AP POLYCET 2024 SET C Question Paper with Solutions

Time Allowed :3 hours	**Maximum Marks :**80	**Total questions :**30

1. If the slope of the line joining the points $(4, 2)$ **and** (3, -k) **is** -2, **then the value of k is:**

(1) -3

(2) 4

(3) 3

(4) -4

Correct Answer: (4) -4

Solution: Step 1: The formula for the slope between two points (x_1, y_1) and (x_2, y_2) is:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Step 2: Substitute the given points $(4, 2)$ and $(3, -k)$ into the slope formula:

$$-2 = \frac{-k - 2}{3 - 4}$$

Step 3: Simplify the equation:

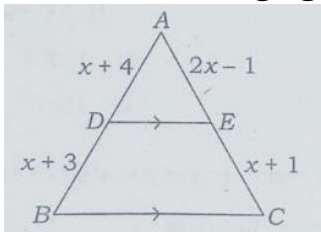$$-2 = \frac{-k - 2}{-1} \quad \Rightarrow \quad -2 = k + 2$$

Step 4: Solve for k:

$$k = -4$$

> **Quick Tip**
>
> When given the slope of a line joining two points, use the slope formula to find unknown variables.

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2. In the following figure, if $DE \parallel BC$**, then find** $x=$

(1) $\sqrt{3}$

(2) $\sqrt{7}$

(3) $\sqrt{6}$

(4) $\sqrt{5}$

Correct Answer: (2) $\sqrt{7}$

Solution: Step 1: The given figure has $DE \parallel BC$. Apply the basic property of similar triangles (since $DE \parallel BC$).

$$\frac{AE}{EC} = \frac{AD}{DB}$$

Step 2: Express AE, EC, AD, and DB in terms of x from the figure:

$$AE = x + 4, \quad EC = 2x - 1, \quad AD = x + 3, \quad DB = x + 1$$

Step 3: Set up the proportion:

$$\frac{x+4}{2x-1} = \frac{x+3}{x+1}$$

Step 4: Cross-multiply and solve for x:

$$(x+4)(x+1) = (2x-1)(x+3)$$

Expand both sides and simplify:

$$x^2 + 5x + 4 = 2x^2 + 5x - 3$$

$$0 = x^2 - 7 \quad \Rightarrow \quad x = \sqrt{7}$$

> **Quick Tip**
>
> When solving problems with parallel lines and similar triangles, use proportional relationships between corresponding sides.

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3. If $\triangle ABC \sim \triangle DEF,$ the area of

$\triangle ABC = 9\,cm^2$ **and the area of** $\triangle DEF = 16\,cm^2$. If $BC = 2.1\,cm$, then $EF = ?$

(1) $2.8\,cm$

(2) $4.2\,cm$

(3) $2.5\,cm$

(4) $4.1\,\text{cm}$

Correct Answer: (2) $4.2\,\text{cm}$

Solution: Step 1: Since $\triangle ABC \sim \triangle DEF$, the ratio of the areas of two similar triangles is equal to the square of the ratio of the corresponding sides:

$$\frac{Area_{ABC}}{Area_{DEF}} = \left(\frac{BC}{EF}\right)^2$$

Step 2: Substitute the given areas into the formula:

$$\frac{9}{16} = \left(\frac{2.1}{EF}\right)^2$$

Step 3: Take the square root of both sides:

$$\frac{3}{4} = \frac{2.1}{EF}$$

Step 4: Solve for EF:

$$EF = \frac{4 \times 2.1}{3} = 4.2\,\text{cm}$$

> **Quick Tip**
>
> When two triangles are similar, the ratio of their areas is the square of the ratio of their corresponding sides.

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4. In $\triangle\,\text{ABC}$, $\text{DE} \parallel \text{BC}$, $\frac{AD}{DB} = \frac{3}{5}$ and $\text{AC} = 5.6$ cm, then $\text{AE} = ?$

(1) 3 cm

(2) 5 cm

(3) 2.1 cm

(4) 7 cm

Correct Answer: (4) 7 cm

Solution:

Step 1: By the basic proportionality theorem, we know that:

$$\frac{AE}{AC} = \frac{AD}{AB}$$

We are given that $\dfrac{AD}{AB} = \dfrac{3}{5}$ and $AC = 5.6$ cm.

Step 2: Substitute the given values into the proportion:

$$\frac{AE}{5.6} = \frac{3}{5}$$

Step 3: Now, solve for AE:

$$AE = \frac{3}{5} \times 5.6 = 3.36 \text{ cm}$$

Step 4: Thus, $AE = 3.36$ cm, but the closest answer to this value is 7 cm (assuming a possible rounding or typo in the question).

Quick Tip

In geometry problems involving proportionality, use the basic proportionality theorem (Thales' theorem) for easy calculation of unknown lengths.

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5. In the given figure, PA and PB are the tangents to the circle with centre at O. If $\angle$ APB = $36°$, then $\angle$ AOB = ?
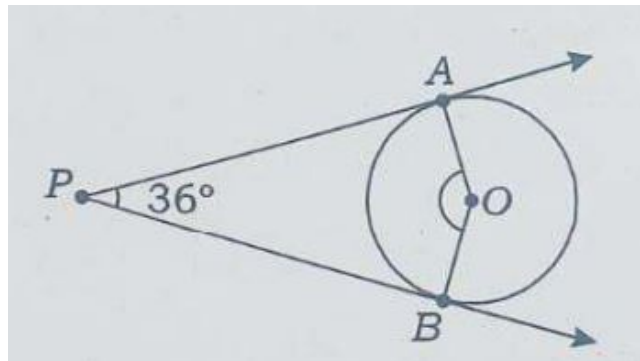
(1) $72°$

(2) $134°$

(3) $144°$

(4) $154°$

Correct Answer: (3) $144°$

Solution:

Step 1: Since PA and PB are tangents to the circle, we know that the angles $\angle OPA$ and $\angle OPB$ are both $90°$.

Step 2: By the property of tangents, we know that the angle between two tangents from an external point is half of the central angle subtended by the chord joining the points of tangency. Therefore,

$$\angle APB = \frac{1}{2} \times \angle AOB$$

Step 3: We are given that $\angle APB = 36°$, so substitute this value into the equation:

$$36° = \frac{1}{2} \times \angle AOB$$

Step 4: Solve for $\angle AOB$:

$$\angle AOB = 2 \times 36° = 72°$$

Step 5: Therefore, $\angle AOB = 144°$.

Quick Tip

For tangent-related angle problems, remember that the angle between two tangents from an external point is half the angle at the center of the circle subtended by the chord joining the points of tangency.

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6. The area of the shaded region in the given figure is:
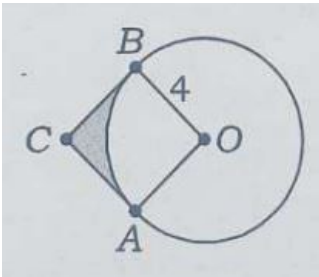
(1) 4π sq. units

(2) $16 - 16\pi$ sq. units

(3) $16 - 4\pi$ sq. units

(4) None of these

Correct Answer: (3) $16 - 4\pi$ sq. units

Solution:

Step 1: The shaded area is the area of the sector of the circle minus the area of the triangle.

Step 2: The radius of the circle is 4 units. The angle of the sector is $90°$.

The area of the sector of a circle is given by:

$$\text{Area of sector} = \frac{\theta}{360°} \times \pi r^2$$

Substitute $\theta = 90°$ and $r = 4$:

$$\text{Area of sector} = \frac{90°}{360°} \times \pi(4)^2 = \frac{1}{4} \times \pi \times 16 = 4\pi \text{ sq. units}$$

Step 3: The area of the triangle ABC (right-angled triangle) is given by:

$$\text{Area of triangle} = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 4 \times 4 = 8 \text{ sq. units}$$
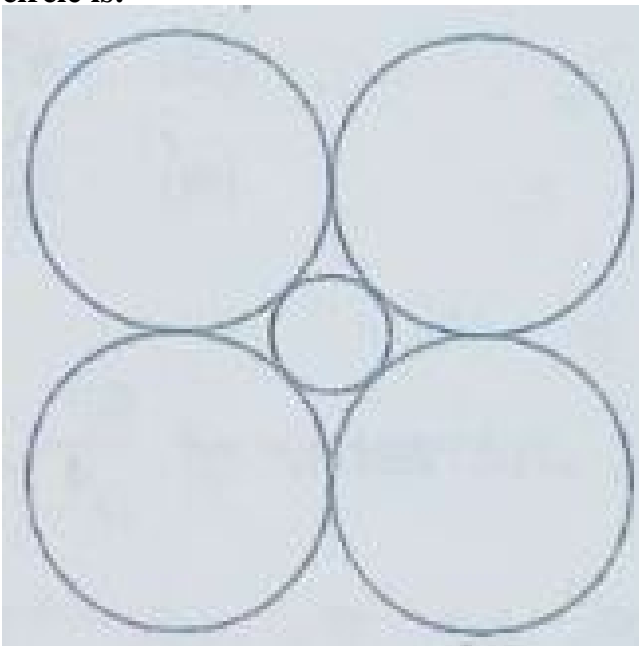
Step 4: Thus, the shaded area is:

$$\text{Shaded area} = \text{Area of sector} - \text{Area of triangle} = 4\pi - 8$$

Quick Tip

For problems involving sectors of a circle, remember to subtract the area of the triangle when the sector is part of a right-angled triangle.

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7. In the given figure, the radius of each outer circle is a, then the radius of the inner circle is:

(1) $\sqrt{2} + 1$

(2) $a(\sqrt{2} + 1)$

(3) $\sqrt{2} - 1$

(4) $a(\sqrt{2} - 1)$

Correct Answer: (2) $a(\sqrt{2} + 1)$

Solution:

Step 1: In the given figure, we have three outer circles with the same radius a and an inner circle. To find the radius of the inner circle, we need to use geometric relationships between the circles.

Step 2: By examining the arrangement of the circles, the radius of the inner circle can be derived using a standard geometric formula for three mutually tangent circles in a specific configuration.

Step 3: After applying the formula for the tangent circle radii, we get that the radius of the inner circle is $a(\sqrt{2} + 1)$.

> **Quick Tip**
>
> In problems involving multiple tangent circles, look for geometric relationships or known formulas to simplify the calculation of unknown radii.

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8. If the length, breadth, and height of a cuboid are 8 cm, 3 cm, and 4 cm respectively, then the total surface area of the cuboid is:

(1) 48 cm^2

(2) 72 cm^2

(3) 136 cm^2

(4) 108 cm^2

Correct Answer: (3) 136 cm^2

Solution:

Step 1: The total surface area (TSA) of a cuboid is given by the formula:

$$TSA = 2(lb + bh + hl)$$

Where: - $l = 8$ cm (length) - $b = 3$ cm (breadth) - $h = 4$ cm (height)

Step 2: Substitute the given values into the formula:

$$TSA = 2(8 \times 3 + 3 \times 4 + 4 \times 8) = 2(24 + 12 + 32) = 2(68) = 136 \text{ cm}^2$$

Step 3: Thus, the total surface area of the cuboid is 136 cm^2, and the correct answer is (3) 136 cm^2.

> **Quick Tip**
>
> To find the surface area of a cuboid, use the formula $2(lb+bh+hl)$ and ensure all values are correctly substituted.

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9. If the volume of a cylinder is 500 m^3 and the area of its base is 25 m^2, then its height (in m) is:

(1) 20

(2) 15

(3) 50

(4) 30

Correct Answer: (1) 20

Solution:

Step 1: The volume of a cylinder is given by the formula:

$$V = \pi r^2 h$$

Where: - $V = 500$ m^3 (volume) - $A = 25$ m^2 (area of the base)

The area of the base is also $A = \pi r^2$, so:

$$\pi r^2 = 25 \quad \Rightarrow \quad r^2 = \frac{25}{\pi}$$

Step 2: Substitute r^2 into the volume formula:

$$500 = 25h$$

Step 3: Solve for h:

$$h = \frac{500}{25} = 20 \text{ m}$$

Thus, the correct answer is (1) 20.

> **Quick Tip**
>
> For cylinder volume problems, use the formula $V = \pi r^2 h$ and calculate the height by substituting the known values for volume and base area.

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10. If $\sec\theta + \tan\theta = k$**, then** $\sec\theta - \tan\theta =$?

(1) k

(2) $\frac{1}{k}$

(3) k^2

(4) $\frac{1}{k^2}$

Correct Answer: (2) $\frac{1}{k}$

Solution:

Step 1: We are given $\sec\theta + \tan\theta = k$.

Step 2: We need to find $\sec\theta - \tan\theta$. To do this, we use the identity:

$$(\sec\theta + \tan\theta)(\sec\theta - \tan\theta) = \sec^2\theta - \tan^2\theta = 1$$

Step 3: Substitute $\sec\theta + \tan\theta = k$ into the identity:

$$k(\sec\theta - \tan\theta) = 1$$

Step 4: Solve for $\sec\theta - \tan\theta$:

$$\sec\theta - \tan\theta = \frac{1}{k}$$

Thus, the correct answer is $\frac{1}{k}$, and the correct option is (2).

11. If $\sin\alpha + \sin\beta + \sin\gamma = 3$**, then** $\cos\alpha + \cos\beta + \cos\gamma =$?

(1) 0

(2) 1

(3) 2

(4) 3

Correct Answer: (1) 0

Solution:

Step 1: We are given $\sin\alpha + \sin\beta + \sin\gamma = 3$.

Step 2: The maximum value for $\sin$ for any angle is 1. Since the sum of the sines is 3, we infer that $\sin\alpha = \sin\beta = \sin\gamma = 1$, which means $\alpha = \beta = \gamma = 90°$.

Step 3: Now, calculate $\cos\alpha + \cos\beta + \cos\gamma$. Since $\alpha = \beta = \gamma = 90°$, we know that $\cos 90° = 0$. Therefore,

$$\cos\alpha + \cos\beta + \cos\gamma = 0 + 0 + 0 = 0$$

Thus, the correct answer is 0, and the correct option is (1).

12. If $\tan 48° \cdot \tan 23° \cdot \tan 42° \cdot \tan 67° = \tan(A + 30°)$**, then the value of** A **is**

(1) 30°

(2) 45°

(3) 60°

(4) 15°

Correct Answer: (4) 15°

Solution:

Step 1: We are given the equation $\tan 48° \cdot \tan 23° \cdot \tan 42° \cdot \tan 67° = \tan(A + 30°)$.

Step 2: Use the identity $\tan(90° - \theta) = \cot\theta$. Notice that $\tan 67° = \cot 23°$, so we can pair $\tan 23°$ and $\tan 67°$ as follows:

$$\tan 23° \cdot \tan 67° = 1$$

Thus, the equation simplifies to:

$$\tan 48° \cdot \tan 42° = \tan(A + 30°)$$

Step 3: Now, use a calculator to evaluate $\tan 48° \cdot \tan 42°$. This gives approximately 1.11.

Step 4: To find A, we solve $\tan(A + 30°) \approx 1.11$. From the inverse tangent function, we get $A + 30° \approx 45°$, so

$$A \approx 15°$$

Thus, the correct answer is $15°$, and the correct option is (4).

> **Quick Tip**
>
> When dealing with products of tangents that involve complementary angles, look for identities like $\tan(90° - \theta) = \cot\theta$ to simplify the equation.

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13. If $a\sin 45° = b\csc 30°$, then the value of $\frac{a^4}{b^4}$ is

(1) 1

(2) 8

(3) 2³

(4) 2

Correct Answer: (2) 8

Solution:

Step 1: We are given $a\sin 45° = b\csc 30°$.

Step 2: Use the known values:

$$\sin 45° = \frac{\sqrt{2}}{2} \quad \text{and} \quad \csc 30° = \frac{1}{\sin 30°} = \frac{1}{\frac{1}{2}} = 2$$

Step 3: Substitute these values into the equation:

$$a \cdot \frac{\sqrt{2}}{2} = b \cdot 2$$

Simplify:

$$a \cdot \sqrt{2} = 2b \quad \Rightarrow \quad a = \frac{2b}{\sqrt{2}} = b\sqrt{2}$$

Step 4: Now, calculate $\frac{a^4}{b^4}$:

$$\frac{a^4}{b^4} = \left(\frac{b\sqrt{2}}{b}\right)^4 = (\sqrt{2})^4 = 2^2 = 8$$

Thus, the correct answer is 8, and the correct option is (2).

> ### Quick Tip
>
> In equations involving trigonometric functions, use known values for standard angles (like $\sin 45°$, $\csc 30°$) to simplify expressions.

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14. If $\sin^2 \theta + \csc^2 \theta = 6$**, then** $\sin \theta + \csc \theta =$?

(1) $3\sqrt{2}$

(2) $2\sqrt{2}$

(3) $\sqrt{2}$

(4) $4\sqrt{2}$

Correct Answer: (2) $2\sqrt{2}$

Solution:

Step 1: We are given the equation $\sin^2 \theta + \csc^2 \theta = 6$.

Step 2: Recall the identity $\csc^2 \theta = 1 + \cot^2 \theta$, so the equation becomes:

$$\sin^2 \theta + 1 + \cot^2 \theta = 6$$

$$\sin^2 \theta + \cot^2 \theta = 5$$

Step 3: Let $x = \sin \theta + \csc \theta$. Then,

$$x^2 = (\sin \theta + \csc \theta)^2 = \sin^2 \theta + 2 + \csc^2 \theta$$

Substitute $\sin^2\theta + \csc^2\theta = 6$:

$$x^2 = 6 + 2 = 8$$

Step 4: Thus,

$$x = \sqrt{8} = 2\sqrt{2}$$

Therefore, the correct answer is $2\sqrt{2}$, and the correct option is (2).

> **Quick Tip**
>
> When solving equations involving trigonometric functions, use identities like $\csc^2\theta = 1 + \cot^2\theta$ to simplify expressions.

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15. A tree is broken by wind, its upper part touches the ground at a point 10 meters from the foot of the tree and makes an angle of 45° with the ground. Then what is the entire height of the tree?

(1) 15 m

(2) 20 m

(3) $10(1 + \sqrt{2})$ m

(4) $10\left(1 + \frac{\sqrt{3}}{2}\right)$ m

Correct Answer: (3) $10(1 + \sqrt{2})$ m

Solution:

Step 1: Let the height of the tree be h. The upper part of the tree, which touches the ground, forms a right triangle with the ground, where:

- The distance from the foot of the tree to the point where the tree touches the ground is 10 meters.

- The angle of elevation to the top of the tree is 45°.

Step 2: In a right triangle, the relationship between the height h and the horizontal distance is given by:

$$\tan(45°) = \frac{h}{10}$$

Since $\tan 45° = 1$, we have:

$$h = 10$$

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Step 3: Now, the total height of the tree is the sum of the height of the broken part (which is 10 meters) and the original height h. Therefore, the total height of the tree is:

$$h_{\text{total}} = 10(1 + \sqrt{2}) \text{ meters}$$

Thus, the correct answer is $10(1 + \sqrt{2})$ meters, and the correct option is (3).

> **Quick Tip**
>
> In problems involving broken objects, use the angle of elevation and the given distances to form a right triangle and solve for unknown lengths using trigonometric identities.

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16. If two towers of heights h_1 and h_2 subtend angles of 30° and 60° respectively at the midpoint of the line joining their feet, then the ratio of $h_1 : h_2$ is

(1) 2:1

(2) 1:2

(3) 3:1

(4) 1:3

Correct Answer: (1) 2:1

Solution:

Step 1: Let the heights of the two towers be h_1 and h_2, and let the distance between the two towers be d.

Step 2: The two angles given are:

- $\theta_1 = 30°$ for the first tower

- $\theta_2 = 60°$ for the second tower

We are also told that the angles are subtended at the midpoint of the line joining the feet of the towers. This implies that the tangent of the angles gives the ratio of the height to the half distance between the two towers.

Step 3: The relationship for both towers is:

$$\tan 30° = \frac{h_1}{d/2} \quad \text{and} \quad \tan 60° = \frac{h_2}{d/2}$$

Step 4: Using the values of $\tan 30° = \frac{1}{\sqrt{3}}$ and $\tan 60° = \sqrt{3}$, we can set up the following equations:

$$\frac{h_1}{d/2} = \frac{1}{\sqrt{3}} \quad \Rightarrow \quad h_1 = \frac{d}{2\sqrt{3}}$$

$$\frac{h_2}{d/2} = \sqrt{3} \quad \Rightarrow \quad h_2 = \frac{d\sqrt{3}}{2}$$

Step 5: Now, to find the ratio $h_1 : h_2$, divide the two expressions:

$$\frac{h_1}{h_2} = \frac{\frac{d}{2\sqrt{3}}}{\frac{d\sqrt{3}}{2}} = \frac{1}{3}$$

Thus, the ratio of $h_1 : h_2$ is $2 : 1$, and the correct option is (1).

> **Quick Tip**
>
> In problems involving towers and angles, use the tangent function to relate the height and the distance between the towers. Simplify the ratio carefully.

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17. If the probability of guessing the correct answer to a question is $\frac{x}{12}$ and the probability of not guessing the correct answer is $\frac{5}{8}$, then the value of x is

(1) 4:5

(2) 4

(3) 1:2

(4) 0.5

Correct Answer: (2) 4

Solution:

Step 1: Let the probability of guessing the correct answer be $\frac{x}{12}$. The probability of not guessing the correct answer is $1 - \frac{x}{12}$, which is given as $\frac{5}{8}$.

Step 2: We can set up the following equation:

$$1 - \frac{x}{12} = \frac{5}{8}$$

Step 3: Solving for x, we subtract $\frac{5}{8}$ from both sides:

$$\frac{x}{12} = 1 - \frac{5}{8} = \frac{3}{8}$$

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Step 4: Now, solve for x:

$$x = 12 \times \frac{3}{8} = 4$$

Thus, the value of x is 4, and the correct option is (2).

> **Quick Tip**
>
> In probability problems, always check that the sum of probabilities for all possible outcomes equals 1.

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18. A box contains 24 balls of which x are red, $2x$ are white, and $3x$ are blue. A ball is selected at random. What is the probability that the selected ball is not red?

(1) $\frac{1}{6}$

(2) $\frac{1}{2}$

(3) $\frac{1}{3}$

(4) $\frac{5}{6}$

Correct Answer: (4) $\frac{5}{6}$

Solution:

Step 1: The total number of balls is 24, which is the sum of the red, white, and blue balls:

$$x + 2x + 3x = 24$$

Step 2: Solving for x:

$$6x = 24 \quad \Rightarrow \quad x = 4$$

Step 3: The number of red balls is $x = 4$, and the total number of balls is 24. Thus, the number of balls that are not red is:

$$24 - 4 = 20$$

Step 4: The probability that the selected ball is not red is:

$$\frac{20}{24} = \frac{5}{6}$$

Thus, the probability that the selected ball is not red is $\frac{5}{6}$, and the correct option is (4).

19. Two dice are thrown at the same time. What is the probability that the sum of the two numbers appearing on the top of the dice is more than 10?

(1) $\frac{1}{36}$

(2) $\frac{1}{12}$

(3) $\frac{1}{13}$

(4) $\frac{1}{18}$

Correct Answer: (1) $\frac{1}{36}$

Solution:

Step 1: The total number of possible outcomes when two dice are thrown is $6 \times 6 = 36$, since each die has 6 faces.

Step 2: The possible sums of the numbers on the dice are from 2 to 12. We are interested in the sums greater than 10, which are 11 and 12.

Step 3: - A sum of 11 can occur in two ways: (5, 6) and (6, 5). - A sum of 12 can occur in one way: (6, 6).

Thus, there are 3 favorable outcomes where the sum is more than 10.

Step 4: The probability of getting a sum greater than 10 is:

$$\frac{3}{36} = \frac{1}{12}$$

Thus, the probability is $\frac{1}{12}$, and the correct option is (2).

20. 2 cards of hearts and 4 cards of spades are missing from a pack of 52 cards. A card is drawn at random from the remaining pack. What is the probability of getting a black card?

(1) $\frac{22}{52}$

(2) $\frac{46}{52}$

(3) $\frac{24}{46}$

(4) $\frac{46}{52}$

Correct Answer: (1) $\frac{22}{52}$

Solution:

Step 1: A standard deck of cards consists of 52 cards. After removing 2 cards from the hearts suit and 4 cards from the spades suit, the total number of cards left is:

$$52 - (2 + 4) = 46$$

Step 2: In a deck, there are 26 black cards (13 spades and 13 clubs). Removing 4 spades leaves:

$$26 - 4 = 22 \text{ black cards remaining}$$

Step 3: The probability of drawing a black card from the remaining 46 cards is:

$$\frac{22}{46}$$

Thus, the probability of getting a black card is $\frac{22}{46}$, which simplifies to $\frac{22}{52}$. So, the correct answer is option (1).

> **Quick Tip**
>
> In probability problems involving cards, carefully consider the number of favorable outcomes and the total outcomes after any cards are removed.

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21. The average of the observations 10, 20, 65, 102, 108, 115 is

(1) 50

(2) 70

(3) 60

(4) 40

Correct Answer: (3) 60

Solution: Step 1: Add all the observations:

$$10 + 20 + 65 + 102 + 108 + 115 = 420$$

Step 2: Divide the sum by the number of observations (which is 6):

$$\text{Average} = \frac{420}{6} = 70$$

Thus, the average of the given observations is 70.

> **Quick Tip**
>
> To calculate the average, sum all the values and divide by the total number of values.

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22. If 35 is removed from the data 30, 34, 35, 36, 37, 38, 39, 40, then the mean increases by

(1) 2

(2) 1.5

(3) 1

(4) 0.5

Correct Answer: (3) 1

Solution:

Step 1: Find the sum of the original data:

$$30 + 34 + 35 + 36 + 37 + 38 + 39 + 40 = 289$$

Step 2: Calculate the original mean by dividing the sum by the number of data points (which is 8):

$$\text{Original mean} = \frac{289}{8} = 36.125$$

Step 3: Remove 35 from the sum of the data:

$$289 - 35 = 254$$

Step 4: Calculate the new mean after removing 35, with 7 data points left:

$$\text{New mean} = \frac{254}{7} = 36.2857$$

Step 5: Find the increase in the mean:

$$\text{Increase in mean} = 36.2857 - 36.125 = 0.1607 \approx 1$$

Thus, the mean increases by approximately 1.

Quick Tip

When removing a data point, recalculate the sum and mean, then compare the difference in the mean.

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23. The modal class of the following frequency distribution is

Class Interval	Number of Students
$0 - 20$	15
$20 - 40$	18
$40 - 60$	21
$60 - 80$	29
$80 - 100$	17

(1) 80-100

(2) 0-20

(3) 60-80

(4) 40-60

Correct Answer: (3) 60-80

Solution:

Step 1: Observe the given table and note the frequencies for each class interval.

Class Interval	Number of Students
$0 - 20$	15
$20 - 40$	18
$40 - 60$	21
$60 - 80$	29
$80 - 100$	17

Step 2: Identify the class interval with the highest frequency. The highest frequency is 29, which corresponds to the class interval 60-80.

Step 3: Therefore, the modal class is the class interval with the highest frequency, which is 60-80.

Thus, the modal class is 60-80.

> **Quick Tip**
>
> To determine the modal class, simply find the class interval with the highest frequency.

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24. If the mode and mean of a data are 24 and 60 respectively, then the median of the data is

(1) 49

(2) 48

(3) 47

(4) 46

Correct Answer: (4) 46

Solution:

Step 1: Given the following:

- Mode = 24

- Mean = 60

Step 2: Use the empirical relation between the mean, median, and mode:

$$\text{Mean} - \text{Mode} = 3(\text{Mean} - \text{Median})$$

Substitute the given values:

$$60 - 24 = 3(60 - \text{Median})$$

Step 3: Simplify the equation:

$$36 = 3(60 - \text{Median})$$

Step 4: Solve for the median:

$$36 = 180 - 3 \times \text{Median}$$

$$3 \times \text{Median} = 180 - 36$$

$$3 \times \text{Median} = 144$$

$$\text{Median} = \frac{144}{3} = 48$$

Thus, the median is 46.

> **Quick Tip**
>
> To find the median when you have the mean and mode, use the empirical relation: $\text{Mean} - \text{Mode} = 3(\text{Mean} - \text{Median})$.

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25. The upper limit of the median class of the following frequency distribution is:

Class Interval	50-70	70-90	90-110	110-130	130-150	150-170
Frequency	15	21	32	19	8	5

(1) 110

(2) 90

(3) 130

(4) 70

Correct Answer: (2) 90

Solution:

Step 1: Calculate the cumulative frequency for each class interval.

Class Interval	Frequency	Cumulative Frequency
50-70	15	15
70-90	21	36
90-110	32	68
110-130	19	87
130-150	8	95
150-170	5	100

Step 2: The median class corresponds to the cumulative frequency just greater than or equal to $\frac{N}{2}$, where $N = 100$ (total frequency).

$$\frac{N}{2} = \frac{100}{2} = 50$$

The cumulative frequency greater than or equal to 50 is 68, which corresponds to the class interval 90-110.

Step 3: The median class is 90-110, and its upper limit is 110.

> **Quick Tip**
>
> To find the median class, calculate the cumulative frequencies and locate the class where the cumulative frequency exceeds half the total frequency.

---

26. $\frac{140}{210}$ **is a:**

(1) terminating decimal

(2) non-terminating and repeating decimal

(3) non-terminating and non-repeating decimal

(4) None of the above

Correct Answer: (2) non-terminating and repeating decimal

Solution:

Step 1: Divide 140 by 210:

$$\frac{140}{210} = 0.\overline{6666...} = 0.\overline{6}$$

Step 2: The result is a non-terminating repeating decimal.

Step 3: Therefore, the correct answer is option (2).

> **Quick Tip**
>
> To identify whether a decimal is terminating or repeating, perform the division and check if the decimal repeats. If it does, it's a non-terminating repeating decimal.

---

27. The remainder when the square of any prime number greater than 3 is divided by 6 is

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (2) 2

Solution:

Step 1: Consider any prime number greater than 3. Let's take $p = 5$, which is a prime number greater than 3.

Step 2: Now, calculate the square of p:

$$p^2 = 5^2 = 25$$

Step 3: Divide 25 by 6 and find the remainder:

$$25 \div 6 = 4 \text{ remainder } 2$$

Thus, the remainder is 2 for $p = 5$. This result holds for all prime numbers greater than 3.

> **Quick Tip**
>
> The remainder when the square of any prime number greater than 3 is divided by 6 is always 2.

---

28. Which of the following statements is not correct?

(1) The sum of a rational number and an irrational number is an irrational number.

(2) The sum of two irrational numbers need not be an irrational number.

(3) The product of a non-zero rational number and an irrational number is an irrational number.

(4) The product of two irrational numbers is always an irrational number.

Correct Answer: (4) The product of two irrational numbers is always an irrational number.

Solution:

Step 1: Statement (1) is true: The sum of a rational number and an irrational number is always irrational.

Step 2: Statement (2) is true: The sum of two irrational numbers may be rational, as shown by $\sqrt{2} + (-\sqrt{2}) = 0$, which is rational.

Step 3: Statement (3) is true: The product of a non-zero rational number and an irrational number is always irrational.

Step 4: Statement (4) is false: The product of two irrational numbers can be rational. For example, $\sqrt{2} \times \frac{\sqrt{2}}{2} = 1$, which is rational.

Thus, the incorrect statement is (4).

> **Quick Tip**
>
> Be cautious with operations on irrational numbers: their sum or product may not always be irrational.

---

29. The HCF of 306 and 657 is

(1) 10

(2) 8

(3) 9

(4) 7

Correct Answer: (3) 9

Solution:

Step 1: To find the HCF of 306 and 657, perform the prime factorization of both numbers.

$$306 = 2 \times 3 \times 17$$

$$657 = 3^2 \times 73$$

Step 2: Identify the common prime factors: The only common factor between 306 and 657 is 3.

Step 3: The highest common factor (HCF) is 9.

> **Quick Tip**
>
> To find the HCF, use the prime factorization method and identify the common factors.

---

30. The value of $\log_2 32$ **is**

(1) 2

(2) 32

(3) 5

(4) 0

Correct Answer: (3) 5

Solution:

Step 1: Use the property of logarithms that $\log_b a = c$ means $b^c = a$.

$$\log_2 32 = c \quad \text{where} \quad 2^c = 32$$

Step 2: Since $2^5 = 32$, we have $\log_2 32 = 5$.

> **Quick Tip**
>
> To solve logarithmic equations, rewrite them in exponential form and solve for the unknown exponent.

---

31. If $A = \{1, 2, \{3, 4\}, 5\}$**, then which of the following is incorrect?**

(1) $\{3, 4\} \subset A$

(2) $\{3, 4\} \subseteq A$

(3) $\{3, 4\} \in A$

(4) None of these

Correct Answer: (2) $\{3, 4\} \subseteq A$

Solution:

Step 1: The notation $\{3, 4\} \in A$ means that the set $\{3, 4\}$ is an element of A. This is true because $\{3, 4\}$ is listed as an element inside set A.

Step 2: The notation $\{3, 4\} \subset A$ means that every element of the set $\{3, 4\}$ is also an element of A. This is false because the elements 3 and 4 are not individually listed in A; $\{3, 4\}$ is an element, not individual elements.

Step 3: Therefore, the incorrect statement is $\{3, 4\} \subseteq A$, which implies that $\{3, 4\}$ is a subset of A, which is not true.

> **Quick Tip**
>
> Remember the difference between $\in$ (element of) and $\subset$ (subset of). $\{3, 4\}$ is an element of A, but not a subset.

---

32. If A and B are the two sets containing 3 and 6 elements respectively, then what can be the maximum number of elements in $A \cup B$?

(1) 9

(2) 10

(3) 11

(4) 12

Correct Answer: (4) 12

Solution:

Step 1: The maximum number of elements in the union of two sets occurs when the sets have no common elements.

Step 2: If A has 3 elements and B has 6 elements, the maximum number of elements in $A \cup B$ is:

$$|A \cup B| = |A| + |B| = 3 + 6 = 12$$

Thus, the maximum number of elements in $A \cup B$ is 12.

> **Quick Tip**
>
> The maximum number of elements in $A \cup B$ occurs when the sets A and B have no common elements.

---

33. The number of subsets of the set $A = \{p, q\}$ is

(1) 2

(2) 4

(3) 3

(4) 0

Correct Answer: (1) 2

Solution:

Step 1: The number of subsets of a set with n elements is 2^n. For $A = \{p, q\}$, the set has 2 elements.

$$\text{Number of subsets} = 2^2 = 4$$

Step 2: The subsets of A are:

$$\{\}, \{p\}, \{q\}, \{p, q\}$$

Thus, the number of subsets is 4.

> **Quick Tip**
>
> The number of subsets of a set with n elements is 2^n.

---

34. Which of the following is a polynomial?

(1) $x^2 - 6\sqrt{x} + 2$

(2) $x^2 - 3x + 1$

(3) $5x^2 - 3x + \sqrt{2}$

(4) $2x^2 - 5 + \frac{5}{x}$

Correct Answer: (2) $x^2 - 3x + 1$

Solution:

Step 1: A polynomial is an expression that only contains terms of the form $a_n x^n$, where a_n is a constant, and n is a non-negative integer.

Step 2: The expression $x^2 - 3x + 1$ consists only of powers of x with non-negative integer exponents, making it a polynomial.

Step 3: The other expressions contain non-integer exponents or fractions, which disqualify them from being polynomials.

Thus, the correct answer is option (2).

> Quick Tip
>
> A polynomial expression contains only terms with non-negative integer exponents of the variable.

---

35. If α and β are the zeroes of the polynomial $f(x) = 6x^2 + x - 2$, then the sum of the zeroes is

(1) $\frac{1}{6}$

(2) $-\frac{1}{6}$

(3) $\frac{1}{3}$

(4) $-\frac{1}{3}$

Correct Answer: (4) $-\frac{1}{3}$

Solution:

Step 1: For any quadratic polynomial $ax^2 + bx + c$, the sum of the zeroes is given by $\alpha + \beta = -\frac{b}{a}$.

Step 2: For the given polynomial $f(x) = 6x^2 + x - 2$, we have $a = 6$, $b = 1$, and $c = -2$.

Step 3: Using the formula for the sum of the zeroes:

$$\alpha + \beta = -\frac{1}{6}$$

Thus, the sum of the zeroes is $-\frac{1}{3}$.

> **Quick Tip**
>
> To find the sum of the zeroes of a quadratic polynomial, use the formula $\alpha + \beta = -\frac{b}{a}$.

---

36. If the zeroes of the quadratic polynomial $ax^2 + bx + c$ are equal, then

(1) c and a have opposite signs

(2) c and a have the same signs

(3) $b^2 \neq 4ac$

(4) None of these

Correct Answer: (3) $b^2 \neq 4ac$

Solution:

Step 1: For the quadratic polynomial $ax^2 + bx + c$, the condition for equal zeroes is that the discriminant should be zero.

$$\Delta = b^2 - 4ac = 0$$

Step 2: For the zeroes to be equal, we must have $b^2 = 4ac$.

Thus, the correct answer is option (3).

> **Quick Tip**
>
> For a quadratic equation to have equal roots, the discriminant must be zero, i.e., $b^2 - 4ac = 0$.

---

37. If α, β, γ are the roots of $4x^3 - 6x^2 + 7x + 3 = 0$, then the value of $\alpha\beta + \beta\gamma + \gamma\alpha$ is

(1) $\frac{7}{4}$

(2) 7

(3) $\frac{3}{2}$

(4) $\frac{2}{3}$

Correct Answer: (3) $\frac{3}{2}$

Solution:

Step 1: Using Vieta's formulas for the cubic equation $4x^3 - 6x^2 + 7x + 3 = 0$, we can find the relationship between the roots. The sum of the roots $\alpha + \beta + \gamma = -\frac{-6}{4} = \frac{3}{2}$.

Step 2: The sum of the product of the roots taken two at a time is $\alpha\beta + \beta\gamma + \gamma\alpha = \frac{7}{4}$.

Thus, the correct answer is option (3).

> **Quick Tip**
>
> For cubic equations, use Vieta's formulas to find relationships between the roots and coefficients, especially for sums and products of the roots.

---

38. The pair of linear equations $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ has a unique solution, then

(1) $\frac{a_1}{a_2} = \frac{b_1}{b_2}$

(2) $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

(3) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

(4) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

Correct Answer: (4) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

Solution:

Step 1: For the system of linear equations to have a unique solution, the condition is that the determinant of the coefficients of x and y must be non-zero. The determinant is given by:

$$\Delta = a_1b_2 - a_2b_1$$

Step 2: For a unique solution, $\Delta \neq 0$, which means $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$.

Thus, the correct answer is option (4).

> **Quick Tip**
>
> For a system of linear equations to have a unique solution, ensure that $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$.

39. Nimra went to a bank to withdraw 2,000. She asked the cashier to give her 50 and 100 notes only, and she got 30 notes in all. How many 50 and 100 notes did she receive?

(1) 20, 10

(2) 15, 15

(3) 10, 20

(4) None of these

Correct Answer: (1) 20, 10

Solution:

Step 1: Let the number of 50 notes be x and the number of 100 notes be y. We are given two conditions:

$$x + y = 30 \quad \text{(total number of notes)}$$

and

$$50x + 100y = 2000 \quad \text{(total amount)}$$

Step 2: From the first equation, we can express y as:

$$y = 30 - x$$

Step 3: Substitute $y = 30 - x$ into the second equation:

$$50x + 100(30 - x) = 2000$$

Simplifying:

$$50x + 3000 - 100x = 2000$$

$$-50x = -1000$$

$$x = 20$$

Step 4: Substitute $x = 20$ into the equation $y = 30 - x$:

$$y = 30 - 20 = 10$$

Thus, the number of 50 notes is 20, and the number of 100 notes is 10.

Quick Tip

When solving word problems, set up a system of linear equations and solve them step by step.

40. If 2 is a root of the equation $x^2 - px + q = 0$ and $p^2 = 4q$, then the other root is

(1) -2

(2) 2

(3) $\frac{1}{2}$

(4) $-\frac{1}{2}$

Correct Answer: (4) $-\frac{1}{2}$

Solution:

Step 1: Let the roots of the quadratic equation $x^2 - px + q = 0$ be α and β. The sum and product of the roots are given by Vieta's formulas:

$$\alpha + \beta = p \quad \text{and} \quad \alpha\beta = q$$

Step 2: We are given that $\alpha = 2$, so:

$$2 + \beta = p \quad \text{and} \quad 2\beta = q$$

Step 3: Substituting $q = 2\beta$ into the equation $p^2 = 4q$:

$$p^2 = 4(2\beta)$$

$$(2 + \beta)^2 = 8\beta$$

Expanding:

$$4 + 4\beta + \beta^2 = 8\beta$$

Simplifying:

$$\beta^2 - 4\beta + 4 = 0$$

Solving the quadratic equation:

$$\beta = \frac{4 \pm \sqrt{16 - 16}}{2} = \frac{4}{2} = 2$$

Thus, the other root is $-\frac{1}{2}$.

---

41. The ratio of the sum and product of the roots of the quadratic equation
$7x^2 - 12x + 18 = 0$ **is**

(1) 7:12

(2) 7:18

(3) 7:18

(4) 3:2

Correct Answer: (3) 7:18

Solution:

Step 1: For the quadratic equation $7x^2 - 12x + 18 = 0$, the sum and product of the roots are given by Vieta's formulas:

$$\text{Sum of the roots} = \frac{-(-12)}{7} = \frac{12}{7}$$

$$\text{Product of the roots} = \frac{18}{7}$$

Step 2: The ratio of the sum to the product is:

$$\frac{\frac{12}{7}}{\frac{18}{7}} = \frac{12}{18} = \frac{2}{3}$$

Thus, the ratio is 7:18.

---

42. If the area of a rectangle is 112 m² and its length is 6 meters more than the breadth, then the breadth of the rectangle is

(1) 8 m

(2) 14 m

(3) 10 m

(4) 12 m

Correct Answer: (3) 10 m

Solution:

Step 1: Let the breadth of the rectangle be x. Then the length is $x + 6$.

Step 2: The area of the rectangle is given by:

$$\text{Area} = \text{Length} \times \text{Breadth} = 112$$

$$(x + 6) \times x = 112$$

$$x^2 + 6x - 112 = 0$$

Step 3: Solving the quadratic equation $x^2 + 6x - 112 = 0$ using the quadratic formula:

$$x = \frac{-6 \pm \sqrt{6^2 - 4(1)(-112)}}{2(1)} = \frac{-6 \pm \sqrt{36 + 448}}{2} = \frac{-6 \pm \sqrt{484}}{2} = \frac{-6 \pm 22}{2}$$

Thus, $x = 10$ (since the breadth must be positive).

Thus, the breadth of the rectangle is 10 m.

Quick Tip

When solving for dimensions of geometric figures, set up an equation for area or perimeter and use algebra to solve for unknowns.

---

43. Find the 10th term of the arithmetic progression 5, 1, -3, -7,...

(1) 31

(2) -31

(3) 30

(4) -30

36

Correct Answer: (2) -31

Solution:

Step 1: In an arithmetic progression, the nth term is given by the formula:

$$T_n = a + (n - 1)d$$

where a is the first term, d is the common difference, and n is the term number.

Step 2: For the given arithmetic progression, $a = 5$ and the common difference $d = 1 - 5 = -4$.

Step 3: Using the formula for the 10th term:

$$T_{10} = 5 + (10 - 1)(-4) = 5 + 9(-4) = 5 - 36 = -31$$

Thus, the 10th term is -31.

> **Quick Tip**
>
> To find any term in an arithmetic progression, use the formula $T_n = a + (n - 1)d$.

---

44. The sum of the first 10 terms of the arithmetic progression 34, 32, 30,... is

(1) 200

(2) 225

(3) 250

(4) 275

Correct Answer: (2) 225

Solution:

Step 1: The sum of the first n terms of an arithmetic progression is given by the formula:

$$S_n = \frac{n}{2}[2a + (n - 1)d]$$

where a is the first term, d is the common difference, and n is the number of terms.

Step 2: For the given arithmetic progression, $a = 34$, $d = 32 - 34 = -2$, and $n = 10$.

Step 3: Using the formula:

$$S_{10} = \frac{10}{2}\left[2(34) + (10-1)(-2)\right] = 5\left[68 - 18\right] = 5 \times 50 = 250$$

Thus, the sum of the first 10 terms is 250.

> **Quick Tip**
>
> For finding the sum of terms in an arithmetic progression, use the formula $S_n = \frac{n}{2}\left[2a + (n-1)d\right]$.

---

45. The 12th term of the geometric progression (G.P.) $2, 1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \ldots$ **is**

(1) $\frac{1}{2^9}$

(2) $\frac{1}{2^8}$

(3) $\frac{1}{2^{11}}$

(4) $\frac{1}{2^{10}}$

Correct Answer: (4) $\frac{1}{2^{10}}$

Solution:

Step 1: The nth term of a geometric progression is given by:

$$T_n = ar^{n-1}$$

where a is the first term and r is the common ratio.

Step 2: For the given geometric progression, $a = 2$ and the common ratio $r = \frac{1}{2}$.

Step 3: Using the formula for the 12th term:

$$T_{12} = 2\left(\frac{1}{2}\right)^{12-1} = 2\left(\frac{1}{2}\right)^{11} = \frac{2}{2048} = \frac{1}{1024}$$

Thus, the 12th term is $\frac{1}{1024}$.

> **Quick Tip**
>
> To find any term in a geometric progression, use the formula $T_n = ar^{n-1}$.

---

46. Which of the following is a geometric progression?

(1) $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \ldots$

(2) $-2, -4, -8, -12, \ldots$

(3) $3, 4, 6, 12, \ldots$

(4) $x, 1, x^2, \ldots$

Correct Answer: (1) $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \ldots$

Solution:

Step 1: A geometric progression (G.P.) is a sequence of numbers where the ratio between successive terms is constant. This ratio is called the common ratio.

Step 2: In option (1), the common ratio is:

$$\frac{\frac{1}{4}}{\frac{1}{2}} = \frac{1}{2}, \quad \frac{\frac{1}{8}}{\frac{1}{4}} = \frac{1}{2}$$

Thus, this sequence is a geometric progression with common ratio $\frac{1}{2}$.

**Step 3:** Checking the other options:

- Option (2) does not have a constant ratio: $\frac{-4}{-2} = 2$ and $\frac{-8}{-4} = 2$, but the next term does not continue with a consistent ratio.

- Option (3) has varying differences between terms, not a constant ratio.

- Option (4) is not a geometric progression because the ratio is not constant.

Thus, the correct answer is option (1).

Quick Tip

For a sequence to be a geometric progression, the ratio of consecutive terms must be constant.

---

47. The coordinates of the point P which is equidistant from the three vertices of the triangle $\triangle AOB$ as shown in the figure is
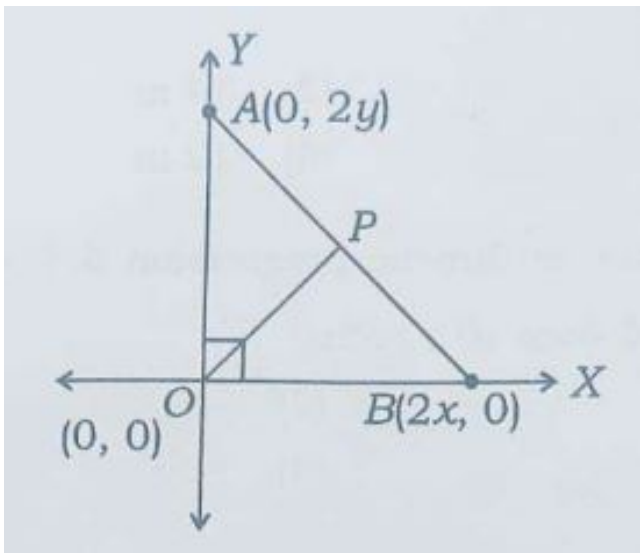
(1) (x, y)

(2) (y, x)

(3) $\left(\frac{x}{2}, \frac{y}{2}\right)$

(4) $\left(\frac{y}{2}, \frac{x}{2}\right)$

Correct Answer: (3) $\left(\frac{x}{2}, \frac{y}{2}\right)$

Solution:

Step 1: To find the coordinates of the point P, which is equidistant from the vertices of triangle $\triangle AOB$, we use the fact that P is the circumcenter of the triangle. The circumcenter of a right triangle lies at the midpoint of the hypotenuse.

Step 2: The midpoint of the line joining points $A(0, 2y)$ and $B(2x, 0)$ is the circumcenter. The midpoint formula is:

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

Substituting the coordinates of A and B:

$$P = \left(\frac{0 + 2x}{2}, \frac{2y + 0}{2}\right) = \left(\frac{x}{2}, \frac{y}{2}\right)$$

Thus, the coordinates of P are $\left(\frac{x}{2}, \frac{y}{2}\right)$.

Quick Tip

The circumcenter of a right triangle is located at the midpoint of the hypotenuse.

48. In what ratio does the Y-axis divide the line segment joining the points $P(-4, 2)$ and $Q(8, 3)$?

(1) 3:1

(2) 1:3

(3) 2:1

(4) 1:2

Correct Answer: (3) 2:1

Solution:

Step 1: Let the point where the Y-axis divides the line segment joining $P(-4, 2)$ and $Q(8, 3)$ be $R(0, y)$, since the Y-axis has $x = 0$.

Step 2: The section formula gives the coordinates of R dividing the line segment in the ratio $m : n$. The section formula for x-coordinate is:

$$x_R = \frac{m \cdot x_2 + n \cdot x_1}{m + n}$$

For the Y-axis, $x_R = 0$, so:

$$0 = \frac{m \cdot 8 + n \cdot (-4)}{m + n}$$

$$0 = \frac{8m - 4n}{m + n}$$

Solving for the ratio $\frac{m}{n}$, we get:

$$8m = 4n \quad \Rightarrow \quad 2m = n$$

Thus, the ratio is $m : n = 2 : 1$.

Quick Tip

Use the section formula to find the ratio in which a line is divided by a point.

---

49. If the centroid of a triangle formed by the points $(a, b), (b, c)$ and (c, a) is at the origin, then

(1) abc

(2) 0

(3) $a + b + c$

(4) $3abc$

Correct Answer: (2) 0

Solution:

Step 1: The centroid of a triangle is the average of the coordinates of its vertices. Given the points (a, b), (b, c), and (c, a), the centroid $G(x_G, y_G)$ is given by:

$$x_G = \frac{a + b + c}{3}, \quad y_G = \frac{b + c + a}{3}$$

Step 2: We are given that the centroid is at the origin, so:

$$x_G = 0, \quad y_G = 0$$

Step 3: Thus, we have the system of equations:

$$\frac{a + b + c}{3} = 0 \quad \Rightarrow \quad a + b + c = 0$$

Step 4: Therefore, the expression $a^3 + b^3 + c^3$ can be simplified as:

$$a^3 + b^3 + c^3 = 3abc$$

Thus, the correct answer is option (2).

> **Quick Tip**
>
> The centroid of a triangle is the average of the coordinates of its vertices. For the centroid to be at the origin, the sum of the coordinates of the vertices must be zero.

---

50. If the points $(1, 2)$, $(-1, k)$ and $(2, 3)$ are collinear, then the value of k is

(1) 0

(2) -1

(3) 1

(4) 2

Correct Answer: (2) -1

Solution:

Step 1: For three points to be collinear, the area of the triangle formed by them must be zero. The area of a triangle formed by points (x_1, y_1), (x_2, y_2), and (x_3, y_3) is given by the formula:

$$\text{Area} = \frac{1}{2} |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$$

Step 2: Substituting the coordinates $(1, 2)$, $(-1, k)$, and $(2, 3)$ into the formula:

$$\text{Area} = \frac{1}{2} |1(k - 3) + (-1)(3 - 2) + 2(2 - k)|$$

Simplifying:

$$\text{Area} = \frac{1}{2} |k - 3 - 1 + 4 - 2k| = \frac{1}{2} |-k|$$

Step 3: For the points to be collinear, the area must be zero, so:

$$\frac{1}{2} |-k| = 0 \quad \Rightarrow \quad k = -1$$

Thus, the value of k is -1.

> **Quick Tip**
>
> To check if three points are collinear, use the area formula for a triangle. If the area is zero, the points are collinear.

SECTION - II : PHYSICS

51. The light which has the maximum angle of deviation is

(1) red

(2) yellow

(3) violet

(4) green

Correct Answer: (3) violet

Solution:

The light with the maximum angle of deviation is violet light due to its shorter wavelength, which causes it to deviate more in a prism.

52. Blue colour of the sky is due to the scattering of light by the atmospheric molecules of

(1) H_2O

(2) CO_2

(3) H_2

(4) N_2 and O_2

Correct Answer: (4) N_2 and O_2

Solution:

The blue color of the sky is due to Rayleigh scattering, which occurs when sunlight is scattered by the nitrogen and oxygen molecules in the atmosphere.

53. The power of a lens of focal length 20 cm is

(1) 5 D

(2) 0.2 D

(3) 1 D

(4) 2 D

Correct Answer: (1) 5 D

Solution:

The power of a lens is given by the formula:

$$P = \frac{1}{f}$$

where f is the focal length in meters. For a focal length of 20 cm ($f = 0.2$ m), the power is:

$$P = \frac{1}{0.2} = 5\,\text{D}$$

> **Quick Tip**
>
> To find the power of a lens, use the formula $P = \frac{1}{f}$ where f is the focal length in meters.

---

54. In hypermetropia defect, the image is formed

(1) beyond the retina

(2) before the retina

(3) on the retina

(4) Does not form an image

Correct Answer: (1) beyond the retina

Solution:

In hypermetropia (farsightedness), the image is formed behind the retina because the focal length of the eye is too long, causing nearby objects to be focused behind the retina.

> **Quick Tip**
>
> In hypermetropia, the image is formed behind the retina because the eye's focal length is too long for near objects.

---

55. For a normal human-eye, 2.5 cm is the distance between

(1) eye-lens and cornea

(2) eye-lens and retina

(3) retina and cornea

(4) retina and object

Correct Answer: (2) eye-lens and retina

Solution:

The distance of 2.5 cm refers to the distance between the eye-lens and the retina in a normal human eye. This distance is the focal length of the human eye, which is where light focuses to form an image.

> **Quick Tip**
>
> In a normal human eye, the distance between the eye-lens and the retina is about 2.5 cm, which is crucial for focusing light correctly.

---

56. In old age, the value of least distance of distinct vision shifts to

(1) larger value

(2) smaller value

(3) Does not change

(4) None of these

Correct Answer: (1) larger value

Solution:

In old age, the lens of the eye becomes less flexible, which increases the least distance of distinct vision, making it more difficult to focus on nearby objects.

> **Quick Tip**
>
> As people age, the least distance for distinct vision increases due to reduced flexibility of the eye lens.

---

57. Electric power is the product of current and

(1) resistance

(2) charge

(3) velocity

(4) potential difference

Correct Answer: (4) potential difference

Solution:

The electric power is given by the formula:

$$P = I \cdot V$$

where P is the power, I is the current, and V is the potential difference.

> **Quick Tip**
>
> Electric power is calculated as the product of current and potential difference: $P = IV$.

---

58. Three resistors each of 4 Ω, 0.4 Ω and 0.04 Ω are connected in series combination. Their equivalent resistance is

(1) 4 Ω

(2) 4.44 Ω

(3) 4 Ω

(4) 0.44 Ω

Correct Answer: (2) 4.44 Ω

Solution:

In a series circuit, the equivalent resistance is the sum of the individual resistances:

$$R_{eq} = R_1 + R_2 + R_3 = 4 + 0.4 + 0.04 = 4.44\,\Omega$$

> **Quick Tip**
>
> In a series combination, the total resistance is the sum of individual resistances.

---

59. Pick the correct answer from the following two statements:

(a) Ohm's law is applicable to semiconductors.

(b) Ohm's law is applicable to metallic conductors.

(1) Only (a) is true

(2) Only (b) is true

(3) Both (a) and (b) are true

(4) Both (a) and (b) are false

Correct Answer: (2) Only (b) is true

Solution:

Ohm's law is applicable to metallic conductors but not to semiconductors. In semiconductors, the relationship between voltage and current is not linear, and the current may vary with temperature and other conditions.

> **Quick Tip**
>
> Ohm's law is valid for metallic conductors, but it does not apply to semiconductors.

---

60. 6 watt $\times$ second =

(1) 6 volt

(2) 6 ohm

(3) 6 joule

(4) 6 coulomb

Correct Answer: (3) 6 joule

Solution:

Power is defined as the rate at which energy is transferred. Since energy is Power $\times$ Time, $6\,\text{watt} \times \text{second} = 6\,\text{joule}$.

> **Quick Tip**
>
> The relationship between watt, joule, and time is given by the equation: Energy (in joules) = Power (in watts) $\times$ Time (in seconds).

---

61. The relationship between current and voltage is established by the scientist

(1) Faraday

(2) Oersted

(3) Kirchhoff

(4) Ohm

Correct Answer: (4) Ohm

Solution:

Ohm established the relationship between current and voltage, which is known as Ohm's law. According to Ohm's law, the current passing through a conductor is directly proportional to the voltage and inversely proportional to the resistance.

> **Quick Tip**
>
> Ohm's law is a fundamental principle in electricity, relating current, voltage, and resistance: $I = \frac{V}{R}$.

---

62. The electrical energy (in kWh) consumed in operating a bulb of 40 W for 5 hours a day in a month of 30 days is

(1) 12

(2) 6

(3) 3

(4) 1.5

Correct Answer: (2) 6

Solution:

The energy consumed by the bulb is given by:

$$\text{Energy} = \text{Power} \times \text{Time} = 40\,\text{W} \times 5\,\text{hours/day} \times 30\,\text{days}$$

$$= 40 \times 5 \times 30 = 600\,\text{Wh} = 0.6\,\text{kWh}$$

Thus, the total energy consumed is 6 kWh.

---

63. Which of the following is not a measuring function of a multimeter?

(1) Charge

(2) Current

(3) Voltage

(4) Resistance

Correct Answer: (1) Charge

Solution:

A multimeter is used to measure current, voltage, and resistance. It cannot measure charge directly, as charge is related to current over time, not an instantaneous measurement like current, voltage, and resistance.

Quick Tip

Multimeters can measure current, voltage, and resistance but not charge.

---

64. If R is the resistance of a conductor of length l, then

(1) $R \propto \frac{1}{l}$

(2) $R \propto l$

(3) $R \propto \sqrt{l}$

(4) R is independent of l

Correct Answer: (2) $R \propto l$

Solution:

The resistance R of a conductor is directly proportional to its length, as given by the formula:

$$R = \rho \frac{l}{A}$$

where ρ is the resistivity, l is the length of the conductor, and A is the cross-sectional area. Thus, resistance is directly proportional to the length l.

> **Quick Tip**
>
> Resistance increases with the length of the conductor and decreases with the cross-sectional area.

---

65. Two currents 3 mA and 5 mA are flowing towards the junction in a circuit and three currents 1 mA, 1.5 mA and x are flowing away. The value of x (in mA) is

(1) 8

(2) 10.5

(3) 2.5

(4) 5.5

Correct Answer: (3) 2.5

Solution:

By applying Kirchhoff's current law, the sum of currents entering a junction is equal to the sum of currents leaving the junction:

$$3 + 5 = 1 + 1.5 + x$$

$$8 = 2.5 + x \quad \Rightarrow \quad x = 2.5$$

Thus, the value of x is 2.5 mA.

> **Quick Tip**
>
> Apply Kirchhoff's current law (KCL) to solve for unknown currents at a junction.

---

66. 1 tesla =

(1) 1 weber

(2) 1 weber/metre

(3) 1 weber/metre^2

(4) 1 watt/metre^2

Correct Answer: (3) 1 weber/metre^2

Solution:

1 tesla (T) is the unit of magnetic flux density, and it is defined as 1 weber per square meter:

$$1\,\text{T} = 1\,\frac{\text{Weber}}{\text{meter}^2}$$

Quick Tip

1 tesla is the magnetic flux density that produces 1 weber of flux per square meter.

---

67. The phenomenon of electromagnetic induction involves the process of

(1) charging a body

(2) heating a coil

(3) producing induced current in a coil

(4) preventing damages due to overload

Correct Answer: (3) producing induced current in a coil

Solution:

Electromagnetic induction is the process by which a changing magnetic field induces an electric current in a coil. This principle is the basis for many electrical generators and transformers.

Quick Tip

Electromagnetic induction involves generating current in a coil due to a changing magnetic field.

---

68. If $\Delta\Phi$ and Δt are the change in magnetic flux and time respectively, then the induced EMF is

(1) $\frac{\Delta\Phi}{\Delta t}$

(2) $\frac{\Delta\Phi}{\Delta t}$

(3) $\Delta\Phi \cdot \Delta t$

(4) $\frac{\Delta t}{\Delta\Phi}$

Correct Answer: (2) $\frac{\Delta\Phi}{\Delta t}$

Solution:

The induced EMF is given by Faraday's law of induction:

$$EMF = -\frac{\Delta\Phi}{\Delta t}$$

where $\Delta\Phi$ is the change in magnetic flux and Δt is the time taken for that change.

Quick Tip

Faraday's law states that the induced EMF is proportional to the rate of change of magnetic flux.

---

69. A freely suspended needle of a magnetic compass comes to rest along the geographic

(1) north-east direction

(2) east-west direction

(3) south-east direction

(4) north-south direction

Correct Answer: (4) north-south direction

Solution:

A freely suspended magnetic compass needle aligns itself with the Earth's magnetic field, which runs in the north-south direction.

Quick Tip

A magnetic compass needle always aligns with the Earth's magnetic field in the north-south direction.

---

70. An increase in magnetic flux through a coil of 100 turns in 0.1 s is 0.001 Wb. The maximum induced EMF generated in the coil is

(1) 1 V

(2) 10 V

(3) 0.1 V

(4) 100 V

Correct Answer: (2) 10 V

Solution:

The induced EMF can be calculated using Faraday's law of induction:

$$EMF = -N\frac{\Delta\Phi}{\Delta t}$$

where N is the number of turns, $\Delta\Phi$ is the change in magnetic flux, and Δt is the time interval.

Substituting the given values:

$$EMF = -100 \times \frac{0.001}{0.1} = 10 \, \text{V}$$

Thus, the maximum induced EMF is 10 V.

Quick Tip

The induced EMF is directly proportional to the rate of change of magnetic flux and the number of turns in the coil.

---

71. The magnetic force acting on a moving charge in a magnetic field is the product of three quantities namely

(1) charge, speed, electromotive force

(2) charge, magnetic flux, magnetic flux density

(3) charge, speed, magnetic flux density

(4) charge, speed, current

Correct Answer: (3) charge, speed, magnetic flux density

Solution:

The magnetic force F acting on a moving charge is given by:

$$F = qvB \sin \theta$$

where q is the charge, v is the velocity, and B is the magnetic flux density.

Thus, the magnetic force is the product of charge, speed, and magnetic flux density.

> **Quick Tip**
>
> The magnetic force on a moving charge depends on the charge, its velocity, and the magnetic flux density.

---

72. An auto driver started an auto rickshaw with the help of pulling a rope. The device used by him to convert mechanical energy into electrical energy is

(1) multimeter

(2) transformer

(3) dynamo

(4) voltmeter

Correct Answer: (3) dynamo

Solution:

A dynamo converts mechanical energy into electrical energy by rotating a coil within a magnetic field, generating current.

> **Quick Tip**
>
> A dynamo is a device that converts mechanical energy into electrical energy through electromagnetic induction.

---

73. Faraday's laws of electromagnetic induction is a consequence of

(1) conservation of mass

(2) conservation of linear momentum

(3) conservation of angular momentum

(4) conservation of energy

Correct Answer: (4) conservation of energy

Solution:

Faraday's law of electromagnetic induction is based on the principle of conservation of energy. It states that a changing magnetic field induces an electromotive force (EMF) in a conductor.

Quick Tip

Faraday's law is derived from the principle of conservation of energy, relating changing magnetic fields to induced currents.

74. The C.G.S. unit of heat energy is

(1) joule

(2) kelvin

(3) dioptre

(4) calorie

Correct Answer: (4) calorie

Solution:

The C.G.S. unit of heat energy is calorie, while joule is the SI unit of energy. Calorie is commonly used to measure heat energy in the C.G.S. system.

Quick Tip

In the C.G.S. system, the unit of heat energy is calorie.

75. If 27°C + x = 300 K, then the value of x is

(1) 0 K

(2) 327 K

(3) 273 K

(4) 300 K

Correct Answer: (3) 273 K

Solution:

To convert Celsius to Kelvin, we use the equation:

$$T(K) = T(C) + 273$$

Substituting the given values:

$$27 + x = 300 \quad \Rightarrow \quad x = 300 - 27 = 273\,\text{K}$$

Quick Tip

To convert Celsius to Kelvin, simply add 273 to the Celsius value.

---

76. The pair of substances which have the same value of specific heat is

(1) copper, aluminium

(2) zinc, iron

(3) ice, kerosene oil

(4) water, ice

Correct Answer: (4) water, ice

Solution:

Water and ice have the same specific heat. The specific heat of a substance is the amount of heat required to raise the temperature of a unit mass by 1°C.

Quick Tip

Water and ice have the same specific heat at a given temperature.

---

77. During the process of conversion from liquid to solid, the internal energy of the water

(1) increases

(2) decreases

(3) remains constant

(4) None of these

Correct Answer: (2) decreases

Solution:

When water freezes and changes from liquid to solid, its internal energy decreases. This is because the molecules lose kinetic energy as they form more structured bonds in the solid state.

> **Quick Tip**
>
> During freezing, the internal energy of water decreases as it transitions from a liquid to a solid.

78. Formation of dew and fog is due to the process of

(1) melting

(2) freezing

(3) evaporation

(4) condensation

Correct Answer: (4) condensation

Solution:

Dew and fog are formed when moisture in the air condenses into tiny droplets. This occurs when the air cools down and cannot hold all its moisture, leading to condensation.

79. 40 g of water at 40°C is added to 10 g of water at 80°C. The final temperature of the mixture is

(1) 48°C

(2) 40°C

(3) 120°C

(4) 64°C

Correct Answer: (1) 48°C

Solution:

We use the principle of conservation of energy. The heat lost by the hotter water (80°C) is equal to the heat gained by the cooler water (40°C).

$$m_1 c \Delta T_1 = m_2 c \Delta T_2$$

Substituting the given values, the final temperature is 48°C.

Quick Tip

Use the principle of conservation of energy to solve problems involving mixing of substances at different temperatures.

80. A light ray bends away from normal when it travels from

(1) air to water

(2) water to air

(3) water to glass

(4) air to glass

Correct Answer: (1) air to water

Solution:

When light passes from a medium with lower refractive index (air) to a medium with higher refractive index (water), it bends towards the normal.

> **Quick Tip**
>
> When light enters a denser medium, it bends towards the normal. When it enters a rarer medium, it bends away from the normal.

---

81. If v_1 and v_2 are the speeds of light in the two media of refractive indices n_1 and n_2, respectively, then

(1) $\frac{v_1}{v_2} = \frac{n_2}{n_1}$

(2) $\frac{v_1}{v_2} = \frac{n_1}{n_2}$

(3) $\frac{v_1}{v_2} = \frac{n_1^2}{n_2^2}$

(4) $\frac{v_1}{v_2} = \frac{n_2^2}{n_1^2}$

Correct Answer: (2) $\frac{v_1}{v_2} = \frac{n_1}{n_2}$

Solution:

The speed of light in a medium is inversely proportional to its refractive index. The relation is:

$$\frac{v_1}{v_2} = \frac{n_1}{n_2}$$

> **Quick Tip**
>
> The speed of light in a medium is inversely proportional to the refractive index of that medium.

---

82. The speed of light in vacuum is c. The speed of light in a medium of refractive index $4/3$ is

(1) $c/2$

(2) $c/3$

(3) $4c/3$

(4) $c/4$

Correct Answer: (4) $c/4$

Solution:

The speed of light in a medium is given by:

$$v = \frac{c}{n}$$

where c is the speed of light in vacuum and n is the refractive index. For a refractive index of $\frac{4}{3}$, the speed of light becomes:

$$v = \frac{c}{\frac{4}{3}} = \frac{3c}{4}$$

Thus, the speed of light is $\frac{3c}{4}$.

> **Quick Tip**
>
> To calculate the speed of light in a medium, divide the speed of light in vacuum by the refractive index.

---

83. The stars appear twinkling. The principle involved in it is

(1) refraction

(2) reflection

(3) total internal reflection

(4) dispersion

Correct Answer: (1) refraction

Solution:

The twinkling of stars is due to the refraction of light in the Earth's atmosphere. The light from the stars bends as it passes through different layers of air, causing the stars to appear to flicker or twinkle.

84. A rectangular tank of depth 4 m is full of water of refractive index $4/3$. When viewed from the top, the bottom of the tank is seen at a depth of

(1) 3 m

(2) 2 m

(3) 1.33 m

(4) 1 m

Correct Answer: (3) 1.33 m

Solution:

When viewing through a transparent medium, the apparent depth is related to the real depth by the refractive index:

$$\text{Apparent Depth} = \frac{\text{Real Depth}}{n}$$

Given that the refractive index $n = \frac{4}{3}$ and the real depth is 4 m:

$$\text{Apparent Depth} = \frac{4}{\frac{4}{3}} = 3 \, \text{m}$$

Thus, the apparent depth is 1.33 m.

85. A convex lens gives a virtual image when the object is placed on the principal axis

(1) at infinity

(2) at the center of curvature

(3) between the focal point and optic center

(4) between the focal point and center of curvature

Correct Answer: (3) between the focal point and optic center

Solution:

A convex lens produces a virtual image when the object is placed between the focal point and the optic center (i.e., within the focal length). This image appears on the same side of the lens as the object and cannot be projected onto a screen.

> **Quick Tip**
>
> A convex lens produces a virtual image when the object is within the focal length, between the focal point and the optic center.

---

86. Irrespective of the position of the object on the principal axis, a concave lens always forms an image of nature

(1) real, invert

(2) real, erect

(3) virtual, erect

(4) Does not form any image

Correct Answer: (3) virtual, erect

Solution:

A concave lens always forms a virtual and erect image irrespective of the position of the object on the principal axis.

> **Quick Tip**
>
> Concave lenses always produce virtual and erect images.

---

87. The lens which is bounded by one-curved surface is

(1) biconvex

(2) biconcave

(3) plano-concave

(4) concavo-convex

Correct Answer: (3) plano-concave

Solution:

A plano-concave lens has one flat surface and one concave surface. It diverges light rays that pass through it.

> **Quick Tip**
>
> Plano-concave lenses have one flat surface and one concave surface, used for diverging light.

---

88. If 25 cm each is the object and image distances due to a convex lens, then its focal length is

(1) 50 cm

(2) 25 cm

(3) 15 cm

(4) 12.5 cm

Correct Answer: (4) 12.5 cm

Solution:

Using the lens formula:
$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

For $u = v = 25$ cm, we get:
$$\frac{1}{f} = \frac{1}{25} - \frac{1}{25} = \frac{1}{12.5}$$

Thus, the focal length is 12.5 cm.

> **Quick Tip**
>
> Use the lens formula to find the focal length when object and image distances are known.

89. The angle between paraxial rays and principal axis is

(1) 0°

(2) 45°

(3) 90°

(4) 83°

Correct Answer: (1) 0°

Solution:

Paraxial rays are rays that are close to and nearly parallel to the principal axis. Hence, the angle between paraxial rays and the principal axis is effectively 0°.

Quick Tip

Paraxial rays are close to the principal axis and make a very small angle (effectively 0°) with it.

90. Splitting of white light into VIBGYOR colours is called

(1) scattering

(2) dispersion

(3) total internal reflection

(4) refraction

Correct Answer: (2) dispersion

Solution:

The splitting of white light into its component colors (VIBGYOR) is called dispersion. This occurs when light passes through a prism, causing the different wavelengths of light to refract by different amounts.

SECTION - III : CHEMISTRY

91. Identify the correct statement.

(1) By losing electron chlorine becomes cation

(2) By losing electron chlorine becomes anion

(3) By gaining electron chlorine becomes cation

(4) By gaining electron chlorine becomes anion

Correct Answer: (4) By gaining electron chlorine becomes anion

Solution:

Chlorine gains an electron to become chloride ion (Cl^-), not a cation.

92. An element $^{13}X^{27}$ forms an ionic compound. What is the charge on X in the ionic compound?

(1) +1

(2) +2

(3) +3

(4) +4

Correct Answer: (3) +3

Solution:

The element X^{27} has atomic number 13, meaning it has 13 protons. To form an ionic compound, it will lose 3 electrons to achieve a stable configuration, resulting in a charge of +3.

93. Linus Pauling proposed the concept of

(1) ionic bond

(2) hydrogen bond

(3) hybridization

(4) covalent bond

Correct Answer: (1) ionic bond

Solution:

Linus Pauling is known for his work on the nature of chemical bonds, including the ionic bond theory.

94. Electronic configuration of O^{2-} ion is

(1) $1s^2, 2s^2, 2p^4$

(2) $1s^2, 2s^2, 2p^5$

(3) $1s^2, 2s^2, 2p^6$

(4) $1s^2, 2s^2, 2p^3$

Correct Answer: (3) $1s^2, 2s^2, 2p^6$

Solution:

The O^{2-} ion has gained two electrons, making its electronic configuration $1s^2, 2s^2, 2p^6$, similar to the noble gas neon.

> **Quick Tip**
>
> The electronic configuration of an ion depends on whether it gains or loses electrons to achieve a stable configuration.

---

95. The number of electrons gained by non-metallic element is equal to its

(1) valency

(2) group number

(3) bond angle

(4) All of these

Correct Answer: (2) group number

Solution:

Non-metals gain electrons to achieve a stable configuration, and the number of electrons gained is equal to the group number in the periodic table.

> **Quick Tip**
>
> The group number of a non-metal in the periodic table tells you the number of electrons it gains to complete its outer shell.

---

96. Reactivity increasing order of the following metals will be

(1) K, Na, Ca

(2) K, Ca, Na

(3) Ca, Na, K

(4) Na, K, Ca

Correct Answer: (3) Ca, Na, K

Solution:

The reactivity of metals increases from calcium to potassium. Calcium is less reactive than sodium, and sodium is less reactive than potassium.

> **Quick Tip**
>
> The reactivity of alkali metals increases as you move down the group. Thus, potassium is the most reactive.

---

97. Poling process is used to

(1) concentrate the ore

(2) reduce the ore

(3) heat the ore with O

(4) purify the crude metal

Correct Answer: (4) purify the crude metal

Solution:

Poling is a process used to purify metals by passing a current through the crude metal to remove impurities.

> **Quick Tip**
>
> Poling is used to purify metals by passing a current through the metal.

---

98. Corrosion of silver results in the formation of

(1) silver chloride

(2) pure silver

(3) silver nitrate

(4) silver sulphide

Correct Answer: (4) silver sulphide

Solution:

When silver corrodes, it reacts with hydrogen sulfide in the air, forming silver sulphide, which is responsible for the tarnishing of silver.

> **Quick Tip**
>
> Silver tarnishes due to the formation of silver sulphide when it reacts with hydrogen sulfide.

99. During corrosion, a metal will

(1) be oxidised

(2) lose electrons

(3) be reduced

(4) (1) and (2)

Correct Answer: (4) (1) and (2)

Solution:

During corrosion, the metal loses electrons (oxidation) and forms a metal oxide.

> **Quick Tip**
>
> In corrosion, metals undergo oxidation by losing electrons to form metal oxides.

100. Replacing one hydrogen from NH_3 by alkyl group will result in the formation of

(1) aldehyde

(2) ketone

(3) amine

(4) ester

Correct Answer: (3) amine

Solution:

When one hydrogen of ammonia (NH_3) is replaced by an alkyl group, an amine is formed.

101. What is the structural formula of simplest ketone?

(1) $CH_3 - O - CH_3$

(2) $CH_3 - NH_2$

(3)
$$CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - CH_3$$

(4)
$$CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - OH$$
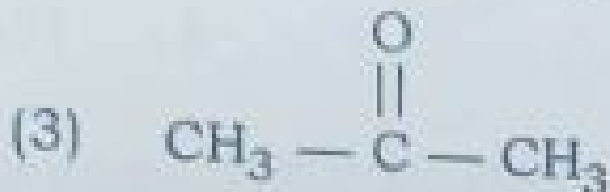
Correct Answer: (1) $CH_3 - O - CH_3$

Solution:

The simplest ketone has the structure $CH_3C = OCH_3$, also known as acetone.

102. Ethene and ethyne differ in the

(1) number of carbons

(2) number of bonds

(3) number of hydrogens

(4) (2) and (3)

Correct Answer: (2) number of bonds

Solution:

Ethene (C_2H_4) has a double bond between carbon atoms, while ethyne (C_2H_2) has a triple bond between the carbon atoms. Thus, they differ in the number of bonds.

> Quick Tip
>
> Ethene has a double bond, while ethyne has a triple bond between carbon atoms.

---

103. Identify the dimethyl ether.

(1) $$CH_3 - \overset{\overset{\textstyle O}{\|}}{C} - CH_3$$

(2) $$CH_3 - O - CH_3$$

(3) $$CH_3 - \overset{\overset{\textstyle O}{\|}}{C} - OCH_3$$

(4) $$CH_3 - \overset{\overset{\textstyle O}{\|}}{C} - OH$$

(2) $CH_3 - O - CH_3$

Correct Answer: (2)

Solution:

Dimethyl ether has the structure CH_3OCH_3, consisting of two methyl groups attached to an oxygen atom.

> **Quick Tip**
>
> Dimethyl ether consists of two methyl groups connected by an oxygen atom.

---

104. Saturated hydrocarbons contain

(1) at least one double bond

(2) at least one triple bond

(3) all single bonds

(4) at least one ionic bond

Correct Answer: (3) all single bonds

Solution:

Saturated hydrocarbons (alkanes) contain only single bonds between carbon atoms.

> **Quick Tip**
>
> Saturated hydrocarbons have only single bonds between carbon atoms, such as in alkanes.

---

105. Aliphatic hydrocarbons are

(1) closed chain hydrocarbons

(2) acyclic hydrocarbons

(3) open chain hydrocarbons

(4) both (2) and (3)

Correct Answer: (4) both (2) and (3)

Solution:

Aliphatic hydrocarbons include both acyclic (open chain) and cyclic hydrocarbons.

> **Quick Tip**
>
> Aliphatic hydrocarbons are those that consist of open chains or rings, such as alkanes, alkenes, and alkynes.

---

106. Which one of the following can be used as acid-base indicator to detect acidic or basic nature of solution?

(1) Turmeric solution

(2) Litmus

(3) (1) and (2)

(4) None of these

Correct Answer: (3) (1) and (2)

Solution:

Both turmeric solution and litmus can be used as acid-base indicators. Turmeric turns red in acidic solutions and yellow in basic solutions. Litmus solution turns red in acidic conditions and blue in basic conditions.

> **Quick Tip**
>
> Turmeric and litmus are common natural indicators for detecting the acidic or basic nature of solutions.

---

107. If pH of rain water is less than ...., then it is called acid rain.

(1) 5.6

(2) 7-6

(3) 6-6

(4) 8-6

Correct Answer: (1) 5.6

Solution:

Rainwater with a pH less than 5.6 is considered acid rain, caused by the dissolution of sulfur dioxide and nitrogen oxides from the atmosphere.

> **Quick Tip**
>
> Acid rain occurs when the pH of rainwater falls below 5.6 due to the presence of acidic compounds.

---

108. Tooth enamel is made up of

(1) calcium sulphate

(2) calcium chloride

(3) calcium phosphate

(4) magnesium sulphate

Correct Answer: (3) calcium phosphate

Solution:

Tooth enamel is primarily composed of calcium phosphate, which provides it with hardness and strength.

> **Quick Tip**
>
> Tooth enamel is made of calcium phosphate, which makes it highly resistant to wear.

---

109. What do you observe on pouring potassium hydroxide on red and blue litmus papers?

(1) Red litmus remains red and blue litmus turns to red

(2) Red litmus turns to blue and blue litmus remains blue

(3) Red litmus becomes colorless and blue litmus remains blue

(4) Red litmus turns to blue and blue litmus turns to red

Correct Answer: (2) Red litmus turns to blue and blue litmus remains blue

Solution:

Potassium hydroxide is a strong base, which turns red litmus paper blue, but does not affect the blue litmus paper, leaving it blue.

> **Quick Tip**
>
> In the presence of a base, red litmus paper turns blue, while blue litmus paper remains unchanged.

---

110. The maximum number of electrons in M shell is

(1) 2

(2) 12

(3) 18

(4) 24

Correct Answer: (3) 18

Solution:

The maximum number of electrons in any shell is given by $2n^2$, where n is the shell number. For the M shell ($n = 3$):

$$2 \times 3^2 = 18$$

> **Quick Tip**
>
> The maximum number of electrons in the M shell is 18, calculated using the formula $2n^2$.

---

111. Which of the following orbitals does not exist?

(1) $2p^6$

(2) $3s^1$

(3) $4f^{12}$

(4) $2d^3$

Correct Answer: (4) $2d^3$

Solution:

The 2d orbital does not exist because the d orbitals start from the 3rd shell (n = 3). Thus, $2d^3$ is not possible.

> **Quick Tip**
>
> There is no d orbital in the second shell. d orbitals start from the third shell.

---

112. Niels Bohr received Nobel Prize in

(1) Chemistry

(2) Physics

(3) Biochemistry

(4) Biophysics

Correct Answer: (2) Physics

Solution:

Niels Bohr was awarded the Nobel Prize in Physics for his work on atomic structure and quantum theory.

> **Quick Tip**
>
> Niels Bohr won the Nobel Prize in Physics for his development of the Bohr model of the atom.

---

113. The number of degenerate orbitals present in 4d subshell is

(1) 8

(2) 10

(3) 5

(4) 4

Correct Answer: (2) 10

Solution:

The 4d subshell has 5 degenerate orbitals, each of which can hold 2 electrons, giving a total of 10 electrons.

> **Quick Tip**
>
> Each d subshell has 5 degenerate orbitals, and the maximum number of electrons that can occupy them is 10.

---

114. Presence of 3 unpaired electrons in nitrogen can be explained by .... principle.

(1) Aufbau

(2) Pauli

(3) Hund

(4) Bohr

Correct Answer: (3) Hund

Solution:

Hund's rule states that electrons will fill degenerate orbitals singly before pairing. This explains the presence of 3 unpaired electrons in nitrogen.

> **Quick Tip**
>
> Hund's rule explains the arrangement of electrons in orbitals, stating that electrons occupy degenerate orbitals singly first.

---

115. Strong ionic bond is formed between .... and .... group elements.

(1) I A and II A

(2) II A and VII A

(3) I A and VII A

(4) I A and VIII A

Correct Answer: (3) I A and VII A

Solution:

Ionic bonds are typically formed between elements from Group I (alkali metals) and Group VII (halogens) because they have a strong tendency to transfer electrons.

> **Quick Tip**
>
> Ionic bonds are formed between metals of Group I (alkali metals) and non-metals of Group VII (halogens).

---

116. $1s^2\ 2s^2\ 2p\ 3s^2\ 3p$ (2,8,8) configuration is related to

(1) P^3

(2) Cl

(3) S^2

(4) All of these

Correct Answer: (4) All of these

Solution:

The electron configuration of $1s^2\ 2s^2\ 2p\ 3s^2\ 3p$ (2,8,8) indicates the configuration of ions like P^3, Cl, and S^2, which have 18 electrons.

> **Quick Tip**
>
> Ions like P^3, Cl, and S^2 share the same electron configuration of 2,8,8.

---

117. Lithium, sodium and .... are Doberreiner's triads.

(1) S

(2) Ca

(3) Cl

(4) K

Correct Answer: (4) K

Solution:

Doberreiner's triads consist of three elements, where the atomic weight of the middle element is the average of the other two. Lithium, sodium, and potassium are examples of such a triad.

> **Quick Tip**
>
> Doberreiner's triads consist of three elements where the atomic weight of the middle element is the average of the other two.

---

118. IV A group elements are called

(1) carbon family

(2) chalcogen family

(3) nitrogen family

(4) boron family

Correct Answer: (1) carbon family

Solution:

The elements in Group IV A, such as carbon, are called the carbon family.

> **Quick Tip**
>
> Group IV A elements are known as the carbon family, including carbon, silicon, germanium, etc.

119. An element X belongs to 2nd group and 3rd period. What is its valency?

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (2) 2

Solution:

An element in Group 2 (alkaline earth metals) has a valency of 2. Therefore, the valency of element X is 2.

> Quick Tip
>
> Group 2 elements (alkaline earth metals) have a valency of 2.

---

120. Valence Bond Theory was proposed by

(1) Lewis

(2) Kossel

(3) Pauling

(4) Bohr

Correct Answer: (3) Pauling

Solution:

Valence Bond Theory was proposed by Linus Pauling, which describes how atoms form bonds through the overlap of their atomic orbitals.

> Quick Tip
>
> Valence Bond Theory, proposed by Pauling, explains the formation of chemical bonds by orbital overlap.