of the following statement(s) regarding the Constituent Assembly of India is/are correct?
1. The Assembly was elected indirectly by the members of the Provincial Legislative Assemblies.
2. The elections were held on the basis of Universal Adult Franchise.
3. The scheme of election was laid down by the Cabinet Delegation.
4. The distribution of seats was done on the basis of the Mountbatten Plan.

Select the correct answer using the codes given below
(a) Only 1 (b) 1, 2 and 3
(c) 2 and 4 (d) 1 and 3

⊙ (**d**) The Constituent Assembly consisting of indirectly elected representatives. It was established to draft a Constitution for India. It existed for

almost 3 years after the Constitution of the Constituent Assembly.

The assembly was not elected on the basis of universal adult suffrage and Sikhs and Muslims received special re-orientation as minorities. Election were held under Cabinet Mission Plan of 1946.

Hence, option (d) is correct.

2016 (I)

139. Which of the following is/are constitutional body/bodies?
1. National Commission for Scheduled Tribes
2. National Commission for Women
3. National Commission for Minorities
4. National Human Rights Commission

Select the correct answer using the codes given below
(a) Only 1 (b) 1, 3 and 4
(c) 3 and 4 (d) 1, 2, 3 and 4

⊙ (**a**) National Commission for Schedule Tribes is constitutional body.

Constitutional bodies are formed by the Constitution which helps the government to run properly. UPSC, CAG, SPSC, Election Commission, National Commission for STs, National Commission for SCs, Finance Commission are some examples. They derive power directly from the Constitution.

National Commission for Women, National Commission for Minorities, National Human Rights Commission are statutory bodies created by law paved by Parliament.

Erstwhile Planning Commission, NITI Aayog, National Development Council are extra constitutional non-statutory bodies created by executive order.

140. Consider the following statements
1. The President of India shall have the power to appoint and remove the Speaker of Lok Sabha.
2. The Speaker has to discharge the functions of his office himself throughout his term and cannot delegate his functions to the Deputy Speaker during his absence from the station or during his illness.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

▷ (**d**) The Speaker of Lok Sabha is elected by the Lok Sabha from amongst its members. The date of election of the Speaker is fixed by the President. Usually, the Speaker remains in office during the life of Lok Sabha. However, he/she has to vacate office earlier in any of the following three cases

- If he ceases to be a member of Lok Sabha.
- If he resigns by writing to the Deputy Speaker.
- If he is removed by a resolution passed by a majority of all the members of Lok Sabha. Such a resolution can be moved only after giving 14 days advance notice.

Hence, option (d) is correct.

141. The Second Administrative Reforms Commission (2005) was concerned with

(a) reforms in institutional arrangements for good governance
(b) reforms in the Indian Penal Code and the Criminal Justice System
(c) creating an ombudsman mechanism for reduction of corruption in public life
(d) devising new measures for urban governance and management

▷ (**a**) The second ARC was set-up by the Government of India in 2005 under the Chairmanship of Shri Virappa Moily to prepare a detailed blueprint for revamping the Public Administration System.

The Commission was given the mandate to suggest measures to achieve a pro-active, responsible, accountable, sustainable and efficient administration for the country at all levels of the government. The commission was asked to, interatic consider the following–

(i) Organisational structure of the Government of India
(ii) Ethics in governance
(iii) Refurbishing of personnel administration
(iv) Strengthening of financial management systems
(v) Steps to ensure effective administration at the state level
(vi) Steps to ensure effective district administration
(vii) Local Self-Government/Panchayati Raj Institutions
(viii) Social capital, trust and participative public service delivery

(ix) Citizen-centric administration
(x) Promoting e-governance
(xi) Issues of federal polity
(xii) Crisis management
(xiii) Public order

Hence, option (a) is correct.

142. As per the Constitution of India, the Writ of Prohibition relates to an order

1. issued against judicial and quasi-judicial authority.
2. to prohibit an inferior Court from proceeding in a particular case where it has no jurisdiction to try.
3. to restrain a person from holding a public office to which he is not entitled.

Select the correct answer using the codes given below

(a) 1 and 2   (b) 2 and 3
(c) Only 1   (d) 1, 2 and 3

▷ (**a**) The Supreme Court Under Article 32 and the High Courts Under Article 226 can issue five types of writs – Habeas Corpus, Mandamus, Prohibition, Certiorari and Quo-warranto not only for the enforcement of Fundamental Rights but also for any other purpose.

Prohibition, literally means to forbid, it is issued by a higher court to a lower court or tribunal to prevent the latter for exceeding its jurisdiction or usurping a jurisdiction that it does not possess.

The writ of Prohibition can be issued only against judicial and quasi-judicial authorities.

It is not available against administrative authorities, legislative bodies and private individuals or bodies.

Hence, option (a) is correct.

143. Who among the following Prime Ministers of India were defeated by a vote of No Confidence?

1. Morarji Desai
2. Vishwanath Pratap Singh
3. HD Deve Gowda
4. Atal Bihari Vajpayee

Select the correct answer using the codes given below

(a) 1, 2, 3 and 4
(b) 1, 2 and 3
(c) 2, 3 and 4
(d) 1 and 4

▷ (**a**) Prime Minister of India, who were defeated by a vote of No Confidence Morarji Desai in 1985; Vishwanath Pratap

Singh in 1990; HD Deve Gowda in 1997 and Atal Bihari Vajpayee in 1999.

A motion of No Confidence can be introduced only in Lok Sabha. The motion needs to the support of 50 members to be admitted.

According to the Constitution, the Council of Minister stays in office only as long as it enjoys the confidence of the Lok Sabha; once the confidence is withdrawn the government is bound to resign.

Hence, option (a) is correct.

144. Which of the following statement(s) regarding Rajya Sabha is/are correct?

1. The maximum permissible strength of Rajya Sabha is 250.
2. In Rajya Sabha, 238 members are elected indirectly from the States and Union Territories.
3. It shares legislative powers equally with Lok Sabha in matters such as creation of All India Services.

Select the correct answer using the codes given below

(a) 1 and 2   (b) 1, 2 and 3
(c) 2 and 3   (d) Only 1

▷ (**a**) Maximum strength of Rajya Sabha is 250, out of which 238 are to be the representatives of the States and UTs (elected indirectly) and 12 are nominated. At present, Rajya Sabha has 245 members.

Special powers of Rajya Sabha

- It can authorise the Parliament to make a law on a subject enumerated in the State List (Article-249).
- It can authorise the Parliament to create new all India services common to both the Centre and States (Article-312).

Hence, option (a) is correct.

145. Which of the following statements relating to the office of the President of India are correct?

1. The President has the power to grant pardon to a criminal in special cases.
2. The President can promulgate ordinances even when the Parliament is in session.
3. The President can dissolve the Rajya Sabha during emergency.
4. The President has the power to nominate two members in the Lok Sabha from the Anglo Indian community.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 1 and 4
(c) 3 and 4   (d) 1, 3 and 4

⊛ (**b**) The President of India is the head of Indian State. He is the first citizen of India and acts as the symbol of unity, integrity and solidarity of the nation.

He has the following powers and functions. He can grant pardon, reprieve, respite and remission of punishment or suspend, remit or commute the sentence of any person convicted for any office under Article 72. He can promulgate ordinances during the recess of Parliament under Article 123. These ordinances have the same force and effect as an act of Parliament to deal with unforeseen or urgent matters.

He can summon or prorogue the both House of Parliament and dissolve The Lok Sabha only not the Rajya Sabha as Rajya Sabha is a Permanent House and its one-third members retire on the expiration of every second year.

He nominates twelve members of the Rajya Sabha from amongst person having special knowledge or practical experience in literature, science, art and social services. He also nominates two members to the Lok Sabha from The Anglo-Indian community.

Hence, option (b) is correct.

146. Which of the statements given below is/are correct?

1. The ideal of a common civil code is set forth in Article-44 of the Constitution of India.
2. In certain respects, the High Courts in India have been given more extensive powers than the Supreme Court.
3. The Supreme Court of India, the first fully independent Court for the country, was set-up under the Constitution of India in 1950.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 2 and 3
(c) Only 1   (d) Only 3

⊛ (**a**) Uniform or Common Civil Code is defined in our Constitution under Article 44 which states that it is the duty of the state to secure for the citizens a Uniform Civil Code throughout the territory of India. Hence, statement 1 is correct.

The judgement of the High Court is considered to be final and there is no appeal to that. A High Court enjoys supervisory jurisdiction and has a large control over its subordinate courts. So, statement 2 is correct.

The Supreme Court of India came into being on 28th January, 1950 under the provisions of Constitution of India. It replaced erstwhile Federal Court of india. Hence, statement 3 is correct.

147. Which of the following statement(s) about Comptroller and Auditor General of India (CAG) is/are correct?

1. The CAG will hold office for a period of six years from the date he assumes the office. He shall vacate office on attaining the age of 65 years, if earlier than the expiry of the 6 years term.
2. The powers of CAG are derived from the Constitution of India.
3. The CAG is a multi-member body appointed by the President of India in consultation with the Prime Minister and the Council of Ministers.
4. The CAG may be removed by the President only on an address from both Houses of Parliament, on the grounds of proved misbehaviour or incapacity.

Select the correct answer using the codes given below
(a) 1, 2 and 4   (b) 1, 2 and 3
(c) 3 and 4   (d) 1 and 2

⊛ (**a**) Article-148 of Constitution of India provides for the office of CAG. He is the guardian of the public purse and controls the entire financial system of the country at both the levels. The CAG is appointed by the President of India by a warrant under his hand and seal. He holds office for a period of 6 years or up to the age of 65 years.

All the statements are true except 3. Hence, option (a) is correct.

148. In which one of the following judgments of the Constitutional Bench of the Supreme Court of India, the 'rarest of rare' principle in the award of death penalty was first laid down?

(a) Bachan Singh *Vs* State of Punjab (1980)
(b) Gopalanachari *Vs* State of Kerala (1980)
(c) Dr. Upendra Baxi *Vs* State of Uttar Pradesh (1983)
(d) Tukaram *Vs* State of Maharashtra (1979)

⊛ (**a**) Indian Judiciary has pointed out their view regarding death penalty by

ruling out in Bachan Singh *Vs* State of Punjab, that the death penalty must be restricted to the 'rarest of rare' case, this view of Supreme Court was very much favouring to minimise the use of capital punishment to penalise the criminals.

Hence, option (a) is correct.

149. Consider the following statements about the President of India:

1. The President has the right to address and send message to the Council of Ministers to elicit specific information.
2. The President can call for information relating to proposals for legislation.
3. All decisions of the Council of Ministers relating to administration of the Union must be communicated to the President.

Which of the statement(s) given above is/are correct?
(a) 1 and 3   (b) 2 and 3
(c) 1 and 2   (d) 1, 2 and 3

⊛ (**d**) As per Article 86 (1) of the Constitution the President has the right to address either Houses or their joint sitting, at any time and to require the attendance of members for this purpose.

Article 78 says that it shall be the duty of the Prime Minister

(a) to communicate to the President for all decisions of the Council of Ministers relating to the administration of the affairs of the union and proposals for legislation;

(b) to furnish such information relating to the administration of the affairs of the Union and proposals for legislation as the President may call for; and

(c) if the President so requires, to submit for the consideration of the Council of Ministers on any matters on which a decision has been taken by a Minister but which has not considered by the Council.

All the statements are true.
Hence, option (d) is correct.

150. In which one of the following cases, the constitutional validity of the Muslim Women (Protection of Rights of Divorce) Act, 1986, was upheld by the Supreme Court of India?

(a) Muhammad Ahmed Khan *Vs* Shah Bano Begum
(b) Daniel Latifi *Vs* Union of India
(c) Mary Roy *Vs* State of Kerala
(d) Shankari Prasad *Vs* Union of India

⊙ (**b**) The Constitutional validity of the Muslim Women (Protection of Rights of Divorce) Act 1986 was challenged on the ground of being violative of Article 14, 15 and 21. The basic question raised by right activists was the necessity of enacting an Act, completely segregating a section of the population. While a secular remedy was already available under Section 125 of the Code of Criminal Procedure.

The Supreme Court in the case of Daniel Latifi *Vs* Union of India approached a middle path and held that reasonable and fair provisions include provision for the future of the divorced wife (including maintenance) and it does not confine itself to the iddat period only. The Constitutional validity of the Act was also upheld.

151. Which of the following statements with regard to preventive detention in India is/are correct?

1. The detenue has no rights other than those mentioned in Clauses (4) and (5) of Article-22 of Constitution of India.
2. The detenue has a right to challenge the detention order on the ground that he was already in jail when the detention order was passed.
3. The detenue can claim bail on the ground that he has been in prison beyond twenty-four hours without an order of the Magistrate.

Select the correct answer using the codes given below
(a) 1 and 2   (b) Only 2
(c) Only 3   (d) All of these

⊙ (**b**) Article 22 of Constitution provides that no person who is arrested shall be detained in custody without being informed on the grounds of such arrest.

The Constitution authorises the legislature to make laws for preventive detention for the security of state, the maintenance of public order or the maintenance of supplies and services essential to the community or reasons connected with defense and foreign affairs. Hence, only statement 2 is true.

152. A Member of Lok Sabha does not become disqualified to continue as a Member of the House if the member

(a) voluntarily gives up his/her membership of the political party from which he/she was elected

(b) is expelled by the political party from which he/she had been elected to the House
(c) joins a political party after being elected as an independent candidate
(d) abstains from voting contrary to the direction by his/her political party

⊙ (**b**) In following condition a member of Lok Sabha can be disqualified to continue as a member of the House if
(i) he holds any office of profit under the Government of India or the government of any state.
(ii) he is of unsound mind and stands so declared by a competent court.
(iii) he is not an Indian citizen or voluntarily acquired citizenship of foreign country.
(iv) he is so disqualified by or under any law made by Parliament (Article 102).

In a dispute regarding qualification the decision of the President in accordance with the opinion of election commission is final.

Hence, (b) is the correct answer.

153. Which one of the following languages is not recognised in the Eighth Schedule to the Constitution of India?
(a) English   (b) Sanskrit
(c) Urdu   (d) Nepali

⊙ (**a**) Eighth Schedule contains list of official languages of Republic of India. English is not recognised in the Eight Schedule to the Constitution. As per Article-344(1) and 351 of Indian Constitution, the 8th Schedule includes 22 language.

(1) Assamese, (2) Bengali, (3) Gujarati, (4) Hindi, (5) Kannada, (6) Kashmiri, (7) Konkani, (8) Malayalam, (9) Manipuri, (10) Marathi, (11) Nepali, (12) Oriya, (13) Punjabi, (14) Sanskrit, (15) Sindhi, (16) Tamil, (17) Telugu, (18) Urdu (19) Bodo, (20) Santhali, (21) Maithili and (22) Dogri.

Hence, option (a) is incorrect.

154. The category of 'Overseas Citizens of India' was entered in the Citizenship Act of India through an amendment in the year
(a) 1986   (b) 1992   (c) 1996   (d) 2003

⊙ (**d**) The category of 'Overseas Citizens of India' was entered in the Citizenship Act of India through amendment in the year in 2003. The Overseas Citizenship of India (OCI) is an immigration status permitting a foreign citizen of Indian origin to live and work in the Republic of India indefinitely.

The OCI was introduced in response to demands for dual citizenship by the Indian Diaspora, particularly in developed countries. Citizenship (Amendment) Act, 2019 stipulates people holding Overseas Citizen of India (OCI) cards can lose their status if they violate local laws for major and minor offences and violations.

155. The Right to Education was added to the Fundamental Rights in the Constitution of India through the
(a) Constitution (86th Amendment) Act, 2002
(b) Constitution (93rd Amendment) Act, 2005
(c) Constitution (87th Amendment) Act, 2003
(d) Constitution (97th Amendment) Act, 2011

⊙ (**a**) Right to Education was added to the Fundamental Rights in the Constitution of India through the 86th Constitution Amendment Act, 2002. This Amendment Act, inserted a new Article. ''The state shall provide free and compulsory education to all children of the age of 6-14 years in such matter as the state may, by law determined.''

• Constitutional (93rd Amendment) Act, 2005 deals with the extension of reservation in education institution for the socially and educationally backward classes or the Scheduled Castes or the Scheduled Tribes.
• Constitution (87th Amendment) Act, 2003, deals with the readjustment and rationalisation of territorial constituencies in the states on the basis of the population figures of 2001 Census and not 1991 Census.
• Constitution (97th Amendment) Act, 2011 deals with the constitutional status and protection to cooperative societies

2015 (II)

156. Which of the following is/are not central feature(s) of Article 343 of the Constitution of India?

1. Hindi in Devanagari script shall be the national language of the Union.
2. The official language of the Union shall be Hindi in Devanagari script.
3. English language shall continue to be used for official purposes within states.

4. If two or more states agree, Hindi language should be the official language of communication between the states.

Select the correct answer using the codes given below
(a) 1, 3 and 4   (b) 2 and 4
(c) 2, 3 and 4   (d) Only 2

⊙ (**a**) Article 343 in the Constitution of India states that

• the official language of the Union shall be Hindi in Devanagari script.

• for a period of 15 years from the commencement of this Constitution the English language shall continue to be used for all official purpose of the union.

The official language for communication between, one state and another or between a state and the Union states are free to use Hindi or English specified in Article 346.

So, statements 1,3 and 4 are incorrect.

157. After the general elections, the Protem Speaker is

(a) elected by the Lok Sabha
(b) appointed by the President of India
(c) appointed by the Chief Justice of the Supreme Court
(d) the seniormost member of the Lok Sabha

⊙ (**b**) The Protem Speaker is mainly an operating and temporary Speaker. After a general election, usually a seniormost member of Lok Sabha has been appointed by the President. The Protem Speaker has all the powers of the Speaker and presides over the first sitting of the newly-elected Lok Sabha. His main duty is to administer oath to the new members.

Hence, option (b) is correct.

158. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Leader)	List II (Party)
A. Shyama Prasad Mukherjee	1. Communist Party of India
B. Minoo Masani	2. Bharatiya Jana Sangh
C. SA Dange	3. Swatantra Party
D. Ashok Mehta	4. Praja Socialist Party

Codes

	A	B	C	D
(a)	2	3	1	4
(b)	4	1	3	2
(c)	2	1	3	4
(d)	4	3	1	2

⊙ (**a**) **Shyama Prasad Mukherjee** founded the Bharatiya Jana Sangh on 21st October, 1951. Later in 1980, it was re-formed as the Bharatiya Janata Party (BJP).

Minoo Masani was a leading figure of the Swatantra Party, which was founded by C Rajagopalachari on 4th June, 1959.

SA Dange was a founding member of the Communist Party of India (CPI).

Ashok Mehta belonged to Praja Socialist Party.

Hence, option (a) is correct.

159. Which of the following is/are not central tenet(s) of the Constitution of India?

1. Prohibits discrimination on grounds of religion.
2. Gives official status to certain religions.
3. Provides freedom to profess any religion.
4. Ensures equality of all citizens within religious communities.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 3 and 4
(c) 2, 3 and 4   (d) Only 2

⊙ (**d**) The basic thrust of the Indian Constitution was to establish a secular polity since very beginning. Though the word secular was added by 42nd Amendment Act, 1976.

The ideal of 'Sarva Dharm Sambhav' better explain the Indian nation of secularism. It also elaborated that these shall be no state religion of India.
Hence, option (d) is correct.

160. Who is the current Vice-Chairperson of NITI Aayog?

(a) Raghuram Rajan
(b) Arvind Panagariya
(c) Bibek Debroy
(d) VK Saraswat

⊙ (**b**) The NITI Aayog is a policy think tank of Government of India.

The National Institution for Transforming India (NITI Aayog) is a policy think tank of the Government of India. It was established with the aim to achieve sustainable development goals with cooperative federalism by fostering the involvement of State Governments of India in the economic policy-making process using a bottom-up approach.

Arvind Panagariya served as first Vice-Chairman of the NITI Aayog between January 2015 and August 2017.

He was succeeded by present Vice Chairman of NITI Aayog Rajiv Kumar. Amitabh Kant is the present CEO of NITI Aayog.

161. Freedom of conscience under the Constitution of India is subject to

1. public order, morality and health.
2. a law providing for social welfare and reform.
3. opening Hindu religious institutions of a public character to all Hindus.
4. defamation or incitement to an offence.

Which of the statement(s) given above is/are correct?
(a) 1 and 2
(b) 1, 2 and 3
(c) 3 and 4
(d) 1 and 2

⊙ (**b**) According to Article 25, freedom of conscience and free profession, morality and health, a law providing for social welfare and reform and opening Hindu religious institutions of a public character to all classes and section of Hindus.

Hence, option (b) is correct.

162. Which of the following Fundamental Right(s) is/are available to non-citizens?

1. Equality Before Law
2. Right Against Discrimination
3. Equality of Opportunity
4. Protection of Life and Personal Liberty

Select the correct answer using the codes given below
(a) Only 1
(b) 1 and 4
(c) 1, 2 and 4
(d) 2 and 3

⊙ (**b**) Following Fundamental Rights are available to non-citizens

• Equality Before Law (Article 14)

• Protection in Respect of Conviction for Offences (Article 20)

• Protection of Life and Personal Liberty (Article 21)

• Right to Elementary Education (Article 21A)

• Freedom to Manage Religious Affairs (Article 26)

Hence, options (b) is correct.

163. Which of the following statement(s) about the formation of the Constituent Assembly is/are correct?

1. The members of the Constituent Assembly were chosen on the basis of the Provincial Elections of 1946.
2. The Constituent Assembly did not include representatives of the princely states.
3. The discussions within the Constituent Assembly were not influenced by opinions expressed by the public.
4. In order to create a sense of collective participation, submissions were solicited from the public.

Select the correct answer using the codes given below
(a) Only 1   (b) 2 and 3
(c) 3 and 4   (d) 1 and 4

⟩ (**a**) The members of the Constituent Assembly were chosen on the basis of two Provincial Elections of 1946. The Constituent Assembly was constituted in November 1946 under the scheme formulated by the Cabinet Mission Plan. Although, the Constituent Assembly was not directly elected by the people on the basis of adult suffrage, the assembly comprised representation of all sections of Indian society.

Hence, option (a) is correct.

164. Which of the following laws have been repealed by the Constitution of India?

1. The Government of India Act, 1935.
2. The Indian Independence Act, 1947.
3. The Abolition of Privy Council Jurisdiction Act, 1949.
4. The Preventive Detention Act, 1950.

Select the correct answer using the codes given below
(a) 1 and 2
(b) 2 and 4
(c) 1 and 3
(d) 1, 2 and 4

⟩ (**d**) After commencement of the Constitution the Government of India Act, 1935 and the Indian Independence Act, 1947 were repealed. The Prevention Detention Act was passed in 1950 but it was also repealed by the Constitution of India in 1969.

Hence, option (d) is correct.

165. A writ of *Habeas Corpus* for the release of a person can be issued

1. where the arrest or detention has taken place in contravention of the procedure established by law.
2. to secure the release of a person imprisoned on a criminal charge.
3. where the arrest has taken place for contempt of court or the Parliament.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 2 and 3
(c) Only 1   (d) 1 and 2

⟩ (**c**) The writ of *Habeas Corpus* has been used by the Indian judiciary effectively, only in order to secure the release of a person from illegal detention.

The writ is not issued where the detention is lawful, the proceeding is for contempt of a legislature or a Court, detention by a competent court and detention is override the jurisdiction of the Court.

166. Which one of the following changes has not been made to the Citizenship Act of India by the Amendment in 2015?

(a) The Overseas Citizens of India will now be called the Overseas Citizens of India cardholders
(b) The Non-Resident Indians are entitled to vote in elections in India
(c) The Persons of Indian Origin have been placed at par with the Overseas Citizens of India
(d) The Persons of Indian Origin are now entitled to life long visa to visit India

⟩ (**b**) The Citizenship Amendment Act 2015 introduced the concept of an 'Overseas Citizen of India Cardholder' (an "OCC") that replaced and consequently merged the OCIs and PIOs. The persons of Indian Origin have been placed at par with Overseas Citizens of India.

The Overseas Citizenship of India (OCI) is an immigration status permitting a foreign citizen of Indian origin to live and work in the Republic of India indefinitely. However, it did not confer the right to vote to Non-Resident Indians.

Citizenship (Amendment) Act, 2019 stipulates people holding Overseas Citizen of India (OCI) cards can lose their status if they violate local laws for major and minor offences and violations. Thus, option (b) is not correct.

167. Which one of the following statements about electoral government in India is not correct?

(a) The superintendence, direction and control of elections are vested in the Election Commission of India
(b) There is one general electoral roll for every territorial constituency
(c) The Parliament has the power to make laws relating to the delimitation of constituencies
(d) The Supreme Court of India has the authority to scrutinise the validity of a law relating to delimitation of constituencies

⟩ (**d**) Article 324 provides for the superintendence, direction and control of elections are vested in the Election Commission of India (ECI) which prepares and periodically revised one general electoral roll for every territorial constituency. It is based on the delimitation act of Parliament. The Supreme Court has no authority to scrutnise the validity of this act.

Hence, option (d) is incorrect.

168. The Electronic Voting Machines (EVMs) are developed jointly with

1. Bharat Heavy Electricals Limited.
2. Bharat Electronics Limited.
3. Electronics Corporation of India Limited.
4. Bharat Sanchar Nigam Limited.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 2 and 3
(c) 2 and 4   (d) 3 and 4

⟩ (**b**) The Electronic Voting Machines are manufactured by Bharat Electronics Limited Bengaluru and Electronic Corporation of India Ltd Hyderabad EVMs are being used in Indian General Election since 2004. The EVMs manufactured in 1989-90 were used on experimental basis for the first time in 16 Assembly constituencies in 1998. It run on ordinary 6 volt alkaline battery.

Hence, option (b) is correct.

169. The Constitution of India guarantees freedom of thought and expression to all its citizens subject to

1. implementation of Directive Principles.
2. Fundamental Duties.
3. Right to Equality.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 2 and 3
(c) Only 1   (d) 1, 2 and 3

⊙ (**c**) The Constitution of India guarantees freedom of thought and expression to all its citizens subject to the right conferred is the interests of the sovereignty and integrity of India, the security of state, public order, friendly relations with foreign states; these are enshrined by the Directive Principles of State Policy.

Article 31C, as inserted by the 25th Amendment Act of 1971 says

• NO law that seeks to implement the socialistic Directive Principles specified in Article 39(b) or (c) shall be void on the ground of Contravention of Fundamental Rights conferred by Article 14 or Article 19.
  Hence, option (c) is correct.

170. Which one of the following does not form part of Immanuel Kant's theory of 'perpetual peace'?

(a) Republican constitutionalism
(b) Federal contract among states to abolish war
(c) World government
(d) Transformation of individual consciousness

⊙ (**d**) The Definitive Articles of the Immanuel Kant theory of Perpetual peace between states :

(i) The civil Constitution in every state shall be Republican.
(ii) The Right of Nation shall be founded on a federation of free states.
(iii) The Right of men as citizens of the world in a cosmo-political system, shall be restricted to conditions of universal Hospitality.

Hence from the above definition it is clear that his theory of perpetual peace does not include transformation of an individual consciousness.

171. Which one of the following statements about the process of the Parliament to make new states is not correct?

(a) The Parliament may by law form a new state and alter the boundaries or names of existing states
(b) A Bill to this effect cannot be introduced in the Parliament except on the recommendation of the President
(c) A Bill to this effect may be referred by the President to the legislature of the affected state
(d) Such a law will fall under the Provision of Article 368

⊙ (**d**) Article 3 of the Constitution vests the power to form new States in Parliament, which may pass the law on

the subject. There should be request sent to the President for formation of a new state by Central or state Government/ Parliament/ Assembly. Presidential reference is sent to State Assembly.

Article 3 provides the following procedure:

• Presidential reference is sent to State Assembly.
• After presidential reference, a resolution is tabled and passed in Assembly.
• Assembly has to pass a Bill creating the new State/States.
• A separate Bill has to be ratified by Parliament.

Article 368 (1) of the Constitution of India grants constituent power to make formal amendments and empowers Parliament to amend the Constitution by way of addition, variation or repeal of any provision according to the procedure laid down therein, which is different from the procedure for ordinary legislation.

Thus option (d) is not correct.

172. Which of the following statements with regard to citizenship provisions of the Constitution of India is/are correct?

1. No person shall be a citizen of India by virtue of Article 5, or be deemed to be a citizen of India by virtue of Article 6 or Article 8, if he/she has voluntarily acquired the citizenship of any foreign state.

2. The Parliament has power to make any provision with respect to the acquisition and termination of citizenship and all other matters relating to citizenship.

Select the correct answer using the codes given below

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ (**c**) Persons voluntarily acquiring citizenship of a foreign state not to be citizens.

No person shall be a citizen of India by virtue of Article 5, or be deemed to be a citizen of India by virtue of Article 6 or Article 8, if he/she has voluntarily acquired the citizenship of any foreign state.

Hence, option (c) is correct.

173. The protection against arrest and detention under Article 22 of the Constitution of India is not available to

1. an enemy alien.
2. a person detained under a preventive detention law.
3. a foreigner.
4. an overseas citizen of India.

Select the correct answer using the codes given below

(a) 1 and 2
(b) 1, 3 and 4
(c) 1, 2 and 3
(d) 3 and 4

⊙ (**a**) Article 22 grants protection to persons who are arrested or detained i.e. no person, who is arrested shall be detained in custody without being informed. Article 22 of the Constitution of India is not available to.

• any person who for the time being is an enemy alien; or
• any person who is arrested or detained under any law providing for preventive detention.

2015 (I)

174. In which of the following cases did the Supreme Court rule that Constitutional Amendments were also laws under Article-13 of the Constitution of India, which could be declared void for being inconsistent with Fundamental Rights?

(a) Keshavanand Bharati Case
(b) Golaknath Case
(c) Minerva Mills Case
(d) Maneka Gandhi Case

⊙ (**b**) Golaknath vs State of Punjab or simply the Golaknath case, was a 1967 Indian Supreme Court case, in which the court ruled that Parliament could not curtail any of the Fundamental Rights in the Constitution.

The judgement reversed the Supreme Court's earlier decision which had upheld Parliament's power to amend all parts of the Constitution, including Part-III related to Fundamental Rights.

175. Which of the following statement(s) is/are not correct for the 9th Schedule of the Constitution of India?

1. It was inserted by the First Amendment in 1951.

2. It includes those laws which are beyond the purview of judicial review.

3. It was inserted by the 42nd Amendment.

4. The laws in the 9th Schedule are primarily those which pertain to the matters of national security.

Select the correct answer using the codes given below
(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) Only 3

⊙ (*a*) To ensure that agrarian reform legislation, the legislature amended the Constitution in the year 1951 which inserted 9th Schedule, by First Amendment. It includes those laws which are beyond the purview of judicial review. However in 2007, the Supreme Court ruled that the laws included in this schedule after 24th April, 1973 are now open to Judicial review.

Hence, option (a) is correct.

176. Which one of the following categories of persons is not treated at par so far as the availability of Fundamental Rights is concerned?

(a) Members of the armed forces
(b) Members of the forces charged with the responsibility of maintenance of public order
(c) Members of the forces employed in connection with the communications systems set-up in the country
(d) Members of the forces employed in connection with the communication systems set-up for maintenance of public order

⊙ (*a*) Article-33 and 34 maintain that Parliament has the power to modify the application of the Fundamental Rights to the members of armed forces and police forces.

Even, the barbers musicians, carpenters, mechanics, etc who are employees of the armed forces also don't have all the Fundamental Rights, which are available to the citizens.

177. Which of the following is not true about the Convention on the Elimination of all forms of Discrimination Against Women (CEDAW)?

(a) It defines what constitutes discrimination against women and sets-up an agenda for national action
(b) It was adopted in 1979 by the United Nations

(c) It commits States to undertake measures to end discrimination in their legal system
(d) India is not a ratifying country and is therefore not legally bound to put its provisions into practice

⊙ (*d*) The Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW) is an international treaty. It was adopted in 1979 by the United Nations General Assembly.

The Convention mandates that states parties ratifying the Convention declare intent to enshrine gender equality into their domestic legislation, repeal all discriminatory provisions in their laws, and enact new provisions to guard against discrimination against women. The convention also obliges states parties to "take all appropriate measures, including legislation, to suppress all forms of discrimination among women. India has been party to the convention through signature and ratification. Hence, option (d) is not correct with respect to CEDAW.

178. The 6th Schedule of the Indian Constitution contains provisions for the administration of Tribal areas. Which of the following States is not covered under this Schedule?

(a) Asom (b) Manipur
(c) Meghalaya (d) Tripura

⊙ (*b*) The 6th Schedule of the Indian Constitution contains provisions for the administration of tribal areas in the states of Asom, Meghalaya, Tripura and Mizoram and Manipur state is not covered under this Schedule. Article 244(2) and 275(1) deal with the provisions of the 6th Schedule.

179. Which one of the following statements is incorrect?

(a) India does not have a Chief of Defence Staff
(b) India does not have a Permanent Chairman, Chiefs of Staff Committee
(c) India has a Chairman, Chiefs of Staff Committee who functions as Chief of the Defence Staff
(d) India has a Chairman, Chiefs of Staff Committee who does not function as Chief of the Defense Staff

⊙ (*c*) India has a Chairman, Chief of Staff Committee, who does not function as Chief of Defence staff, hence statement-3 is incorrect rest all statements are correct.

180. Information under the RTI Act, 2005 can be provided in respect of

(a) National Security Council Secretariat
(b) Assam Rifles
(c) Border Road Development Board
(d) Border Road Organisation

⊙ (*d*) Information under RTI Act, 2005 cannot be provided for Intelligence Bureau, Research and Analysis Wing of the Cabinet Secretariat, Directorate of Revenue Intelligence, Central Economic Intelligence Bureau, Directorate of Enforcement, Narcotics Control Bureau, Aviation Research Centre, Special Frontier Force, Border Security Force, Central Reserve Police Force, Indo-Tibetan Border Police, Central Industrial Security Force, National Security Guards, Assam Rifles, Special Service Bureau, Border Road Development Board, Special Branch (CID), Andaman and Nicobar, The Crime Branch-CID-CB, Dadra and Nagar Haveli, Special Branch, Lakshadweep Police.

Hence, option (d) is correct.

181. Who acts as the chairman of the Chiefs of Staff Committee?

(a) The President of India in his capacity as the Commander-in-Chief
(b) The Prime Minister
(c) The Defence Minister
(d) The seniormost Chief of Staff

⊙ (*d*) The senior-most Chief of Staff Acts as the chairman of the Staff Committee. The position of Chairman devolves on the longest serving Chief of Staff and rotates amongst the Chiefs of Services.

182. Which one of the following statements is correct?

(a) The President cannot pardon a person sentenced by a Court Martial
(b) The supreme command of the defence forces of the Union vests in the President, but its exercise has to be regulated by law
(c) A person awarded rigorous imprisonment cannot be compelled to do hard work as this would amount to violation of Article-23 of the Constitution of India
(d) The Armed Forces Tribunal Act, 2007 excludes the powers of the High Courts under Article-226 of the Constitution of India in relation to service matters of persons in the armed forces

⊙ (*b*) The President of India is the Supreme Commander of the Indian

Armed Forces. The Indian Armed Forces are under the management of the Ministry of Defense (MoD) and its exercise has to be regulated by law.

Hence, option (b) is correct. Option (a) is wrong as Article-72 of the Constitution of India empower President to grant pardon to a person sentenced by a court martial.

Hence, option (b) is correct.

183. Which of the following is not a laid down principle of the Panchsheel?

(a) Mutual respect for each other's territorial integrity
(b) Mutual non-aggression
(c) Mutual support for each other in world forum
(d) Mutual non-interference in each other's internal affairs

⊙ (*c*) Panchsheel the Agreement on Trade and intercourse between the Tibet region of China and India was singed on 29th April, 1954 in Beijing.

The Five Principles of Peaceful Co-existence, known in India as the Panchsheel Treaty (from Sanskrit, **panch : five**, **sheel : virtues**), are a set of principles to govern relations between states. The following are the five principles of Panchsheel

(i) Mutual respect for each other's territorial integrity and sovereignty.
(ii) Mutual non-aggression.
(iii) Mutual non-interference in each other's internal affairs.
(iv) Equality and co-operation for mutual benefit.
(v) Peaceful co-existence.

Hence, options (c) is not a Principle of Panchsheel.

184. Which one of the following statements is not correct?

(a) The Central Government is empowered to issue a notification to specify any service in a state as a service of vital importance to the community
(b) Such a notification remains valid for 6th months
(c) Every command given by a superior officer casts a duty on all persons subject to the Army Act, 1950, the Air Force Act, 1950 or the Navy Act, 1957 to obey the command when such a notification is in force
(d) The provision of the Armed Forces (Emergency Duties) Act, 1947 are applicable in connection with vital services imposed in a emergency on the armed forces

⊙ (*b*) The Central Government is empowered to issue a notification to specify any service in a state as a service of vital importance to the community, such a notification valid for 1 month in the first instance but may be extended from time-to-time by a hike notification.

Hence, option (b) is not correct.

185. Which of the following statement(s) is/are not true for the category of the Overseas Citizens of India (OCI) inserted by the amendment the Citizenship Act of India in 2003?

1. It gives dual citizenship to Persons on India Origin (PIO), who are citizens of another country.
2. It gives Persons of Indian origin (PIO), who are citizens of another country, are OCI card without citizenship.
3. It permits the OCI to vote in general elections in India.
4. It allows the OCI to travel to Indian without visa.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 1 and 3
(c) Only 3   (d) 2 and 4

⊙ (*b*) A Person on Indian Origin (PIO) means a foreign citizen (except a national of Pakistan, Afghanistan, Bangladesh, China, Iran, Bhutan, Sri Lanka and Nepal), who at any time held an Indian passport or who or either of their parents/grand parents/great grand parents was born and permanently resident in India as defined in Government of India Act, 1935

Other territories that became part of India thereafter provided neither was at any time a citizen of any of the aforesaid countries (as referred above).

Overseas Citizen of India (OCI) **Card** A foreign national, who was eligible to become citizen of India on 26th January, 1950 or was a citizen of India on or at anytime after 26th January, 1950 or belonged to a territory that became part of India after 15th August, 1947 is eligible for registration as Overseas Citizen of India (OCI). Minor children of such person are also eligible for OCI.

However, if the applicant had ever been a citizen of Pakistan or Bangladesh, he/she will not be eligible for OCI.

Hence, statements 1 and 3 are false.

186. Which of the following statement(s) with regard to the Armed Forces (Special Powers) Act, 1958 is/are correct?

1. The Act is applicable only to the States of Manipur, Tripura and Nagaland.
2. A person taken into custody under the above Act must be handed over to the officer-in-charge of the nearest police station with least possible delay.
3. An area can be declared as a disturbed area under the above Act only when the State Government is of the opinion that the use of the armed forces in aid of civil power is necessary to contain a dangerous condition in the concerned area.

Select the correct answer using the codes given below
(a) Only 2   (b) 1 and 2
(c) Only 3   (d) All of these

⊙ (*c*) AFSPA to enable certain special powers to be conferred upon members of the armed forces in disturbed areas in the States of Assam, Manipur, Meghalaya, Nagaland, Tripura, Arunachal Pradesh, Mizoram and the Union Territory of Chandigarh.

It enacted by Parliament in the 9th year of the Republic of India.

Power to declare areas to be disturbed areas If, in relation to any State or Union Territory to which this Act extends, the Governor of that State or the Administrator of that Union Territory of the Central Government in either case, is of the opinion that the whole or any part of such State or Union Territory, as the case may be, is in such a disturbed or dangerous condition that the use of armed forces in aid of the civil power is necessary.

The Governor of that State or the Administrator of that Union Territory or the Central Government, as the case may be, may, by notification in the Official Gazette, declare the whole or such part of such State or Union Territory to be a disturbed area.

Hence, option (c) is correct.

187. The power to decide the date of an election to a State Legislative Assembly rests with the

(a) President of India
(b) Chief Minister and his/her Cabinet
(c) Election Commission of India
(d) Parliament

⊙ (**c**) The Election Commission of India is an autonomous, constitutionally established federal authority responsible for administering all the electoral processes in the Republic of India.

Under the supervision of the commission, free and fair elections have been held in India at regular intervals as per the principles enshrined in the Constitution.

The Election Commission has the power of superintendence, direction and control of all elections to the Parliament of India and the State Legislatures and of elections to the office of the President of India and the Vice-President of India. Elections are conducted according to the constitutional provisions, supplemented by laws made by Parliament.

188. A Parliamentary Democracy is one where

1. a balance of popular participation and elite rule takes place.
2. the government is responsible not to the public but to the elected representatives.
3. the parliamentarians are delegated the responsibility of thinking and acting on behalf of their constituents.

Select the correct answer using the codes given below

(a) Only 2   (b) 2 and 3
(c) 1 and 3   (d) All of these

⊙ (**b**) A parliamentary democracy is a system of governance, in which the head of state is usually a person from legislature and directly elected by the people.

The government is responsible for elected representatives and also accountable to that of Parliament.

In parliamentary system, the parliamentarians are delegated the responsibility of thinking and acting as representatives of their constituency.

189. When martial law is imposed, Parliament cannot make law in respect of which one of the following matters?

(a) Indemnify any person in respect of any act done by him in connection with the maintenance of order in the area where martial law in force

(b) Parliament can by law validate any sentence passed when martial law was in force in the area

(c) A law of Parliament can validate forfeiture ordered when martial law was in force in the area

(d) Any act done under martial law can be validated by Parliament by law

⊙ (**d**) Article-34 provides for the restrictions on Fundamental Rights while martial law is in force in any area within the territory of India.

It empowers the Parliament to indemnify any person in respect of any Act done by him in connection with the maintenance of order in the area where martial law was in force.

The Parliament can also validate any sentence passed when martial law was in force in the area. A law of Parliament can validate forfeiture ordered when martial law was in force in the area.

Hence option (d) is correct.

190. Which among the following features of a federal system is not found in the Indian Political System?

(a) Dual citizenship
(b) Distribution of powers between the Federal and the State Governments
(c) Supremacy of the Constitution
(d) Authority of the Courts to interpret the Constitution

⊙ (**a**) Article-1 States that India, that is Bharat shall be a Union of States. Indian Constitution does not mentioned anywhere that India is a Federation of States. Still we get so many federal features in our Constitution. The following are the federal features of Indian Constitution.

- Dual government (Federal government at Central level and State Government at State level).
- Distribution of powers between Federal and the State Governments.
- Supremacy of the Constitution.
- Independent Judiciary.
- Authority of the courts to interpret the Constitution.

There is Prevalence of single citizenship in our country. Dual citizenship is a feature of American Federation.

191. Which of the following is not true of Article-32 of the Indian Constitution?

(a) It gives the Supreme Court and the High Courts the power to issue writs for the enforcement of Fundamental Rights

(b) It is included in Part III of the Indian Constitution and is therefore itself a Fundamental Right

(c) Dr Ambedkar called it the 'very soul of the Indian Constitution'

(d) An aggrieved person has no right to complain under Article-32 where a Fundamental Right has not been violated

⊙ (**a**) Article-32 confers the right to remedies for the enforcement of the Fundamental Rights of an aggrieved citizen. In other words, the right to get the Fundamental Rights protected is in itself a Fundamental Right. This makes the Fundamental Rights real. That is why Dr Ambedkar called Article-32 as the most important Article of the Constitution : 'It is the very Soul of the Constitution and the very heart of it'.

Right to constitutional remedies consists of right to move the Supreme Court for the enforcement of Fundamental Rights including the writs of (i) Habeas corpus (ii) Mandamus (iii) Prohibition (iv) Certiorari and (v) Quo-warranto.

Only the Fundamental Rights guaranteed by the Constitution can be enforced under Article-32 and not any other right like non-fundamental Constitutional rights, statutory rights and so on.

Article-226 vests original powers in the High Court to issue directions. Orders and writs of all kinds for the enforcement of the Fundamental Rights.

Hence, option (a) is incorrect.

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192. Consider the following statements about local government in India :

1. Article-40 of Indian Constitution provides for the State to organise village panchayats and endow them with such powers and authority as may be necessary to make them function as units of self-government.

2. The 73rd and 74th Constitution Amendments inserted Part-IX and IX A in the Constitution.

3. The provisions in Part-IX and IX A of Indian Constitution are more or less parallel and analogous.

4. The 73rd Constitution Amendment is applicable to all States irrespective of size of population.

Which of the statements given above are correct?

(a) 1 and 2   (b) 1, 2 and 3
(c) 3 and 4   (d) 1, 2, 3 and 4

⊚ (**b**) Article-40 of Indian Constitution provides for States to organise village panchayats. 73rd Constitution Amendment inserted Part-IX that deals with panchayats and 74th Constitution Amendment inserted Part-IX (A) that deals with municipalities.

Both the amendments give provisions that run parallel and are analogous. 73rd Amendment is not applicable in certain areas and in States like Nagaland, Mizoram, etc, where regional councils exist. Hence, option (b) is correct.

193. Consider the following statements about State Election Commission :

1. The State Election Commissioner shall be appointed by the Governor of the State.
2. The State Election Commission shall have the power of even preparing the electoral rolls besides the power of superintendence, direction and control of election to the panchayats.
3. The State Election Commissioner cannot be removed in any manner from his office until he demits himself or completes his tenure.

Which of the statements given above is/are correct?

(a) 1, 2 and 3   (b) 1 and 2
(c) 2 and 3   (d) Only 1

⊚ (**b**) The State Election Commissioner (SEC) is appointed by the Governor and he has the power of preparing electoral rolls, superintendence, direction and controls of election to the Panchayat.

He cannot be removed in any manner other than as Judge of High Court, till he demits himself or completes his tenure.

Hence, option (b) is correct.

194. Which of the following statements about Indian Judiciary is not correct?

(a) The Constitution of India has not provided for double system of courts as in the United States.

(b) The organisation of the subordinate judiciary in India varies slightly from State to State.
(c) Every State in India has separate High Court.
(d) The Supreme Court has issued direction to constitute an All India Judicial Service to bring about uniformity in designation of officers in criminal and civil side.

⊚ (**c**) The Constitution of India does not provide for double system of courts as in the USA.

The organisation subordinate judiciary varies slightly for State-to-State, as we see that every State in India does not have a separate High Court. e.g. Guwahati High Court has jurisdiction over Arunachal Pradesh, Assam, Nagaland and Mizoram.

Supreme Court has directed to constitute All India Judicial Services so as to ensure uniformity in designation of officers in criminal and civil side.

Hence, option (c) is not correct.

195. Consider the following statements about world's first Modern Slavery Bill, published in June, 2014 by the British House of Commons :

1. This is the first of its kind bill in Europe which specifically addresses slavery and trafficking in the 21st century.
2. The Bill fixes the maximum sentence available for the most serious offenders up to 14 years.

Which of the statements given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊚ (**c**) The Modern Slavery Bill is the first of its kind in Europe, and one of the first in the world, to specifically address slavery and trafficking in the 21st century.

It will give law enforcement, the tool they need to target today's slave drivers, ensure perpetrators are severely punished and improve support and protection for victims.

The maximum sentence available for the most serious offenders from 14 years to life imprisonment.

196. Which of the following about the principles of Panchsheel are correct?

1. These are a set of five principles governing relations between States.

2. The assumption of Panchsheel was that newly independent States after decolonisation would be able to develop a new and more principled approach to international relations.
3. The first formal codification in treaty form was done in an agreement between China and India.

Select the correct answer using the codes given below

(a) 1 and 2   (b) 2 and 3
(c) 1, 2 and 3   (d) 1 and 3

⊚ (**c**) The five principles of peaceful co-existence, known in India as Panchsheel Treaty, are a set of principles to govern relations between States. Their first formal codification in treaty form was in an agreement between China and India on 29th April, 1954. An underlying assumption of the Five Principles was that newly independent States after decolonisation would be able to develop a new and more principled approach to international relations.

2014 (I)

197. Certain Bills cannot be introduced or proceeded with unless the recommendation of the President is received. However, no recommendation is required in some other cases. In which one of the following cases such recommendation is not required?

(a) For introduction of Bills and for moving amendments relating to financial matters
(b) For introduction of a Bill relating to formation of new states or of alternation of areas of existing states
(c) For moving of an amendment making provision for the reduction or abolition of any tax
(d) For introduction of a Bill or moving of an amendment affecting taxation in which states are interested

⊚ (**a**) Money Bill can not be introduced without President's prior approval. So, both (c) and (d) need President's approval. Article 3 of the Constitution states that prior President's recommendation is required for introduction of a Bill relating to formation of new states or alternation of area of existing states.

198. 'The Draft Constitution as framed only provides a machinery for the government of the country. It is not a contrivance to install any particular party in power as has been done in some countries. Who should be in power is left to be determined by the people, as it must be, if the system is to satisfy the test of democracy'.

The above passage from Constituent Assembly debates is attributed to

(a) Pandit Jawaharlal Nehru
(b) Dr BR Ambedkar
(c) Maulana Abdul Kalam Azad
(d) Acharya J B Kriplani

⊚ (**b**) Speaking about the value of Directive Principles of state policy inclusion in the Constitution Dr. BR Ambedkar said the above passage in the constituent Assembly. This is Dr. Ambedkar second argument rested on the Legistimacy of the democratic system. On 29th August, 1947, the Drafting committee was appointed with Dr. Ambedkar as the chairman along with 6 other members assisted by constitutional advisor.

A Draft Constitution was prepared by the committee and submitted to the assembly on 4th November 1947.

Hence, option (b) is correct.

199. Which of the following statements are correct regarding Joint Session of the Houses of the Parliament in India?

1. It is an enabling provision, empowering the President to take steps for resolving deadlock between the two Houses.
2. It is not obligatory upon the President to summon the Houses to meet in a joint sitting.
3. It is being notified by the President.
4. It is frequently resorted to establish the supremacy of the Lok Sabha.

Select the correct answer using the codes given below

(a) 1 and 2   (b) 1, 2 and 3
(c) 2 and 3   (d) 3 and 4

⊚ (**b**) The Parliament of India is bicameral. Concurrence of both houses is required to pass any bill. However, in case of deadlock between the Rajya Sabha and the Lok Sabha, Constitution of India provides for Joint sittings of both the Houses to break this deadlock. The joint sitting of the Parliament is called by the President and is presided over by the Speaker. It is an enabling provision for resolving the deadlock. However, it is not obligatory upon President, since Article 108 has laid down the provisions for calling a joint sitting. It does not establish the supremacy of Lok Sabha.

Hence option (d) is incorrect.

200. Consider the following statements about democracy

1. It consists with the formation of government elected by the people.
2. In democracy, those currently in power have a fair chance of losing.
3. Each vote has one value.

Which of the statement(s) given above is/are correct?

(a) 1 and 2   (b) 1, 2 and 3
(c) Only 1   (d) 2 and 3

⊚ (**b**) Democracy is a form of government in which the rulers are elected by the people. It is based on a free and fair election where these currently in a power having a free chance of loosing. In a democracy, each adult citizen have one vote and each vote have one value and the final decision-making power rests with those elected by the people. Democracy also enhances the dignity of citizens. According to Abraham Lincoln, "Democracy is the government of the people, by the people and for the people.

Hence, all the statements are correct.

201. Which one of the following statements regarding the Departmental Committee of the Parliament of India on the empowerment of women is correct?

(a) The Committee will consist of members of the Lok Sabha only
(b) A Cabinet Minister can be a member of the Committees
(c) The term of office of the members of the Committee shall not exceed two years
(d) It reports on the working of welfare programmes for the women

⊚ (**d**) The committee consists 20 Lok Sabha members and 10 Rajya Sabha members. The committee's term is of one year. No cabinet minister can be a member of committee. The committee reports on the working of various welfare programmes for the women.

Hence, option (d) is correct.

202. Match the following

List I (Person)		List II (Role in making of the Constitution of India)
A. Rajendra Prasad	1.	Member, Drafting Committee
B. TT Krishanamachari	2.	Chairman, Constituent Assembly
C. HC Mukherjee	3.	Chairman, Drafting Committee
D. BR Ambedkar	4.	Vice Chairman, Constituent Assembly

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	4	3	(b)	2	4	1	3
(c)	3	4	1	2	(d)	3	1	4	2

⊚ (**a**) On 11th December, 1946, Dr Rajendra Prasad and HC Mukherjee are elected as Chairman and Vice-chairman of the Constituent Assembly respectively.

Drafting Committee was set-up on 29th August, 1947 for preparing a draft of the new Constitution. It consisted of one Chairman and 6 members. Dr BR Ambedkar was the chairman of Drafting Committee.

TT Krishnamachari, N Gopalaswamy Ayyangar, AK Ayyar, KM Munshi, SM Sadullah, and N Madhava Rau were the members of Drafting committee.

Hence, option (a) is correct.

203. Consider the following statements

1. Forming a cooperative society is a Fundamental Right in India.
2. Cooperative societies do not fall within the ambit of the Right to Information Act, 2005.

Which of the statements given above is/are correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊚ (**a**) By 97th Amendment Act to the Indian Constitution, Article 19(1)(c) has been amended to move right to form cooperative societies as a Fundamental Right. As per Supreme Court ruling, cooperative societies doubt fall within the ambit of RTI Act, 2005.

⊚ Hence, option (a) is correct.

204. The legislative power of the Parliament includes making laws

1. on matters not enumerated in the Concurrent List and State List.

2. in respect of entries in the State List if two or more State Legislatures consider it desirable
3. for implementing any treaty agreement or convention with any country even if it falls in the State List.

Select the correct answer using the codes given below
(a) Only 2 (b) 1 and 2
(c) 1 and 3 (d) All of these

⊙ (*d*) As per Article 248, Parliament has exclusive power to make any law with respect to matters not enumerated in the Concurrent List and State List.

As per Article 252, Parliament has power to legislate for two or more states by consent and adoption of such legislation by any other state.

Article 253 gives power to Parliament to make any law for any part of territory of India for implementing any treaty, agreement or convention with any other country.

Therefore, all the given statements are true. Hence, option (d) is correct.

205. Which of the following statement(s) in the context of structure of the Parliament is/are correct?

1. The Parliament of India consists of the President, the Council of States and the House of the People.
2. The President of India is directly elected by an electoral college consisting of the elected members of both the Houses of the Parliament only.

Select the correct answer using the codes given below
(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2

⊙ (*a*) As per Article 79, Parliament shall consist of the President and the two Houses, i.e. House of the People and Council of States.As per Article 54, President shall be elected by an electoral college consisting of
(i) elected members of both the houses.
(ii) elected members of Legislative Assemblies of State.
Hence, option (a) is correct.

206. There are provisions in the Constitution of India which empower the Parliament to modify or annual the operation of certain provisions of the

Constitution without actually amending them. They include
1. any law made under Article 2 (relating to admission or establishment of new states).
2. any law made under Article 3 (relating to formation of new states).
3. amendment of First Schedule and Fourth Schedule.

Select the correct answer using the codes given below
(a) 1 and 2 (b) 2 and 3
(c) 1, 2 and 3 (d) None of these

⊙ (*a*) Article 4 itself declares that law made for the admission or establishment of new States under Article 2 and formation of new States and alteration of areas, boundaries or names of existing States under Article 3 are not to be considered as amendments of the Constitution under Article 368. This means that such laws can be passed by a simple majority and by the ordinary legislative process. The amendment of the 4th Schedule is related to the federal structure of the polity with actually amending the Constitution.

Hence, option (a) is correct.

207. The Annual Financial Statement of the Government of India in respect of each financial year shall be presented to the House on such day as the
(a) Speaker may direct
(b) President of India may direct
(c) Parliament may decide
(d) Finance Minister may decide

⊙ (*b*) According to Article 112 of the Indian Constitution, the President shall in respect of every financial year cause to be laid before both the Houses of Parliament a statement of the estimated receipts and expenditure of the Government of India for that year, in this part referred to as the 'Annual Financial Statement'.

208. Which of the following principles is/are taken into consideration by the Speaker while recognising a parliamentary party or group?
1. An association of members who have an organisation both inside and outside the House.
2. An association of members who shall have at least one-third of the total number of members of the House.
3. An association of members who have a distinct programme of parliamentary work.

Select the correct answer using the codes given below
(a) 1, 2 and 3 (b) Only 1
(c) 1 and 3 (d) 2 and 3

⊙ (*c*) While recognising a parliamentary party or group the Speaker shall take into consideration the following principles :
(i) An association of members who propose to form a Parliamentary Party -
• shall have announced at the time of the general elections a distinct ideology and programme of Parliamentary work on which they have been returned to the House;
• shall have an organisation both inside and outside the House; and
• shall have at least a strength equal to the quorum fixed to constitute a sitting of the House, that is one-third of the total number of members of the House.
(ii) An association of members to form a Parliamentary Group shall satisfy the conditions specified in Parts (a) and (b) of Clause (i) and shall have at least a strength of 30 members. Hence, option (c) is correct.

209. Which one among the following was not a proposal of the Cabinet Mission, 1946?
(a) The Constituent Assembly was to be constituted on the democratic principle of population strength
(b) Provision for an Indian Union of Provinces and States
(c) All the members of the Constituent Assembly were to be Indians
(d) British Government was to supervise the affairs of the Constituent Assembly

⊙ (*d*) All the given statements except (d) are ture. Cabinet Mission was sent in February 1926 to India by the Atlee Government (British PM). The cabinet mission aim was to discuss the transfer of power from British to Indian leadership. Proposal of the Cabinet Mission, 1946 were as follows
(a) The unity of India had to be retained
(b) It proposed a very loose union of all the Indian. territories under a centre that would countrol merely defence, the foreign affairs and the communication.
(c) The Princely legislative would then elect a constituent assembly. Each province being allotted a specified number of seats propertionate to its population.
(d) The proposed constituent assembly was to consist of 292 member from British India and 93 from Indian states.

210. After a Bill has been passed by the Houses of the Parliament, it is presented to the President who may either give assent to the Bill or with hold his assent. The President may

(a) assent within six months
(b) assent or reject the Bill as soon as possible
(c) return the Bill as soon as possible after the Bill is presented to him with a message requesting the House to reconsider the Bill
(d) with hold his assent even if the Bill is passed again by the Houses

⊙ (**C**) The President can accept or with hold his assent to a Bill or he can return a Bill, other than a Money Bill. If President gives his assent the Bill becomes an act.
Hence, options (c) is correct.

211. Which of the statements relating to the Deputy Speaker of the Lok Sabha is/are correct?

1. The office of the Deputy Speaker acquired a more prominent position after the enforcement of the Constitution of India in 1950.
2. He/She is elected from amongst the members.
3. He/She holds office until he/she ceases to be a member of the House.

Select the correct answer using the codes given below
(a) Only 1
(b) 1 and 2
(c) 1, 2 and 3
(d) 2 and 3

⊙ (**C**) The Deputy Speaker of the Lok Sabha is the vice-Presiding officer of the Lok Sabha. He/She is elected from amongst the member. Lok Sabha is the lower house of the Parliament of India. Deputy Speaker of the Lok Sabha acquired a more prominent position after 1950.

The election of Deputy speaker shall be held. On the such data as the speaker may fix and the secretary-General shall send notice of this data to every member of Lok Sabha. Deputy speaker acts as the presiding offier in case of leave or absence of speaker of the Lok Sabha.

He holds the office till either he ceases to be member of the Lok Sabha or resigns himself.

212. The citizenship means

1. full civil and political rights of the citizens.
2. the right of suffrage for election to the House of the People (of the Union) and the Legislative Assembly of every state.
3. the right to become a Member of the Parliament and Member of Legislative Assemblies.

Select the correct answer using the codes given below
(a) 1 and 2
(b) 1 and 3
(c) 2 and 3
(d) All of these

⊙ (**b**) In Part II of Constitution under Article 5-11, citizenship clause has been explained. Full civil and political rights are entitled to the citizen of India. Also they are entitled to be a Member of Parliament or State Legislature.

But one has to also satisfy the age limit criterion in order to be an MP or MLA. Hence, option (b) is correct.

213. The Committee on Public Accounts under the Constitution of India is meant for

1. the examination of accounts showing the appropriation of sums granted by the House for the expenditure of the Government of India.
2. scrutinising the report of the Comptroller and Auditor-General.
3. suggesting the form in which estimates shall be presented to the Parliament.

Select the correct answer using the codes given below
(a) Only 1
(b) Only 2
(c) 1 and 2
(d) All of these

⊙ (**C**) Public Accounts is fund accounts for flows for those transactions where the government is merely acting as a banker. The committee on Public Accounts was first constituted in 1921 under the act of 1919.

It is constituted by Parliament each year for examination of accounts showing the appropriation as sums granted by Parliament for expenditure of Government of India.

Apart from the reports of the Comptroller and Auditor General of India on appropriation accounts of the Union Government, the committee also

examines the various audit reports of Comptroller and Auditor General on revenue receipts, expenditure by various ministries/ Department of Government and accounts of autonomous bodies.
Hence option (c) is correct.

214. The principle of 'collective responsibility' under parliamentary democracy implies that

1. a motion of no-confidence can be moved in the Council of Ministers as a whole as well as an individual minister.
2. no person shall be nominated to the cabinet except on the advice of the Prime Minister.
3. no person shall be retained as a member of the Cabinet if the Prime minister says that he shall be dismissed.

Select the correct answer using the codes given below
(a) Only 1
(b) Only 2
(c) Only 3
(d) 2 and 3

⊙ (**d**) Statement 1 is wrong since no confidence motion can be moved against the entire council of minister only. On the other hand, censure motion can be moved against either individual minister or the whole council.

Statement 2 and 3 are right. According to Dr.Ambedkar,"Collective responsibility can be achieved only through the instrumentality of the Prime Minister. Therefore, unless and until we create that office and endow that office with statutory authority to nominate and dismiss ministers, there can be no collective responsibility."
Hence, answer (d) is correct.

215. Which of the following statements relating to Comptroller and Auditor General in India is/are correct?

1. He/She is not an officer of the Parliament but an officer under the President.
2. He/She is an independent constitutional authority not directly answerable to the House.

Select the correct answer using the codes given below
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

◈ (**b**) The Comptroller of the Constitution of India audits all receipts and expenditure of the Government of India and the state governments. The CAG is mentioned in the Constitution of India under Article 148 – 151.

The Comptroller and Auditor-General of India is appointed by the President of India following a recommendation by the Prime Minister.

Report of CAG of Union Accounts is submitted to President which causes them to laid before each house of Parliament. Thus, only statement 2 is correct.

Hence, option (b) is correct.

216. The Departmental Committee of the Parliament of India on the welfare of the Scheduled Castes (SCs) and the Scheduled Tribes (STs) shall

1. examine whether the Union Government has secured due representation of the SCs and the STs in the services and posts under its control.
2. report on the working of the welfare programmes for the SCs and the STs in the Union Territories.

Select the correct answer using the codes given below

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

◈ (**a**) The Departmental Committee of Parliament of India on welfare of SC/ST examines whether Union Government has secured due representation of SC/ST in services and posts under it. It has no obligation to report on working of welfare programmes for SC/ST. Hence, options (a) is correct.

217. The subject matter of an adjournment motion in the Parliament

1. must be directly related to the conduct of the Union Government.
2. may involve failure of the Government of India to perform its duties in accordance with the Constitution.

Select the correct answer using the codes given below

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

◈ (**a**) An adjournment motion may be introduced in the House for the purpose of discussing a definite matter of urgent public importance.

Adjournment motion requires a role of at least 50 members of Parliament for its introduction. This can be presented in any House of Parliament. It is directly related to the matters of the conduct of Union Government. But the question of failure of government to perform constitutional duties can not be raised through adjournment motion.

Hence, option (a) is correct.

218. Political theory

1. deals with the ideas and principles that shape Constitutions.
2. clarifies the meaning of freedom, equality and justice.
3. probes the significance of principles of rule of law, separation of power and judicial review.

Select the correct answer using the codes given below

(a) 1 and 2
(b) Only 1
(c) 2 and 3
(d) All of these

◈ (**d**) Political theory deals with ideas that shape Constitution, clarifies the meaning of freedom, equality and justice and probes the significance of rule of law, separation of power and judicial review.

All the statements are true.

Hence, option (d) is correct.

219. The functions of the committee on estimates, as incorporated in the Constitution of India, shall be to

1. report what economies, improvements in organisation, efficiency or administrative reform may be effected.
2. suggest alternative policies in order to bring about efficiency and economy in administration.
3. examine whether the money is well laid out within the limits of the policy implied in the estimates.
4. examine the reports, if any, of the Comptroller and Auditor General on the public undertakings.

Select the correct answer using the codes given below

(a) 1 and 2
(b) 2 and 3
(c) 1, 2 and 3
(d) 3 and 4

◈ (**c**) The first estimates committee in the post-independence was constituted in 1950 on the recommendation of John Mathai, Finance Minister. Originally, it had 25 members but in 1956 its members was raised to 30.

All the thirty members are from Lok Sabha only. The Rajya Sabha has no representation in this committee. (1), (2) and (3) are the functions of the committee on estimates, while (4) is the function of committee on public undertakings.

2019 (II)

1. Which one of the following equals Personal Disposable Income?

(a) Personal Income - Direct taxes paid by households and miscellaneous fees, fines, etc.
(b) Private Income - Saving of Private Corporate Sectors - Corporation Tax
(c) Private Income - Taxes
(d) Total expenditure of households - Income Tax gifts received

⊙ **(a)** Personal Income measures the income that is received by individuals, but not necessarily earned.

Disposable personal income, is the amount that households have available for spending and saving after income taxes have been accommodated for.

Personal Disposable Income

= Personal Income – Direct taxes paid by households and miscellaneous fees, fines, etc.

Hence, option (a) is correct.

2. The working of the price mechanism in a free-market economy refers to which one of the following?

(a) The interplay of the forces of demand and supply
(b) Determination of the inflation rate in the economy
(c) Determination of the economy's propensity to consume
(d) Determination of the economy's full employment output

⊙ **(a)** Free market is an economic system based on supply and demand with little or no goverment control.

It depends on interplay of the forces of demand and supply.

It is a summary description of all voluntary exchanges that take place in a given economic environment.

3. Indexation is a method whose use can be associated with which one of the following?

(a) Controlling inflation
(b) Nominal GDP estimation
(c) Measurement of savings rate
(d) Fixing of wage compensation

⊙ **(a)** Indexation is a method or technique used by organisations or government to control Inflation by connecting prices and asset value to inflation.

This is done by linking adjustments made to the value of a good, service or another metric, to a predetermined index.

4. Which one of the following statements regarding sex composition is not correct?

(a) In some countries, sex ratio is expressed as number of males per thousand females.
(b) In India, sex ratio is expressed as number of females per thousands males.
(c) At world level, sex ratio is about 102 males per 100 females.
(d) In Asia, there is high sex ratio.

⊙ **(d)** In some countries, sex ratio is expressed as number of males per thousand females. Whereas, in India, it is expressed as number of females per thousand males.

At world level, sex ratio is about 102 males per 100 females. Europe has highest sex ratio in the world whereas Asia has lowest.

Hence, option (d) is incorrect.

5. Who among the following has given the concept of Human Development?

(a) Amartya Sen
(b) Mahbub-ul-Haq
(c) Sukhamoy Chakravarty
(d) GS Chaddha

⊙ **(b)** The concept of Human Development was developed by economist Mahbub-ul-Haq.

Human Development is defined as the process of Enlarging people's freedom and opportunities and improving their well being.

6. What do you mean by 'Demographic Dividend'?

(a) A rise in the rate of economic growth due to a higher share of working age people in a population
(b) A rise in the rate of literacy due to development of educational institutions in different parts of the country
(c) A rise in the standard of living of the people due to the growth of alternative livelihood practices
(d) A rise in the gross employment ratio of a country due to government policies

⊙ **(a)** 'Demographic Dividend' means a rise in the rate of economic growth due to a higher share of working age people in a population.

The change in working age people is typically brought by a decline in fertility and mortality rates.

7. Which one of the following statements with regard to economic models is not correct?

(a) They involve simplification of complex processes
(b) They represent the whole or a part of a theory
(c) They can be expressed only through equations
(d) They help in gaining an insight into cause and effect

⊙ **(c)** Economic model is a theoretical construct representing economic processes by a set of variables and a set of logical relationship between them. This can be expressed through equations, models etc.

They involve simplification of complex processes. They help in gaining an insight into cause and effect.

8. The value of the slope of a normal demand curve is

(a) positive
(b) negative
(c) zero
(d) infinity

⊘ *(b)* In a market equilibrium, whenever price of a commodity rises, the demand of commodity declines, in same way when prices fall, demand increases.

So, demand and prices have negative relationship with each other. Therefore, the value of slope of a normal demand curve is negative.

9. Which one of the following is an example of a price floor?

(a) Minimum Support Price (MSP) for Jowar in India
(b) Subsidy given to farmers to buy fertilizers
(c) Price paid by people to buy goods from ration shops
(d) Maximum Retail Price (MRP) printed on the covers/packets of goods sold in India

⊘ *(a)* A price floor is a minimum price. It is a regulatory tool. Price floor is defined as an intervertion to raise market prices if the government feels that price is too law. MSP for Jowar in India or minimum wage are examples of price floor.

10. Which one of the following factors is not considered in determining the Minimum Support Price (MSP) in India?

(a) Cost of production
(b) Price trends in international and domestic markets
(c) Cost of living index
(d) Inter-crop price parity

⊘ *(c)* In formulating Minimum Supports Price (MSP), the Commission for Agricultural Cost and Prices (CACP) considers

• Cost of production
• Changes in input prices
• Input-output price parity
• Trends in market prices
• Demand and supply
• Inter-crop price parity
• Effect in industrial cost structure
• Effect on cost of living
• Effect on general price level
• International price situation
• Parity between prices paid and prices received by the farmers.
• Effect on issue prices and implication for subsidy.

Hence option (c) is not consider in determining the MSP.

11. Which one of the following is not a dimension of the Human Development Index (HDI)?

(a) A long and healthy life
(b) Knowledge
(c) Access to banking and other financial provisions
(d) A decent standard of living

⊘ *(c)* Human development index (HDI) is an index of life expectancy, education and per capita income indicators.

There are three dimensions of index—Long and healthy life, knowledge and a decent standard of living.

Hence, option (c) is not a dimension of the human development Index.

12. Gini Coefficient or Gini Ratio can be associated with which one of the following measurements in an economy?

(a) Rate of inflation
(b) Poverty index
(c) Income inequality
(d) Personal income

⊘ *(c)* In economics, Gini Coefficient represents income or wealth distribution of a nation's residents and most commonly used to measure income inequality.

It was developed by the Italian statistician and sociologist Corrado Gini and published in his 1912 paper 'Variability and Mutability'.

13. Which one of the following countries is not a founding member of the New Development Bank?

(a) Brazil   (b) Canada
(c) Russia   (d) India

⊘ *(b)* New Development Bank, formerly, referred to as the BRICS Development Bank, is a multilateral development bank established by the BRICS States (Brazil, Russia, India, China, South Africa).

The bank is headquartered in Shanghai (China). The first regional office of the NDB is in Johannesburg (South Africa). As Canada is not a member of BRICS, it is not a member of the New Development Bank.

14. The South Asian Association for Regional Cooperation (SAARC) was founded in

(a) Colombo   (b) Islamabad
(c) Kathmandu   (d) Dhaka

⊘ *(d)* The South Asian Association for Regional Cooperation (SAARC) is the regional inter-governmental organisation in South Asia.

SAARC was founded in Dhaka on 8th December, 1985. Its secretariat is based in Kathmandu (Nepal). The organisation promotes development of economic and regional integration.

Its member states include Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

2019 (I)

15. Which one of the following statements is not correct?

(a) When total utility is maximum, marginal utility is zero
(b) When total utility is decreasing, marginal utility is negative
(c) When total utility is increasing marginal utility is positive
(d) When total utility is maximum, marginal and average utility are equal to each other

⊘ *(d)* Total Utility (TU) means total benefit obtained by a person from consumption of goods and services, whereas, Marginal Utility (MU) means the amount of utility, a person gains from the consumption of each successive unit of a commodity.

Relation between total utility and marginal utility
(i) When total utility is maximum, marginal utility is zero
(ii) When total utility increase, marginal utility is positive
(iii) When total utility decrease, marginal utility is negative

Hence, option (d) is not correct.

16. Consider the following statements about indifference curves.

1. Indifference curves are convex to the origin.
2. Higher indifference curve represents higher level of satisfaction.
3. Two indifference curves cut each other.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) Only 3

⊘ *(b)* An indifference curve is a locus of combinations of goods which derive the same level of satisfaction so that the consumer is indifferent to any of the combination he consumes.

Hence statement (1) is correct.

Higher indifference curve means higher level of satisfaction as higher

indifference curve consists of more of two goods or the same quantity of one good and more quantity of the other good.

Hence statement (2) is correct.

Also, two indifference curves cannot cut each other.

Thus, statement (3) is incorrect.

17. Consider the following statements about a joint-stock company.

1. It has a legal existence.
2. There is limited liability of shareholders.
3. It has a democratic management.
4. It has a collective ownership.

Which of the statements given above are correct?

(a) 1 and 2
(b) 1, 2 and 3
(c) 3 and 4
(d) 1, 2, 3 and 4

⊙ *(d)* A joint-stock company is a business entity in which shares of the company's stock can be bought and sold by share holders.

Each shareholder owns company stock in proportion, evidenced by their shares.

All the above are features of a joint-stock company

(i) It has a legal existence .

(ii) There is limited liability of shareholders for satisfaction of the debt of the company the personal property of the shareholders cannot be used.

(iii) It has a democratic management.

(iv) It has a collective ownership.

18. When some goods or productive factors are completely fixed in amount, regardless of price, the supply curve is

(a) horizontal
(b) downward sloping to the right
(c) vertical
(d) upward sloping to the right

⊙ *(d)* When some goods or productive factors are completely fixed in amount regardless of price, the supply curve is upward sloping to the right.

Supply curve is a graphic representation of the correlation between the cost of a good or service and the quantity supplied for a given period.

The upward sloping means that the firms will be willing to increase the production in response to a higher market price because the higher price may make additional production profitable.

19. 'Sub-prime crisis' is a term associated with which one of the following events?

(a) Economic recession
(b) Political instability
(c) Structural adjustment programmes
(d) Growing social inequality

⊙ *(a)* Subprime crisis is Economic recession that took place in the USA from 2007 to 2010.

Economic recession is a slow down or massive contraction in economic activities.

The primary cause was the collapse of the housing bubble. As a result of this crisis, job growth, saving and investment reduced to abysmal.

20. A market situation when many firms sell similar, but not identical products is termed as

(a) perfect competition
(b) imperfect competition
(c) monopolistic competition
(d) oligopoly

⊙ *(c)* **Monopolistic competition** is situation where many firms are competing against each other but selling products that are distinctive, this type of situation leads to imperfect competition in the market.

This market situation is against the interest of consumers.

Perfect competition is the situation prevailing in a market in which buyers and sellers are so numerous and well informed that all elements of monopoly are absent and the market price of a commodity is beyond the control of individual buyers and sellers.

Imperfect competition is the situation prevailing in a market in which elements of monopoly allow individual producers or consumers to exercise some control over market prices.

An oligopoly is a market form wherein a market or industry is dominated by a small number of large sellers.

21. Consider the following statements.

1. Inflation in India continued to be moderate during 2017-18.
2. There was significant reduction in food inflation, particularly pulses and vegetables during the period.

Which of the statement(s) given above is/are correct?

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ *(c)* As per economic survey. Inflation in india continued to be moderate 3.3% during 2017-18.

It was mainly due to the significant reduction in food inflation, particularly pulses and vegetables during the period.

Hence, Both the statements are true.

22. Which one of the following hypotheses postulates that individual's consumption in any time period depends upon resources available to the individual, rate of return on his capital and age of the individual?

(a) Absolute Income Hypothesis
(b) Relative Income Hypothesis
(c) Life-Cycle Hypothesis
(d) Permanent Income Hypothesis

⊙ *(c)* The life-cycle hypothesis postulates that individual consumption in anytime period depends on.

(i) The resources available to the individual.

(ii) The rate of return on his capital.

(iii) The age of the individual.

It was developed by Franco Modigliani.

23. According to John Maynard Keynes, employment depends upon

(a) aggregate demand
(b) aggregate supply
(c) effective demand
(d) rate of interest

⊙ *(c)* John Maynard Keynes was the founder of modern macro-economics. He was a British economist.

As per his book the general theory of employment, interest and money, employment depends on effective demand.

With the increase in demand, manufacturing and other services require more person to manufacture goods and provide services thus leading to job growth.

Hence, option (c) is true.

24. Which one among the following is the most populated state in India as per Census 2011?

(a) Goa
(b) Mizoram
(c) Meghalaya
(d) Sikkim

⊙ *(c)* The Census of 2011 was 15th Census held in two phases.

Among the above state Meghalaya is most populated and Sikkim is least populated.

The state of Uttar Pradesh (First rank), Maharashtra (Second rank) and Bihar (Third rank) are among top three populated states according to the census 2011.

25. EK Janaki Ammal National Award on Taxonomy is administered by the

(a) Ministry of Agriculture and Farmers Welfare
(b) Ministry of New and Renewable Energy
(c) Ministry of Health and Family Welfare
(d) Ministry of Environment, Forest and Climate Change

⊙ *(d)* EK Janaki Ammal National award on Taxonomy is administered by the Ministry of Environment, Forest and Climate change.

This award is categorised in three fields Plants, Animals and Microbial Taxonomy.

The award is named after EK Janaki Ammal legendary Botanist from Kerala.

26. Which one of the following canons of taxation was not advocated by Adam Smith?

(a) Canon of equality
(b) Canon of certainty
(c) Canon of convenience
(d) Canon of fiscal adequacy

⊙ *(d)* Adam Smith was an economist, best known for his book *'Wealth of Nation'*.

He presented four canon of taxation, later many other canon were developed. Smith's canon of taxation include

(i) Canon of equality
(ii) Canon of certainty
(iii) Canon of convenience
(iv) Canon of economy

So canon of fiscal adequacy was not advocated by adam smith.

2018 (II)

27. As per Census 2011, the concentration of Scheduled Caste population (going by percentage of Scheduled Caste population to total population of the State) is the highest in the state of

(a) Uttar Pradesh
(b) Himachal Pradesh
(c) Punjab
(d) West Bengal

⊙ *(c)* Punjab has the largest share of Schedule Caste people in its population at 31.9%.

Himachal Pradesh and West Bengal follow Punjab with 25.2% and 23.5%. Uttar Pradesh has 20.7% Schedule Caste people in its population.

28. Which one of the following is the correct ascending sequence of states with regard to percentage of urban population (2011)?

(a) Tamil Nadu–Mizoram–Goa–Maharashtra
(b) Goa–Mizoram–Maharashtra–Kerala
(c) Maharashtra–Kerala–Mizoram–Goa
(d) Mizoram–Goa–Maharashtra–Kerala

⊙ *(c)* Percentage of urban population in Goa is 62.17%, Mizoram is 51.51% , Maharashtra is 45.23% and Kerala is 47.72%.

The correct sequeuce is Maharastra–Kerela–Mizoram–Goa

29. According to the latest Reserve Bank of India study on state finances, capital spending is maximum on

(a) rural development
(b) water supply and sanitation
(c) urban development
(d) education

⊙ *(c)* According to reveal by the latest Reserve Bank of India (RBI) study on state finances, capital spending was maximum on urban development.

Capital outlay by all states was expected to touch a staggering ₹ 5.37 trillion in 2018-19 , up from ₹ 4.7 trillion in 2017-18 (RE).

The spending amounted to 2.9 per cent of Gross Domestic Product (GDP). Under AMRUT scheme, states have to spend large amounts on urban development.

30. The Fourteenth Finance Commission assigned different weights to the following parameters for distribution of tax proceeds to the states

1. Income distance
2. Population
3. Demographic changes
4. Area

Arrange the aforesaid parameters in descending order in terms of their weights.

(a) 1,2,3,4   (b) 1,2,4,3
(c) 1,3,2,4   (d) 4,3,2,1

⊙ *(b)* The total devolution to states during the five year (2015-20) period will be ₹ 39.48 lakh crore. Criteria and weights for the horizontal distribution of the tax is as follows

Criteria	Weight (%)
1. Income Distance	50
2. Population (1 971)	17.5
3. Area	15
4. Demographic Change (2011)	10
5. Forest Cover	7.5

The 14th Finance Commission of India is constituted in the Chairmanship of the former RBI Governor Mr. YV Reddy for the period of 1st April, 2015 to 31st March, 2020.

The 14th Finance Commission has recommended a record 10% increase in the states' share in the Union taxes to 42% as compared to the 13th Finance Commission.

Hence, option (b) is the correct answer.

31. The natural rate of unemployment hypothesis was advocated by

(a) Milton Friedman (b) A W Phillips
(c) J M Keynes   (d) R G Lipsey

⊙ *(a)* The natural rate of unemployment is the name that was given to a key concept in the study of economic activity by Milton Friedman.

The natural rate of unemployment is the difference between those who would accept a job at the current wage rate and those who are able and willing to take a job.

32. **Statement I** Private investments in research have severely lagged public investments in India.

Statement II Universities play a relatively small role in the research activities of the country.

Codes

(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true and statement II is not the correct explanation of statement I
(c) Statement I is true, but statement II is false
(d) Statement I is false, but statement II is true

⊙ *(b)* Private investments in research have severely lagged public investments in India.

According to one analysis (Forbes, 2017) there are 26 Indian companies in the list of the top 2,500 global R and D spenders compared to 301 Chinese companies.

Hence, statement 1 is correct.

The economic survey also highlighted that universities play a relatively small role in the research activities of the country.

Hence statement 2 is correct.

33. SWAYAM is
(a) a network that aims to tap the talent pool of scientists and entrepreneurs towards global excellence
(b) a Massive Open Online Courses (MOOCs) initiative on a national platform
(c) an empowerment scheme for advancing the participation of girls in education
(d) a scheme that supports differently abled children to pursue technical education

⊙ *(b)* SWAYAM is a Massive Online Open Courses (MOOC) programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality.

The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

34. **Statement I** There has been a sharp decline in savings rate in Indian economy between 2007-2008 to 2015-2016.

Statement II There has been a fall in household and public savings.

Codes
(a) Both the statements are individually true and statement II is the correct explanation of statement I
(b) Both the statements are individually true and statement II is not the correct explanation of statement I
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true

⊙ *(c)* According to IMF, India's gross savings rate has fallen in 2015-16. It was 37% in 2007-08 and recorded 31% in 2015-16. The slowdown is more a function of low incomes, tough economic conditions, falling real returns and high inflation, rather than structural impediments of a rising dependency ratio or a fall in working age population.

So, fall in household and public savings is responsible for sharp decline in saving rates.

Hence, option (c) is correct.

2018 (I)

35. Consider the following statements about impact of tax.
1. A tax is shifted forward to consumers if the demand is inelastic relative to supply.
2. A tax is shifted backward to producers if the supply is relatively more inelastic than demand.

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(c)* Price elasticity of demand is a measure of the change in the quantity demanded or purchased of a product in relation to its price change.

Forward shifting takes place if the burden falls entirely on the user, rather than the supplier of the commodity or service in question.

For example, an excise tax on luxuries that increases their price to the purchaser.

Backward shifting occurs when the price of the article taxed remains the same but the cost of the tax is borne by those engaged in producing it.

For example, through lower wages and salaries, lower prices for raw materials or a lower return on borrowed capital. Finally, a tax may not be shifted at all.

For example, a tax on business profits may reduce the net income of the business owner.

Hence, option (c) is true.

36. According to the law of diminishing marginal utility, as the amount of a good consumed increases, the marginal utility of that good tends to
(a) improve   (b) diminish
(c) remain constant
(d) first diminish and then improve

⊙ *(b)* The law of diminishing marginal utility is a law of economics stating that as a person increases consumption of a product while keeping consumption of other products constant, there is a decline in the marginal utility that a person derives from consuming each additional unit of that product.

37. Which one of the following statements about Exchange-Traded Fund (ETF) is not correct?
(a) It is a marketable security
(b) It experiences price changes throughout the day

(c) It typically has lower daily liquidity and higher fees than mutual fund shares
(d) An ETF does not have its Net Assest Value calculated once at the end of every day

⊙ *(c)* An ETF or Exchange-Traded Fund, is a marketable security that tracks an index, a commodity, bonds or a basket of assets like an index fund.

ETFs typically have higher daily liquidity and lower fees than mutual fund shares, making them an attractive alternative for individual investors. Unlike mutual funds, an ETF trades like a common stock on a stock exchange.

ETFs experience price changes throughout the day as they are bought and sold. Because it trades like a stock, an ETF does not have its Net Asset Value (NAV) calculated once at the end of every day like a mutual fund does.

Hence, option (c) is not correct.

38. Which one of the following is the maximum age of joining National Pension System (NPS) under the NPS-Private Sector?
(a) 55 yr (b) 60 yr   (c) 65 yr (d) 70 yr

⊙ *(c)* The National Pension System (NPS) is a voluntary defined contribution pension system administered and regulated by the Pension Fund Regulatory and Development Authority (PFRDA), created by an Act of the Parliament of India on 1st January, 2004.

The age of joining NPS should be between 18 and 65 years old as of the date of submission of his/her application.

39. Which of the following statements about 'Niryat Bandhu Scheme' is correct?
(a) It is a scheme for mentoring first generation entrepreneurs
(b) It is a scheme for crop protection
(c) It is a scheme for the vulnerable section of the society
(d) It is a scheme for monitoring rural poor

⊙ *(a)* Niryat Bandhu Scheme was launched by the Ministry of Commerce and Industry in 2015.

The objective of the Niryat Bandhu Scheme is to reach out to the new and potential exporters and mentor the first generation entrepreneurs through orientation programmes, counselling sessions, individual facilitation, etc.

This will facilitate exporter for being able to get into international trade and boost exports from India.

Hence, option (a) is correct.

2017 (II)

40. The monetary policy in India uses which of the following tools?

1. Bank rate
2. Open market operations
3. Public debt
4. Public revenue

Select the correct answer using the codes given below
(a) 1 and 2   (b) 2 and 3
(c) 1 and 4   (d) All of the above

⊙ *(a)* Monetary policy of India is formulated and executed by RBI to achieve specific objectives.

It refers to that policy by which central bank of the country controls the supply of money and cost of money.

The monetary policy tools include bank rate and open market operations.

Bank rate refers to the official interest rate at which RBI provides loans to the banking system.

Open market operations refers to the buying and selling of government securities in the market in the open market.

Public debt refers to a part of the total borrowings by the Union Government which includes market loans, treasury bills etc.

Public revenue means the income of the government through all sources.

Hence, option (a) is true.

41. Devaluation of currency will be more beneficial if prices of

(a) domestic goods remain constant
(b) exports become cheaper to importers
(c) imports remain constant
(d) exports rise proportionality

⊙ *(b)* Devaluation of currency will be more beneficial if pricss of exports become cheaper to importers.

A devaluation means that more local currency is needed to purchase imports and exporters get more local currency when they convert the export proceeds.

In other words, imports become more expensive and exporters earn more money. Hence, option (b) is correct.

42. In India, the base year of the new GDP series has been shifted from 2004-05 to

(a) 2007-08   (b) 2008-09
(c) 2010-11   (d) 2011-12

⊙ *(d)* A base year is the year used for comparison in the measure of a business activity or economic Index. It gives an idea about changes in purchasing power and allows calculation of inflation-adjusted growth estimates. The change in base year done in every 7 to 10 years. Currently it is shifted from 2004-05 to 2011-12 in India.

43. Match List I with List II and select the correct answer using the codes given below the lists.

List I (Type of Deficit)	List II (Explanation)
A. Fiscal Deficit	1. Total Expenditure-Revenue Receipts and Non-debt Capital Receipts
B. Revenue Deficit	2. Revenue Expenditure-Revenue Receipts
C. Effective Revenue Deficit	3. Revenue Deficit-Grants for Creation of Capital Assets
D. Primary Deficit	4. Fiscal Deficit- Interest Payments

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	1	3	2	4
(c)	4	2	3	1	(d)	4	3	2	1

⊙ *(a)*

1. **Fiscal Deficit** is the difference between total revenue and total expenditure of the government is termed as fiscal deficit. It is an indication of the total borrowings needed by the government.
Fiscal Deficit = Total Expenditure – Revenue Receipts and Non-debt Capital Receipts.

2. **A Revenue Deficit** occurs when realized net income is less than the projected net income. This happens when the actual amount of revenue and/or the actual amount of expenditures do not correspond with budgeted revenue and expenditures.
Revenue Deficit = Revenue Expenditure – Revenue Receipts.

3. **Effective Revenue Deficit** is the difference between revenue deficit and grants for creation of capital assets. The concept of effective revenue deficit has been suggested by the Rangarajan Committee on Public Expenditure.
Effective Revenue Deficit = Revenue Deficit – Grants for Creation of Capital Assets.

4. **Primary Deficit** refers to difference between fiscal deficit of the current year and interest payments on the previous borrowings.
Primary Deficit = Fiscal Deficit – Interest Payments.

44. Which one of the following criteria got the highest weight for determination of shares of states in the formula given by the 14th Finance Commission?

(a) Population   (b) Income distance
(c) Area   (d) Tax effort

⊙ *(b)* Among states, the horizontal distribution of tax revenue is determined by the 14th Finance Commission through a formula.

The Finance Commission formula for horizontal devolution is as below :

1. Fiscal Capacity or Income Distance (from 47.5% → 50%)
2. Population 1971 (25% → 17.5%)
3. Population 2011 (newly introduced by FFC-10%)
4. Area (10% → 15%)
5. Fiscal discipline (17.5%) → This has been removed
6. Forest cover (newly introduced by FCC-7.5%)

Hence, option (b) is true.

45. A Money Bill passed by the Lok Sabha can be held up by the Rajya Sabha for how many weeks?

(a) Two   (b) Three
(c) Four   (d) Five

⊙ *(a)* A Money Bill after having been passed by the Lok Sabha, and sent to Rajya Sabha for its recommendations, has to be returned to Lok Sabha by the Rajya Sabha, within a period of two weeks (fourteen days) from the date of its receipt, with or without recommendations.

Hence, option(a) is true.

46. UBI, as an alternative for substance in poverty alleviation, stands for

(a) Union Basic Income
(b) Undefined Basic Income
(c) Unconditional Basic Income
(d) Universal Basic Income

⊙ *(d)* Universal Basic Income (UBI) is a form of social security in which all citizens or residents of a country receive a regular, unconditional sum of money, either from a government or some other public institution, independent of any other income. UBI has potential to reduce poverty, or even eradicate poverty.

The essential principle behind basic income is the idea that all citizens are entitled to a livable income, whether or not they contribute to production and despite the particular circumstances into which they are born.

47. 'Pragati scholarship scheme of the Government of India is meant for

(a) higher education of girls
(b) technical education of girls
(c) secondary education of girls
(d) elementary education of girls

⊙ **(b)** 'Pragati' is a scheme of AICTE aimed at providing assistance for Advancement of Girls participation in Technical Education .

This is an attempt to give every young Woman the opportunity to further her education and prepare for a successful future by "Empowering Women Through Technical Education".

It is basically to provide encouragement and support to Girl Child to pursue technical education.

48. Which one of the following is not a feature of the Sansad Adarsh Gram Yojana (SAGY)?

(a) It focuses on community participation
(b) It is to be guided by a Member of the Parliament
(c) It aims at creating infrastructure for the village
(d) A Village Development Plan would be prepared for every identified Gram Panchayat

⊙ **(b)** Sansad Adarsh Gram Yojana (SAGY) is a village development project launched by Government of India in October, 2014, under which each Member of Parliament will take the responsibility of developing physical and institutional infrastructure in three villages by 2019.

Hence, option (b) is not correct.

The main objectives of SAGY are

(i) To trigger processes which lead to holistic development of the identified Gram Panchayats

(ii) To substantially improve the standard of living and quality of life of all sections of the population through - improved basic amenities, higher productivity, enhanced human development, better livelihood opportunities, reduced disparities, access to rights and entitlements, wider social mobilisation, enriched social capital.

(iii) To generate models of local level development and effective local governance which can motivate and inspire neighbouring Gram Panchayats to learn and adapt.

2017 (I)

49. Which one of the following statements is correct? For the purpose of census-2011.

(a) a person aged seven and above who can both read and write with understanding in any language is treated as a literate
(b) a person aged eight and above, who can both read and write with understanding in any language is treated as a literate
(c) a person aged nine and above, who can both read and write with understanding in any language is treated as a literate
(d) a person aged ten and above who can both read and write with understanding in any language is treated as a literate

⊙ **(a)** Literacy is meant as the ability to read and write. In India a person aged seven and above who can both read and write with understanding in any language is treated as literate.

A person who can read only but cannot write, is illiterate. The data provides details of state code, district code, area name, age-group, literates, illiterates, literates without education level, below primary, middle, matric, intermediate, pre-university/senior secondary, non-technical diploma or certificate not equal to degree, graduate and above and unclassified education level.

50. 'Rand/ZAR' is the currency of

(a) Burundi   (b) Libya
(c) Sudan   (d) South Africa

⊙ **(d)** Rand/ZAR is the currency of South Africa.

Burundi	-	Franc
Libya	-	Libyan Dinar
Sudan	-	Sudanese Pound
South Africa	-	Rand/ZAR

51. Which one of the following is not a component of Revenue Receipts of the Union Government?

(a) Corporate tax receipts
(b) Dividends and profits
(c) Disinvestment receipts
(d) Interest receipts

⊙ **(c)** Revenue receipts of the government are generally classified under two heads :

 (i) Tax revenue   (ii) Non-tax revenue

Disinvestment receipts come under capital receipts, other options come under tax and non-tax revenues.

52. TRIPS agreement pertains to

(a) international tariff regime
(b) intellectual property protection
(c) international practices on trade facilitation
(d) international taxation of property

⊙ **(b)** The agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) is an international legal agreement between all the member nations of the World Trade Organisation (WTO).

It sets down minimum standards for the regulation by national governments of many forms of Intellectual Property (IP) as applied to nationals of other WTO member nations.

53. The 7.6% growth rate registered by Indian economy during the year 2015-16 is based on

(a) Gross National Product at market prices
(b) Gross Value Added at constant prices
(c) Gross Domestic Product at market prices
(d) Gross Domestic Product at constant prices

⊙ **(d)** Central Statistics Office (CSO) under the Ministry of Statistics and Programme Implementation (MOSPI) on 31st May, 2016 released the growth rate for year 2015-16.

It was 7.6% which was based on Gross Domestic Product at Constant (2011-12) prices.

54. Which of the following statements about the Trans-Pacific Partnership (TPP) is/are correct?

1. The TPP was signed by 12 Pacific Rim nations in the year 2015.

2. The TPP is likely to be a game-changer in global trade as member countries account for about 40% of global GDP.

3. India is a founder member of TPP.

Select the correct answer using the codes given below.

(a) 1, 2 and 3   (b) 1 and 2
(c) 2 and 3   (d) Only 1

⊙ **(b)** The Trans-Pacific Partnership (TPP) was a free-trade agreement between the United States and 11 other countries that border the Pacific Ocean but in 2018 USA, pulled out of TPP.

The TPP was signed by 12 pacific rim Nations (Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, the United States, and Vietnam) in the year 2015.

The countries involved produce 40% of the world's total gross domestic product of $107.5 trillion.

Hence, statement 1 and 2 are correct.

India is not a founding member of TPP. Hence, statement 3 is incorrect.

55. Which of the following statement(s) about Bitcoin is/are correct?

1. It is a decentralised virtual currency.
2. It is generated through complex computer software systems.
3. The Reserve Bank of India recognised it as a legal tender in January, 2016.

Select the correct answer using the codes given below

(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) 1, 2 and 3

▷ *(b)* Bitcoin is a cryptocurrency. It is a decentralised digital currency without a central bank or single administrator.

Bitcoin can be sent from user to user on the peer-to-peer bitcoin network through complex computer software systems.

This eliminates the need for intermediaries. Hence, statement 1 and 2 are correct.

The Reserve Bank of India (RBI) does not recognise any of the virtual currencies as legal tender.

Hence statement 3 is incorrect.

56. Which one of the following indices is now used by the Reserve Bank of India (RBI) to measure the rate of inflation in India?

(a) NASDAQ Index
(b) BSE Index
(c) Consumer Price Index
(d) Wholesale Price Index

▷ *(c)* The Former Reserve Bank of India (RBI) Governor, Raghuram Rajan, said that the Central Bank had adopted the new Consumer Price Index (CPI) (combined) as the key measure of inflation.

This decision is based on the Urjit Patel Committee report.

57. Goods and Services Tax likely to be levied in India is not a

(a) gross value tax
(b) value-added tax
(c) consumption tax
(d) destination-based tax

▷ *(a)* GST would be a comprehensive indirect tax on manufacture, sale and consumption of goods and services throughout India to replace taxes levied by the Central and State Governments.

Goods and Services tax would be levied and collected at each stage of sale or purchase of goods or services according to value added based on the input tax credit method.

58. Amartya Sen was awarded the Nobel Prize for his contribution to

(a) Monetary Economics
(b) Welfare Economics
(c) Environmental Economics
(d) Development Economics

▷ *(b)* Amarty a sen was awardad the Nobel Prize for his contribution to welfare economics in 1998.

Welfare Economics is defined as a branch of economics that studies how the distribution of income, resources and goods affects the economic well-being.

An example of welfare economics is the study of how certain health services help bridge the barrier between different classes of people.

59. Which one of the following statements is not correct in respect of the South Asian Association for Regional Cooperation (SAARC)?

(a) Its Headquarters is located in Kathmandu
(b) China is the only country with an Observer status in SAARC
(c) The First SAARC Summit was held in Dhaka
(d) The Eighteenth SAARC Summit was held in Nepal

▷ *(b)* The South Asian Association for Regional Cooperation (SAARC) is the regional inter-governmental organisation and geopolitical union of nations in South Asia.

SAARC has 9 observers—Australia, China, European Union, Iran, Japan, Republic of Korea, Mauritius, Myanmar and USA.

Its member countries include Afghanistan, Bangladesh, Bhutan, India, Nepal, the Maldives, Pakistan and Sri Lanka.

SAARC comprises 3% of the world's area, 21% of the world's population and 3.8% ($ 2.9 trillion) of the global economy, as of 2015.

Hence, option (b) is not correct.

2016 (II)

60. The All India Census was

1. first attempted in 1872.
2. regularly undertaken since 1881.
3. always undertaken as a five-years exercise.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) 2 and 3
(c) 1 and 2   (d) All of these

▷ *(c)* The Indian Census is the largest single source of a variety of statistical information on different characteristics of the people of India. It was begun from 1872 when the first census was conducted in India non-synchronously in different parts.

The first synchronous decennial census was conducted in 1881 and has continued thus, since.

Hence, option (c) is correct.

61. According to Census 2011, which one of the following is the correct sequence of states in decreasing order of their total size of population?

(a) Kerala, Jharkhand, Assam, Punjab
(b) Jharkhand, Kerala, Assam, Punjab
(c) Kerala, Jharkhand, Punjab, Assam
(d) Jharkhand, Kerala, Punjab, Assam

▷ *(a)* According to Census 2011, population of

Kerala	33406061
Jharkhand	32988134
Assam	31205576
Punjab	27743338

Hence, decresing order of total size of population is Kerala, Jharkhand, Assam, Punjab.

62. According to the Classical Theory of Employment, deviations from the State of full employment are

(a) purely temporary in nature
(b) permanent in nature
(c) imaginary situations
(d) normal situations

▷ *(a)* The deviations from the state of full employment are purely temporary in nature. The classical economists believed in the existence of full employment in the economy.

To them, full employment is normal situation and any deviation from this regarded as something abnormal or temporary. Marshall and Pigou say the tendency of the economic system is to automatically provide full employment in the labour market when the demand and supply of labour are equal.

63. Capital deepening refers to

(a) going for more fixed capital per worker
(b) emphasis on social overhead capital
(c) constant capital-output ratio
(d) increasing capital-output ratio

⊘ *(d)* Capital deepening refers to an increase in capital-output (labour) ratio. It is a situation, where the capital per worker is increasing in the economy.

This is also referred to as increase in the capital intensity. For example, a new technology, which makes capital more productive, therefore, capital deepening will lead to rising labour productivity.

Capital deepening is often measured by the rate of change in capital stock per labour hour.

64. The headquarters of 'Economic and Social Commission for Asia and the Pacific' is located at

(a) Singapore   (b) Manila
(c) Bangkok   (d) Hong Kong

⊘ *(c)* The Economic and Social Commission for Asia and Pacific is located in the United Nations building in Bangkok, Thailand.

It is one of the five regional commissions of United Nations Economic and Social Council under the administrative direction of the United Nations headquarters.

It was established in 1947 to encourage economic cooperation among member states.

65. Which of the following with regard to the term 'bank run' is correct?

(a) The net balance of money a bank has in its chest at the end of the day's business
(b) The ratio of bank's total deposits and total liabilities
(c) A panic situation when the deposit holders start withdrawing cash from the banks
(d) The period in which a bank creates highest credit in the market

⊘ *(c)* Bank Run is a panic situation when the large number of customers withdraw cash from deposit accounts.

A bank run occurs in a fractional reserve banking system, where banks keeps a small proportion of their assets as cash.

It is the belief of the customers that the financial institution might become insolvent and keep the cash or transfer into other assets.

66. Which of the following will be the outcome, if an economy is under the inflationary pressure?

1. Domestic currency heads for depreciation.

2. Exports become less competitive imports become costlier.
3. Cost of borrowing decreases.
4. Bondholders get benefitted and the creditor is at loss.

Which of the statement(s) given above is/are correct?

(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 3 and 4

⊘ *(d)* Inflation is a result of many factors which at compositely in an economy.

These factors are responsible for either slack in production of the goods or surge in demand of that good, which causes inflation.

1. Inflation erodes the purchasing power of a currency, hence it gets depreciated.
2. Exports suffer on account of higher input costs and lesser competitions and imports seem attractive on the same amounts.
3. The cost of borrowing decreases as the money paid back is lesser.
4. The holder of a bond gets benefitted while creditor/lender gets to loose money with inflation.

Hence, statements (d) is correct.

67. Which one of the following statements is correct with respect to the composition of national income in India?

(a) The share of manufacturing sector has declined
(b) The share of services sector has increased sharply
(c) The share of agriculture has remained static
(d) The share of services sector has declined

⊘ *(b)* National income is calculated from many sectors. It can be classified into three major sectors i.e. primary, secondary and tertiary.

The primary sector in India is the highest contributor in the development.

The course of development falls down and share of the secondary sector will be greater than the primary.

At a very high level of development, the share of service sector in the national income will be more.

68. In India, the term 'Hot money' is used to refer to

(a) Currency + Reserves with the RBI
(b) Net GDR
(c) Net Foreign Direct Investment
(d) Foreign Portfolio Investment

⊘ *(d)* The term 'hot money' is used to refer to foreign portfolio investments.

Hot money is the flow of funds from one country to another in order to earn a short-term profit on interest rate differences and anticipated exchange rate shifts.

These speculative capital flows are called 'Hot money' because they can move very quickly in and out of markets, potentially leading to market instability.

69. Which of the following is/are credit rating agency/agencies in India?

(a) CRISIL   (b) CARE
(c) ICRA   (d) All of these

⊘ *(d)* The credit rating agencies in India mainly includes ICRA and CRISIL. ICRA was formally referred to the Investment Information and Credit Rating Agencies in India.

CARE Ratings commenced ITS operations in April 1993. Over the period, it has established itself as the second-largest credit rating agency in India.

Their main functions are to grade the different sectors and companies in terms of performance and offer solutions for upgradation.

2016 (I)

70. Which one of the Five Year Plans had a high priority to bring inflation under control and to achieve stability in the economic situation?

(a) Fourth Plan (1969-74)
(b) Fifth Plan (1974-79)
(c) Sixth Plan (1980-85)
(d) Seventh Plan (1985-90)

⊘ *(a)*

Five Year Plan	Objective
4th FYP (1969-74)	'Growth with stability and progressive achievement of self-reliance' and bring prices under control.
5th FYP (1974-79)	Poverty eradication and attainment of self-reliance.
6th FYP (1980-85)	Removal of poverty economic and technological self-reliance employment generation.
7th FYP (1985-90)	Establishment of self-sufficient economy.

71. Which of the following statements is/are true with respect to Phillips Curve?

1. It shows the trade-off between unemployment and inflation.
2. The downward sloping curve of Phillips Curve is generally held to be valid only in the short run.
3. In the long run, Phillips Curve is usually thought to be horizontal at the Non-Accelerating Inflation Rate of Unemployment (NAIRU).

Select the correct answer using the codes given below

(a) Only 1   (b) 2 and 3
(c) 1 and 2   (d) 1, 2 and 3

⊘ *(c)* Philips Curve depicts a negative relationship between inflation and unemployment.

At higher levels of inflation, there will be unemployment and *vice-versa*. This curve is valid only in the short run.

The long run Philip Curve is seen as vertical line at the natural rate of unemployment, where the rate of inflation has no effect on employment.

Hence, option (c) is correct.

72. Which one of the following nations is not a member of the Eurasian Economic Union?

(a) Belarus
(b) Russia
(c) Kazakhstan
(d) Uzbekistan

⊘ *(d)* The Eurasian Economic Union (EEU) is an Economic Union of States located primarily in Northern Eurasia.

A treaty aiming for the establishment of EEU was signed on 29th May, 2014 by leaders of Belarus, Kazakhstan and Russia. Uzbekistan is not the member of EEU.

73. BRICS leaders signed the agreement to establish a New Development Bank at the summit held in

(a) New Delhi, India (2012)
(b) Durban, South Africa (2013)
(c) Fortaleza, Brazil (2014)
(d) Ufa, Russia (2015)

⊘ *(c)* The term 'BRIC' was coined in 2001, by the then Chairman of Goldman Sachs, Jim O' Neill. BRICS — Brazil, Russia, India, China and South Africa since 2009, the BRICS nations have met annually at formal summit.

BRICS leaders decided to established a 'New Development Bank' in his SHIKAR summit which was held on 15th July, 2014 in fortaleza, Brazil.

First summit —Yekaterinburg, 2009. In 2010, South Africa became the member.

74. *Shishu*, *Kishor* and *Tarun* are the schemes of

(a) Regional Rural Banks
(b) Micro Units Development and Refinance Agency Limited (MUDRA)
(c) Small Industries Development Bank of India
(d) Industrial Development Bank of India

⊘ *(b)* Micro Units Development and Refinance Agency (MUDRA) Bank is a public sector financial institution in India.

The bank will classify its clients into three categories

• *Shishu*—Allowed loans up to ₹ 50000
• *Kishor*—Allowed loans ₹ 50000 - ₹ 5 lakh
• *Tarun*—Allowed loans ₹ 5 lakh - ₹ 10 lakh

Those eligible to borrow from MUDRA bank are small manufacturing unit, shopkeeper, fruit and vegetable vendors, artisans.

75. Which of the following statements are true with respect to the concept of EFFICIENCY as used in mainstream economics?

1. Efficiency occurs when no possible reorganisation of production can make anyone better off without making someone else worse off.
2. An economy is clearly inefficient if it is inside the Production Possibility Frontier (PPF).
3. At a minimum, an efficient economy is on its Production Possibility Frontier (PPF).
4. The terms such as 'Pareto Efficiency', 'Pareto Optimality' and 'Allocative Efficiency' are all essentially one and the same which denote 'efficiency in resource allocation'.

Select the correct answer using the codes given below

(a) 1 and 4
(b) 1 and 3
(c) 2 and 3
(d) 1, 2, 3 and 4

⊘ *(d)* In microeconomics, economic efficiency is a situation in which nothing can be improved without something else being hurt. Hence, Statement 1 is correct.

The Pareto Efficiency states that any point within the PPF curve is considered inefficient because the total output of commodities is below the output capacity.

In situations with limited resources, an efficient economy lies along the PPFcurve.

Hence the statement 2 and 3 are correct.

The terms such as 'Pareto Efficiency', 'Pareto Optimality' and 'Allocative Efficiency' are all essentially one and the same which denote 'efficiency in resource allocation'.

Hence, statement 4 is also correct.

76. Which one of the following nations has faced severe economic crisis in the year 2015 resulting in default in repayment of IMF loan?

(a) China   (b) Greece
(c) Ireland   (d) Belgium

⊘ *(b)* The International Monetary Fund (IMF) is an organisation of 188 countries, working to foster global monetary cooperation, secure financial stability, facilitate international trade, promote high employment and sustainable economic growth and reduce poverty around the world.

Greece is the first developed country. Who has faced severe economic crisis in the year 2015 and did not deposit the installment of the loan, taken by the IMF.

77. Which of the following is not a 'Public Good'?

(a) Electricity
(b) National Defence
(c) Light House
(d) Public Parks

⊘ *(a)* A public good is a product (National Defence, Light House, Public Parks) that one individual can consume without reducing its availability to another individual and from which no one is excluded.

Hence option (a) is not a public good.

78. Which one of the following is not among the aims of the Second Five Year Plan (1956-57 to 1960-61)?

(a) Rapid industrialisation with particular emphasis on the development of basic and heavy industries
(b) Large expansion of employment opportunities
(c) Achieve self-sufficiency in foodgrains and increase agricultural production to meet the requirements of industry and exports
(d) Reduction of inequalities in income and wealth and a more even distribution of economic power

⊘ *(c)* Second Five Year Plan was based on the PC Mahalanobis model. The objectives of this Plan were:

(i) Rapid industrialisation with particular emphasis on the development of basic and heavy industries.

(ii) Promote socialist pattern of society (as envisaged at Avadi summit of INC, 1955).

(iii) To increase national income by 25%.

(iv) Expansion of employment and reduction of inequality.

(v) Increase the vote of investment from 7%-11% of GDP.

Hence, option(c) is not the aims of the Second Five Year Plan (1956-57 to 1960-61).

79. Which of the following is/are the example(s) of Transfer Payment(s)?

1. Unemployment allowance
2. Payment of salary
3. Social security payments
4. Old age pension

Select the correct answer using the codes given below

(a) 1 and 3   (b) 1, 2 and 3
(c) 1, 3 and 4   (d) None of these

⟩ (**c**) Transfer payment as the name suggest, is done through by transferring the cash benefits (part of Government's Welfare Scheme) to the beneficieries.

Unemployment allow once social security paymeils, and old age pension are the examples of Transfer payment.

80. Which of the following statements with regard to UID/Aadhar Card are correct?

1. It is a 12-digit unique form of identification for all residents of India.
2. It is an identity number along with the biometric information of the individuals.
3. It is a national identity and citizenship card.

Select the correct answer using the codes given below

(a) 2 and 3   (b) 1 and 2
(c) 1 and 3   (d) 1, 2 and 3

⟩ (**b**) Unique Identification Number (UID) renamed as Aadhar, is a 12 digit individual indentification number with the biometric information of individual, issued by Unique Identification Authority of India (UIDAI).

Aadhar is an important component of government's JAM trinity, i.e. Jan Dhan, Aadhar and Mobile phone. Recently, government passed a bill to provide Aadhar, a statutory status. But its not a national identity and cilizenship card. Hence, option (b) is correct.

81. Human Development Report for each year at global level is published by

(a) WTO   (b) World Bank
(c) UNDP   (d) IMF

⟩ (**c**) Human Development Report (HDR) is an annual report published by United Nations Development Programme (UNDP).

The report was first launched in 1990 by the Pakistani economist Mahbub-ul-Haq and Indian Nobel Laureate Amartya Sen.

82. Which one of the following is not a monitorable target of the *Beti Bachao Beti Padhao Abhiyan*?

(a) Provide girls' toilet in every school in 100 Child Sex Ratio (CSR) districts by the year 2017
(b) 100% girls' enrolment in secondary education by the year 2020
(c) Promote a protective environment for girl children through implementation of Protection of Children from Sexual Offences (POCSO) Act 2012
(d) Train Elected Representatives/ Grassroot functionaries as Community Champions to mobilise communities to improve CSR and promote girls' education

⟩ (**b**) *Beti Bachao Beti Padhao* is a Government of India scheme that aims to generate awareness and improving the efficiency of welfare scheme meant for women.

The scheme was introduced in October, 2014 to address the issue or declining child sex ratio.

This is a joint initiative of Ministry of Women and Child Development, Ministry of Health and Family Welfare and Ministry of Human Resource and Development.

Hence, option (b) is not a monitarable target of the Beti Bacho beti padhao Abhiyan.

• Monitorable targets of Beti Bachao Beti Padhao Abhiyaan are as follows:

• Improve the Sex Ratio at Birth (SRB)in selected gender critical districts by 2 points in a year. ii

• Reduce Gender differentials in Under Five Child Mortality Rate from 7 points in 2014(latest available SRS report) to 1.5 points per year.

• At least 1.5 % increase per year of Institutional Deliveries.

• At least 1% increase per year of 1st Trimester ANC Registration. (v) Increase enrolment of girls in

secondary education to 82% by 2018-19.

• Provide functional toilet for girls in every school in selected districts.

• Improve the nutrition status of girls - by reducing number of underweight and anemic girls under 5 years of age.

• Ensure universalization of ICDS,girls' attendance and equal care monitored, using joint ICDS NHM Mother Child Protection Cards.

• Promote a protective environment for Girl Children through implementation of Protection of Children from Sexual Offences (POCSO)Act 2012.

• Train Elected Representatives/ Grassroot functionaries as Community Champions to mobilise communities to improve CSR and promote Girl's education.

83. The National Policy for Children 2013 recognises every person as a child below the age of

(a) 12 years   (b) 14 years
(c) 16 years   (d) 18 years

⟩ (**d**) The National Policy for Children recognises every person below the age of 18 years as a child and covers all such children within the territory and jurisdiction of the country.

The policy has identified 4 key sectors i.e. survival, health and nutrition, education and employment and protection and participation for focused attention.

84. Which of the following is not an objective of the Rashtriya Uchchatar Shiksha Abhiyan (RUSA)?

(a) Improve the overall quality of private educational institutions
(b) Ensure reforms in the affiliation, academic and examination systems
(c) Correct regional imbalances in access to higher education
(d) Create an enabling atmosphere in the higher education institutions to devote themselves to research and innovations

⟩ (**a**) Rashtriya Uchchatar Shiksha Abhiyan (RUSA) is a Centrally Sponsored Scheme (CSS) which was launched in 2013.

RUSA does not seek to improve the quality of private educational institutions.

Its aim is to provide strategic funding to eligible state higher educational institutions.

Hence, option (a) is incorrect.

85. Which of the following is/are example(s) of 'Near Money'?
1. Treasury Bill
2. Credit Card
3. Savings accounts and small time deposits.
4. Retail money market mutual funds.

Select the correct answer using the codes given below:
(a) Only 1   (b) Only 2
(c) 1, 2 and 3   (d) 1, 3 and 4

⊙ *(d)* 'Near Money' term is used in Economics to describe highly liquid assets that can easily be converted into cash. Tresury Bill, saving accounts and small time deposits and Rental money market mutual funds are the ecamples of Near Money. Hence, option (d) is correct.

86. Which one of the following terms is used in Economics to denote a technique for avoiding a risk by making a counteracting transaction?
(a) Dumping   (b) Hedging
(c) Discounting   (d) Deflating

⊙ *(b)* **Hedging** means reducing or controlling risk.

This is done of the taking a position in future market, with the objective of reducing or limiting risks, associated with price challenge.

Dumping is a term used in the context of international trade. It's when a country or company exports a product at a price that is lower in the foreign importing market than the price in the exporter's domestic market.

Discounting is the process of determining the present value of a payment or a stream of payments that is to be received in the future.

Deflating in economics refer to a general reduction of price levels in an economy. Deflation is a decrease in the general price level of goods and services. Deflation occurs when the inflation rate falls below 0%.

87. Which of the following statements are correct?
1. Ability to pay principle of taxation holds that the amount of taxes people pay should relate to their income or wealth.
2. The Benefit Principle of taxation states that individuals should be taxed in proportion to the benefit they receive from government programmes.
3. A progressive tax takes a larger share of tax from poor families than it does from rich families.
4. Indirect taxes have the advantage of being cheaper and easier to collect.

Select the correct answer using the codes given below
(a) 1 and 3   (b) 2 and 4
(c) 1, 2 and 4   (d) 1, 2, 3 and 4

⊙ *(c)* The ability to pay principle states that the amount of tax an individual pays should be dependent on the level of burden the tax will create relative to the wealth of the individual.

The Benefit principle recognises that the purpose of taxation is to pay for government services.

If taxes are imposed according to the benefit principle, people pay taxes in proportion to the benefits they receive from government spending.

Indirect taxes are tax levied on goods and services rather than on income or profits. The advantages of indirect taxes are that they are cheaper and easier to collect. Hence, statement 1, 2 and 4 are correct. A progressive tax imposes a higher rate on the wealthy than on the poor. It's based on the taxpayer's ability to pay.

Hence, statement 3 is incorrect.

88. Which of the following statement(s) is/are false?
1. Wage Boards are tripartite in nature, with representatives from workers, employers and independent members.
2. Except for the Wage Boards for Journalists and Non-Journalists, all the other wage boards are statutory in nature.
3. Second National Commission on Labour has recommended against the utility of wage boards.

Select the correct answer using the codes given below
(a) Only 1   (b) Only 2
(c) 1 and 2   (d) 1, 2 and 3

⊙ *(b)* Wage Boards are established by law to investigate wage rate.

Government has discretion to decide its members.

Except for wage boards for journalist and non-journalists newspaper and news agency employees other wage boards are non-statutory in nature.

Hence, options (b) is correct.

89. Norman Borlaug won Nobel Peace Prize for his contributions in
1. development of high-yielding crops
2. modernisation of irrigation infrastructure
3. introduction of synthetic fertilizers and pesticides

Select the correct answer using the codes given below
(a) Only 1   (b) Only 2
(c) 2 and 3   (d) 1, 2 and 3

⊙ *(a)* Norman E Borlaug won Nobel Peace Prize for his efforts to increase foodgrain production by developing high dwarf wheat variety.

This had led to Green Revolution and he is regarded as 'Father of Green Revolution'.

90. Which one of the following island nations went for Parliamentary elections in the month of August, 2015?
(a) Maldives   (b) Fiji
(c) Sri Lanka   (d) Singapore

⊙ *(c)* The 2015 Sri Lankan Parliamentary election-UNP leader Ranil Wickremesinghe became the Prime Minister.

Except Fiji, others are Indian Ocean island nation. Fiji is in Eastern Pacific.

2015 (II)

91. Under flexible exchange rate system, the exchange rate is determined
(a) predominantly by market mechanism
(b) by the Central Bank
(c) as a weighted index of a group of currencies
(d) by the World Trade Organisation

⊙ *(a)* Flexible exchange rates can be defined as exchange rates determined predominantly by market Mechanism

In other words, they are prices of foreign exchange determined by the market, that can rapidly change due to supply and demand and are neither pegged nor controlled by Central Banks.

92. A Bill is deemed to be a 'Money Bill' if it has any provision dealing with
1. imposition, abolition, remission, alteration or regulation of any tax.
2. appropriation of money from the Consolidated Fund of India.

3. imposition of fines or other pecuniary penalties.

4. payment of fee for licences or fee for service rendered.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 1, 3 and 4
(c) 1, 2 and 3   (d) Only 2

⊙ *(a)* A Bill shall be deemed to be a Money Bill, if it contains only provisions dealing with all or any of the following matters:

The imposition, abolition, remission, alteration or regulation of any tax.

The custody of the Consolidated Fund or Contingency Fund of India, the payment of money into or the withdrawal of money from any such fund.

The appropriation of money out of the Consolidated Fund of India.

Hence, option (a) is true.

93. Which one of the following is not a part of service sector in India?

(a) Transport
(b) Construction
(c) Hotels and restaurants
(d) Insurance

⊙ *(b)* Activities in the service or ternary sector include retail, banks, hotels, real estate, education, health, social work, computer services, recreation, media, communications, electricity, gas and water supply.

Secondary activities include manufacturing, processing and **construction (infrastructure)** of industries.

Hence, optoin(b) is true.

94. Which one of the following is not correct in the context of industrial clusters development in India?

(a) Industrial clusters play an important role for the MSME participants in their inclusiveness, technology absorption and efficiency improvement
(b) Industrial clusters are visible in traditional handloom, handicrafts and modern SMC
(c) Industrial cluster programmes in India are administered by various ministries
(d) Industrial clusters lead to promotion of monopoly in the market

⊙ *(d)* Industrial clusters not lead to Promotion of monopoly in the market.

The objectives of industrial clusters development in India are

(i) To enhance the productivity and competitiveness of micro and small enterprises.
(ii) To facilitate economies of scale in terms of deployment of resources.
(iii) To build capacity of MSEs through formation of SHG, Mutual credit guarantee funds, BDS development etc.

Hence, option (d) is not correct.

95. Private investment in Indian agriculture is mostly on labour saving mechanisation. This could be a response to

(a) rising productivity of agricultural sector
(b) rising inequality in agriculture
(c) rising wages and tighter labour market
(d) debt write-off by the government

⊙ *(c)* Private investment in Indian agriculture is mostly on labour saving mechanisation.

This could be a response to rising wages and tighter labour market.

96. Which one of the following is not a recommendation of the 14th Finance Commission?

(a) Share of states in Central Divisible Pool is increased from 32%-42%
(b) Area under forest cover is an important variable in distribution of states' share among states
(c) Fiscal discipline is dropped as a variable in distribution of states' share among states
(d) Sector-specific grant is recommended as in the previous Finance Commissions

⊙ *(d)* **Major recommendations of 14th Finance Commission**

• States' share in net proceeds of tax revenues be 42%, a huge jump from the 32% recommend by the 13th Finance Commission.
• Area under forest cover is an important variable in distribution of states' share among states.
• Fiscal deficit should come down to 3.6% of GDP in 2015-2016 from projected 4.1% in 2014-15.
• Centre's debt come down from 45.4% of GDP in 2014-15 to 43.6% in 2015-16

Hence option (d) is not correct.

97. Which of the following statements with regard to New Development Bank (NDB), formerly referred to as the BRICS Development Bank is/are correct?

1. The headquarters of the bank is situated at Moscow, Russia.
2. KV Kamath is the first President of the bank.

Select the correct answer using the codes given below
(a) Only 1   (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2

⊙ *(b)* The New Development Bank (NDB) is formerly referred to as the BRICS Development Bank.

The headquarter of the bank is in Shanghai, China. KV Kamath was appointed as first President of the bank, he is from India.

Hence, option (b) is correct.

98. Which of the following factors led to a decline in inflation rate in India during 2014-15?

1. Persistent decline in crude oil prices.
2. Softness in global prices of tradables such as edible oils and coal.
3. Tight monetary policy pursued by the Reserve Bank of India.

Select the correct answer using the codes given below
(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) 1, 2 and 3

⊙ *(d)* Factors led to a decline in inflation rate in India during 2014-15 are as follows:

(i) Persistent decline in crude oil prices.
(ii) Softness in global prices of tradables such as edible oils and coal.
(iii) Tight monetary policy pursued by the RBI.
(iv) The Average Whole Price Index (WPI) declined to 3.4%.
(v) The rupee remained relatively stable *vis-a-vis* the currency of peer emerging countries.
(vi) Moderation in wage rate growth.

Hence option (d) is correct.

99. Which one of the following statements about the Companies Act, 2013 is not correct?

(a) The Act regulates the corporate sector to make it accountable
(b) It provides for Corporate Social Responsibility (CSR)
(c) It provides more opportunities for new entrepreneurs
(d) It enables wide application of information technology

⊙ *(c)* Following are the provisions of Companies Act, 2013

(i) It regulates the corporate sector to make it accountable.

(ii) It provides for Corporate Social Responsibility (CSR).

(iii) It enables wide application of information technology.

(iv) Private companies maximum number of members will be 200 in place of 50.

Hence, option (c) is not correct.

100. Which one of the following is an example of a 'natural monopoly'?

(a) Indian Airlines
(b) Delhi Jal Board
(c) Delhi Transport Corporation
(d) Steel Authority of India Limited

⟩ *(b)* In terms of monopolies, an existing business with an established infrastructure has a cost advantage when producing large quantities of a given product, enabling it to undercut the competition on price.

This is known as a natural monopoly and most typically refers to public utilities such as water services, natural gas and electricity, e.g. Delhi Jal Board.

Hence, option (b) is correct.

101. What is meant by 'Price discrimination'?

(a) Increase in price of a commodity over time
(b) A situation where the same product is sold to different consumers for different prices
(c) Subsidisation of a product by the government to sell it at a lower price
(d) General decrease in price of a commodity over time

⟩ *(b)* Price discrimination is a pricing strategy that charges customers different prices for the same product or service.

In pure price discrimination, the seller will charge each customer the maximum price that he or she is willing to pay.

102. What is meant by 'Public Good'?

(a) A commodity produced by government
(b) A commodity whose benefits are indivisibly spread among the entire community
(c) A government scheme that benefits the poor households
(d) Any commodity that is very popular among general public

⟩ *(b)* A product that one individual can consume without reducing its availability to another individual and from which no one is excluded.

National defense, sewer systems, public parks and basic television and radio broadcasts are all be considered as public goods.

103. Which one of the following statements with regard to India's economy between 1814-1860 is not correct?

(a) Between 1814 and 1850, four commodities dominated India's exports— raw silk, opium, cotton and indigo
(b) Between 1814 and 1860, five commodities dominated India's exports— raw silk, opium, cotton, indigo and jute
(c) Indigo and raw silk required processing techniques
(d) Indigo and raw silk were financed by foreign capital

⟩ *(b)* India's economy between 1814-1860 was important because in this period, four commodities dominated India's exports— raw silk, opium, cotton indigo, jute.

Indigo and raw silk were financed by foreign capital and required processing techniques.

Hence option (b) is correct.

104. In view of the fact that kerosene is an inferior good in India, what is/are its implication(s)?

1. As households get richer, they consume less kerosene.
2. Over time there is a decline in quality of kerosene.
3. Government needs to stop subsidies on kerosene.

Select the correct answer using the codes given below

(a) Only 1
(b) 1 and 2
(c) 2 and 3
(d) 1, 2 and 3

⟩ *(a)* Inferior goods are those which are cheap and of low quality. Kerosene is an example of inferior good.

People of low income level use kerosene for cooking. It is inferior to LPG.

If the income level of poor household increases or if the government pushes through subsidies people switch to LPG and the kerosene consumption will be reduced.

105. Which one of the following is the major source of Gross Tax Revenue (GTR) for the Government of India?

(a) Income tax   (b) Corporation tax
(c) Customs duty   (d) Service tax

⟩ *(b)* Corporation tax is the major source of Gross Tax Revenue (GTR)for the Government of India.

A corporate tax is a direct tax imposed by a jurisdiction on the income or capital of corporations or analogous legal entities.

Many countries impose such taxes at the national level and a similar tax may be imposed at state or local levels.

The taxes may also be referred to as income tax or capital tax.

106. Which one of the following represents a progressive tax structure?

(a) Tax rate is the same across all incomes
(b) Tax rate increases as income increases
(c) Tax rate decreases as income increases
(d) Each household pays equal amount of tax

⟩ *(b)* Progressive tax is the taxing mechanism, in which the taxing authority charges more taxes as the income of the taxpayer increases.

A higher tax is collected from the taxpayers who earn more and lower taxes from taxpayers earning less.

107. 'Weibo' is a social media platform, popularly used in

(a) South Korea
(b) China
(c) Thailand
(d) Japan

⟩ *(b)* Weibo refers to microblogging in china or China-based microblogging services.

108. Which one of the following is not provided regular budgetary support by the Ministry of Defence?

(a) Himalayan Mountaineering Institute, Darjeeling
(b) Institute for Defence Studies and Analysis, New Delhi
(c) Armed Forces Tribunal
(d) United Service Institution of India, New Delhi

⟩ *(d)* United service Institution of India New Delhi is not provided regular budgetary support by the Ministry of Defence vdefence ministry of Defence is provided regular financial assistance of these institutions

1. The Institute for Defence Studies and Analysis, New Delhi
2. Mountaineering Institute at Darjeeling and Uttarkashi
3. The Jawahar Institute of Mountaineering and Winter Sports (JIM) at Pahalgam.

It carries out all its activities from the resource generated within.

Hence, option (d) is incorrect.

109. In April 2015, India and France agreed to conclude an inter-governmental agreement in respect of which one of the following platforms?

(a) Rafale medium multirole combat aircraft
(b) Scorpene submarines
(c) Infantry mobility vehicles
(d) Precision guided munitions system

⊙ (**a**) India and France agreed to conclude an inter-governmental agreement for supply of the Rafale medium multirole combat aircraft on terms that would be better than conveyed by Dassault Aviation as part of a separate process under way the delivery would be in time-frame that would be compatible with the operational requirement of IAF.

110. Where was the 14th Asia Security Summit (Shangri-La Dialogue) held in May 2015?

(a) Beijing   (b) Bangkok
(c) Jakarta   (d) Singapore

⊙ (**d**) The 14th Asia Security Summit took place from 29th-31st May, 2015 in Singapore.

111. Which of the following are members of BRICS?

(a) Bhutan, Russia, India, China and Sri Lanka
(b) Brazil, Russia, India, China and South Africa
(c) Brazil, Russia, Indonesia, China and Singapore
(d) Bangladesh, Republic of Korea, Indonesia, Canada and Sri Lanka

⊙ (**b**) BRICS is an association of five major emerging national economies. They are   Brazil, Russia, India, China and South Africa.

The grouping was originally known as 'BRIC' before the inclusion of South Africa in 2010.

Hence, option (b) is correct.

112. The 'Panchsheel Agreement' for peaceful co-existence was signed between

(a) India and Bhutan
(b) India and Nepal
(c) India and China
(d) India and Pakistan

⊙ (**c**) Panchsheel or the five principles of peaceful co-existence were first formally enunciated in India and China.

113. Which one of the following is not a member of MERCOSUR (Southern Common Market)?

(a) Argentina   (b) Paraguay
(c) Uruguay   (d) Chile

⊙ (**d**) MERCOSUR is South America's leading trading bloc, known as the Common Market of the South.

It aims to bring about the free movement of goods, capital, services and people among its member states.

Its full members are Argentina, Bolivia, Brazil, Paraguay, Uruguay and Venezuela. Its associate members are Chile, Peru, Columbia and Equador.

Hence chile is not a member of MERCOSUR.

2015 (I)

114. When two goods are completely inter- changeable, they are

(a) perfect substitutes
(b) perfect complements
(c) Giffen goods
(d) Veblen goods

⊙ (**a**) When two product's functions are literally identical so that a consumer is willing to swap for the other at a fixed rate, we call them perfect substitutes.

Perfect complementary goods are those which must be consumed with another good.

Giffen good is an inferior product that people consume more of, as the price rises and *vice-versa*, violating the basic principle of demand in microeconomics.

Veblen good is a good for which the demand increases as the price increases, because of its exclusive nature and appeal as a symbol of status.

115. Match the List I with List II and select the correct answer using the codes given below the lists

	List I (Industry)		List II (Location)
A.	Railway equipment	1.	Cochin
B.	Automobile	2.	Ludhiana
C.	Ship-building	3.	Bhilai
D.	Bicycle	4.	Jabalpur

Codes

	A	B	C	D		A	B	C	D
(a)	3	4	1	2	(b)	3	1	4	2
(c)	2	1	4	3	(d)	2	4	1	3

⊙ (**a**) **Railway Equipment**   Rail and sleeper bars are manufactured in iron and steel works at Bhilai and wheels, tyres and axles at Durgapur.

Automobile   Vehicle factory Jabalpur is a military motor vehicle manufacturing company located in Jabalpur.

Ship Building   The major centres of ship building are the Hindustan Shipyard at Visakhapatnam, Mazgaon Docks, Mumbai; Cochin Shipyard and Garden Reach Workshop at Kolkata.

Bicycle Industry   Industries are located in Ludhana and Jalandhar in Punjab and Haryana.

Hence option (a) is the correct answer.

116. Consider the following statements with regard to the First Renewable Energy Global Investors Meet and Expo (2015):

1. This is a follow-up to the 'Make in India' initiative.
2. The central theme of the meet is to attract large scale investments in the renewable energy sector in India.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ (**c**) As a follow-up to the 'Make in India' initiative launched by the Prime Minister, the Ministry of New and Renewable Energy (MNRE) has announced organisation of the First Renewable Energy Global Investors Meet and Expo (RE-INVEST) on 15th-17th February, 2015 in New Delhi.

The central theme of the meet is to attract large-scale investments in the renewable energy sector in India.

Hence both the statements are correct.

117. Rise in the price of a commodity means

(a) rise in the value of currency only
(b) fall in the value of currency only
(c) rise in the value of commodity only
(d) fall in the value of currency and rise in the value of commodity

⊙ (**d**) When there is rise in price of commodity inflation occurs. In that case the value of currency decreases because of decrease in its purchasing power.

Again rise in the price of commodity also indicates that there is rise in the value of commodity which may be due to various reasons (i.e. increase in demand or supply shortage).

118. Which of the following statements with regard to the proposed Asian Infrastructure Investment Bank is/are correct?

1. India is one of the founding members of the bank.
2. The bank is to be headquartered in Shanghai.

Select the correct answer using the codes given below

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(a)* Asian Infrastructure Investment Bank (AIIB) is a multilateral development bank that aims to support the infrastructure building in the Asia-Pacific region.

The bank currently has 74 members from around the world.

- it started on 16th January, 2016 and is headquartered in Beijing, China.
- India is one of the founding partners of AIIB as it signed and ratified the articles of Agreement. India holds the second highest voting rights in AIIB i.e., 7.65% just behind China with 26.63%.

119. Which of the following statements is/are true with regard to the newly launched *Vanbandhu Kalyan Yojana*?

1. Under the scheme, Centre will provide ₹ 10 crore each for every State and Union Territory of the country for the development of various facilities for the tribals.
2. The scheme mainly focuses on bridging infrastructural gaps and gap in human development indices between Schedule Tribes and other Social Groups.

Select the correct answer using the codes given below

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(b)* Vanbandhu Kalyan Yojana is for Tribal Welfare. Under the Scheme centre will provide ₹ 10 crore for each block for the development of various facilities for the Tribals of States of Andhra Pradesh, Madhya Pradesh, Himachal Pradesh, Telangana, Odisha, Jharkhand, Chhattisgarh, Rajasthan, Maharashtra and Gujarat.

Hence statement (1) is not correct.

This Scheme mainly focuse on bridging infrastructural gaps and gap in human development indices between Schedule tribes and other social groups.

Hence statement (2) is correct

120. Which of the following statements is not true?

(a) The General Agreement on Tariffs and Trade (GATT) had regulated global trade since, 1947
(b) GATT was replaced by the World Trade Organisation (WTO) in 1995
(c) The Most Favoured Nation principle under GATT provided that preferential trading agreements reached with one country should be extended to other countries

(d) The WTO has been able to cover in an agreements the agriculture and textile sectors which are the principal concerned for the Least Developed Countries (LDCs)

⊙ *(d)* The WTO's Agriculture Agreement was negotiated in the 1986-94 Uruguay round and is a significant first step towards fairer competition and a less distorted sector. WTO member government agreed to improve market access and reduce trade-distoring subsides in agriculture.

Hence, option(d) is not true.

121. Which of the following is not a part of contemporary Indian foreign policy in relationships with its neighbours?

(a) Look East Policy for linking up with South-East Asia *via* Myanmar
(b) Panchsheel
(c) Non-alignment
(d) SAARC

⊙ *(c)* After economic liberalisation of 1990s. India's foreign policy stance change from Idealism to Realism.

Now India's foreign policy strategy is shifted to multi-alignment from non-alignment for strategic and enlighted self-interest.

Hence, option (c) is incorrect.

122. Consider the following statements:

1. The Nirmal Bharat Abhiyan is restructured into the Swachh Bharat Mission.
2. The Swachh Bharat Mission has two sub-missions — Union Territories and States.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(a)* Nirmal Bharat Mission (NBA) is restructured into the Swachh Bharat Mission with two sub-missions - Swachh Bharat Mission (Gramin) and Swachh Bharat Mission (Urban).

Budgetary provisions for the two sub-missions are provided separately in the demand for Grant of the Ministries of Drinking Water and Sanitation (for Gramin) and Ministry of Urban Development (for Urban).

Hence option (a) is correct.

123. Which of the following is/are the objective(s) of National AYUSH Mission, approved by the Union Cabinet recently?

1. Improvement of AYUSH educations through

enhancement in the number of upgraded educational institutions.
2. Better access to AYUSH services through increase in the AYUSH hospitals and dispensaries, availability of drugs and manpower.
3. Providing sustained availability of quality raw material for AYUSH systems of medicine.

Select the correct answer using the codes given below

(a) Only 1   (b) 2 and 3
(c) 1 and 2   (d) All of these

⊙ *(d)* The Union Cabinet, in September 2014, gave its nod for launching the National AYUSH Mission (NAM) with 'core and flexible components'.

The Mission will help in the improvement of AYUSH education through enhancement in the number of upgraded educational institutions.

Better access to AYUSH services through increase in number of AYUSH hospitals and dispensaries.

Availability of drugs and manpower;providing sustained availability of quality raw material for AYUSH systems of medicine; and improving availability of quality Ayurvedic, Siddha, Unani and Homeopathy drugs through increase in the number of pharmacies, drug laboratories and improved enforcement mechanism.''
Hence all the statements are correct.

124. In recent plans, certain words/phrases were used in the title of the plan along with 'growth'. They are

1. inclusive   2. faster
3. more inclusive   4. sustainable
5. more sustainable

Which combination is true of the 12th Five Year Plan (2012-17)?

(a) 1, 2 and 3   (b) 1, 4 and 5
(c) 2, 3 and 4   (d) 1, 2 and 4

⊙ *(c)* The title of the 12th Five Year Plan (2012-2017) was faster, more inclusive and sustainable growth.

The 12th Five Year Plan was proposed 25 core monitorable targets to reflect the vision of rapid, sustainable and more inclusive growth.

Some important targets were
- Real GDP growth rate of 8.0%,
- Agriculture growth rate of 4.0%
- Head count ratio of consumption poverty to be reduced by 10% points.
- Reduce total fertility rate to 2.1% in 2017.

125. Demand for a commodity refers to
  (a) desire for that commodity
  (b) need for that commodity
  (c) quantity demanded of that commodity
  (d) quantity demanded at certain price during any particular period of time

  (>) *(d)* Demand for a commodity refers to an economic principle that describes a consumer's desire and willingness to pay a price for a specific goods and services.

  Holding all other factors constant, the price of a goods and services increases as its demand increases and *vice-versa*.

126. An exceptional demand curve is one that slopes
  (a) downward to the right
  (b) upward to the right
  (c) horizontally
  (d) upward to the left

  (>) *(b)* There are certain exceptional cases when the demand curve instead of sloping downward rises upwards.

  A demand curve rising upward shows that people buy more when the price increase i.e. more in demanded at a higher price than at a lower price.

127. Which of the following is not a central tenet of Socialism?
  (a) Historical Materialism
  (b) Dialectical Materialism
  (c) Alienation and Class Struggle
  (d) Individual Freedom

  (>) *(d)* In Marxist theory, socialism, also called lower-stage communism or the socialist mode of production, refers to specific historical phase of economic development and its corresponding set of social relations that supersede capitalism in the scheme of historical materialism.

  Socialism is defined as a mode of production where the sole criterion for production is use-value and therefore the law of value no longer directs economic activity.

  Dialectical materialism and Alienation and class struggle are also central tenets of socialism.

  Hence, option (a) is not a central tenat of socialism.

128. Which of the following is not true for South Asian Free Trade Area (SAFTA)?
  (a) It is a step towards a South Asian customs union and common market
  (b) The agreement came into effect in 2006
  (c) The SAFTA is a trade liberalisation regime

  (d) The SAFTA agreement takes precedence over any other agreement a member country may have with States outside SAFTA

  (>) *(d)* SAFTA is an agreement reached on 6th January, 2004 at the 12th SAARC summit in Islamabad, Pakistan. It came into force on 1st January, 2016.

  It came into effort for a common market and custom Union creation in South Asia, by promoting and sustaining mutual trade and economic cooperation by exchange of concessions.

  Since each person receines its share inder socialism where mean of production al coned by society as a whole, individual freedom does not form the central tent of socialism.

  Hence opton (d) is answer.

129. The 3rd Meeting of the SAARC Culture Ministers, convened in New Delhi on 25th September, 2014, unanimously resolved
  1. to declare 2015-16 as the SAARC Year of Cultural Heritage.
  2. that Bamiyan will be the SAARC cultural capital for 2015-16.
  3. to promote SAARC culture online by launching a dedicated SAARC website on culture, with emphasis on digitisation of rare manuscripts, rare books and other articles of intangible cultural value.

  Select the correct answer using the codes given below:
  (a) Only 2   (b) 1 and 3
  (c) 2 and 3   (d) All of these

  (>) *(c)* The third meeting of Culture Ministers from the SAARC countries was held in New Delhi on September 25th, 2014. They adopted the Delhi Resolution as a roadmap for cultural relations in the SAARC region for the period 2014-17.

  The SAARC Culture Ministers unanimously resolved the following:
  • To declare 2016-17 as the SAARC Year of Cultural Heritage. Hence statement 1 is incorrect.
  • For 2015-16, Bamiyan to be the SAARC cultural capital.
  • To promote SAARC culture online by launching a dedicated SAARC website on culture, with emphasis on digitisation of rare manuscripts, rare books and other articles of intangible cultural value. Hence statements 2 and 3 are correct.

130. Inclusion strategy does not focus on
  (a) reduction of inequality
  (b) reduction of poverty

  (c) diversifying livelihood for tribal population
  (d) getting poorer countries closer

  (>) *(d)* Inclusion refers to achievement of an environment in which all individuals are treated fairly and respectfully, have equal access to opportunities and resources, and can contribute fully to the organisation's success, Inclusion strategy does not focus on getting poorer countries closer. However, reduction of inequality, reduction of barrier, diversifying livelihood for tribal population are some of the tenet of inclusion strategy on which it focuses on.

131. Which among the following is not an aspect of Gender Mainstreaming (GM)?
  (a) GM was established as a global strategy for achieving gender equality by the United Nations
  (b) It was adopted in 1995 in the Beijing Platform of Action
  (c) It requires a review of government policy in all sectors for eliminating gender disparity
  (d) GM was followed by the Convention on the Elimination of all forms of Discrimination Against Women (CEDAW)

  (>) *(d)* The gender equality and women's empowerment mandate agreed by United Nations Charter reaffirmed the equal rights of men and women the 1995 Fourth World Conference on women endorsed gender mainstreaming as a critical and strategic approach of achieving gender equality commitments.

  This conference was resulting Beijing declaration and platform for action.

  The 1997 agreed conclusions of ECOSOC defined gender mainstreaming as the process of assessing the implication for women and men of any planned action including legislation, policies or programmes.

2014 (II)

132. Consider the following statements relating to the World Trade Organisation (WTO):
  1. The WTO deals with the global rules of trade between nations.
  2. The goal of the WTO is to help producers of goods and services, exporters and importers conduct their business.
  3. The WTO, which is a successor body of the General Agreement on Tariffs and Trade, came into being following the Uruguay Round of Negotiations.

4. The WTO distances itself in framing of rules on trade in intellectual property rights.

Which of the statements given above are correct?

(a) 1, 2 and 3   (b) 2, 3 and 4
(c) 1, 2 and 4   (d) 1 and 3

⊙ (*a*) The WTO commenced under the Marrakesh Agreement in 1995 and replaced GATT.

Most of the issues it deals with have been derived from the Uruguay round of negotiations.

It deals with the global rules of trade between nations, helps producers of goods and services, exporters and importers conduct their business.

The WTO's agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS), was negotiated in 1986-94 Uruguay round.

Rules related to trade, tariff, patent and intellectual property rights are framed by the WTO.

Hence, option (a) is correct.

133. Consider the following statements relating to the World Bank:

1. The World Bank was established in 1946, which is headquartered in New York.
2. The World Bank Group has set for itself the goal to end extreme poverty from the world by 2030.
3. The World Bank is a vital source of financial and technical assistance to developing countries around the world. It is not a bank in the ordinary sense but a unique partnership to reduce poverty and support development.
4. The World Bank Group comprises five institutions managed by their member countries in order to promote shared prosperity by fostering the income growth of the bottom 40% for every country.

Which of the statements given above are correct?

(a) 1, 2 and 3   (b) 2, 3 and 4
(c) 1, 3 and 4   (d) 2 and 4

⊙ (*b*) The World Bank was established in 1944 Bretton Woods Conference and is headquartered at Washington DC (USA).

Hence, statement (1) is not correct.

It is a source of financial and technical assistance for developing countries to reduce poverty and support development.

The World Bank Group intends to end extreme poverty by 2030 and mainly

comprises of IBRD, IFC, IDA, ICSID and MIGA, who are managed by their members to promote prosperity by strengthening the growth in income of the bottom 40% of every country.

134. Which of the following statements about International Monetary Fund (IMF) are correct?

1. The IMF is a United Nations specialised agency.
2. The IMF was founded at the Bretton Woods Conference in 1944 to secure international monetary cooperation.
3. The objective of the IMF is to stabilise currency exchange rates and to expand international liquidity (access to hard currencies).

Select the correct answer using the codes given below

(a) 1, 2 and 3   (b) 2 and 3
(c) 1 and 2   (d) 1 and 3

⊙ (*a*) The IMF is a specialised agency of United Nations, founded in 1944 at Bretton Woods Conference. Its objectives are :

(i) To secure International monetary cooperation.
(ii) To stabilise currency exchange rates.
(iii) To expand international liquidity and trade.
(iv) To promote capital investment in under developed nation.
(v) To bring equilibrium in balance of payments.
(vi) To achieve balanced economic growth.

135. Union government in June, 2014 granted *Navaratna* status to

1. Engineers India Limited
2. Coal India Limited
3. India Trade Promotion Organisation
4. National Buildings Construction Corporation Limited

Select the correct answer using the codes given below

(a) 1, 2, 3 and 4   (b) 2 and 3
(c) 1 and 4   (d) 1, 2 and 3

⊙ (*c*) The Union government on 24th June, 2014 granted Navaratna status to Engineers India Limited (EIL) and National Buildings Construction Corporation (NBCC).

Department of Public Enterprises under the Ministry of Heavy Industries and Public Enterprises granted the Navaratna status to enhance the greater financial and operational autonomy.

136. World Bank in June, 2014 released a study report on India's Power Sector titled 'More Power to India : The Challenge of Electricity Distribution'. Which of the following is/are the key recommendation (s) of the report?

1. Ensure regulatory autonomy, effectiveness and accountability for utilities and regulators.
2. Insulate utilities from State Governments to prevent interference with internal operations.
3. Scrap the Electricity Act, 2003 in order to improve the revenue generation of the power distribution companies.

Select the correct answer using the codes given below

(a) 1, 2 and 3   (b) 1 and 2
(c) Only 2   (d) 1 and 3

⊙ (*b*) 'More Power to India : The Challenge of Electricity Distribution' ensures regulatory autonomy and accountability along with insulating utilities from the State Government to prevent interference with internal operations.

It reviewed the Electricity Act 2003, but did not recommend to scrap it.

Hence, option (b) is correct.

137. Which of the following is not the recommendation of the Arvind Mayaram Committee on rationalising the FDI/FPI definition (June, 2014)?

(a) Foreign investment of 10% or more in a listed company will be treated as Foreign Direct Investment (FDI).
(b) In a particular company, an investor can hold the investments either under the Foreign Portfolio Investment (FPI) route or under the FDI route, but not both.
(c) Any investment by way of equity shares, compulsorily convertible preference shares/debentures which is less than 10% of the post-issue paid up equity capital of a company shall be treated as FPI.
(d) On NRI Investors, the Committee recommended treating non-repatriable investment as FDI.

⊙ (*d*) The government set-up a four member committee headed by Economic Affairs Secretary Arvind Mayaram to define FDI and FPI and remove the ambiguity between them.

On NRI investors, the committee recommended treating non- repatriable investment as domestic and exempting it from FDI related conditions.

138. Which one among the following pairs is not correctly matched?

(a)	When total product increases at an increasing rate	Marginal product increases
(b)	When total product increases at a diminishing rate	Marginal product declines
(c)	When total product reaches its maximum	Marginal product becomes zero
(d)	When total product begins to decline	Marginal product becomes positive

⊙ *(d)* According to the law of variable proportions, when the variable factor is increased in the short-run, then marginal product first increases, then starts to fall and can become negative also.

This law is characterised by the presence of three stages, i.e. Increasing return to factor, diminishing returns to factor and negative returns to factor.

In the third stage, total product falls and marginal product becomes negative.

Hence, option (d) is not correctly matched

139. The way total output changes due to change in all inputs in same proportion is known as law of

(a) returns to scale
(b) diminishing returns
(c) increasing returns
(d) constant returns

⊙ *(a)* In the long run all factors of production are variable. No factor is fixed.

Accordingly, the scale of production can be changed by changing the quantity of all factors of production.

The term returns to scale refer to the changes in output as all factors change by the same proportion.

Hence, option (a) is correct.

140. Which of the following statements are correct?

1. When marginal revenue is positive, total revenue increases with increase in output.
2. When marginal revenue is zero, total revenue is maximum.
3. When marginal revenue becomes negative, total revenue falls with increase in output.

Select the correct answer using the codes given below

(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 2 and 3

⊙ *(d)* Marginal revenue is calculated by dividing the change in total revenue by the change in output quantity.

While marginal revenue can remain constant level of output, it follows the law of diminishing returns and eventually slow down, as the output level increases.

Perfectly competitive firms continue producing output until marginal revenue equals to marginal cost.

Hence, all the statements are correct.

141. Which of the following statements is/are true?

1. If increase in demand and supply are of equal magnitude, the price will remain unchanged, but the equilibrium quantity will increase.
2. If increase in demand is of greater magnitude than increase in supply, both equilibrium price and equilibrium quantity will increase.
3. If increase in supply is of greater magnitude than increase in demand, equilibrium price will fall but equilibrium quantity will increase.

Select the correct answer using the codes given below

(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) 1, 2 and 3

⊙ *(d)* If demand and supply both increases then the equilibrium price will remain unchanged and equilibrium quantity will be increased. If increase in demand is greater than, increase in supply then the price will increase and the equilibrium quantity is also increased due to increase in supply.

If increase in supply is greater than, increase in demand then the price will fall but the equilibrium quantity will be increased due to increase in supply.

Hence all the statements are correct.

142. A market in which there are large numbers of sellers of a particular product, but each seller sells somewhat differentiated but close products is termed as

(a) perfect competition
(b) monopoly
(c) monopolistic competition
(d) oligopoly

⊙ *(c)* The model of monopolistic competition describes a common structure in which firms have many competitors, but each one sells a slightly different product.

Perfect competition is the situation prevailing in a market in which buyers and sellers are so numerous and well informed that all elements of monopoly are absent and the market price of a commodity is beyond the control of individual buyers and sellers.

Monopoly is a market structure characterised by a single seller, selling a unique product in the market.

An oligopoly is a market form wherein a market or industry is dominated by a small number of large sellers.

143. The value of all final goods and services produced by the normal residents of a country and their property, whether operating within the domestic territory of the country or outside in an year is termed as

(a) Gross National Income
(b) Net National Income
(c) Gross Domestic Product
(d) Net Domestic Product

⊙ *(a)* Gross National Income (GNI) is defined as the sum of value added by all producers, who are residents in a nation, plus any product taxes (minus subsidies) not included in output, plus income received from abroad such as employee compensation and property income.

Net National Income (NNI) is net national product minus indirect taxes. Net national income encompasses the income of households, businesses, and the government.

Gross Domestic Product (GDP) is the monetary value of all finished goods and services made within a country during a a specific period.

The Net Domestic Product (NDP) equals the Gross Domestic Product (GDP) minus depreciation on a country's capital goods. Net domestic product accounts for capital that has been consumed over the year in the form of housing, vehicle, or machinery deterioration.

144. National product at factor cost is equal to

(a) Domestic product + Net factor income from abroad
(b) National product at market prices – Indirect taxes + Subsidies
(c) Gross domestic product – Depreciation
(d) National product at market prices + direct taxes + Subsidies

⊙ *(b)* National income at factor cost is a measure of the sum of all factor incomes earned by the residents of a country both from within the country as well as abroad.

It is infact an alternative name for net National product at factor cost.

National income at factor cost or Net National product at factor cost is the total income earned by a nation's residents in the production of goods and services.

It is inclusive of net factor income earned from abroad. The main components of national income at factor costs.

National income at factor cost = National income at market price – Indirect taxes + Subsidies.

Hence, option (b) is correct.

145. Which of the following theories form the basis of international trade?
1. Absolute cost difference
2. Comparative cost difference
3. Opportunity cost

Select the correct answer using the codes given below
(a) Only 1   (b) Only 2
(c) 1 and 2   (d) 1, 2 and 3

⊚ *(d)* International trade is the system by which countries exchange goods and services.

International trade takes place because of the variations in productive factors in different countries.

The variations of productive factors cause differences in price in different countries and the price differences are the main cause of international trade.

Hence, all the theories are correct.

146. Which one among the following is not a source of tax revenue for the Central Government in India?
(a) Income tax
(b) Customs duties
(c) Service tax
(d) Motor vehicle tax

⊚ *(d)* Motor Vehicle tax in India was imposed by state government prior to GST regime. Goods and Services Tax (GST) is an indirect tax used in India on the supply of goods and services.

It is a comprehensive, multistage, destination based tax: comprehensive because it has subsumed almost all the indirect taxes except a few state taxes. Income tax and custom duties are source of revenue for Central government. Service Tax has also been subsumed into GST.

147. Which of the following does not form part of current account of Balance of Payments?
(a) Export and import of goods
(b) Export and import of services

(c) Income receipts and payments
(d) Capital receipts and payments

⊚ *(d)* The Balance of Payments (BoP) of a country is the record of all economic transactions between the residents of a country and the rest of the world in particular period (over a quarter of an year or more commonly over an year).

These transactions are made by individuals, firms and government bodies.

Capital receipls and payments are not the part of Balance of Payments.

Current account might include :
(i) *Trade* (Buying and selling of goods and services)
(ii) *Exports* (A credit entry)
(iii) *Imports* (A debit entry)
(iv) *Trade balance* (The sum of exports and imports)
(v) *Factor income* (Repayments and dividends from loans and investments)
(vi) *Factor earnings* (A credit entry)
(vii) *Factor payments* (A debit entry)
(viii) *Factor income balance* (The sum of earnings and payments)
Hence option (d) is incorrect.

148. Consider the following statements:
1. Government of India has upgraded the National Industrial Classification from NIC-1987 to NIC-2008.
2. NIC is an essential statistical standard for developing and maintaining comparable database according to economic activities.

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊚ *(c)* Union Ministry of Commerce and Industry on 27th June, 2014 upgraded the NIC-1987 to NIC-2008.

The National Industrial Classification (NIC) is an essential statistical standard for developing and maintaining comparable database according to economic activities.

Hence, option (c) is correct.

149. Under the forceful thrust of British rule, a rapid transformation of the Indian economy took place. In this context, which of the following statements is/are correct?
1. Indian economy was transformed into a colonial

economy in the 19th century whose structure was determined by Britain's fast developing industrial economy.
2. The influx of cheap Indian products into England gave a great blow to English textile industries.
3. The 19th century saw the collapse of the traditional Indian village economy and fresh economic alignment along commercial lines.

Select the correct answer using the codes given below
(a) 1 and 3   (b) Only 1
(c) Only 2   (d) 1 and 2

⊚ *(a)* The economic policies followed by the British led to the rapid transformation of India's economy into a colonial economy in 19th century.

Whose nature and structure were determined by the needs of the British economy.

The ruler prior to British made no basic changes in the country's economic structure. The peasant, the artisan and the trader had continued to lead the same type of existence as before.

The basic economic pattern was that of the self-sufficient rural economy. However, the British conquerors totally disrupted the traditional structure of the Indian economy.

Hence, statements 1 and 3 are correct.

Britain began to export machine-made yarn and cloth to India in the 1780s.

Encouraging exports of low-cost fabric and imposing tariffs on imports of Indian cloth enabled Britain's textile industry to grow rapidly, but severely hampered the development of India's own industry. Hence, statement 2 is not correct.

150. In May, 2014, an agreement for credit of $ 24 million (equivalent) from World Bank for additional financing for Uttarakhand Rural Water Supply and Sanitation Project was signed. The objective/objectives of the agreement was/were
1. to improve the effectiveness of Rural Water Supply and Sanitation (RWSS) services through decentralisation.
2. to restore services of damaged schemes in the disaster affected areas in the State of Uttarakhand.

Select the correct answer using the codes given below
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊘ *(c)* The objective of the Uttarakhand Rural Water Supply and Sanitation Project is to improve the effectiveness of Rural Water Supply and Sanitation (RWSS) services through decentralisation and increased role of Panchayati Raj institutions and local communities in Uttarakhand.

World Bank has given a $ 24 million additional credit to restore the services of damaged schemes in the disaster affected areas of Uttarakhand.

Hence, both the statements are correct.

151. Consider the following statements relating to the Non-Alignment Movement:

1. The Non-Aligned Movement (NAM) was created and founded during the collapse of the colonial system and the independence struggles of the people of Africa, Asia, Latin America and other regions of the world and at the height of the Cold War.

2. The First Summit of the Movement of Non-Aligned countries was convened by the leaders of India, Indonesia, Egypt, Syria and Yugoslavia at Belgrade on 1-6 September, 1961.

3. During the early days of the Movement, its actions were a key factor in the decolonisation process, which led later to the attainment of freedom by many countries and to the founding of several new sovereign states.

4. The fundamental principle of the movement is to maintain equal distance from both the super powers by joining the military alliances of both the blocs.

Which of the statements given above are correct?
(a) 1, 2 and 3
(b) 2 and 3
(c) 1, 3 and 4
(d) 1 and 2

⊘ *(a)* The NAM was founded during the collapse of colonial system, independence struggle of Asian, African and Latin American countries and at the height of Cold War.

The leaders of India, Burma, Indonesia, Egypt, Yugoslavia, Ghana played important role though Syria too participated in the first NAM Summit.

It did help the decolonisation process, but it does not encourage to join the military alliances of both the blocs.

In fact, non-adherence to multilateral military pacts was one of the primary objectives.

Hence, all the statements are correct.

152. Which of the following is not correct regarding the 2014 FIFA Football World Cup?

(a) 'We Are One' is the official song
(b) *'Dar um, Jeito'* (We Will Find A Way)' is the official anthem
(c) Brazil is the first country to host a World Cup for the second time
(d) For the first time two consecutive World Cups are not hosted in Europe

⊘ *(c)* 'We Are One' was the official song and *Dar Um Jeito* (We Will Find A way) was the official anthem of 2014 FIFA Football World Cup. Mexico is the first country to host a World Cup for the second time.

It hosted World Cup in 1970 and 1986. Brazil hosted it in 1950 and then in 2014.

In 2014, it is for the first time that two consecutive World Cups are not hosted in Europe.

It was held in Africa (South Africa) in 2010 and in South America (Brazil) in 2014.

Hence, option (c) is incorrect.

153. Which of the following statements about Marrakesh Treaty is/are correct?

1. The main goal of the treaty is to create a set of mandatory limitations and exceptions for the benefits of the blind and visually impaired.

2. India has ratified the treaty.

3. The treaty has come into force from July, 2014.

Select the correct answer using the codes given below
(a) Only 1   (b) 1 and 2
(c) Only 2   (d) 1, 2 and 3

⊘ *(b)* The Marrakesh Treaty focuses on copyright exceptions to facilitate the creation of accessible versions of books and other copyrighted works.

It sets a norm for countries ratifying the treaty to have a domestic copyright exception covering these activities, and allowing for the import and export of such materials.

As of 6th July, 2014, 79 countries have signed the Treaty. India ratified the treaty on 24th July, 2014 and was the first country to do so.

This treaty was signed at Morocco on 28th June, 2013.

Hence statements 1 and 2 are correct and 3 is incorrect.

154. Consider the following statements about SAARC:

1. The SAARC Secretariat is located at Kathmandu.

2. The Secretariat is headed by the Secretary General, who is appointed by the Council of Ministers from Member States in alphabetical order for a three year term.

3. The Secretary General is assisted by eight Directors on deputation from the Member States.

Select the correct answer using the codes given below
(a) Only 1
(b) 2 and 3
(c) 1, 2 and 3
(d) 1 and 3

⊘ *(c)* The SAARC Secretariat is based in Kathmandu, Nepal. It coordinates and monitors implementation of activities, prepares for services meetings and serves as a channel of communication between the association and its member states as well as other regional organisations.

The Secretariat is headed by the Secretary General, who is appointed by the Council of Ministers from Member States in alphabetical order for a three year term.

Arjun Bahadur Thapa from Nepal is the current Secretary General of the SAARC. The Secretary General is assisted by eight Directors on deputation from the Member States.

The SAARC Secretariat and Member States observe 8th December as the 'SAARC Charter Day'.

155. Match List I with List II and select the correct answer using the codes given below the Lists:

	List I (Training Institute)		List II (Location)
A.	National Academy of Direct Taxes	1.	Hyderabad
B.	Rafi Ahmed Kidwai National Postal Academy	2.	Nagpur
C.	Sardar Vallabhbhai Patel National Police Academy	3.	Dehradun
D.	Indira Gandhi National Forest Academy	4.	Ghaziabad

Codes

	A	B	C	D		A	B	C	D
(a)	2	4	1	3	(b)	2	1	4	3
(c)	3	4	1	2	(d)	3	1	4	2

⊙ *(a)* **The National Academy of Direct Taxes**, Nagpur is the apex training institution of the Indian Revenue Service and the Income Tax.

Rafi Ahmed Kidwai National Postal Academy, Ghaziabad was previously known as Postal Staff College of India (PSCI). It was set-up in the year 1977, as the apex training institution of India Post.

Sardar Vallabhbhai Patel National Police Academy is the Indian National Institute for training of Indian Police Service (IPS) officers before they are sent to their respective State cadres to carry out their duties.

The academy is in Hyderabad.

Indira Gandhi National Forest Academy, Dehradun was constituted in the year 1987 by renaming the erstwhile Indian Forest College, which was originally established in 1938 for training senior forest officers.

Hence option (a) is the correct Matching.

156. Consider the following statements on SAFTA:

1. SAFTA is a trade liberalisation programme among the South-Eastern countries of Asia.
2. According to SAFTA, the Ministerial Council shall meet at least once every year or more often as and when considered necessary by the Contracting States.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ *(b)* The SAFTA is a trade liberalisation programme among the South Asian Countries of Asia i.e., India, Bangladesh, Bhutan, Nepal, Pakistan, Sri Lanka, Afghanistan and Maldives, It was agreed upon on 6th January 2004 and came into force in 2006.

It was finalised in the 12th SAARC annual summit at Islamabad, Pakistan.

According to the SAFTA, minisprial council shall meet at least once every year or more often as and when considered necessary by the contrating states.

Hence, only statement 2 is correct.

157. Consider the following statements on Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)

1. BIMSTEC has seven members Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand.
2. BIMSTEC provides a link between South Asia and South-East Asia by way of economic cooperation and linkages in identified areas of cooperation.
3. BIMSTEC was rechristened as BISTEC in the year 2014.

Which of the statement(s) given above is/are correct?

(a) Only 1
(b) Only 2
(c) 1 and 2
(d) 1, 2 and 3

⊙ *(c)* The Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) is an international organisation involving a group of countries in South Asia and South-East Asia.

These are Bangladesh, India, Myanmar, Sri Lanka, Thailand, Bhutan and Nepal. On 6th June, 1997, it was formed in Bangkok and given the name BISTEC (Bangladesh, India, Sri Lanka and Thailand Economic Cooperation).

In the first summit on 31st July, 2004, leaders of the group agreed that the name of grouping should be known as the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC).

Hence, statements 1 and 2 are correct and 3 is incorrect.

158. According to the Companies Act, 2013, 'nominal capital' implies

(a) such part of capital, which has been called for payment
(b) the maximum amount of share capital of a company
(c) such part of capital, which has been received by a company from its shareholders
(d) such capital as the company issues from time to time for subscription

⊙ *(b)* According to the Companies Act, 2013 'authorised capital' or 'nominal capital' refers to such capital as is authorised by the memorandum of a company to be the maximum amount of share capital of the company. Hence option (b) is correct.

159. Which of the following is/are the objective(s) of 'Mahatma Gandhi Pravasi Suraksha Yojana'?
To encourage and enable the overseas Indian workers by giving government contribution to

1. save for their return and resettlement.
2. save for their old age.
3. obtain a life insurance cover against natural death for the entire life of the worker.

Select the correct answer using the codes given below
(a) 2 and 3   (b) 1 and 2
(c) Only 1   (d) All of these

⊙ *(b)* Mahatma Gandhi Pravasi Suraksha Yojana is a Special Social Security Scheme which includes Pension and Life Insurance.

It has been introduced by Ministry of Overseas Indian Affairs for the overseas Indian workers in possession of Emigration Check Required (ECR)passports.

It is a voluntary scheme designed to help workers to meet their three financial needs:
• saving for retirement
• saving for their return and resettlement
• providing free life insurance offering coverage for death from natural causes

Since the insurance cover is only for the period of coverage, statement 3 is incorrect.

160. 'Inclusive growth' is a phrase used in India's

1. 9th Plan
2. 10th Plan
3. 11th Plan
4. 12th Plan

Select the correct answer using the codes given below

(a) 1, 2 and 3   (b) 2 and 4
(c) 3 and 4   (d) Only 4

⊙ *(c)* The Slogan of 11th Five Year Plan was 'Inclusive and sustainable growth' and the slogan of 12th Five Year Plan is 'Faster, more inclusive and sustainable growth'.

Hence, option (c) is correct.

161. Corporation tax in India is levied on income of a company. Which one of the following does not include Corporation tax?

(a) Profit from business
(b) Capital gain
(c) Interest on securities
(d) Sale proceed of assets

⊙ *(d)* Corporation tax in India relates to taxation of companies. The income from following are liable for taxation

(i) Profit from business
(ii) Capital gains
(iii) Income from property
(iv) Income from interest on securities

Sales proceed of assets does not include in corporation tax.

162. In India, contribution of food inflation to overall inflation is around $\frac{1}{3}$rd to $\frac{2}{5}$th. Within food inflation, contribution of food articles is higher because price rise in food articles is

(a) higher and their weight is also higher compared to food products
(b) higher but their weight is lower compared to food products
(c) lower but their weight is higher compared to food products
(d) lower and their weight is also lower compared to food products

⊙ *(a)* The contribution of food article on inflation is higher because the price rise in food article is higher and their weight is also higher compared to food products.

163. In India, mergers and acquisition of firms are regulated by

(a) National Manufacturing Competitiveness Council
(b) Competition Commission of India
(c) Security and Exchange Board of India
(d) Department of Industrial Policy and Promotion

⊙ *(b)* Competition commission of India (CCI) is responsible for enforcing the competition Act, 2002.

Act regulates the acquisition, acquiring of control and merger and acquisition.

National Manufacturing Competitiveness Council (NMCC) was established 2004 as a part of its Common Minimum Programme (CMP). Its mandate was to provide a continuing forum for policy dialogue to energize and sustain the growth of manufacturing industry.

The Securities and Exchange Board of India is the regulator for the securities market in India owned by the Government of India.
It was established in 1988.

The Department for Promotion of Industry and Internal Trade (DPIIT) is a central government department under the Ministry of Commerce and Industry. It was founded in 1995.

164. Which of the following statements about India's unorganised sector are true?

1. Labour is more in number than that in the organised sector.
2. Job security and work regulation are better in unorganised sector.
3. They are usually not organised into trade unions.
4. Workers are usually employed for a limited number of days.

Select the correct answer using the codes given below

(a) 1, 2 and 4
(b) 1, 3 and 4
(c) 3 and 4
(d) 1 and 3

⊙ *(b)* Unorganised Workers (UW) in India have increased many folds post independence. Around 52% of UW's are engaged in agriculture and allied sector and they constitute more than 90% of the labour work force. Characteristics of unorganised sector are:

• Excessive seasonality of employment
• Poor working conditions
• No fixed jobs
• Work in very poor working environment
• No security of employment
• Employed for a limited period

165. Classification of an enterprise into public or private sector is based on

(a) number of employees in the enterprise
(b) ownership of assets of the enterprise
(c) employment conditions for workers in the enterprise
(d) nature of products manufactured by the enterprise

⊙ *(b)* An enterprise is public or private is decided on the basis of the ownership of assets.

If major portion of enterprise is owned by government, then it is classed in public sector and if owned privately, then it comes under private sector.

166. Share of food in total consumption expenditure has been coming down as Per Capita Income grew over time in last sixty years becuase

(a) people have been purchasing less food
(b) people have been preferring non-cereal items in their food basket
(c) growth in food expenditure has been lower than growth in per capita income
(d) percentage of the poor in population has increased over time

⊙ *(c)* Share of food in total consumption is coming down because the growth in food expenditure has been lower than growth in per capita income.

This shift is evident after the rapid economic growth of India and diversification of food basket.

Hence, option (c) is correct.

GENERAL KNOWLEDGE

2019 (II)

1. In how many phases was the general election 2019 conducted in India?

(a) 6 phases   (b) 7 phases
(c) 8 phases   (d) 9 phases

⊙ (**b**) The 2019 Indian general election was held in 7 phases from 11th April to 19th May, 2019 to constitute the 17th Lok Sabha. The votes were counted and result was declared on 23rd May, 2019. The voting turnout was over 67% the highest ever as well as the highest participation by women voters.

The BJP-led National Democratic Alliance (NDA) won 353 seats whereas Congress-led United Progressive Alliance (UPA) won 91 seats.

Since, no party was able to secure at least 10% of seats of total strength of Lok Sabha i.e. 55, there is no opposition leader in 17th Lok Sabha.

2. Who among the following won the Italian Open Women's Tennis Singles Title 2019?

(a) Karolina Pliskova
(b) Johanna Konta
(c) Naomi Osaka
(d) Serena Williams

⊙ (**a**) Karolina Pliskova won the Italian Open Women's Tennis Singles Title 2019, defeating Johanna Konta in the final. Naomi Osaka lost the tennis US Open Women's single title.

3. Which among the following in ship(s) participated in the SIMBEX-19?

1. INS Kolkata
2. INS Shakti
3. INS Vikrant

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 1 and 2
(c) 2 and 3   (d) Only 1

⊙ (**b**) SIMBEX (Singapore India Maritime Bilateral Exercise) is an annual bilateral naval exercise between India and Singapore.

On the Indian side, two vessels 'INS Kolkata' and 'INS Shakti' participated in the exercise. Meanwhile, Singapore was represented by 'RSN Steadfast' and 'RSN Valiant'.

INS Vikrant is an Indigenous Aircraft Carrier 1 which is expected to enter the service in 2023.

4. 'Triples' is a new format of

(a) Boxing   (b) Judo
(c) Chess   (d) Badminton

⊙ (**d**) The world body governing badminton, BFA has launched two new formats of the game-'Air Badminton' and 'Triples' with new dimension of the court and an innovative shuttlecock called Airshuttle.

In triples format, the match will be played between a team of three players each with presence of at least one female. Traditional competitive badminton has been an indoor game. But in the new format launched Air Badminton will be outdoor sports.

5. Who among the following was the Chairman of the Committee on Deepening Digital Payments appointed by the RBI?

(a) HR Khan
(b) Nandan Nilekani
(c) NR Narayana Murthy
(d) Sanjay Jain

⊙ (**b**) The Reserve Bank of India had constituted a high-level committee on Deepening of Digital Payments under the Chairmanship of 'Nandan Nilekani', former Chairman, UIDAI, in January, 2019.

6. 'The Sasakawa Award' of United Nations is given in recognition of the work done in the field of

(a) disaster reduction
(b) peace keeping
(c) health services
(d) poverty alleviation

⊙ (**a**) United Nations Office for Disaster Risk Reduction (UNDRR) conferred 'The Sasakawa Award 2019' for Disaster Reduction to Dr. Pramod Kumar Mishra, Additional Principal Secretary to Prime Minister of India.

The award was announced at the 6th session of global platform for Disaster Risk Reduction, 2019 at Geneva. The award was given in recognition of his long-term dedication to improve the resilience of communities most exposed to disasters.

The UN Sasakawa Award is the most prestigious international award for disaster risk management.

7. Why was India's GS Lakshmi in news?

(a) She was the first Indian to play cricket for an English County Club.
(b) She became the first female ICC match referee.
(c) She was awarded the Ramon Magsaysay Award for the year 2019.
(d) She was the recipient of the Booker Prize in the year 2019.

⊙ (**b**) The ICC appointed India's GS Lakshmi as first ever female match referee. Lakshmi was a match referee in domestic women's cricket in 2008-09 and has also overseen three women's ODI matches and three women's T-20 matches in capacity of a match referee.

8. Who among the following was elected as the President of Indonesia for the second term?

(a) Joko Widodo
(b) Prabowo Subianto
(c) Sandiaga Uno
(d) Jusuf Kalla

(⊘) (**a**) Joko Widodo (better known as Jokowi) won a second term in office as Indonesian President. He got 55% of votes against his opponent Prabowo Subianto. In 2014, also Jokowi won by a slightly narrower margin. Voters enduring support for Jokowi can be partly explained his sensible policies.

9. Which of the following statements with regard to the 'Make in India' initiative is/are correct?

1. It was launched in the year 2018.
2. Its objective is to foster innovation.

Select the correct answer using the codes given below

(a) Only 1   (b) Only 2
(c) Both 1and 2   (d) Neither 1 nor 2

(⊘) (**d**) 'Make in India' initiative was lunched by Prime Minister Modi in September, 2014 as part of a wider set of nation building initiatives.

It's aim to transform India into a global design and manufacturing hub. It covers twenty five sectors of the economy.

Hence, option (d) is correct.

10. Which one of the following is the motto of NCC?

(a) Unity and Discipline
(b) Unity and Integrity
(c) Unity and Command
(d) Unity and Service

(⊘) (**a**) National Cadet Corps (NCC) is youth wing of armed forces with its headquarters at New Delhi (India).

It is open to school and college students on voluntary basis. The discussion for motto of NCC was started in 11th Central Advisory Meeting (CAD) held on 11th August, 1978, at that time there were many motto in mind like 'duty and discipline', 'duty, unity and discipline', 'duty and unity'.

Later, at the 12th CAD meeting 'unity and discipline' was selected as the motto of NCC.

11. Which one of the following departments is not under the Ministry of Home Affairs?

(a) Department of Official Languages
(b) Department of Border Management

(c) Department of Jammu and Kashmir Affairs
(d) Department of Legal Affairs

(⊘) (**d**) The Ministry of Home Affairs is a Ministry of the Government of India, it is mainly responsible for the maintenance of internal security and domestic policy.

The Ministry has 6 departments, namely– Department of Border Management, Department of Internal Security, Department of Jammu and Kashmir Affairs, Department of Home, Department of Official Languages and Department of States.

Ministry of Home Affairs do not have Department of Legal Affairs under it.

It is under Ministry of Law and Justice.

12. Which of the following statements is/are correct?

1. India is a signatory to the United Nations Convention to Combat Desertification (UNCCD).
2. Ministry of Home Affairs is the nodal ministry in the Government of India for the UNCCD.

Select the correct answer using the codes given below

(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

(⊘) (**a**) United Nations Convention to Combat Desertification (UNCCD) is a convention to mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements.

The convention was adopted in France (Paris) on 17th June, 1994 and entered into force in December, 1996.

India became a signatory to UNCCD on 14th October, 1994 and ratified it on 17th December, 1996.

Ministry of Environment, Forest and Climate Change is the nodal ministry for the convention, not Ministry of Home Affairs.

Hence, statement 1 is correct and statement 2 is incorrect.

13. The Public Financial Management System (PFMS) is a web-based online software application designed, developed, owned and implemented by the

(a) Department of Financial Services
(b) Institute of Government Accounts and Finance
(c) Controller General of Accounts
(d) National Institute of Financial Management

(⊘) (**c**) The Public Financial Management System (PFMS), earlier known as Central Plan Schemes Monitoring System (CPSMS), is a web-based online software application developed and implemented by the office of Controller General of Accounts (CGA).

PFMS was initially started during 2009 as a Central Sector Scheme of Planning Commission with the objective of tracking funds released under all plan schemes of Government of India and real time reporting of expenditure at all levels of programme implementation.

From 2014, it has been envisaged that digitisation of accounts shall be achieved through PFMS. Controller General of Accounts (CGA) is the Principal Accounting Adviser to Government of India in the department of expenditure, Ministry of Finance.

14. Match List I with List II and select the correct answer using the codes given below the lists.

	List I (Institute)		List II (Location)
A.	National Institute of Ayurveda	1.	Chennai
B.	National Institute of Homoeopathy	2.	Bengaluru
C.	National Institute of Unani Medicine	3.	Kolkata
D.	National Institute of Siddha	4.	Jaipur

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	1	3	2	4
(c)	4	3	2	1
(d)	4	2	3	1

(⊘) (**c**) **National Institute of Ayurveda**, established in 1976 at Jaipur by the Ministry of Health and Family Welfare, Government of India. It is the lone institute of Ayurveda under the AYUSH.

National Institute of Homoeopathy is an autonomous organisation under Ministry of AYUSH, Government of India. It was established on 10th December, 1975 in Kolkata.

National Institute of Unani Medicine is an autonomous organisation for research and training in Unani medicine in India. It was established in 1984 at Bengaluru. Under Ministry of AYUSH.

National Institute of Siddha is a institute for study and research of Siddha medicine. It was established in 2005 at Chennai.

Hence, option (c) is the correct match.

15. Which of the following statements about 'Invest India' is/are correct ?

1. It is a joint venture (not for profit) company.
2. It is the National Investment Promotion and Facilitation Agency of India.

Select the correct answer using the codes given below
(a) Only 1
(b) Only 2
(c) Both 1and 2
(d) Neither 1 nor 2

⊙ (**c**) Invest India was operationalised in early 2010, as a joint venture company between the Department of Industrial Policy and Promotion (DIPP) (35% equity), Federation of Indian Chambers of Commerce and Industry (FICCI) (51% equity) and State Govenment of India (0.5% each).

The core mandate of Invest India is investment promotion and facilitation. It provides sector-specific and state-specific information to a foreign investor, assists in expediting regulatory approvals and offers hand-holding services.

Hence, both the statements are correct.

16. The National Dope Testing Laboratory functions under
(a) Ministry of Health and Family Welfare
(b) Ministry of Science and Technology
(c) Ministry of Youth Affairs and Sports
(d) Ministry of Home Affairs

⊙ (**c**) National Dope Testing Laboratory (NDTL) is a premier analytical testing and research organisation established as an autonomous body under the Ministry of Youth Affairs and Sports, Government of India.

It is the only laboratory in the country responsible for human sports dope testing. It was established in 2008 with an aim to get permanently accredited by International Olympic Committee and world anti-doping agency to do the testing for the banned drugs in human sports.

Hence, option (c) is correct.

17. Which one of the following statements about the Organisation of Islamic Cooperation is not correct?
(a) Its permanent secretariat is located at Jeddah.
(b) It endeavours to safeguard and protect interests of the, Muslim world in the spirit of promoting international peace and harmony among various people of the world.

(c) It is the largest inter-governmental organisation of the world.
(d) It has consultative and cooperative relations with the UN.

⊙ (**c**) The Organisation of Islamic Cooperation (OIC) is an international organisation founded in 1969, consisting of 57 member states, with 53 being Muslim majority countries. The permanent secretariat is the executive organ of the organisation, located in Jeddah (Saudi Arabia).

The organisation has consultative and cooperative relations with the UN and other inter-governmental organisations to protect the vital interest of the Muslims. It endeavours to safeguard and protect interest of the Muslim world in the spirit of promoting international peace and harmony among various people of the world.

The OIC is the second largest inter-government organisation in the world after the UN.

Hence, option (c) is not correct.

18. In India, 21st May is observed as
(a) NRI Day
(b) National Youth Day
(c) National Technology Day
(d) National Anti-Terrorism Day

⊙ (**d**) Every year 21st May is observed as Anti-terrorism Day in India to wean away the youth from terrorism and showing as to how it is prejudicial to the national interest. The date is chosen to commemorate the death anniversary of one of the most eminent PM of India, 'Rajiv Gandhi' (20th August, 1941-21st May, 1991).

19. What is SWAYAM?
(a) Study Webs of Active-Learning for Young Aspiring Minds
(b) Study Webs of Active-Learning for Youth Aspiring Minds
(c) Study Webs of Active-Learning for Young Aspiration Minds
(d) Study Webs of Active-Learning for Youth of Aspiration Minds

⊙ (**a**) 'SWAYAM' stands for Study Webs of Active-Learning for Young Aspiring Minds. It is a programme of Ministry of Human Resource Development, Government of India. It provides opportunities for life long learning.

Here, learner can choose from hundred of courses, virtually every course that is taught at the university, college, school level and these shall be offered by best of the teachers in India and elsewhere.

20. Who among the following in his book 'The Managerial Revolution' argued that a

managerial class dominated all industrial societies, both capitalist and communist, by virtue of its technical and scientific knowledge and its administrative skills?
(a) James Burnham (b) Robert Michels
(c) Gaetano Mosca (d) Vilfredo Pareto

⊙ (**a**) James Burnham in his book 'The Managerial Revolution' argued that a managerial class dominated all industrial societies, both capitalist and communist, by virtue of its technical and scientific knowledge and its administrative skills.

21. Who was the author of the book '*Plagues and Peoples*'?
(a) William H McNeil
(b) WI Thomas
(c) Rachel Carson
(d) David Cannadine

⊙ (**a**) 'Plagues and Peoples' is a book on epidemiological history by William Hardy McNeil published in New York City in 1976. It was a critical and popular success, offering a radically new interpretation of the extra ordinary impact of infectious disease on culture as a means of enemy attack.
The book ranges from examining the effects of small pox in Mexico, the bubonic plague in China, to the typhoid epidemic in Europe.

2019 (I)

22. Paul Allen, who died in October, 2018, was the co-founder of
(a) Oracle (b) IBM (c) Microsoft (d) SAP

⊙ (**c**) Paul Allen was co-founder of Microsoft along with the Bill Gates. Microsoft is an American Multinational Company with its headquarter is in Washington. The CEO of Microsoft as on 2019 is Satya Nadella.

23. The mobile app 'eVIGIL' is helpful in
(a) conducting free and fair e-tendering process in government offices.
(b) fighting against corruption in public services.
(c) removing garbage from the municipal areas.
(d) reporting violation of model code of conduct in election-bound states.

⊙ (**d**) The Election Commission of India had launched eVIGIL app for citizens to report any violation of the Model Code of Conduct (MCC) during elections. The android based app aimed at empowering people across the country to share evidence of malpractice by political parties, their candidates and activists directly to ECI.

24. 'Prahaar' is
    (a) a battle tank
    (b) a surface-to-surface missile
    (c) an aircraft carrier
    (d) a submarine

⊗ (**b**) Prahaar is a surface-to-surface short range tactical ballistic missile. **Prahaar** has been indigenously developed by Defence Research and Development Organisation (DRDO).

It is a quick-reaction, all-weather, all-terrain, highly accurate battle field support tactical missile with advance manoeuvring capability. It is capable of carrying multiple types of warheads weighing around 200 kg and neutralising different types of targets.

25. Who among the following is/are the recipient/recipients of Rajiv Gandhi Khel Ratna Award, 2018?
    (a) Virat Kohli
    (b) S Mirabai Chanu and Virat Kohli
    (c) Neeraj Chopra
    (d) Hima Das and Neeraj Chopra

⊗ (**b**) The Rajiv Gandhi Khel Ratna Award is the highest sporting honour in our country. It was started in 1991-92.

In 2018 Virat Kohli and Mirabai Chanu were bestowed with this award in the field of Cricket and Weightlifting.

In 2019, Deepa Malik and Bajrang Punia were awarded Rajiv Gandhi Khel Ratna in the field of Paralympic and Freestyle Wrestling respectively.

26. Saurabh Chaudhary excels in which one of the following sports?
    (a) Archery   (b) Shooting
    (c) Boxing   (d) Judo

⊗ (**b**) Saurabh Chaudhary is an Indian shooter. He won the gold medal at 2018 Asian Games in 10m Air   pistol. He created history by becoming youngest Indian to win gold medal at the Asian Games.

27. Which one of the following statements with regard to India's surgical strike mission inside Pakistan occupied Kashmir is correct?
    (a) It was conducted in the year 2018
    (b) It was led by the Indian Air Force
    (c) It was not given any name
    (d) It was sanctioned by the United Nations

⊗ (**c**) On 29th September, 2016 India announced that it conducted "surgical strikes" against the launch pads of militants across the line of control in

Pakistan occupied Kashmir (PoK). The operation was not given any name. In 2019, Balakot strike were conducted by Indian Air Force in response of Pulwama attack.

Hence, option (c) is correct.

28. Eight states have achieved more than 99% household electrification prior to the launch of 'Saubhagya Scheme'. Which one of the following is not among them?
    (a) Kerala
    (b) Punjab
    (c) Himachal Pradesh
    (d) Madhya Pradesh

⊗ (**d**) Eight states which achieved more than 99% household electrification prior to the launch of Saubhagya Scheme are Andhra Pradesh, Gujarat, Goa, Haryana, Himachal Pradesh, Kerala, Punjab and Tamil Nadu.

So, Madhya Pradesh is not among them. Pradhan Mantri Sahaj Bijli Har Ghar Yojna (Saubhagya) to ensure electrification of all willing household in the country.

29. In October, 2018, India was elected as a member to the United Nations Human Rights Council for a period of
    (a) five years   (b) four years
    (c) three years   (d) two years

⊗ (**c**) India was elected for three years (till October 2021) as a member of UNHRC. India received 188 votes, the highest polled by any of the 18 countries elected in the voting.

This is the 5th time India is elected to the Geneva-based Council, the main body of the UN charged with promoting and monitoring human rights. India will join China and Nepal, besides Pakistan, which were elected to the 47 Member Council in previous years to serve three year terms.

30. Who among the following won India's first ever gold medal in the International Youth Olympic Games (2018) held in Argentina?
    (a) Neeraj Chopra
    (b) Praveen Chitravel
    (c) Jeremy Lalrinnunga
    (d) Suraj Panwar

⊗ (**c**) Jeremy Lalrinnunga becomes India's first ever gold medalist after winning gold in the mens 62 kg weightlifting competition.

He hails from State of Mizoram. India ranked 17th with 13 medals which include 3 Gold, 9 Silver and 1 Bronze.

31. Which one of the following viruses is responsible for the recent death of lions in Gir National Park?
    (a) Canine Distemper Virus
    (b) Nipah Virus
    (c) Hendra Virus
    (d) Foot–and–Mouth Disease Virus

⊗ (**a**) Canine Distemper Virus is the main cause of recent death of lions in Gir National Park. It is a member of Paramyxoviridae family that causes canine distemper disease which affects a wide variety of animal families, i.e., dogs, cats, etc.

This disease is highly contagious *via* inhalation. It affects gestrointestinal and respiratory tracts and sometimes nervous system. High fever, eye inflammation, coughing, diarrhea, loss of appetite, hardening of nose, etc, are its common symptoms.

32. Till 2018, which of the following countries have legalised the possession and use of recreational cannabis?
    1. America   2. Canada
    3. Nigeria   4. Uruguay
    Select the correct answer using the codes given below
    (a) 1, 2 and 3   (b) 2 and 4
    (c) 1 and 4   (d) 1, 2 and 4

⊗ (**b**) Cannabis (Marijuana), is a psycho active drug used for medical and recreational purpose.

Canada became the second country after Uruguay to legalise possession and use of recreational cannabis.

In US, it is legalised at federal level, but few State allow use of cannabis for recreational purpose.

33. The 11th BRICS Summit in 2019 hosted by
    (a) China   (b) Russia
    (c) Brazil   (d) India

⊗ (**c**) The 11th BRICS Summit in 2019 was held in Brazil. BRICS is an association of five major emerging national economies. It include Brazil, Russia, India, China and South Africa. The 12th edition of BRICS Summit will be hosted by Russia at Saint Petersburg in July 2020.

34. The United Nations has been observing International Day of Rural Women on
    (a) 15th July   (b) 15th August
    (c) 15th September   (d) 15th October

⊗ (**d**) The United Nations observes International Day of Rural Women on 15th October.

International Day of Rural Women is observed to celebrate the crucial role that women and girls play in ensuring the sustainability of rural households and communities, thus, improving rural livelihoods and overall well-being.

The First International Day of Rural Women was observed on 15th October, 2008.

35. Who among the following is the first Indian to win Pulitzer Prize?
(a) Arundhati Roy   (b) Gobind Bihari Lal
(c) Vijay Seshadri   (d) Jhumpa Lahiri

⊙ (**b**) The Pulitzer Prize is awarded for the achievement in the field of journalism, literature and musical composition, presented by Columbia University.

Govind Bihari Lal was first Indian to win Pulitzer prize in 1937. Vijay Seshadri and Jhumpa Lahiri won the Pulitzer Prize in the year of 2014 and 2006 respectively.

36. Which Arab scientist could be given the credit of christening the mathematical discipline of algorithm?
(a) Al-Khwarizmi   (b) Ibn al-Haytham
(c) Ibn Rushd   (d) Ibn Sina

⊙ (**a**) The credit of christening the mathematical discipline of algorithm goes to Arab scientist Muhammad Ibn Musa Al-Khwarizmi. He was a Persian scholar who produced works in mathematic, astronomy and geography.

In 820 AD, he was appointed as the astronomer and head of the library of House of Wisdom in Baghdad.

37. Which one of the following issues was included in the Indo-US Nuclear Agreement of 2007?
(a) India has 'advance right to reprocess' US-origin safeguarded spent fuel.
(b) India did not have the right to build a strategic fuel reserve with the help of the other supplier countries.
(c) India should not test a nuclear device.
(d) The US will impede the growth of India's nuclear weapons programme.

⊙ (**c**) The Indo-US nuclear agreement also known as 123 agreement was watershed moment in Indo-US relationship. The deal would have indirectly bring India under purview of NSG and US laws that would not allow India to conduct nuclear test in the future. The issue of nuclear test was later clarified as the moratorium on nuclear test was unilateral and voluntary and there was no pressure on India from outside.

Thus, (c) is the correct answer.

38. Which of the following are the core functions of the United Nations multidimensional peacekeeping operations?
1. Stabilisation
2. Peace consolidation
3. To extend support to a losing state in a war
Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 2 and 3
(c) 1 and 3   (d) 1 and 2

⊙ (**d**) The United Nation peacekeeping was established in 1948, to help countries to cross the difficult path from conflict to peace. Their main work peace building, peace making and peace enforcement.

They do not take part in war with the objective winning or helping loosing state.

Hence, option (d) is correct.

39. The South China Sea dispute involves which of the following countries?
1. China   2. Vietnam
3. Malaysia   4. Indonesia
Select the correct answer using the codes given below
(a) 1 and 4   (b) 1 and 2
(c) 1, 2 and 3   (d) 2, 3 and 4

⊙ (**c**) The South China disputes involve both island and maritime claims among several sovereign states within the region, namely, Brunei, the People's Republic of China (PRC), Republic of China (Taiwan), Malaysia, the Phillippines, and Vietnam.

Hence, option (c) is correct.

40. Which one of the following statements about the National Green Tribunal is not correct?
(a) It was set-up in the year 2010.
(b) It is involved in effective and expeditious disposal of cases relating to environmental protection and conservation of forests.
(c) It may consider giving relief and compensation for damages to persons and property.
(d) It is bound by the procedures laid down under the Code of Civil Procedure, 1908.

⊙ (**d**) The Legislate Act of Parliament defines the National Green Tribunal Act, 2010 as follows,

''An act to provide for the establishment of a National Green Tribunal for the effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including

enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto."

The tribunal shall not be bound by the procedure laid down under the Code of Civil Procedure, 1908, but shall be guided by principles of natural justice.

Hence, option (d) is not correct.

41. Consider the following statements about the Bureau of Pharma PSUs of India (BPPI)
1. It is the implementing agency of Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP).
2. It has been registered as an independent society under the Societies Registration Act, 1860.
Which of the statement(s) given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ (**c**) Both the statements are true. Pradhan Mantri Bhartiya Janaushadhi Pariyojana was launched in 2015 with an objective to make quality education available of affordable prices for all particularly, poor and disadvantage.

It is implemented by Bureau of Pharma PSUs of India (BPPI) which is registered as an independents society under the Societies Registration Act, 1860.

Hence, both the statements are correct.

42. Consider the following statements about a scheme launched by the Government of India.

It was launched to provide social security during old age and to protect elderly persons aged 60 years and above against a future fall in their interest income due to uncertain market conditions. The scheme enables old age income security for senior citizens through provision of assured pension/return linked to the subscription amount based on government guarantee to Life Insurance Corporation of India (LIC). Identify the scheme.
(a) Pradhan Mantri Swasthya Suraksha Yojana
(b) Pradhan Mantri Vaya Vandana Yojana
(c) Liveability Index Programme
(d) Rashtriya Vayoshri Yojana

⊙ (**b**) Pradhan Mantri Vaya Vandana Yojana (PMVVY) provides an assured pension based on a guaranteed rate of return of 8% per annum for 10 year. Its salient feature

(i) Investment limit extended upto 15 lakh.

(ii) Time period for subscription up to 21st March, 2020.

(iii) On premature exit 98% purchase price will be refunded.

(iv) Senior citizen will get a pension upto 10000 per month.

43. Which one of the following pairs of military training institute of India and location is not correctly matched?

(a) Army War College : Mhow
(b) High Altitude Warfare School : Gulmarg
(c) Army Air Defence College : Pune
(d) Rashtriya Indian Military College : Dehradun

⊙ (**c**)

Institute	Location
Army War College	Mhow (Madhya Pradesh)
High Altitude Warfare School	Gulmarg (Jammu and Kashmir)
Army Air Defence College	Gopalpur (Odisha)
Rashtriya Indian Military College	Dehradun (Uttarakhand)

Army War College is located in Mhow (Madhya Pradesh). It is a Tactical training and research institution established in 1971.

High Altitude Warfare School is located in Gulmarg (Jammu and Kashmir). It is a training and research establishment of Indian Army set up in 1948.

Army Air Defence College is located in Gopalpur (Odisha). It is a training academy of Indian Army established in 1940.

Rashtriya Indian Military College is located in Dehradun (Uttarakhand). It is a military school for boys established in 1922.

44. Which of the following are the benefits of the Pradhan Mantri Jan Arogya Yojana (PMJAY)?

1. Free treatment available at all public and empanelled private hospitals in times of need.
2. Cashless and paperless access to quality health-care services.
3. Government provides health insurance cover of up to ₹ 5,00,000 per family per year.

4. Pre-existing diseases are not covered.

Select the correct answer using the codes given below
(a) 1 and 3 　　　(b) 1, 2 and 3
(c) 2 and 4 　　　(d) 2, 3 and 4

⊙ (**b**) Benefits of PMJAY Scheme have been enumerated below

(i) **Ayushman Bharat** Pradhan Mantri Jan Arogya Yojana (PMJAY) will provide a cover of up to ₹ 5 lakhs per family per year, for secondary and tertiary care hospitalisation.

(ii) When fully implemented, PMJAY will become the world's largest fully government-financed health protection scheme.

It is a visionary step towards advancing the agenda of Universal Health Coverage (UHC).

(iii) PMJAY will provide cashless and paperless access to service for the beneficiary at the point of service.

(iv) PMJAY will help reduce catastrophic expenditure for hospitalisations, which impoverishes people and will help mitigate the financial risk arising out of catastrophic health episodes.

(v) Over 10.74 crore vulnerable entitled families (approximately 50 crore beneficiaries) will be eligible for these benefits.

(vi) Entitled families will be able to use the quality health services they need without facing financial hardships.

Hence, statements 1, 2, 3 are correct and statement 4 is incorrect.

2018 (II)

45. According to the World Bank's Doing Business Report, 2018, India's ranking has improved in 2018 as compared to 2017 in which of the following areas?

1. Paying taxes
2. Resolving insolvency
3. Starting a business
4. Getting electricity

Select the correct answer using the codes given below
(a) Only 1 　　　(b) 1 and 2
(c) 1, 2 and 3 　　(d) 2, 3 and 4

⊙ (**b**) India improved its ranking from 100th position in 2017 to 77th position in 2018 (a jump of 23 positions) among 190 countries. India has improved its rank in 6 out of 10 indicators in 2018 report.

These parameters include ease of starting a business construction permits getting electricity, getting credit, paying

takes, trading across borders, enforcing contracts and resolving insolvency.

India recorded a leap of 53 ranks in paying takes from 172 to 119 in 2018 improved from 136 to 103 in resolving insolving parameters.

World Bank's Ease of Doing Business Index ranks 190 countries based on 10 parameters.

India was placed at 63rd position in 2019 with an improvement of 14 places from 77th position in 2018.

46. The 2+2 Bilateral Dialogue was held in September 2018 between

(a) External Affairs and Defence Ministers of India with their US counterparts.
(b) Finance and Defence Ministers of India with their Russian counterparts.
(c) Home and Defence Ministers of India and their counterparts in Pakistan.
(d) External Affairs and Defence Ministers of India with their counterparts in Pakistan.

⊙ (**a**) The first edition of 2+2 dialogue between India-US held in New Delhi. In the inaugural meeting, Minister of External Affairs (MEA) Sushma Swaraj and Minister of Defence Smt Nirmala Sitharaman met with their US counterparts Secretary of State Mr. Michael R. Pompeo and Secretary of Defence Mr. James N. Mattis.

The second 2 + 2 dialogue between India and US was held in Washington in December 2019. The US Secretary Mike Pompeo and Defence Secretary Mark Esper hosted the meeting for MEA Shri. S. Jai Shankar and Defence Minister Rajnath Singh.

Hence, option (a) is correct.

47. Who is the Chairman of the Defence Planning Committee set up in April, 2018?

(a) The Prime Minister
(b) The National Security Advisor
(c) The Defence Minister
(d) The Chief of the Army Staff

⊙ (**b**) On 18th April, 2018, the government has revamped the existing defence planning system by establishing a Defence Planning Committee (DPC) under the Chairmanship of the National Security Adviser (NSA).

The committee will be a permanent body and it will prepare national security strategy besides undertaking strategic defence review and formulating international defence engagement strategy.

It will consist of Chairman Chiefs of the Staff Committee (COSC), Service

Chiefs, Defence Secretary, Foreign Secretary and Secretary (expenditure) in Finance Ministry.

48. 'Tejas' is the name of which one of the following?

(a) Main battle tank
(b) Nuclear submarine
(c) Light combat aircraft
(d) Aircraft carrier

⊙ (**c**) Tejas is an Indian single-seat, single-jet engine, multirale light fighter designed by the Aeronautical Development Agency (ADA) and Hindustan Aeronautics Ltd (HAL) for the Indian Air Force and Indian Navy.

It came from the Light Combat Aircraft (LCA) programme, which began in the 1980s to replace India's ageing MIG-21 fighters.

In 2003, the LCA was officially named 'Tejas'.

Hence, option (c) is correct.

49. As per the extant policy, Foreign Direct Ltd Investment is permitted in the defence sector under the automatic route upto which one of the following limits?

(a) 26 per cent   (b) 74 per cent
(c) 51 per cent   (d) 49 per cent

⊙ (**d**) On 10th November, 2017 the government relaxed Foreign Direct Investment (FDI) norms in the defence sector by allowing FDI upto 49 per cent under automatic route and beyond that through the FIPB's approval.

The government has also done away with the earlier requirement of mandatory permission from the Cabinet Committee on Security (CCS) beyond 49 per cent.

50. The policy on strategic partnership in defence was approved by the Ministry of Defence in May, 2017. Which of the following is not among the four segments identified by the Ministry for acquisition through the strategic partnership route?

(a) Artillery guns
(b) Fighter aircraft and helicopters
(c) Submarines
(d) Armoured fighting vehicles and main battle tanks

⊙ (**a**) The policy on Strategic Partnerships in Defence sector was approved by Defence Acquisition Council (DAC) in May, 2017.

Under this policy select private firms will be roped into build military platforms in addition to defence PSUs.

The following four segments have been identified for acquisition under Strategic Partnership (SP) route

(i) Fighter Aircraft
(ii) Helicopters
(iii) Submarines
(iv) Armoured Fighting Vehicles (AFVs)/ Main Battle Tanks (MBTs).

51. The acronym 'CAATSA' refers to a piece of legislation enacted by which one of the following countries?

(a) United Kingdom
(b) United States of America
(c) Russia
(d) India

⊙ (**b**) The Countering America's Adversaries Through Sanctions Act, CAATSA is a United States federal law that imposed sanctions on Iran, North Korea and Russia.

CAATSA is a specifically enacted legislation. Its 'ultimate goal', in the words of a senior State Department official, "is to prevent revenue from flowing to the Russian Government."

52. Who among the following is the Convener of the 'Task Force' set up in November, 2017 by the Government of India to review the Income-tax Act and draft a new direct tax law?

(a) Girish Ahuja   (b) Mukesh Patel
(c) Arbind Modi   (d) Mansi Kedia

⊙ (**c**) The finance ministry sets up a six-member task force to draft a new direct tax law that will better serve the country's economic needs by widening the tax base, improving compliance and ease of doing business. Arbind Modi, member of Central Board of Direct Taxes, was named convener of the six-member panel that has been tasked to draft a new law.

Modi was also a key contributor to the direct taxes code proposed by the previous UPA Government.

Later, Akhilesh Ranjan was appointed as the convener of task force after the retirement of Arbind Modi. The task force submitted its report in August 2019.

53. In which one of the following states was 'DEFEXPO 2018' held in April, 2018?

(a) Goa   (b) Karnataka
(c) Tamil Nadu   (d) Andhra Pradesh

⊙ (**c**) The 10th edition of DEFEXPO has been held in Tamil Nadu from 11th to 14th April, 2018. The location of the event is Tiruvidanthal, Kancheepuram district on the East Coast road near Chennai.

The 11th edition of DEFEXPO was held at Lucknow from 5th to 8th February, 2020. The theme of DEFEXPO 2020 was 'Digital Transformation of Defence'.

54. The two defence industrial corridors announced by the Finance Minister in his 2018 budget speech are coming up in which of the following states?

(a) Odisha and West Bengal
(b) Punjab and Haryana
(c) Gujarat and Maharashtra
(d) Uttar Pradesh and Tamil Nadu

⊙ (**d**) The government will develop two defence industrial production corridors and bring out an industry-friendly military production policy to promote the defence industry in Uttar Pradesh and Tamil Nadu.

The first of the two corridors will be constructed between Chennai and Bengaluru, linking Kattupalli port, Chennai, Tiruchi, Coimbatore and Hosur.

The second industrial corridors will link Agra, Aligarh, Lucknow, Kanpur, Jhansi and Chitrakoot. It will be constructed keeping in mind the development requirements of Bundelkhand region.

Hence, option (d) is correct.

55. What is India's first Indigenous Aircraft Carrier (IAC) called?

(a) Vikrant   (b) Virat
(c) Vaibhav   (d) Varaha

⊙ (**a**) INS Vikrant (IAC-I) is the first indigenous aircraft carrier built in India and the first Vikrant class aircraft carrier built by Cochin Shipyard Ltd (CSL) in Kochi, Kerala for the Indian Navy.

The motto of the ship is Jayema Sam Yudhi Sprdhah, which is taken from Rigveda 1.8.3 and can be translated as "I defeat those who fight against me".

India's first domestically built aircraft carrier was built in India under the Indigenous Aircraft Carrier (IAC) program.

Hence, option (b) is correct.

56. Which one of the following manufacturers is engaged in upgradation of the Swedish 155-mm Bofors Howitzer under the project 'Dhanush'?

(a) Bharat Electronics Limited
(b) Ordnance Factory Board
(c) Bharat Dynamics Limited
(d) Mishra Dhatu Nigam

⊙ (**b**) Dhanush is a 155mm x 45mm calibre artillery gun and is also called the Desi Bofors. Dhanush will be the first artillery gun to be acquired by the army since the purchase of Bofors guns from Sweden in 1987.

It is a modified version of the Bofors upgraded by Ordnance Factory Board (OFB). It is a conglomerate of 39 ordnance factories with another two new projects being set up at Nalanda in Bihar and Korwa in Uttar Pradesh.

57. Which one of the following is the official Mascot of Tokyo 2020 Olympic Games?

(a) Soohorang
(b) Vinicius de Moraes
(c) The Hare, the Polar Bear and the Leopard
(d) Miraitowa

⊙ (**d**) The Mascot for the 2020 Tokyo Olympics is named Miraitowa. Miraitowa is a combination of the Japanese words for future and eternity.

Someity is the Mascot of 2020 Summer Paralympics Someity's name references the English phrase ''so mighty''.

58. 'Mission Satyanishtha', a programme on ethics in public governance, was launched recently by the

(a) Indian Railways
(b) Central Bureau of Investigation
(c) Supreme Court
(d) Enforcement Directorate

⊙ (**a**) 'Mission Satyanishtha' launched on by Indian Railways. It 27th July, 2018 aims at sensitising all railway employees about the need to adhere to good ethics and to maintain high standards of integrity at work. . This mission is a first of its kind event held by any government organisation.

59. According to the updated World Bank data for 2017, India is the sixth biggest economy of the world (in terms of GDP). Which one of the following is not ahead of India?

(a) Japan
(b) UK
(c) France
(d) Germany

⊙ (**c**) In 2017, India became the sixth largest economy with a Gross Domestic Product (GDP) of $2.60 trillion, relegating France to the seventh position. As per the data, GDP of France stood at $2.58 trillion. However, as per the World Bank data of 2018, India is ranked at 7th position after France.

60. Name the Indian cricketer who is not inducted to the ICC Cricket Hall of Fame (till July, 2018).

(a) Rahul Dravid
(b) Sunil Gavaskar
(c) Sachin Tendulkar
(d) Anil Kumble

⊙ (**c**) The ICC Cricket 'Hall of Fame' recognises the achievements of the legends of the cricket.

Since 1932 till date just five Indians have been included in this list. Rahul Dravid, the former wall of Indian cricket is the latest Indian player who is included in the list of ICC Hall of Fame in 2018.

Other are Bishan Singh Bedi, Kapil Dev, Sunil Gavaskar in 2009 and Anil Kumble (2015).

Tendulkar became the sixth Indian to be inducted into ICC Cricket Hall of Fame in July 2019.

61. The Central Water Commission has entered into a collaborative agreement with which one of the following entities for flood forecasting?

(a) Skymet
(b) Google
(c) MetService
(d) AccuWeather

⊙ (**b**) The Central Water Commission (CWC) has entered into an agreement with Google to improve flood forecast systems and disseminate flood-related information by using technology developed by the tech giant.

The initiative is likely to help crisis management agencies to deal extreme hydrological events in a better manner.

62. The headquarters of Metro Railway Zone is located in

(a) New Delhi
(b) Mumbai
(c) Kolkata
(d) Chennai

⊙ (**c**) Apart from the headquarters of the Eastern and the South Eastern Railways, Kolkata also has the headquarters of the Kolkata Metro Railways which is now a zone of the Indian Railways.

63. Which one of the following statements regarding the Universal Declaration of Human Rights is not correct?

(a) The UN General Assembly adopted the Human Rights Charter on 10th December, 1948.
(b) Some of the provisions of the Fundamental Rights enshrined in the Constitution of India are similar to the provisions of the Universal Declaration of Human Rights.
(c) The Rights to Property is not a part of the Universal Declaration of Human Rights.
(d) India is a signatory to the Universal Declaration of Human Rights.

⊙ (**c**) The Universal Declaration of Human Rights (UDHR) was adopted by the United Nations General Assembly at its third session on 10th December, 1948.

India is a signatory to the Universal Declaration of Human Rights. Our Indian Constitution was greatly influenced by the Universal Declaration of Human Rights specially the part three i.e. Fundamental rights. Right to Property (Housing) is also a human right under this declaration.

Hence, option (c) is incorrect.

64. Which one of the following statements regarding the Human Rights Council is not correct?

(a) It is an inter-governmental body within the United Nations system made up of all members of the UN.
(b) It is responsible for the promotion and protection of all human rights around the globe.
(c) It replaced the former United Nations Commission on Human Rights.
(d) It is made up of 47 UN Member States which are elected by the UN General Assembly.

⊙ (**a**) The Human Rights Council is an inter-governmental body within the United Nations system made up of 47 states responsible for the promotion and protection of all human rights around the globe. It replaced the former United Nations Commission on Human Rights.

Hence, all UN members are not of its part.

65. Which one of the following is correct about 'Aaykar Setu'?

(a) It is a mechanism for achieving excellence in public sector delivery related to GST.
(b) With the use of a mobile app, it facilitates online payment of taxes.
(c) It is a communication strategy designed to collect information and build a database of tax defaulters.
(d) It enables electronic filing and processing of import and export declarations.

⊙ (**b**) The Central Board of Direct Taxes has launched an app 'Aaykar Setu'. The app helps to file Income Tax Return (ITR) online, locate the nearest Tax Return Prepares (TRP), provides calculators and other tools, helps manage PAN and TDS etc.

Hence, option (b) is correct.

66. Under the PRASAD Tourism Scheme, which one of the following has not been identified as a religious site for development?

(a) Ajmer (Rajasthan)
(b) Haridwar (Uttarakhand)
(c) Dwaraka (Gujarat)
(d) Velankanni (Tamil Nadu)

> (**b**) PRASAD (Pilgrimage Rejuvenation and Spiritual Augmentation Drive) scheme has been launched to identify and develop pilgrimage tourist destinations on the principles of high tourist visits, competitiveness and sustainability to enrich the religious tourism experience.

Twelve cities namely Amaravati (Andhra Pradesh), Gaya (Bihar), Dwaraka (Gujarat), Amritsar (Punjab), Ajmer (Rajasthan), Kanchipuram (Tamil Nadu), Velankanni (Tamil Nadu), Puri (Odisha), Varanasi (Uttar Pradesh), Mathura (Uttar Pradesh), Kedarnath (Uttarakhand) and Kamakhya (Assam) have been identified for development under PRASAD by the Ministry of Tourism.

Hence, Haridwar has not been identified as a religious site for development.

67. The tagline 'Invaluable Treasures of Incredible India' is associated with the logo for
(a) Archaeological Survey of India
(b) India Tourism Development Corporation
(c) Geological Survey of India
(d) Geographical Indications (GI) of India

> (**d**) Department of Industrial Policy and Promotion (DIPP) under Ministry of Commerce and Industry has unveiled tricolour logo for Geographical Indications (GI) certified products.

The logo has tagline "Invaluable Treasures of Incredible India" printed below it. The tagline represents the spirit of Geographical Indications of India and will be helpful in effective branding and promotion of GIs.

68. Who among the following is the author of the book, *The Social Contract*?
(a) Voltaire   (b) Hobbes
(c) Locke   (d) Rousseau

> (**d**) The *Social Contract* by Jean-Jacques Rousseau in a 1762, book in which Rousseau theorised about the best way to establish a political community in the face of the problems of commercial society. The book helped to inspire political reforms or revolutions in Europe, especially in France.

It argued against the idea that monarchs were divinely empowered to legislate, Rousseau asserts that only the people, who are sovereign, have that all powerful right.

2018 (I)

69. 'SAMPRITI-2017' is a joint military exercise between armed forces of India and
(a) Bhutan   (b) Bangladesh
(c) Pakistan   (d) Myanmar

> (**b**) Joint Indo-Bangladesh Training Exercise, SAMPRITI-2017 was culminated at Counter Insurgency and Jungle Warfare School, Vairengte in Mizoram. The exercise aims to strengthen and broaden the aspects of interoperability and cooperation between the India and Bangladesh armies. SAMPRITI 2019 was held at Tangail, Bangladesh.

70. The Reserve Bank of India has constituted a high-level task force on Public Credit Registry (PCR) to suggest a road map for developing a transparent, comprehensive and near-real-time PCR for India. The task force is headed by
(a) Sekar Karnam
(b) Vishakha Mulye
(c) Sriram Kalyanaraman
(d) YM Deosthalee

> (**d**) The Reserve Bank of India has constituted a 10-members 'High Level Task Force' headed by YM Deosthalee on Public Credit Registry (PCR) for India', which will, suggest a roadmap for developing a transparent, comprehensive and near-real-time PCR for India.

71. In October, 2017, India sent its first shipment of wheat to Afghanistan as a part of commitment made by the Government of India to supply 1.1 million tonnes of wheat that country on grant basis. The shipment was sent through
(a) Iran   (b) Pakistan
(c) Tajikistan   (d) China

> (**a**) Iran's key strategic port of Chabahar (in Gulf of Oman) became operational with the maiden shipment of wheat from India to Afghanistan.

This is a major push for India's Afghan outreach bypassing Pakistan for the first time under the 2016 Indo-Afghan-Iran trilateral pact.

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72. Which of the following statements about the India Post Payments Bank (IPPB) is/are correct?
1. It has been incorporated as a Public Limited Company.
2. It started its operation by establishment two pilot branches at Hyderabad and Varanasi.

Select the correct answer using the codes given below
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

> (**a**) India Post Payment Bank (IPPB) has been incorporated as a Public LImited Company under the Department of Posts with 100% government equity.

IPPB was launched on 30th January, 2017 in Ranchi and Raipur with the objective of being present in all corners of India in the coming years.

Hence, only statement 1 is correct.

73. In November, 2017, India's MC Mary Kom won the gold medal at the Asian Boxing Championship 2017 held at Ho Chi Minh City in Vietnam. In which one of the following categories was she declared winner?
(a) 48 kg (b) 51 kg (c) 54 kg (d) 57 kg

> (**a**) Indian boxer MC Mary Kom on 8th November, 2017 won the Gold Medal at the Asian Boxing Championship 2017 in 48 kg category. Mary Kom defeated North Korea's Hyang Mi Kim by 5-0.

In 2019 Amit Panghal picked up his second successive Gold Medal in the Asian championship in Bangkok.

74. Which one of the following is the theme of the World Soil Day 2017?
(a) Soils and pulses, symbol for life
(b) Caring for the planet starts from the ground
(c) Soils, a solid ground for life
(d) Soils, foundation for family farming

> (**b**) World Soil Day is celebrated annually on the 5th of December at the Food and Agriculture Organisation (FAO) of the United Nations headquarters in Rome, the regional offices and through national and local events.

The theme for 2017 was 'Caring for the planet starts from the ground'.
The theme for 2019 World Soil Day was 'stop soil erosion, saveour future'.
Hence, option (b) is correct.

75. Who among the following is the winner of the National Badminton Championship (Men) 2017?

(a) Kidambi Srikanth (b) HS Prannoy
(c) Ajay Jayaram   (d) Sai Praneeth

⊙ (b) In men's event of Senior National Badminton Championship, HS Prannoy defeated Kidambi Shrikanth to clinch the title in 2017.

Saina Nehwal defeated PV Sindhu in straight games to clinch the women's singles title in the Senior National Badminton Championship.

Saina Nehwal and Sourabh Verma won 83rd National Badminton Championship 2019 in women and men's category respectively.

76. Consider the following statements about National Wildlife Action Plan (NWAP) of India for 2017-2031

1. This is the third National Wildlife Action Plan.
2. The NWAP as unique as this is the first time India has recognised the concerns relating to climate change impact on wildlife.
3. The NWAP has ten components.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) 1 and 2
(c) 2 and 3   (d) All of these

⊙ (b) The Union Ministry of Environment, Forests and Climate Change (UMoEFCC) has unveiled third National Wildlife Action Plan for 2017-2031 to chalk out future road map for wildlife conservation. It is third action plan after first released in 1983 to 2001 and second from 2002 to 2016.

The NWAP has five components, 17 themes, 103 conservation actions and 250 projects.
Hence, statement (1) and (2) are correct.

77. Growth in production (in per cent) of which one of the following core industries in India during the period 2015-2016 was negative?

(a) Natural gas
(b) Refinery products
(c) Fertilizer
(d) Coal

⊙ (**a**) According to the economic survey 2015-16, the growth rate in production of natural gas for the year 2015-16 was (4.7%), refinery products (4.9%), fertilizers (7%), coal (4.8%).

78. Which one of the following was a focus country of the 'World Food India', a mega food event held in November, 2017 in New Delhi?

(a) Germany   (b) Japan
(c) Denmark   (d) Italy

⊙ (**d**) Prime Minister Narendra Modi has inaugurated World Food India 2017 (WFI) on 3rd November, 2017 at the India Gate lawns in New Delhi. Germany, Japan and Denmark were partner countries and Italy was the focus country to World Food India.

The three day event was organised by Ministry of Food Processing Industries. The theme of WFI 2017 is 'Transforming the Food Economy'. The theme of WFI 2019 is 'Forging Partnerships Growth'.

79. Which one of the following states hosted the Nobel Prize Series–India 2018 (Science Impacts Life) Exhibition?

(a) Gujarat
(b) Rajasthan
(c) Goa
(d) Madhya Pradesh

⊙ (**c**) Nobel Prize Series-India 2018, a five-day unique programme to stimulate engagement in science, literature and peace took place in Goa, Mumbai and New Delhi.

During Nobel Prize Series, five Nobel Laureates gave lectures and took part in round table discussions and meetings together with experts and students from several universities.

The Nobel Prize Series-India 2019 was hosted by Mohali in September 2019 and later held at Ludhiana and Delhi too.

80. Which one of the following temples of India has won the 'UNESCO Asia Pacific Award of Merit 2017' for cultural heritage conservation?

(a) Kamakhya Temple, Guwahati
(b) Sri Ranganathaswamy Temple, Srirangam
(c) Meenakshi Temple, Madurai
(d) Kedarnath Temple, Kedarnath

⊙ (**b**) The massive renovation and restoration effort at the Sri Ranganathaswamy Temple in Srirangam, executed through the public-private partnership model, has won the UNESCO

Asia Pacific Award of Merit 2017 for cultural heritage conservation.

The Ranganathaswamy Temple at Srirangam, also known as Thiruvaranga Tirupati, is located about 12 kilometres North of the city of Tiruchirappalli, South-West of Chennai.

A temple at Srirangam is mentioned in Tamil literature of the Sangam era (1st to the 4th century AD).

In 2019 Award of Distinction has given to Vikram Sarabhai Library, IIM Ahmedabad India.

81. Which one of the following teams was defeated by India to win the Women's Hockey Asia Cup title, 2017?

(a) Japan   (b) China
(c) South Korea (d) Pakistan

⊙ (**b**) India won the 2017 Women's Hockey Asia Cup after beating China in the final.The tournament was held from 28th October to 5th November, 2017 in Kakamigahara, Gifu, Japan.

The winner of this tournament qualified for the 2018 World Cup.

82. Which one of the following is India's first indigenously designed and developed long-range subsonic cruise missile which can be deployed from multiple platforms?

(a) Astra   (b) Akash
(c) Nirbhay   (d) Shankhnaad

⊙ (**c**) Nirbhay is a long range, all-weather, subsonic cruise missile designed and developed in India by the Defence Research and Development Organisation (DRDO).

Its operational range is 1000-1500km.

The missile can be launched from multiple platforms and is capable of carrying conventional and nuclear warheads.

The Astra is an active radar homing Beyond-Visual-Range Air-to-Air Missile (BVRAAM) developed by the DRDO, India.

Akash is a medium-range mobile surface-to-air missile defense system developed by the DRDO.

83. The Ministry of Power, Government of India has constituted a committee to investigate the causes of the accident that occurred on 1st November, 2017 at Feroze Gandhi Thermal Power Plant Limited, Unchahar, in Uttar

Pradesh. Who among the following is the Chairman of the Committee?

(a) Dr. L D Papney
(b) Dhawal Prakash Antapurkar
(c) Subir Chakraborty
(d) PD Siwal

⊙ (**d**) In exercise of powers conferred under Section 161 (2) of the Electricity Act, the Ministry of Power, Government of India, has constituted a committee to investigate the causes of the accident that occurred on 1st November, 2017 at the Feroze Gandhi Thermal Power Plant Ltd. (Unit VI: 500MW) in Uttar Pradesh. The committee will be headed by Shri PD Siwal.

84. In November, 2017, an Indian short film, *The School Bag* won the Best Short Film Award at the South Asian Film Festival held at Montreal. Who among the following is the Director of the film?

(a) Anurag Kashyap (b) Dheeraj Jindal
(c) Sujoy Ghosh   (d) Samvida Nanda

⊙ (**b**) Indian short film 'The School Bag' was directed by Dheeraj Jindal. It tells a story based in Pakistan and has won the Best Short Film Award at the South Asian Film Festival of Montreal (SAFFM).

85. Which of the following statements about the Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY) is not correct?

(a) It is a placement-linked skill training programme exclusively for rural girls.
(b) It aims to convert India's demographic surplus into a demographic dividend.
(c) The scheme aims to benefit more than 55 million poor rural folk.
(d) It is a generational poverty alleviation programme.

⊙ (**a**) India has 55 million potential workers between the ages of 15 and 35 years in rural areas.

At the same time, the world is expected to face a shortage of 57 million workers by 2020. This presents a historic opportunity for India to transform its demographic surplus into a demographic dividend.

The Ministry of Rural Development implements DDU-GKY to drive this national agenda for inclusive growth, by developing skills and productive capacity of the rural youth from poor families.

DDU-GKY bridges this gap by funding training projects benchmarked to global standards, with an emphasis on placement, retention, career progression and foreign placement.

Hence, all the statement are correct except option (a).

86. Which one of the following statements about the National Adaptation Fund for Climate Change is not correct?

(a) The fund is meant to assist national and state level activities to meet the cost of adaptation measures.
(b) This scheme has been taken as a Central Sector Scheme.
(c) The Indian Council of Agricultural Research is the national implementing entity for the fund.
(d) The scheme has been in force since 2015-2016.

⊙ (**c**) National Adaptation Fund on Climate Change (NAFCC) is a Central Sector Scheme setup in the year 2015-16.

The objective of the fund is to assist State and Union Territories that are particularly vulnerable to the adverse effects of climate change in meeting the cost of adaptation.

The National Bank for Agriculture and Rural Development (NABARD) has been appointed as National Implementing Entity (NIE) for this fund.

Hence, option (c) is not correct.

87. The first BRICS Summit, after the inclusion of South Africa, was held at

(a) Brasilia   (b) Sanya
(c) Yekaterinburg   (d) Durban

⊙ (**b**) The first BRICS Summit, after the inclusion of South Africa was held at Sanya in 2011.

South Africa officially became a member nation on 24th December, 2010, after being formally invited by the BRIC countries to join the group.

The group was renamed BRICS–with the 'S' standing for South Africa–to reflect the group's expanded membership.

In April, 2011, the President of South Africa, Jacob Zuma, attended the 2011 BRICS Summit in Sanya, China, as a permanent member.

88. eBiz is one of the integrated services projects and part of the 31 Mission Mode Projects (MMPs) under the National e-Governance Plan of the Government of India eBiz is being implemented under the

guidance and aegis of the Department of Industrial Policy and Promotion, Ministry of Commerce and Industry by

(a) Tata Consultancy Services
(b) Infosys Technologies Limited
(c) Wipro
(d) HCL Technologies

⊙ (**b**) Ministry of Commerce and Industry has launched eBiz, India's first Government-to-Business (G2B) portal which aims at transforming and developing a conducive business environment in the country.

The portal which has been developed by Infosys is a Public-Private-Partnership model will provide a one-stop shop for providing G2B services to investors and business communities in India.

The portal will also help in reducing the delays and complexity in obtaining information and services.
Hence, option (b) is correct.

89. Which of the following statements about the olive ridley turtles is/are correct?

1. They are the smallest and most abundant of all sea turtles found in the world.
2. They live in warm waters of Pacific, Atlantic and Indian Oceans.
3. The Coromandel Coast in India is the largest mass nesting site for the olive ridley turtles.

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 1 and 2
(c) 2 and 3   (d) Only 1

⊙ (**b**) The olive ridley turtles are the smallest and most abundant of all sea turtles found in the world. They inhabit in warm waters of the Pacific, Atlantic and Indian Oceans.

These turtles, along with their cousin the Kemps ridley turtle, are best known for their unique mass nesting called Arribada, where thousands of females come together on the same beach to lay eggs.

The coast of Odisha in India is the largest mass nesting site for the olive-ridley, followed by the coasts of Mexico and Costa Rica.

The majority of olive ridleys nest in two or three large groups near Gahirmatha in Odisha.

Hence, statements (1), (2) are correct and statement (3) is incorrect.

90. Which one of the following events is not correctly matched with the year in which it happened?
   (a) Inauguration of the SWIFT system of electronic interbank fund transfers worldwide–1985
   (b) Conclusion of the Uruguay Round of GATT–1994
   (c) Inauguration of the World Trade Organisation–1995
   (d) Establishment of the first wholly Electronic Stock Exchange (Nasdaq)–1971

⊘ (**a**) SWIFT stands for the Society for Worldwide Interbank Financial Telecommunications founded in Brussels in 1973.

It is a messaging network that financial institutions use to securely transmit information and instructions through a standardised system of codes.

91. Consider the following statements about Indo-Tibetan Border Police (ITBP):
   1. ITBP is raised in 1962.
   2. ITBP is basically a mountain trained force.
   3. ITBP replaced Assam Rifles in Sikkim and Arunachal Pradesh in 2004-2005 for border guarding duty.
   4. ITBP presently has 52 service battalions.

   Which of the statements given above are correct?
   (a) 1, 2 and 4
   (b) 3 and 4
   (c) 1, 2 and 3
   (d) All of the above

⊘ (**c**) The Indo-Tibetan Border Police (ITBP) is one of the five Central Armed Police Forces of India.

It was raised on 24th October, 1962, under the CRPF Act, in the wake of the Sino-Indian War of 1962.

The ITBP was intended for deployment along India's border with China's-Tibet Autonomous Region.

In 2004-05, it replaced the Assam Rifles on the Indo-China border in Sikkim and Arunachal Pradesh under the concept of 'One Force, One Border'.

The ITBP, was started with 4 battalions. Since 1978, it has undergone expansion to a force of 56 battalions. As of 2017, it has sanctioned strength of 89,432 personnels.

Hence, statements 1, 2, 3 are correct and statement 4 is incorrect.

92. Which one of the following statements with regard to Antrix Corporation Limited is correct?
   (a) It is a commercial arm of the Department of Industrial Policy and Promotion.
   (b) It is under the administrative control of the Department of Space.
   (c) It is under the administrative control of the Ministry of Health and Family Welfare.
   (d) It is a commercial arm of the Department of Science and Technology.

⊘ (**b**) Antrix Corporation Limited (ACL), Bengaluru is a wholly-owned Government of India Company under the administrative control of the Department of Space.

Antrix Corporation Limited was incorporated as a private limited company owned by Government of India in September, 1992 as a Marketing arm of Indian Space Research Organisation (ISRO).

It's objective is promotion and commercial exploitation of space products, technical consultancy services and transfer of technologies developed by ISRO.

Its another major objective is to facilitate development of space related industrial capabilities in India.

93. Which one of the following statements about India is not correct?
   (a) India has 12 major ports and about 200 non-major ports.
   (b) 95 per cent of India's trade by volume and 68% by value are. moved through maritime transport.
   (c) India has a coastline of about 7500 km.
   (d) In the Maritime Agenda, 2010-2020, a target of 300 MT port capacity has been set for the year 2020.

⊘ (**d**) The Ministry of Shipping launched the Maritime Agenda 2010-2020, a perspective plan of the Shipping Ministry for the present decade.

The main objective of the agenda was "To create a port capacity of around 3200 MT to handle the expected traffic of about 2500 MT by 2020.

Hence, option (d) is incorrect.

94. Which one of the following statements is not correct?
   (a) India joined MTCR in 2016.
   (b) India submitted a formal application for membership of the NSG in 2016.
   (c) India proposed the Comprehensive Convention on International Terrorism in 1996.

   (d) The Commonwealth Heads of Government Meeting (CHoGM) was held in 2016 at Malta.

⊘ (**d**) The Commonwealth Heads of Government meeting is held once every two years, a biennial summit of the heads of government from all commonwealth nations.
It is the associations ultimate policy and decision-making forum.
The November 2015 meeting held in Malta has the theme of ''Commonwealth: adding global value.
Adding global value is about the commonwealth's strength in international politics to interence and eventually effect changes on important global issue.
In 2018 the meeting was held in Reldin United Kingdom.
Hence, option (d) is incorrect.

95. Which of the following about the role of Indian Coast Guard is/are correct?
   1. Indian Coast Guard has been entrusted with the offshore. security coordination authority.
   2. Lead intelligence agency for coastal and sea border.
   3. Coastal security in territorial waters.
      Select the correct answer using the codes given below
   (a) 1 and 3   (b) Only 3
   (c) 1 and 2   (d) None of these

⊘ (**d**) The Indian Coast Guard (ICG) protects India's maritime interests and enforces maritime law, with jurisdiction over the territorial waters of India, including its contiguous zone and exclusive economic zone.

The Indian Coast Guard was formally established on 18th August, 1978 by the Coast Guard Act, 1978. Role of Indian Coast Guard includes:
   (i) Safety and protection of artificial islands, offshore terminals and other installations.
   (ii) Protection and assistance to fishermen and mariners at sea.
   (iii) Preservation and protection of marine ecology and environment including pollution control.
   (iv) Assistance to the Department of Customs and other authorities in anti-smuggling operations.
   (v) Law enforcement in territorial as well as international waters.
   (vi) Scientific data collection and support.
   (vii) National defence during hostilities (under the operational control of the Indian Navy).

Hence, all the statement are correct.

96. Which one of the following became a part of China in 1997 following the principle of 'one country, two systems'?

(a) Tibet
(b) Hong Kong
(c) Xinjiang
(d) Inner Mongolia

(**b**) 'Hong Kong' became a part of China in 1997 following the principle of 'One Country, Two Systems'. Hong Kong is an autonomous territory in the province of Guangdong.

Hong Kong was formerly a colony of the British empire. Under the principle of 'One Country, Two Systems', Hong Kong maintains a separate political and economic system apart from China. Except in military defence and foreign affairs, Hong Kong retains independent executive, legislative and judiciary powers.

2017 (II)

97. Which one of the following statements about various horticulture crops of India for the year 2016 – 17 is not correct?

(a) The area under horticulture crops has increased over previous year.
(b) Fruit production during the current year is higher than the previous year.
(c) Rate of increase in onion production is more than potato production in the current year in comparison to the previous year.
(d) The major tomato-growing states are Madhya Pradesh, Andhra Pradesh , Karnataka, Odisha and Gujarat.

(**c**) Potato is an economical food, as it provides a source of low cost energy to human diet.

The states of Uttar Pradesh, West Bengal, Punjab, Bihar and Gujarat accounted for more than 80% share in total production.

In potato year the production of potato was decreased due to large scale damage by 'late blight' diseases in West Bengal.

But after the recovery, there was an increase in the production of potato. In 2016-17, onion production saw an increase of 3.8% over the previous year, whereas, potato registered a growth 11.1% higher than the previous year.

Hence, option (c) is incorrect.

98. Who among the following is the recipient of the Jnanpith Award, 2016?

(a) Shankha Ghosh
(b) Raghuveer Chaudhari
(c) Pratibha Ray
(d) Rehman Rahi

(**a**) Eminent modern Bengali poet Shankha Ghosh was chosen for the prestigious Jnanpith award for the year 2016. He is the 52nd recipient of Jnanpith award.

He is regarded a leading authority on Rabindranath in addition to being one of the most prolific writers in Bengali. Some of his famous poems are 'Adim lata gulmonary', 'Kabir abhipray', 'Babarer prarthana'.

Jnanpith award is India's highest literary honour. It is bestowed upon any Indian citizen who writes in any 22 official languages of India mentioned in 8th Schedule of Constitution of India.

In 2018 Jnanpith award given to Amitav Ghosh and Malayalam Poet Akkitham wins 55th Jnanpith award for the year 2019.

99. The Sustainable Development Goals [SDGs], which were adapted by the UNO in place of the Millennium Development Goals [MGDs] 2015, aim to achieve the 17 goals by the year.

(a) 2020   (b) 2030
(c) 2040   (d) 2050

(**b**) The Sustainable Development Goals (SDGs) are a set of 17 Global Goals by the year of 2030, which are measured by progress against 169 targets.

The SDGs cover a broad range of social issues like poverty, hunger, health, education, climate change, gender equality and social justice.

The SDGs are officially known as "Transforming our World : the 2030 Agenda for sustainable development".

The SDGs framework does not distinguish between 'developed' and 'developing' nations. Instead, it articulates goals that apply to all countries.

100. Teejan Bai, a recipient of the MS Subbulakshmi Centenary Award, 2016, is an exponent in

(a) Kannanda classical vocal
(b) Kajari dance
(c) Bihu dance
(d) Pandavani, a traditional performing art

(**d**) Teejan Bai is an exponent of traditional art form, Pandavani a form of folk theater quite popular in Chhattisgarh and in the neighbouring tribal areas of Odisha and Andhra Pradesh.

Pandavani is a folk singing style involving narration of tales from the ancient Indian epic Mahabharat. The singing also involves musical accompaniment. Bhima, the second of the Pandava is the hero of the story in this style.

101. Who among the following is the recipient of the Dadasaheb Phalke Award, 2016 ?

(a) Nana Patekar   (b) Manoj Kumar
(c) Javed Akhtar   (d) K Viswanath

(**d**) Kasinathuni Viswanath, one of the most prolific directors in Indian Cinema, has been conferred with the Dadasaheb Phalke Award (2016).

A presenter of classical and traditional art, music and dance, K Viswanath has been a guiding force in the Indian film industry.

The Dadasaheb Phalke award is an annual award given by the Indian Government for life time contribution to Indian Cinema. It was instituted in 1969. Manoj Kumar was awarded Dadasaheb Phalke Award in 2015.

In 2019 Amitabh Bachchan was awarded by Dadasaheb Phalke award.

102. The Nobel Prize in Physics for the year 2016 was given to

(a) David J Thouless
(b) F Duncan M Haldane
(c) J Michael Kosterlitz
(d) All of the above

(**d**) The 2016 Nobel Prize in Physics has been jointly shared by David J Thouless, Duncan Haldane and Michael Kosterlitz for their work on exotic states of matter. Their work helps explain why some materials have unexpected electrical properties, such as superconductivity, and in future their work could pave the way for quantum computers.

The 2019 Nobel Prize in Physics was awarded to Jim Peebles, Michel Mayor and Didier Queloz for contributions to our understanding of the evolution of the Universe and Earth's place in the cosmos.

103. Which one of the following political parties was launched by Irom Sharmila in Manipur?

(a) People's Resurgence and Justice Alliance
(b) Manipur Resistance Alliance
(c) Tribal Resistance Party
(d) Revolutionary People's Party

⊘ (*a*) Irom Chanu Sharmila who is a famous social activist from Manipur has launched the People's Resurgence and Justice Alliance.

Irom Sharmila began a hunger strike against the draconian act of AFSPA (Armed Forces Special Powers Act) which she ended on 9th August, 2016 after 16 years of fasting.

In October, 2016, she launched the political party to contest two Assembly constituencies of Khurai and Khangabok.

104. Which one of the following planets was explored by Cassini Mission launched by NASA, which ended in September, 2017?

(a) Sun (b) Neptune (c) Saturn (d) Jupiter

⊘ (*c*) The Cassini-Huygens mission commonly called cassini was a collaboration between NASA, the European Space Agency (ESA) and the Italian Space Agency (ASI) to send a probe to study the planet Saturn and its system including its natural satellites.

It was launched in 1997 and completed its of term in September, 2017.

105. Which of the following indicators have been used by the World Economic Forum to calculate Global Competitiveness Index for 2016-17?

1. Efficiency enhancer subindex.
2. Innovation and sophistication factors subindex.
3. Life expectancy enhancer subindex.

Select the correct answer using the codes given below
(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

⊘ (*a*) The index is composed of 12 pillars of competitiveness. They are

Basic Requirement Institutions, Infrastructure, Macroeconomic stability, Health and Primary Education.

Efficiency Enhancer Higher Education and Training, Goods Market Efficiency, Labour Market Sophistication, Technlogical Readiness, Market Readiness.

Innovation and Sophistication Factor Business Sophistication.

India was ranked 39th among 138 countries in the Global Competitiveness Index of 2016-17. India slipped to 68th rank in Global Competitiveness Index 2019.

Hence, statements (1) and (2) are correct.

106. 'Tuvalu' has become a point of discussion. Why?

(a) Potato plant that could grow in high altitude
(b) Place in equatorial Africa, where snow is found
(c) New innovative technology to meet global warming
(d) A country under threat of submergence due to ice melting and sea level rise

⊘ (*d*) Tuvalu is a Polynesian Island nation located in the Pacific Ocean. It is a country under threat of submergence due to the melting of ice and sea level rise.

It is a part of SIDS (Small Island Developing States) and face maximum threat of sea level rise in the immediate future.

As low-lying islands lack a surrounding shallow shelf, the communities of Tuvalu are especially susceptible to changes in sea level and undissipated storms.

At its highest, Tuvalu is only 4.6 metres (15 ft) above sea level, and Tuvaluan leaders have been concerned about the effects of rising sea levels for a few years.

It is estimated that a sea level rise of 20-40 centimetres (8-16 inches) in the next 100 years could make Tuvalu uninhabitable.

107. Venus, the first environment research satellite, was launched in August 2017 by which one of the following countries?

(a) India (b) Russia
(c) China (d) Israel

⊘ (*d*) Israel has launched its first environmental research satellite named as Venus (Vegetation and Environment Monitoring New Micro-satellite).

It is a joint venture between the Israel Space Agency (ISA) and its French counterpart CNES.

The Venus satellite is an earth observation micro-satellite.
It is considered the smallest satellite of its kind in the world.

108. Where is the world's first Partition Museum inaugurated in 2017?

(a) New Delhi (b) Lahore
(c) Amritsar (d) Islamabad

⊘ (*c*) The world's first Partition Museum is a part of the newly inaugurated Heritage Street at Amritsar, which starts at the Golden Temple and ends at the Town Hall.

The Partition Museum was inaugurated (with the curtain raiser exhibition) on 2nd October, 2016.

The Partition Museum Project (TPMP) was initiated by The Arts and Cultural Heritage Trust (TAACHT) to work towards the establishment of a world class, physical museum, dedicated to the memory of the partition of the sub-continent in 1947 its victims, its survivors and its lasting legacy.

In one of the greatest and most painful upheavals of contemporary history, over twenty million people migrated to a new homeland on the other side of a quickly demarcated border, leaving behind precious memories.

109. Match List I with List II and select the correct answer using the codes given below the lists.

	List I (Concern)		List II (Product)
A.	TISCO	1.	Chemicals
B.	BALCO	2.	Iron and steel
C.	BPCL	3.	Electronics
D.	BEL	4.	Aluminium

Codes

	A	B	C	D
(a)	2	1	4	3
(b)	2	4	1	3
(c)	3	4	1	2
(d)	3	1	4	2

⊘ (*b*) **Tata Steel Limited** formerly Tata Iron and Steel Company Limited **(TISCO)** is an Indian multinational steel-making company headquartered in Mumbai, Maharashtra, and a subsidiary of the Tata Group.

It was founded by Jamshetji Tata and established by Dorabji Tata.

Bharat Aluminium Company (BALCO) is one of the largest producers of aluminium situated on Chhattisgarh. BALCO has an integrated aluminium plant with captive bauxite mines, a captive power plant, refineries and smelters. BALCO has proved its mettle by developing and supplying special aluminium alloys to the nation's intermediate range ballistic missiles Agni and surface missiles Prithvi.

Bharat Petroleum Corporation Limited (BPCL) is an Indian state-controlled Maharatna oil and gas company headquartered in Mumbai, Maharashtra. The Corporation operates two large refineries of the country located at Mumbai and Kochi.

Bharat Electronics Limited (BEL) is an Indian state-owned aerospace and defence company with about nine factories, and several regional offices in India.

110. One carbon credit is accepted as equivalent to
- (a) 100 kg of carbon
- (b) 100 kg of carbon dioxide
- (c) 1000 kg of carbon
- (d) 1000 kg of carbon dioxide

(*d*) Carbon credit is a generic term for any tradable certificate or permit representing the right to emit (one tone) of carbon dioxide or the equivalent amount of a different greenhouse gas.

The ultimate goal of carbon credits is to reduce the emission of greenhouse gases into the atmosphere.

111. Who among the following scholars argued that 'capital created underdevelopment not because it exploited the underdeveloped world, but because it did not exploit it enough?
- (a) Bill Warren
- (b) Paul Baran
- (c) Geoffrey Key
- (d) Lenin

(*c*) Geoffrey Key in his book 'Development and Underdevelopment: A Marxist Analysis' argued that capital created underdevelopment not because it exploited the underdeveloped world, but because it did not exploit it enough.

112. Which one of the following statements about the All India Services is correct ?
- (a) The All India Services may be created by an Act of the Parliament.
- (b) The endorsement of the Rajya Sabha is not essential for the creation of the All India Services.
- (c) The rules of recruitment to the All India Services are determined by the UPSC.
- (d) The conditions of service to the All India Services may be altered by the UPSC.

(*a*) The All India Services comprises of Civil Services of India, namely IAS, IPS and IFS (Indian Forest Service).

Article 312 provides for the creation of All India Services. The Article provides that an All India Service can be created only if the council of states declares by a resolution supported by not less than a two-thirds majority that it is necessary in the national interest to create one or more such All India Services.

Hence, option (a) is correct.

113. The National Handloom Day is observed on
- (a) 7th June
- (b) 17th July
- (c) 7th August
- (d) 17th September

(*c*) The National Handloom Day is being observed every year on 7th August to honour the handloom weaves in the country and also carter an impetus to India's handloom industry.

The celebration of the day seeks to highlight the contribution of handloom to the socio-economic development of the country and promote handlooms to increase income of weavers and also enhance their pride.

114. Which one of the following was the theme of the World Environment Day, 2017?
- (a) Green Economy : Does it include you?
- (b) Connecting People to Nature
- (c) Think, Eat, Save
- (d) Many Species, One Planet, One Future

(*b*) World Environment Day which is observed on 5th June every year across the globe is the largest annual event for positive environmental action. It was inaugurated in 1972 following the United Nations Conference on the Human Environment in Stockholm, Sweden.

The theme for 2017 is 'Connecting People to Nature'. The theme for World Environment Day 2017, implores us to get outdoors and into nature, to appreciate its beauty and its importance and to take forward the call to protect the Earth that we share.

The theme for 2019 is 'Air Pollution'.

115. The all-women expedition of Indian Navy to circumnavigate the globe on the sailing vessel, INSV Tarini, is scheduled to have four stopovers. Which one of the following is not one of them?
- (a) Fremantle
- (b) Lyttelton
- (c) Port Stanley
- (d) Durban

(*d*) INSV Tarini is the second sailboat of the Indian Navy. It is a cruising sloop built at the Aquarius Shipyard in Divar, Goa.

Navika Sagar Parikrama is the name of expedition for circumnavigation the globe on INSV Tarini by Indian Navy's Women Naval Officers. The six member all-woman team circumnavigated and managed the whole operation in their first ever global journey.

The voyage was finished around March 2018, with only 4 port calls in Fremantle, Lyltelton, Port Stanley and Cape Town.

116. Which one of the following statements about the Global Environment Facility Grant Agreement, signed by India in August, 2017 with the World Bank for 'Ecosystems Service Improvement Project', is not correct ?
- (a) The size of the project is about USD 25 million.
- (b) The duration of the project is 15 years.
- (c) The project will entirely be financed by the World Bank out of its GEF Trust Fund.
- (d) The Ministry of Environment, Forest and Climate Change will implement the project.

(*b*) In August 2017, India signs Global Environment Facility (GEF) Grant Agreement with the World Bank for USD 24.64 Million for "Ecosystems Service Improvement Project". The project's duration is 05 years. Hence, statement (b) is incorrect.

Ministry of Environment, Forest and Climate Change (MoEF and CC) will implement the project in the states of Chhattisgarh and Madhya Pradesh through Indian Council of Forestry Research and Education under the National Mission for Green India.

The objective of the project is to strengthen the institutional capacity of the Departments of Forestry and Community Organisations to enhance forest ecosystem services and improve the livelihoods of forest dependent communities in Central Indian Highlands.

117. Which one of the following authorities has recently launched the mobile apps 'MyFASTag' and 'FASTag Partner'?
- (a) Telecom Regulatory Authority
- (b) National Highways Authority
- (c) Airports Economic Regulatory Authority
- (d) National Disaster Management Authority

(*b*) National Highways Authority has recently launched the mobile app My FASTag for easy access of this facility. It would be a perfect solution for a hassle free trip on national highways.

FASTag is a simple to use, reloadable tag which enables automatic deduction of toll charges and lets you pass through the toll plaza without stopping for the cash transaction.

FASTag is linked to a prepaid account from which the applicable toll amount is deducted.

The tag employs Radio-Frequency Identification (RFID) technology and is affixed on the vehicle's windscreen after the tag account is active.

118. Which one of the following is not included in the National Air Quality Index?

(a) Sulphur
(b) Nitrogen dioxide
(c) Lead
(d) Methane

⊙ (*d*) Air Quality Index (AQI) is a tool for effective communication of air quality status to people in terms, which are easy to understand.

It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and colour. It includes eight pollutants namely (PM10, PM2.5, NO_2, SO_2, CO, O_3, NH_3, and Pb) for which short-term (upto 24-hours) National Ambient Air Quality Standards are prescribed.

Hence methane is not included in National Air Quality Index.

119. The sensitive information leaked in August, 2016 concerns, which one of the following defense platforms of India?

(a) Fifth Generation Fighter Aircraft
(b) Combat Helicopters
(c) Submarines
(d) Unmanned Aerial Vehicles

⊙ (*c*) Sensitive data related to India's Scorpenel submarines has been leaked, with French shipbuilder DCNS, which designed the submarine, facing a leak of documents spreading over 22000 pages.

INS-Kalvari, first of the Scorpene-class submarines, is expected to be inducted into the Indian Navy later this year.

120. How many medals were won by India in 2016 Summer Olympics?

(a) One Silver and one Bronze
(b) Two Gold
(c) Two Bronze
(d) None of the above

⊙ (*a*) PV Sindhu, at 21, became the youngest to win an Olympic Medal a silver, which was never achieved in badminton; and Sakshi's bronze was also a first for women's wrestling.

121. India became a member of which one of the following in 2016?

(a) Non-Proliferation Treaty
(b) Missile Technology Control Regime
(c) Nuclear Suppliers Group
(d) Wassenaar Arrangement

⊙ (*b*) India became the 35th full member of Missile Technology Control Regime (MTCR) in July 2016. It marked India's

first entry into any multilateral export control regime.

MTCR aims at restricting the proliferation of missiles, complete rocket systems, unmanned air vehicles and related technology for those systems capable of carrying a 500 km payload for at least 300 km, as well as systems intended for the delivery of Weapons of Mass Destruction (WMD).

122. India signed an agreement in 2016 to develop a strategic port in one of its neighbouring countries. What is the name of the port?

(a) Chabahar   (b) Gwadar
(c) Hambantota   (d) Mongla

⊙ (*a*) In 2016, India signed a historic deal with Iran to develop the strategic port of Chabahar in Iran. India also agreed on a three nation pact to build a transport and trade corridor through Afganistan.

Developing the Chabahar port was crucial for India as it will not only allow New Delhi to bypass Pakistan and Occess global markets but also counter China's increasing influence in the Indian ocean region.

123. Who among the following won a gold medal for India in Men's Javelin Throw event at the 2016 Rio Paralympic Games?

(a) Rinku Hooda
(b) Devendra Jhajharia
(c) Sundar Singh Gurjar
(d) Mariyappan Thangavelu

⊙ (*b*) Thangavelu Mariyappan (high jump) and Devendra Jhajharia (javelin throw) won Paralympic Gold Medals, while Deepa Malik (shot put) had claimed a silver. Varun Singh Bhati (high jump) had won a bronze medal.
Hence, option (b) is correct.

124. Hindustan Aeronautics Limited handed over the first two indigenously designed and manufactured light combat aircrafts to the Indian Air Force in 2016. What is the name of these new combat aircrafts?

(a) Marut   (b) Garud
(c) Tejas   (d) Pushpak

⊙ (*c*) Hindustan Aeronautics Limited (HAL) handed over the first two Tejas aircrafts to IAF, which will make up the 'Flying Daggers' 45, the name of the first squadron of the LCA. India's first indigenous LCA, which is all set to replace the MiG-21 series, is a result of several years of design and development work by Aeronautical Development Agency (ADA) and HAL.

125. Which country signed a Memorandum of Understanding with India for promoting the production of Pigeon Peas/Tur and other pulses in July, 2016?

(a) South Africa
(b) Syria
(c) Egypt
(d) Mozambique

⊙ (*d*) India and Mozambique have signed three Memorandum of Understandings (MoU) in areas of drug trafficking, pulse trading and sports.

India had signed a MoU with Mozambique on cooperation in the field of production and marketing of Pigeon Peas.

126. The Indian Navy in October, 2016 commissioned the highly manoeuverable fast attack craft INS-Tihayu. INS-Tihayu would be based in

(a) Kochi   (b) Panaji
(c) Visakhapatnam   (d) Mumbai

⊙ (*c*) The 315-tonne INS-Tihayu is the sixth WJFAC Car Nicobar Class vessel to be commissioned and allotted to the Eastern Fleet of the Navy. It will be based in Visakhapatnam.

127. Which one of the following sectors is not affected by the changes made in the Foreign Direct Investment Policy in June, 2016?

(a) Multi-brand retailing
(b) Defence
(c) Private security agencies
(d) Manufacturing of small arms and ammunitions covered under the Arms Act, 1959

⊙ (*a*) Government has approved some changes in Foreign Direct Investment Policy in June, 2016 to liberalise and Simplify the policy for greater FDI inflow. Major sectors that are affected through these changes. are:

Defence Private Security Agencies, manufacturing of small arms and ammunition covered under the Arms Act, 1959. Single brand retailing, Civil Aviation etc.

Hence, option (a) is not correct.

128. BREXIT refers to the Great Britain leaving which one of the following?

(a) International Monetary Fund
(b) Commonwealth
(c) World Trade Organisation
(d) European Union

(**d**) BREXIT is the popular term for the prospective withdrawal of the United Kingdom (UK) from European Union (EU). In a referendum held on 23rd June, 2016, 51.9% of the participating UK electorate voted to leave the EU.

UK left the EU at 11 pm GMT on 31st January, 2020. This began a transition period that is set to end on 31st December, 2020, during which the UK and EU will negotiate their future relationship.

129. In which one of the following cities are the Summer Olympics, 2020 going to be held?

(a) London
(b) Paris
(c) Tokyo
(d) Moscow

(**c**) 2020 Summer Olympics officially known as the Games of the XXXII Olympiad and commonly known as Tokyo 2020. The games are planned to be held from 24th July to 9th August, 2020 in Tokyo.

Miraitowa is the mascot of 2020 Summer Olympic.

130. Who among the following is the President of Republic of the Union of Myanmar?

(a) Aung San Suu-Kyi
(b) Htin Kyaw
(c) Myint Swe
(d) Henry Van Thio

(**b**) Htin Kyaw was elected as the ninth President of Myanmar on 15th March, 2016 by 360 of the 652 MPs at the Assembly of the Union; Aung San Suu-Kyi was appointed as the State Counsellor, a position similar to Prime Minister, on 6th April, 2016.

As on 2018, **Win Myint** is the President of Myanmar.

131. Consider the following statement about the famous football player : "He was diagnosed with a growth hormone deficiency during his childhood but went on to win three European Golden shoes in his career." Who is that player?

(a) Andres Inista
(b) Lionel Messi
(c) Cristiano Ronaldo
(d) Zinedine Zidane

(**b**) Lionel Messi was diagnosed with a Growth Hormone Disorder or GHD. It is often called idiopathic short stature,

but there are problems that go beyond being shorter than average.

Lionel Messi is an Argentina professional footballer. He play for Spanish Club Barcelona and Argentina National team.

132. Which one of the following is not an Inter-Services Establishment?

(a) Officers Training Academy
(b) National Defence Academy
(c) National Defence College
(d) Armed Forces Medical College

(**a**) National Defence Academy, National Defence College and Armed Forces Medical College are the joint services academy of the Indian Armed Forces where cadets of the three services, the Army, the Navy and the Air Force trained together before they go on to respective service academies for further pre-commissioning training.

These are inter-service establishment because one can go into different services through them but through Officers Training Academy, one can go only into Indian Army.

133. Which one of the following is a Peacetime Gallantry Award?

(a) Shaurya Chakra
(b) Vir Chakra
(c) Yudh Seva Medal
(d) Param Vir Chakra

(**a**) Shaurya Chakra is an Indian military decoration awarded for valour, courageous action or self-sacrifice while not engaged in direct action with the enemy.

It may be awarded to civilians as well as military personnel, sometimes posthumously.

It is the peacetime equivalent of the Vir Chakra. Other peace time gallantary awards are Ashok Chakra and Kirti Chakra.

Ashoka Chakra is highest peacetime gallantary award. Kirti Chakra is second in order of precedence of peacetime gallantary awards.

134. Who among the following is the author of the book *A Comparison Between Women and Men?*

(a) Pandita Ramabai
(b) Sarojini Naidu
(c) Tarabai Shinde
(d) Rameshwari Nehru

(**c**) Tarabai Shinde (1850-1910) was a feminist activist, who protested

patriarchy and caste in 19th century India.

She is known for her published work, 'A Comparison Between Women and Men' (Stree-Purush Tulana), originally published in Marathi in 1882.

2016 (II)

135. Which one of the following statements about reusable space vehicle of ISRO is not correct?

(a) In June, 2016, ISRO successfully launched India's first reusable space vehicle
(b) The space vehicle was launched from Satish Dhawan Space Centre at Sriharikota in Andhra Pradesh
(c) The reusable launch vehicle climbed to a height of 65 km before automatically steering back for landing
(d) The vehicle was initially boosted by a rocket that contained liquid fuel

(**a**) In 23rd May, 2016, ISRO successfully launched India's first indigenous winged Reusable Launch Vehicle (RLV) from Satish Dhawan Space Centre at Sriharikota spaceport in Andhra Pradesh.

In this experimental mission, HS9 solid rocket booster carrying Reusable Launch Vehicle-Technology Demonstrator (RLV-TD) lifted off from the first Launch Pad at Sriharikota.

Hence, statement (a) is not correct.

136. Which one of the following statements is not correct?

(a) Brahmos is a supersonic cruise missile made by India and Russian Federation
(b) The name Brahmos came from two rivers, Brahmaputra of India and Moskva of Russia
(c) Indian military scientists were capable of integrating Brahmos cruise missile with Sukhoi-30 MKI fighter
(d) Defence Research and Development Organisation is the manufacturer of Sukhoi-30 MKI fighter

(**d**) Brahmos is a supersonic cruise missile being developed by Brahmos Aerospace, a joint venture between Defence Research and Development Organisation (DRDO) of India and MPO Mashinostroeyenia (NPOM) of Russia.

The missile can be launched against ships and land-based targets.

The missile is named after two rivers, the Brahmaputra in India and the Moskva in Russia.

The Indian Government has decided to lower the weight and strengthen the structure of the aircraft and rocket launcher of the Brahmos in order to make it more suitable for integration with the Sukhoi SU-30 MKI, and the Indian military scientists are capable to integrate it.

The Sukhoi SU-30 MKI is a twin jet multi-role air superiority fighter developed by Russia's Sukhoi and built under licence by India's Hindustan Aeronautics Limited (HAL) for the Indian Air Force (IAF).

Hence, option (d) is incorrect.

137. Neil O'Brien, who died in June 2016, was a famous

(a) journalist
(b) billiards player
(c) dramatist
(d) quiz master

⊘ (*d*) Neil O'Brien was a leader of the Anglo-Indian community, who is credited with pioneering quizzing in the country. He passed away in Kolkata at the age of 82 in 2016.

138. Recently, the Government of India cleared the proposal for the production of 18 indigenous 'Dhanush' artillery guns to be produced in India by

(a) Indian Army
(b) US Army
(c) Indian Ordinance Factory Board
(d) Indian and US Army jointly

⊘ (*c*) The Dhanush project was started by the Indian Ordnance Factory Board to replace the older 105 mm Indian Field Gun, 105 mm Light Field Gun and the Russian 122 mm guns with a modern 155 mm artillery gun.

The Dhanush is a 155 mm towed howitzer gun, which is now used by the Indian Army. The design is based on Bofors, (now Haubits FH77) which India acquired in the 1982.

139. Who among the following won the men's singles title in the Australian Open tennis tournament, 2016?

(a) Jamie Murray   (b) Bruno Soares
(c) Novak Djokovic (d) Andy Murray

⊘ (*c*) Novak Djokovic won the men's singles title in the 2016 Australian Open tennis tournament by defeating Andy Murray.

In 2019, Novak Djokovic again won the Australian Open tennis tournament by defeating Rafael Nadal, Novak Diokvoic plays for Serbia.

140. Which one of the following statements is not correct?

(a) Creation of National Investment and Infrastructure Fund (NIIF) was announced in the Union Budget, 2015-16.
(b) NIIF is a fund for enhancing infrastructure facility in the country.
(c) National Investment and Infrastructure Fund (NIIF) and National Investment Fund (NIF) are the names of the same organisation.
(d) NIIF can have more than one alternative investment fund.

⊘ (*c*) The National Investment and Infrastructure Fund (NIIF) was announced in the Union Budget, 2015-16.

The objective of NIIF is to maximise economic impact through infrastructure development in viable projects both in Greenfield and Brownfield, including stalled projects, mainly in the core infra sector.

NIIF has been structured as a fund of funds and set-up as Category II Alternate Investment Fund (AIF) under the Securities and Exchange Board of India (SEBI) Regulations. As on the above, the NIIF is a fund of funds, means that there would be multiple alternative investment funds underneath the main fund.

National Investment Fund (NIF) is resporate from NIIF as it was established to receive disinvestment proceeds of CPSUs and investing the same to generate earnings.

141. Who among the following was defeated by Chile to win the Copa America Football Championship, 2016?

(a) Colombia   (b) Argentina
(c) Ecuador   (d) Peru

⊘ (*b*) Copa America is an international men's football tournament contested between national teams.

In the final match played at Metlife Stadium, New Jersey (US), Chile defeated, Argentina by 4-2 goals in the penalty shootout as in the regulation period both teams failed to score goal. Argentina defeated by Chile to win the Copa America Football Championship, 2016.

The 2019 edition of Copa America Football was won by Brazil, Brazil defeated Pure by 3-1 in finals.

142. Who among the following is the Chairman of the 14th Finance Commission?

(a) C Rangarajan
(b) Vijay Kelkar
(c) YV Reddy
(d) Rakesh Mohan

⊘ (*c*) The Chairman of the 14th Finance Commission was V Reddy. NK Singh is the Chairman of 25th Finance Commission.

The Finance Commission came into existence in 1951. The provision for Finance Commission comes under Article-280 of the Indian Constitution. The function of Finance Commission is to define the financial relations between Centre and the State.

The commission term is 5 years once it is appointed. It consists of a chairman and four other members.

143. Which of the following voted for Brexit in June, 2016?

(a) England and Scotland
(b) England and Wales
(c) Scotland and Northern Ireland
(d) Wales and Northern Ireland

⊘ (*b*) The withdrawal of the United Kingdom from European Union is commonly known a Brexit. In June, 2016, a referendum was held in which England and Wales voted for Brexit. However, the other two geographical regions of UK i.e. Scotland and Northern Ireland voted against Brexit.

144. The 'four great needs' of the people as identified by the Guomindang were

(a) clothing, food, housing and transportation
(b) education, food, housing and health care
(c) food, housing, education and employment
(d) employment, housing, education and health care

⊘ (*a*) Guomindang identified the 'four great needs' of the people into four areas : clothing, food, housing and transportation. Chinese Government, can take care of these people through ideal planning. The concept may be understood as social welfare as well.

145. Which one of the following statements about the Missile Technology Control Regime is not correct?

(a) The Missile Technology Control Regime is an informal and voluntary partnership initially formed among G-7 countries
(b) Members of the Missile Technology Control Regime prevent the proliferation of missile and

unmanned aerial vehicle technology capable of carrying above 500 kg payload for more than 300 km

(c) China applied to join the Regime but members did not offer the membership

(d) No other country outside the membership follows the regime rules

⊚ (**d**) The Missile Technology Control Regime was established in April, 1987 by G7 countries. The member countries are Canada, France, Germany, Italy, Japan, Great Britain and USA.

The MTCR was created in order to curb the spread of unmanned delivery systems for nuclear weapons, specifically delivery systems that could carry a payload of 500 kg for a distance of 300 km.

India became the member of MTCR in June, 2015 with active support from France and USA.

Hence, option (d) is incorrect.

146. The members of NAFTA are

(a) USA, Canada and Mexico
(b) USA, Canada and India
(c) USA, Canada and Japan
(d) USA, UK and India

⊚ (**a**) The North American Free Trade Agreement (NAFTA) is an agreement between Canada, Mexico and United States that created a trilateral trade bloc in North America.

NAFTA was created with the aim to eliminate barriers to trade and investment between participating countries.

This agreement was basically a free trade agreement, but it served as a framework for further regional cooperation.

147. Which one of the following does not signify a battle tank?

(a) T-55   (b) T-155 (c) T-72   (d) T-90

⊚ (**b**) T-55, T-72 and T-90 battle are USSR/Russian Origin battle tanks and are respectively based on first, second and third generation battle tank technologies.

T-155 is a Turkish 155 mm self-propelled Howitzer based on the K9 thunder by Samsung Techwin of South Korea. The T-155 has a maximum firing range of 40 km, depending on the type of ammunition used. It can reach a top speed of 66 km/h and has an operational range of 480 km.

148. Which one of the following was the earlier name of Tokyo?

(a) Osaka   (b) Kyoto
(c) Samurai   (d) Edo

⊚ (**d**) Edo was the earlier name of Tokyo. It was the seat of power for the Tokugawa Shogunate, which ruled Japan from 1603 to 1868.

During this period, it became one of the largest cities in the world.

149. Which one of the following sources tells us about women protesting against the infidelity of their husbands or the neglect of the wife and children by the male head of the household?

(a) The *Kitab-ul-Hind*
(b) Documents belonging to the village panchayats of Rajasthan, Gujarat and Maharashtra
(c) Sculptures from Mandor
(d) The *Ain-i-Akbari* of Abul Fazl

⊚ (**b**) The documents from Western India (Rajasthan, Gujarat and Maharashtra) record petitions sent by women to the village panchayats to seek redress and justice. Wives protested against the infidelity of their husbands or the neglect of the wife and children by the male head of the household, the grihasthi.

While male infidelity was not always punished, the State and 'superior' caste groups did intervene, when it came to ensuring that the family was adequately provided for.

2016 (I)

150. Which one of the following services of 'India Post' has permanently been discontinued?

(a) Money Order
(b) Telegram
(c) Postal Life Insurance
(d) Inland Letter

⊚ (**b**) Telegram is a written message transmitted by using an electric device, was started in 1850 on experimental basis between Kolkata and Diamond Harbour. It was made public in 1854 and discontinued permanently in 2013.

151. Which of the following statements about India's scientific and research mission in Antarctica is/are correct?

1. The first scientific base station in Antarctica was Dakshin Gangotri.
2. Dakshin Gangotri is now being used as supply base and transit camp.
3. The Maitri station is manned throughout the year for scientific activities.

Select the correct answer using the codes given below
(a) Only 1   (b) 2 and 3
(c) 1 and 2   (d) 1, 2 and 3

⊚ (**d**) The first station Dakshin Gangotri was buried in ice and abandoned in 1990-91.

The second station Maitri is situated on the Rocky mountainous region called Schirmacher Oasis. 'Bharati', India's third and newest permanent research base in situated on a rocky promontory fringing the Prydz Bay between Stornes and Broknes peninsula in the Larsemann Hill area.
Hence, all the statements are correct.

152. The first summit of the Forum for India-Pacific Islands Cooperation (FIPIC) was held in
(a) Jaipur   (b) Suva
(c) New Delhi   (d) Port Moresby

⊚ (**b**) First summit of Forum for India-Pacific Islands Cooperation (FIPIC) was held in Suva.

It is a multinational grouping developed in 2014 for cooperation between India and 14 Pacific island nations. Second Summit was held at Jaipur in 2015.

153. Which of the following statements relating to the Bandung Conference on Afro-Asian Resurgence (1955) are correct?

1. Bandung Conference was organised by Indonesia, Myanmar (Burma), Ceylon (Sri Lanka), India, and Pakistan in which 29 countries representing more than half of the world's population sent delegates.
2. The Conference reflected the five sponsors' dissatisfaction with what they regarded as a reluctance by the Western powers to consult with them on decisions affecting Asia.
3. The Conference was concerned over tension between the People's Republic of China and the United States.

Select the correct answer using the codes given below
(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 2 and 3

⊚ (**d**) The Bandung Conference was meeting of Asian and African states, which took place on 18th-24th April, 1955 in Banding Indonesia. The conference was organised by Indonesia,

Myanmar (Burma), Ceylon (Sri Lanka), India and Pakistan in which 29 countries sent their delegates.

The five sponsors countries shown dis-satisfaction as the way western powers are not consulting them regarding decisions that affect Asia.

The conference also showed their concern regarding tension between USA and People's Republic of China.

154. The Erawan Shrine, which witnessed a major bomb blast in August, 2015, is located at
(a) Singapore   (b) Bangkok
(c) Kuala Lumpur   (d) Kabul

⟩ (**b**) Erawan Shrine, formally known as Thao Maha Shrine, i.e. 'Shrine of Lord Brahma the Great' is a Hindu temple in Bangkok (Thailand).

On 17th August, 2015 a bombing took place at this shrine killing 20 people and injuring 125.

155. Who among the following is the first Indian sportsperson to reach the finals in the World Badminton Championship (Women) in 2015?
(a) Jwala Gutta   (b) Saina Nehwal
(c) PV Sindhu   (d) Madhumita Bisht

⟩ (**b**) Saina Nehwal is the 1st Indian woman badminton player to win Bronze medal in Olympic 2014.

She has also won Padma Bhushan Award (2015). Saina Nehwal is the first Indian sports person to reach the final in the world Badminton Championship (women) in 2015.

The 2015 World champion title was the first women sports person to win.

156. Leander Paes won the US Open Mixed Doubles Tennis Title (2015) partnering with
(a) Kristina Mladenovic
(b) Flavia Pennetta
(c) Martina Hingis
(d) Sania Mirza

⟩ (**c**) Leander Paes along with Martina Hingis won US Open Mixed Doubles Tennis Title-2015. They defeated Bethanie Mattek and Sam Querrey by 6-4, 3-6, 10-7 and won the title.

157. Who among the following is the winner of the World Food Prize (2015)?
(a) Sanjaya Rajaram
(b) Baldev Singh Dhillon
(c) Sir Fazle Hasan Abed
(d) Rajendra Singh Paroda

⟩ (**c**) World Food Prize Foundation declared World Food Prize, 2015 to Sir Fazle Hasan Abed of Bangladesh. In one of the American State Department Programme Abed's name was declared as winner of the award.

Vegetable breeder Simon Groot of the Netherland won the 2019 World Food Prize.

158. 'Citizenfour', the 87th Academy Award winner in the category of documentary feature, is based on the life of
(a) Abraham Lincoln
(b) Albert Einstein
(c) Edward Snowden
(d) Laura Poitras

⟩ (**c**) 'Citizenfour'–is a 2014 documentary film directed by Laura Poitras, It is based on life of Edward Snowden and NSA spying scandal.

159. The rank of Major General in Indian Army is equivalent to
(a) Air Marshal in Indian Air Force
(b) Rear Admiral in Indian Navy
(c) Air Commodore in Indian Air Force
(d) Commodore in Indian Navy

⟩ (**b**) Rank of Major General in Indian Army is equivalent to Rear Admiral in Indian Navy and Air Vice-Marshal in Indian Air Force.

160. Among the operational Indian satellites, there is no
(a) Communication satellite
(b) Navigation satellite
(c) Earth observation satellite
(d) Jupiter orbiter satellite

⟩ (**d**) Among Indian satellites there is no Jupiter orbiter satellites

Type of Satellite	Name
Communication satellite	GSAT 15
Navigation satellite	IRNSS 1E
Earth observation satellite	Bhuban

161. The *Lilavati* of Bhaskara is a standard text on
(a) Mathematics
(b) Surgery
(c) Peotics
(d) Linguistics

⟩ (**a**) The *Lilavati* is Indian mathematician Bhaskara-II's treatise on Mathematics, written in 1150. It is the first volume of his main work '*Siddhanta Shiromani*' alongside the *Bijaganita*, the *Grahaganita* and *Goladhyaya*.

2015 (II)

162. Government of which one of the following states has (in May 2015) decided to withdraw the Armed Forces (Special Powers) Act from the state?
(a) Tripura
(b) Assam
(c) Nagaland
(d) Arunachal Pradesh

⟩ (**a**) The Tripura Government decided to lift Armed Forces Special Power Act (AFSPA) from the state, where the controversial law was in effect for the last 18 years to curb insurgency.

163. Which one of the following is not a component of the Realist Theory?
(a) The state is the pre-eminent actor
(b) State sovereignty is important for the affirmation of judical authority over territory
(c) The primary objective of all states is survival
(d) Survival can be assured in cooperation with international organisations

⟩ (**d**) Survival of all states can be assured in cooperation with international organisations is not a component of the Realist Theory.

The three important component of Realist Theory of international relation are:

Statism Realists believe that nation states are the main actors in international politics.

Survival Realists believe that the international system is governed by anarchy, meaning that there is no central authority. Therefore, international politics is a struggle for power between self-interested states.

Self-help Realists believe that no other states can be relied upon to help guarantee the states survival.

164. Khan Saheb Osman Ali Stadium is located at
(a) Karachi
(b) Dhaka
(c) Fatullah
(d) Chittagong

⟩ (**c**) Khan Saheb Osman Ali Stadium is a cricket stadium located in Fatullah, Narayanganj in Central Bangladesh.

It has a capacity of around 25000 people. The field dimension is 181 m × 145 m.

165. 31st May is celebrated as 'World No Tobacco Day' by the World Health Organisation. Which one of the following was the theme of the 'World No Tobacco Day 2015'?

(a) Raise taxes on tobacco
(b) Stop illicit trade of tobacco products
(c) Ban tobacco advertising, promotion and sponsorship
(d) Tobacco free youth

⊙ (**b**) 31st May is celebrated as 'World No Tobacco Day' by the World Health Organisation. The theme of the 2019 World tabacco day was ''Tabacco and Lung Health.''

World No Tobacco Day, 2015 theme was 'Stop illicit trade of tobacco products'—the campaign will focus on getting countries to work together to stop illicit tobacco trade.

166. 'Red Flag' is the name of a joint exercise between India and which one of the following countries?

(a) China
(b) Saudi Arabia
(c) The USA
(d) Japan

⊙ (**c**) The Red Flag exercise is held every 3 months for a duration of around 2 weeks, and it generally involves NATO allies of the USA.

167. Who among the following is the author of the autobiography entitled *Amar Katha* (1913)?

(a) Satyajit Ray
(b) Rassundari Devi
(c) Ganesh Chandra Ghosh
(d) Binodini Dasi

⊙ (**d**) Binodini Dasi also known as 'Notee Binodini', was a Bengali-speaking she renowned actress and thespian. She wrote her noted autobiography, *Amar Katha* (The Story of My Life) which was published in 1913.

168. The *Dashakumaracharita* or *Tales of Ten Princes* was composed by

(a) Bhatti
(b) Banabhatta
(c) Bhasa
(d) Dandin

⊙ (**d**) *Dashakumaracharita* is considered as an attempt by Dandin to teach the doctrines of the Nitishastra through attractive characterisation. It is a prose romance in Sanskrit.

2015 (I)

169. Notification regarding commencement or cessation of a State of war is the responsibility of

(a) Ministry of Home Affairs
(b) Ministry of Defence
(c) Ministry of External Affairs
(d) None of these

⊙ (**c**) Notification regarding commencement or cessation of a state of war is the responsibility of Ministry of External Affairs.

Other responsibilities are extradition of criminals and accused persons from India to foreign and Commonwealth countries and *vice-versa*.

170. Which of the following statement(s) about caste movements in early 20th century Kerala is/are false?

1. Kerala's first modern novel *Indulekha* attacked the social dominance of Nambudiri Brahmans in Kerala.
2. CV Raman Pillai's novel *Marthanda Varma* was written against the exploitation of peasants by Nair landlords.
3. Sree Narayana Guru was one of the founders of the Sree Narayana Dharma Paripalana Yogam that was engaged in the upliftment of the Ezhavas in Kerala.
4. Dr Palpu, the first Ezhava graduate, was one of the founders of the Sree Narayana Dharma Paripalana Yogam that was engaged in the upliftment of the Ezhavas in Kerala.

Select the correct answer using the codes given below

(a) Only 1
(b) 1 and 3
(c) Only 2
(d) 2 and 4

⊙ (**c**) Kerala's first modern novel, Chander Menon's Indulekha (1889), attacked Nambudiri social domination and taraved constraints on romantic love, while CV Raman Pillai's historical novel Marthanda Varma (1891) attempted an evocation of lost Nair

military glory through its hero Ananda Padmanabhan.

The Sree Narayana Dharma Paripalana Yogam (SNDP) was founded in 1903 with the guidance and blessings of Sree Narayana Guru. The SNDP is a charitable society working for the spiritual and educational uplift of the Ezhava community for the past 102 years. Dr Palpu the first Ezhave graduate.

Hence, option (c) is not correct.

171. Which one among the following was the theme of the International Day for the Preservation of the Ozone Layer 2014?

(a) Ozone Day : A Healthy Atmosphere, The Future We Want
(b) Protecting Our Atmosphere for Generations to Come
(c) HCFC Phase Out : A Unique Opportunity
(d) Ozone Layer Protection : The Mission Goes On

⊙ (**d**) The Theme of the International Day for the Preservation of the Ozone Layer in 2014 was : 'Ozone Layer Protection : The Mission Goes On'.

September 16 was designated by the United Nations General Assembly as the international Day for the preservation of the Ozone layer. The designation had been made on 19th December, 2020. Its the commemoration of the date in 1987 on which nations signed the Montreal Protocol on substances that deplete the ozone layer.

The theme for 2019 International Day for Preservation and Ozone layer was '32 years and Healing'.

172. What was the claim to fame of Dr Dwarkanath Kotnis?

(a) He provided succour to the poor
(b) He set-up hospitals in the difficult to reach regions of India
(c) He was a leading Indian nationalist
(d) He laid down his life providing medical help to the Eighth Route Army

⊙ (**d**) Dwarkanath Shantaram Kotnis was one of five Indian physicians dispatched to China to provide medical assistance during the Second Sino-Japanese War in 1938.

In 1939, Dr Kotnis joined the Eighth Route Army (led by Mao Zedong) at the Jin-Cha-Ji border near the Wutai Mountain area, after his efforts all across the Northern China region.

173. Which among the following teams won the Duleep Trophy Cricket Tournament 2014?

(a) East Zone (b) Central Zone
(c) West Zone (d) South Zone

⊙ (**b**) The Duleep Trophy is a domestic first-class cricket competition played in India between teams representing geographical zones of India.

Central Zone won the Duleep Trophy Cricket Tournament 2014 after defeating South Zone at Feroz Shah Kotla Ground, Delhi. The 2019-20 Duleep Trophy was 58th season. It was won by India Red.

174. What was the common element among (i) GD Birla, (ii) Ambalal Sarabhai and (iii) Walchand Hirachand?

(a) They were leading members of the socialist movement in India
(b) They were Indian industrialists
(c) They were nationalist leaders
(d) All of the above

⊙ (**b**) **Ghanshyam Das Birla** is considered as a doyen of Indian Industry. He was the most important pre-Independence contributor to the Indian National Congress.

Ambalal Sarabhai (1890-1967) was a leading industrialist of Ahmedabad and also played an important role in India's freedom struggle.

He was founder of Sarabhai Group of Companies, like Sarabhai Textiles, Calico Textile Mills, Sarabhai Chemicals and others.

Walchand Hirachand Doshi (23rd November, 1882-18th April, 1953) was an Indian industrialist, founder of Walchand Group of Companies.

He established India's first modern shipyard, first aircraft factory and first car factory besides having established construction companies, sugar plantation, sugar factory, confectionery, engineering companies and many other business.

Hence, option (b) is correct.

175. Which of the following statements is/are correct?

1. 'Yudh Abhyas 2014' was an India-USA military exercise.
2. 'Yudh Abhyas 2014' was conducted in Himachal Pradesh.

Select the correct answer using the codes given below

(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2

⊙ (**a**) Yudh Abhyas, an India-USA military exercise, conducted in

Uttarakhand, has seen combined training between detachments of both armies' special forces as well as given a platform for both sides to share their experiences in UN-mandated counter-insurgency/ counter-terrorism mission.

The 2019 Yudh Abhyas was held at Washington USA.

Hence, only statement (1) is correct.

176. The Central Industrial Security Force is under the administration control of which of the following ministries?

(a) Ministry Heavy Industries and Public Enterprises
(b) Headquarters of the Integrated Joint Staff
(c) Ministry of Home Affairs
(d) PMO

⊙ (**c**) The Central Industrial Security Force (CISF) (established in its present form : 15th June, 1983) is a Central Armed Police Force in India. It is directly under the federal Ministry of Home Affairs and its headquarter is at New Delhi.

It was set-up under an Act of the Parliament of India on 10th March, 1969 with a strength of 2800. CISF was subsequently made an armed force of the Union of India by another Act of Parliament passed on 15th June, 1983. Its current strength is 165000.

The strength will be raised to 200000 over the next 2-3 years. CISF is the largest industrial security force in the world.

177. Which of the following is/are not the characteristic(s) of the First Past The Post (FPTP) system?

1. It is a majoritarian system where minorities are likely to remain unrepresented.
2. A candidate may win an election even if he/she gets less than the majority of the votes cast.
3. It generates proportionality between the votes cast and the seats won.
4. It always leads to a two party system and a stable and accountable government.

Select the correct answer using the codes given below

(a) 3 and 4 (b) 1 and 2
(c) 2 and 3 (d) Only 4

⊙ (**a**) FPTP is the second most widely used voting system in the world, after Party List-PR.

It is a system in which the 'winner takes all' and usually gives a clear majority both at constituency and national level.

This means that a candidate in a constituency only needs one more vote than the nearest rival to win the seat. It is a majoritarian system where minorities are likely to remain unpresented.

Hence, statements (3) and (4) are incorrect.

178. Indian Coast Guard is

(a) a branch of the Indian Navy
(b) an organisation under the Central Board of Excise and Customs
(c) an organisation under the Ministry of Defence
(d) a para-military force under the Ministry of Home Affairs

⊙ (**c**) ICG was formally established on 18th August, 1978 by the Coast Guard Act, 1978 of the Parliament of India as an independent Armed force of India. It operates under the Ministry of Defence.

The Coast Guard works in close cooperation with the Indian Navy, Department of Fisheries, Department of Revenue (Customs) and the Central and State police forces.

Hence, option (c) is correct.

179. Seeking to revive historic ties, the Indian Air Force has gifted a vintage Dakota Aircraft from its museum to (September, 2014)

(a) the Pakistan Air Force
(b) the Bangladesh Air Force
(c) the Chinese Air Force
(d) the Sri Lankan Air Force

⊙ (**b**) Indian Air Force on 18th September, 2014 gifted a vintage Dakota Aircraft from its museum to Bangladesh Air Force.

The Dakota Aircraft was given on a formal request from Bangladesh Air Force to review and revive the historic ties between the two countries.

180. Which one of the following statements is incorrect?

(a) The Armed Forces Tribunal has the power to adjudicate disputes relating to conditions of service of persons subject to the Army Act, 1950

(b) Findings and sentences of court martial can be challenged before the Armed Forces Tribunal

(c) The Chairperson and members of the Armed Forces Tribunal shall be appointed only after consultation with the Chief Justices of India

(d) The Chairperson and members of the Armed Forces Tribunal can be removed only after consultation with the Chief Justice of India

(*d*) The Armed Forces Tribunal Act 2007, was passed by the Parliament and led to the formation of AFT with the power provided for the adjudication or trial of disputes and complaints with respect to commission, appointments, enrolments and conditions of service in respect of persons subject to the Army Act, 1950, The Navy Act, 1957 and the Air Force Act, 1950.

It can further provide a platform for appeals against courts-martial.

The Chairperson and other Members of the Tribunal shall be appointed by the President.

Provided that no appointment under this shall be made except after consultation with the Chief Justice of India.

The Chairperson or a Member shall not be removed from his office except by an order made by the President on the ground of proved misbehaviour or incapacity after an inquiry made by a sitting Judge of the Supreme Court.

Hence, option (d) is not correct.

181. 'And Then One Day : A Memoir' is an autobiography of

(a) Kamal Hasan
(b) Shahrukh Khan
(c) Naseeruddin Shah
(d) Karan Johar

(*c*) 'And Then One day : A Memoir' is an autobiography of Naseeruddin Shah. He has explained his struggle in this autobiography.

2014 (II)

182. Which of the following is/are department(s) in Ministry of Defence?

1. Department of Defence
2. Department of Defence Research and Development
3. Department of Defence Production
4. Department of Defence Finance

Select the correct answer using the codes given below
(a) 1 and 2   (b) 1, 2 and 3
(c) 2, 3 and 4   (d) Only 1

(*b*) Department of Defence (DoD), Defence Research and Development Organisation (DRDO) and Department of Defence Production (DDP) are the departments in Ministry of Defence.

Another department in the same Ministry is Department of Ex-Servicemen Welfare (DESW). Department of Defence Finance is not a department in Ministry of Defence.

Hence, option (b) is correct.

183. Which of the following is/are Paramilitary Force(s) of India?

1. Indian Coast Guard
2. Assam Rifles
3. Directorate General of Resettlement

Select the correct answer using the codes given below
(a) 1, 2 and 3   (b) 1 and 3
(c) Only 2   (d) 1 and 2

(*c*) Para-military forces in India are Assam Rifles led by Indian Army officers reporting to Ministry of Home Affairs and the Special Frontier Force led by Indian Army officers reporting to Indian intelligence.

184. 'Garuda-V', concluded recently, is a joint exercise between the Air Forces of India and

(a) Japan   (b) Canada
(c) Russia   (d) France

(*d*) Garuda-V is a joint exercise between the Air Forces of India and France. It aimed at training the pilots and crew of Indian and French fighters in air superiority operations in Rajasthan's Jodhpur Airbase.

185. 'Arihant' is the name of

(a) an infantry combat vehicle
(b) a ballistic missile
(c) an attack helicopter
(d) a nuclear-powered submarine

(*d*) Arihant, India's first indigenously built nuclear submarine.

It was jointly developed by the Indian Navy, Bhabha Atomic Research Centre (BARC) and Defence Research and Development Organisation (DRDO) at the naval dockyard in Visakhapatnam.

186. Consider the following statements about GAGAN (GPS Aided Geo Augmented Navigation) system:

1. It offers free enhanced satellite navigation signals over India which are ten times more precise than GPS.
2. It was developed jointly by ISRO and NASA

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

(*a*) GPS Aided Geo Augmented Navigation (GAGAN) system is meant for the advancement of air navigation.

The system was launched as a pay load with GSAT-8 in 2011. It was also launched with recently launched GSAT-10.

It will modernise air traffic management and communication navigation surveillance system.

It offers free enhanced satellite navigation signals over india which is ten times more precise than GPS. It was developed by the Airport Authority of India (AAI) with the help of the ISRO.

Hence, only statement (1) is correct.

187. Andaman and Nicobar Command is

(a) a Command of the Indian Army
(b) a regional Command of the Indian Coast Guard
(c) an integrated theatre Command operating directly under the Chiefs of Staff Committee
(d) a joint Command of the Indian Navy and the Indian Air Force

(*c*) The Andaman and Nicobar Command (created in 2001) is a tri-service theatre command of Indian armed forces, based at Port Blair in the Andaman and Nicobar Islands. It is operated directly VI 2019 by the Chiefs of Staff Committee.

188. Which one among the following is not a Command of the Indian Army?

(a) South-Western Command
(b) South-Eastern Command
(c) Army Training Command
(d) Central Command

(*b*) The Army operates six operational commands and one training command. Each command is headed by General Officer Commanding-in-Chief with the rank of Lieutenant General. Each command is directly affiliated to the Army headquarters in New Delhi.

• Central Command (Headquartered at Lucknow)
• Eastern Command (Headquartered at Kolkata)
• Northern Command (Headquartered at Udhampur, J&K),
• Southern Command (Headquartered at Pune, Maharashtra)
• South-Western Command (Headquartered at Jaipur)
• Western Command (Headquartered at Chandi Mandir, Panchkula, Haryana)
• Army Training Command (Headquartered at Shimla) Hence, options (b) is not a command of the Indian Army.

189. Master Chief Petty Officer is a rank in the
(a) Indian Navy
(b) Military Engineering Service
(c) Army Aviation Corps
(d) Indian Air Force

⊙ (**a**) Master Chief Petty Officer is a rank in the Indian Navy.

They are generally of four types— Petty Officer, Chief Petty Officer, Master Chief Petty Officer (2nd class) and Master Chief Petty Officer (1st class). They belong to the sailor category.

190. 'Project Seabird' is connected with
(a) greenfield naval base at West coast of India
(b) anti-pirate operation at Somalia
(c) Indian Navy's island development project
(d) shipyard in Kutch district, Gujarat

⊙ (**a**) Project Seabird is connected with greenfield naval base at West coast of India. It will be one of the largest naval bases of India and will be completed in two phases. It will house various warships including India's largest warship and aircraft carrier INS-Vikramaditya. Once completed, Project Seabird will become the country's biggest naval base by 2025.

191. Consider the following statements about 'Project Mausam':
1. The project was launched in June, 2014 by the Ministry of External Affairs.
2. At the macro level, the project aims to re-connect and re-establish communications between countries of the Indian Ocean world, which would lead to an enhanced understanding of cultural values and concerns; while at the micro level, the focus is on understanding national cultures in their regional maritime milieu.

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ (**b**) Project Mausam is a Ministry of Culture project to be implemented by the Indira Gandhi National Centre for the Arts (IGNCA), New Delhi.
The endeavour of Project Mausam is to position itself at two levels:
• At the macro level, it aims to re-connect and re-establish communications between countries of the Indian Ocean World, which

would lead to an enhanced understanding of cultural values and concerns.
• At the micro level, the focus is on understanding national cultures in their regional maritime milieu.

Hence, only statement (2) is correct.

192. Consider the following statements about Star Alliance network:
1. Established in the year 1997, it is the leading global airline network with the highest number of member airlines, daily flights, destinations and countries flown to.
2. Air India has recently joined the Star Alliance in a bid to garner more revenue.

Which of the statement(s) given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ (**c**) The Star Alliance network is the leading network, with the highest number of airlines, daily flights, destinations and countries flown to.

It was established in 1997 as the first truly global airline alliance to offer customers convenient worldwide reach and a smoother travel experience. Air India is the first Indian airline to join a global alliance in July, 2014.

Hence, both statements are correct.

193. Stepwell *Rani-ki-Vav* was approved as a World Heritage Site by the UNESCO 2014. It is located at
(a) Rajasthan   (b) Gujarat
(c) Madhya Pradesh (d) Maharashtra

⊙ (**b**) Rani-ki-Vav is an stepwell situated in the town of Patan in Gujarat, India. It was added to the list of UNESCO's World Heritage Sites on 22nd June, 2014. Rani-ki-Vav Queen's stepwell was constructed during the rule of the Solanki dynasty.

194. Consider the following statements:
1. World Vitiligo Day is observed on 25th June every year.
2. Vitiligo is a progressive skin disease.

Which of the statements given above is/are correct?
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ (**c**) The World Vitiligo Day, observed on 25th June, is an initiative aimed to build global awareness about vitiligo, a

frequent and often disfiguring disease that can have significant negative psychosocial impact on patients, also because of numerous misconceptions still present in large parts of the world. Vitiligo is an acquired disease characterised by skin depigmentation due to destruction or malfunction of melanocytes.

Hence, both statements are correct.

195. Novak Djokovic, who won the Men's Wimbledon tennis tournament 2014, is from
(a) Serbia
(b) Spain
(c) Switzerland
(d) England

⊙ (**a**) Novak Djokovic (born on 22nd May, 1987) is a Serbian professional tennis player who is currently ranked World No 1 by the Association of Tennis Professionals (ATP). He is considered as one of the greatest tennis players of all time. Novak Djokovic also won the 2019 Australian open title.

196. Match List I with List II and select the correct answer using the codes given below the lists

List I (Founder/First Director)		List II (Premier Research Institute)
A. Vikram Sarabhai	1.	Indian Statistical Institute
B. Homi J. Bhabha	2.	Jawaharlal Nehru Centre for Advanced Scientific Research
C. CNR Rao	3.	Tata Institute of Fundamental Research
D. PC Mahalanobis	4.	Physical Research Laboratory

Codes

	A	B	C	D
(a)	4	3	2	1
(b)	4	2	3	1
(c)	1	3	2	4
(d)	1	2	3	4

⊙ (**a**) PC Mahalanobis set-up the Statistical Laboratory in the Presidency College sometime in the 1920s. On 17th December, 1931, the Indian Statistical Institute was founded as a learned society and housed in the Statistical Laboratory.

Tata Institute of Fundamental Research was founded on 1st June, 1945 by Homi J. Bhabha.

Jawaharlal Nehru Centre for Advanced Scientific Research was founded by CNR Rao and Physical Research Laboratory by Vikram Sarabhai.

Hence, option (a) is correct.

197. Consider the following statements about Pragati Missile System of India

1. It is a short range solid fuel missile system.
2. It has all weather day and night operational launch capability.

Which of the statement(s) given above is/are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ (**c**) India developed a new tactical surface-to-surface missile Pragati which has a range between 60-170 km.

The Pragati missile is based on the Prahaar missile and it has been developed by the DRDO for the Army. It has all weather day and night operational launch capability.

Hence, both the statement are correct.

198. Consider the following statements about UN Frontline Workers Global Leadership Award

1. Martha Dodray, an auxiliary nurse and midwife from Bihar, was conferred the Award in the year 2013.
2. Martha Dodray was awarded for her dedicated service in the bird flu affected areas of India.

Which of the statement(s) given above is/are incorrect?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

⊙ (**b**) UN Frontline Workers Global Leadership Award for year 2013 was given to Martha Dodray, an auxillary nurse from Bihar. She worked in the field of 'polio' eradication.

199. Carefully read the following passage and identify the person referred to in that

Her best known works are *The Golden Notebook, Memoirs of a Survivor* and *The Summer Before the Dark*. She was the oldest recipient of the Nobel Prize in Literature.
(a) Alice Munro
(b) Doris Lessing
(c) Herta Muller
(d) Elfriede Jelinek

⊙ (**b**) Doris Lessing, was a British novelist, playwriter and story teller. She

was awarded Nobel Prize in Literature in year 2007. She has also written books like. The Grass is Singing and the Good Terrorist among many others.

200. The technique of inducing rain from cloud is called
(a) Cloud computing
(b) Cloud control
(c) Cloud engineering
(d) Cloud seeding

⊙ (**d**) Cloud seeding is the technique of inducing rain from a cloud, usually by dropping suitable particles into clouds containing supercooled water in an attempt to cause them to dissipate, modify their structure, or alter the intensity of associated phenomena, such as wind speed or hail.

Cloud seeding got its start in 1946 when Dr. Vincent J. Schaefer, working at the General Electric Laboratory in New York, was involved with research to create artificial clouds in a chilled chamber.

201. Which of the following statements about Prof. CNR Rao is/are correct?

1. He is considered to be an international authority in solid-state and structural chemistry.
2. He is the first Indian to reach the H-index of 100, reflecting the economy of the body of his published research work.

Select the correct answer using the codes given below
(a) Only 1   (b) Only 2
(c) Both 1 and 2   (d) Neither 1 nor 2

⊙ (**c**) Professor CNR Rao is an Indian Chemist who has worked mainly in Solid-state and Structural Chemistry. He currently serves as the Head of the Scientific Advisory Council to the Prime Minister of India.

He has been awarded with Bharat Ratna on 4th February, 2014. He has authored around 1500 research papers and 45 scientific books.

Hence, both statements are correct.

202. Rachel Carson's famous book, *Silent Spring* refers to
(a) geology of terrain where river originates
(b) ecology and degradation of a hot spring due to excessive tourism
(c) biodiversity of an unknown terrain rich in flora and fauna
(d) the death of songbirds due to eating insects poisoned with pesticides

⊙ (**d**) Rachel Carson's book *Silent Spring* argued that uncontrolled use of

pesticides was harming animals, birds and humans.

The book highlighted the death of song birds due to eating insects poisoned with pesticides. The book documented the adverse environmental effects caused by indiscriminate use of pesticides.

2014 (I)

203. The concept of hegemony is used to understand the capacity to 'manufacture consent'. Here, hegemony implies

1. class ascendency in ideological spheres.
2. deploying ideological resources to shape behaviour of weaker states/powers.
3. provision of global public goods by a dominant power.
4. military dominance in relative and absolute terms.

Select the correct answer using the codes given below
(a) 1 and 2
(b) 2 and 3
(c) Only 4
(d) Only 1

⊙ (**b**) To understand the capacity 'manufacture consent' the concept of 'hegemony' is used. Hegemony means deploying ideology to shape behaviour of weaker state/powers and also the provision of global public goods by a dominant power.

There is no role of military dominance in concept of hagemony.

Hence, statement (2) and (3) are correct.

204. Heena Sidhu, who won a World Cup Gold Medal for India in 2014 is associated with
(a) shooting   (b) archery
(c) weightlifting   (d) boxing

⊙ (**a**) Heena Sidhu is an Indian shooter. In 2013, Sidhu became the first Indian Pistol Shooter to win a gold medal in an ISSF World Cup finals when she won the 10 m air pistol event.

In 2014, Sidhu was the World record holder in the 10m air pistol event with a final score of 203.8.

205. Internal Security Academy is located at
(a) Nashik
(b) Mount Abu
(c) Hyderabad
(d) Pune

> (*b*) The Internal Security Academy was set-up in 1975 and is located at Mount Abu, a hill station of Rajasthan, in the Aravali ranges.

It is one of the premier police training institutions in the country, which conducts various in service courses for the officers of the CRPF as well as other police organisations.

206. Indian Navy commissioned its first Advanced Light Helicopter Squadron at Kochi in November 2013. What is the name of the helicopter?

(a) Chetak   (b) Dhruv
(c) Rudra   (d) Cheetah

> (*b*) The first Advanced Light Helicopter (ALH) Squadron, named Dhruv, was commissioned on 12th November, 2013 by Western Naval Command Chief Vice Admiral Shekhar Sinha. It is the first indigenously designed and manufactured helicopter built by the HAL. The newly commissioned squadron would be named as Indian Naval Air Squadron (INAS) 322.

207. Consider the following statements regarding Indian Ocean Rim Association

1. The 13th Council of Ministers meeting of the Association was held in November 2013 in Perth.
2. India was elected Chair of the Association from 2013 to 2015.
3. There are twenty member nations in the Association.

Which of the statement(s) given above is/are correct?

(a) Only 1   (b) Only 2
(c) 1 and 3   (d) All of these

> (*c*) Indian Ocean Rim Association (IORA) is an international organisation consisting of 22 coastal states bordering the Indian Ocean.

The coordinating secretariat of IORA is located at Ebene, Mauritices. 13th Council of Ministers meeting of IORA was held in November 2013 in Perth, Australia. India handed over the chair to Australia in this meeting. IORA has 20 members till now.

Hence, statement (1) and (3) are true.

208. Match the following.

List I (Author)		List II (Concept/Book)
A.	Hobbes	1. Natural Law
B.	Rousseau	2. 'Might is Right'
C.	Locke	3. Discourse on Inequality
D.	Adam Smith	4. The Wealth of Nations

Codes

	A	B	C	D
(a)	2	1	3	4
(b)	2	3	1	4
(c)	4	3	1	2
(d)	4	1	3	2

> (*b*) The Book **Might is Right** was written by Hobbes.

Discourse on Inequality was written by Jean-Jacques Rousseau.

The concept of **Natural Law** was given by Locke.

The Wealth of Nations was written by Adam Smith.

Hence, option (b) is the correct match.

209. Non-military Confidence Building Measures (CBMs) in a peace process include

1. people to people contact across borders.
2. literary and cultural interaction under government and non-governmental agencies.
3. increase in travel facilities.
4. joint initiatives to tackle common socio-economic problems.

Select the correct answer using the codes given below

(a) 2 and 3
(b) 1 and 3
(c) 2 and 4
(d) All of the above

> (*d*) As per non-military confidence building measures, people-to-people contact across borders is encouraged, also cultural interactions, increase in travel facilities and joint socio-economic solutions are taken.

Hence, all the statements are correct.

210. The Union Ministry of Environment and Forest recently approved in principle a proposal for Western Ghats development prepared K Kasturirangan-led panel. The panel has recommended a ban on development activities in around 60000 sq km ecologically sensitive area spread over

(a) Gujarat, Andhra Pradesh, Tamil Nadu, Maharashtra, Kerala and Karnataka
(b) Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu
(c) Odisha, Maharashtra, Goa, Kerala, Andhra Pradesh and Tamil Nadu
(d) Karnataka, Odisha, Gujarat, Kerala, Maharashtra and Tamil Nadu

> (*b*) The Western Ghats, also known as Satyadri are mountain range that covers an area of 140,0 square kilometers in astretch of 1,600 kilometer that run parallel to Western coast of India Peninsula.

The ban on development activities was proposed in the Western states namely Gujarat, Maharashtra, Goa, Karnataka, Kerala and also in Tamil Nadu.

211. Which of the following nations were recently suspended with regard to the voting rights by the UNESCO for not paying their dues to it?

1. USA
2. Israel
3. Iran
4. Iraq

Select the correct answer using the codes given below

(a) 3 and 4
(b) 1 and 2
(c) 2 and 3
(d) All of the above

> (*b*) UNESCO, on 8th November, 2013 suspended the voting rights of the USA and Israel. The suspension happened as the two countries stopped paying the dues to the United Nations cultural arm from two years in the protest over the grant of full membership to the Palestinians.