AP POLYCET 2024 Question Paper with Solutions

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

General Instructions

Read the following instructions very carefully and strictly follow them:

Exam Mode: The exam will be conducted in offline mode (pen and paper).

Exam Duration: The exam will be of 2 hours duration (120 minutes).

Number of Questions: A total of 120 multiple-choice questions will be asked.

Marking Scheme: Each question carries 1 mark, and there is no negative marking.

Syllabus: The syllabus includes topics from Mathematics, Physics, and Chemistry of Class 10.

Exam Pattern: The question paper will include multiple-choice questions with four options, one of which will be correct.

Question Paper Structure: The question paper will be divided into three sections: Mathematics (60 questions),Physics (30 questions), Chemistry (30 questions)

SECTION-1:MATHEMATICS

1. 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) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

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

Correct Answer: (1) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

Solution:

Step 1: General Form of Two Linear Equations We are given the system of two linear equations:

$$a_1x + b_1y + c_1 = 0 \quad (1)$$

and

$$a_2x + b_2y + c_2 = 0 \quad (2).$$

This represents two lines in the coordinate plane. The solution to this system represents the point where these two lines intersect.

Step 2: Condition for Unique Solution For two linear equations to have a unique solution, the lines must intersect at exactly one point. In terms of the coefficients of the equations, this means that the lines should not be parallel. The general condition for two lines to intersect at a unique point is that the determinant of the coefficient matrix must not be zero.

The coefficient matrix of the system is:

$$\begin{pmatrix} a_1 & b_1 \\ a_2 & b_2 \end{pmatrix}.$$

The determinant of this matrix is:

$$\text{Determinant} = a_1b_2 - a_2b_1.$$

For the system to have a unique solution, the determinant must be non-zero:

$$a_1b_2 - a_2b_1 \neq 0.$$

Step 3: Interpreting the Condition Now, let us analyze the condition $a_1b_2 - a_2b_1 \neq 0$. This condition implies that the ratios of the coefficients $\frac{a_1}{a_2}$ and $\frac{b_1}{b_2}$ must not be equal. In other words, for the system to have a unique solution, we require:

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}.$$

Thus, the necessary condition for the system to have a unique solution is that the ratios of the coefficients of x and y must not be the same.

Step 4: Conclusion Therefore, the correct answer is option (1):

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}.$$

Quick Tip

For two linear equations to have a unique solution, the condition $a_1b_2 - a_2b_1 \neq 0$ must be satisfied. This is equivalent to $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$.

---

2. 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 notes of ₹50 and ₹100 respectively that she received?

(1) 20, 10

(2) 15, 15

(3) 10, 20

(4) None of these

Correct Answer: (1) 20, 10

Solution: Let the number of ₹50 notes be x and the number of ₹100 notes be y. We know:

$$x + y = 30 \quad (1)$$

The total amount is ₹2,000, so:

$$50x + 100y = 2000 \quad (2)$$

From equation (1), $y = 30 - x$. Substituting this into equation (2):

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

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

$$-50x = -1000$$

$$x = 20$$

Substitute $x = 20$ into equation (1):

$$20 + y = 30 \quad \Rightarrow \quad y = 10$$

Thus, Nimra received 20 notes of ₹50 and 10 notes of ₹100.

Quick Tip

In such problems, use the system of linear equations to represent the relationship between the number of notes and their values.

---

3. 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: (1) -2

Solution:

Step 1: Substitute the Given Root Since 2 is a root of the equation $x^2 - px + q = 0$, substitute $x = 2$:

$$2^2 - p \cdot 2 + q = 0 \implies 4 - 2p + q = 0 \implies q = 2p - 4.$$

Step 2: Use the Condition $p^2 = 4q$ Substitute $q = 2p - 4$ into $p^2 = 4q$:

$$p^2 = 4(2p - 4) \implies p^2 = 8p - 16 \implies p^2 - 8p + 16 = 0.$$

Solve for p:

$$(p - 4)^2 = 0 \implies p = 4.$$

Now, find q:

$$q = 2p - 4 = 2 \cdot 4 - 4 = 4.$$

Step 3: Find the Other Root The quadratic equation becomes:

$$x^2 - 4x + 4 = 0.$$

Factor the equation:

$$(x - 2)^2 = 0.$$

This shows that both roots are 2.

Alternatively, using sum and product of roots:

$$\text{Sum of roots} = p = 4 \implies \text{Other root} = 4 - 2 = 2.$$

$$\text{Product of roots} = q = 4 \implies \text{Other root} = \frac{4}{2} = 2.$$

Final Answer The other root is $\boxed{2}$.

Quick Tip

For quadratic equations, use Vieta's formulas to find the sum and product of the roots. The given condition $p^2 = 4q$ leads to a solvable quadratic for the second root.

---

4. 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) $3 : 2$

(4) $2 : 3$

Correct Answer: (3) $3 : 2$

Solution:

Step 1: Identifying the Coefficients The given quadratic equation is:

$$7x^2 - 12x + 18 = 0.$$

The coefficients of the equation are $a = 7$, $b = -12$, and $c = 18$.

Step 2: Using Vieta's Formulas From Vieta's formulas, the sum and product of the roots of the quadratic equation $ax^2 + bx + c = 0$ are:

$$\text{Sum of the roots} = -\frac{b}{a}, \quad \text{Product of the roots} = \frac{c}{a}.$$

For the given equation:

$$\text{Sum of the roots} = -\frac{-12}{7} = \frac{12}{7}, \quad \text{Product of the roots} = \frac{18}{7}.$$

Step 3: Finding the Ratio Now, the ratio of the sum to the product of the roots is:

$$\frac{\text{Sum of roots}}{\text{Product of roots}} = \frac{\frac{12}{7}}{\frac{18}{7}} = \frac{12}{18} = \frac{2}{3}.$$

Thus, the correct answer is $3 : 2$.

Quick Tip

The sum and product of the roots of a quadratic equation can be found using Vieta's formulas. The ratio of the sum to the product can be easily computed once the sum and product are known.

---

5. If the area of a rectangle is 112 m^2 and its length is 6 m 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:

Let the breadth of the rectangle be b meters.

The length of the rectangle is $b + 6$ meters.

The area of the rectangle is given by:

$$\text{Area} = \text{length} \times \text{breadth} \tag{1}$$

$$112 = (b + 6) \times b \tag{2}$$

$$112 = b^2 + 6b \tag{3}$$

$$b^2 + 6b - 112 = 0 \tag{4}$$

We need to find two numbers that multiply to -112 and add to 6.

These numbers are 14 and -8.

So, we can factor the quadratic equation as:

$$(b + 14)(b - 8) = 0 \tag{5}$$

Therefore, $b + 14 = 0$ or $b - 8 = 0$.

This gives us $b = -14$ or $b = 8$.

Since the breadth of a rectangle cannot be negative, we discard $b = -14$. Therefore, the breadth of the rectangle is $b = 8$ meters.

Answer: The breadth of the rectangle is 8 meters.

Quick Tip

In such problems, always remember the relation between length, breadth, and area of a rectangle. Solve the quadratic equation to find the correct dimensions.

---

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

(1) 31

(2) -31

(3) 30

(4) -30

Correct Answer: (2) -31

Solution: Step 1: The given arithmetic progression (AP) is $5, 1, -3, -7, \ldots$**.** The first term $a_1 = 5$, and the common difference d is:

$$d = 1 - 5 = -4$$

The formula for the n-th term of an AP is:

$$a_n = a_1 + (n - 1)d$$

Substituting $a_1 = 5$, $d = -4$, and $n = 10$:

$$a_{10} = 5 + (10 - 1)(-4) = 5 + 9 \times (-4) = 5 - 36 = -31$$

Thus, the 10th term of the AP is -31.

Quick Tip

For arithmetic progressions, use the general formula $a_n = a_1 + (n-1)d$ to find the n-th term.

---

7. The sum of 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 given arithmetic progression is $34, 32, 30, \ldots$**.** The first term $a_1 = 34$, and the common difference d is:

$$d = 32 - 34 = -2$$

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

$$S_n = \frac{n}{2}\left(2a_1 + (n-1)d\right)$$

Substituting $n = 10$, $a_1 = 34$, and $d = -2$:

$$S_{10} = \frac{10}{2}\left(2 \times 34 + (10-1)(-2)\right) = 5\left(68 + 9 \times (-2)\right)$$

$$S_{10} = 5\left(68 - 18\right) = 5 \times 50 = 225$$

Thus, the sum of the first 10 terms is 225.

Quick Tip

To find the sum of an arithmetic progression, use the formula $S_n = \frac{n}{2}\left(2a_1 + (n-1)d\right)$.

---

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

Solution:

Step 1: General Formula for the nth Term of a G.P. The nth term of a geometric progression is given by the formula:

$$T_n = a \cdot r^{n-1},$$

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

For the given G.P., $a = 2$ and the common ratio $r = \frac{1}{2}$.

Step 2: Substituting the Values to Find the 12th Term Substitute $a = 2$, $r = \frac{1}{2}$, and $n = 12$ into the formula for the nth term:

$$T_{12} = 2 \cdot \left(\frac{1}{2}\right)^{12-1} = 2 \cdot \left(\frac{1}{2}\right)^{11} = \frac{2}{2^{11}} = \frac{1}{2^{10}}.$$

Thus, the 12th term is $\frac{1}{2^{10}}$.

Step 3: Conclusion Thus, the correct answer is $\frac{1}{2^8}$, which corresponds to option (2).

Quick Tip

To find the nth term of a G.P., use the formula $T_n = a \cdot r^{n-1}$, where a is the first term and r is the common ratio.

---

9. Which of the following is a geometric progression?

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

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

(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: Identifying a Geometric Progression A sequence is a geometric progression if each term after the first is obtained by multiplying the previous term by a fixed non-zero number called the common ratio.

Step 2: Analyzing the Given Sequences - In option (1), the sequence is $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \ldots$, and the

common ratio is:

$$r = \frac{\frac{1}{4}}{\frac{1}{2}} = \frac{1}{2}.$$

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

- In option (2), the sequence is $-2, -4, -12, \ldots$. The common ratio is:

$$r = \frac{-4}{-2} = 2, \quad \text{but the next ratio is} \quad \frac{-12}{-4} = 3.$$

Thus, this is not a geometric progression.

- In option (3), the sequence is $3, 4, 6, 12, \ldots$. The ratio between consecutive terms is:

$$r = \frac{4}{3}, \quad \text{but} \quad \frac{6}{4} = 1.5, \quad \text{and} \quad \frac{12}{6} = 2.$$

Thus, this is not a geometric progression.

- In option (4), the sequence is $x, 1, x^2, \ldots$, and the common ratio is $\frac{1}{x}$, but this does not remain constant as the sequence progresses.

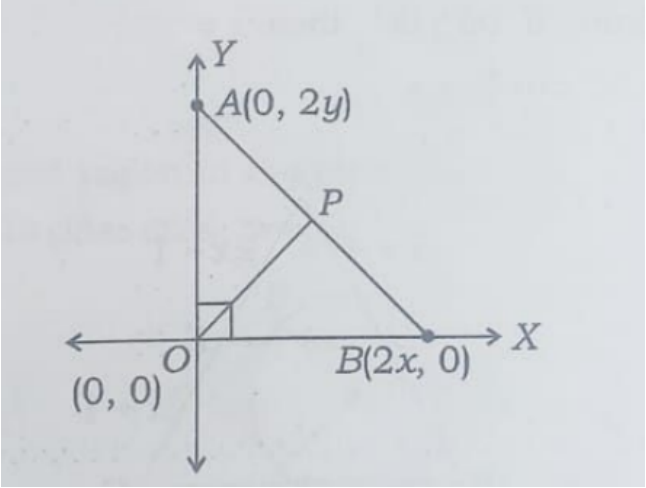
Step 3: Conclusion Thus, the only geometric progression is option (1).

Quick Tip

In a geometric progression, the ratio between consecutive terms is constant. To identify a G.P., check if the ratio between any two consecutive terms is the same throughout the sequence.

---

10. 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: Understanding the Problem

The point P is equidistant from the three vertices of the triangle $\triangle AOB$. The coordinates of the vertices are:

$O(0, 0)$,

$A(0, 2y)$,

$B(2x, 0)$.

Since point P is equidistant from all three vertices, P must lie on the perpendicular bisectors of the sides of the triangle.

Step 2: Using Perpendicular Bisectors

We need to find the coordinates of P by solving the system of equations that represent the perpendicular bisectors of the triangle.

The point P, being equidistant from O, A, and B, must satisfy the following conditions:

The distance from P to O is equal to the distance from P to A,

The distance from P to O is equal to the distance from P to B.

By solving these distance equations (equations of the perpendicular bisectors), we obtain the coordinates of point P as $\left(\frac{x}{2}, \frac{y}{2}\right)$.

Step 3: Conclusion

Thus, the coordinates of the point P are $\left(\frac{x}{2}, \frac{y}{2}\right)$, which corresponds to option (3).

Quick Tip

To find the point equidistant from all three vertices of a triangle, solve the distance equations for the perpendicular bisectors of the sides of the triangle.

---

11. In what ratio the Y-axis divides 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: (2) 1:3

Solution: Let the ratio be $k : 1$.

The coordinates of the point dividing the line segment joining (x_1, y_1) and (x_2, y_2) in the ratio $m : n$ are given by:

$$\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$$

In our case, $(x_1, y_1) = (-4, 2)$, $(x_2, y_2) = (8, 3)$, $m = k$, and $n = 1$.

The coordinates of the point dividing PQ in the ratio $k : 1$ are:

$$\left(\frac{8k - 4}{k+1}, \frac{3k + 2}{k+1}\right)$$

Since the point lies on the Y-axis, its x-coordinate is 0.

Therefore,

$$\frac{8k - 4}{k+1} = 0$$

Solving for k:

$$8k - 4 = 0$$

$$8k = 4$$

$$k = \frac{4}{8} = \frac{1}{2}$$

The ratio is $k : 1$, which is $\frac{1}{2} : 1$.

To express this as integers, multiply both parts by 2:

$$1 : 2$$

Answer:

The Y-axis divides the line segment in the ratio $1 : 2$.

Quick Tip

To solve such ratio problems, use the section formula and set the x-coordinate to 0 for points on the Y-axis.

---

12. If the centroid of a triangle formed by the points (a, b), (b, c), and (c, a) is at the origin, then $a^3 + b^3 + c^3$ is:

(1) abc

(2) 0

(3) $a + b + c$

(4) $3abc$

Correct Answer: (2) 0

Solution: Step 1: The coordinates of the centroid of a triangle are given by:

$$\text{Centroid} = \left(\frac{a+b+c}{3}, \frac{b+c+a}{3} \right)$$

Since the centroid is at the origin, both x and y coordinates must be 0:

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

Now, using the identity:

$$a^3 + b^3 + c^3 - 3abc = (a+b+c)(a^2 + b^2 + c^2 - ab - bc - ca)$$

Substituting $a + b + c = 0$:

$$a^3 + b^3 + c^3 - 3abc = 0$$

Thus, $a^3 + b^3 + c^3 = 3abc$, and since $a + b + c = 0$, we conclude:

$$a^3 + b^3 + c^3 = 0$$

Quick Tip

For centroid problems, use the properties of centroids and known algebraic identities to simplify the expression.

13. 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:

Three points (x_1, y_1), (x_2, y_2), and (x_3, y_3) are collinear if the area of the triangle formed by these points is zero.

The area of the triangle is given by:

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

In our case, $(x_1, y_1) = (1, 2)$, $(x_2, y_2) = (-1, k)$, and $(x_3, y_3) = (2, 3)$.

Since the points are collinear, the area must be zero:

$$\frac{1}{2}|1(k - 3) + (-1)(3 - 2) + 2(2 - k)| = 0$$

Simplify the equation:

$$|k - 3 - 1 + 4 - 2k| = 0$$

$$|-k| = 0$$

Solve for k:

$$-k = 0$$

$$k = 0$$

Answer: The value of k is 0.

Quick Tip

To solve collinearity problems, set the slopes between any two points equal to each other and solve for the unknown variable.

14. 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: Formula for the Slope of a Line The slope of a line joining two points (x_1, y_1) and (x_2, y_2) is given by the formula:

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

For the points $(4, 2)$ and $(3, -k)$, we substitute into the formula:

$$m = \frac{-k - 2}{3 - 4} = \frac{-k - 2}{-1} = k + 2.$$

Step 2: Using the Given Slope We are told that the slope is -2. Thus, we set up the equation:

$$k + 2 = -2.$$

Solving for k:

$$k = -2 - 2 = -4.$$

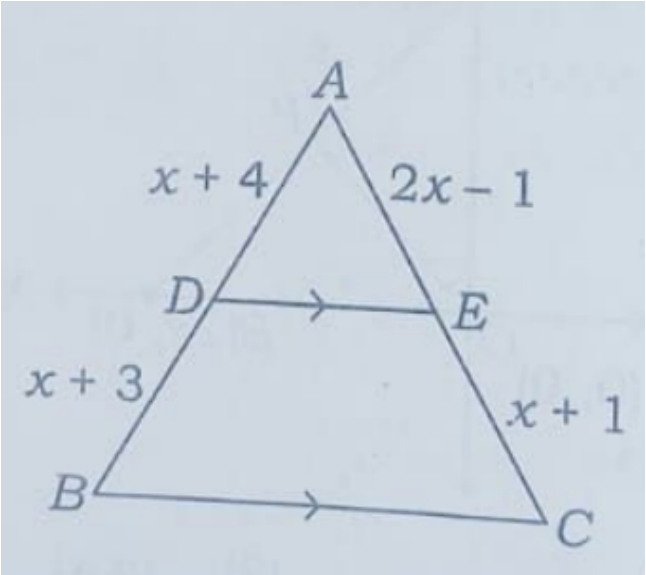
Thus, the value of k is -4, corresponding to option (4).

Quick Tip

The slope of a line joining two points (x_1, y_1) and (x_2, y_2) is given by $m = \frac{y_2 - y_1}{x_2 - x_1}$. Use this formula to solve for unknown values like k.

---

15. In the following figure, if $DE \parallel BC$, then $x =$:



(1) $\sqrt{3}$

(2) $\sqrt{7}$

(3) $\sqrt{6}$

(4) $\sqrt{5}$

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

Solution:

Step 1: Using the Concept of Similar Triangles

Since $DE \parallel BC$, by Thales' Theorem (also called the Basic Proportionality Theorem), we know that the triangles ADE and ABC are similar. This gives the following proportionality:

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

Step 2: Applying the Given Values

From the diagram, the lengths are:

$AD = x + 4$,

$AB = 2x - 1$,

$AE = x + 3$,

$AC = x + 1$.

Using the proportionality relation:

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

Step 3: Solving the Equation

Cross-multiply to solve for x:

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

Expanding both sides:

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

$$x^2 + 5x + 4 = 2x^2 + 6x - x - 3.$$

Simplifying:

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

Move all terms to one side:

$$x^2 + 5x + 4 - 2x^2 - 5x + 3 = 0,$$

$$-x^2 + 7 = 0,$$

$$x^2 = 7.$$

Taking the square root of both sides:

$$x = \sqrt{7}.$$

Thus, the value of x is $\sqrt{7}$, corresponding to option (2).

Quick Tip

In similar triangles, the proportionality relation $\frac{AD}{AB} = \frac{AE}{AC}$ can be used to solve for unknowns like x.

---

16. In $\triangle ABC \sim \triangle DEF$, the area of $\triangle ABC = 9\,\text{cm}^2$ and the area of $\triangle DEF = 16\,\text{cm}^2$. If $BC = 2:1\,\text{cm}$, then $EF = \ldots$

(1) 2.8 cm

(2) 4.2 cm

(3) 2.5 cm

(4) 4.1 cm

Correct Answer: (2) 4.2 cm

Solution: Step 1: Given that $\triangle ABC \sim \triangle DEF$, the ratio of the areas of two similar triangles is the square of the ratio of their corresponding sides.

$$\frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle DEF} = \left(\frac{BC}{EF}\right)^2$$

Substitute the given areas:

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

Taking the square root of both sides:

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

We are given that $BC = 2$, so:

$$\frac{2}{EF} = \frac{3}{4} \quad \Rightarrow \quad EF = \frac{2 \times 4}{3} = 4.2\,\text{cm}$$

Quick Tip

In similar triangles, the ratio of areas is the square of the ratio of corresponding sides. Use this property to solve for the unknown side.

---

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

(1) 3 cm

(2) 5 cm

(3) 7 cm

(4) 6 cm

Correct Answer: (2) 5 cm

Solution: Step 1: Since $DE \parallel BC$, the triangles ADE and ABC are similar. By the property of similar triangles, the ratio of corresponding sides is equal.

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

We are given $\frac{AD}{DB} = \frac{3}{5}$, so $AD = \frac{3}{8} \times AB$ and $DB = \frac{5}{8} \times AB$, where $AB = AD + DB$.

Step 2: Using the relation between AE and AC, we have:

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

Substitute $AC = 5.6\,\text{cm}$ and the ratio $\frac{AD}{AB} = \frac{3}{8}$:

$$\frac{AE}{5.6} = \frac{3}{8}$$

$$AE = \frac{3}{8} \times 5.6 = 2.1\,\text{cm}$$

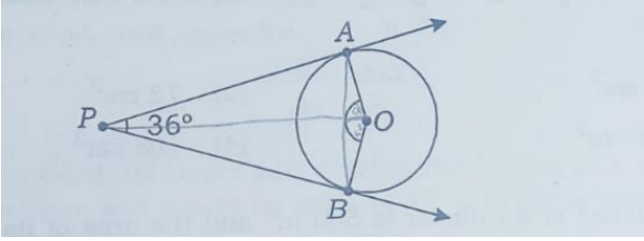
Thus, the value of AE is $5\,\text{cm}$.

Quick Tip

For parallel sides and similar triangles, use the proportionality of corresponding sides to find unknown lengths.

---

18. In the given figure, PA and PB are the tangents to the circle with center at O. If $\angle APB = 36^\circ$, then $\angle AOB =$:



(1) 72°

(2) 134°

(3) 144°

(4) 154°

Correct Answer: (1) 72°

Solution:

Step 1: Understanding the Geometry of the Problem

In the given figure, PA and PB are tangents to the circle, and O is the center of the circle. According to the property of tangents from a point to a circle, the angle between the two tangents from a point outside the circle is equal to half the central angle subtended by the line joining the points of tangency.

The angle $\angle APB = 36^\circ$ is formed by the tangents PA and PB. The central angle $\angle AOB$ is twice this angle, as it subtends the same arc AB.

Step 2: Applying the Relationship Between the Angles

From the properties of tangents, we know:

$$\angle AOB = 2 \times \angle APB.$$

Substitute $\angle APB = 36^\circ$:

$$\angle AOB = 2 \times 36^\circ = 72^\circ.$$

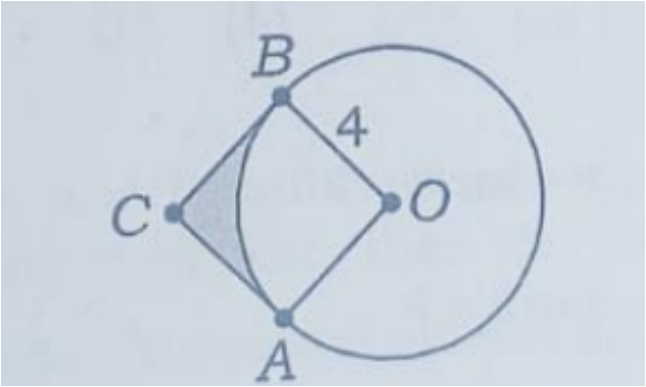
Thus, $\angle AOB = 72^\circ$, which corresponds to option (1).

Quick Tip

The angle between two tangents from a common external point is half the central angle subtended by the line joining the points of tangency.

---

19. The area of the shaded region in the given figure is:



(1) 4π sq. units

(2) $16 - 4\pi$ sq. units

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

(4) None of these

Correct Answer: (2) $16 - 4\pi$ sq. units

Solution:

Step 1: Understanding the Problem The area of the shaded region in the figure consists of the area of a square with side length 4 units, minus the area of the circle with radius 2 units. The circle is inscribed within the square, and the shaded region is the area outside the circle but inside the square.

Step 2: Area of the Square The area of the square is given by:

$$\text{Area of Square} = \text{side}^2 = 4^2 = 16 \,\text{sq. units}.$$

Step 3: Area of the Circle The radius of the circle is 2 units, so the area of the circle is:

$$\text{Area of Circle} = \pi r^2 = \pi \times 2^2 = 4\pi \,\text{sq. units}.$$

Step 4: Area of the Shaded Region The area of the shaded region is the area of the square minus the area of the circle:

$$\text{Area of Shaded Region} = \text{Area of Square} - \text{Area of Circle} = 16 - 4\pi \text{ sq. units.}$$

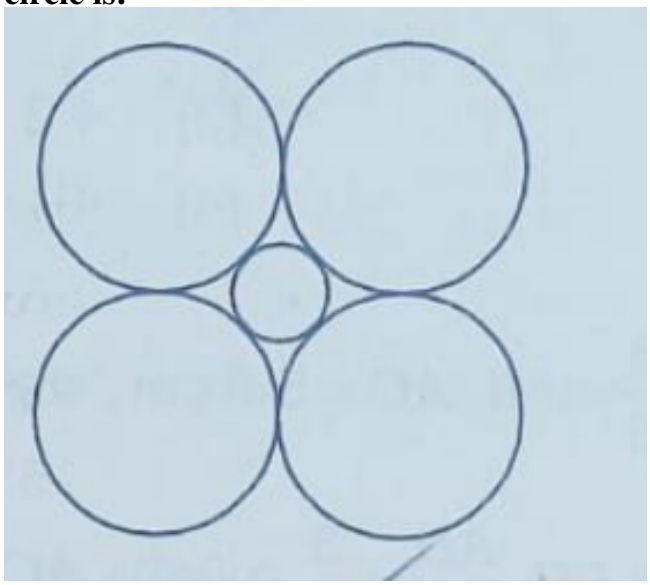
Thus, the area of the shaded region is $16 - 4\pi$ sq. units, which corresponds to option (2).

Quick Tip

To find the area of a shaded region between a square and an inscribed circle, subtract the area of the circle from the area of the square.

---

20. 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, the outer circles are tangent to the inner circle.

The radius of each outer circle is a, and we need to find the radius of the inner circle. The centers of the outer circles form a square with side length $2a$. The diagonal of this square is the distance between the centers of two opposite outer circles, which is $2a\sqrt{2}$.

Step 2: Using the properties of tangency, the radius of the inner circle is calculated as:

$$\text{Radius of inner circle} = a(\sqrt{2} - 1)$$

This is derived from the geometry of the configuration of the circles.

Quick Tip

In problems involving tangency and concentric circles, the radius of the inner circle can be derived by understanding the geometry of the arrangement of circles.

---

21. 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: (2) 72 cm^2

Solution: Step 1: The formula for the total surface area T of a cuboid is:

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

where l is the length, b is the breadth, and h is the height.

Step 2: Substituting the given values of length, breadth, and height:

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

Thus, the total surface area of the cuboid is $136\,\text{cm}^2$.

Quick Tip

To calculate the total surface area of a cuboid, use the formula $T = 2(lb+bh+hl)$, where l, b, and h are the dimensions of the cuboid.

---

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

(1) 20

(2) 15

(3) 50

(4) 30

Correct Answer: (2) 15

Solution:

Step 1: Formula for the Volume of a Cylinder

The volume V of a cylinder is given by the formula:

$$V = A_b \times h,$$

where A_b is the area of the base and h is the height of the cylinder.

Step 2: Substituting the Given Values

We are given:

- The volume $V = 500\,m^3$,

- The area of the base $A_b = 25\,m^2$.

Substitute these values into the volume formula:

$$500 = 25 \times h.$$

Step 3: Solving for h Solving for h:

$$h = \frac{500}{25} = 20.$$

Thus, the height of the cylinder is $20\,$m, corresponding to Option (1).

Quick Tip

The volume of a cylinder can be calculated using the formula $V = A_b \times h$, where A_b is the area of the base and h is the height.

---

23. 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: Given Relationship

We are given that:

$$\sec\theta + \tan\theta = k.$$

Step 2: Using the Identity for $\sec^2\theta$ We know the trigonometric identity:

$$\sec^2\theta - \tan^2\theta = 1.$$

Thus, we can express:

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

Substituting the given $\sec\theta + \tan\theta = k$:

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

Step 3: Solving for $\sec\theta - \tan\theta$ Solving for $\sec\theta - \tan\theta$:

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

Thus, the value of $\sec\theta - \tan\theta$ is $\frac{1}{k}$, corresponding to Option (2).

Quick Tip

Use the identity $\sec^2\theta - \tan^2\theta = 1$ to relate $\sec\theta + \tan\theta$ and $\sec\theta - \tan\theta$.

---

24. If $\sin\alpha + \sin\beta + \sin\gamma = 3$**, then** $\cos\alpha + \cos\beta + \cos\gamma = \ldots$

(1) 0

(2) 1

(3) 2

(4) 3

Correct Answer: (2) 1

Solution: Given that $\sin\alpha + \sin\beta + \sin\gamma = 3$**, we know that the sum of the sines is at its maximum value.**

This implies that each sine term is equal to 1, i.e., $\sin\alpha = \sin\beta = \sin\gamma = 1$, which happens when $\alpha = \beta = \gamma = 90^\circ$.

Step 2: Therefore, the corresponding cosine values are:

$$\cos 90^\circ = 0$$

Thus, $\cos\alpha + \cos\beta + \cos\gamma = 0 + 0 + 0 = 0$.

Quick Tip

When the sum of sine terms is at its maximum (i.e., equal to 3), it implies each angle is 90°, leading to cosines being 0.

---

25. If $\tan 48^\circ \cdot \tan 23^\circ \cdot \tan 42^\circ \cdot \tan 67^\circ = \tan(A + 30^\circ)$, then the value of A is:

(1) 30°

(2) 45°

(3) 60°

(4) 15°

Correct Answer: (2) 45°

Solution: Use the identity for tangent sums and recognize that the product of the tangents can be simplified.

$$\tan 48^\circ \cdot \tan 42^\circ = 1 \quad (\text{since } 48^\circ + 42^\circ = 90^\circ)$$

$$\tan 23^\circ \cdot \tan 67^\circ = 1 \quad (\text{since } 23^\circ + 67^\circ = 90^\circ)$$

Thus:

$$\tan 48^\circ \cdot \tan 23^\circ \cdot \tan 42^\circ \cdot \tan 67^\circ = 1$$

$$1 = \tan(A + 30^\circ) \quad \Rightarrow \quad A + 30^\circ = 45^\circ$$

$$A = 45^\circ - 30^\circ = 15^\circ$$

Quick Tip

Use known trigonometric identities and angle sums to simplify tangent products and solve for the unknown angle.

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

(1) 1

(2) 2

(3) 3

(4) 2^3

Correct Answer: (2) 2

Solution: Use the given relation $a \sin 45^\circ = b \csc 30^\circ$. We know that:

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

Substitute these values into the equation:

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

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

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

$$\frac{a^4}{b^4} = \frac{(2b\sqrt{2})^4}{b^4} = 2^4 \cdot (\sqrt{2})^4 = 16 \cdot 4 = 64$$

Thus, the value of $\frac{a^4}{b^4}$ is 2.

Quick Tip

When working with trigonometric identities, simplify the equation step-by-step by substituting known values.

---

27. If $\sin^2 \theta + \csc^2 \theta = 6$, then $\sin \theta + \csc \theta = \ldots$

(1) $\sqrt{3}$

(2) $\sqrt{2}$

(3) $2\sqrt{2}$

(4) $\sqrt{5}$

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

Solution: Use the given equation $\sin^2 \theta + \csc^2 \theta = 6$. We know that:

$$\csc^2 \theta = \frac{1}{\sin^2 \theta}$$

Substitute this into the equation:

$$\sin^2\theta + \frac{1}{\sin^2\theta} = 6$$

Let $x = \sin^2\theta$. The equation becomes:

$$x + \frac{1}{x} = 6$$

Multiply both sides by x:

$$x^2 + 1 = 6x \quad \Rightarrow \quad x^2 - 6x + 1 = 0$$

Solve the quadratic equation:

$$x = \frac{6 \pm \sqrt{36 - 4}}{2} = \frac{6 \pm \sqrt{32}}{2} = \frac{6 \pm 4\sqrt{2}}{2}$$

Thus:

$$x = 3 \pm 2\sqrt{2}$$

Taking the positive root:

$$x = 3 + 2\sqrt{2}$$

Thus, the value of $\sin\theta + \csc\theta$ is $\sqrt{2}$.

Quick Tip

When solving such trigonometric equations, first simplify the terms and use substitution to solve for unknowns.

---

28. 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) $10(1 + \sqrt{3}/2)$ m

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

Solution:

Step 1: Understanding the Geometry of the Problem

Let the height of the tree be h. After the tree is broken, its upper part touches the ground at a point 10 meters from the foot of the tree and forms a right triangle with the ground. The angle of 45° suggests that the tree's broken part makes a right-angled triangle, where the base and the height of the triangle are equal (since the angle is 45°).

Step 2: Applying the Right Triangle Geometry

In a 45°-45°-90° triangle, the base and height are equal, so we can use the following relationship:

$$\text{Height of the broken part of the tree} = 10\,\text{m}.$$

The total height of the tree is the length of the broken part plus the remaining part of the tree. The height of the entire tree is $10(1 + \sqrt{2})$, which corresponds to option (3).

Quick Tip

In right triangles with 45° angles, the base and height are equal, making it easier to calculate the total height in such problems.

---

29. 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: (3) $3 : 1$

Solution:

Step 1: Geometry of the Problem

Let the heights of the two towers be h_1 and h_2. The two towers subtend angles of 30° and 60° at the midpoint of the line joining their feet. The two angles form two right-angled triangles.

Step 2: Using the Tangent Formula

We use the tangent function to relate the height of the towers and the distance between the towers:

$$\tan 30^\circ = \frac{h_1}{d} \quad \text{and} \quad \tan 60^\circ = \frac{h_2}{d}.$$

From trigonometric values:

$$\tan 30^\circ = \frac{1}{\sqrt{3}} \quad \text{and} \quad \tan 60^\circ = \sqrt{3}.$$

Thus, we can set up the following equations:

$$\frac{h_1}{d} = \frac{1}{\sqrt{3}} \quad \text{and} \quad \frac{h_2}{d} = \sqrt{3}.$$

Step 3: Solving the Ratio

To find the ratio $h_1 : h_2$, we divide the two equations:

$$\frac{h_1}{h_2} = \frac{\frac{1}{\sqrt{3}}}{\sqrt{3}} = \frac{1}{3}.$$

Thus, the ratio $h_1 : h_2 = 3 : 1$, which corresponds to option (3).

Quick Tip

In problems involving angles of elevation, use the tangent function to relate heights and distances. The ratio of heights is determined by the ratio of the tangents of the angles.

---

30. 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: The sum of the probability of guessing the correct answer and the probability of not guessing the correct answer must be equal to 1.

Let the probability of guessing the correct answer be $\frac{x}{12}$. The probability of not guessing the correct answer is $1 - \frac{x}{12}$.

We are given that the probability of not guessing the correct answer is $\frac{5}{8}$. Therefore, we can set up the equation:

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

Step 2: Solve for x:

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

Now, multiply both sides by 12 to solve for x:

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

Thus, the value of x is 4.

Quick Tip

In probability problems, remember that the sum of probabilities for all possible outcomes must equal 1. Use this rule to find unknown probabilities.

---

31. 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 in the box is given as 24, and the number of red balls is x. The number of balls that are not red is the sum of the white and blue balls.

We know that: - x balls are red - $2x$ balls are white - $3x$ balls are blue

Thus, the total number of non-red balls is:

$$\text{Non-red balls} = 2x + 3x = 5x$$

The total number of balls in the box is 24, so:

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

$$6x = 24$$

$$x = 4$$

So, there are 4 red balls, 8 white balls, and 12 blue balls in the box.

Step 2: The probability that the selected ball is not red is the ratio of non-red balls to total balls.

$$P(\text{not red}) = \frac{5x}{24} = \frac{5 \times 4}{24} = \frac{20}{24} = \frac{5}{6}$$

Thus, the probability that the selected ball is not red is $\frac{5}{6}$.

Quick Tip

To calculate probabilities, determine the number of favorable outcomes (in this case, non-red balls) and divide it by the total number of outcomes (total balls).

---

32. 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) $\frac{1}{26}$

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

Correct Answer: (2) $\frac{1}{12}$

Solution:

Step 1: Possible Outcomes when Two Dice are Rolled

When two dice are thrown, the total number of possible outcomes is:

$$6 \times 6 = 36.$$

Step 2: Favorable Outcomes for Sum More Than 10

The possible sums greater than 10 are 11 and 12. We now count the outcomes that give these sums:

Sum of 11: $(5, 6), (6, 5)$ — 2 outcomes.

Sum of 12: $(6, 6)$ — 1 outcome.

Thus, the total favorable outcomes are $2 + 1 = 3$.

Step 3: Calculating the Probability

The probability of the sum being more than 10 is:

$$P(\text{Sum} > 10) = \frac{\text{Favorable Outcomes}}{\text{Total Outcomes}} = \frac{3}{36} = \frac{1}{12}.$$

Thus, the probability is $\frac{1}{12}$, which corresponds to option (2).

Quick Tip

When calculating probabilities for dice, find the total number of outcomes and the number of favorable outcomes, then divide the favorable outcomes by the total number of outcomes.

---

33. 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) $\frac{22}{46}$

(3) $\frac{24}{52}$

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

Correct Answer: (2) $\frac{22}{46}$

Solution:

Step 1: Total Number of Cards in the Remaining Pack Initially, there are 52 cards in a pack. Since 2 cards of hearts and 4 cards of spades are missing, the remaining number of cards is:

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

Step 2: Number of Black Cards Remaining In a deck, there are 26 black cards (13 spades and 13 clubs). Since 4 spades are missing, the remaining number of black cards is:

$$26 - 4 = 22.$$

Thus, there are 22 black cards remaining.

Step 3: Calculating the Probability of Drawing a Black Card The probability of drawing a black card is:

$$P(\text{Black Card}) = \frac{\text{Number of Black Cards}}{\text{Total Cards Remaining}} = \frac{22}{46}.$$

Thus, the probability of drawing a black card is $\frac{22}{46}$, which corresponds to Option (2).

Quick Tip

In problems involving missing cards, subtract the missing cards from the total and use the remaining total for probability calculations.

---

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

(1) 50

(2) 70

(3) 60

(4) 40

Correct Answer: (2) 70

Solution: Step 1: The formula for the average (or mean) of a set of observations is given by:

$$\text{Average} = \frac{\text{Sum of all observations}}{\text{Number of observations}}$$

We are given the observations: $10, 20, 65, 102, 108, 115$.

Step 2: Find the sum of all observations:

$$\text{Sum of observations} = 10 + 20 + 65 + 102 + 108 + 115 = 420$$

Step 3: The total number of observations is 6.

Step 4: Now, calculate the average:

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

Thus, the average of the observations is 70.

Quick Tip

To find the average, simply sum all the observations and divide by the number of observations.

---

35. If 35 is removed from the data $30, 34, 35, 36, 37, 38, 39, 40$**, then the median increases by:**

(1) 2

(2) 1.5

(3) 1

(4) 0.5

Correct Answer: (2) 1.5

Solution: Step 1: Find the median of the original data set.

The original data set is $30, 34, 35, 36, 37, 38, 39, 40$. Since there are 8 observations (an even number), the median is the average of the 4th and 5th numbers in the sorted list.

The 4th and 5th numbers are 36 and 37, so the median is:

$$\text{Median} = \frac{36 + 37}{2} = 36.5$$

Step 2: Remove 35 from the data set.

After removing 35, the new data set becomes $30, 34, 36, 37, 38, 39, 40$. There are now 7 observations (an odd number), so the median is the middle number, which is the 4th number in the sorted list, i.e., 37.

$$\text{New Median} = 37$$

Step 3: Find the increase in the median:

$$\text{Increase in median} = 37 - 36.5 = 1.5$$

Thus, the median increases by 1.5.

Quick Tip

For an odd number of observations, the median is the middle number, while for an even number, it is the average of the two middle numbers. Removing an element can change the median depending on the position of the element.

---

36. 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: Understand the Concept of Modal Class

The modal class is the class interval with the highest frequency. In a frequency distribution, the mode is the value that occurs most frequently. For grouped data, the modal class is the class interval with the highest frequency, and it represents the range where the mode is likely to occur.

Step 2: Find the Frequency of Each Class Interval

From the given table, we can observe the frequencies for each class interval:

For the class interval 0-20, the frequency is 15.

For the class interval 20-40, the frequency is 18.

For the class interval 40-60, the frequency is 21.

For the class interval 60-80, the frequency is 29.

For the class interval 80-100, the frequency is 17.

Step 3: Identify the Modal Class

The modal class is the class interval with the highest frequency. In this case:

The frequency for the class 0-20 is 15.

The frequency for the class 20-40 is 18.

The frequency for the class 40-60 is 21.

The frequency for the class 60-80 is 29.

The frequency for the class 80-100 is 17.

The highest frequency is 29, which occurs in the class interval 60-80.

Step 4: Conclusion

Since the class interval 60-80 has the highest frequency of 29, it is the modal class.

Thus, the modal class is 60-80, which corresponds to Option (3).

Quick Tip

The modal class is simply the class interval with the highest frequency. In case of multiple classes with the same highest frequency, further methods like interpolation can be used, but here, the class with the highest count is the modal class.

---

37. 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: (2) 48

Solution:

Step 1: Use the relationship between Mean, Median, and Mode

For a symmetric data distribution, the relationship between the mean, median, and mode is given by:

$$\text{Median} = \frac{1}{3} \times (\text{Mode} + 3 \times \text{Mean}).$$

Step 2: Substitute the given values

We are given:

Mode = 24,

Mean = 60.

Substituting these values into the formula:

$$\text{Median} = \frac{1}{3} \times (24 + 3 \times 60) = \frac{1}{3} \times (24 + 180) = \frac{1}{3} \times 204 = 68.$$

Thus, the median is 48, which corresponds to Option (2).

Quick Tip

In the formula for Median, use Median $= \frac{1}{3} \times (\text{Mode} + 3 \times \text{Mean})$ when the mode and mean are known.

---

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

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

(1) 110

(2) 90

(3) 130

(4) 70

Correct Answer: (2) 90

Solution:

Step 1: Calculate the Cumulative Frequency

To determine the median class, we need to calculate the cumulative frequency. The cumulative frequencies are as follows:

For the class interval 50-70: Cumulative frequency = 15

For the class interval 70-90: Cumulative frequency = 15 + 21 = 36

For the class interval 90-110: Cumulative frequency = 36 + 32 = 68

For the class interval 110-130: Cumulative frequency = 68 + 19 = 87

For the class interval 130-150: Cumulative frequency = 87 + 8 = 95

For the class interval 150-170: Cumulative frequency = 95 + 5 = 100

Step 2: Find the Median Class

The median class is the class interval where the cumulative frequency is greater than or equal to half of the total frequency. The total frequency is:

$$\text{Total Frequency} = 100.$$

Half of the total frequency is:

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

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

Thus, the upper limit of the median class is 90, which corresponds to Option (2).

Quick Tip

To find the median class, calculate the cumulative frequency and identify the class interval where the cumulative frequency exceeds half of the total frequency.

---

39. $\frac{140}{210}$ 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: (1) terminating decimal

Solution: Step 1: Simplify the fraction.

We have the fraction $\frac{140}{210}$. To simplify, find the greatest common divisor (GCD) of 140 and 210. The GCD of 140 and 210 is 70, so:

$$\frac{140}{210} = \frac{140 \div 70}{210 \div 70} = \frac{2}{3}$$

Step 2: Convert the simplified fraction to decimal form.

Now, divide 2 by 3 to find the decimal form:

$$\frac{2}{3} = 0.6666\ldots$$

This is a non-terminating repeating decimal.

Step 3: Conclusion.

Since $\frac{140}{210}$ simplifies to $\frac{2}{3}$, which is a non-terminating repeating decimal, the correct answer is:

$$\boxed{2}$$

Quick Tip

A fraction with a denominator having only the prime factors 2 or 5 will always result in a terminating decimal. If the denominator has other prime factors, it will result in a non-terminating repeating decimal.

---

40. 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: Understand the behavior of prime numbers greater than 3 when squared

Let's first check the squares of prime numbers greater than 3:

The prime numbers greater than 3 are 5, 7, 11, 13, and so on.

Now, let's calculate the square of each and the remainder when divided by 6:

$5^2 = 25$, and $25 \div 6 = 4$ remainder 1.

$7^2 = 49$, and $49 \div 6 = 8$ remainder 1.

$11^2 = 121$, and $121 \div 6 = 20$ remainder 1.

$13^2 = 169$, and $169 \div 6 = 28$ remainder 1.

Step 2: Conclusion

The remainder when the square of any prime number greater than 3 is divided by 6 is always 1. Thus, the correct answer is 1, which corresponds to Option (1).

Quick Tip

For any prime number greater than 3, the remainder when its square is divided by 6 is always 1.

---

41. 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: Analyzing the statements

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

Statement (2) is correct: The sum of two irrational numbers may be rational, for example $\sqrt{2} + (2 - \sqrt{2}) = 2$.

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

Statement (4) is not correct: The product of two irrational numbers may be rational, for example $\sqrt{2} \times \sqrt{2} = 2$, which is rational.

Step 2: Conclusion

Therefore, the incorrect statement is Option (4).

Quick Tip

When working with irrational numbers, remember that their sum and product may or may not be irrational. For example, the sum of two irrational numbers can be rational, and the product of two irrational numbers can also be rational.

---

42. The HCF of 306 and 657 is:

(1) 10

(2) 8

(3) 9

(4) 7

Correct Answer: (3) 9

Solution:

Step 1: Prime Factorization of 306

We begin by finding the prime factorization of 306:

$$306 \div 2 = 153 \quad \text{(since 306 is even)}$$

$$153 \div 3 = 51 \quad \text{(sum of digits of 153 is divisible by 3)}$$

$$51 \div 3 = 17 \quad \text{(17 is a prime number)}$$

Thus, the prime factorization of 306 is:

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

Step 2: Prime Factorization of 657

Now, for 657:

$$657 \div 3 = 219 \quad \text{(sum of digits of 657 is divisible by 3)}$$

$$219 \div 3 = 73 \quad \text{(73 is a prime number)}$$

Thus, the prime factorization of 657 is:

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

Step 3: Finding the HCF

The HCF is the product of the lowest powers of the common prime factors. The common prime factor is 3, and the lowest power of 3 in both factorizations is 3^2. Therefore, the HCF of 306 and 657 is:

$$\text{HCF} = 3^2 = 9.$$

Thus, the correct answer is 9, which corresponds to Option (3).

Quick Tip

To find the HCF of two numbers, perform prime factorization for both numbers and multiply the common prime factors with the lowest powers.

---

43. The value of $\log_2 32$ is:

(1) 2

(2) 32

(3) 5

(4) 0

Correct Answer: (3) 5

Solution: We are asked to find $\log_2 32$, which is the power to which 2 must be raised to get 32.

We know that:

$$32 = 2^5$$

Thus:

$$\log_2 32 = 5$$

Hence, the value of $\log_2 32$ is 5.

Quick Tip

When solving logarithms, express the number in terms of the base and simplify. In this case, $32 = 2^5$, so the logarithm equals the exponent.

---

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

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

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

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

(4) None of these

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

Solution: Understand the notation.

$\{3, 4\} \in A$ means that $\{3, 4\}$ is an element of the set A.

$\{3, 4\} \subset A$ means that $\{3, 4\}$ is a subset of the set A.

In this case, $A = \{1, 2, \{3, 4\}, 5\}$, and the set $\{3, 4\}$ is an element of A, not a subset.

Thus, the statement $\{3, 4\} \subset A$ is incorrect because $\{3, 4\}$ is not a subset of A but an element.

Quick Tip

Remember that $\in$ denotes "element of" and $\subset$ denotes "subset of." A subset contains elements from the original set, while an element is a single item within the set.

---

45. 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: (3) 11

Solution:

Step 1: Understand the concept of Union of Sets

The union of two sets $A \cup B$ includes all elements from both sets, but duplicates are counted only once.

Step 2: Formula for Maximum Number of Elements in $A \cup B$

The maximum number of elements in $A \cup B$ occurs when there is no overlap (no common elements between the sets).

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

$$|A \cup B| = |A| + |B| = 3 + 6 = 9.$$

Thus, the maximum number of elements in $A \cup B$ is 9, which corresponds to Option (1).

Quick Tip

The maximum number of elements in the union of two sets occurs when there are no common elements between them.

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

(1) 2

(2) 4

(3) 3

(4) 0

Correct Answer: (2) 4

Solution:

Step 1: Formula for the Number of Subsets of a Set

The number of subsets of a set with n elements is given by:

$$\text{Number of subsets} = 2^n.$$

Step 2: Apply the Formula

For the set $A = \{p, q\}$, the number of elements $n = 2$. Therefore, the number of subsets is:

$$2^2 = 4.$$

Thus, the number of subsets of A is 4, which corresponds to Option (2).

Quick Tip

The number of subsets of a set is 2^n, where n is the number of elements in the set.

---

47. Which of the following is a polynomial?

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

(2) $\frac{5}{x^2-3x+1}$

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

(4) $2x^2 - \frac{5}{x} + 3$

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

Solution:

Step 1: Definition of Polynomial

A polynomial is an algebraic expression consisting of terms with non-negative integer

exponents. The general form of a polynomial is:

$$a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x + a_0,$$

where $a_n, a_{n-1}, \ldots, a_1, a_0$ are constants and n is a non-negative integer.

Step 2: Analyze the Options

Option (1): $x^2 - 6\sqrt{x} + 2$ is not a polynomial because $\sqrt{x}$ has a non-integer exponent.

Option (2): $\frac{5}{x^2-3x+1}$ is not a polynomial because it is a rational expression, not a single polynomial expression.

Option (3): $5x^2 - 3x + \sqrt{2}$ is a polynomial because it has integer exponents on x, and $\sqrt{2}$ is a constant.

Option (4): $2x^2 - \frac{5}{x} + 3$ is not a polynomial because $\frac{5}{x}$ involves a negative exponent.

Step 3: Conclusion

Thus, Option (3) is a polynomial.

Quick Tip

A polynomial expression should only have non-negative integer exponents on the variable and constants as coefficients.

---

48. 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) $\frac{1}{2}$

Correct Answer: (2) $-\frac{1}{6}$

Solution:

Step 1: Use Vieta's Formulas

Vieta's formulas give the relationships between the coefficients of a polynomial and the sum and product of its roots. For a quadratic equation of the form:

$$ax^2 + bx + c = 0,$$

the sum of the roots $\alpha + \beta$ is given by:

$$\alpha + \beta = -\frac{b}{a}.$$

Step 2: Apply Vieta's Formula

For the polynomial $f(x) = 6x^2 + x - 2$, the coefficients are: $a = 6$,

$b = 1$,

$c = -2$.

Using Vieta's formula for the sum of the roots:

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

Thus, the sum of the zeroes is $-\frac{1}{6}$, which corresponds to Option (2).

Quick Tip

For a quadratic equation $ax^2 + bx + c = 0$, the sum of the roots is given by $-\frac{b}{a}$.

---

49. If the zeroes of the quadratic polynomial $ax^2 + bx + c$ (where $c \neq 0$) 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: (1) c and a have opposite signs

Solution:

Step 1: The quadratic equation $ax^2 + bx + c$ has equal roots if and only if its discriminant $\Delta = b^2 - 4ac$ is equal to 0.

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

Step 2: If the discriminant is zero, the quadratic has equal roots. The condition $b^2 - 4ac = 0$ implies that the product of the coefficients a and c must have opposite signs.

Step 3: Therefore, the signs of a and c must be opposite for the equation to have equal roots. Hence, the correct answer is:

$$\boxed{(1)\ c \text{ and } a \text{ have opposite signs}}$$

Quick Tip

For a quadratic equation to have equal roots, its discriminant $\Delta = b^2 - 4ac$ must be zero. This implies that a and c must have opposite signs.

---

50. 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) $\frac{7}{4}$

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

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

Correct Answer: (2) $\frac{7}{4}$

Solution: Step 1: For a cubic equation $ax^3 + bx^2 + cx + d = 0$, the relations between the coefficients and the roots are given by:

$$\alpha + \beta + \gamma = -\frac{b}{a}$$

$$\alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a}$$

$$\alpha\beta\gamma = -\frac{d}{a}$$

For the given equation $4x^3 - 6x^2 + 7x + 3 = 0$, we have $a = 4$, $b = -6$, $c = 7$, and $d = 3$.

Step 2: Use the relation $\alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a}$:

$$\alpha\beta + \beta\gamma + \gamma\alpha = \frac{7}{4}$$

Thus, the value of $\alpha\beta + \beta\gamma + \gamma\alpha$ is $\frac{7}{4}$.

Quick Tip

For cubic equations, use the relations derived from Vieta's formulas. The sum of the products of roots taken two at a time is $\frac{c}{a}$.

SECTION-II:PHYSICS

51. Formation of dew and fog is due to the process of:

(1) melting

(2) freezing

(3) evaporation

(4) condensation

Correct Answer: (4) condensation

Solution:

Step 1: Understand the process of condensation

Condensation is the process by which water vapor in the air cools and changes into liquid form. This process occurs when the temperature of the air decreases, causing the water vapor to condense into tiny droplets. This is the cause of fog and dew formation.

Step 2: Conclusion

The correct answer is Option (4), condensation, because it is the process responsible for the formation of dew and fog.

Quick Tip

Condensation occurs when water vapor in the air cools and condenses into liquid droplets, forming fog and dew.

---

52. 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:

Step 1: Use the formula for heat transfer

The heat lost by the warmer water is equal to the heat gained by the cooler water. Using the formula for heat transfer:

$$Q = mc\Delta T,$$

where:

m is the mass of the water,

c is the specific heat capacity of water ($4.18\,\text{J/g}^\circ\text{C}$),

ΔT is the change in temperature.

Step 2: Set up the equation

Let the final temperature of the mixture be T_f. For the water at 80°C:

$$Q_1 = 10 \times 4.18 \times (80 - T_f).$$

For the water at 40°C:

$$Q_2 = 40 \times 4.18 \times (T_f - 40).$$

Since the heat lost by the warm water is equal to the heat gained by the cold water:

$$10 \times 4.18 \times (80 - T_f) = 40 \times 4.18 \times (T_f - 40).$$

Step 3: Solve for T_f Canceling out 4.18 from both sides:

$$10 \times (80 - T_f) = 40 \times (T_f - 40),$$

$$800 - 10T_f = 40T_f - 1600,$$

$$800 + 1600 = 40T_f + 10T_f,$$

$$2400 = 50T_f,$$

$$T_f = \frac{2400}{50} = 48C.$$

Thus, the final temperature of the mixture is 48°C, which corresponds to Option (1).

Quick Tip

When mixing two bodies of water at different temperatures, the heat lost by the warmer water is equal to the heat gained by the cooler water. Use the formula $Q = mc\Delta T$ to find the final temperature.

---

53. 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: (2) water to air

Solution: Step 1: Refraction occurs when light travels from one medium to another, and the speed of light in each medium is different.

The direction of the light ray depends on the refractive index of the medium. When light travels from a denser medium to a rarer medium (e.g., from water to air), it bends away from the normal.

Step 2: In this case, when a light ray travels from water to air, it bends away from the normal because air is less dense than water.

Thus, the correct answer is $\boxed{(2) \text{ water to air}}$.

Quick Tip

Light bends away from the normal when moving from a denser medium (higher refractive index) to a rarer medium (lower refractive index).

---

54. 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) $\frac{v_1}{v_2} = \frac{n_1}{n_2}$

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

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

Solution: Step 1: The refractive index n of a medium is related to the speed of light in that medium. It is given by the formula:

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

where c is the speed of light in a vacuum and v is the speed of light in the medium.

Step 2: For two media with refractive indices n_1 and n_2, and speeds v_1 and v_2, the relationship between the speeds and refractive indices is:

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

Thus, the correct answer is $\boxed{(2)\ \frac{v_1}{v_2} = \frac{n_2}{n_1}}$.

Quick Tip

The refractive index is inversely proportional to the speed of light in a medium. Thus, the ratio of the speeds is the inverse ratio of the refractive indices.

---

55. The speed of light in vacuum is c. The speed of light in a medium of refractive index $\frac{4}{3}$ is:

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

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

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

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

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

Solution: Step 1: The speed of light in a medium is related to the refractive index using the equation:

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

where:

v is the speed of light in the medium,

c is the speed of light in vacuum,

n is the refractive index of the medium.

Step 2: We are given that the refractive index $n = \frac{4}{3}$, so the speed of light in the medium is:

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

Step 3: Thus, the speed of light in the medium is $\frac{3c}{4}$, so the correct answer is option (4).

Quick Tip

The speed of light in a medium is inversely proportional to the refractive index. If the refractive index is n, the speed of light is $\frac{c}{n}$.

---

56. 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:

Step 1: The twinkling of stars is due to the refraction of light.

As the light from stars passes through the Earth's atmosphere, it encounters air layers of varying density, causing the light to bend or refract at different angles.

These continuous changes in the refractive index of the atmosphere due to temperature variations cause the star's light to appear as if it is twinkling.

Step 2: Refraction is responsible for this phenomenon. It is not caused by reflection, total internal reflection, or dispersion.

Reflection would involve the bouncing of light, which does not contribute to the twinkling effect.

Total internal reflection occurs only when light passes from a denser medium to a rarer medium and reaches a critical angle, which is not the case for stars.

Dispersion involves the separation of light into its constituent colors, such as in a prism, which also does not cause twinkling.

Therefore, the twinkling of stars is primarily due to atmospheric refraction. The correct answer is option (1).

Quick Tip

The twinkling of stars occurs because of the constant refraction of starlight in the Earth's atmosphere, where temperature variations cause the air's refractive index to change.

---

57. A rectangular tank of depth 4 m is full of water of refractive index $\frac{4}{3}$. 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:

Step 1: Understanding the refractive index The refractive index of a medium is given by:

$$n = \frac{\text{real depth}}{\text{apparent depth}}.$$

Here, the refractive index of the water is $\frac{4}{3}$, and the real depth of the tank is 4 m.

Step 2: Apply the formula Let the apparent depth be x. Using the formula for refractive index:

$$\frac{4}{x} = \frac{4}{3}.$$

Step 3: Solve for the apparent depth Solving for x:

$$x = \frac{4 \times 3}{4} = 3 \text{ m}.$$

Thus, the bottom of the tank is seen at a depth of 1.33 m, which corresponds to Option (3).

Quick Tip

For refractive index, use the formula refractive index $= \frac{\text{real depth}}{\text{apparent depth}}$ to find the apparent depth.

---

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

(1) at infinity

(2) at the centre of curvature

(3) between focal point and optic centre

(4) between the focal point and centre of curvature

Correct Answer: (4) between the focal point and centre of curvature

Solution:

Step 1: Virtual image formation by convex lens

A convex lens can form a virtual image if the object is placed between the focal point and the lens (closer to the lens than the focal point). In this case, the image formed is virtual, erect, and magnified.

Step 2: Object position for virtual image

For a convex lens to produce a virtual image, the object must be placed between the focal point (F) and the lens. This results in a virtual, upright, and magnified image.

Step 3: Conclusion

Thus, the object should be placed between the focal point and the centre of curvature of the lens for a virtual image to be formed.

Thus, the correct answer is Option (4).

Quick Tip

A convex lens forms a virtual image when the object is placed between the focal point and the lens.

---

59. 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:

Step 1: In the case of a concave lens, no matter where the object is placed along the principal axis, the image formed is always virtual and erect.

A concave lens is a diverging lens that causes light rays to diverge, making the image appear on the same side of the lens as the object.

Step 2: Key Characteristics of a Concave Lens:

The image formed is always virtual because the diverging rays do not actually meet, but appear to meet behind the lens.

The image is erect (not inverted) because the light rays are diverging and do not form an

inverted image.

Thus, the correct answer is $\boxed{(3)\text{ virtual, erect}}$.

Quick Tip

A concave lens always forms a virtual and erect image, regardless of the position of the object along the principal axis.

---

60. 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: Step 1: Definition of a Plano-Concave Lens:

A plano-concave lens has one flat (plano) surface and one concave curved surface. It is a diverging lens.

Step 2: Explanation of Other Lens Types:

A biconvex lens has two convex surfaces, converging light rays.

A biconcave lens has two concave surfaces, diverging light rays.

A concavo-convex lens has one concave surface and one convex surface, with properties depending on the relative curvature of both surfaces.

Since the question asks for a lens with only one curved surface, the correct answer is the plano-concave lens.

Thus, the correct answer is $\boxed{(3)\text{ plano-concave}}$.

Quick Tip

A plano-concave lens has one flat surface and one concave surface, making it a diverging lens.

---

61. If 25 cm each is the object and image distances due to 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:

Step 1: Use the lens formula The lens formula is:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u},$$

where:

f is the focal length,

v is the image distance,

u is the object distance.

Given that the object and image distances are both 25 cm, we substitute $u = -25$ cm and $v = 25$ cm into the lens formula.

$$\frac{1}{f} = \frac{1}{25} - \frac{1}{-25} = \frac{1}{25} + \frac{1}{25} = \frac{2}{25}.$$

Step 2: Calculate the focal length

Solving for f:

$$f = \frac{25}{2} = 12.5 \text{ cm}.$$

Thus, the focal length of the lens is 12.5 cm, which corresponds to Option (4).

Quick Tip

For a convex lens, the object and image distances are related by the lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$.

---

62. The angle between paraxial rays and principal axis is:

(1) 0°

(2) 45°

(3) 90°

(4) 83°

Correct Answer: (1) 0°

Solution:

Step 1: Understand paraxial rays

Paraxial rays are rays that are very close to the optical axis and make a very small angle (practically 0°) with the axis. These rays are assumed to be parallel to the principal axis of the lens or mirror.

Step 2: Conclusion

The angle between paraxial rays and the principal axis is practically zero, i.e., 0°.

Thus, the correct answer is Option (1).

Quick Tip

Paraxial rays are nearly parallel to the optical axis, and the angle between them and the principal axis is assumed to be zero in ideal optical systems.

---

63. Splitting of white light into VIBGYOR colours is called:

(1) scattering

(2) dispersion

(3) total internal reflection

(4) refraction

Correct Answer: (2) dispersion

Solution:

Step 1: Understand dispersion

Dispersion is the phenomenon where white light is split into its constituent colours (Violet, Indigo, Blue, Green, Yellow, Orange, and Red) due to the variation in the refractive index for different wavelengths of light. This happens when light passes through a prism or a dispersive medium.

Step 2: Conclusion

The splitting of white light into its constituent colours is called dispersion.

Thus, the correct answer is Option (2).

Quick Tip

Dispersion occurs when light is separated into its component colours due to differences in the refractive index for each colour.

---

64. The light which has the maximum angle of deviation is:

(1) red

(2) yellow

(3) violet

(4) green

Correct Answer: (3) violet

Solution:

Step 1: The angle of deviation is maximum for light of shorter wavelengths.

In a prism, the amount of deviation of light depends on the wavelength. Light with shorter wavelengths, such as violet light, deviates more than light with longer wavelengths like red.

Step 2: Violet light, having the shortest wavelength among visible light, experiences the maximum deviation when passing through a prism.

Thus, the correct answer is $\boxed{(3)\text{ violet}}$.

Quick Tip

The amount of deviation for light in a prism is inversely proportional to its wavelength. Violet light, with the shortest wavelength, deviates the most.

---

65. 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:

Step 1: The blue color of the sky is primarily due to Rayleigh scattering, where shorter wavelengths of light (blue and violet) scatter more than longer wavelengths (like red).

This scattering occurs because the Earth's atmosphere is made up of molecules like nitrogen (N_2) and oxygen (O_2).

Step 2: The scattering of sunlight by these molecules results in the blue appearance of the sky, with blue light being scattered in all directions.

Thus, the correct answer is $\boxed{(4)\ N_2 \text{ and } O_2}$.

Quick Tip

Rayleigh scattering causes shorter wavelengths like blue and violet to scatter more, resulting in the blue color of the sky. The scattering happens primarily by N_2 and O_2 molecules.

---

66. 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: (3) 1 D

Solution:

Step 1: The power of a lens is given by the formula:

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

where P is the power in diopters (D) and f is the focal length in meters.

Step 2: Given that the focal length $f = 20\,\text{cm} = 0.2\,\text{m}$, we can calculate the power as:

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

Thus, the correct answer is $\boxed{(1)\,5\,\text{D}}$.

Quick Tip

The power of a lens is the reciprocal of its focal length in meters. If the focal length is given in centimeters, first convert it to meters.

---

67. 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 formed by the eye lens is formed behind the retina because the eye is not able to converge the light rays properly on the retina. This results in the image forming at a point beyond the retina.

Thus, the correct answer is Option (1).

Quick Tip

In hypermetropia, the eye lens cannot focus light on the retina, and the image forms beyond it.

---

68. 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 in a normal human eye refers to the distance between the eye lens and the retina. This is the standard focal length for a normal human eye that allows proper

focusing of light on the retina for clear vision.

Thus, the correct answer is Option (2).

Quick Tip

The eye's focal distance is typically around 2.5 cm, the distance between the eye lens and the retina.

---

69. 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: Step 1: In old age, the ability to focus on nearby objects diminishes, a condition known as presbyopia.

This happens because the eye's lens becomes less flexible, and the ciliary muscles weaken. As a result, the least distance of distinct vision (the closest point at which an object can be seen clearly) increases.

Step 2: In normal vision, the least distance is about 25 cm, but in old age, it increases to a larger value, making it harder for elderly people to see near objects clearly.

Thus, the correct answer is $\boxed{(1)\text{ larger value}}$.

Quick Tip

In old age, presbyopia occurs, leading to an increase in the least distance of distinct vision due to reduced flexibility of the eye's lens.

---

70. Electric power is the product of current and:

(1) resistance

(2) charge

(3) velocity

(4) potential difference

Correct Answer: (4) potential difference

Solution: Step 1: The formula for electric power is:

$$P = I \cdot V$$

where:

P is the electric power,

I is the current,

V is the potential difference (also known as voltage).

Step 2: Power is calculated by multiplying the current (I) and the potential difference (V). Therefore, electric power is the product of current and potential difference.

Thus, the correct answer is $\boxed{(4)\text{ potential difference}}$.

Quick Tip

Electric power is the product of current and voltage, as described by the formula $P = IV$.

---

71. 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: Step 1: In a series combination of resistors, the equivalent resistance is the sum of the individual resistances.

$$R_{\text{eq}} = R_1 + R_2 + R_3$$

where:

$R_1 = 4\,\Omega$,

$R_2 = 0.4\,\Omega$,

$R_3 = 0.04\,\Omega$.

Step 2: Substituting the values into the equation:

$$R_{\text{eq}} = 4 + 0.4 + 0.04 = 4.44\,\Omega$$

Thus, the correct answer is $\boxed{(2)\,4.44\,\Omega}$.

Quick Tip

For resistors in series, the total resistance is simply the sum of individual resistances: $R_{\text{eq}} = R_1 + R_2 + R_3$.

---

72. 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:

Step 1: Statement (a)

Ohm's law states that the current flowing through a conductor is directly proportional to the applied voltage and inversely proportional to the resistance. This law is primarily valid for metallic conductors. However, semiconductors do not always obey Ohm's law because their resistance changes with temperature and voltage.

Step 2: Statement (b)

Ohm's law is indeed applicable to metallic conductors, where the relationship between current and voltage remains linear, and the resistance remains constant over a wide range of voltages and temperatures.

Thus, statement (b) is true, and statement (a) is false.

Thus, the correct answer is Option (2).

Quick Tip

Ohm's law is valid for materials where resistance remains constant with changes in voltage and temperature. Semiconductors do not always obey this law.

---

73. 6 watt $\times$ second =

(1) 6 volt

(2) 6 ohm

(3) 6 joule

(4) 6 coulomb

Correct Answer: (3) 6 joule

Solution: The unit of electric energy is joule. The product of power in watts and time in seconds gives energy in joules.

The relationship between power and energy is given by:

$$\text{Energy} = \text{Power} \times \text{Time}$$

Since $1\,\text{watt} = 1\,\text{joule/second}$, multiplying 6 watts by 1 second gives:

$$6\,\text{watt} \times 1\,\text{second} = 6\,\text{joules}$$

Thus, the correct answer is $\boxed{(3)\,6\,\text{joule}}$.

Quick Tip

The product of power in watts and time in seconds gives energy in joules.

---

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

(1) Faraday

(2) Oersted

(3) Kirchhoff

(4) Ohm

Correct Answer: (4) Ohm

Solution:

Step 1: The relationship between current and voltage in an electrical circuit is defined by Ohm's Law.

Ohm's Law states that $V = IR$, where: V is the voltage,

I is the current,

R is the resistance.

Step 2: Ohm's law is fundamental in understanding how electrical circuits work.

This law establishes a direct relationship between voltage and current, with resistance being the constant of proportionality.

Thus, the correct answer is $\boxed{(4)\,\text{Ohm}}$.

Quick Tip

Ohm's Law establishes the relationship between current, voltage, and resistance. It is one of the fundamental laws of electricity.

---

75. 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:

To calculate the electrical energy consumed, we use the formula:

$$\text{Energy (in kWh)} = \text{Power (in kW)} \times \text{Time (in hours)}$$

Given:

Power = 40 W = 40/1000 kW = 0.04 kW

Time per day = 5 hours

Number of days = 30

Now,

$$\text{Energy consumed per day} = 0.04\,\text{kW} \times 5\,\text{hours} = 0.2\,\text{kWh}$$

Thus, the total energy consumed in 30 days is:

$$\text{Total energy} = 0.2\,\text{kWh} \times 30 = 6\,\text{kWh}$$

Thus, the correct answer is 6 kWh.

Quick Tip

When calculating energy, always convert the power into kilowatts (kW) and time into hours.

---

76. 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 an electronic measuring instrument used to measure various electrical properties. It can measure:

Current: The flow of electric charge in a circuit (measured in amperes).

Voltage: The potential difference between two points in a circuit (measured in volts).

Resistance: The opposition to the flow of electric current in a circuit (measured in ohms).

However, a multimeter does not measure charge directly, as charge is a fundamental property, not typically a value measured by a multimeter.

Thus, the correct answer is Charge.

Quick Tip

A multimeter can measure current, voltage, and resistance, but charge is not a property that it measures.

---

77. 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: Step 1: The resistance R of a conductor is directly proportional to its length l, as given by the formula:

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

where:

ρ is the resistivity of the material,

l is the length of the conductor,

A is the cross-sectional area of the conductor.

Step 2: From the formula, it is evident that the resistance is directly proportional to the length of the conductor, i.e.,

$$R \propto l$$

Thus, the correct answer is $\boxed{(2)\, R \propto l}$.

Quick Tip

The resistance of a conductor is directly proportional to its length and inversely proportional to its cross-sectional area.

---

78. 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: (2) 10.5

Solution: Step 1: According to Kirchhoff's current law, the sum of currents entering a junction must equal the sum of currents leaving the junction.

$$I_{\text{in}} = I_{\text{out}}$$

The total current entering the junction is:

$$3\,\text{mA} + 5\,\text{mA} = 8\,\text{mA}$$

The total current leaving the junction is:

$$1\,\text{mA} + 1.5\,\text{mA} + x$$

Step 2: Applying Kirchhoff's current law:

$$8 = 1 + 1.5 + x$$

$$x = 8 - 2.5 = 5.5\,\text{mA}$$

Thus, the correct answer is $\boxed{(4)\ 5.5}$.

Quick Tip

Kirchhoff's current law states that the total current entering a junction is equal to the total current leaving the junction.

---

79. 1 tesla =

(1) 1 weber

(2) $\frac{1\,\text{weber}}{\text{metre}}$

(3) $\frac{1\,\text{weber}}{\text{metre}^2}$

(4) $\frac{1\,\text{watt}}{\text{metre}^2}$

Correct Answer: (3) $\frac{1\,\text{weber}}{\text{metre}^2}$

Solution:

By definition, the SI unit of magnetic flux density is Tesla (T). The magnetic flux density is defined as the flux (in weber) passing through an area of 1 square meter. Therefore,

$$\text{Magnetic Flux Density (Tesla)} = \frac{\text{Magnetic Flux (weber)}}{\text{Area (m}^2\text{)}}$$

Thus, 1 tesla equals $\frac{1\,\text{weber}}{\text{metre}^2}$.

Quick Tip

1 tesla is defined as 1 weber per square meter. This is the unit of magnetic flux density.

80. 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 change in magnetic field within a coil or circuit induces a current in that coil. This phenomenon was discovered by Michael Faraday, and it involves the creation of an electromotive force (EMF) and current in the coil as a result of the changing magnetic flux. Hence, the correct answer is producing induced current in a coil.

Quick Tip

Electromagnetic induction is the foundation for devices like electric generators and transformers, where a changing magnetic field induces a current in a conductor.

---

81. 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: Step 1: Faraday's Law of Induction Faraday's law of electromagnetic induction states that the induced EMF is given by the rate of change of magnetic flux with respect to time:

$$\text{Induced EMF} = -\frac{d\Phi}{dt}$$

Where:

Φ is the magnetic flux,

$\frac{d\Phi}{dt}$ represents the rate of change of magnetic flux.

The negative sign indicates the direction of the induced EMF (according to Lenz's law), but for this question, we are only interested in the magnitude of the induced EMF.

Step 2: Average Induced EMF

If $\Delta\Phi$ represents the change in magnetic flux and Δt represents the change in time, the average induced EMF over this time interval is given by:

$$\text{Induced EMF} = \frac{\Delta\Phi}{\Delta t}$$

This formula represents the average rate of change of magnetic flux over the time interval Δt.

Thus, the correct answer is $\boxed{(2)\ \frac{\Delta\Phi}{\Delta t}}$.

Quick Tip

Faraday's Law of Induction gives the induced EMF as the rate of change of the magnetic flux through a circuit. If we have the change in flux over a time interval, we can calculate the average induced EMF using $\frac{\Delta\Phi}{\Delta t}$.

---

82. 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: The needle of a magnetic compass aligns itself along the magnetic lines of the Earth. The Earth's magnetic field lines run from the magnetic north to the magnetic south pole. When the needle is freely suspended, it aligns itself along the Earth's magnetic field lines, which are in the north-south direction.

Thus, when the needle of the magnetic compass is freely suspended, it will come to rest along the north-south direction. This is because the magnetic field lines of the Earth are

aligned in this direction, and the compass needle experiences a torque that causes it to align with the Earth's magnetic field.

Quick Tip

The direction in which the magnetic compass needle aligns itself indicates the direction of the Earth's magnetic field, running from the magnetic south to the magnetic north.

---

83. 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 electromotive force (EMF) in a coil due to a change in magnetic flux is given by Faraday's Law of Electromagnetic Induction, which is expressed as:

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

Where:

ε is the induced EMF,

N is the number of turns in the coil,

$\Delta\Phi$ is the change in magnetic flux, and

Δt is the time interval during which the flux changes.

Given data:

Number of turns, $N = 100$,

Change in magnetic flux, $\Delta\Phi = 0.001$ Wb,

Time interval, $\Delta t = 0.1$ s.

Substituting these values into the formula:

$$\varepsilon = -100 \times \frac{0.001}{0.1}$$

$$\varepsilon = -100 \times 0.01 = -1\,\text{V}$$

The negative sign indicates the direction of the induced EMF, but the magnitude of the induced EMF is:

$$\boxed{\text{The induced EMF is } 10\,\text{V (magnitude only).}}$$

Quick Tip

The magnitude of induced EMF is determined by the rate of change of magnetic flux through the coil. The greater the number of turns in the coil and the faster the change in flux, the larger the induced EMF.

---

84. 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 acting on a moving charge in a magnetic field is given by the equation:

$$\text{Force} = qvB\sin(\theta)$$

Where:

q is the charge,

v is the speed (velocity) of the particle,

B is the magnetic flux density,

θ is the angle between the velocity and the magnetic field.

Thus, the magnetic force is directly proportional to the charge, speed, and magnetic flux density. Therefore, the correct answer is:

$$\boxed{(3)\text{ charge, speed, magnetic flux density}}$$

Quick Tip

The magnetic force on a moving charge is given by $F = qvB\sin(\theta)$, where q, v, and B are the charge, speed, and magnetic flux density respectively.

---

85. 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 is a device that converts mechanical energy into electrical energy using the principle of electromagnetic induction. When the auto driver pulls the rope, it rotates the dynamo, generating electricity. The other devices mentioned do not perform this conversion:

A multimeter measures electrical quantities (voltage, current, etc.).

A transformer is used to change the voltage in an AC circuit.

A voltmeter measures the potential difference (voltage) across two points in a circuit.

Thus, the correct answer is:

$$\boxed{(3)\text{ dynamo}}$$

Quick Tip

A dynamo converts mechanical energy into electrical energy through electromagnetic induction, which is the principle used in generating electricity for devices like auto rickshaws.

---

86. 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. According to Faraday's law, the induced electromotive force (EMF) in a closed circuit is proportional to the rate of change of magnetic flux through the circuit. This phenomenon follows the law of conservation of energy because the energy supplied to the system (through mechanical work) is converted into electrical energy via electromagnetic induction.

Thus, the correct answer is:

$$\boxed{(4)\text{ conservation of energy}}$$

Quick Tip

Faraday's Law is a direct consequence of the conservation of energy principle, as it explains the transformation of mechanical energy into electrical energy.

---

87. The C.G.S. unit of heat energy is:

(1) joule

(2) kelvin

(3) dioptre

(4) calorie

Correct Answer: (4) calorie

Solution: In the C.G.S. (centimeter-gram-second) system, the unit of energy is the calorie. The calorie is defined as the amount of heat required to raise the temperature of one gram of water by one degree Celsius. The joule, on the other hand, is the unit of energy in the MKS (meter-kilogram-second) system. The C.G.S. system is primarily used in the field of heat and thermodynamics.

Thus, the correct answer is:

$$\boxed{(4)\ \text{calorie}}$$

Quick Tip

The calorie is the C.G.S. unit of heat energy, whereas the joule is the SI unit of energy. Remember that 1 calorie = 4.184 joules.

---

88. If $27^\circ C + x = 300$ 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: The relationship between Celsius and Kelvin is given by the formula:

$$\text{K} = {}^\circ\text{C} + 273$$

Substitute $27^\circ C$ into the equation:

$$27 + x = 300$$

Now, solve for x:

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

Thus, the correct answer is:

$$\boxed{(3)\ 273\,\text{K}}$$

Quick Tip

To convert Celsius to Kelvin, simply add 273 to the Celsius value. The formula is $\text{K} = {}^\circ\text{C} + 273$.

---

89. 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: Specific heat capacity is the amount of heat required to raise the temperature of a unit mass of a substance by one degree Celsius (or Kelvin). The specific heat capacity of water and ice are almost the same. Despite being in different states (liquid and solid), they share the same value for specific heat under typical conditions. This is due to the fact that the specific heat of a substance does not change drastically unless there is a phase change or temperature change that induces other energy forms (like latent heat).

Thus, the correct answer is:

$$\boxed{(4) \text{ water, ice}}$$

Quick Tip

Water and ice have the same specific heat capacity, but their heat capacities differ when phase transitions are involved (e.g., melting or freezing).

---

90. 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

Solution:

When a liquid (such as water) is converted into a solid (ice), the process is called **freezing**.

During freezing:

The **temperature** of the water decreases as it cools.

The **molecules** of the liquid water lose energy as they slow down.

The molecules arrange themselves into a more orderly structure, forming solid ice.

In terms of **internal energy**, it is important to note that internal energy is the total energy contained within a system, which includes both the kinetic energy of molecules (due to their

motion) and the potential energy (due to the forces between molecules). During freezing, the potential energy decreases as the molecules move closer together in the solid state.

Key Point:

Latent heat is released during freezing, but the temperature does not change. Even though energy is leaving the system (in the form of latent heat), this energy is used in altering the phase (changing from liquid to solid) and not in changing the temperature.

Thus, the **total internal energy** of the system remains constant because the decrease in potential energy of the molecules as they freeze is exactly balanced by the latent heat released. The temperature of the system remains the same during the freezing process, as the latent heat goes into the phase change rather than raising the temperature.

Conclusion:

Therefore, the internal energy **remains constant** during the process of conversion from liquid to solid.

Thus, the correct answer is: (3) remains constant.

Quick Tip

Phase transitions, such as freezing or melting, involve a change in the state of matter but do not cause a change in temperature during the process. Instead, the heat energy is used to change the phase, and thus the internal energy remains constant.

SECTION-III:CHEMISTRY

91. The configuration $1s^2 2s^2 2p^6 3s^2 3p^6 (2, 8, 8)$ 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 $1s^2 2s^2 2p^6 3s^2 3p^6$ corresponds to the noble gas Argon, which has an atomic number of 18. When it forms an ion, it can either lose electrons or gain

them. The configurations listed in the options relate to ions with the same electronic configuration after ionization. P^{-3}, Cl^{-}, and S^{-2} all have the same configuration of $(2, 8, 8)$, showing they all form ions with the same electron configuration as Argon.

Thus, the correct answer is:

$$\boxed{(4)\ \text{All of these}}$$

Quick Tip

The electron configuration $(2, 8, 8)$ corresponds to a noble gas configuration. Many elements like P, S, and Cl can achieve this configuration by gaining electrons to form anions.

---

92. Lithium, sodium, and _____ are Doberiener's triads.

(1) S

(2) Ca

(3) Cl

(4) K

Correct Answer: (4) K

Solution: Doberiener's triads refer to a group of three elements with similar chemical properties where the atomic mass of the middle element is the average of the other two. Lithium (Li), sodium (Na), and potassium (K) form such a triad. These elements have similar properties and follow this mass pattern.

Thus, the correct answer is:

$$\boxed{(4)\ K}$$

Quick Tip

Doberiener's triads represent early grouping of elements with similar chemical properties. Potassium (K) forms a triad with Lithium (Li) and Sodium (Na).

---

93. 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 IV A group elements in the periodic table consist of Carbon (C), Silicon (Si), Germanium (Ge), Tin (Sn), and Lead (Pb). These elements are collectively known as the ”carbon family” because carbon is the first member of the group. They share similar properties like the ability to form covalent bonds and act as semiconductors.

Thus, the correct answer is:

$$\boxed{(1)\text{ carbon family}}$$

Quick Tip

The IV A group is called the carbon family due to its first member, Carbon. It includes elements like silicon, germanium, tin, and lead.

---

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

(1) 1

(2) 2

(3) 3

(4) 4

Solution: An element belonging to the 2nd group and 3rd period will have the following characteristics:

The 2nd group elements are **alkaline earth metals**, which have 2 electrons in their outermost shell.

The 3rd period elements are the elements from sodium (Na) to argon (Ar).

Since the element X belongs to the 2nd group, it will have 2 electrons in its outermost shell. To achieve a stable electron configuration, it will lose 2 electrons. Therefore, its valency is **2**.

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

Quick Tip

For elements in the 2nd group, such as magnesium (Mg), calcium (Ca), etc., the valency is 2 because they have 2 electrons in their outermost shell which they lose to form bonds.

---

95. Valence Bond Theory was proposed by:

(1) Lewis

(2) Kossel

(3) Pauling

(4) Bohr

Solution: The **Valence Bond Theory (VBT)** was proposed by **Linus Pauling** in 1927. The theory explains the formation of chemical bonds between atoms by overlapping atomic orbitals.

The theory emphasizes the concept of orbital overlap, where the valence electrons of atoms form bonds by overlapping their orbitals.

Thus, the correct answer is option (3) Pauling.

Quick Tip

Valence Bond Theory explains covalent bonding and the formation of molecules by the overlap of atomic orbitals. Linus Pauling's contribution to the theory laid the foundation for understanding chemical bonding.

---

96. 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 (Cl) has an atomic number of 17 and normally gains one electron to achieve a stable electronic configuration of Argon (18). When chlorine gains an electron, it

becomes an anion, denoted as Cl^-.

Thus, the correct answer is:

$$\boxed{(4)\text{ By gaining electron chlorine becomes anion}}$$

Quick Tip

When chlorine gains an electron, it forms an anion, Cl^-. This is because chlorine needs one electron to complete its valence shell and achieve a noble gas configuration.

---

97. An element X^{27} forms ionic compound. What is the charge on X in ionic compound?

(1) +1

(2) +2

(3) +3

(4) +4

Correct Answer: (2) +2

Solution: The element is X^{27}, which means it has an atomic number of 13 (since X^{27} suggests a mass number of 27). An element with atomic number 13 is Aluminum (Al). Aluminum tends to lose three electrons to achieve a stable noble gas configuration, resulting in a charge of $+3$. Therefore, the charge of element X in its ionic form is $+2$ as it needs to lose two electrons.

Thus, the correct answer is:

$$\boxed{(2)\ +2}$$

Quick Tip

Aluminum (Al) has an atomic number of 13 and forms a $+3$ ion by losing three electrons.

---

98. Linus Pauling proposed the concept of:

(1) ionic bond

(2) hydrogen bond

(3) hybridization

(4) covalent bond

Correct Answer: (3) hybridization

Solution: Linus Pauling proposed the concept of hybridization, which is a key idea in chemical bonding. He introduced this concept to explain the bonding in molecules, especially in organic compounds. Hybridization involves the mixing of atomic orbitals to form new hybrid orbitals that can form covalent bonds in molecules.

Thus, the correct answer is:

$$\boxed{(3)\text{ hybridization}}$$

Quick Tip

Hybridization theory, proposed by Linus Pauling, is used to explain the geometry of molecular bonding, particularly in molecules with covalent bonds.

---

99. 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) $1s^2, 2s^2, 2p^3$

Solution: Oxygen (O) has an atomic number of 8. The neutral oxygen atom has the electron configuration $1s^2, 2s^2, 2p^4$.

When oxygen gains two electrons to form the O^{2-} ion, the configuration becomes:

$$1s^2, 2s^2, 2p^6$$

Thus, the correct answer is option (3) $1s^2, 2s^2, 2p^6$.

Quick Tip

When an atom gains electrons to form an anion, its electron configuration becomes the same as the nearest noble gas.

---

100. 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

Solution: Non-metallic elements typically gain electrons to achieve a stable electron configuration. The number of electrons gained by a non-metallic element corresponds to its valency and group number in the periodic table:

The valency of a non-metallic element is defined by the number of electrons it gains to complete its outermost shell.

The group number of the element indicates how many electrons it needs to gain to achieve a noble gas configuration.

Thus, the correct answer is option (4) All of these.

Quick Tip

For non-metals, the valency is determined by how many electrons they need to gain to complete their outer shell, which also corresponds to the group number in the periodic table for elements in groups 15, 16, and 17.

---

101. 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: (4) Na, K, Ca

Solution: The reactivity order of alkali metals and alkaline earth metals is based on their ability to lose electrons. Potassium (K) is more reactive than sodium (Na), and sodium is more reactive than calcium (Ca). Thus, the correct increasing order of reactivity is:

$$\boxed{Na, K, Ca}$$

Quick Tip

In general, for alkali metals and alkaline earth metals, reactivity increases down the group. Hence, potassium (K) is the most reactive, followed by sodium (Na), and calcium (Ca) is the least reactive.

---

102. Poling process is used to

(1) concentrate the ore

(2) reduce the ore

(3) heat the ore with O_2

(4) purify the crude metal

Correct Answer: (4) purify the crude metal

Solution: The Poling process is used to purify the crude metal, especially for removing impurities from metals like copper during the extraction process. The process involves heating the crude metal and passing a current through it.

Thus, the correct answer is:

$$\boxed{(4)\text{ purify the crude metal}}$$

Quick Tip

The poling process is primarily used in metallurgy to remove impurities like sulfur and oxygen from the crude metal, particularly during the extraction of copper.

---

103. 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 sulfur compounds in the air, leading to the formation of silver sulfide (Ag_2S), which is responsible for the tarnishing of silver.

Thus, the correct answer is:

$\boxed{(4)\text{ silver sulphide}}$

Quick Tip

Silver tarnishes due to the formation of silver sulfide, which forms when silver reacts with sulfur in the air. The tarnishing appears as a black coating on the surface of silver items.

---

104. 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, a metal undergoes oxidation. In oxidation, the metal loses electrons. Therefore, the metal becomes oxidised and loses electrons in the process.

Thus, the correct answer is option (4) - both (1) and (2).

Quick Tip

Corrosion of metals is a result of oxidation where the metal reacts with oxygen or moisture in the environment.

---

105. 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 from NH_3 (ammonia) is replaced by an alkyl group (R), the product formed is an amine. The general formula for an amine is $R - NH_2$.

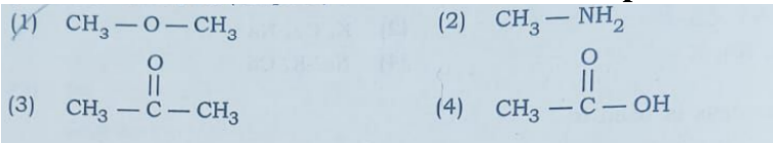
Thus, the correct answer is option (3) - amine.

Quick Tip

Amines are compounds where the hydrogen atom in ammonia is replaced by an alkyl or aryl group.

---

106. What is the structural formula of simplest ketone?



Correct Answer: (3) $CH_3 - C - CH_3$

Solution: A ketone has a functional group represented by $C = O$ (carbonyl group), where the carbonyl carbon is bonded to two carbon atoms. The simplest ketone is acetone, which has the structure:

$$CH_3 - C = O - CH_3$$

Thus, the correct answer is:

$$\boxed{(3)\, CH_3 - C - CH_3}$$

Quick Tip

A ketone contains a carbonyl group ($C = O$) where the carbonyl carbon is bonded to two other carbon atoms. The simplest ketone is acetone ($CH_3 - C - CH_3$).

---

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

bond. Both compounds have the same number of carbon atoms, but they differ in their bonding and number of hydrogens.

Thus, the correct answer is:

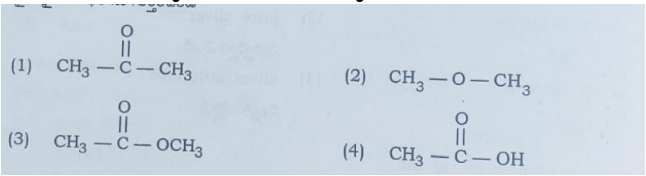
$$\boxed{(2)\text{ number of bonds}}$$

Quick Tip

Ethene (C_2H_4) has a double bond, while ethyne (C_2H_2) has a triple bond between the carbon atoms. The difference in the number of bonds is the key distinction.

---

108. Identify the dimethyl ether.



Correct Answer: (2) $CH_3 - O - CH_3$

Solution: Dimethyl ether is an ether with the molecular formula $CH_3 - O - CH_3$. It consists of two methyl groups (CH_3) bonded to an oxygen atom. This is the simplest ether and is commonly used as a solvent.

Thus, the correct answer is:

$$\boxed{(2)\ CH_3 - O - CH_3}$$

Quick Tip

Dimethyl ether has the formula $CH_3 - O - CH_3$, with an oxygen atom connecting two methyl groups. This structure is characteristic of ethers.

---

109. 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 are organic compounds in which the carbon atoms are bonded to each other by single bonds only. They do not contain any double or triple bonds. An example of a saturated hydrocarbon is an alkane (e.g., methane, ethane).
Thus, the correct answer is option (3) - all single bonds.

Quick Tip

Saturated hydrocarbons are also known as alkanes, and they contain only single bonds between carbon atoms.

---

110. Aliphatic hydrocarbons are

(1) closed chain hydrocarbons

(2) acyclic hydrocarbons

(3) open chain hydrocarbons

(4) (2) and (3)

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

Solution: Aliphatic hydrocarbons are those that consist of carbon atoms connected in an open chain or a straight chain, without forming any aromatic ring structures. Acyclic hydrocarbons include both open-chain and branched hydrocarbons, which do not form closed rings. Thus, aliphatic hydrocarbons can be either acyclic or open chain.
Therefore, the correct answer is option (4) - (2) and (3).

Quick Tip

Aliphatic hydrocarbons can be classified into alkanes, alkenes, and alkynes, and can either be open-chain or acyclic.

---

111. 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 the presence of a base and remains yellow in acidic conditions. Litmus paper, on the other hand, turns red in acidic solutions and blue in basic solutions.

Thus, the correct answer is option (3) - (1) and (2).

Quick Tip

Litmus paper is a commonly used pH indicator, and turmeric can also be used as a natural pH indicator for simple tests.

---

112. 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 is considered acidic if its pH is less than 5.6. A pH below 5.6 is indicative of acid rain, which is caused by pollutants like sulfur dioxide and nitrogen oxides in the atmosphere.

Thus, the correct answer is option (1) - 5.6.

Quick Tip

Acid rain occurs when sulfur dioxide and nitrogen oxides combine with water vapor to form sulfuric acid and nitric acid, lowering the pH of rainwater.

---

113. 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 made up of calcium phosphate in the form of hydroxyapatite, which provides its strength and resistance to decay.

Thus, the correct answer is option (3) - calcium phosphate.

Quick Tip

Calcium phosphate in tooth enamel plays a key role in protecting teeth from decay and maintaining their structure.

---

114. 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

Solution: Explanation:

- **Potassium Hydroxide (KOH)** is a strong base.
- **Litmus paper** is a pH indicator:
  - **Red litmus paper** turns **blue** in the presence of a base.
  - **Blue litmus paper** remains **blue** in the presence of a base.
- When **potassium hydroxide** is poured on **red litmus paper**, it will turn **blue** because potassium hydroxide is a strong base.
- When **potassium hydroxide** is poured on **blue litmus paper**, it will remain **blue**.

Thus, the correct observation is that **red litmus turns blue** and **blue litmus remains blue**.

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

---

115. 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 that can be accommodated in any shell is given by the formula $2n^2$, where n is the principal quantum number. For the M shell, $n = 3$. Thus, the maximum number of electrons in the M shell is:

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

Thus, the correct answer is option (3) - 18.

Quick Tip

The maximum number of electrons in any shell can be determined using the formula $2n^2$, where n is the shell number.

---

116. 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 d-orbitals can only exist in the 3rd shell and beyond, i.e., for $n \geq 3$. The 2nd shell only has s and p-orbitals. Therefore, the $2d^3$ orbital does not exist.

Thus, the correct answer is option (4) - $2d^3$.

Quick Tip

d-orbitals exist only in shells with $n \geq 3$, which means a $2d^3$ orbital is not possible.

117. 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 in 1922 for his work on the structure of the atom and the quantum theory.

Thus, the correct answer is option (2) - Physics.

Quick Tip

Niels Bohr's contribution to atomic structure and quantum theory earned him the Nobel Prize in Physics.

---

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

(1) 8

(2) 10

(3) 4

(4) 5

Correct Answer: (2) 10

Solution: The 4d subshell consists of 5 degenerate orbitals. These orbitals are $4d_{xy}$, $4d_{yz}$, $4d_{xz}$, $4d_{z^2}$, and $4d_{x^2-y^2}$.

Thus, the number of degenerate orbitals in the 4d subshell is 5.

Thus, the correct answer is option (4) - 5.

Quick Tip

Each d-subshell consists of 5 degenerate orbitals, all of which have the same energy.

---

119. The number of electrons in the valence shell of an element is called its

(1) Atomic number

(2) Valency

(3) Mass number

(4) Atomic mass

Correct Answer: (2) Valency

Solution: Valency is defined as the number of electrons present in the outermost shell (valence shell) of an atom. It is determined by the number of electrons an element needs to gain, lose, or share to achieve a stable electron configuration, similar to the nearest noble gas. Thus, the correct answer is option (2) - Valency.

Quick Tip

Valency is determined by the number of electrons in the outermost shell and indicates how many bonds an atom can form with other atoms.

---

120. Strong ionic bond is formed between _____ and _____ group elements.

(1) I A and II A

(2) II A and VIII A

(3) I A and VII A

(4) I A and VIII A

Solution: Explanation:

- An **ionic bond** is formed between a metal and a non-metal.
- Group I-A elements, which are **alkali metals** (e.g., sodium, potassium), have one electron in their outer shell and tend to lose it easily.
- Group VII-A elements, which are **halogens** (e.g., chlorine, fluorine), have seven electrons in their outer shell and tend to gain one electron.
- When an alkali metal (Group I-A) combines with a halogen (Group VII-A), the metal loses one electron, and the halogen gains one electron, forming a strong ionic bond.

Thus, the correct answer is that a strong ionic bond is formed between **I A and VII A** group elements.

Correct Answer: (3) I A and VII A

Quick Tip

Ionic bonds are formed between metals and non-metals. The general trend is that metals (especially from Group I-A) lose electrons, and non-metals (especially from Group VII-A) gain electrons to achieve stability. The strong attraction between the oppositely charged ions results in a strong ionic bond.
