NIMCET 2014 Previous Year Paper

120 Questions

Que. 1 A password consists of two alphabets from English followed by three numbers chosen from 0 to 3. If repetitions are allowed, the number of different passwords is:

1. $^{26}P_1 \times {}^{26}P_2 \times {}^{4}P_1 \times {}^{3}P_1 \times {}^{2}P_1$
2. $(^{26}P_1)^2 \times (^{4}P_1)^3$
3. $^{26}P_1 \times {}^{26}P_2 \times {}^{4}P_1 \times {}^{4}P_2 \times {}^{4}P_3$
4. $(^{26}P_1 \times {}^{4}P_1)^2$

Testbook Solution Correct Option **- 2**

Concept:

Combinations: The number of ways in which **r** distinct objects can be **selected simultaneously** from a group of **n** distinct objects, is:

$^{n}C_r = \frac{n!}{r!(n-r)!}$.

Permutations: The number of ways in which **r** objects can be **arranged** in **n** places (without repetition) is:

$^{n}P_r = \frac{n!}{(n-r)!}$.

- $^{n}P_r = r! \times {}^{n}C_r$.
  $^{n}P_1 = {}^{n}C_1$.
- $n! = 1 \times 2 \times 3 \times ... \times n$.
- $0! = 1$.

Calculation:

There are a total of 5 symbols: 2 alphabets (out of 26) + 3 numbers (out of 4).

Since repetition is allowed, we will consider the number of arrangements of each symbol individually.

Each of the 2 alphabets can be arranged in $^{26}P_1$ ways and each of the 3 numbers can be arranged in $^{4}P_1$ ways.

Using the basic principle of counting, the total number of arrangements will be:

$^{26}P_1 \times {}^{26}P_1 \times {}^{4}P_1 \times {}^{4}P_1 \times {}^{4}P_1$

$= \mathbf{(^{26}P_1)^2 \times (^{4}P_1)^3}$.

Additional Information

Basic Principle of Counting:

If there are m ways for happening of an event A, and corresponding to each possibility there are n ways for happening of event B, then the total number of different possible ways for happening of events A and B are:

- Either event A alone **OR** event B alone: **m + n**.
- Both event A **AND** event B together: **m × n**.

Que. 2 An equilateral triangle is inscribed in the parabola $y^2 = 4ax$, such that one of the vertices of the triangle coincides with the vertex of the parabola. The length of the side of the triangle is:

1. $a\sqrt{3}$
2. $2a\sqrt{3}$
3. $4a\sqrt{3}$
4. $8a\sqrt{3}$

Testbook Solution Correct Option **- 4**

Concept:

- The distance 'd' between two points (x_1, y_1) and (x_2, y_2) is obtained by using the Pythagoras' Theorem:

  $d^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2$
- If a point (a, b) lies on the curve y = f(x), then b = f(a).
- The general co-ordinates of a point on the parabola $y^2 = 4ax$ will be $(at^2, \pm 2at)$.
- The vertex of the parabola $y^2 = 4ax$ is at the origin (0, 0).

Calculation:

Let's say that an equilateral ΔABC lies on the parabola $y^2 = 4ax$, such that the vertex A coincides with the vertex (0, 0) of the parabola.

Because the parabola $y^2 = 4ax$ is symmetric about the x-axis, we can assume the co-ordinates of the vertices B and C to be $(at^2, 2at)$ and $(at^2, -2at)$ respectively, $t \neq 0$.

Since the ΔABC is equilateral, we must have:

AB = BC

Using the distance formula, we get:

$\Rightarrow (0 - at^2)^2 + (0 - 2at)^2 = (at^2 - at^2)^2 + [2at - (-2at)]^2$

$\Rightarrow a^2t^4 + 4a^2t^2 = 0 + 16a^2t^2$

$\Rightarrow a^2t^4 = 12a^2t^2$

Dividing both sides by $a \neq 0$ and $t \neq 0$, we get:

$\Rightarrow t^2 = 12$ ...(1)

Using the expression for BC above, we have:

$BC^2 = 16a^2t^2$

Using the value from equation (1), we get:

$\Rightarrow BC^2 = 16(12)a^2$.

$\Rightarrow BC = 8a\sqrt{3}$

Hence, the length of each of the sides of the equilateral ΔABC is $8a\sqrt{3}$.

Que. 3 A chain of video stores sells three different brands of DVD players. Of its DVD player sales, 50% are brand 1, 30% are brand 2 and 20% are brand 3. Each manufacturer offers one year warranty on parts and labor. It is known that 25% of brand 1 DVD players require warranty repair work whereas the corresponding percentage for brands 2 and 3 are 20% and 10% respectively. The probability that a randomly selected purchaser has a DVD player that will need repair while under warranty, is:

1. 0.795
2. 0.205
3. 0.125
4. 0.060

Testbook Solution Correct Option **- 2**

Concept:

- The probability of the occurrence of an event A out of a total possible outcomes N, is given by: P(A) = $\frac{n(A)}{N}$, where n(A) is the number of ways in which the event A can occur.
- **Probability of a Compound Event** [(A and B) or (B and C)] is calculated as:
  P[(A and B) or (B and C)] = [P(A) × P(B)] + [P(C) × P(D)]
  (**'and'** means **'×'** and **'or'** means **'+'**)

Calculation:

Let's say that there are 100 DVD players: 50 of brand 1, 30 of brand 2, 20 of brand 3.

The event (E) of purchasing a DVD player that will need repair, can be written as the following compound event:

E = (The player is of brand 1) OR (The player is of brand 2) OR (The player is of brand 3)

∴ The required probability will be:

$P(E) = \frac{n(E)}{N}$

$\Rightarrow P(E) = \frac{(25\% \text{ of } 50)+(20\% \text{ of } 30)+(10\% \text{ of } 20)}{100}$

$\Rightarrow P(E) = \frac{12.5+6+2}{100}$

$\Rightarrow P(E) = \mathbf{0.205}$.

Que. 4 The locus of the intersection of the two lines $\sqrt{3}x - y = 4k\sqrt{3}$ and $k\left(\sqrt{3}x + y\right) = 4\sqrt{3}$, for different values of k, is a hyperbola. The eccentricity of the hyperbola is:

1. 1.5
2. $\sqrt{3}$
3. 2
4. $\frac{\sqrt{3}}{2}$

Testbook Solution Correct Option **- 3**

Concept:

Two curves f(x, y) = 0 and g(x, y) = 0 cut/touch at a point (a, b) if f(a, b) = g(a, b) = 0.

The eccentricity (e) of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is given by: $e = \frac{c}{a} = \sqrt{1 + \frac{b^2}{a^2}}$.

Calculation:

Let's say that the lines are $f(x, y) = \sqrt{3}x - y - 4k\sqrt{3} = 0$ and $g(x, y) = k\sqrt{3}x + ky - 4\sqrt{3} = 0$.

If f(x, y) = 0 and g(x, y) = 0 intersect at a point (a, b), then we must have:

f(a, b) = g(a, b) = 0

$\Rightarrow \sqrt{3}a - b - 4k\sqrt{3} = k\sqrt{3}a + kb - 4\sqrt{3} = 0$

Multiplying the first expression by -k will give us:

$\Rightarrow -k\sqrt{3}a + kb + 4k^2\sqrt{3} = k\sqrt{3}a + kb - 4\sqrt{3} = 0$

$\Rightarrow 2k\sqrt{3}a = 4k^2\sqrt{3} + 4\sqrt{3}$

$\Rightarrow ka = 2k^2 + 2$

$\Rightarrow a = 2\left(\frac{k^2+1}{k}\right)$

Substituting this in f(a, b) = 0 [or g(a, b) = 0], we get:

$\Rightarrow b = \sqrt{3}(a - 4k)$

$\Rightarrow b = \sqrt{3}\left(\frac{2k^2+2}{k} - 4k\right)$

$\Rightarrow b = 2\sqrt{3}\left(\frac{1-k^2}{k}\right)$

It can be observed that

$\left(a\sqrt{3}\right)^2 - b^2 = \left[2\sqrt{3}\left(\frac{k^2+1}{k}\right)\right]^2 - \left[2\sqrt{3}\left(\frac{1-k^2}{k}\right)\right]^2$

$\Rightarrow 3a^2 - b^2 = 12\left(\frac{k^4+2k^2+1-k^4+2k^2-1}{k^2}\right)$

$= 3a^2 - b^2 = 48$

∴ The locus of the point of intersection (a, b) is:

$3x^2 - y^2 = 48$

$\Rightarrow \frac{x^2}{16} - \frac{y^2}{48} = 1$

Comparing this with the general equation of a hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ and using the formula $e = \sqrt{1 + \frac{b^2}{a^2}}$, we have:

$e = \sqrt{1 + \frac{48}{16}} = \sqrt{1+3} = 2.$

Que. 5 Constant forces $\vec{P}$ = 2î - 5ĵ + 6k̂ and $\vec{Q}$ = -î + 2ĵ - k̂ act on a particle. The work done when the particle is displaced from A whose position vector is 4î - 3ĵ - 2k̂, to B whose position vector is 6î + ĵ - 3k̂, is:

1. 10 units.
2. -15 units.
3. -50 units.
4. 25 units.

Testbook Solution Correct Option **- 2**

Concept:

If two points A and B have position vectors $\vec{A}$ and $\vec{B}$ respectively, then the vector $\overrightarrow{AB} = \vec{B} - \vec{A}$.

For two vectors $\vec{A}$ and $\vec{B}$ at an angle θ to each other:

- **Dot Product** is defined as: $\vec{A}.\vec{B} = |\vec{A}||\vec{B}|\cos\theta$.
- **Resultant Vector** is equal $\vec{A} + \vec{B}$.
- **Work:** The work (W) done by a force ($\vec{F}$) in moving (displacing) an object along a vector $\vec{D}$ is given by: $W = \vec{F}.\vec{D} = |\vec{F}||\vec{D}|\cos\theta$.

Calculation:

Let's say that the forces acting on the particle are $\vec{P}$ = 2î - 5ĵ + 6k̂ and $\vec{Q}$ = -î + 2ĵ - k̂.

∴ The resulting force acting on the particle will be $\vec{F} = \vec{P} + \vec{Q}$.

$\Rightarrow \vec{F}$ = (2î - 5ĵ + 6k̂) + (-î + 2ĵ - k̂)

$\Rightarrow \vec{F}$ = î - 3ĵ + 5k̂.

Since the particle is moved from the point 4î - 3ĵ - 2k̂ to the point 3î + ĵ - 3k̂, the displacement vector $\vec{\ }$ will be:

$\vec{D} = \overrightarrow{AB} = \vec{B} - \vec{A}$

= (6î + ĵ - 3k̂) - (4î - 3ĵ - 2k̂)

⇒ $\vec{D}$ = 2î + 4ĵ - k̂.

And finally, the work done W will be:

W = $\vec{F}.\vec{D}$ = (î - 3ĵ + 5k̂).(2î + 4ĵ - k̂)

⇒ W = (1)(2) + (-3)(4) + (5)(-1)

⇒ W = 2 - 12 - 5 = **-15 units**.

Que. 6 The value of $\int \sqrt{x}e^{\sqrt{x}}\,dx$ is equal to:

1. $2\sqrt{x} - e^{\sqrt{x}} - 4\sqrt{xe^{\sqrt{x}}} + C$
2. $(2x - 4\sqrt{x} + 4)e^{\sqrt{x}} + C$
3. $(2x + 4\sqrt{x} + 4)e^{\sqrt{x}} + C$
4. $(1 - 4\sqrt{x})e^{\sqrt{x}} + C$

Testbook Solution Correct Option **- 2**

Concept:

Integration by Parts:

$\int f(x)\,g(x)\,dx = f(x)\int g(x)\,dx - \int [f'(x)\int g(x)\,dx]\,dx$.

Integration by substitution:

If we substitute x = f(t), then dx = f'(t) dt and $\int f(x)\,dx = \int f[f(t)]\,f'(t)\,dt$.

- $\int e^x\,dx = e^x + C$.

Calculation:

Let $I = \int \sqrt{x}e^{\sqrt{x}}\,dx$

Substituting $\sqrt{x} = t$, we get:

$\frac{1}{2\sqrt{x}}dx = dt$

⇒ dx = 2t dt

$\therefore I = \int t \times e^t \times 2t\,dt$

Integrating by parts, taking t^2 as the first function and e^t as the second function, we get:

$\Rightarrow I = 2\left[t^2\int e^t\,dt - \int\left(\frac{d}{dt}t^2\int e^t\,dt\right)\,dt\right] + C$

$\Rightarrow I = 2t^2e^t - 4\int te^t\,dt + C$

Integrating $\int te^t\,dt$ by parts, we get:

$\Rightarrow I = 2t^2e^t - 4\left[t\int e^t\,dt - \int\left(\frac{d}{dt}t\int e^t\,dt\right)\,dt\right] + C$

$\Rightarrow I = 2t^2e^t - 4\left(te^t - e^t\right) + C$

$\Rightarrow I = \left(2t^2 - 4t + 4\right)e^t + C$

Back substituting $\sqrt{x} = t$, we get:

$\Rightarrow I = (2x - 4\sqrt{x} + 4)e^{\sqrt{x}} + C$.

Que. 7 For the vectors $\vec{a} = -4\hat{i} + 2\hat{j}$, $\vec{b} = 2\hat{i} + \hat{j}$ and $\vec{c} = 2\hat{i} + 3\hat{j}$, if $\vec{c} = m\vec{a} + n\vec{b}$, then the value of m + n is:

1. $\frac{1}{2}$
2. $\frac{3}{2}$
3. $\frac{5}{2}$
4. $\frac{7}{2}$

Testbook Solution Correct Option **- 3**

Concept:

If two vectors $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$ and $\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$ are equal, then $a_1 = b_1$, $a_2 = b_2$ and $c_1 = c_2$.

Calculation:

We have $\vec{c} = m\vec{a} + n\vec{b}$.

$\Rightarrow 2\hat{i} + 3\hat{j} = m(-4\hat{i} + 2\hat{j}) + n(2\hat{i} + \hat{j})$

$\Rightarrow 2\hat{i} + 3\hat{j} = (-4m + 2n)\hat{i} + (2m + n)\hat{j}$

Equating the scalar coefficients, we get:

$-4m + 2n = 2$ ... (1)

$2m + n = 3$ ... (2)

Multiplying equation (2) by 2 and adding to equation (1), we get:

$4n = 8$

$\Rightarrow n = 2$

Using either of the equations above, we also get:

$m = \frac{1}{2}$

$\therefore m + n = 2 + \frac{1}{2} = \frac{5}{2}$.

Que. 8 The value of $\int_0^{\frac{\pi}{4}} \log(1 + \tan x)\, dx$ is equal to:

1. $\frac{\pi}{4}\log 2$
2. $\frac{\pi}{6}\log 2$
3. $\frac{\pi}{8}\log 2$
4. $\frac{\pi}{2}\log 2$

Testbook Solution Correct Option **- 3**

Concept:

Definite Integral:

If $\int f(x)\, dx = g(x) + C$, then $\int_a^b f(x)\, dx = [g(x)]_a^b = g(b) - g(a)$.

$\int_a^b f(x)\, dx = \int_a^b f(a + b - x)\, dx$.

- $\tan\left(\frac{\pi}{4} - x\right) = \frac{1-\tan x}{1+\tan x}$.

Calculation:

Let $I = \int_0^{\frac{\pi}{4}} \log(1 + \tan x)\, dx$.

Using $\int_a^b f(x)\,dx = \int_a^b f(a+b-x)\,dx$, we get:

$\Rightarrow I = \int_0^{\frac{\pi}{4}} \log\left[1+\tan\left(\frac{\pi}{4}-x\right)\right] dx$

$\Rightarrow I = \int_0^{\frac{\pi}{4}} \log\left(1+\frac{1-\tan x}{1+\tan x}\right) dx$

$\Rightarrow I = \int_0^{\frac{\pi}{4}} \log\left(\frac{2}{1+\tan x}\right) dx$

$\Rightarrow I = \int_0^{\frac{\pi}{4}} (\log 2)\ dx - \int_0^{\frac{\pi}{4}} \log(1+\tan x)\,dx$

$\Rightarrow I = (\log 2)\int_0^{\frac{\pi}{4}} 1\,dx - I$

$\Rightarrow 2I = (\log 2)\,[x]_0^{\frac{\pi}{4}}$

$\Rightarrow 2I = (\log 2)\left(\frac{\pi}{4}\right)$

$\Rightarrow I = \frac{\pi}{8}\log 2.$

Additional Information

If f(x) = f(2a - x), then $\int_0^{2a} f(x)\,dx = 2\int_0^a f(x)\,dx$.

Que. 9 The number of ways in which 5 days can be chosen in each of the 12 months of a non-leap year, is:

1. $({}^{30}C_5)^4 \times ({}^{31}C_5)^7 \times ({}^{28}C_5)$
2. $({}^{30}C_5)^6 \times ({}^{28}C_5)^6$
3. $({}^{30}C_5)^7 \times ({}^{31}C_5)^4 \times ({}^{28}C_5)$
4. $({}^{30}C_5)^5 \times ({}^{31}C_5)^6 \times ({}^{28}C_5)$

Testbook Solution Correct Option **- 1**

Concept:

- There are 29 days in the month of February in a leap year and 28 days in a non-leap year. Other months have either 30 or 31 days.
- The number of ways in which r distinct objects can be selected from a group of n distinct objects, is:

  ${}^nC_r = \frac{n!}{r!(n-r)!}$.

  $n! = 1 \times 2 \times 3 \times \ldots \times n$.

  $0! = 1$.

Calculation:

The months and their number of days, in a non-leap year, are listed in the following table:

Month	Number of days
January	31
February	28
March	31
April	30
May	31
June	30

July	31
August	31
September	30
October	31
November	30
December	31

There are 1 month with 28 days, 4 months with 30 days and 7 months with 31 days.

The required number of selecting 5 days from each of them would be:

$({}^{30}C_5)^4 \times ({}^{31}C_5)^7 \times ({}^{28}C_5)$

Que. 10 If [x] represents the greatest integer not exceeding x, then $\int_0^9 [x]\, dx$ is

1. 32
2. 36
3. 40
4. 28

Testbook Solution Correct Option **- 2**

Concept:

Definite Integral:

If $\int f(x)\, dx = g(x) + C$, then $\int_a^b f(x)\, dx = [g(x)]_a^b = g(b) - g(a)$.

- $\int_a^b f(x)\, dx = \int_a^c f(x)\, dx + \int_c^b f(x)\, dx$.
- $\sum n = \frac{n(n+1)}{2}$.

Calculation:

[x] is a multi-valued function in the interval 0-9, with:

[x] = 0, x ∈ (0, 1)

[x] = 1, x ∈ (1, 2)

[x] = 2, x ∈ (2, 3)

And so on.

$\therefore \int_0^9 [x]\, dx$

$= \int_0^1 0\, dx + \int_1^2 1\, dx + \ldots + \int_8^9 8\, dx$

$= 0[x]_0^1 + 1[x]_1^2 + \ldots + 8[x]_8^9$

= 0[1 - 0] + 1[2 - 1] + ... + 8[9 - 8]

= 0 + 1 + 2 + ... + 8

$= \frac{8(8+1)}{2}$

= 36.

Que. 11 In a group of 200 students, the mean and the standard deviation of scores were found to be 40 and 15, respectively. Later on it was found that the two scores 43 and 35 were misread as 34 and 53,

respectively. The corrected mean of scores is:

1. 40.965
2. 39.035
3. 39.965
4. 40.035

Testbook Solution Correct Option **- 3**

Concept:

- **Average/Mean:** Mean of 'n' observations = $\overline{x} = \frac{\text{Sum of Observations}}{n}$.
- If some values are changed/added/removed, then $\text{Average}_{new} = \text{Average}_{old}$ + (Average of the change), where the "Average of the change" is calculated for the final total number of objects.

Calculation:

Here, the final number of students is 200 (no change).

The change in the value is: (43 - 34) + (35 - 53) = 11 - 18 = -7.

Using $\text{Average}_{new} = \text{Average}_{old}$ + (Average of change), we have:

$\text{Average}_{new} = 40 + \left(\frac{-7}{200}\right)$

= 40 - 0.035

= **39.965**

Que. 12 If the matrix $\begin{bmatrix} -1 & 3 & 2 \\ 1 & K & -3 \\ 1 & 4 & 5 \end{bmatrix}$ has an inverse matrix, then the value of K is:

1. K is any real number.
2. $K \neq -4$.
3. K = -4.
4. $K \neq 4$.

Testbook Solution Correct Option **- 2**

Concept:

A matrix whose determinant is NOT equal to 0, is invertible.

Calculation:

Let $[A] = \begin{bmatrix} -1 & 3 & 2 \\ 1 & K & -3 \\ 1 & 4 & 5 \end{bmatrix}$.

The determinant of A is:

$\Rightarrow |A| = \begin{vmatrix} -1 & 3 & 2 \\ 1 & K & -3 \\ 1 & 4 & 5 \end{vmatrix}$

Using $R_2 \rightarrow R_1 + R_2$ and $R_3 \rightarrow R_1 + R_3$, we get:

$$\Rightarrow |A| = \begin{vmatrix} -1 & 3 & 2 \\ 0 & K+3 & -1 \\ 0 & 7 & 7 \end{vmatrix}$$

Using $C_2 \rightarrow C_2 - C_3$, we get:

$$\Rightarrow |A| = \begin{vmatrix} -1 & 1 & 2 \\ 0 & K+4 & -1 \\ 0 & 0 & 7 \end{vmatrix}$$

Using R3 ↔ R1, we get:

$$\Rightarrow -|A| = \begin{vmatrix} 0 & 0 & 7 \\ 0 & K+4 & -1 \\ -1 & 1 & 2 \end{vmatrix}$$

Expanding along R_1, we get:

$\Rightarrow -|A| = 0 + 0 + 7[0 - (-1)(K + 4)]$

$\Rightarrow |A| = -(K + 4)$

For the matrix to be invertible, determinant of A must be non zero:

$\Rightarrow |A| = -(K + 4) \neq 0$

$\Rightarrow$ **K ≠ -4**.

Que. 13 The mean deviation from the mean of the AP a, a + d, a + 2d, ..., a + 2nd, is:

1. $\frac{n}{n+1}d$
2. $\frac{n}{2n+1}d$
3. $\frac{n+1}{2n+1}d$
4. $\frac{n(n+1)}{2n+1}d$

Testbook Solution Correct Option **- 4**

Concept:

- The deviation an observation x_i from the mean $\bar{x}$, is simply the difference $(\bar{x} - x_i)$.
- **Arithmetic Progression (AP):** The series of numbers where the difference of any two consecutive terms is the same, is called an Arithmetic Progression.
- The mean of an AP is also the mean of the first and the last terms, or of any two terms equidistant from the first and the last terms.

Calculation:

The mean of the given AP will be: $\frac{\text{First Term} + \text{Last Term}}{2}$.

$= \frac{(a)+(a+2nd)}{2}$

$= a + nd$

Since the terms are equidistant, the magnitude of the deviations of each term less than the mean will be the same as the magnitude of the deviations of the terms more than the mean.

$\therefore$ Mean deviation $= \frac{\text{Sum of the magnitudes of the deviations}}{\text{Number of observations}}$

$= \frac{2\times[(n)d+(n-1)d+...+(1)d+(0)d]}{2n+1}$

$= \frac{2\times\left[\frac{n(n+1)}{2}d\right]}{2n+1}$

$= \frac{n(n+1)}{2n+1}d.$

Que. 14 If (x_0, y_0) is the solution of the equations $(2x)^{\ln 2} = (3y)^{\ln 3}$ and $3^{\ln x} = 2^{\ln y}$, then x_0 is:

1. $\frac{1}{6}$
2. $\frac{1}{3}$
3. $\frac{1}{2}$
4. 6

Testbook Solution Correct Option **- 3**

Concept:

- **Logarithms:** If $a^x = b$, then we say that $\log_a b = x$.
  $\log (ab) = \log a + \log b$.

Calculation:

Let's say that $\ln 2 = a$ and $\ln 3 = b$.

$(2x)^{\ln 2} = (3y)^{\ln 3}$

$(2x)^a = (3y)^b$

Taking the natural log of both the sides, we get:

$\Rightarrow a (\ln 2x) = b (\ln 3y)$

$\Rightarrow a (\ln 2 + \ln x) = b (\ln 3 + \ln y)$

$\Rightarrow a (a + \ln x) = b (b + \ln y)$

$\Rightarrow a^2 + a \ln x = b^2 + b \ln y$

$\Rightarrow a \ln x - b \ln y = b^2 - a^2$ ... (1)

$3^{\ln x} = 2^{\ln y}$

Taking the natural log of both the sides, we get:

$\Rightarrow (\ln x)(\ln 3) = (\ln y)(\ln 2)$

$\Rightarrow \ln y = \frac{b}{a}(\ln x)$ ... (2)

Substituting the value from equation (2) in equation (1), we get:

$\Rightarrow a \ln x - b \times \frac{b}{a}(\ln x) = b^2 - a^2$

$\Rightarrow (\ln x)(a^2 - b^2) = a(b^2 - a^2)$

$\Rightarrow \ln x = -a = -\ln 2$

$\Rightarrow \ln x = \ln 2^{-1}$

$\Rightarrow x = 2^{-1} = \frac{1}{2}$.

Therefore, the solution x_0 is $\frac{1}{2}$.

Que. 15 The value of $\tan 1° \tan 2° \tan 3° \ldots \tan 89°$ is:

1. 0
2. $\frac{1}{\sqrt{2}}$
3. 1
4. 2

Testbook Solution Correct Option **- 3**

Concept:

- tan (90° - θ) = cot θ.
- tan θ × cot θ = 1.
- tan 45° = 1.

Calculation:

The given expression tan 1° tan 2° tan 3° ... tan 89° can be written as:

= (tan 1° tan 2° ... tan 44°) tan 45° (tan 46° tan 47° ... tan 89°)

= (tan 1° tan 2° ... tan 44°) tan 45° [tan (90° - 44°) tan (90° - 43°) ... tan (90° - 1°)]

= (tan 1° tan 2° ... tan 44°) tan 45°(cot 44° cot 46° ... cot 1°)

Since tan θ cot θ = 1 and tan 45° = 1, we get:

= **1**.

Que. 16 If α and β are the roots of the equation $2x^2 + 2px + p^2 = 0$, where p is a non-zero real number, and α^4 and β^4 are the roots of $x^2 - rx + s = 0$, then the roots of $2x^2 - 4p^2x + 4p^4 - 2r = 0$ are:

1. Real and unequal.
2. Equal and zero.
3. Imaginary.
4. Equal and non-zero.

Testbook Solution Correct Option **- 3**

Concept:

The solution to the quadratic equation $Ax^2 + Bx + C = 0$ can also be given by: $x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$.

The quantity $B^2 - 4AC$ is also called the discriminant.

- If $B^2 - 4AC \geq 0$, the roots are real.
- If $B^2 - 4AC = 0$, the roots are real and equal.
- If $B^2 - 4AC < 0$, the roots will be complex and conjugates of each other.

The sum of both the roots of the quadratic equation $Ax^2 + Bx + C = 0$ is $-\frac{B}{A}$ and the product of the roots is $\frac{C}{A}$.

Calculation:

Using the expressions for the sum and the product of the roots, we have:

$\alpha + \beta = -p$ ... (1)

$\alpha\beta = \frac{p^2}{2}$ ... (2)

$\alpha^4 + \beta^4 = r$ ... (3)

Squaring equation (1), we get:

$\alpha^2 + \beta^2 + 2\alpha\beta = p^2$

Using equation (2), we get:

$\Rightarrow \alpha^2 + \beta^2 = 0$

Squaring again, we get:

$\Rightarrow \alpha^4 + \beta^4 + 2\alpha^2\beta^2 = 0$

Using equations (2) and (3), we get:

$\Rightarrow r = \frac{p^4}{2}$ ... (4)

The discriminant of the equation $2x^2 - 4p^2x + 4p^4 - 2r = 0$ is:

$(-4p^2)^2 - 4(2)(4p^4 - 2r)$

$= 16p^4 - 32p^4 + 16r$

Using equation (4), we get:

$= 16p^4 - 32p^4 + 8p^4$

$= -8p^4$, which is always negative for non-zero real p.

Since the discriminant is < 0, the roots are **imaginary**.

Que. 17 The number of ways to arrange the letters of the English alphabet, so that there are exactly 5 letters between a and b, is:

1. ${}^{24}P_5$
2. ${}^{24}P_5 \times 20!$
3. $2 \times {}^{24}P_5 \times 20!$
4. $2 \times {}^{24}P_5 \times 24!$

Testbook Solution Correct Option **- 3**

Concept:

Combinations: The number of ways in which **r** distinct objects can be **selected simultaneously** from a group of **n** distinct objects, is:

${}^nC_r = \frac{n!}{r!(n-r)!}$.

Permutations: The number of ways in which **r** objects can be **arranged** in **n** places (without repetition) is:

${}^nP_r = \frac{n!}{(n-r)!}$.

- ${}^nP_r = {}^nC_r \times r!$.
- $n! = 1 \times 2 \times 3 \times ... \times n$.
- $0! = 1$.

Calculation:

There are 26 letters in the English alphabet. If we separate the group (a, some 5 letters, b), we will be left with 19 more letters.

These 20 objects (1 group + 19 letters) can be arranged among themselves in 20! ways.

Since either a or b can be at the beginning or the end of the group of 7 letters (a, some 5 letters, b), the number of possible arrangements of the group will be $2 \times ({}^1P_1 \times {}^5P_5 \times {}^1P_1) = 2 \times 5!$.

Also, each group of 5 letters can be selected from the remaining 24 letters (except a and b) in $^{24}C_5$ ways.

Required total number of ways = $(2 \times 5! \times {}^{24}C_5) \times 20!$

= $\mathbf{2 \times {}^{24}P_5 \times 20!}$.

Que. 18 Suppose, the system of linear equations

$-2x + y + z = l$

$x - 2y + z = m$

$x + y - 2z = n$

is such that $l + m + n = 0$, then the system has:

1. A non-zero unique solution.
2. Trivial solution.
3. Infinitely many solutions.
4. No solution.

Testbook Solution Correct Option **- 3**

Concept:

- A system of equations is **consistent** if it has **at least one solution**. An **inconsistent** system has **no solutions**.
- **Rouché–Capelli theorem:** A system of linear equations with **n variables** has a solution **if and only if** the **rank of its coefficient matrix** [A] **is equal to** the **rank of its augmented matrix** [A|B].
  - If n = rank(A) = rank(A|B) and det(A) ≠ 0: consistent; there is a unique solution.
  - If n > rank(A) = rank(A|B) and det(A) = 0: consistent and dependent; there are infinitely many solutions.
  - If rank(A) ≠ rank(A|B): inconsistent; there are no solutions.
- Rank of a matrix A corresponds to the maximal number of linearly independent rows/columns of A. In other words, it is the number of non-zero rows when the matrix is expressed in **row echelon form** (all rows consisting of only zeroes are at the bottom).

Calculation:

The coefficient matrix for the given system of equations is:

$$[A] = \begin{bmatrix} -2 & 1 & 1 \\ 1 & -2 & 1 \\ 1 & 1 & -2 \end{bmatrix}$$

The augmented matrix will be:

$$[A|B] = \left[\begin{array}{ccc|c} -2 & 1 & 1 & l \\ 1 & -2 & 1 & m \\ 1 & 1 & -2 & n \end{array}\right]$$

In order to find the rank of both the matrices, lets convert into row echelon form using the following elementary row operations:

$R_3 \rightarrow R_1 + R_2 + R_3$

$$[A|B] = \left[\begin{array}{ccc|c} -2 & 1 & 1 & l \\ 1 & -2 & 1 & m \\ 0 & 0 & 0 & l+m+n \end{array}\right]$$

Since l + m + n = 0 (given), we have rank(A) = rank(A|B) = 2 which is less than the number of variables 3.
Therefore, there are **infinitely many solutions**.

Additional Information

On further reduction, we get:

$$[A|B] = \begin{bmatrix} -2 & 1 & 1 & | & l \\ 1 & -2 & 1 & | & m \\ 0 & 0 & 0 & | & l+m+n \end{bmatrix}$$

$R_2 \rightarrow R_1 + 2R_2$

$$[A|B] = \begin{bmatrix} -2 & 1 & 1 & | & l \\ 0 & -3 & 3 & | & l+2m \\ 0 & 0 & 0 & | & 0 \end{bmatrix}$$

$R_1 \rightarrow 3R_1 + R_2$

$$[A|B] = \begin{bmatrix} -6 & 0 & 3 & | & 4l+2m \\ 0 & -3 & 3 & | & l+2m \\ 0 & 0 & 0 & | & 0 \end{bmatrix}$$

The solution is $y = -\frac{2m}{3} - \frac{n}{3} + x$ and $z = -\frac{m}{3} - \frac{2n}{3} + x$.

Que. 19 If $\vec{A} = 4\hat{i} + 3\hat{j} + \hat{k}$ and $\vec{B} = 2\hat{i} - \hat{j} + 2\hat{k}$, then the unit vector $\hat{N}$ perpendicular to the vectors $\vec{A}$ and $\vec{B}$, such that $\vec{A}$, $\vec{B}$ and $\hat{N}$ form a right handed system, is:

1. $\frac{1}{\sqrt{185}}\left(7\hat{i} - 6\hat{j} - 10\hat{k}\right)$
2. $\frac{1}{7}\left(6\hat{i} + 2\hat{j} + 3\hat{k}\right)$
3. $\frac{1}{\sqrt{21}}\left(2\hat{i} + 4\hat{j} - \hat{k}\right)$
4. $\frac{1}{\sqrt{21}}\left(-2\hat{i} - 4\hat{j} + \hat{k}\right)$

Testbook Solution Correct Option **- 1**

Concept:

- **Cross Product:** For two vectors $\vec{A}$ and $\vec{B}$ at an angle θ to each other, the cross product is defined as: $\vec{A} \times \vec{B} = \vec{n}|\vec{A}||\vec{B}| \sin\theta$, where $\vec{n}$ is the unit vector perpendicular to the plane containing the vectors $\vec{A}$ and $\vec{B}$.
- If $\vec{A} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$ and $\vec{B} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$, then their cross product is:
  $$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}.$$
- The unit vector $\vec{u}$ in the direction of a vector $\vec{A}$, can be calculated as:
  $\vec{u} = \frac{\vec{A}}{|\vec{A}|}$, where $|\vec{A}|$ is the magnitude (length) of the vector $\vec{A}$.

Calculation:

We have $\vec{A} = 4\hat{i} + 3\hat{j} + \hat{k}$ and $\vec{B} = 2\hat{i} - \hat{j} + 2\hat{k}$. Therefore, their cross product will be:

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & 3 & 1 \\ 2 & -1 & 2 \end{vmatrix}$$

Expanding along R_1, we get:

$= (6 + 1)\hat{i} + (2 - 8)\hat{j} + (-4 - 6)\hat{k}$

$= 7\hat{i} - 6\hat{j} - 10\hat{k}$

The magnitude of $\vec{A} \times \vec{B}$ is:

$$\left|\vec{A} \times \vec{B}\right| = \sqrt{7^2 + (-6)^2 + (-10)^2}$$

$= \sqrt{49 + 36 + 100}$

$= \sqrt{185}$

The unit vector $\hat{N}$ along $\vec{A} \times \vec{B}$ will be:

$$\hat{N} = \frac{\vec{A} \times \vec{B}}{\left|\vec{A} \times \vec{B}\right|}$$

$$\Rightarrow \hat{N} = \frac{1}{\sqrt{185}}\left(7\hat{i} - 6\hat{j} - 10\hat{k}\right).$$

Que. 20 The value of $\int \frac{(x+1)}{x(xe^x+1)}\,dx$ is equal to:

1. $\log\left(\frac{1+xe^x}{xe^x}\right) + C$
2. $\log[xe^x(1 + xe^x)] + C$
3. $\log\left(\frac{1}{1+xe^x}\right) + C$
4. $\log\left(\frac{xe^x}{1+xe^x}\right) + C$

Testbook Solution Correct Option **- 4**

Concept:

Integration by substitution:

If we substitute x = f(t), then dx = f'(t) dt and $\int f(x)\,dx = \int f[f(t)]\,f'(t)\,dt$.

Calculation:

Let $I = \int \frac{(x+1)}{x(xe^x+1)}\,dx$.

Let's substitute $xe^x + 1 = t$.

$\Rightarrow (xe^x + e^x)dx = dt$

$\Rightarrow e^x(x + 1)dx = dt$

Now, $I = \int \frac{1}{(xe^x)t}\,dt$

$\Rightarrow I = \int \frac{1}{(t-1)t}\,dt$

$\Rightarrow I = \int \frac{(1-t)+t}{(t-1)t}\,dt$

$\Rightarrow I = \int \frac{1}{t-1}\,dt - \int \frac{1}{t}\,dt$

$\Rightarrow I = \log(t - 1) - \log t + C$

$\Rightarrow I = \log\left(\frac{t-1}{t}\right) + C$

Substituting back $xe^x + 1 = t$, we get:

$\Rightarrow I = \log\left(\frac{xe^x}{1+xe^x}\right) + C.$

Que. 21 The sum of two vectors $\vec{a}$ and $\vec{b}$ is a vector $\vec{c}$ such that $|\vec{a}| = |\vec{b}| = |\vec{c}| = 2$. Then, the magnitude of $\vec{a} - \vec{b}$ is equal to:

1. $2\sqrt{3}$
2. 2
3. $\sqrt{3}$
4. 0

Testbook Solution Correct Option **- 1**

Concept:

Dot Product of two vectors $\vec{A}$ and $\vec{B}$ is defined as $\vec{A}.\vec{B} = |\vec{A}||\vec{B}|\cos\theta$, where $|\vec{A}|$ is the magnitude of vector $\vec{A}$.

$\vec{A}.\vec{A} = |\vec{A}|^2$.

Calculation:

We are given that "sum of two vectors $\vec{a}$ and $\vec{b}$ is a vector $\vec{c}$".

$\Rightarrow \vec{a} + \vec{b} = \vec{c}$

Taking dot product of both sides with themselves, the magnitudes will still be equal:

$\Rightarrow (\vec{a} + \vec{b}) . (\vec{a} + \vec{b}) = (\vec{c}) . (\vec{c})$

$\Rightarrow |\vec{a}|^2 + |\vec{b}|^2 + 2\vec{a}.\vec{b} = |\vec{c}|^2$

Since $|\vec{a}| = |\vec{b}| = |\vec{c}| = 2$, we get:

$\Rightarrow 2^2 + 2^2 + 2\vec{a}.\vec{b} = 2^2$

$\Rightarrow 4 + 4 + 2\vec{a}.\vec{b} = 4$

$\Rightarrow 2\vec{a}.\vec{b} = -4$

Now, $|\vec{a} - \vec{b}|^2 = (\vec{a} - \vec{b}) . (\vec{a} - \vec{b})$

$= |\vec{a}|^2 + |\vec{b}|^2 - 2\vec{a}.\vec{b}$

= 4 + 4 - (-4)

= 12

$\Rightarrow |\vec{a} - \vec{b}| = \sqrt{12} = 2\sqrt{3}.$

Que. 22 If x and y are positive real numbers satisfying the system of equations $x^2 + y\sqrt{xy} = 336$ and $y^2 + x\sqrt{xy} = 112$, then x + y is:

1. $\sqrt{448}$
2. $\sqrt{224}$

3. 20
4. 40

Testbook Solution Correct Option **- 3**

Concept:

Simultaneous equations of degree not equal to 1 (not linear) can be solved comparatively easily by elimination/substitution.

Calculation:

It is given that $x^2 + y\sqrt{xy} = 336$.

Dividing by $\sqrt{x}$, we get:

$\Rightarrow x\sqrt{x} + y\sqrt{y} = \frac{336}{\sqrt{x}}$ ... (1)

It is also given that $y^2 + x\sqrt{xy} = 112$.

Dividing by $\sqrt{y}$, we get:

$\Rightarrow y\sqrt{y} + x\sqrt{x} = \frac{112}{\sqrt{y}}$ ... (2)

From equations (1) and (2), we get:

$\Rightarrow \frac{336}{\sqrt{x}} = \frac{112}{\sqrt{y}}$

$\Rightarrow 3\sqrt{y} = \sqrt{x}$ ... (3)

Squaring both sides, we get:

$\Rightarrow 9y = x$ ... (4)

Substituting values from equations (3) and (4) in equation (1) [or equation (2)], we get:

$\Rightarrow 9y\left(3\sqrt{y}\right) + y\sqrt{y} = \frac{336}{3\sqrt{y}}$

$\Rightarrow 81y^2 + 3y^2 = 336$

$\Rightarrow 84y^2 = 336$

$\Rightarrow y^2 = 4$

Since x and y are positive real numbers, we must have y = 2, and using equation (4) we get x = 18.

$\therefore x + y =$ **20**.

Que. 23 From three collinear points A, B and C on a level ground, which are on the same side of a tower, the angles of elevation of the top of the tower are 30°, 45° and 60° respectively. If BC = 60 m, then AB is:

1. $15\sqrt{3}$ m
2. $30\sqrt{3}$ m
3. $45\sqrt{3}$ m
4. $60\sqrt{3}$ m

Testbook Solution Correct Option **- 4**

Concept:

Trigonometry:

- In a right-angled triangle with length of the side opposite to angle θ as perpendicular (P), base (B) and hypotenuse (H):
  $\sin\theta = \frac{P}{H}$, $\cos\theta = \frac{B}{H}$, $\tan\theta = \frac{P}{B}$.

  $P^2 + B^2 = H^2$ (Pythagoras' Theorem).

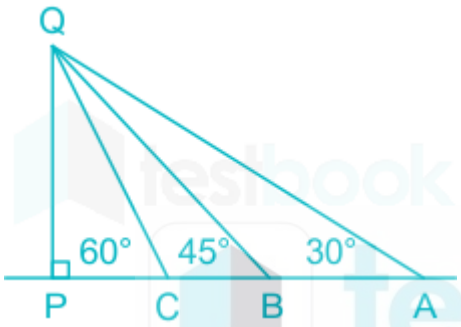
Values of Trigonometric Ratios for Common Angles:

	0°	30°	45°	60°	90°
sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	∞
csc	∞	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	∞
cot	∞	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

Calculation:

It can be noted that the angle of elevation from closer points is more than the angle from farther points.

The position of the three points is shown in the following diagram:



Using the definition of trigonometric ratio tan θ:

$AP = \frac{QP}{\tan 30^\circ} = \sqrt{3}QP$

$BP = \frac{QP}{\tan 45^\circ} = QP$

$CP = \frac{QP}{\tan 60^\circ} = \frac{QP}{\sqrt{3}}$

It is given that BC = 60 m.

$\Rightarrow BP - CP = 60$

$\Rightarrow QP - \frac{QP}{\sqrt{3}} = 60$

$\Rightarrow QP = \frac{60\sqrt{3}}{\sqrt{3}-1}$

Now, AB = AP - BP

$= \sqrt{3}QP - QP$

$= QP\left(\sqrt{3} - 1\right)$

$= \frac{60\sqrt{3}}{\sqrt{3}-1}\left(\sqrt{3} - 1\right)$

$= 60\sqrt{3}$ m

Que. 24 If x = 1 is the directrix of the parabola $y^2 = kx - 8$, then k is:

1. $\frac{1}{8}$
2. 8
3. 4
4. $\frac{1}{4}$

Testbook Solution Correct Option **- 3**

Concept:

The directrix of a parabola whose is equation is of the form $(y - q)^2 = 4a(x - p)$, is the line $x = p - a$.

Calculation:

The given equation of the parabola $y^2 = kx - 8$ can be re-written as:

$\Rightarrow (y - 0)^2 = 4\left(\frac{k}{4}\right)\left(x - \frac{8}{k}\right)$

Comparing the above equation with the general form of the equation $(y - q)^2 = 4a(x - p)$, we have:

$q = 0, a = \frac{k}{4}, p = \frac{8}{k}$.

The equation of the directrix is:

$x = p - a$

$\Rightarrow x = \frac{8}{k} - \frac{k}{4}$

According to the question, $x = 1$ is the directrix.

$\therefore \frac{8}{k} - \frac{k}{4} = 1$

$\Rightarrow k^2 + 4k - 32 = 0$

$\Rightarrow k^2 + 8k - 4k - 32 = 0$

$\Rightarrow k(k + 8) - 4(k + 8) = 0$

$\Rightarrow (k + 8)(k - 4) = 0$

$\Rightarrow k + 8 = 0$ OR $k - 4 = 0$

$\Rightarrow k = \mathbf{-8}$ OR $k = \mathbf{4}$.

Que. 25 If $\sin x + a \cos x = b$, then $|a \sin x - \cos x|$ is:

1. $\sqrt{a^2 + b^2 + 1}$
2. $\sqrt{a^2 - b^2 + 1}$
3. $\sqrt{a^2 + b^2 - 1}$
4. None of the above.

Testbook Solution Correct Option **- 2**

Concept:

- $\sin^2 \theta + \cos^2 \theta = 1$.
- $(a \pm b)^2 = a^2 \pm 2ab + b^2$.

Calculation:

$\sin x + a \cos x = b$

$\Rightarrow (\sin x + a \cos x)^2 = b^2$

$\Rightarrow \sin^2 x + a^2 \cos^2 x + 2a \sin x \cos x = b^2$

$\Rightarrow (1 - \cos^2 x) + a^2 \cos^2 x + 2a \sin x \cos x = b^2$ ... [Using $\sin^2 x = 1 - \cos^2 x$]

$\Rightarrow (a^2 - 1) \cos^2 x + 2a \sin x \cos x = b^2 - 1$

$\Rightarrow 2a \sin x \cos x = b^2 - 1 + (1 - a^2) \cos^2 x$ ... (1)

Let $k = |a \sin x - \cos x|$

$\Rightarrow k^2 = (a \sin x - \cos x)^2$

$\Rightarrow k^2 = a^2 \sin^2 x + \cos^2 x - 2a \sin x \cos x$

$\Rightarrow k^2 = a^2 (1 - \cos^2 x) + \cos^2 x - 2a \sin x \cos x$ ... [Using $\sin^2 x = 1 - \cos^2 x$]

$\Rightarrow k^2 = a^2 + (1 - a^2) \cos^2 x - 2a \sin x \cos x$

$\Rightarrow k^2 = a^2 + (1 - a^2) \cos^2 x - [b^2 - 1 + (1 - a^2) \cos^2 x]$ ... [Using equation (1)]

$\Rightarrow k^2 = a^2 - b^2 + 1$

$\Rightarrow k = \sqrt{a^2 - b^2 + 1}.$

$\therefore |a \sin x - \cos x| = \sqrt{a^2 - b^2 + 1}.$

Que. 26 A condition that $x^3 + ax^2 + bx + c$ may have no extremum is

1. $a^2 \geq 3b$
2. $b^2 < 3b$
3. $a^2 < 3b$
4. $b^2 \geq 3b$

Testbook Solution Correct Option **- 3**

Concept:

- The function f(x) has no extremum if, $f'(x) > 0$
- For an equation $ax^2 + bx + c > 0$ at all $x \in R$ if; $a > 0$ and $b^2 - 4ac < 0$

Calculation:

$f(x) = x^3 + ax^2 + bx + c$

$\Rightarrow f'(x) = \frac{d}{dx} (x^3 + ax^2 + bx + c)$

$\Rightarrow f'(x) = 3x^2 + 2ax + b$

For no extremum f'(x) > 0

$\Rightarrow 3x^2 + 2ax + b > 0$

It is possible only if a > 0 and D < 0

$\Rightarrow (2a)^2 - 4 \times 3b < 0$

$\Rightarrow a^2 - 3b < 0$

$\Rightarrow$ **$a^2 < 3b$**

Que. 27 If n and r are integers such that $1 \leq r \leq n$, then the value of $n({}^{n-1}C_{r-1})$ is

1. ${}^nC_r$
2. $r({}^nC_r)$
3. $n({}^nC_r)$
4. $(n - 1)({}^nC_r)$

Testbook Solution Correct Option **- 2**

Concept:

$^{n}C_{r} = \frac{n!}{r! \times (n-r)!}$

Calculation:

$X = n\left(^{n-1}C_{r-1}\right)$

$X = n\left(\frac{(n-1)!}{(r-1)! \times ((n-1)-(r-1))!}\right)$

$X = \frac{n \times (n-1)!}{(r-1)! \times (n-r)!}$

$\mathbf{X = \frac{n!}{(r-1)! \times (n-r)!}}$ ($\because$ n × (n-1)! = n!)

Multiply r to numerator and denominator

$X = \frac{r \times n!}{(r \times (r-1)!) \times (n-r)!}$

$X = r\left(\frac{n!}{r! \times (n-r)!}\right)$ ($\because$ r × (r-1)! = n!)

$\mathbf{X = r\left(^{n}C_{r}\right)}$

Que. 28 If the foci of the ellipse $b^2x^2 + 16y^2 = 16b^2$ and the hyperbola $81x^2 - 144y^2 = \frac{81 \times 144}{25}$ coincide, then the value of b, is

1. 1
2. $\sqrt{5}$
3. $\sqrt{7}$
4. 3

Testbook Solution Correct Option **- 3**

Concept:

The eccentricity of the curve $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is $e^2 = 1 - \left(\frac{b^2}{a^2}\right)$

The eccentricity of the curve $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is $e^2 = 1 + \left(\frac{b^2}{a^2}\right)$

Foci of Hyperbola and Ellipse are (ae, 0) and (ae, 0)

Calculation:

For given Hyperbola $81x^2 - 144y^2 = \frac{81 \times 144}{25}$

$\Rightarrow \frac{25}{144}x^2 - \frac{25}{81}y^2 = 1$

$\therefore a_h{}^2 = \frac{144}{25}$ and $b_h{}^2 = \frac{81}{25}$

Eccentricity of hyperbola

$e_h{}^2 = 1 + \left(\frac{b_h{}^2}{a_h{}^2}\right)$

$\Rightarrow e_h{}^2 = 1 + \left(\frac{81}{144}\right)$

$\Rightarrow e_h{}^2 = \frac{225}{144} \Rightarrow \mathbf{e_h = \frac{15}{12}}$

Focus of hyperbola $F_h = (a_he_h, 0)$, Where e_h is the eccentricity of the hyperbola.

$\Rightarrow F_h = \left(\left(\frac{12}{5} \times \frac{15}{12}\right), 0\right)$

$\Rightarrow$ **$F_h = (3, 0)$**

For given Ellipse $b^2x^2 + 16y^2 = 16b^2$

$\Rightarrow \frac{x^2}{16} + \frac{y^2}{b^2} = 1$

$\therefore {a_e}^2 = 16$ and ${b_e}^2 = b^2$

Focus of ellipse $F_e = (ae, 0) = (4e_e, 0)$, Where e_e is eccentricity of the ellipse.

Given Focus of ellipse $F_e = F_h$

$\Rightarrow (4e_e, 0) = (3, 0)$

$\Rightarrow 4e_e = 3 \Rightarrow e_e = \frac{3}{4}$

Also Eccentricity of an ellipse

${e_e}^2 = 1 - \left(\frac{{b_e}^2}{{a_e}^2}\right)$

$\Rightarrow \left(\frac{3}{4}\right)^2 = 1 - \left(\frac{b^2}{4^2}\right)$

$\Rightarrow 1 - \frac{9}{16} = \frac{b^2}{16}$

$\Rightarrow$ **$b^2 = 7 \Rightarrow b = \sqrt{7}$**

Que. 29 There are 8 students appearing in an examination of which 3 have to appear in Mathematics paper and the remaining 5 in different subjects. Then, the number of ways they can be made to sit in a row, if the candidates in Mathematics cannot sit next to each other is

1. 2400
2. 16200
3. 4200
4. 14400

Testbook Solution Correct Option **- 4**

Calculation:

Given: 8 students appearing in an examination of which 3 have to appear in Mathematics paper and the remaining 5 in different subjects.

There are 5 candidates not appearing in mathematics.
Let us arrange these 5 in a row, each shown by X
They can be arranged in 5! = 120 ways.
On both sides of each X, we put an M, as shown below.
MXMXMXMXMXM

Now, 3 candidates in mathematics can be arranged at 6 places in ${}^6P_3$ ways = 120 ways.

Hence, The total number of arrangements =(120 × 120) = 14400.

Que. 30 If x is so small that x^2 and higher powers of x can be neglected, then $\frac{(9+2x)^{1/2}(3+4x)}{(1-x)^{1/5}}$ is approximately equal to

1. $9 + \frac{74}{15}x$
2. $9 + \frac{74}{5}x$

3. $3 + \frac{74}{15}x$
4. $3 + \frac{74}{5}x$

Testbook Solution Correct Option **- 2**

Concept:

Expansion of $(1 + x)^n$ when n < 1

- $(1 + x)^n = 1 + nx + n(n-1)/2!\ x^2 + ...$

Calculation:

$E = \frac{(9 + 2x)^{1/2}(3 + 4x)}{(1 - x)^{1/5}}$

$\Rightarrow E = (9 + 2x)^{1/2}(3 + 4x)(1 - x)^{-1/5}$

$\Rightarrow E = \left[3(1 + \frac{2}{9}x)^{1/2}\right]\left[3(1 + \frac{4}{3}x)\right](1 - x)^{-1/5}$

Expanding and neglecting higher powers we get;

$\Rightarrow E = 9(1 + \frac{2}{9} \times \frac{1}{2}x)(1 + \frac{4}{3}x)\left(1 - \left(-\frac{1}{5}\right)x\right)$

$\Rightarrow \mathbf{E = 9(1 + \frac{1}{9}x)(1 + \frac{4}{3}x)\left(1 + \frac{1}{5}x\right)}$

Neglecting the higher powers during multiplication

$\Rightarrow E = 9(1 + \frac{1}{9}x + \frac{4}{3}x)\left(1 + \frac{1}{5}x\right)$

$\Rightarrow E = 9(1 + \frac{13}{9}x + \frac{1}{5}x)$

$\Rightarrow E = 9(1 + \frac{74}{45}x)$

$\Rightarrow \mathbf{E = 9 + \frac{74}{5}x}$

Que. 31 If the sets A and B are defined as $A = \{(x, y)|y = 1 / x, 0 \neq x \in R\}$, $B = \{(x, y)|y = -x \in R\}$ then

1. $A \cap B = \phi$
2. $A \cap B = B$
3. $A \cap B = A$
4. None of these

Testbook Solution Correct Option **- 1**

Concept:

Set theory:

- $A \cup B$ means set of all the values in the set A and B.
- $A \cap B$ is the set of common elements of A and B.

Calculation:

Given sets:

$A = \{(x, y)|y = 1 / x, 0 \neq x \in R\}$ and $B = \{(x, y)|y = -x \in R\}$

For any value of $x \in R$ and $x \neq 0$;

In set A element will be **(x, 1/x)**; and in set B will be **(x, - x)**

For A ∩ B;

$\frac{1}{x} = -x$

$\Rightarrow x^2 = -1$

which is not possible for any $x \in R$

$\therefore$ **$A \cap B = \phi$**

Que. 32 If A, B and C is three angles of a ΔABC, whose area is Δ. Let a, b and c be the sides opposite to the angles A, B and C respectively. If $s = \frac{a+b+c}{2} = 6$, then the product $\frac{1}{3}s^2(s-a)(s-b)(s-c)$ is equal to

1. 2Δ
2. $2\Delta^2$
3. $\sqrt{2}\Delta$
4. Δ^2

Testbook Solution Correct Option **- 2**

Concept:

The area of any triangle can be defined as:

$A = \sqrt{s(s-a)(s-b)(s-c)}$

where a, b and c are the sides of the triangle and $s = \frac{a+b+c}{2}$

Calculation:

Given $s = \frac{a+b+c}{2} = 6$

Area of the triangle $= \sqrt{s(s-a)(s-b)(s-c)} = \Delta$

$\Rightarrow s(s-a)(s-b)(s-c) = \Delta^2$

Multiplying both side by s

$\Rightarrow s \times s(s-a)(s-b)(s-c) = s \times \Delta^2$

$\Rightarrow s^2(s-a)(s-b)(s-c) = 6\,\Delta^2$

Multiplying both side by $\frac{1}{3}$

$\Rightarrow$ **$\frac{1}{3}\,s^2(s-a)(s-b)(s-c) = 2\,\Delta^2$**

Que. 33 A normal to the curve $x^2 = 4y$ passes through the point (1, 2). The distance of the origin from the normal is

1. $\sqrt{2}$
2. $2\sqrt{2}$
3. $\frac{1}{\sqrt{2}}$
4. $\frac{3}{\sqrt{2}}$

Testbook Solution Correct Option **- 4**

Concept:

The slope of the line normal to the curve;

$\frac{y_2-y_1}{x_2-x_1} = -\left(\frac{dx}{dy}\right)_{at(x_1,y_1)}$

where (x_1, y_1) are the point on which normal cuts the curve and (x_2, y_2) is any other point on normal

Equation of the line with 2 points (x_1, y_1) and (x_2, y_2) is;

$\frac{y-y_1}{x-x_1} = \frac{y_2-y_1}{x_2-x_1}$

Distance of a point (p, q) from a line ax + by + c = 0;

$D = \left|\frac{ap+bq+c}{\sqrt{a^2+b^2}}\right|$

Calculation:

Given curve $x^2 = 4y$

Differentiating w.r.t x on both sides

$\Rightarrow \frac{d}{dx}x^2 = \frac{d}{dx}4y$

$\Rightarrow 2x = 4\ \frac{dy}{dx}$

Let the point on which normal cuts the curve be (x_1, y_1)

$\Rightarrow \frac{dy}{dx} = \frac{x_1}{2}$

$\Rightarrow$ Slope of normal $m = -\frac{dx}{dy} = -\frac{2}{x_1}$

$\Rightarrow \frac{2-y_1}{1-x_1} = -\frac{2}{x_1}$

Also $y_1 = \frac{x^2}{4}$

$\Rightarrow \left(2 - \frac{x_1^2}{4}\right) x_1 = 2x_1 - 2$

$\Rightarrow 2x_1 - \frac{{x_1}^3}{4} = 2x_1 - 2$

$\Rightarrow {x_1}^3 = 8 \Rightarrow \mathbf{x_1 = 2}$

$\mathbf{y_1 = \frac{x_1^2}{4} = 1}$

Now equation of the normal passing through (2, 1) and (1, 2)

$\frac{y-y_1}{x-x_1} = \frac{y_2-y_1}{x_2-x_1}$

$\Rightarrow \frac{y-1}{x-2} = \frac{2-1}{1-2}$

$\Rightarrow \frac{y-1}{x-2} = -1$

$\Rightarrow y - 1 = 2 - x$

$\Rightarrow \mathbf{y + x - 3 = 0}$

So, distance of the origin (0, 0) from normal is;

$D = \left|\frac{ap+bq+c}{\sqrt{a^2+b^2}}\right|$

$\Rightarrow D = \left|\frac{1\times0+1\times0+(-3)}{\sqrt{1^2+1^2}}\right|$

$\Rightarrow \mathbf{D} = \left|\frac{-3}{\sqrt{2}}\right| = \frac{3}{\sqrt{2}}$

Que. 34 Suppose r integers, $0 < r < 10$, are chosen from (0, 1, 2, ...,9) at random and with replacement. The probability that no two are equal, is

1. $\frac{10!}{10!r!}$
2. $\frac{10!}{10!(10-r)!}$
3. $\frac{10!}{r!(10-r)!}$
4. $\frac{10!}{10^r \times r! \times (10-r)!}$

Testbook Solution Correct Option **- 4**

Calculation:

Given: r integers, 0 < r < 10, are chosen from (0, 1, 2, ...,9) at random and with replacement.

Total possible outcomes = 10^r

No two integers are equal = ${}^{10}C_r$

The probability that no two are equal = $\frac{{}^{10}C_r}{10^r}$

$= \frac{10!}{10^r \times r! \times (10-r)!}$

Que. 35 If $x^2 + 2ax + 10 - 3a > 0$ for all $x \in R$, then

1. $-5 < a < 2$
2. $a < -5$
3. $a > 5$
4. $2 < a < 5$

Testbook Solution Correct Option **- 1**

Concept:

For an equation $ax^2 + bx + c > 0$ at all $x \in R$ if: $a > 0$ and $b^2 - 4ac < 0$

Calculation:

Equation $x^2 + 2ax + 10 - 3a > 0$ for all $x \in R$

$\Rightarrow (2a)^2 - [4 \times (10 - 3a)] < 0$

$\Rightarrow 4a^2 - [40 - 12a] < 0$

$\Rightarrow a^2 + 3a - 10 < 0$

$\Rightarrow (a + 5)(a - 2) < 0$

$\Rightarrow$ **$-5 < a < 2$**

Que. 36 A box contains 3 coins, one coin is fair, one coin is two headed and one coin is weighted, so that the probability of heads appearing is $\frac{1}{3}$. A coin is selected at random and tossed, then the probability that head appears, is

1. $\frac{11}{18}$

2. $\frac{7}{18}$
3. $\frac{1}{8}$
4. $\frac{1}{4}$

Testbook Solution Correct Option **- 1**

Concept:

If there are 2 cases A and B with probability P(A) and P(B) respectively, then

- P(A ∪ B) = P(A) + P(B) - P(A ∩ B)
- P(A ∩ B) = P(A) × P(B)

Calculation:

Case A: Selecting a coin

P(A) = $\frac{1}{3}$

Case B: Head appears

P(B) = $\frac{1}{2}$ (for fair coin) + 1 (for two headed coin) + $\frac{1}{3}$ (for biased coin)

⇒ P(B) = $\frac{11}{6}$

The probability that the head appears

P(X) = P(A) × P(B)

⇒ **P(X)** = $\frac{1}{3} \times \frac{11}{6} = \frac{11}{18}$

Que. 37 If a vector $\vec{a}$ makes an equal angle with the coordinate axes and has magnitude 3, then the angle between $\vec{a}$ and each of the three coordinate axes is

1. $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$
2. $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$
3. $\frac{\pi}{6}$
4. $\frac{\pi}{3}$

Testbook Solution Correct Option **- 1**

Calculation:

Let $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$

Given: Magnitude of $\vec{a}$ = 3

Magnitude of $\vec{a} = |\vec{a}| = \sqrt{a_1^2 + a_2^2 + a_3^2} = 3$

Sqaring both sides, we get

$a_1^2 + a_2^2 + a_3^2 = 9$

Given: vector $\vec{a}$ makes an equal angle with the coordinate axes

Assume angle be α

$\vec{a} \cdot \hat{i} = |\vec{a}||\hat{i}| \cos\alpha$

$\Rightarrow (a_1\hat{i} + a_2\hat{j} + a_3\hat{k}) \cdot \hat{i} = 3\cos\alpha$

$\Rightarrow a_1 = 3\cos\alpha$ .... (1)

Similarly,

$\vec{a} \cdot \hat{j} = |\vec{a}||\hat{j}|\cos\alpha$

$\Rightarrow (a_1\hat{i} + a_2\hat{j} + a_3\hat{k}) \cdot \hat{j} = 3\cos\alpha$

$\Rightarrow a_2 = 3\cos\alpha$ .... (2)

Similarly,

$\vec{a} \cdot \hat{k} = |\vec{a}||\hat{k}|\cos\alpha$

$\Rightarrow (a_1\hat{i} + a_2\hat{j} + a_3\hat{k}) \cdot \hat{k} = 3\cos\alpha$

$\Rightarrow a_3 = 3\cos\alpha$ .... (3)

Squaring and adding equation (1), (2) and (3), we get

$\Rightarrow a_1^2 + a_2^2 + a_3^2 = 9\cos^2\alpha + 9\cos^2\alpha + 9\cos^2\alpha$

$\Rightarrow 27\cos^2\alpha = 9$

$\Rightarrow \cos^2\alpha = \frac{1}{3}$

$\Rightarrow \cos\alpha = \frac{1}{\sqrt{3}}$

$\therefore \alpha = \cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

Que. 38 If $f(x) = \begin{cases} \frac{\sin[x]}{[x]}, & [x] \neq 0 \\ 0, & [x] = 0 \end{cases}$, where [x] is the largest integer but not larger than x, then $\lim\limits_{x\to 0} f(x)$ is

1. -1
2. 0
3. 1
4. Does not exist

Testbook Solution Correct Option **- 4**

Concept:

Greatest Integer Function:

Greatest Integer Function [x] indicates an integral part of the real number x which is a nearest and smaller integer to x. It is also known as floor of x

- In general, If $n \leq x \leq n+1$ Then $[x] = n$ $(n \in \text{Integer})$
- Means if x lies in [n, n+1) then the Greatest Integer Function of x will be n.

Calculation:

Given:

$f(x) = \begin{cases} \frac{\sin[x]}{[x]}, & [x] \neq 0 \\ 0, & [x] = 0 \end{cases}$

$$f(x)=\begin{cases}\dfrac{\sin(-1)}{-1}=\sin 1, & -1\le x<0\\ 0, & 0\le x<1\end{cases}$$

$\lim\limits_{x\to 0^-} f(x)=\sin 1$

$\lim\limits_{x\to 0^+} f(x)=0$

$\lim\limits_{x\to 0^-} f(x)\neq \lim\limits_{x\to 0^+} f(x)$

So, $\lim\limits_{x\to 0} f(x)$ doesn't exists

Que. 39 If tan A - tan B = x and cot B - cot A = y, then cot (A - B) is equal to

1. $\dfrac{1}{x}+\dfrac{1}{y}$
2. $\dfrac{1}{x}-\dfrac{1}{y}$
3. $-\dfrac{1}{x}+\dfrac{1}{y}$
4. $-\dfrac{1}{x}-\dfrac{1}{y}$

Testbook Solution Correct Option **- 1**

Concept:

The identities of trigonometry are:

- $\tan a=\frac{\sin a}{\cos a}$
- $\cot a=\frac{\cos a}{\sin a}=\frac{1}{\tan a}$
- $\tan(a+b)=\frac{\tan a+\tan b}{1-\tan a\tan b}$
- $\tan(a-b)=\frac{\tan a-\tan b}{1+\tan a\tan b}$

Calculation:

Given

cot B - cot A = y

$\Rightarrow \frac{1}{\tan B}-\frac{1}{\tan A}=y$

$\Rightarrow \frac{\tan A-\tan B}{\tan A\tan B}=y$

Given tan A - tan B = x

$\Rightarrow \frac{x}{\tan A\tan B}=y$

$\Rightarrow \mathbf{\tan A\tan B=\frac{x}{y}}$

Now, $\tan(A-B)=\frac{\tan A-\tan B}{1+\tan A\tan B}$

$\Rightarrow$ tan (A - B) = $\frac{x}{1+\frac{x}{y}}$

$\Rightarrow$ tan (A - B) = $\frac{xy}{x+y}$

cot (A - B) = $\frac{1}{\tan(A-B)}$

$\Rightarrow \cot(A - B) = \frac{x+y}{xy}$

$\Rightarrow \mathbf{\cot(A - B) = \frac{1}{y} + \frac{1}{x}}$

Que. 40 If $a = \log_{12} 18$, $b = \log_{24} 54$, then $ab + 5(a - b)$ is

1. 1
2. 0
3. 2
4. $\frac{3}{2}$

Testbook Solution Correct Option **- 1**

Concept:

Logarithm properties:

Product Rule	$\log(mn) = \log(m) + \log(n)$
Quotient Rule	$\log(\frac{m}{n}) = \log(m) - \log(n)$
Power Rule	$\log(m^n) = n\log(m)$
Change of Base	$\mathbf{\log_m(n) = \frac{1}{\log_n(m)} = \frac{\log(n)}{\log(m)}}$

Calculation:

$a = \frac{\log 18}{\log 12} = \frac{\log(3^2 \times 2)}{\log(2^2 \times 3)}$

$\Rightarrow a = \frac{2\log 3 + \log 2}{2\log 2 + \log 3}$

$b = \frac{\log 54}{\log 24} = \frac{\log(3^3 \times 2)}{\log(2^3 \times 3)}$

$\Rightarrow b = \frac{3\log 3 + \log 2}{3\log 2 + \log 3}$

Let log 2 = x and log 3 = y

$S = ab + 5(a - b)$

$\Rightarrow S = \frac{2\log 3+\log 2}{2\log 2+\log 3} \times \frac{3\log 3+\log 2}{3\log 2+\log 3} + 5\left(\frac{2\log 3+\log 2}{2\log 2+\log 3} - \frac{3\log 3+\log 2}{3\log 2+\log 3}\right)$

$\Rightarrow S = \frac{2y+x}{2x+y} \times \frac{3y+x}{3x+y} + 5\left(\frac{2y+x}{2x+y} - \frac{3y+x}{3x+y}\right)$

$\Rightarrow S = \frac{6y^2+5xy+x^2}{6x^2+5xy+y^2} + 5\left(\frac{3x^2+7xy+2y^2-(2x^2+7xy+3y^2)}{6x^2+5xy+y^2}\right)$

$\Rightarrow S = \frac{6y^2+5xy+x^2}{6x^2+5xy+y^2} + 5\left(\frac{x^2-y^2}{6x^2+5xy+y^2}\right)$

$\Rightarrow S = \frac{6y^2+5xy+x^2}{6x^2+5xy+y^2} + \frac{5x^2-5y^2}{6x^2+5xy+y^2}$

$\Rightarrow S = \frac{6y^2+5xy+x^2+5x^2-5y^2}{6x^2+5xy+y^2}$

$\Rightarrow S = \frac{6x^2+5xy+y^2}{6x^2+5xy+y^2}$

$\Rightarrow \mathbf{S = 1}$

Que. 41 A student takes a quiz consisting of 5 multiple choice questions. Each question has 4 possible answers. If a student is guessing the answer at random and answer to different are independent, then the

probability of atleast one correct answer is

1. 0.237
2. 0.00076
3. 0.7627
4. 1

Testbook Solution Correct Option **- 3**

Concept:

If there can be only 2 cases of true and false, then:

Probability of r true cases out of n (≥ r) $P(x = r) = {}^{n}C_{r}\, p^{r}q^{(n-r)}$

where p is the probability of case being true and q is probability of case being false

Note: p and q are ≤ 1

Calculation:

The probability of correct answer **p** = $\frac{1}{4}$ = 0.25

The probability of wrong answer **q** = $\frac{3}{4}$ = 0.75

Total questions **n** = 5

Probability of atleast one correct answer (**x ≥ 1**):

$P(x \geq 1) = 1 - P(x = 0)$

$\Rightarrow P(x \geq 1) = 1 - {}^{5}C_{0}\, p^{0}q^{5}$

$\Rightarrow P(x \geq 1) = 1 - (0.75)^{5}$

$\Rightarrow P(x \geq 1) = 1 - 0.2373$

$\Rightarrow$ **$P(x \geq 1) \approx 0.7627$**

Que. 42 The condition that the line lx + my + n = 0 becomes a tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, is

1. $a^2l + b^2m + n = 0$
2. $al^2 + bm^2 = n^2$
3. al + bm = n
4. $a^2l^2 + b^2m^2 = n^2$

Testbook Solution Correct Option **- 4**

Concept:

The standard form of the equation of ellipse:

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

where center coordinates are (0, 0),

a = length of semi-major axis, and

b = length of semi-minor axis

For a line $y = mx + c$ to be tangent of such ellipse

where m is the slope of the line and c is a constant, then: $c^2 = a^2m^2 + b^2$ condition must follow, i.e.,

$\mathbf{y = mx \pm \sqrt{a^2m^2 + b^2}}$ is the standard form of tangent to $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ellipse

Calculation:

Given equation of line lx + my + n = 0

Rewriting the equation $y = -\frac{l}{m}x - \frac{n}{m}$

Comparing it to the standard form of tangent to ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ which is $\mathbf{y = mx \pm \sqrt{a^2m^2 + b^2}}$

$\Rightarrow -\frac{n}{m} = \sqrt{a^2\left(-\frac{l}{m}\right)^2 + b^2}$

$\Rightarrow \frac{n^2}{m^2} = \frac{a^2l^2}{m^2} + b^2$

$\Rightarrow \mathbf{n^2 = a^2l^2 + b^2m^2}$

Que. 43 The value of sin 20° sin 40° sin 80° is

1. $\frac{1}{2}$
2. $\frac{\sqrt{3}}{2}$
3. $\frac{\sqrt{3}}{8}$
4. $\frac{1}{8}$

Testbook Solution Correct Option **- 3**

Concept:

- Sin (A + B) + Sin (A - B) = 2 sin A cos B
- Sin (A + B) - Sin (A - B) = 2 cos A sin B
- Cos (A + B) + Cos (A - B) = 2 cos A cos B
- Cos (A - B) - Cos (A + B) = 2 sin A sin B

Calculation:

S = sin 20° sin 40° sin 80°

$\Rightarrow$ S = $\frac{1}{2}$ sin 40° (2 sin 80° sin 20°)

$\Rightarrow$ S = $\frac{1}{2}$ sin 40° [cos(80 - 20) - cos(80 + 20)]

$\Rightarrow$ S = $\frac{1}{2}$ sin 40° [cos 60 - cos 100]

$\Rightarrow$ S = $\frac{1}{4}$ sin 40° - $\frac{1}{2}$ sin 40 cos 100

$\Rightarrow$ S = $\frac{1}{4}$ sin 40° - $\frac{1}{4}$ (2 sin 40 cos 100)

$\Rightarrow$ S = $\frac{1}{4}$ sin 40° - $\frac{1}{4}$ [sin (100 + 40) - sin(100 - 40)]

$\Rightarrow$ S = $\frac{1}{4}$ sin 40° - $\frac{1}{4}$ [sin 140 - sin 60]

$\Rightarrow$ S = $\frac{1}{4}$ sin 40° - $\frac{1}{4}$ sin 140 + $\frac{1}{4}$ sin 60

$\Rightarrow$ S = $\frac{1}{4}$ (sin 40° - sin 140) + $\frac{\sqrt{3}}{8}$

$\Rightarrow$ S = $\frac{1}{4}$ [sin 40° - sin (180 - 40)] + $\frac{\sqrt{3}}{8}$

$\because$ sin (180 - x) = sin x

$\Rightarrow S = \frac{1}{4}(\sin 40° - \sin 40) + \frac{\sqrt{3}}{8}$

$\Rightarrow \mathbf{S = \frac{\sqrt{3}}{8}}$

Que. 44 Two non-negative numbers whose sum is 9 and the product of the one number and square of the other number is maximum, are

1. 5 and 4
2. 3 and 6
3. 1 and 8
4. 7 and 2

Testbook Solution Correct Option **- 2**

Concept:

For a function f(X) is maximum if:

- f'(X) =0
- f''(X) < 0
- if f'(X) = 0, f'''(X) < 0.... and so on

NOTE: If f'(X) > 0, the function is minimum

Calcuation:

Let the numbers be A and B

Given A + B = 9 and $f = AB^2$ is maximum

$\Rightarrow A = 9 - B$

For f to be maximum; f' = 0

$\Rightarrow \frac{d}{dB}((9 - B)B^2) = 0$

$\Rightarrow \frac{d}{dB}(9B^2 - B^3) = 0$

$\Rightarrow 18B - 3B^2 = 0$

So, either B = 0 or B = 6

$\Rightarrow f' = \frac{d}{dB}(18B - 3B^2)$

$\Rightarrow f' = 18 - 6B$

At B = 0, f' = 18, so function is minimum

At B = 6, f' = 0, checking f'';

$\Rightarrow f'' = \frac{d}{dB}(18 - 6B)$

$\Rightarrow f'' = -6$

$\therefore$ At B = 6, $f = AB^2$ is maximum

A = 9 - B = 3

Hence the numbers are A = 3 and B = 6

Que. 45 The median AD of ΔABC is bisected at E and BE is produced to meet the side AC at F. Then, AF : FC is

1. 2 : 1

2. 1 : 2
3. 3 : 1
4. 1 : 3

Testbook Solution Correct Option **- 4**

Concept:

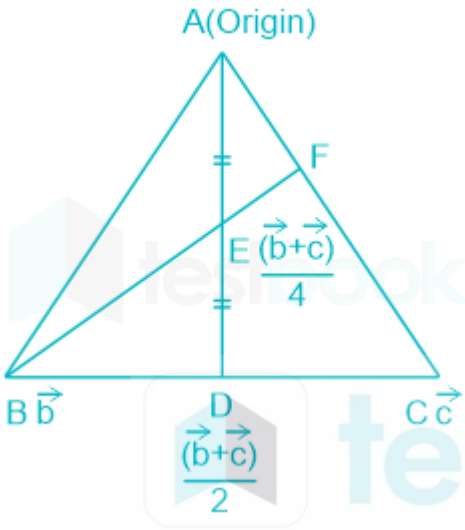
Equation of a line:

Vector equation for the line passing through the points with position vector $\vec{a}$ and $\vec{b}$is given by:

$\vec{r} = \vec{a} + \lambda(\vec{b} - \vec{a})$

Calculation:

Let A as the origin let the positive vector of B and C be $\vec{b}$ and $\vec{c}$respectively



Equation of lines BF: $\vec{r} = \vec{b} + \lambda(\frac{\vec{b}+\vec{c}}{4} - \vec{b})$

Equation of lines AC: $\vec{r} = 0 + \mu\vec{c} = \mu\vec{c}$

For a point of intersection F, we have

$\vec{b} + \lambda(\frac{\vec{b}+\vec{c}}{4} - \vec{b}) = \mu\vec{c}$

$\Rightarrow (1 - \frac{3\lambda}{4})\vec{b} + \frac{\lambda}{4}\vec{c} = \mu\vec{c}$

Equating coefficient of $\vec{b}$ and $\vec{c}$, we get

$(1 - \frac{3\lambda}{4}) = 0$ and $\frac{\lambda}{4} = \mu$

$\Rightarrow \lambda = \frac{4}{3}$ and $\mu = \frac{1}{3}$

Therefore, the position vector of $\vec{F}$ is $\vec{r} = \mu\vec{c} = \frac{\vec{c}}{3}$

Now, $\overrightarrow{AF} = \frac{\overrightarrow{AC}}{3}$

Hence AF : AC = 1 : 3

Que. 46 If PQ is a double ordinate of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ such that OPQ is an equilateral triangle, where O is the centre of the hyperbola, then which of the following is true?

1. $b^2 > \frac{-a^2}{\sqrt{3}}$
2. $b^2 > \frac{a^2}{3}$
3. $b^2 < \frac{a^2}{3}$
4. $b^2 < \frac{-a^2}{3}$

Testbook Solution Correct Option **- 2**

Concept:

The eccentricity of the curve $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is $e^2 = 1 + \left(\frac{b^2}{a^2}\right)$

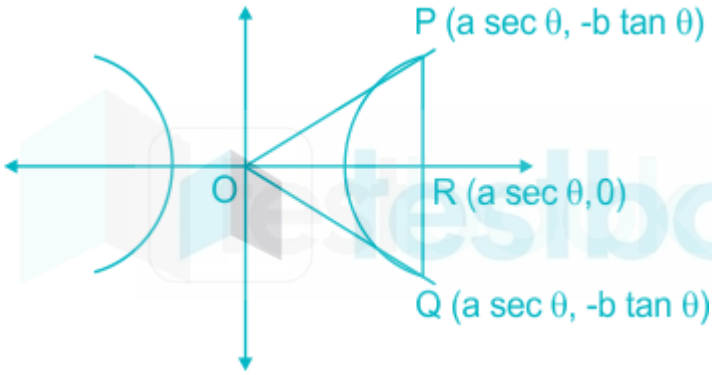
Focus of Hyperbola is (ae, 0)

The point on hyperbola in parametric form is (± a secθ. ± b tanθ)

Calculation:

The center of the hyperbola O = (0, 0)

Let the double ordinate PQ be (a secθ, ± b tanθ)



In △OPQ, given as equilateral triangle so;

∠POQ = 60° and PQ = 2b tanθ

Also, in △OPR, ∠POR = 30°, OR = a secθ and PR = b tanθ

Thus from △OPR,

$\tan 30 = \frac{PR}{OR}$

$\Rightarrow \tan 30 = \frac{b \tan\theta}{a \sec\theta}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{b}{a} \frac{\sin\theta}{\cos\theta \sec\theta}$

$\Rightarrow \frac{a}{b} = \sqrt{3}\sin\theta$

$\Rightarrow \frac{a^2}{b^2} = 3\sin^2\theta$

$\because \sin^2\theta \leq 1$

$\Rightarrow \frac{a^2}{b^2} \leq 3$

$\Rightarrow \mathbf{b^2 \geq \frac{a^2}{3}}$

Que. 47 In ΔABC, if a = 2, b = 4 and ∠C = 60°, then A and B are respectively equal to

1. 90°, 30°
2. 45°, 75°
3. 60°, 60°
4. 30°, 90°

Testbook Solution Correct Option **- 1**

Concept:

For a triangle:

- Cosine rule: $\cos C = \frac{a^2+b^2-c^2}{2ab}$
- Sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

where A, B and C are the angles of the triangle and a, b and c are sides opposite to angle A, B and C respectively

Calculation:

Given a = 2, b = 4 and ∠C = 60°

Using cosine rule,

$\cos C = \frac{a^2+b^2-c^2}{2ab}$

$\Rightarrow \cos 60 = \frac{2^2+4^2-c^2}{2(2\times4)}$

$\Rightarrow \frac{1}{2} = \frac{4+16-c^2}{16}$

$\Rightarrow 8 = 20 - c^2$

$\Rightarrow$ **c = √12 = 2√3**

Now applying sine rule;

$\frac{a}{\sin A} = \frac{c}{\sin C}$

$\Rightarrow \sin A = \frac{a\times\sin C}{c}$

$\Rightarrow \sin A = \frac{2\times\sin 60}{2\sqrt{3}} = \frac{1}{2}$

$\Rightarrow$ **∠A = 30°**

Also ∠A + ∠B + ∠C = 180

$\Rightarrow$ 30 + B + 60 = 180

$\Rightarrow$ **∠B = 90°**

Que. 48 If $\int \frac{xe^x}{\sqrt{1+e^x}}dx = f(x)\sqrt{1+e^x} - 2\log\frac{\sqrt{1+e^x}-1}{\sqrt{1+e^x}+1} + C$, then f(x) is

1. 2x - 1
2. 2x - 4
3. x + 4
4. x - 4

Testbook Solution Correct Option **- 2**

Concept:

Integration by parts: Integration by parts is a method to find integrals of products. The formula for integrating by parts is given by:

$\Rightarrow \int uvdx = u\int vdx - \int \left(\frac{du}{dx} \times \int vdx\right) dx + C$

where u is the function u(x) and v is the function v(x)

ILATE rule is Usually, the preference order of this rule is based on some functions such as Inverse, Logarithm, Algebraic, Trigonometric and Exponent.

Formula:

$\int \frac{1}{x^2-a^2} dx = \frac{1}{2a}\log\left|\frac{x-a}{x+a}\right| + c$

Calculation:

Let $I = \int \frac{xe^x}{\sqrt{1+e^x}} dx$

Take $1 + e^x = t^2$ .... (1)

Differentiating with respect to x, we get

$\Rightarrow e^x dx = 2tdt$

From equation (1), we get

$e^x = t^2 - 1$

So, $x = \log (t^2 - 1)$

Now,

$I = \int \frac{\log(t^2-1)}{\sqrt{t^2}} 2tdt$

$= 2 \times \int \frac{\log(t^2-1)}{t} \times tdt$

$= 2 \int \log (t^2 - 1) dt$

Using integration by parts rule, we get

$= 2 [\log (t^2 - 1) \times t - 2 \int \frac{t^2}{t^2-1} dt]$

$= 2t \log (t^2 - 1) - 4 \int \left[1 + \frac{1}{t^2-1}\right] dt$

$= 2t \log (t^2 - 1) - 4t - 4 \times \frac{1}{2}\log\left(\frac{t-1}{t+1}\right) + c$

$= 2t \log (t^2 - 1) - 4t - 2\log\left(\frac{t-1}{t+1}\right) + c$

$= 2t(\log (t^2 - 1) - 2) - 2\log\left(\frac{t-1}{t+1}\right) + c$

Resubstitute the value of t, we get

$= 2 (x - 2) \sqrt{1+e^x} - 2\log \frac{\sqrt{1+e^x}-1}{\sqrt{1+e^x}+1} + C$

$= (2x - 4)\sqrt{1 + e^x} - 2\log \frac{\sqrt{1+e^x}-1}{\sqrt{1+e^x}+1} + C$

Que. 49 The average marks of boys in a class is 52 and that of girls is 42. The average marks of boys and girls combined is 50. The percentage of boys in the class is

1. 80%
2. 60%
3. 40%
4. 20%

Testbook Solution Correct Option **- 1**

Concept:

The average marks = $\frac{\text{Sum of marks of all the students}}{\text{Total number of students}}$

Calculation:

Given the avg. marks of boys = 52 and that of girls = 42

Let the no. of boys be x and of girls be y

Sum of marks of boys = **52 x**

Sum of marks of girls = **42 y**

According to the question, if 50 is the combined average;

⇒ 52x + 42y = 50(x + y)

⇒ 52x + 42y = 50x + 50y

⇒ 2x = 8y

∴ x = 4y

Total number of students in the class = x + y = 4y + y = 5y

% of boys = $\frac{\text{No of boys}}{\text{Total No. of students}} \times 100$

$= \frac{4y}{5y} \times 100$

= 80%

Que. 50 How many even integers between 4000 and 7000 have four different digits?

1. 672
2. 840
3. 504
4. 728

Testbook Solution Correct Option **- 1**

Concept:

Find the total number of thousand place, hundred places and unit digit.

Calculation:

In 4000 to 7000 , the thousand place digit are $\in 4, 5, 6$

Case 1: Thousand place digit is even, i.e., 4, 6

⇒ Then there are only $\frac{4+5}{2} - 1 = 4$ possibilities for the units digit.

This leaves 8 possible digits for the hundreds place and 7 for the tens places,

⇒ Total of even integers = 2. 8.7.4 = 448

Case 2: Thousand place digit is odd, i.e., 5

⇒ There are 5 choices for the units digit, with 8 digits for the hundreds and 7 for the tens place. This gives 1.8.7.5 = 280 possibilities.

The total number of even integers = 448 + 280 = 728

Que. 51 A road network has parallel roads, which are equidistant from each other and running North-South or East-West only. The road junctions A, B, C, H and X are such that A is East of B and West of C. H is South-West of C and South-East of B. B is South-East of X. Which of the junctions are the farthest South and the farthest East?

1. H, B
2. H, C
3. C, H
4. B, H

Testbook Solution Correct Option **- 2**

Given:

A road network has parallel roads, which are equidistant from each other and running North-South or East-West only.

The Junctions are A, B, C, H, and X

A is East of Band West of C.

H is South-West of C and South-East of B.

B is South-East of X.

According to the information:

Hence, Farthest South is H and Farthest East is C.

Que. 52 Four players A, B, C, and D have to form into two pairs, however, no pair can play together more than seven times in a row A and B have played seven games in a row. C and D have three in a row. C does not to work with A. Who should play with B?

1. A
2. D
3. C
4. Cannot be determined

Testbook Solution Correct Option **- 4**

Given:

Four players A, B, C, and D have to form into two pairs.

No pair can play together more than **seven times** in a row.

A and B have played seven games in a row.

C and D have three in a row.

C **does not work** with A.

Then, C and D can still play 4 times.

B either will play with C or D.

Hence, it cannot be determined exactly.

Que. 53 If ROSE is coded as 6821, CHAIR is coded as 73456 and PREACH is coded as 961473, then the code for SEARCH is

1. 216473
2. 214673
3. 214763
4. 246173

Testbook Solution Correct Option **- 2**

According to the given coded form:

Letter	R	O	**S**	**E**
code	6	8	2	1

And,

Letter	**C**	**H**	**A**	I	**R**
Code	7	3	4	5	6

And,

Letter	P	**R**	**E**	**A**	**C**	**H**
Code	9	6	1	4	7	3

Similarly,

Letter	S	E	A	R	C	H
Code	2	1	4	6	7	3

Hence, SEARCH is coded as **214673.**

Que. 54 Cricket clubs in five towns A, B, C, D and E have one team each named P, Q, R, S and T, not necessarily in the same order.

The team in A has beaten R, P and S, Q has beaten the teams in E, C and A. Team R is in B and the team in C is not S.

Which team is in A?

1. P
2. Q
3. S
4. T

Testbook Solution Correct Option **- 4**

Given:

Cricket clubs in five towns A, B, C, D, and E have one team each named P, Q, R, S, and T, not necessarily in the same order.

The team in A has beaten R, P, and S

This means A will have team Q or T

Town	**Teams**
A	Q/T

B	
C	
D	
E	

Q has beaten the teams in E, C, and A.

This means A will not have Q as a team. Then A has T team.

Team R is in B.

Q will not in E and C as beaten.

Town	Teams
A	T
B	R
C	
D	Q
E	

S is not in C then is in E.

Town	Teams
A	T
B	R
C	P
D	Q
E	S

Hence, A has team T.

Que. 55 Where is the team P?

1. A
2. B
3. C
4. D

Testbook Solution Correct Option **- 3**

Given:

Cricket clubs in five towns A, B, C, D, and E have one team each named P, Q, R, S, and T, not necessarily in the same order.

The team in A has beaten R, P, and S

This means A will have team Q or T

Town	Teams
A	Q/T
B	
C	
D	
E	

Q has beaten the teams in E, C, and A.

This means A will not have Q as a team. Then A has T team.

Team R is in B.

Q will not in E and C as beaten.

Town	Teams
A	T
B	R
C	
D	Q
E	

S is not in C then is in E.

Town	Teams
A	T
B	R
C	P
D	Q
E	S

Hence, team P is in C

Que. 56 Where is the team Q?

1. A
2. B
3. C
4. D

Testbook Solution Correct Option **- 4**

Given:

Cricket clubs in five towns A, B, C, D, and E have one team each named P, Q, R, S, and T, not necessarily in the same order.

The team in A has beaten R, P, and S

This means A will have team Q or T

Town	Teams
A	Q/T
B	
C	
D	
E	

Q has beaten the teams in E, C, and A.

This means A will not have Q as a team. Then A has T team.

Team R is in B.

Q will not in E and C as beaten.

Town	Teams
A	T
B	R
C	

D	Q
E	

S is not in C then is in E.

Town	Teams
A	T
B	R
C	P
D	Q
E	S

Hence, team Q is in D

Que. 57 Find the number that comes next in the series

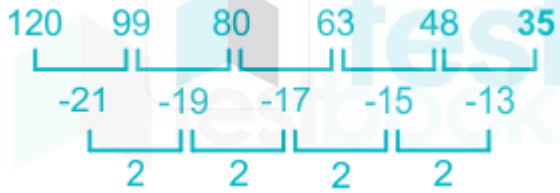
120, 99, 80, 63, 48, ...

1. 35
2. 38
3. 39
4. 40

Testbook Solution Correct Option **- 1**

The series follows pattern of subtraction.

The numbers are getting subtracted from left side by 21, 19,...and so on.



Hence, the next number will be 35.

Que. 58 In a certain school, the number of students in each section was 24. After admitting some students, three new sections have been started and now there are 16 sections with 21 students in each. What is the number of newly admitted students?

1. 14
2. 24
3. 16
4. 26

Testbook Solution Correct Option **- 2**

Given,

Total section added = 3

Total number of new sections = 16

∴ Total number of sections earlier = 16 – 3 = 13

Now, there are 24 students in each sections earlier

⇒ Total students in school earlier = 24 × 13 = 312

After adding some new students there are 21 students in each section

⇒ Total number of students now = 21 × 16 = 336

∴ **The number of newly admitted students = 336 – 312 = 24**

Que. 59 The nine alphabets L, M, N, O, P, Q, R, S, and T are assigned to nine integers 1 to 9 not necessarily in the same order 4 is assigned to P. The difference between P and T is 5. The difference between N and T is 3.

What is the integer assigned to N?

1. 7
2. 6
3. 5
4. 4

Testbook Solution Correct Option **- 2**

Given:

The nine alphabets L, M, N, O, P, Q, R, S, and T are assigned to nine integers 1 to 9 not necessarily in the same order.

4 is assigned to P

P = 4

The difference between P and T is 5.

Only 9 can be subtracted from 4 to get the difference of 5

So, **T = 9**

The difference between N and T is 3

To get the difference of 3, another number must be 6

Hence, **N = 6**

Que. 60 Five boys A, B, C, D, E and five girls P, Q, R, S, T are standing in two rows facing each other not necessarily in the order. E is not at any end. C is to the immediate right of B and D is to the immediate left of A, who is facing P. There are as many girls between P and Q as between R and S. A is second to the left of B. S and R are not facing either B or D.

Who is facing B?

1. R
2. S
3. Q
4. T

Testbook Solution Correct Option **- 3**

Given:

Five boys A, B, C, D, E and five girls P, Q, R, S, T are standing in two rows facing each other not necessarily in the order.

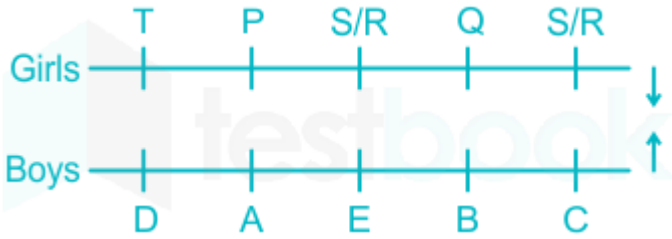
A is second to the left of B.

C is to the immediate right of B

D is to the immediate left of A, who is facing P.

S and R are not facing either B or D

There are as many girls between P and Q as between R and S (which is one.)



From the diagram, Q is facing B.

Que. 61 Who is standing to the immediate right of A?

1. E
2. C
3. D
4. B

Testbook Solution Correct Option **- 1**

Given:

Five boys A, B, C, D, E and five girls P, Q, R, S, T are standing in two rows facing each other not necessarily in the order.

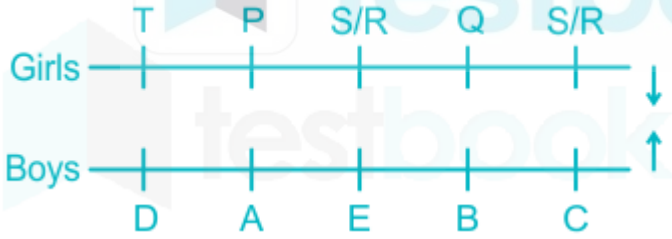
A is second to the left of B.

C is to the immediate right of B

D is to the immediate left of A, who is facing P.

S and R are not facing either B or D

There are as many girls between P and Q as between R and S (which is one.)



From diagram it is clear that **E** is standing to the immediate right of A.

Que. 62 Which of the following is definitely true?

1. C is third to the right of D
2. C and D are at ends
3. C is facing S
4. None of these

Testbook Solution Correct Option **- 1**

Given:

Five boys A, B, C, D, E and five girls P, Q, R, S, T are standing in two rows facing each other not necessarily in the order.

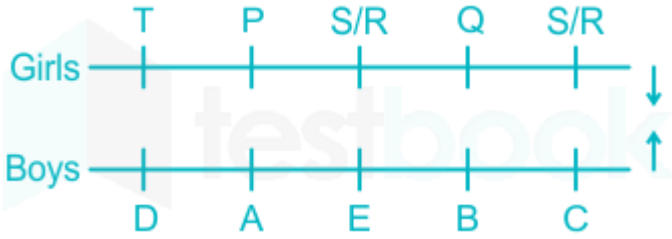
A is second to the left of B.

C is to the immediate right of B

D is to the immediate left of A, who is facing P.

S and R are not facing either B or D

There are as many girls between P and Q as between R and S (which is one.)



From the diagram it is clear that C and D are at ends.

Que. 63 Which pair of boys are standing at the ends of the row?

1. C and D
2. C and B
3. D and B
4. None of these

Testbook Solution Correct Option **- 1**

Given:

Five boys A, B, C, D, E and five girls P, Q, R, S, T are standing in two rows facing each other not necessarily in the order.

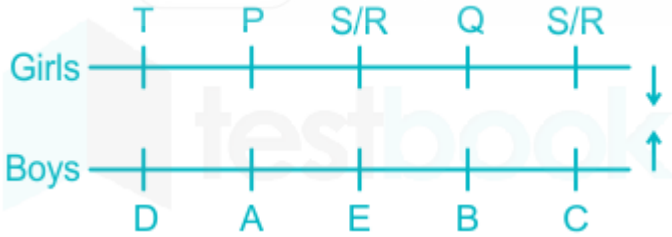
A is second to the left of B.

C is to the immediate right of B

D is to the immediate left of A, who is facing P.

S and R are not facing either B or D

There are as many girls between P and Q as between R and S (which is one.)



Hence, D and C are standing at the end of the row.

Que. 64 The sum of ages of a daughter and mother is 63 yr. Four years back, the mother's age was 4 times that of daughter's age at that time. What is the present age of the mother?

1. 46 yr
2. 48 yr
3. 50 yr
4. 59 yr

Testbook Solution Correct Option **- 2**

The sum of ages of a daughter and mother is 63 yr.

Let the age of daughter be A and the age of the mother be B.

A + B = 63

Four years back.

A - 4 and B - 4

This means A + B = 55 (after deduction 4 years from both mother and daughter.)

Four years back mother's age was 4 times that of the daughter's age at that time

If the daughter's age is 1x yr then the mother's age is 4x years.

Adding both the ages, we get 5x yr.

5x = 55

x = 11

Then, Four years back the age of the daughter was 11yrs and the mother was 44 years old

At present,

Daughter is of age 11 + 4 = 15 yrs.

Mother is of age 44 + 4 = **48 yrs.**

Que. 65 A watch gains 10 s in 5 min was set correct at 9.00 am. When the watch indicated 20 min past 7.00 pm in the same evening, the correct time is

1. 7.00 pm
2. 7.40 pm
3. 7.10 pm
4. 8.00 pm

Testbook Solution Correct Option **- 1**

A watch gains **10 s in 5 min**

It was set correct at 9.00 am.

20 min past 7.00 pm means 10 hrs 20 min has been passed.

Or 620 minutes has been passed.

According to the bold part, the watch must have gained 1240 sec. in 620 minutes.

1240 sec = 20 min 40 sec (gained)

The correct time should be 7.00 pm

Que. 66 Father is aged three times more than the age of his son Rohit. After 8 yr, he would be two and a half of Rohit's age. After further 8 yr, how many times would he be of Rohit's age?

1. 2 times
2. 3 times
3. 2.5 times

Testbook Solution Correct Option **- 1**

Father is aged **three times more** than the age of his son Rohit.

Let the age of son be x

Age of father is 4x. (three times more = x + 3x

After 8 years:

Father's age is two and a half of Son's age.

4x + 8 = 5/2(x + 8) **two and a half = 5/2**

On solving x = 8 yrs.

Present age:

Son age = 8: Father age = 32

After 8 yr;

Son age = 16; Father age = 40

After further 8 yr

Son age = 24; Father age 48.

Father's age is **2 times** of Rohit's (son's) age.

Que. 67 What is the number that comes next in the series?

1, 2, 3, 6, 11, 20, 37, 68,

1. 105
2. 124
3. 125
4. 126

Testbook Solution Correct Option **- 3**

The pattern followed here is:

0 + 1 + 2 = 3;

1 + 2 + 3 = 6;

2 + 3 + 6 = 11;

3 + 6 + 11 = 20;

6 + 11 + 20 = 37;

11 + 20 + 37 = 68;

20 + 37 + 68 = 125

Hence. 125 will come next.

Que. 68 Six friends A, B, C, D, E, and F are sitting around a hexagonal table. F, who is sitting exactly opposite A, is to be immediate right of B, D is between A and B and is exactly opposite to C.All are facing inside.

Who is sitting opposite to B?

1. A
2. C
3. E
4. F

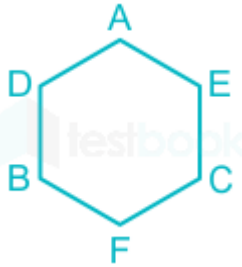
Testbook Solution Correct Option **- 3**

Given:

Six friends A, B, C, D, E, and F are sitting around a hexagonal table.

F, who is sitting exactly opposite to A, is to be immediate right of B

D is between A and B and is exactly opposite to C.



Hence, E is sitting opposite to B

Que. 69 Who are sitting next to A?

1. D and E
2. D and F
3. C and E
4. B and D

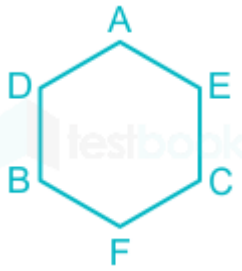
Testbook Solution Correct Option **- 1**

Given:

Six friends A, B, C, D, E, and F are sitting around a hexagonal table.

F, who is sitting exactly opposite A, is to be immediate right of B

D is between A and B and is exactly opposite to C.



Hence, D and E are sitting next to A

Que. 70 The arithmetic mean of 2^{10} and 2^{20} is

1. 2^{15}
2. $2^5 + 2^{10}$
3. $2^9 + 2^{20}$
4. $2^9 + 2^{19}$

Testbook Solution Correct Option **- 4**

Arithmetic mean or average of number 2^{10} and 2^{20}

$\Rightarrow$ Average $= (2^{10} + 2^{20})/2$

$\Rightarrow$ Average $= 2^{10}/2 + 2^{20}/2$

$\Rightarrow$ Average $= 2^9 + 2^{19}$

$\therefore$ **The arithmetic mean of 2^{10} and 2^{20} is $2^9 + 2^{19}$**

Que. 71 There are five different boxes of different unknown weights each less than 100 kg. These boxes were weighted in pairs and the weights obtained are 110, 112, 113, 114, 115, 116, 117, 118, 120 and 121 kg. What is the weight in kg of the heaviest box?

1. 60
2. 62
3. 64
4. 61

Testbook Solution Correct Option **- 2**

Calculation:

Let, the weight of the five boxes with the shipping clerk is p, q, r, s and t.

Where $p \le q \le r \le s \le t$.

$110 = p + q < p + r < .... < r + t < s + t = 121$

$p + r = 112$ and $r + t = 120$

$\Rightarrow$ Each box is weighed four times.

Thus, $4p + 4q + 4r + 4s + 4t = 110 + 112 + 113 + 114 + 115 + 116 + 117 + 118 + 120 + 121$

$4 (p + q + r + s + t) = 1156$

$p + q + r + s + t = 1156/4$

$p + q + r + s + t = 289$

$\Rightarrow$ that means, $p + q = 110$ and $s + t = 121$

$\therefore 110 + r + 121 = 289$

$\therefore r = 289 - 231$

$r = 58$

$\Rightarrow$ place this value in $r + t = 120$

$58 + t = 120$

$t = 120 - 58$

$t = 62$ kg

Thus, the weight of the heaviest box is 62 kg.

Que. 72 All the roads of a city are either perpendicular or parallel to one another. The roads are all straight. Roads A, B, C, D and E are parallel to one another. Roads F, G, H, I, J, K, L and M are parallel to one another

Road A is 1 km East of road B.

Road B is 1/2 km West of road C.

Road D is 1 km West of road E.

Road G is 1/2 km South of road H.

Road I is 1 km North of road J.

Road K is 1/2 km North of road L.

Road K is 1 km South of road M.

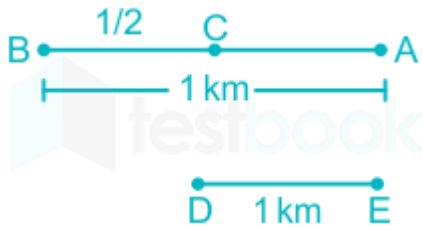
If K is parallel to I, K is 1/2 km South of J and 1 km North of G, then which of the following two roads would be 1/2 km apart?

1. I and K
2. J and G
3. I and G
4. J and K

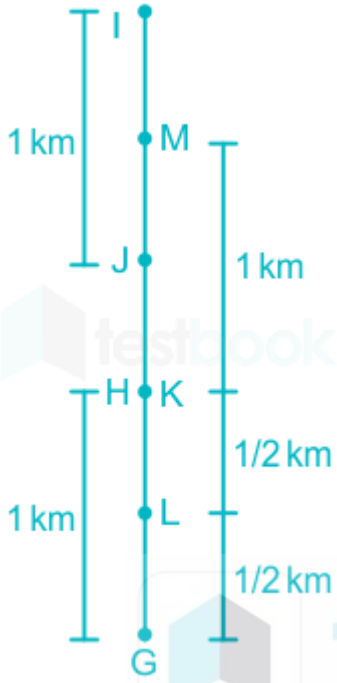
Testbook Solution Correct Option **- 4**

According to the given information, the diagram is as follows:

For East-West roads



For North-South roads



From the diagram, it is clear that **J and K roads** are 1/2 km apart

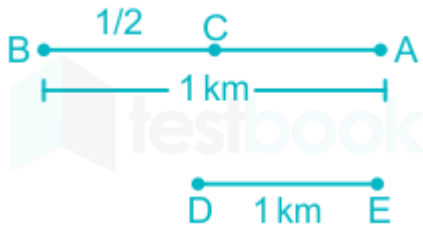
Que. 73 Which of the following possibilities are true?

1. L is 1/2 km North of I
2. C is 1 km West of D
3. I is 1/2 km North of K
4. C and B are 1/2 km apart

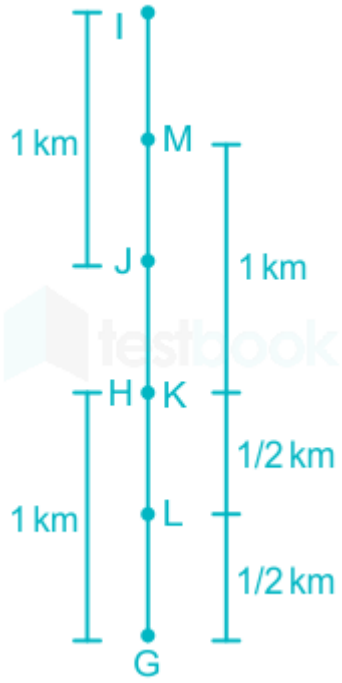
Testbook Solution Correct Option **- 4**

According to the given information, the diagram is as follows:

For East-West roads



For North-South roads



From the diagram, **C and B are 1/2 km apart is true**

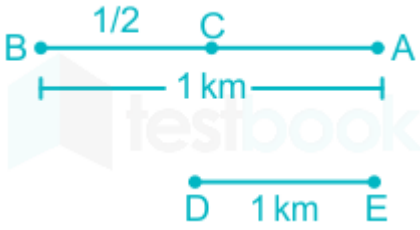
Que. 74 If road E is between B and C, then the distance between A and D is

1. less than 1 km
2. C is 1 km West of D
3. between 1 km and 2 km
4. more than 2 km

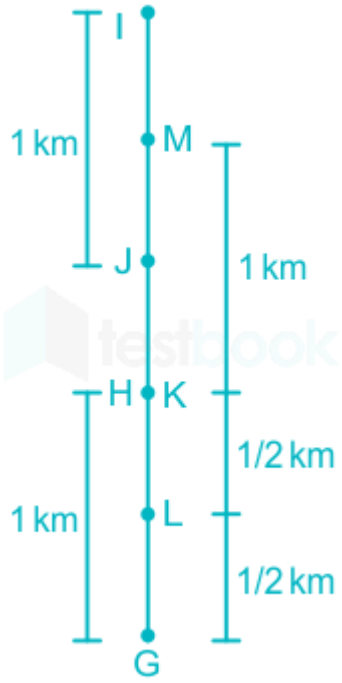
Testbook Solution Correct Option **- 3**

According to the given information, the diagram is as follows:

For East-West roads



For North-South roads



From the diagram, it is clear that the distance **between 1 km and 2 km.**

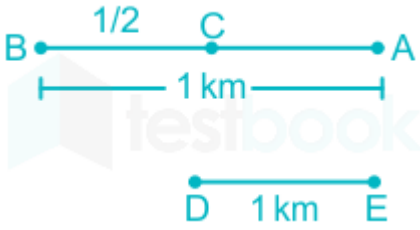
Que. 75 If E is between B and C, then which of the following is false?

1. D is 2 km West of A
2. C is less than 1.5 km from D
3. Distance from E to B equal to distance of E and C is 1/2 km
4. E is less than 1 km from A

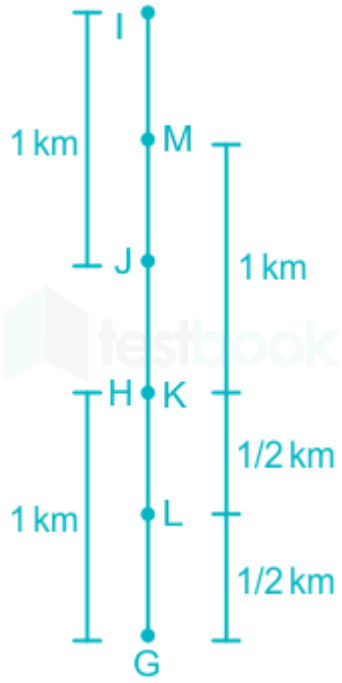
Testbook Solution Correct Option **- 1**

According to the given information, the diagram is as follows:

For East-West roads



For North-South roads



From the diagram, when we place E in between B and C then;

All options will satisfy but **D is 2 km west of A is false.**

This can only happen when E is at B position.

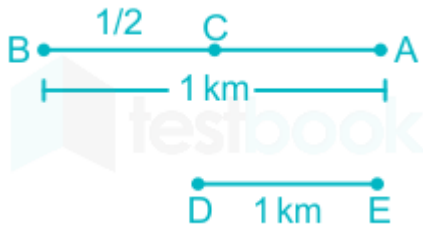
Que. 76 Which of the following is necessarily true?

1. E and B intersect
2. D is 2 km West of B
3. D is atleast 2 km West of A
4. M is 1.5 km North of L

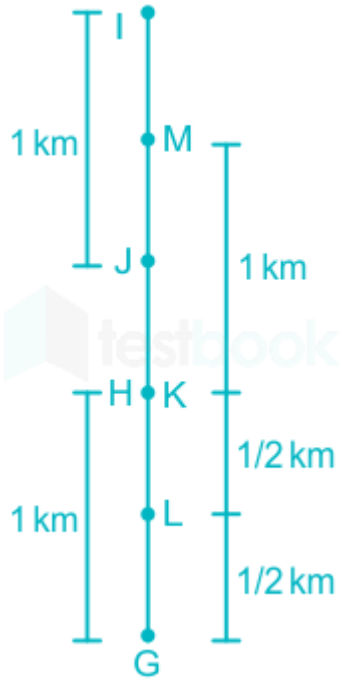
Testbook Solution Correct Option **- 4**

According to the given information, the diagram is as follows:

For East-West roads



For North-South roads



From the diagram;

M is 1.5 km North of L is necessarily true.

Que. 77 The students in three classes are in the ratio 2 : 3 : 5. If 20 students are increased in each class, the ratio changes to 4 : 5 : 7. The total number of students before the increase were

1. 10
2. 90
3. 100
4. None of these

Testbook Solution Correct Option **- 3**

Given,

The students in three classes are in the ratio 2 : 3 : 5

⇒ Let the students in the class be 2x, 3x and 5x respectively

Now,20 students are added to the class and the ratio is 4 : 5 : 7

∴ $(2x + 20)/(3x + 20) = 4/5$

⇒ $10x + 100 = 12x + 80$

⇒ $2x = 20$

⇒ $x = 10$

∴ The total number of students before the increase = $(2 + 3 + 5) \times 10 = 100$

∴ **The total number of students before the increase were 100**

Que. 78 Ajith is three times older than Babita. Chetu is half the age of Das. Babita is older than Chetu. Which of the following additional information is needed to estimate the age of Ajith?

I. Chetu is 10 yr old.

II. Both Babita and Das are older than Chetu by the same number of years.

1. Only I
2. Only II

3. I and II
4. None of these

Testbook Solution Correct Option **- 3**

Given,

Ajith is three times older than Babita

Chetu is half the age of Das

⇒ Let the age of Chetu be x

Then, the age of Das = 2x

Using statement (i)

Chetu is 10 years old

∴ x = 10

Age of Das = 2 × 10 = 20 years

∴ Statement (i) alone is not sufficient to answer the question

Using statement (ii)

Both Babita and Das are older than Chetu by the same number of years

∴ Statement (ii) alone is not sufficient to answer the question

Using statement (i) and statement (ii) together

Age of Das = 20 years

Difference between the age of Das and Chetu = 20 – 10 = 10 years

∴ Babita is older than Chetu by 10 years

⇒ Age of Babita = 10 + 10 = 20 years

∴ Age of Ajith = 3 × age of Babita

⇒ Age of Ajith = 3 × 20 = 60 years

∴ **Statement (i) and (ii) together are necessary to answer the question**

Que. 79 Six friends P, Q, R, S, T and U are standing in two rows facing one another P is the middle of one row. U is to the left to S and facing R, Q and T are not in the same row. Only one person is in between R and T.

Which of the following pairs are facing each other?

1. RS
2. TU
3. PU
4. TQ

Testbook Solution Correct Option **- 4**

Given:

Six friends P, Q, R, S, T, and U are standing in two rows facing one another.

P is the middle of one row.

_ P _

_ _ _

U is to the left to S and facing R

R P _

U S _

Q and T are not in the same row.

Only one person is in between R and T.

R P T

U S Q

Hence, **TQ** are facing each other.

Que. 80 Who faces P?

1. Q
2. T
3. S
4. U

Testbook Solution Correct Option **- 3**

Given:

Six friends P, Q, R, S, T, and U are standing in two rows facing one another.

P is the middle of one row.

_ P _

_ _ _

U is to the left to S and facing R

R P _

U S _

Q and T are not in the same row.

Only one person is in between R and T.

R P T

U S Q

Hence, **S** faces P

Que. 81 Who is to the left of S?

1. P
2. U
3. S
4. Q

Testbook Solution Correct Option **- 2**

Given:

Six friends P, Q, R, S, T, and U are standing in two rows facing one another.

P is the middle of one row.

_ P _

_ _ _

U is to the left to S and facing R

R P _

U S _

Q and T are not in the same row.

Only one person is in between R and T.

R P T

U S Q

Hence, **U** is in the left of S.

Que. 82 Which of the following are in the same row?

1. U, S and T
2. R, P and T
3. U, Q and P
4. U, R and Q

Testbook Solution Correct Option **- 2**

Given:

Six friends P, Q, R, S, T, and U are standing in two rows facing one another.

P is the middle of one row.

_ P _

_ _ _

U is to the left to S and facing R

R P _

U S _

Q and T are not in the same row.

Only one person is in between R and T.

R P T

U S Q

Hence, **R, P, and T** are in the same row.

Que. 83 Six members of a family A, B, C, D, E, and F are Psychologist, Manager, Advocate, Jeweller, Doctor and Engineer but not necessarily in the same order.

Doctor is the grandfather of F, who is a Psychologist

Manager D is married to A

Jeweller C is married to Advocate

B is the mother of F and E

There are two married couples in the family.

Who are the two couples in the family?

1. AD and CB
2. AB and CD
3. AC and BD
4. None of these

Testbook Solution Correct Option **- 1**

Given:

Six members of a family A, B, C, D, E, and F are Psychologist, Manager, Advocate, Jeweller, Doctor, and Engineer but not necessarily in the same order.

According to the given information:

There are two married couples in the family.

D is married to A

C who is a jeweler married to Advocate will be married to B.

Manager D is married to A means A is the doctor and Grandfather of F and E.

Also, for Engineer, E is left. Then, E is an engineer.

D is manager married to A.

Hence, **AD and CB are couples.**

Que. 84 How many male members are there in the family?

1. Two
2. Three
3. Four
4. Can't be determined

Testbook Solution Correct Option **- 4**

Given:

Six members of a family A, B, C, D, E, and F are Psychologist, Manager, Advocate, Jeweller, Doctor, and Engineer but not necessarily in the same order.

According to the given information:

There are two married couples in the family.

D is married to A

C who is a jeweler married to Advocate will be married to B.

Manager D is married to A means A is the doctor and Grandfather of F and E.

Also, Engineer and E is left. Then, E is an engineer.

D is manager married to A.

Hence, we can't say about the gender of E and F. So **can't be determined**.

Que. 85 How is A related to E?

1. Grandmother
2. Wife
3. Grandfather
4. None of these

Testbook Solution Correct Option **- 3**

Given:

Six members of a family A, B, C, D, E, and F are Psychologist, Manager, Advocate, Jeweller, Doctor, and Engineer but not necessarily in the same order.

According to the given information:

There are two married couples in the family.

D is married to A

C who is a jeweler married to Advocate will be married to B.

Manager D is married to A means A is the doctor and Grandfather of F and E.

Also, for Engineer, E is left. Then, E is an engineer.

D is manager married to A.

Hence, **A is the Grandfather of E**

Que. 86 What is the profession of E?

1. Manager
2. Engineer
3. Doctor
4. None of these

Testbook Solution Correct Option **- 2**

Given:

Six members of a family A, B, C, D, E, and F are Psychologist, Manager, Advocate, Jeweller, Doctor, and Engineer but not necessarily in the same order.

According to the given information:

There are two married couples in the family.

D is married to A

C who is a jeweler married to Advocate will be married to B.

Manager D is married to A means A is the doctor and Grandfather of F and E.

Also, for Engineer, E is left. Then, E is an engineer.

D is manager married to A.

Hence, **E is an Engineer.**

Que. 87 Which is the profession of A?

1. Manager
2. Engineer
3. Can't be determined
4. None of these

Testbook Solution Correct Option **- 4**

Given:

Six members of a family A, B, C, D, E, and F are Psychologist, Manager, Advocate, Jeweller, Doctor, and Engineer but not necessarily in the same order.

According to the given information:

There are two married couples in the family.

D is married to A

C who is a jeweler married to Advocate will be married to B.

Manager D is married to A means A is the doctor and Grandfather of F and E.

Also, for Engineer E is left. Then, E is an engineer.

D is manager married to A.

Hence, **A is the doctor**

Que. 88 At a small company, parking spaces are reserved for the top executives: CEO, President, Vice-President, Secretary and Treasurer with the spaces lined up in that order. The parking lot guard can tell at a glance, if the cars are parked correctly by looking at the colour of the cars. The cars are yellow, green, purple, red and blue and the executive names are Alice, Bert, Cheryl, David and Enid.

The car in the first space is red.

A blue car is parked between the red car and the green car.

The car in the last space is purple.

The secretary drives a yellow car.

Alice's is parked next to David's.

Enid drives a green car.

Bert's car is parked between Cheryl's and Endid's.

David's car is parked in the last space.

What colour is the President car?

1. Green
2. Yellow
3. Blue
4. Purple

Testbook Solution Correct Option **- 3**

Given:

Executives: CEO, President, Vice-President, Secretary, and Treasurer.

The cars are yellow, green, purple, red and blue

Executive names are Alice, Bert, Cheryl, David, and Enid

From Options:

Purple car is of Treasurer's and at last place

Yellow is of Secretary.

The president car must be after red car because red is of CEO.

Blue car is in between red and Green. **So President has Blue car.**

Que. 89 Who is the CEO?

1. Alice
2. Bert
3. Cheryl
4. David

Testbook Solution Correct Option **- 3**

Given:

Executives: CEO, President, Vice-President, Secretary, and Treasurer.

The cars are yellow, green, purple, red and blue

Executive names are Alice, Bert, Cheryl, David, and Enid

CEO drives Red car which is in the first space. According to the designation, the car is parked. CEO is top level.

From Options:

Alice's car is parked next to David's who's at the last place.

Bert's car is not in the first space.

Hence, **Cheryl is the CEO.**

Que. 90 Who is the secretary?

1. Enid
2. David
3. Cheryl
4. Alice

Testbook Solution Correct Option **- 4**

Given:

Executives: CEO, President, Vice-President, Secretary, and Treasurer.

The cars are yellow, green, purple, red and blue

Executive names are Alice, Bert, Cheryl, David, and Enid

From Options:

Enid can't be a secretary because he drives a green car and Secretary drives a yellow car.

David's car parked in the last and last car has the purple color

Cheryl can't be secretary as she's CEO.

Hence, Alice is the secretary.

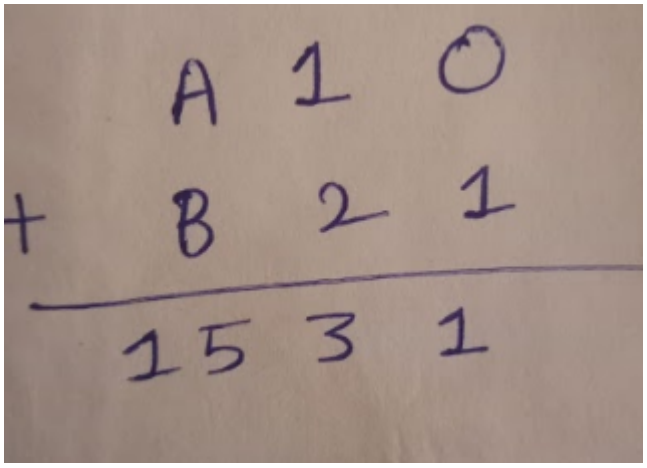
Que. 91 The decimal equivalent of the hexadecimal operation A10 + B21 is

1. 5425
2. 5246
3. 2849
4. 5344

Testbook Solution Correct Option **- 1**

For the addition of two hexadecimal numbers, there are two methods:

- In the 1st method, we first convert the hexadecimal number to decimal then add both numbers. After that, we convert that decimal number to hexadecimal number. But it is a time-consuming method and also calculations become bulky.
- In the 2nd method, we directly add both hexadecimal numbers as shown below



The decimal equivalent of the hexadecimal 1531

$(1531)_{16} = 1 \times 16^3 + D \times 16^2 + 8 \times 16^1 + 5 \times 16^0$

$= 1 \times 16^3 + D \times 16^2 + 8 \times 16^1 + 5 \times 16^0 = \mathbf{(5425)_{10}}$

Que. 92 What is the 2's complement of 0011 0101 1001 1100?

1. 1100 1010 1100 1011
2. 1100 1010 0110 0011
3. 1100 1010 0110 0100
4. 1100 1010 1111 1111

Testbook Solution Correct Option **- 3**

Concept:

1's complement of Binary: 1's complement of a Binary number is defined by the value obtained by inverting all the bit, i.e, 0 as 1 and 1 as 0.

∴ 1's complement of 1100 0110 = 0011 1001

2's complement of Binary: It is the sum of 1's complement of Binary number and 1 to the least significant bit (LSB).

∴ 2's complement = 1's complement + 1 (LSB)

Calculation:

Given Binary Number,

0011 0101 1001 1100

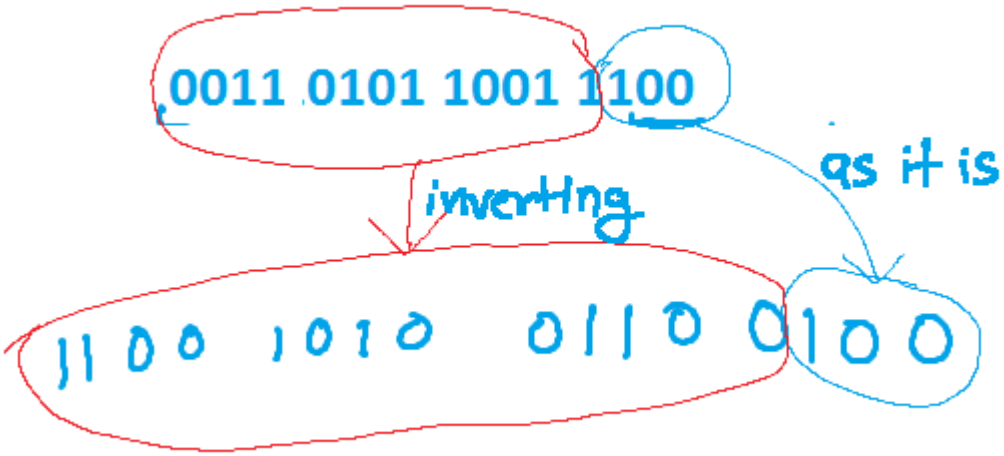
1's complement = 1100 1010 0110 0011

2's complement = 1's complement + 1 (LSB)

```
1100 1010 0110 0011
+                 1
-------------------
1100 1010 0110 0100
```

Alternate Method

Note: A shortcut method of forming the 2's complement of a **binary number is to copy bits from the right until a one-bit has been copied**, then **invert the remaining** bits i.e, **0 as 1 and 1 as 0.**



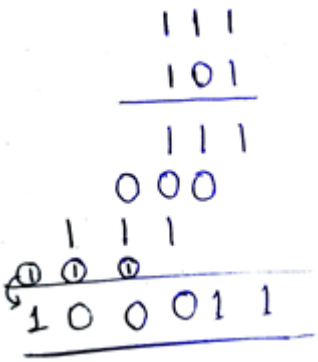
Que. 93 Multiplication of 111_2 by 101_2 is

1. 110011_2
2. 100011_2
3. 111100_2
4. 000101_2

Testbook Solution Correct Option **- 2**
This problem can be solved in two ways

Method 1:

By following simple multiplication rule as shown



Method 2:

By converting binary to decimal, performing multiplication, and then again converting decimal to binary.

Here, $(111)_2 = 2^2 + 2^1 + 2^0 = (7)_{10}$

$(101)_2 = 2^2 + 2^0 = (5)_{10}$

$\Rightarrow 5 \times 7 = (35)_{10} = 2^5 + 2^1 + 2^0 = \mathbf{(100011)_2}$

Que. 94 What is the 8 bit 2's complement representation of the negative integer-93?

1. 10100011
2. 10100010
3. 0XA2
4. None of these

Testbook Solution Correct Option **- 1**

Step 1: We start with the positive version of the number:

$\Rightarrow$ |-93| = 93

Step 2: Divide the number repeatedly by 2, keeping track of each remainder, until we get a quotient that is equal to zero:

$\Rightarrow$ dividend ÷ divisor = quotient + remainder

- 93 ÷ 2 = 46 + 1;
- 46 ÷ 2 = 23 + 1;
- 23 ÷ 2 = 11 + 1;
- 11 ÷ 2 = 5 + 1;
- 5 ÷ 2 = 2 + 1;
- 2 ÷ 2 = 1 + 0;
- 1 ÷ 2 = 0 + 1;

Now we got the quotient 0.

Step 3: Construct the base 2 representation of the positive number, by taking all the remainders starting from the bottom of the list in step 2.

$\Rightarrow 93_{(10)} = 1011101_{(2)}$

Step 4: Determine the signed binary number bit length:

The base 2 number's actual length, in bits: 5.

A signed binary's bit length must be equal to a power of 2, as of:

$2^1 = 2; 2^2 = 4; 2^3 = 8; 2^4 = 16; 2^5 = 32; 2^6 = 64; ...$

First bit (the leftmost) indicates the sign,

1 = negative, 0 = positive.

The least number that is a power of 2 and is larger than the actual length so that the first bit (leftmost) could be zero is: 8.

Step 5: Positive binary computer representation on 8 bits - if needed, add extra 0s in front (to the left) of the base 2 number, up to the required length:

$\Rightarrow 93_{(10)} = 01011101$

Step 6: To get the negative integer number representation on 8 bits, signed binary one's complement, replace all the bits on 0 with 1s and all the bits set on 1 with 0s (reversing the digits):

01011101 = 10100010

Step 7: To get the negative integer number representation on 8 bits, signed binary two's complement, add 1 to the number calculated above in step 6:

$\Rightarrow$ 10100010 + 1 = 10100011

Conclusion:

Number -93, a signed integer, converted from decimal system (base 10) to a signed binary two's complement representation is $-93_{(10)} = 10100011$

Que. 95 Consider the values $A = 2.0 \times 10^{30}$, $B = -2.0 \times 10^{30}$ C = 1.0. Assume, that the floating point numbers are represented with 32 bits. What are the values of X and Y, when the following sequence of operations are executed on a computer?

X = A + B

Y = A + C

X = X + C

Y = Y + B

1. X = 1.0, Y = 1.0
2. X = 1.0, Y = 0.0
3. X = 0.0, Y = 1.0
4. X = 0.0, Y = 0.0

Testbook Solution Correct Option **- 2**

Concept:

Floating point have precision up to 6 places only.

Explanation:

Since A and B are floating point integers, and floating point have precision up to 6 places. Hence these floating point operations will give the following results.

X = A + B = 0.0

C = 1.0 and A has 10^{30} digits, C becomes negligible. As the precision is only up to 6 decimal places, it will remain A.

Y = A + C = A

X = X + C = 0.0 + 1.0 = 1.0

Y = Y + B = A + B = 0.0

Que. 96 The Boolean expression X (X + Y) is same as

1. X . (1 + Y)
2. X
3. X . 1
4. All of these

Testbook Solution Correct Option **- 4**

Given expression:

X (X + Y)

X.X + X.Y

By property

A . A = A

X + XY

Take common X

→ **X . (1 + Y)**

→ **X . 1**

→ **X**

Important Point

Name	AND Form	OR Form
Identity law	1.A = A	0 + A = A
Null Law	0.A = 0	1 + A = 1
Idempotent Law	A.A = A	A + A = A
Inverse Law	AA' = 0	A + A' = 1
Commutative Law	AB = BA	A + B = B + A
Associative Law	(AB)C	(A + B) + C = A + (B + C)
Distributive Law	A + BC = (A + B)(A + C)	A(B + C) = AB + AC
Absorption Law	A(A + B) = A	A + AB = A
De Morgan's Law	(AB)' = A' + B'	(A + B)' = A'B'

Que. 97 How many bytes are there in a nibble?

1. one - fourth

2. half
3. 2
4. 4

Testbook Solution Correct Option **- 2**
Bit:

- The **smallest unit of data** in a computer is called Bit (Binary Digit).
- A bit has a single binary value, either **0 or 1.**

Nibble:

- Half a byte **(four bits)** is called a nibble.
- There is a **half byte in a nibble.**

Byte:

- In most computer systems, a byte is a unit of data that is **eight binary digits long**.
- **1 Byte has 2 Nibble.**
- A byte is a unit most computers use to represent a character such as a letter, number, or typographic symbol (for example, “g”, “5”, or “?”).

Bit: 1 digit
Nibble: 4 digits
Byte: 8 digits

Que. 98 The number of bit strings of length 8, that start with the bit 0 or end with the bits 11 is

1. 132
2. 180
3. 256
4. 160

Testbook Solution Correct Option **- 4**
Consider the 8-bit number with 8 blanks as shown _ _ _ _ _ _ _ _
case 1: Probability of number having first bit as 0 can be given as P(0)
⇒ 0 _ _ _ _ _ _ _ ⇒ each blank can be filled in 2 ways either 1 or 0
then, $P(0) = 2^7 = 128$ combinations is possible
case 2: Probability of number having last bits as 11 can be given as P(11)
⇒ _ _ _ _ _ _ 1 1 ⇒ each blank can be filled in 2 ways either 1 or 0
then, $P(11) = 2^6 = 64$ combinations is possible
case 3: Probability of number having first bit as 0 last bits as 11 can be given as P(0 & 11)
⇒ 0 _ _ _ _ _ 1 1 ⇒ each blank can be filled in 2 ways either 1 or 0
then, $P(0 \& 11) = 2^5 = 32$ combinations is possible

Finally, the total number of combinations possible for having an 8-bit number that starts with the bit 0 or ends with the bits 11 is P(T)

P(T) = P(0) + P(11) - P(0 & 11)

P(T) = 128 + 64 - 32 = 160.

Que. 99 The result of multiplication of the numbers $(10101)_2$ and $(11101)_2$ in hexadecimal form is

1. 609
2. 216
3. 261
4. 906

Testbook Solution Correct Option **- 3**

Concept:

Multiplication process:

Step 1: Convert the given binary numbers to decimal

Step 2: Perform multiplication operation to the decimal numbers

Step 3: Convert the result to requires number system.

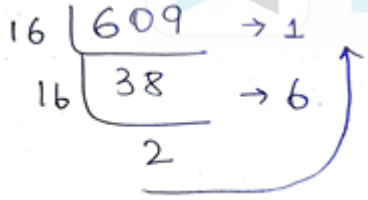
Calculation:

$\Rightarrow (10101)_2 = 2^4 + 2^2 + 2^0 = (21)_{10}$

$\Rightarrow (11101)_2 = 2^4 + 2^3 + 2^2 + 20 = (29)_{10}$

$\Rightarrow 21 \times 29 = (609)_{10}$

Then we convert resulted decimal to hexa decial as shown below



∴ **Result in hexa decimal form = $(261)_{16}$**

Que. 100 The binary equivalent of $(531.53125)_{10}$ is

1. $(10010100111.00001)_2$
2. $(1000010011.10011)_2$
3. $(1010010011.11001)_2$
4. $(1000010011.10001)_2$

Testbook Solution Correct Option **- 1**

CONCEPT:

Convert decimal to binary

Conversion steps:

- Divide the number by 2.
- Get the integer quotient for the next iteration.
- Get the remainder for the binary digit.
- Repeat the steps until the quotient is equal to 0.

Conversion of Fractional Decimal Numbers into Binary Numbers:

Fractional numbers can be converted to binary form by successive multiplication by 2. In each step, the digit before the decimal point is being transferred binary record and the process is repeated with the remaining fraction.

The last step is reached, if the fraction part is zero or it is terminated, when the desire accuracy is attained.

Note:

The first bit obtained is the most significant and the last is the least significant.

CALCULATION:

Here, we have to find the binary equivalent of the number 531.53125

Integer part: 531

Fractional part: 0.53125

Convert integer part into binary:

		Remainder
2	**531**	**1**
2	**265**	**1**
2	**132**	**0**
2	**66**	**0**
2	**33**	**1**
2	**16**	**0**
2	**8**	**0**
2	**4**	**0**
2	**2**	**0**
	1	

So, the binary equivalent of 531 is $(1000010011)_2$

Now let's convert fractional part into binary:

$0.53125 \times 2 = 1.0625$ [1]

$0.0625 \times 2 = 0.125$ [0]

$0.125 \times 2 = 0.25$ [0]

$0.25 \times 2 = 0.5$ [0]

$0.5 \times 2 = 1.00$ [1]

So, the binary equivalent of 0.53125 is $(0.10001)_2$

So, the binary equivalent of the decimal number 531.53125 is $\mathbf{(1000010011.10001)_2}$

Que. 101 Fill in the blank with a correct word.

The kitten was soaked to the skin from the _____.

1. craven
2. storm
3. abyss
4. wind

Testbook Solution Correct Option **- 2**

The correct answer is- **storm.**

Key-Points

- Let's have a look at the meanings of the given words:
  - **craven-** contemptibly lacking in courage; cowardly
  - **storm-** a violent disturbance of the atmosphere with strong winds and usually rain, thunder, lightning, or snow
  - **abyss-** a deep or seemingly bottomless chasm
  - **wind-** the perceptible natural movement of the air, especially in the form of a current of air blowing from a particular direction
- As per the **meanings and the description of the kitten's state (wet),** the correct choice will be the **2nd option i.e. storm.**

Correct Sentence: *The kitten was soaked to the skin from the **storm**.*

Que. 102 Fill in the blank with a correct word.

The ship was attacked by _____ near a deserted Island.

1. burglars
2. gangsters
3. pirates
4. thieves

Testbook Solution Correct Option **- 3**

The correct answer is - **pirates.**

Key-Points

- Let's look at the meanings of the given words:
  - **burglars-** a person who commits burglary
  - **gangsters-** a member of a gang of violent criminals
  - **pirates-** a person who attacks and robs ships at sea
  - **thieves-** a person who steals another person's property, especially by stealth and without using force or violence
- As per the **meanings and the description of the place,** the correct choice will be the **3rd option i.e. pirates.**

Correct Sentence: *The ship was attacked by **pirates** near a deserted Island.*

Que. 103 **From the given alternatives, chosen the one which best express the given sentence in indirect/direct speech.**

The boy said, 'Who dare call you a thief?'

1. The boy enquired who dared call him a thief
2. The boy asked who called him a thief
3. The boy told that who dared called him a thief
4. The boy wondered who dared called him a thief

Testbook Solution Correct Option **- 1**
The correct answer is - **The boy enquired who dared call him a thief.**

Key-Points

- Let's look at the steps to change the sentence from **direct to indirect speech:**
- When the direct speech is in the **interrogative** form, we follow the steps given below:
  - Change the sentence in the **direct speech** from **interrogative** to **assertive**.
  - The **tense** of **reported speech** is changed only when the **reporting verb** is in the **past tense**.
  - The reporting verb **said** is converted into **enquired.**
  - The **present simple tense** (are planning) in direct speech changes to the **past simple** in **indirect** as: **Subject + V_2 + Object.**
  - Therefore, the verb '**dare**' becomes '**dared**'.
  - The **personal pronouns** will be changed according to the **subject and object** of the **reporting verb.**
  - Here, **'you'** will be converted into **'him'** as per the **subject i.e. The boy.**
- At last, line up the remaining part.

Following these steps, we finally get - *The boy enquired who dared call him a thief.*

Que. 104 **Choose the one which can be substituted for the sentence.**

"The study of ancient societies'.

1. Anthropology
2. Archeology
3. History
4. Etnology

Testbook Solution Correct Option **- 1**
The correct answer is- **Anthropology.**

Key-Points

- Let's look at the meaning of the marked option:
  - **Anthropology-** the study of human societies and cultures and their development
- Let's look at the meanings of the other given options:
  - **Archeology-** the study of human history and prehistory through the excavation of sites and the analysis of artifacts and other physical remains
  - **History-** the study of past events, particularly in human affairs
  - **Ethnology-** the study of the characteristics of various peoples and the differences and relationships between them
- Hence, from the given meanings, we find that **Anthropology** is the correct **one-word substitute.**

Que. 105 Population explosion, malnutrition and ill health are the problems that modern scientists examine for solutions. The agriculture scientists are required to concentrate not only on large production, but also more on improved varieties and protein-rich foods to ward off the ills of malnutrition. The medical scientists responsibilities is not limited to the manufacture of drugs to cure diseases, they must invent medicines to rpot zumanity from epidemics. UoJess important is the area of war and weapons.

The large scale devastation in Japan by the atom bomb is a stigma on the lair name of scientist. The modem scientist must make a point not to help in the proliferation of atomic weapons. They should rather devote their energies to the peaceful uses of atomic energy for the emancipation of humanity from hunger and diseases. They must realise that the benefit of their researches and inventions should reach the hands of all, the rich and poor alike.

What does the expression 'malnutrition' used in the passage mean?

1. Excessive nourishment
2. Prevention of epidemics
3. Proliferation of diseases
4. Lack of proteins

Testbook Solution Correct Option **- 4**
The correct answer is- **Lack of proteins.**

Key-Points

- Let's have a look at the **2nd sentence** from the **1st** paragraph:
  - *"The agriculture scientists are required to concentrate not only on a large production but also more on improved varieties and protein-rich foods to ward off the ills of malnutrition."*
- Upon perusal of the above statement, it can be concluded that **malnutrition is primarily linked to lack of proteins.**

Que. 106 Modern scientists must make point not to help-

1. In the peaceful use of atomic energy
2. In the prevention of malnutrition
3. In the proliferation of atomic weapons
4. In the removal of ill health

Testbook Solution Correct Option **- 3**
The correct answer is- **In the proliferation of atomic weapons.**

Key-Points

- Let's have a look at the **2nd sentence** from the **2nd** paragraph:
  - *"The modem scientist must make a point not to help in the proliferation of atomic weapons."*
- Upon perusal of the above statement, it can be concluded that **modern scientists must not help in the proliferation of atomic weapons.**

Que. 107 **Change the voice:**

Why did your brother write such a letter?

1. Why was such a letter written by your brother?
2. Why did your brother write such a letter?
3. Why was such a letter wrote by your brother?
4. Why does your brother write such a letter?

Testbook Solution Correct Option **- 1**
The correct answer is- **Why was such a letter written by your brother?**

Key-Points

- The given sentence is in an **active voice form**, hence we need to convert it into a **passive voice form.**
- We need to follow these instructions while changing the voice of an **interrogative sentence**.
  - The **interrogative word 'Why'** will remain at its **original position.**
  - Find the **subject (your brother)** and **object (such a book)** of the sentence and **exchange their places.**
  - The **passive verb form** for the **simple past interrogative** sentence: **was/were + subject + past participle form of the verb.**
  - So, '**did your brother write**' changes into '**was such a letter written**'.
- At last line up the remaining part.
- Following this structure, we get the **1st option** as the correct answer.

Following these steps, we finally get- *Why was such a letter written by your brother?*

Que. 108 **The first and the last parts of a sentence are numbered as 1 and 6. The rest of the sentence is split into four parts named P, Q, R, S. These four parts are not given in their proper order. Read the sentence and find out which of the four combinations is correct.**

1. Let's never

P. that food

Q. virtually impossible

R. forget

S. is seductive and

6. to resist

1. SRPQ
2. PSRQ
3. QSRP
4. RPSQ

Testbook Solution Correct Option **- 4**
The correct answer is- **RPSQ.**

Key-Points

- While arranging the parts of the passage, we should find some grammatical or contextual connections between them-
  - The introductory phrase '**Let's never**' is given.
  - **Sentence R contains the required verb 'forget' qualified by the adverb 'never'.** Hence it will be put in the **first place.**

- **Sentence P** follows **sentence R** as it **starts with** the conjunction **'that' which introduces another clause.** It will be put in **second place.**
- **Sentence S** is in **continuation** of the previous sentence. Hence it will be the **3rd** sentence.
- **The last sentence is Q.**

- Thus, the correct order is- **RPSQ.**

Que. 109 Arrange the given words to form a meaningful sentence

(a) dejected

(b) students

(c) lot

(d) of

(e) a

(f) were

1. dbfeac
2. abfecd
3. ecdbfa
4. afebcd

Testbook Solution Correct Option **- 3**
The correct answer is- **ecdbfa.**

Key-Points

- Let's look at the explanation given below:
  - An **assertive sentence** generally starts with a **noun, pronoun, or an article followed by an auxiliary verb or a verb.**
  - In this way, **the 2nd and the 4th option are rejected** as these options start with the **verb i.e. dejected.**
  - In this way, the **1st option is also rejected** as this option starts with a **preposition i.e. of.**
  - Thus we are left with the only correct choice: **ecdbfa.**

Thus, the correct sentence would be: **ecdbfa.**

Que. 110 Fill in the blank with the appropriate question tag.

She lives in Chennai now, _____.

1. lives she?
2. doesn't she?
3. does she?
4. she does?

Testbook Solution Correct Option **- 2**
The correct answer is- **doesn't she?**

Key-Points

- If the **statement** is **negative**, the **question tag** must be **positive** and **vice versa.**
- The **sentence** and the **question tag** must be in the **same tense.**
- There is no contracted form of **'am not',** the question tag **'aren't I'** is used.
- Example:
  - *I am fine here,* ***were I?*** ✗
  - *I am fine here,* ***aren't I?*** ✓
- Thus in the **blank** part of the given question, **'doesn't she?'** will be the correct choice.

Correct Sentence: *She lives in Chennai now,* ***doesn't she?***

Additional Information

- If the sentence starts with **'There',** the question tag will have **'there'** instead of the **pronoun.**
- Example:
  - *There is no air in space,* ***was there?*** ✗
  - *There is no air in space,* ***is there?*** ✓

Que. 111 Pick out the correct word that best expresses the meaning of the given word.

Prudent

1. Skillful
2. Efficient
3. Wise
4. Profitable

Testbook Solution Correct Option **- 3**

The correct answer is- **Wise.**

Key-Points

- Let's look at the meanings of the given word and marked option:
  - **Prudent-** acting with or showing care and thought for the future
  - **Wise-** having or showing experience, knowledge, and good judgment
- Let's look at the meanings of the other given options:
  - **Skillful-** having or showing skill
  - **Efficient-** (especially of a system or machine) achieving maximum productivity with minimum wasted effort or expense
  - **Profitable-** (of a business or activity) yielding profit or financial gain
- Hence from the given meanings, we find that **Prudent** and **Wise** are **synonyms.**

Que. 112 Choose the correct article for the sentence below

"Many _____ flower is born to blush unseen."

1. an
2. the
3. a

4. No article

Testbook Solution Correct Option **- 3**
The correct answer is- **a.**

Key-Points

- In a sentence, the **verb** is used according to **person and number.**
- In the case of the **following words**, the **verbs** used will be **singular:**
  - **Each, every/everyone, someone/somebody, none/ nobody, one, any, Many a, more than one, etc.**
- For example:
  - Everyone **are** addicted to smartphones nowadays. ✗
  - Everyone **is** addicted to smartphones nowadays. ✓
- The phrase **'Many a'** is always followed by a **singular noun i.e. flower (in this case).**
- As per the rule and phrases given above, **'a'** will be used in the blank part of the given question.

Correct Sentence: *"Many **a** flower is born to blush unseen."*

Que. 113 The synonym of 'stupendous' is

1. astounding
2. horrible
3. appealing
4. comforting

Testbook Solution Correct Option **- 1**
The correct answer is- **astounding.**

Key-Points

- Let's look at the meanings of the given word and marked option:
  - **astounding-** surprisingly impressive or notable
  - **stupendous-** extremely impressive
- Let's look at the meanings of the other given options:
  - **horrible-** causing or likely to cause horror; shocking
  - **appealing-** make a serious or urgent request, typically to the public
  - **comforting-** serving to alleviate a person's feelings of grief or distress
- Hence from the given meanings, we find that **stupendous** and **astounding** are **synonyms.**

Que. 114 Select the pair with the same relationship AFTER : BEFORE

(a) FIRST	SECOND
(b) CONTEMPORARY	HISTORIC
(c) PRESENT	PAST
(d) SUCCESSOR	PREDECESSOR

1. a

2. b
3. c
4. d

Testbook Solution Correct Option **- 4**
The correct answer is- **d.**

Key-Points

- The pair of the words given in the question consists of **antonyms**.
- Let's look at the meaning of the marked option **a pair of antonyms:**
  - **Successor-** a person or thing that succeeds another
  - **Predecessor-** a person who held a job or office before the current holder, A thing that has been followed or replaced by another.
- Hence, from the given meanings, we find that **d** is the correct option.
- Let's look at the possible **pair of antonyms** for the other options:
  - **First- Last**
  - **Contemporary- Old fashioned**
  - **Present- Absent/Past/Future**

Que. 115 Choose the one which can be substituted for the phrase.

"A person who insists on something"

1. Disciplinarian
2. Stickler
3. Instantaneous
4. Boaster

Testbook Solution Correct Option **- 2**
The correct answer is- **Stickler.**

Key-Points

- Let's look at the meaning of the marked option:
  - **Stickler-** a person who insists on a certain quality or type of behavior
- Let's look at the meanings of the other given options:
  - **Disciplinarian-** a person who believes in or practices firm discipline
  - **Instantaneous-** occurring or done in an instant or instantly
  - **Boaster-** a person talking with excessive pride and self-satisfaction
- Hence, from the given meanings, we find that **Stickler** is the correct **one-word substitute.**

Que. 116 Choose the correct form of the verb for the sentence below.

I propose that the meeting _____ put off till Sunday next.

1. will be
2. is to be
3. should be
4. be

Testbook Solution Correct Option **- 3**

The correct answer is- **should be.**

Key-Points

- The modal verb '**should**' is the **past tense** form of '**shall**' in indirect speech.
- It is used to **talk about what is the ideal or best thing to do in a situation, give advice and make suggestions, talk about what is likely to happen, etc.**
- Example:
  - *There **should** be more public hospitals. **(ideal situation)***
  - *You **should** tell him what you think. **(suggestion or advice)***
- The verb '**propose**' used at the beginning of the sentence suggests that **the subject suggests postponing the meeting until next Sunday.**
- Thus the **3rd option i.e. 'should be'** will be used as per the rule given above.

Correct Sentence: *I propose that the meeting **should be** put off till Sunday next.*

Additional Information

- Let's have a look at the **modal** formations given below:
  - **Can/could not help + V_1 + ing**
  - **Can/could not help + but + V_1**
- Both of the phrases mean to have a **compulsion** to do something that is **too strong** to **ignore or avoid.**
- Example:
  - *My cousin **can't help but meddling** in my life.* ✗
  - *My cousin **can't help but meddle** in my life.* ✓

Que. 117 Fill in the blank with the correct preposition.

The policeman told me to keep _____ the left.

1. for
2. of
3. to
4. by

Testbook Solution Correct Option **- 3**

The correct answer is**- to.**

Key-Points

- Let's look at the meanings of the following phrasal verbs:
  - **keep at-** continue with something difficult
  - **keep from-** control or refrain
  - **keep to-** stay within limits
  - **keep up-** maintain a continuous action or persist
- Of the given options, only the **3rd option i.e. to** makes sense with the given verb.
- As per the context of the sentence, **the subject was told by the policeman to stay to the left side.**
- Thus the preposition '**to**' will be the correct choice in the **blank** part of the sentence.

Correct Sentence: *The policeman told me to keep **to** the left.*

Que. 118 Choose the most suitable synonym for the word "Amicable".

1. Just
2. Pleasant
3. Peaceful
4. Complete

Testbook Solution Correct Option **- 2**
The correct answer is- **Pleasant.**

Key-Points

- Let's look at the meanings of the given word and marked option:
  - **Amicable-** (of relations between people) having a spirit of friendliness
  - **Pleasant-** giving a sense of happy satisfaction or enjoyment
- Let's look at the meanings of the other given options:
  - **Just-** based on or behaving according to what is morally right and fair
  - **Peaceful-** free from disturbance; tranquil
  - **Complete-** having all the necessary or appropriate parts
- Hence from the given meanings, we find that **Amicable** and **Pleasant** are **synonyms.**

Que. 119 Choose the most suitable antonym for the word 'Rude'.

1. Sweet
2. Polite
3. Decent
4. Gentle

Testbook Solution Correct Option **- 2**
The correct answer is- **Polite.**

Key-Points

- Let's look at the meanings of the given word and marked option:
  - **Rude-** offensively impolite or ill-mannered
  - **Polite-** having or showing behavior that is respectful and considerate of other people
- Let's look at the meanings of the other given options:
  - **Sweet-** having the pleasant taste characteristic of sugar or honey; not salty, sour, or bitter
  - **Decent-** conforming with generally accepted standards of respectable or moral behavior
  - **Gentle-** having or showing a mild, kind, or tender temperament or character
- Hence from the given meanings, we find that **Rude** and **Polite** are **antonyms.**

Que. 120 Choose the word that matches suitably with the word underlined in the given sentence.

"Developing indigenous technology is important to lead the nation to self-sufficiency."

1. Intelligent
2. Native

3. Capitalistic
4. Wise

Testbook Solution Correct Option **- 2**
The correct answer is- **Native.**

Key-Points

- Let's look at the meanings of the given word and marked option:
  - **Indigenous-** originating or occurring naturally in a particular place; **Native**
- Let's look at the meanings of the other given options:
  - **Intelligent-** having or showing intelligence, especially of a high level
  - **Capitalistic-** supporting or based on the principles of capitalism
  - **Wise-** having or showing experience, knowledge, and good judgment
- Hence from the given meanings, we find that **Indigenous** and **Native** are **synonyms.**

120 Questions

Que. 1	Correct Option - 2
Que. 2	Correct Option - 4
Que. 3	Correct Option - 2
Que. 4	Correct Option - 3
Que. 5	Correct Option - 2
Que. 6	Correct Option - 2
Que. 7	Correct Option - 3
Que. 8	Correct Option - 3
Que. 9	Correct Option - 1
Que. 10	Correct Option - 2
Que. 11	Correct Option - 3
Que. 12	Correct Option - 2
Que. 13	Correct Option - 4
Que. 14	Correct Option - 3
Que. 15	Correct Option - 3
Que. 16	Correct Option - 3
Que. 17	Correct Option - 3
Que. 18	Correct Option - 3
Que. 19	Correct Option - 1
Que. 20	Correct Option - 4
Que. 21	Correct Option - 1
Que. 22	Correct Option - 3
Que. 23	Correct Option - 4
Que. 24	Correct Option - 3
Que. 25	Correct Option - 2

Que. 26	Correct Option - 3
Que. 27	Correct Option - 2
Que. 28	Correct Option - 3
Que. 29	Correct Option - 4
Que. 30	Correct Option - 2
Que. 31	Correct Option - 1
Que. 32	Correct Option - 2
Que. 33	Correct Option - 4
Que. 34	Correct Option - 4
Que. 35	Correct Option - 1
Que. 36	Correct Option - 1
Que. 37	Correct Option - 1
Que. 38	Correct Option - 4
Que. 39	Correct Option - 1
Que. 40	Correct Option - 1
Que. 41	Correct Option - 3
Que. 42	Correct Option - 4
Que. 43	Correct Option - 3
Que. 44	Correct Option - 2
Que. 45	Correct Option - 4
Que. 46	Correct Option - 2
Que. 47	Correct Option - 1
Que. 48	Correct Option - 2
Que. 49	Correct Option - 1
Que. 50	Correct Option - 1
Que. 51	Correct Option - 2

Que. 52	Correct Option - 4
Que. 53	Correct Option - 2
Que. 54	Correct Option - 4
Que. 55	Correct Option - 3
Que. 56	Correct Option - 4
Que. 57	Correct Option - 1
Que. 58	Correct Option - 2
Que. 59	Correct Option - 2
Que. 60	Correct Option - 3
Que. 61	Correct Option - 1
Que. 62	Correct Option - 1
Que. 63	Correct Option - 1
Que. 64	Correct Option - 2
Que. 65	Correct Option - 1
Que. 66	Correct Option - 1
Que. 67	Correct Option - 3
Que. 68	Correct Option - 3
Que. 69	Correct Option - 1
Que. 70	Correct Option - 4
Que. 71	Correct Option - 2
Que. 72	Correct Option - 4
Que. 73	Correct Option - 4
Que. 74	Correct Option - 3
Que. 75	Correct Option - 1
Que. 76	Correct Option - 4
Que. 77	Correct Option - 3
Que. 78	

	Correct Option - 3
Que. 79	Correct Option - 4
Que. 80	Correct Option - 3
Que. 81	Correct Option - 2
Que. 82	Correct Option - 2
Que. 83	Correct Option - 1
Que. 84	Correct Option - 4
Que. 85	Correct Option - 3
Que. 86	Correct Option - 2
Que. 87	Correct Option - 4
Que. 88	Correct Option - 3
Que. 89	Correct Option - 3
Que. 90	Correct Option - 4
Que. 91	Correct Option - 1
Que. 92	Correct Option - 3
Que. 93	Correct Option - 2
Que. 94	Correct Option - 1
Que. 95	Correct Option - 2
Que. 96	Correct Option - 4
Que. 97	Correct Option - 2
Que. 98	Correct Option - 4
Que. 99	Correct Option - 3
Que. 100	Correct Option - 1
Que. 101	Correct Option - 2
Que. 102	Correct Option - 3
Que. 103	Correct Option - 1
Que. 104	

	Correct Option - 1
Que. 105	Correct Option - 4
Que. 106	Correct Option - 3
Que. 107	Correct Option - 1
Que. 108	Correct Option - 4
Que. 109	Correct Option - 3
Que. 110	Correct Option - 2
Que. 111	Correct Option - 3
Que. 112	Correct Option - 3
Que. 113	Correct Option - 1
Que. 114	Correct Option - 4
Que. 115	Correct Option - 2
Que. 116	Correct Option - 3
Que. 117	Correct Option - 3
Que. 118	Correct Option - 2
Que. 119	Correct Option - 2
Que. 120	Correct Option - 2