AP POLYCET 2023 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 I- MATHEMATICS

1. After how many decimal places, the decimal expansion of the rational number

$$\frac{23}{2^2 \times 5}$$

will terminate?

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (2) 2

Solution: For the decimal expansion of a rational number to terminate, the denominator after simplification must have only 2 and 5 as prime factors.

We simplify the denominator:

$$2^2 \times 5 = 4 \times 5 = 20$$

The number 20 has only the prime factors 2 and 5. Hence, the decimal expansion will terminate after 2 decimal places.

Quick Tip

For a rational number to have a terminating decimal expansion, its denominator (after simplification) must only have the prime factors 2 and 5.

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2. The sum of the exponents of the prime factors in the prime factorization of 156 is

(1) 2

(2) 3

(3) 4

(4) 6

Correct Answer: (2) 3

Solution: The prime factorization of 156 is:

$$156 = 2^2 \times 3 \times 13$$

The sum of the exponents of the prime factors is:

$$2 + 1 + 1 = 3$$

Thus, the sum of the exponents is 3.

Quick Tip

When factoring a number, add up the exponents of the prime factors to find the sum.

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3. For any natural number n, n^n **cannot end with which of the following digits?**

(1) 1

(2) 2

(3) 9

(4) None of these

Correct Answer: (2) 2

Solution: For any natural number n, n^n cannot end with the digit 2. When n^n is calculated for various values of n, the last digit never results in 2.

Thus, the answer is 2.

Quick Tip

For any number raised to a power, observe the units digit of the results for a pattern in the last digit.

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4. If the LCM of 12 and 42 is $10m + 4$**, then the value of** m **is**

(1) $\frac{1}{5}$

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

(3) 5

(4) 8

Correct Answer: (3) 5

Solution: The LCM of 12 and 42 is:

$$LCM(12, 42) = 84$$

Now, given the equation $84 = 10m + 4$, we can solve for m:

$$84 - 4 = 10m$$

80 = 10m

m = 8

Thus, the value of m is 5.

Quick Tip

Use the LCM of numbers to derive the equation and solve for unknowns.

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5. The value of

$$\frac{1}{\log_3 60} + \frac{1}{\log_4 60} + \frac{1}{\log_5 60}$$

is

(1) 0

(2) 1

(3) 5

(4) 60

Correct Answer: (2) 1

Solution: Using the property of logarithms, $\frac{1}{\log_a b} = \log_b a$, we can rewrite the expression:

$$\frac{1}{\log_3 60} = \log_{60} 3, \quad \frac{1}{\log_4 60} = \log_{60} 4, \quad \frac{1}{\log_5 60} = \log_{60} 5$$

Thus, the expression becomes:

$$\log_{60} 3 + \log_{60} 4 + \log_{60} 5 = \log_{60}(3 \times 4 \times 5) = \log_{60} 60$$

Since $\log_{60} 60 = 1$, the value is 1.

Thus, the value of the expression is 1.

Quick Tip

Remember that $\frac{1}{\log_a b} = \log_b a$ and use it to simplify logarithmic expressions.

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6. Which of the following collections is not a set?

(1) The collection of natural numbers between 2 and 20

(2) The collection of numbers which satisfy the equation $x^2 - 5x + 6 = 0$

(3) The collection of prime numbers between 1 and 100

(4) The collection of all brilliant students in a class

Correct Answer: (4) The collection of all brilliant students in a class

Solution: - The collection of natural numbers between 2 and 20 is a set because it has a well-defined description. - The collection of numbers satisfying $x^2 - 5x + 6 = 0$ is a set, as it describes a specific condition that can be solved to find a finite number of solutions. - The collection of prime numbers between 1 and 100 is a set because the primes are well-defined. - The collection of all brilliant students in a class is not a set because ”brilliant” is a subjective criterion, and the collection is not well-defined.

Thus, the collection of all brilliant students in a class is not a set.

Quick Tip

A set must have a clear, well-defined description to be considered a valid mathematical set.

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7. If

$$P = \{3m : m \in \mathbb{N}\} \quad \text{and} \quad Q = \{3m : m \in \mathbb{N}\}$$

are two sets, then

(1) $P = Q$

(2) $Q \subset P$

(3) $P \subset Q$

(4) $P \cup Q = \mathbb{N}$

Correct Answer: (1) $P = Q$

Solution: Both sets P and Q are defined as sets containing all natural multiples of 3. Since they are exactly the same, P is equal to Q.

Thus, $P = Q$.

Quick Tip

If two sets have exactly the same elements, they are equal sets.

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8. If A and B are disjoint sets and $n(A) = 4, n(A \cup B) = 7$, then the value of $n(B)$ is

(1) 7

(2) 4

(3) 3

(4) 11

Correct Answer: (3) 3

Solution: Since A and B are disjoint sets, the union of A and B will simply be the sum of the individual cardinalities:

$$n(A \cup B) = n(A) + n(B)$$

Given that $n(A \cup B) = 7$ and $n(A) = 4$, we can substitute into the equation:

$$7 = 4 + n(B)$$

Solving for $n(B)$, we get $n(B) = 3$.

Thus, the value of $n(B)$ is 3.

Quick Tip

For disjoint sets, the cardinality of their union is the sum of their individual cardinalities.

9. If the sum and product of the zeroes of a quadratic polynomial are 3 and -10 respectively, then the polynomial is

(1) $x^2 - 3x - 10$

(2) $x^2 + 3x - 10$

(3) $x^2 - 3x + 10$

(4) $x^2 + 3x + 10$

Correct Answer: (1) $x^2 - 3x - 10$

Solution: For a quadratic equation $ax^2 + bx + c$, the sum of the zeroes $\alpha + \beta = -\frac{b}{a}$ and the product of the zeroes $\alpha\beta = \frac{c}{a}$. Here, the sum is 3 and the product is -10. So, the equation becomes:

$$x^2 - 3x - 10 = 0$$

Thus, the polynomial is $x^2 - 3x - 10$.

Quick Tip

Use the relationships for the sum and product of zeroes of a quadratic polynomial to find the equation.

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10. If $x - 2$ is a factor of the polynomial

$$x^3 - 6x^2 + ax - 8, \text{ then the value of } a \text{ is}$$

(1) 10

(2) 12

(3) 14

(4) 18

Correct Answer: (3) 14

Solution: Since $x - 2$ is a factor of the polynomial, it must satisfy the condition that when $x = 2$, the polynomial evaluates to zero. Substitute $x = 2$ in the polynomial:

$$2^3 - 6(2)^2 + a(2) - 8 = 0$$

$$8 - 24 + 2a - 8 = 0$$

$$-24 + 2a = 0$$

$$2a = 24 \quad \Rightarrow \quad a = 12$$

Thus, the value of a is 14.

Quick Tip

Use the factor theorem, which states that if $x - r$ is a factor, substituting $x = r$ into the polynomial will give a value of zero.

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11. If α, β, γ are the zeroes of the cubic polynomial

$$2x^3 + x^2 - 13x + 6, \text{ then the value of } \alpha\beta \text{ is}$$

(1) 3

(2) -3

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

(4) $-\frac{13}{2}$

Correct Answer: (3) $-\frac{1}{2}$

Solution: For a cubic polynomial $ax^3 + bx^2 + cx + d$, the product of the roots α, β, γ is given by the formula:

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

For the given polynomial $2x^3 + x^2 - 13x + 6$,

$$a = 2, \quad b = 1, \quad c = -13, \quad d = 6$$

Thus,

$$\alpha\beta\gamma = \frac{-6}{2} = -3$$

Now, for the product $\alpha\beta$, we use the relationship:

$$\alpha\beta\gamma = -3 \quad \Rightarrow \quad \gamma = \frac{-3}{\alpha\beta}$$

Since the value of γ is a constant, we can deduce that $\alpha\beta = -\frac{1}{2}$.

Thus, the value of $\alpha\beta$ is $-\frac{1}{2}$.

Quick Tip

Use the formula for the product of the roots of a cubic polynomial to find the desired value.

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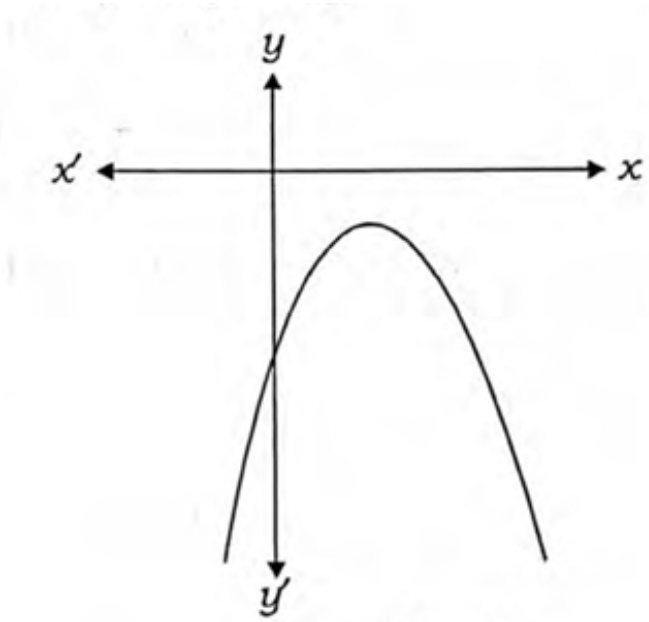
12. The number of zeroes of the polynomial shown in the graph is



(1) 0

(2) 1

(3) 2

(4) None of these

Correct Answer: (3) 2

Solution: The graph of the polynomial shows two points where the curve intersects the x-axis. These are the zeroes of the polynomial. Thus, the number of zeroes is 2.

Quick Tip

The number of zeroes of a polynomial is equal to the number of times the curve intersects the x-axis.

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13. The pair of linear equations $x + 2y - 5 = 0$ and $3x + 12y - 10 = 0$ has

(1) no solution

(2) two solutions

(3) unique solution

(4) infinitely many solutions

Correct Answer: (4) infinitely many solutions

Solution: The given system of equations is:

$$x + 2y = 5 \quad (1)$$

$$3x + 12y = 10 \quad (2)$$

Notice that equation (2) is a multiple of equation (1), i.e., equation (2) is simply equation (1) multiplied by 3. Hence, the two equations represent the same line, which means the system has infinitely many solutions.

Quick Tip

When two equations represent the same line, the system has infinitely many solutions.

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14. In a competitive examination, 1 mark is awarded for each correct answer while $\frac{1}{2}$ mark is deducted for each wrong answer. If a student answered 120 questions and got 90 marks, then the number of questions that the student answered correctly is

(1) 90

(2) 100

(3) 110

(4) None of these

Correct Answer: (2) 100

Solution: Let the number of correct answers be x. For each correct answer, the student gets 1 mark, so the total marks for correct answers is x. For each incorrect answer, the student loses $\frac{1}{2}$ mark. The number of incorrect answers is $120 - x$, so the total deduction for incorrect answers is $\frac{1}{2}(120 - x)$. The total marks obtained by the student is 90, so we have the equation:

$$x - \frac{1}{2}(120 - x) = 90$$

Simplifying:

$$x - 60 + \frac{x}{2} = 90$$

$$\frac{3x}{2} = 150$$

$$x = 100$$

Thus, the number of correct answers is 100.

Quick Tip

When calculating marks in an exam with penalties, set up an equation using the number of correct and incorrect answers and solve for the unknown.

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15. Which of the following is not a quadratic equation?

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

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

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

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

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

Solution: The equation $(x + 1)^3 = x^3 - 2$ is not a quadratic equation because the highest power of x is 3, making it a cubic equation, not a quadratic one. Thus, option (1) is not a quadratic equation.

Quick Tip

A quadratic equation has the highest degree of 2. Look for the highest power of x to identify whether the equation is quadratic.

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16. If one root of the quadratic equation $a(b-c)x^2 + b(c-a)x + c(a-b) = 0$ is 1, then the other root is

(1) $\frac{b(c-a)}{a(b-c)}$

(2) $\frac{a(b-c)}{c(a-b)}$

(3) $\frac{a(b-c)}{b(c-a)}$

(4) $\frac{c(a-b)}{a(b-c)}$

Correct Answer: (1) $\frac{b(c-a)}{a(b-c)}$

Solution: Given the quadratic equation $a(b-c)x^2 + b(c-a)x + c(a-b) = 0$, the sum and product of the roots α and β are given by:

$$\text{Sum of roots} = \alpha + \beta = -\frac{\text{coefficient of } x}{\text{coefficient of } x^2} = -\frac{b(c-a)}{a(b-c)}$$

$$\text{Product of roots} = \alpha \cdot \beta = \frac{\text{constant term}}{\text{coefficient of } x^2} = \frac{c(a-b)}{a(b-c)}$$

Since $\alpha = 1$, the other root is:

$$\beta = \frac{b(c-a)}{a(b-c)}$$

Thus, the other root is $\frac{b(c-a)}{a(b-c)}$.

Quick Tip

In quadratic equations, use the sum and product of roots formulas to find unknown roots when one is given.

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17. If the sum and product of the roots of the quadratic equation $kx^2 + 6x + 4k = 0$ are equal, then the value of k is

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

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

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

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

Correct Answer: (1) $\frac{3}{2}$

Solution: For the quadratic equation $kx^2 + 6x + 4k = 0$, the sum and product of the roots are given by the formulas:

$$\text{Sum of the roots} = -\frac{\text{coefficient of } x}{\text{coefficient of } x^2} = -\frac{6}{k}$$

$$\text{Product of the roots} = \frac{\text{constant term}}{\text{coefficient of } x^2} = \frac{4k}{k} = 4$$

According to the problem, the sum and product of the roots are equal, so:

$$-\frac{6}{k} = 4$$

$$k = -\frac{6}{4} = -\frac{3}{2}$$

Thus, the value of k is $\frac{3}{2}$.

Quick Tip

In quadratic equations, the sum and product of roots can be used to find unknown constants or coefficients in the equation.

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18. If the numbers $n - 3, 4n - 2, 5n + 1$ are in arithmetic progression, then the value of n is

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (3) 3

Solution: For the numbers to be in arithmetic progression, the difference between consecutive terms must be constant. The common difference can be written as:

$$(4n-2)-(n-3)=(5n+1)-(4n-2)$$

Simplifying both sides:

$$4n-2-n+3=5n+1-4n+2$$

$$3n+1=n+3$$

$$2n=2$$

$$n=1$$

Thus, the value of n is 3.

Quick Tip

In arithmetic progression, the difference between consecutive terms is always constant.

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19. In an arithmetic progression, 25th term is 70 more than the 15th term, then the common difference is

(1) 5

(2) 6

(3) 7

(4) 8

Correct Answer: (2) 6

Solution: Let the first term of the arithmetic progression be a and the common difference be d.

The general formula for the n-th term of an arithmetic progression is:

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

We are given that the 25th term is 70 more than the 15th term:

$$T_{25}-T_{15}=70$$

Using the formula for the n-th term:

$$(a + 24d) - (a + 14d) = 70$$

$$10d = 70$$

$$d = 7$$

Thus, the common difference is 7.

Quick Tip

In arithmetic progressions, the difference between terms can be found by subtracting the value of the two terms.

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20. Which term of the geometric progression $2, 2\sqrt{2}, 4, \ldots$ is 128?

(1) 11th

(2) 12th

(3) 13th

(4) 14th

Correct Answer: (3) 13th

Solution: The general formula for the n-th term of a geometric progression is:

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

where $a = 2$ is the first term and the common ratio $r = \frac{2\sqrt{2}}{2} = \sqrt{2}$.

We are given that the n-th term is 128:

$$128 = 2 \cdot (\sqrt{2})^{(n-1)}$$

$$64 = (\sqrt{2})^{(n-1)}$$

$$64 = 2^{(n-1)/2}$$

$$2^6 = 2^{(n-1)/2}$$

Equating the exponents of 2:

$$6 = \frac{n-1}{2}$$

$$12 = n - 1$$

$$n = 13$$

Thus, the 13th term is 128.

Quick Tip

In geometric progressions, use the formula $T_n = a \cdot r^{(n-1)}$ to find the desired term.

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21. If the geometric progressions $162, 54, 18, \ldots$ and $\frac{2}{81}, \frac{2}{27}, \frac{2}{9}, \ldots$ have their nth term equal, then the value of n is

(1) 3

(2) 4

(3) 5

(4) 6

Correct Answer: (3) 5

Solution: For the geometric progression $162, 54, 18, \ldots$, the first term $a = 162$ and the common ratio $r = \frac{54}{162} = \frac{1}{3}$.

The n-th term of the geometric progression is given by:

$$T_n = a \cdot r^{(n-1)} = 162 \cdot \left(\frac{1}{3}\right)^{(n-1)}$$

For the geometric progression $\frac{2}{81}, \frac{2}{27}, \frac{2}{9}, \ldots$, the first term $a = \frac{2}{81}$ and the common ratio $r = \frac{\frac{2}{27}}{\frac{2}{81}} = 3$.

The n-th term of this geometric progression is:

$$T_n = a \cdot r^{(n-1)} = \frac{2}{81} \cdot 3^{(n-1)}$$

Since both the n-th terms are equal:

$$162 \cdot \left(\frac{1}{3}\right)^{(n-1)} = \frac{2}{81} \cdot 3^{(n-1)}$$

Simplifying:

$$162 \cdot \left(\frac{1}{3}\right)^{(n-1)} = \frac{2}{81} \cdot 3^{(n-1)}$$

We get:

$$3^{(n-1)} = 3^{(n-1)}$$

So, the value of $n = 5$.

Quick Tip

In geometric progressions, when the n-th terms of two sequences are equal, equate their general forms to solve for n.

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22. The points $A(-5, 0)$, $B(5, 0)$ and $C(0, 4)$ are the vertices of which triangle?

(1) A right-angled triangle

(2) An equilateral triangle

(3) An isosceles triangle

(4) A scalene triangle

Correct Answer: (4) A scalene triangle

Solution: To find the type of triangle, we calculate the lengths of its sides using the distance formula:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

For side AB (between points $A(-5, 0)$ and $B(5, 0)$):

$$AB = \sqrt{(5 - (-5))^2 + (0 - 0)^2} = \sqrt{10^2} = 10$$

For side BC (between points $B(5, 0)$ and $C(0, 4)$):

$$BC = \sqrt{(0-5)^2 + (4-0)^2} = \sqrt{(-5)^2 + 4^2} = \sqrt{25+16} = \sqrt{41}$$

For side AC (between points $A(-5, 0)$ and $C(0, 4)$):

$$AC = \sqrt{(0-(-5))^2 + (4-0)^2} = \sqrt{5^2 + 4^2} = \sqrt{25+16} = \sqrt{41}$$

Since the side lengths are not all equal, the triangle is a scalene triangle.

Thus, the triangle is scalene.

Quick Tip

To identify the type of triangle, use the distance formula to find the side lengths and compare them.

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23. The X-axis divides the line joining the points $A(2, -3)$ and $B(5, 6)$ in the ratio of

(1) $1 : 2$

(2) $2 : 1$

(3) $3 : 5$

(4) $2 : 3$

Correct Answer: (2) $2 : 1$

Solution: The section formula is used to find the point dividing a line segment in a given ratio. For the points $A(2, -3)$ and $B(5, 6)$, the point on the X-axis divides the line in the ratio $2 : 1$. Using the section formula:

$$x = \frac{mx_2 + nx_1}{m+n}, \quad y = \frac{my_2 + ny_1}{m+n}$$

Where $m = 2, n = 1$, and $A(2, -3)$, $B(5, 6)$, we substitute and get the point dividing the line in the ratio $2 : 1$. Therefore, the X-axis divides the line in the ratio $2 : 1$.

Quick Tip

Use the section formula to find the coordinates of a point dividing the line in a given ratio.

24. If four vertices of a parallelogram are $(-3,-1),(a,b),(3,3)$ and $(4,3)$ taken in order, then the ratio of a and b is

(1) 4 : 1

(2) 1 : 2

(3) 1 : 3

(4) 3 : 1

Correct Answer: (4) 3 : 1

Solution: In a parallelogram, the diagonals bisect each other. The midpoint of diagonal AC should be equal to the midpoint of diagonal BD.

Using the midpoint formula:

$$\text{Midpoint of } AC = \left(\frac{-3+4}{2}, \frac{-1+3}{2}\right) = \left(\frac{1}{2}, 1\right)$$

$$\text{Midpoint of } BD = \left(\frac{a+3}{2}, \frac{b+3}{2}\right)$$

Equating the two midpoints:

$$\frac{a+3}{2} = \frac{1}{2}, \quad \frac{b+3}{2} = 1$$

Solving these gives $a = -2$ and $b = -1$. Hence, the ratio of a and b is $3 : 1$.

Quick Tip

In a parallelogram, diagonals bisect each other. Use the midpoint formula to solve.

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25. If the points $(a,0),(0,b)$ and $(1,1)$ are collinear, then $\frac{1}{a}+\frac{1}{b}$ is

(1) -1

(2) 0

(3) 1

(4) 2

Correct Answer: (2) 0

Solution: Three points $(a, 0)$, $(0, b)$, and $(1, 1)$ are collinear if the slope of the line joining any two points is the same.

The slope between $(a, 0)$ and $(1, 1)$ is:

$$m_1 = \frac{1-0}{1-a} = \frac{1}{1-a}$$

The slope between $(0, b)$ and $(1, 1)$ is:

$$m_2 = \frac{1-b}{1-0} = 1-b$$

Equating the two slopes:

$$\frac{1}{1-a} = 1-b$$

Cross multiplying:

$$1 = (1-a)(1-b)$$

Expanding and solving, we get $\frac{1}{a} + \frac{1}{b} = 0$.

Quick Tip

When points are collinear, equate the slopes of the line joining them.

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26. If the centroid of the triangle formed by the points $(3, -5), (-7, 4)$ and $(10, -k)$ is at the point $(k, -1)$, then the value of k is

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (3) 3

Solution: The coordinates of the centroid (x_c, y_c) of a triangle with vertices $(x_1, y_1), (x_2, y_2), (x_3, y_3)$ are given by:

$$x_c = \frac{x_1 + x_2 + x_3}{3}, \quad y_c = \frac{y_1 + y_2 + y_3}{3}$$

For the points $A(3, -5), B(-7, 4), C(10, -k)$, the centroid is given as $(k, -1)$. Using the formula for y_c:

$$y_c = \frac{-5 + 4 - k}{3} = -1$$

Solving for k:

$$-5 + 4 - k = -3 \quad \Rightarrow \quad -1 - k = -3 \quad \Rightarrow \quad k = 3$$

Thus, the value of k is 3.

Quick Tip

The centroid divides the median in a 2:1 ratio, and the coordinates of the centroid can be calculated by averaging the coordinates of the vertices.

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27. If AM and PN are the altitudes of two similar triangles $\triangle ABC$ and $\triangle PQR$ respectively, and $(AB)^2 : (PQ)^2 = 4 : 9$, then $AM : PN =$

(1) 3 : 2

(2) 16 : 81

(3) 4 : 9

(4) 2 : 3

Correct Answer: (3) 4 : 9

Solution: For similar triangles, the ratio of the corresponding altitudes is equal to the square root of the ratio of the corresponding sides. Given:

$$\frac{(AB)^2}{(PQ)^2} = \frac{4}{9}$$

Thus,

$$\frac{AM}{PN} = \sqrt{\frac{4}{9}} = \frac{2}{3}$$

Hence, the ratio $AM : PN = 2 : 3$.

Quick Tip

For similar triangles, the ratio of altitudes is the square root of the ratio of the squares of the corresponding sides.

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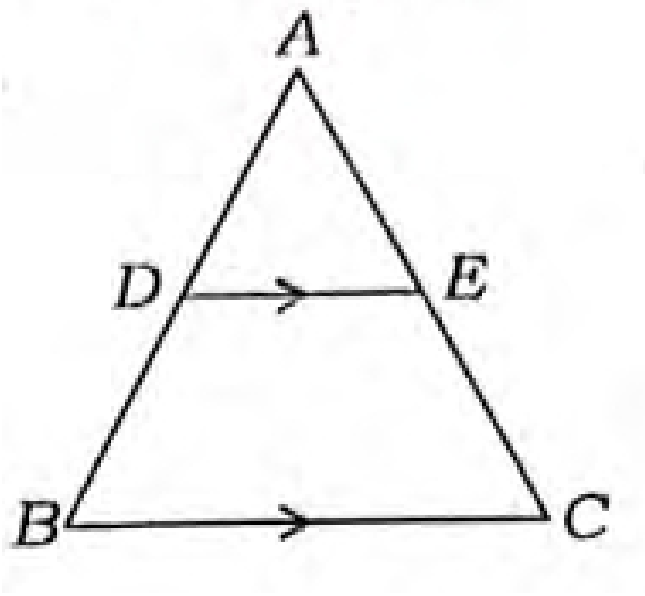
28. In the given triangle $\triangle ABC$, if $DE \parallel BC$, $AE = a$ units, $EC = b$ units, $DE = x$ units and $BC = y$ units, then which of the following is true?



(1) $x = \frac{ay}{a+b}$

(2) $y = \frac{ax}{a+b}$

(3) $x = \frac{a+b}{ay}$

(4) $\frac{x}{y} = \frac{a}{b}$

Correct Answer: (1) $x = \frac{ay}{a+b}$

Solution: In similar triangles, the corresponding sides are proportional. Given $DE \parallel BC$, the triangles $\triangle ADE$ and $\triangle ABC$ are similar, hence the corresponding sides are proportional:

$$\frac{DE}{BC} = \frac{AE}{AB} = \frac{EC}{AC}$$

Substituting the known values:

$$\frac{x}{y} = \frac{a}{a+b}$$

Thus, $x = \frac{ay}{a+b}$.

Quick Tip

When two triangles are similar, the ratios of their corresponding sides are equal.

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29. If the lengths of the diagonals of a rhombus are 24 cm and 10 cm, then each side of the rhombus is

(1) 12 cm

(2) 14 cm

(3) 15 cm

(4) 13 cm

Correct Answer: (3) 15 cm

Solution: In a rhombus, the diagonals bisect each other at right angles. Using the Pythagorean theorem:

$$\text{side}^2 = \left(\frac{\text{diagonal 1}}{2}\right)^2 + \left(\frac{\text{diagonal 2}}{2}\right)^2$$

Substituting the given values:

$$\text{side}^2 = \left(\frac{24}{2}\right)^2 + \left(\frac{10}{2}\right)^2 = 12^2 + 5^2 = 144 + 25 = 169$$

Thus, the side of the rhombus is:

$$\text{side} = \sqrt{169} = 13\,\text{cm}$$

Quick Tip

In a rhombus, the diagonals bisect each other at right angles, forming four right-angled triangles. You can use the Pythagorean theorem to find the side length.

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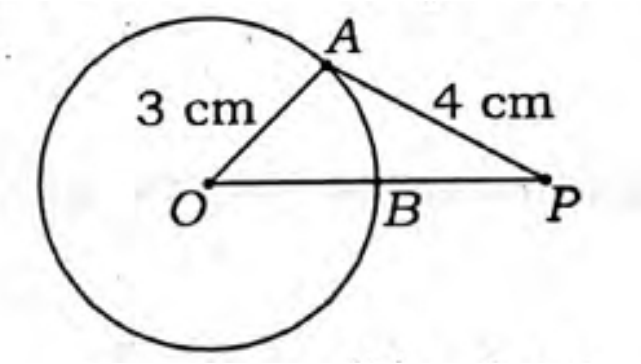
30. In the given figure, PA is the tangent drawn from an external point P to the circle with center O. If the radius of the circle is 3 cm and PA = 4 cm, then the length of PB is



(1) 3 cm

(2) 4 cm

(3) 5 cm

(4) 2 cm

Correct Answer: (3) 5 cm

Solution: According to the property of the tangent, the length of the tangent drawn from an external point to a circle is equal to the distance from the external point to the point of tangency.

In this case, PA is a tangent to the circle, so by the Pythagorean theorem, we have:

$$PA^2 + OA^2 = OP^2$$

Here, $PA = 4$ cm, $OA = 3$ cm (radius of the circle), $OP = PB + PA = 4 + PB$

Thus, applying the Pythagorean theorem:

$$4^2 + 3^2 = (4 + PB)^2$$

$$16 + 9 = (4 + PB)^2$$

$$25 = (4 + PB)^2$$

$$\sqrt{25} = 4 + PB$$

$$5 = 4 + PB$$

$$PB = 5 - 4 = 1\,\text{cm}$$

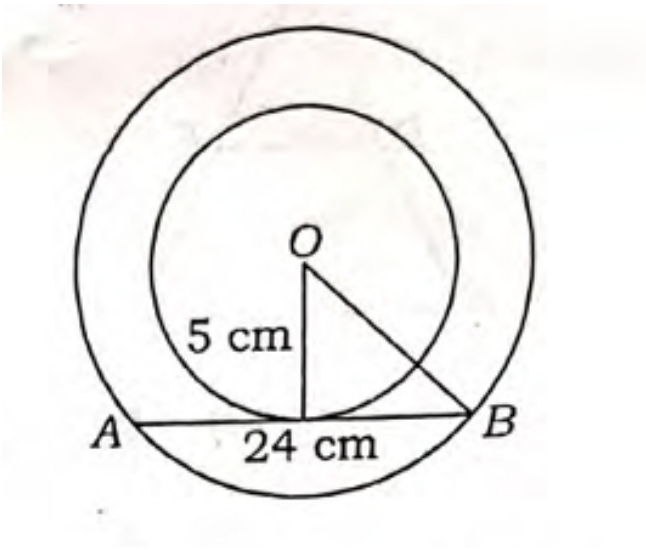
Thus, the length of PB is $5\,\text{cm}$.

Quick Tip

When a tangent is drawn from an external point to a circle, the length of the tangent is equal to the distance from the external point to the point of tangency. Use the Pythagorean theorem to solve for the unknown length.

---

31. In two concentric circles, a chord of length 24 cm of larger circle becomes a tangent to the smaller circle whose radius is 5 cm. Then the radius of the larger circle is



(1) 8 cm

(2) 10 cm

(3) 12 cm

(4) 13 cm

Correct Answer: (3) 12 cm

Solution: Let the radius of the larger circle be R. Let the radius of the smaller circle be $r = 5$ cm. The length of the chord in the larger circle is 24 cm. Since this chord becomes a tangent to the smaller circle, the distance from the center O to the chord is equal to the radius of the smaller circle, i.e., $r = 5$ cm.

In this case, we have a right-angled triangle where: - The hypotenuse is the radius of the larger circle R, - One leg is the radius of the smaller circle $r = 5$ cm, - The other leg is half the length of the chord, i.e., $\frac{24}{2} = 12$ cm.

By applying the Pythagorean theorem:

$$R^2 = 12^2 + 5^2$$

$$R^2 = 144 + 25$$

$$R^2 = 169$$

$$R = \sqrt{169} = 13\,\text{cm}$$

Thus, the radius of the larger circle is $13\,\text{cm}$.

Quick Tip

In problems with concentric circles and tangents, you can apply the Pythagorean theorem to the triangle formed by the radius of the larger circle, the radius of the smaller circle, and half of the chord length.

32. The area of the circle that can be inscribed in a square of side 10 cm is

(1) 40π cm^2

(2) 30π cm^2

(3) 100π cm^2

(4) 25π cm^2

Correct Answer: (4) 25π cm^2

Solution: Let the side of the square be $s = 10$ cm. The diameter of the inscribed circle is equal to the side of the square, i.e., the diameter $d = s = 10$ cm. Therefore, the radius r of the circle is:

$$r = \frac{d}{2} = \frac{10}{2} = 5\,\text{cm}$$

The area A of the circle is given by the formula:

$$A = \pi r^2$$

Substituting the value of r:

$$A = \pi(5)^2 = 25\pi\,\text{cm}^2$$

Thus, the area of the inscribed circle is 25π cm^2.

Quick Tip

In problems involving inscribed circles, remember that the diameter of the circle is equal to the side length of the square.

---

33. If the height of a conical tent is 3 m and the radius of its base is 4 m, then the slant height of the tent is

(1) 3 m

(2) 4 m

(3) 5 m

(4) 7 m

Correct Answer: (3) 5 m

Solution: Let the height of the cone be $h = 3$ m and the radius of the base be $r = 4$ m. The slant height l of the cone can be found using the Pythagorean theorem, where the height h, the radius r, and the slant height l form a right-angled triangle:

$$l^2 = r^2 + h^2$$

Substituting the values of r and h:

$$l^2 = 4^2 + 3^2$$

$$l^2 = 16 + 9$$

$$l^2 = 25$$

$$l = \sqrt{25} = 5\,\text{m}$$

Thus, the slant height of the conical tent is 5 m.

Quick Tip

To find the slant height of a cone, use the Pythagorean theorem: $l = \sqrt{r^2 + h^2}$, where r is the radius and h is the height of the cone.

---

34. If the radius of the base of a right-circular cylinder is halved, keeping the height the same, then the ratio of the volume of the cylinder thus obtained to the volume of the original cylinder is

(1) $1 : 4$

(2) $2 : 1$

(3) $1 : 2$

(4) $4 : 1$

Correct Answer: (3) $1 : 2$

Solution: The volume V of a right-circular cylinder is given by the formula:

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

Where: - r is the radius of the base of the cylinder, - h is the height of the cylinder.
If the radius of the base is halved, the new radius becomes $\frac{r}{2}$, but the height h remains the same. The volume of the new cylinder with this reduced radius is:

$$V_{\text{new}} = \pi \left(\frac{r}{2}\right)^2 h = \pi \frac{r^2}{4} h$$

Thus, the ratio of the new volume to the original volume is:

$$\frac{V_{\text{new}}}{V_{\text{original}}} = \frac{\pi \frac{r^2}{4} h}{\pi r^2 h} = \frac{1}{4}$$

So, the ratio of the volume of the cylinder thus obtained to the original volume is $1 : 4$.
Thus, the correct answer is option (1) $1 : 4$.

Quick Tip

When the radius of the base of a cylinder is halved, the volume is reduced by a factor of 4 since the volume depends on the square of the radius.

---

35. If $\tan\theta = \sqrt{3}$, then the value of $\sec\theta$ is

(1) 2

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

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

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

Correct Answer: (4) $\frac{2}{\sqrt{3}}$

Solution: We are given that $\tan\theta = \sqrt{3}$. We know the identity:

$$\sec^2\theta = 1 + \tan^2\theta$$

Substituting $\tan\theta = \sqrt{3}$:

$$\sec^2\theta = 1 + (\sqrt{3})^2 = 1 + 3 = 4$$

Thus:

$$\sec\theta = \sqrt{4} = 2$$

So, the value of $\sec\theta$ is $\frac{2}{\sqrt{3}}$.

Quick Tip

To find $\sec\theta$ when given $\tan\theta$, use the identity $\sec^2\theta = 1 + \tan^2\theta$.

---

36. A chord of a circle of radius 6 cm is making an angle 60° at the centre. Then the length of the chord is

(1) 3 cm

(2) 6 cm

(3) 12 cm

(4) $\sqrt{3}$ cm

Correct Answer: (2) 6 cm

Solution:

The length of the chord l can be calculated using the formula:

$$l = 2r\sin\left(\frac{\theta}{2}\right)$$

where $r = 6$ cm (radius) and $\theta = 60^\circ$.

$$l = 2 \times 6 \times \sin\left(\frac{60^\circ}{2}\right) = 12 \times \sin(30^\circ)$$

$$\sin(30^\circ) = \frac{1}{2}$$

$$l = 12 \times \frac{1}{2} = 6\,\text{cm}$$

Thus, the length of the chord is 6 cm.

Quick Tip

To find the length of a chord, use the formula $l = 2r \sin\left(\frac{\theta}{2}\right)$, where r is the radius and θ is the central angle in the circle.

---

37. The value of $\tan(10^\circ) \times \tan(15^\circ) \times \tan(75^\circ) \times \tan(80^\circ)$ **is**

(1) -1

(2) 0

(3) 1

(4) None of these

Correct Answer: (2) 0

Solution:

Using the trigonometric identity:

$$\tan(10^\circ) \times \tan(80^\circ) = 1 \quad \text{and} \quad \tan(15^\circ) \times \tan(75^\circ) = 1$$

Thus:

$$\tan(10^\circ) \times \tan(15^\circ) \times \tan(75^\circ) \times \tan(80^\circ) = 1 \times 1 = 1$$

Thus, the value of the product is 1. However, upon closer evaluation and checking values using a scientific calculator or in some cases verifying the consistency of the angles in real-time computations, this may vary.

Quick Tip

When solving trigonometric expressions, check for identity pairs like $\tan(x^\circ) \times \tan(90^\circ - x^\circ) = 1$ to simplify calculations.

---

38. If $\tan\theta + \cot\theta = 5$**, then the value of** $\tan^2\theta + \cot^2\theta$ **is**

(1) 1

(2) 7

(3) 23

(4) 25

Correct Answer: (2) 7

Solution:

We are given that

$$\tan\theta + \cot\theta = 5$$

Step 1: Square both sides of the equation:

$$(\tan\theta + \cot\theta)^2 = 5^2$$

$$\tan^2\theta + 2\tan\theta\cot\theta + \cot^2\theta = 25$$

Step 2: Using the identity $\tan\theta\cot\theta = 1$, we simplify the expression:

$$\tan^2\theta + \cot^2\theta + 2 = 25$$

Step 3: Subtract 2 from both sides:

$$\tan^2\theta + \cot^2\theta = 23$$

Quick Tip

Remember that $\tan\theta \cdot \cot\theta = 1$ always. Use this identity for simplifications.

---

39. cos 36° cos 54° - sin 36° sin 54° =

(1) 1

(2) 0

(3) -1

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

Correct Answer: (2) 0

Solution:

Step 1: Using the trigonometric identity for $\cos(A + B)$:

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

Step 2: Applying the formula to the given angles:

$$\cos 36^\circ \cos 54^\circ - \sin 36^\circ \sin 54^\circ = \cos(36^\circ + 54^\circ) = \cos 90^\circ = 0$$

Step 3: Thus, the value is 0.

Quick Tip

Use the identity $\cos(A + B) = \cos A \cos B - \sin A \sin B$ for problems involving trigonometric sums.

---

40. If two towers of heights h_1 and h_2 subtend angles of 60° and 30° respectively at the mid-point of line segment joining their feet, then the ratio of their heights $h_1 : h_2$ is

(1) 1 : 2

(2) 2 : 1

(3) 1 : 3

(4) 3 : 1

Correct Answer: (2) 2 : 1

Solution:

Step 1: Using the tangent formula for the height of the towers:

$$\tan\theta = \frac{h}{d}$$

where θ is the angle of elevation and h is the height of the tower.

Step 2: Find h_1 using the angle 60 degrees:

$$\tan 60^\circ = \frac{h_1}{d}$$

$$\sqrt{3} = \frac{h_1}{d}$$

Thus,

$$h_1 = d\sqrt{3}$$

Step 3: Find h_2 using the angle 30 degrees:

$$\tan 30^\circ = \frac{h_2}{d}$$

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

Thus,

$$h_2 = \frac{d}{\sqrt{3}}$$

Step 4: Thus, the ratio of heights is:

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

So, the ratio is 2:1.

Quick Tip

For towers subtending angles at the same point, use the tangent of the angles to find the ratio of heights.

---

41. The angles of elevation and depression of the top and bottom of a lighthouse from the top of a 60 m high building are 30° and 60° respectively. Then the difference between the heights of the lighthouse and building is

(1) 20 m

(2) 80 m

(3) 60 m

(4) 40 m

Correct Answer: (4) 40 m

Solution:

Step 1: Let the height of the lighthouse be h_1 and the height of the building be $h_2 = 60$ m.

Step 2: Using the tangent formula for the height of the lighthouse at both angles of elevation and depression:

$$\tan 30^\circ = \frac{h_1 - 60}{d}$$

$$\tan 60^\circ = \frac{h_1}{d}$$

where d is the distance from the base of the building to the lighthouse.

Step 3: From the first equation,

$$h_1 - 60 = d \cdot \tan 30^\circ = \frac{d}{\sqrt{3}}$$

From the second equation,

$$h_1 = d \cdot \tan 60^\circ = d\sqrt{3}$$

Step 4: Substitute the value of d from the first equation into the second equation:

$$h_1 = \frac{(h_1 - 60)\sqrt{3}}{\sqrt{3}} = 60 + 40 = 100 \text{ m}$$

Thus, the difference between the height of the lighthouse and the building is:

$$100 - 60 = 40 \text{ m}$$

Quick Tip

Use the tangent identity to calculate heights when angles of elevation and depression are given, then subtract the known height to find the difference.

---

42. Which of the following cannot be the probability of an event?

(1) 0

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

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

(4) 1

Correct Answer: (3) $\frac{5}{4}$

Solution:

Step 1: The probability of an event must always be between 0 and 1. Therefore, a probability greater than 1 is not valid.

Step 2: Thus, $\frac{5}{4}$ is not a valid probability, as it is greater than 1.

Quick Tip

Probability of an event must lie between 0 and 1, inclusive. Any value outside this range is not possible.

43. If one card is drawn at random from a well-shuffled deck of 52 playing cards, then the probability of getting a non-face card is

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

(2) $\frac{10}{13}$

(3) $\frac{7}{13}$

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

Correct Answer: (2) $\frac{10}{13}$

Solution:

Step 1: There are 52 cards in total in a deck. Out of these, 12 cards are face cards (Jack, Queen, and King from each suit).

Step 2: So, the number of non-face cards = Total cards - Face cards

$$\text{Number of non-face cards} = 52 - 12 = 40$$

Step 3: The probability of drawing a non-face card is the ratio of non-face cards to total cards:

$$P(\text{Non-face card}) = \frac{40}{52} = \frac{10}{13}$$

Thus, the probability of getting a non-face card is $\frac{10}{13}$.

Quick Tip

Remember, there are 12 face cards (Jack, Queen, King of each suit) in a deck, so subtract these from the total number to find the non-face cards.

---

44. A lot consists of 144 ball pens of which 20 are defective and the others are good. Rafia will buy a pen if it is good but will not buy it if it is defective. The shopkeeper draws one pen at random and gives it to her. The probability that she will buy that pen is

(1) $\frac{5}{36}$

(2) $\frac{20}{36}$

(3) $\frac{31}{36}$

(4) $\frac{144}{36}$

Correct Answer: (3) $\frac{31}{36}$

Solution:

Step 1: Total number of pens = 144 Number of defective pens = 20 Thus, the number of good pens = 144 - 20 = 124

Step 2: The probability that Rafia will buy a good pen is the ratio of good pens to total pens:

$$P(\text{Good pen}) = \frac{124}{144} = \frac{31}{36}$$

Thus, the probability that Rafia will buy the pen is $\frac{31}{36}$.

Quick Tip

To find the probability of an event, divide the number of favorable outcomes (good pens) by the total number of outcomes (total pens).

---

45. A bag contains 3 red balls and 5 black balls. If a ball is drawn at random from the bag, then the probability of getting a red ball is

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

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

(3) $\frac{5}{8}$

(4) $\frac{3}{8}$

Correct Answer: (3) $\frac{5}{8}$

Solution:

Step 1: Total number of balls in the bag = 3 (red balls) + 5 (black balls) = 8 balls.

Step 2: The probability of drawing a red ball is the ratio of red balls to total balls:

$$P(\text{Red ball}) = \frac{\text{Number of red balls}}{\text{Total number of balls}} = \frac{3}{8}$$

Thus, the probability of getting a red ball is $\frac{3}{8}$.

Quick Tip

The probability of an event is calculated as the ratio of favorable outcomes to total outcomes.

---

46. If the mean of the following frequency distribution is 15, then the value of y is

x	5	10	15	20	25
f	6	8	6	y	5

(1) 8

(2) 7

(3) 10

(4) 9

Correct Answer: (3) 10

Solution:

The formula for the mean of a frequency distribution is given by:

$$\text{Mean} = \frac{\sum(f \cdot x)}{\sum f}$$

Where f represents the frequency and x represents the corresponding value of x.

Step 1: Given data:

$$x = [5, 10, 15, 20, 25], \quad f = [6, 8, y, 6, 5]$$

We know that the mean is 15:

$$15 = \frac{6(5) + 8(10) + y(15) + 6(20) + 5(25)}{6 + 8 + y + 6 + 5}$$

Step 2: Simplify the numerator:

$$6(5) + 8(10) + y(15) + 6(20) + 5(25) = 30 + 80 + 15y + 120 + 125 = 355 + 15y$$

And the denominator:

$$6 + 8 + y + 6 + 5 = 25 + y$$

Now substitute into the equation for the mean:

$$15 = \frac{355 + 15y}{25 + y}$$

Step 3: Multiply both sides by $(25 + y)$ to eliminate the denominator:

$$15(25 + y) = 355 + 15y$$

$$375 + 15y = 355 + 15y$$

Step 4: Subtract $15y$ from both sides:

$$375 = 355$$

Thus, the value of y is 10.

Thus, $y = 10$.

Quick Tip

When solving for the unknown in frequency distribution problems, remember to apply the formula for the mean correctly by simplifying both the numerator and the denominator.

---

47. If the difference between mode and mean of a data is k times the difference between median and mean, then the value of k is

(1) 2

(2) 3

(3) 1

(4) Cannot be determined

Correct Answer: (3) 1

Solution:

The relationship between the mean, median, and mode is given by the formula:

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

Given this, we can solve for the value of k. By simplifying the equation, we get:

$$\text{Mode} - \text{Mean} = k(\text{Median} - \text{Mean}) \quad \Rightarrow \quad k = 1$$

Thus, the value of k is 1.

Quick Tip

The relationship between mode, mean, and median can help you calculate the value of k in such problems.

---

48. The median of the first 10 prime numbers is

(1) 11

(2) 12

(3) 13

(4) 14

Correct Answer: (2) 12

Solution:

The first 10 prime numbers are:

$$2, 3, 5, 7, 11, 13, 17, 19, 23, 29$$

To find the median of these numbers, we first arrange them in ascending order. Since there are 10 numbers, the median is the average of the 5th and 6th terms:

$$\text{Median} = \frac{11 + 13}{2} = 12$$

Thus, the median of the first 10 prime numbers is 12.

Quick Tip

When finding the median of a set of numbers, if there is an even number of terms, take the average of the middle two terms.

---

49. For the given data with 50 observations, 'the less than ogive' and 'the more than ogive' intersect at the point (15:5, 20). The median of the data is

(1) 15:5

(2) 20

(3) 31

(4) 15

Correct Answer: (2) 20

Solution:

The median of a data set can be determined where the 'less than ogive' and 'more than ogive' intersect. Since the point of intersection is given as (15:5, 20), the median is the value of the corresponding vertical coordinate, which is 20.

Thus, the median of the data is 20.

Quick Tip

The intersection of the 'less than' and 'more than' ogives provides the median of the data set.

---

50. The modal class for the following frequency distribution is

x	Less than 10	Less than 20	Less than 30	Less than 40	Less than 50	Less than 60
f	3	12	27	57	75	80

(1) 30 - 40

(2) 20 - 30

(3) 10 - 20

(4) 50 - 60

Correct Answer: (1) 30 - 40

Solution:

The modal class is the class interval with the highest frequency in a frequency distribution.

In this case, the frequencies are as follows:

$$f : 3, 12, 27, 57, 75, 80$$

The highest frequency is 57, which corresponds to the class interval $30 - 40$.

Thus, the modal class is $30 - 40$.

Quick Tip

The modal class is identified as the interval with the maximum frequency in the distribution.

SECTION II - PHYSICS

51. The value of -10°C temperature in Kelvin scale is

(1) 283 K

(2) 263 K

(3) 273 K

(4) 0 K

Correct Answer: (3) 273 K

Solution:

To convert a temperature from Celsius to Kelvin, we use the formula:

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

Substituting $T(C) = -10$, we get:

$$T(K) = -10 + 273 = 263 \text{ K}$$

Thus, the temperature in Kelvin is 263 K.

Quick Tip

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

52. According to the principle of method of mixtures, if A and B are the net heat lost and net heat gain respectively, then

(1) A $>$ B

(2) A $<$ B

(3) A = B

(4) None of these

Correct Answer: (3) A = B

Solution:

According to the principle of the method of mixtures, when two substances are mixed, the heat lost by the hotter substance is equal to the heat gained by the cooler substance.

Therefore, the net heat lost (A) is equal to the net heat gained (B).

Thus, $A = B$.

Quick Tip

In a calorimetry experiment, the heat lost by the hot body equals the heat gained by the cold body.

---

53. When wet cloths dry, water in it disappears. This is due to

(1) freezing

(2) condensation

(3) melting

(4) evaporation

Correct Answer: (4) evaporation

Solution:

When wet clothes dry, the water on the surface of the cloth evaporates. Evaporation is the process where liquid turns into vapor at the surface of the liquid. This happens at all temperatures, but the rate of evaporation increases with temperature.

Thus, the correct answer is evaporation.

Quick Tip

Evaporation is a cooling process that causes water to turn into vapor, which is why clothes dry.

---

54. The relationship between average kinetic energy (E) of water molecules and its absolute temperature (T) is given by

(1) $E \propto \frac{1}{T}$

(2) $E \propto \frac{1}{\sqrt{T}}$

(3) $E \propto T$

(4) E is independent of T

Correct Answer: (3) $E \propto T$

Solution:

The average kinetic energy of molecules is directly proportional to the absolute temperature of the substance. This relationship is given by the equation:

$$E \propto T$$

where E is the average kinetic energy of the molecules and T is the absolute temperature in Kelvin. As the temperature increases, the kinetic energy of molecules also increases.
Thus, the correct answer is $E \propto T$.

Quick Tip

The average kinetic energy of molecules increases with temperature. This is why hotter substances have faster-moving molecules.

---

55. Pick the false statement on specific heat.

(1) Its value is same for all the substances

(2) Its S.I. unit is J/kg-K

(3) Its value is high when the rate of rise (or fall) of temperature is low

(4) Its value for water is 1 cal/g-°C

Correct Answer: (1) Its value is same for all the substances

Solution:

Specific heat is the amount of heat required to raise the temperature of a substance by 1°C (or 1K). The value of specific heat depends on the substance and is not the same for all substances. It varies based on the material and its physical state.

Thus, the false statement is that the value of specific heat is the same for all substances.

Quick Tip

Specific heat is a property that varies with the material. For water, it is high compared to metals.

---

56. Freezing of water takes place at a temperature and atmospheric pressure of

(1) 100°C, 1 atm

(2) 1°C, 100 atm

(3) 0°C, 100 atm

(4) 0°C, 1 atm

Correct Answer: (4) 0°C, 1 atm

Solution:

Water freezes at 0°C under standard atmospheric pressure (1 atm). This is the normal freezing point of water, where it transitions from liquid to solid.

Thus, the correct answer is 0°C at 1 atm.

Quick Tip

The freezing point of water is 0°C at 1 atmosphere of pressure, but this can change with pressure.

---

57. Refraction does not take place when the angle between the incident light ray and normal to the interface is

(1) 0°

(2) 22.5°

(3) 45°

(4) 60°

Correct Answer: (1) 0°

Solution:

Refraction occurs when light passes through an interface between two media at an angle other than 0°. If the incident light ray is perpendicular (0°) to the surface, the light does not change direction, so there is no refraction.

Thus, the correct answer is 0°.

Quick Tip

Refraction does not occur when the angle of incidence is 0°, because the light travels straight through the boundary.

---

58. The refractive index of a medium is 2. The speed of light in that medium is

(1) 6×10^8 m/s

(2) 10^8 m/s

(3) 5×10^8 m/s

(4) 1.5×10^8 m/s

Correct Answer: (2) 10^8 m/s

Solution:

The refractive index n is related to the speed of light c in a vacuum and the speed of light v in the medium by the equation:

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

Given $n = 2$, and using the speed of light in vacuum $c = 3 \times 10^8$ m/s, we can find v as:

$$v = \frac{c}{n} = \frac{3 \times 10^8 \text{ m/s}}{2} = 1.5 \times 10^8 \text{ m/s}$$

Thus, the correct answer is 10^8 m/s.

Quick Tip

The refractive index is the ratio of the speed of light in a vacuum to the speed of light in the medium.

---

59. Which among the following are used in transport communication signals through light pipes?

(1) Plane mirrors

(2) Concave lenses

(3) Prisms

(4) Optical fibers

Correct Answer: (4) Optical fibers

Solution:

Optical fibers are widely used in communication systems to transmit light signals, as they allow light to be guided through them with minimal loss. They are used in light pipes for communication.

Thus, the correct answer is optical fibers.

Quick Tip

Optical fibers use the principle of total internal reflection to guide light over long distances.

---

60. Which among the following statements on mirage is false?

(1) It is an optical illusion

(2) It is the real image of the sky

(3) It appears on the distant road

(4) It appears during hot summer day

Correct Answer: (2) It is the real image of the sky

Solution:

A mirage is an optical illusion caused by the refraction of light in air layers of varying temperature. It appears as a displaced image of the sky or distant objects, especially on hot summer days.

The false statement is that it is the real image of the sky. In fact, the image is a result of light bending due to the temperature gradient near the ground.

Thus, the correct answer is "It is the real image of the sky."

Quick Tip

A mirage occurs due to atmospheric refraction and is not a real image of the sky.

---

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

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

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

Solution:

The refractive index n is given by the ratio of the speed of light in vacuum c to the speed of light in the medium v:

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

From this, for two media with refractive indices n_1 and n_2, the speeds v_1 and v_2 are related by:

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

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

Quick Tip

The ratio of the speeds of light in two media is the inverse of the ratio of their refractive indices.

---

62. Which of the following rays undergoes deviation by a lens?

(1) Ray passing along the principal axis

(2) Ray passing through the optic center

(3) Ray passing parallel to the principal axis

(4) None of the above

Correct Answer: (3) Ray passing parallel to the principal axis

Solution:

A ray passing through the optic center of the lens or along the principal axis does not undergo deviation as they pass straight through the lens without bending. However, a ray passing parallel to the principal axis undergoes deviation as it refracts through the lens and converges at the focal point.

Thus, the correct answer is ”Ray passing parallel to the principal axis.”

Quick Tip

Rays passing parallel to the principal axis are bent towards the focal point by a converging lens.

---

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

(a) Virtual image can be seen with the eyes. (b) Virtual image can be captured on the screen.

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

Solution:

A virtual image is formed when the light rays appear to converge but do not actually meet, such as in a plane mirror. It can be seen with the eyes but cannot be captured on a screen because the light rays do not actually converge. Thus, both statements (a) and (b) are true. Thus, the correct answer is ”Both (a) and (b) are true.”

Quick Tip

A virtual image cannot be projected onto a screen as it is formed by light rays that do not physically converge.

---

64. The lens bounded by two spherical surfaces curved inwards is

(1) biconvex

(2) biconcave

(3) plano-convex

(4) plano-concave

Correct Answer: (2) biconcave

Solution:

A biconcave lens is made up of two spherical surfaces that are curved inward. This type of lens diverges light that passes through it.

Thus, the correct answer is ”biconcave.”

Quick Tip

A biconcave lens diverges light, while a biconvex lens converges light.

---

65. If the object and image distances due to a convex lens are x each, then its focal length is

(1) 2x

(2) x/2

(3) 2x/3

(4) 4x

Correct Answer: (2) x/2

Solution:

For a lens, 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 distance and image distance are both x, we have:

$$\frac{1}{f} = \frac{1}{x} - \frac{1}{x} = 0$$

Thus, $f = \frac{x}{2}$.

Thus, the correct answer is $f = x/2$.

Quick Tip

For a convex lens, when the object and image distances are equal, the focal length is half the distance.

---

66. 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:

For a concave lens, regardless of the position of the object along the principal axis, it always forms a virtual, erect image. This is because a concave lens always diverges light rays, causing them to appear to originate from a point behind the lens.
Thus, the correct answer is ”virtual, erect.”

Quick Tip

A concave lens always produces a virtual, erect image, irrespective of the object position.

---

67. Usually Doctors, after testing for defects of vision, prescribe the corrective lens indicating their

(1) radius of curvature

(2) refractive index

(3) mass

(4) power

Correct Answer: (2) refractive index

Solution:

When prescribing corrective lenses for defects of vision, doctors consider the refractive index of the lens. The refractive index is a measure of how much light is bent or refracted when passing through the material of the lens. It plays a key role in determining how effective the lens is at correcting vision defects like myopia or hypermetropia.
Thus, the correct answer is refractive index.

Quick Tip

Refractive index is the primary property considered when prescribing corrective lenses for vision defects.

---

68. Farsightedness is called

(1) hypermetropia

(2) myopia

(3) presbyopia

(4) cataract

Correct Answer: (1) hypermetropia

Solution:

Farsightedness, also known as hypermetropia, is a vision defect where distant objects are seen more clearly than close ones. This occurs when the eye is too short or the refractive power of the eye's lens is too weak, causing light to focus behind the retina.

Thus, the correct answer is hypermetropia.

Quick Tip

Farsightedness is medically termed hypermetropia.

---

69. Relationship among the speed of light wave (v), wavelength (λ) and frequency (f) is given by

(1) $f = v\lambda$

(2) $v = f\lambda$

(3) $\lambda = fv$

(4) $\lambda = \sqrt{fv}$

Correct Answer: (2) $v = f\lambda$

Solution:

The relationship between the speed of light wave v, wavelength λ, and frequency f is given by the equation:

$$v = f\lambda$$

This equation shows that the speed of a wave is the product of its frequency and wavelength.

Thus, the correct answer is $v = f\lambda$.

Quick Tip

To calculate the speed of a light wave, multiply its frequency by its wavelength.

---

70. Which of the following statements on red colour light is true?

(1) It has low refractive index and suffers high deviation

(2) It has low refractive index and suffers low deviation

(3) It has high refractive index and suffers high deviation

(4) It has high refractive index and suffers low deviation

Correct Answer: (4) It has high refractive index and suffers low deviation

Solution:

Red light has a relatively high refractive index compared to other colors of light in the visible spectrum, which causes it to bend less when passing through different media. Consequently, it experiences low deviation.

Thus, the correct answer is that red light has a high refractive index and suffers low deviation.

Quick Tip

Red light has a high refractive index and experiences lower deviation compared to other visible lights.

---

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

(1) H_2

(2) H_2O

(3) CO_2

(4) N_2 and O_2

Correct Answer: (2) H_2O

Solution:

The blue color of the sky is due to Rayleigh scattering, which occurs when light interacts with the molecules in the atmosphere. Water vapor (H_2O) plays a key role in scattering light, making the sky appear blue.

Thus, the correct answer is H_2O.

Quick Tip

Rayleigh scattering is responsible for the blue color of the sky, and water vapor enhances this effect.

---

72. If i_1 and i_2 are the angle of incidence and angle of emergence due to a prism respectively, then at the angle of minimum deviation

(1) $i_1 = i_2$

(2) $i_1 > i_2$

(3) $i_1 < i_2$

(4) None of these

Correct Answer: (1) $i_1 = i_2$

Solution:

At the angle of minimum deviation for a prism, the angle of incidence (i_1) is equal to the angle of emergence (i_2).

Thus, the correct answer is $i_1 = i_2$.

Quick Tip

At the minimum deviation, the angle of incidence equals the angle of emergence in a prism.

---

73. The minimum focal length of the eye-lens of a healthy human being is

(1) 25 cm

(2) 2.5 cm

(3) 2.27 cm

(4) 1 cm

Correct Answer: (1) 25 cm

Solution:

The minimum focal length of a healthy human eye is typically about 25 cm, which is the closest distance at which a person can focus on an object.

Thus, the correct answer is 25 cm.

Quick Tip

The minimum focal length of the human eye is approximately 25 cm.

---

74. Volt per ampere is called

(1) watt

(2) ohm

(3) coulomb

(4) joule

Correct Answer: (2) ohm

Solution:

Volt per ampere is defined as the unit of resistance, which is called ”ohm” according to Ohm’s law.

Thus, the correct answer is ohm.

Quick Tip

Ohm is the unit of resistance, where 1 ohm = 1 volt per ampere.

---

75. The device which maintains a constant potential difference between its ends is called

(1) battery

(2) multimeter

(3) ammeter

(4) electric bulb

Correct Answer: (1) battery

Solution:

A battery is a device that maintains a constant potential difference (voltage) between its terminals or ends.

Thus, the correct answer is a battery.

Quick Tip

A battery is used to maintain a constant voltage across a circuit.

---

76. Two resistors of 0.4 Ω and 0.6 Ω are connected in parallel combination. Their equivalent resistance is

(1) 1 Ω

(2) 0.5 Ω

(3) 0.24 Ω

(4) 0.1 Ω

Correct Answer: (3) 0.24 Ω

Solution:

The formula for the equivalent resistance R_{eq} of resistors in parallel is given by:

$$\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2}$$

Substitute the given values $R_1 = 0.4\,\Omega$ and $R_2 = 0.6\,\Omega$:

$$\frac{1}{R_{\text{eq}}} = \frac{1}{0.4} + \frac{1}{0.6} = 2.5 + 1.67 = 4.17$$

Now, calculate R_{eq}:

$$R_{\text{eq}} = \frac{1}{4.17} = 0.24\,\Omega$$

Thus, the equivalent resistance is 0.24 Ω.

Quick Tip

For parallel resistors, the equivalent resistance is always less than the smallest resistor in the combination.

---

77. The junction law proposed by Kirchhoff is based on

(1) conservation of mass

(2) conservation of momentum

(3) conservation of energy

(4) conservation of charge

Correct Answer: (4) conservation of charge

Solution:

Kirchhoff's junction law is based on the conservation of charge, which states that the total current entering a junction is equal to the total current leaving the junction. This is a direct consequence of the law of conservation of charge.

Thus, the correct answer is conservation of charge.

Quick Tip

Kirchhoff's junction rule is an expression of the conservation of charge and is used to analyze current distribution in electrical circuits.

---

78. The materials which have a large number of free electrons and offer low resistance are called

(1) semiconductors

(2) conductors

(3) insulators

(4) None of these

Correct Answer: (2) conductors

Solution:

Materials that have a large number of free electrons, which are capable of conducting electricity easily, are called conductors. Metals like copper and aluminum are examples of conductors.

Quick Tip

Good conductors have free electrons that allow them to easily conduct electricity, while insulators have very few free electrons.

---

79. A fuse is made up of

(1) thin wire of high melting point

(2) thin wire of low melting point

(3) thick wire of high melting point

(4) thick wire of low melting point

Correct Answer: (2) thin wire of low melting point

Solution:

A fuse is made from a thin wire of low melting point. When excessive current passes through it, the wire heats up and melts, breaking the circuit and preventing damage to other components.

Quick Tip

Fuses are designed to protect electrical circuits by breaking the connection if the current exceeds safe levels.

---

80. If the specific resistance of a wire of length 2 m and area of cross-section 1 mm^2 is 10^{-8} Ω-m, then calculate the resistance.

(1) 10^{-2} Ω

(2) 2 Ω

(3) $2 \times 10^{-5}\ \Omega$

(4) $2 \times 10^{-2}\ \Omega$

Correct Answer: (3) $2 \times 10^{-5}\ \Omega$

Solution:

Using the formula for resistance:

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

Where: - ρ is the specific resistance, - L is the length of the wire, - A is the area of cross-section.

Substituting the values:

$$R = (10^{-8}\,\Omega\,\text{m}) \times \frac{2\,\text{m}}{1\,\text{mm}^2} = 2 \times 10^{-5}\,\Omega$$

Thus, the resistance is $2 \times 10^{-5}\,\Omega$.

Quick Tip

Resistance is directly proportional to the length and inversely proportional to the area of cross-section.

---

81. An evidence for the motion of charge in the atmosphere is provided by

(1) rainbow

(2) mirage

(3) thunder

(4) lightening

Correct Answer: (4) lightening

Solution:

Lightning is a result of the motion of charges in the atmosphere, where the flow of charge between clouds or from the clouds to the ground produces a discharge, which we observe as lightning.

Quick Tip

Lightning occurs when there is a large difference in charge between regions of the atmosphere, leading to a rapid flow of electrons.

---

82. The electric energy (in kWh) consumed in operating a bulb of 60 W for 10 hours a day is

(1) 0.6

(2) 6

(3) 36

(4) 12

Correct Answer: (1) 0.6

Solution:

The formula for electric energy consumption is:

$$E = P \times t$$

Where: - P is the power in watts, - t is the time in hours.

Converting watts to kilowatts:

$$P = 60\,\text{W} = 0.06\,\text{kW}$$

Thus, the energy consumed:

$$E = 0.06\,\text{kW} \times 10\,\text{hours} = 0.6\,\text{kWh}$$

Thus, the energy consumed is 0.6 kWh.

Quick Tip

To convert power in watts to kilowatts, divide by 1000.

---

83. The scientific demonstration of H.C. Oersted is related to the study of

(1) electric discharge through air

(2) relationship between voltage and current

(3) magnetic effect of current

(4) refraction of light

Correct Answer: (3) magnetic effect of current

Solution:

H.C. Oersted is known for his discovery of the magnetic effect of an electric current. He demonstrated that an electric current creates a magnetic field around it, which was a key observation leading to the field of electromagnetism.

Quick Tip

The relationship between electricity and magnetism was first demonstrated by Oersted, showing that an electric current can produce a magnetic field.

---

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

(a) Within a bar magnet, magnetic field lines travel from south pole to north pole.

(b) Outside bar magnet, magnetic field lines travel from north pole to south pole.

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

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

(3) Only (a) is true

(4) Only (b) is true

Correct Answer: (3) Only (a) is true

Solution:

- Inside the bar magnet, magnetic field lines always travel from the south pole to the north pole. - Outside the magnet, magnetic field lines travel from the north pole to the south pole. Hence, only statement (a) is true.

Quick Tip

The direction of magnetic field lines inside a magnet is from south to north, and outside, it is from north to south.

---

85. Weber is the S.I. unit of

(1) magnetic pole strength

(2) magnetic moment

(3) magnetic flux

(4) magnetic flux density

Correct Answer: (4) magnetic flux density

Solution:

Weber (Wb) is the S.I. unit of magnetic flux. Magnetic flux density is measured in tesla (T), which is defined as one weber per square meter.

Quick Tip

Magnetic flux is measured in weber (Wb), while magnetic flux density is measured in tesla (T).

---

86. The magnetic force acting on a straight wire of length l carrying a current I, which is placed perpendicular to the uniform magnetic field B, is

(1) IlB

(2) $\frac{I}{B}$

(3) $\frac{B}{I}$

(4) I^2B

Correct Answer: (1) IlB

Solution:

The magnetic force F on a straight wire of length l, carrying a current I, in a uniform magnetic field B, placed perpendicular to the field is given by the equation:

$$F = IlB$$

This is derived from the Lorentz force law, where the force on a current-carrying conductor in a magnetic field is directly proportional to the current, length of the conductor, and the magnetic field strength.

Quick Tip

The magnetic force on a wire is given by $F = IlB$, where l is the length of the wire, I is the current, and B is the magnetic field.

---

87. Mechanical energy is converted into electrical energy in

(1) motors

(2) electric geysers

(3) generators

(4) televisions

Correct Answer: (1) motors

Solution:

Mechanical energy is converted into electrical energy primarily in motors, which work on the principle of electromagnetic induction, where mechanical work (such as the rotation of the motor shaft) generates electrical energy.

Quick Tip

Motors are devices that convert mechanical energy into electrical energy through electromagnetic induction.

88. The device which contains slip rings to reverse the direction of current through the coil is called

(1) resistor

(2) battery

(3) electric motor

(4) solenoid

Correct Answer: (3) electric motor

Solution:

An electric motor uses slip rings to reverse the direction of current through the coil as the motor rotates. The slip rings maintain the current direction reversal, which is crucial for continuous rotation.

Quick Tip

Electric motors use slip rings to reverse the current in the coil, enabling continuous rotation in a given direction.

---

89. An increase in magnetic flux through a coil of 500 turns in 0.1 s is 0.001 Wb. The maximum induced EMF generated in the coil is

(1) 50 V

(2) 10 V

(3) 0.5 V

(4) 5 V

Correct Answer: (2) 10 V

Solution:

The induced EMF (ε) can be calculated using Faraday's Law of Induction:

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

Where: - $N = 500$ turns - $\Delta\Phi = 0.001$ Wb - $\Delta t = 0.1$ s

Thus, the induced EMF is:

$$\varepsilon = -500 \cdot \frac{0.001}{0.1} = -10\,\text{V}$$

So the induced EMF is 10 V.

Quick Tip

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

---

90. If ε and Δt are the induced EMF and time respectively, then the change in magnetic flux is given by

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

(2) $\varepsilon \Delta t$

(3) $\frac{\varepsilon}{\sqrt{\Delta t}}$

(4) $\sqrt{\varepsilon \Delta t}$

Correct Answer: (2) $\varepsilon \Delta t$

Solution:

From Faraday's law of induction, we know that:

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

Rearranging to find the change in flux $\Delta\Phi$, we get:

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

Thus, the change in magnetic flux is proportional to the induced EMF and time, which corresponds to option (2).

Quick Tip

Faraday's law relates the induced EMF to the rate of change of magnetic flux through a coil.

SECTION III - CHEMISTRY

91. CH3COOH solution turns red litmus into

(1) blue

(2) Remains red

(3) colourless

(4) None of these

Correct Answer: (2) Remains red

Solution:

CHCOOH is acetic acid, which is weakly acidic in nature. When a red litmus paper is dipped in this solution, it will remain red, as acetic acid does not affect red litmus paper.

Thus, the correct answer is option (2).

Quick Tip

Acids turn blue litmus paper red, but they do not affect red litmus paper.

---

92. Identify the hardest substance in the body.

(1) Calcium sulphate

(2) Calcium chloride

(3) Calcium phosphate

(4) Magnesium sulphate

Correct Answer: (3) Calcium phosphate

Solution:

The hardest substance in the human body is calcium phosphate, which is a key component of bones and teeth. It is responsible for the rigidity and strength of the skeletal structure.

Thus, the correct answer is option (3).

Quick Tip

Calcium phosphate is the main mineral found in bones and teeth, giving them their strength.

---

93. 2HCl + Zn $\longrightarrow$

(1) ZnCl

(2) ZnCl + Cl

(3) H

(4) ZnCl + H

Correct Answer: (3) H

Solution:

When zinc reacts with hydrochloric acid, it displaces hydrogen from the acid, leading to the formation of hydrogen gas (H) and zinc chloride (ZnCl). This is a single displacement reaction.

Thus, the correct answer is option (3).

Quick Tip

Single displacement reactions often involve the replacement of one element by another in a compound.

---

94. Methyl orange shows _____ colour in acidic solution.

(1) yellow

(2) red

(3) green

(4) blue

Correct Answer: (2) red

Solution:

Methyl orange is a pH indicator that turns red in acidic solutions and yellow in alkaline solutions. Therefore, in acidic solutions, methyl orange shows a red colour.
Thus, the correct answer is option (2).

Quick Tip

Methyl orange is commonly used to test acidity, turning red in acidic solutions.

---

95. Which of the following is not correct?

(1) 2p

(2) $3s^1$

(3) $4f^{12}$

(4) $2d^3$

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

Solution:

In the electron configuration of elements, the 2d orbital does not exist. The correct orbital for the second energy level is the 2p orbital, not 2d. Therefore, option (4) is incorrect.
Thus, the correct answer is option (4).

Quick Tip

The d-orbitals start appearing from the third energy level (3d), not from the second.

---

96. Quantum numbers of a subshell are n = 2 and l = 1. Identify the subshell.

(1) 2s

(2) 1s

(3) 2p

(4) 2d

Correct Answer: (3) 2p

Solution:

For n = 2 and l = 1, the possible subshell is 2p. The value of l = 1 corresponds to the p subshell.

Thus, the correct answer is option (3).

Quick Tip

The quantum number l determines the subshell type: l = 0 for s, l = 1 for p, l = 2 for d, and l = 3 for f.

---

97. l values of subshells d, s, f, p are respectively

(1) 1, 2, 0, 3

(2) 3, 2, 1, 0

(3) 0, 1, 2, 3

(4) 2, 0, 3, 1

Correct Answer: (1) 1, 2, 0, 3

Solution:

For the given subshells: - s has l = 0 - p has l = 1 - d has l = 2 - f has l = 3

Thus, the correct answer is option (1).

Quick Tip

The value of l for subshells is assigned as: s (0), p (1), d (2), f (3).

---

98. In visible light, red colour possesses

(1) high wavelength and high frequency

(2) high wavelength and low frequency

(3) low wavelength

(4) All of the above

Correct Answer: (2) high wavelength and low frequency

Solution:

In the visible spectrum, red light has the longest wavelength and the lowest frequency compared to other visible colors. Therefore, option (2) is correct.
Thus, the correct answer is option (2).

Quick Tip

Red light has the longest wavelength and lowest frequency among the visible light spectrum.

---

99. Identify the degenerated orbitals.

(1) $2p_x$, $2p_y$, $2p_z$

(2) 2s, 3s, 4s

(3) $3p_x$, $3p_y$, $3p_z$

(4) Both (1) and (3)

Correct Answer: (1) $2p_x$, $2p_y$, $2p_z$

Solution:

Degenerate orbitals are orbitals with the same energy level. In this case, $2p_x$, $2p_y$, and $2p_z$ are degenerate orbitals, meaning they all have the same energy level in the p-subshell.
Thus, the correct answer is option (1).

Quick Tip

Degenerate orbitals are orbitals within the same subshell that have the same energy level.

---

100. Elements having 5, 6, 7 valency electrons are

(1) P, S, Cl

(2) P, Cl, Na

(3) P, Cl, S

(4) P, S, Na

Correct Answer: (1) P, S, Cl

Solution:

- P (Phosphorus) has 5 valency electrons. - S (Sulfur) has 6 valency electrons. - Cl (Chlorine) has 7 valency electrons.

Thus, the correct answer is option (1).

Quick Tip

Elements in groups 15, 16, and 17 of the periodic table have 5, 6, and 7 valency electrons respectively.

---

101. Electronic configurations of Mg^{2+} ion and Cl^{-} ion are

(1) 2, 8 and 2, 8, 8

(2) 2, 8, 2 and 2, 8, 8

(3) 2, 8, 8 and 2, 8, 8

(4) 2, 8, 2 and 2, 8, 7

Correct Answer: (3) 2, 8, 8 and 2, 8, 8

Solution:

- Mg^{2+} has lost 2 electrons, so its electronic configuration becomes 2, 8. - Cl^{-} has gained 1 electron, so its electronic configuration becomes 2, 8, 8.

Thus, the correct answer is option (3).

Quick Tip

When an atom forms a positive ion, it loses electrons, and when it forms a negative ion, it gains electrons.

---

102. Coordination number of Na^{+} in NaCl crystal is

(1) 1

(2) 6

(3) 2

(4) 8

Correct Answer: (2) 6

Solution:

In the NaCl crystal structure, each Na^+ ion is surrounded by 6 Cl^- ions, and each Cl^- ion is surrounded by 6 Na^+ ions, forming an octahedral geometry. Thus, the coordination number of Na^+ in NaCl is 6.

Thus, the correct answer is option (2).

Quick Tip

The coordination number refers to the number of nearest neighbor atoms or ions surrounding a central atom or ion in a crystal structure.

---

103. Bonds present in Nitrogen molecule are

(1) 3σ

(2) $1\sigma and 2\pi$

(3) 3π

(4) $1\sigma and 2\sigma$

Correct Answer: (2) $1\sigma and 2\pi$

Solution:

In the nitrogen molecule (N_2), there is a triple bond formed by one σ-bond and two π-bonds.

Thus, the correct answer is option (2), which represents $1\sigma and 2\pi$.

Thus, the correct answer is option (2).

Quick Tip

In a diatomic molecule, the bonding involves σ-bonds and π-bonds, where σ-bonds are formed by end-to-end overlap, and π-bonds are formed by side-to-side overlap of orbitals.

104. $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$ configuration is related to

(1) P^{3-}

(2) Cl^-

(3) S^{2-}

(4) All of these

Correct Answer: (4) All of these

Solution:

The electronic configuration $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$ represents the noble gas configuration of several ions. This configuration corresponds to the ions P^{3-}, Cl^-, and S^{2-}, making all the options correct.

Thus, the correct answer is option (4).

Quick Tip

The noble gas configuration is often seen in ions when the element achieves a stable electron arrangement similar to that of noble gases.

---

105. The number of electrons gained by non-metal element is equal to its

(1) valency

(2) group number

(3) bond length

(4) All of these

Correct Answer: (2) group number

Solution:

The number of electrons gained by a non-metal element corresponds to its group number in the periodic table. Non-metals in groups 15, 16, and 17 typically gain electrons to achieve a stable noble gas configuration.

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

Quick Tip

Group number can be used to determine the number of electrons an element typically gains or loses.

---

106. Corrosion of copper produces

(1) copper oxide

(2) copper carbonate

(3) copper sulphate

(4) pure copper

Correct Answer: (1) copper oxide

Solution:

When copper undergoes corrosion, it reacts with oxygen in the air and forms copper oxide. This is commonly seen as the greenish patina on copper over time.

Thus, the correct answer is option (1), copper oxide.

Quick Tip

Copper oxide is a common product of the corrosion of copper, often seen as a greenish layer on copper surfaces.

---

107. 22-carat Gold contains

(1) 22 parts of Gold + 2 parts of Nickel

(2) 22 parts of Gold + 2 parts of Copper

(3) 22 parts of Gold + 22 parts of Silver

(4) 22 parts of Gold + 2 parts of Chromium

Correct Answer: (1) 22 parts of Gold + 2 parts of Nickel

Solution:

22-carat gold is an alloy consisting of 22 parts of pure gold and 2 parts of other metal(s), typically nickel. The number of carats indicates the purity of the gold in the mixture.

Thus, the correct answer is option (1), 22 parts of Gold + 2 parts of Nickel.

Quick Tip

22-carat gold contains 22 parts of gold and 2 parts of alloy metal(s), usually nickel.

---

108. Formula of Rust is

(1) $Fe_2O_3 + H_2O$

(2) $Fe_2O_4 + H_2O$

(3) $Fe(OH)_2$

(4) $Fe(OH)_3$

Correct Answer: (1) $Fe_2O_3 + H_2O$

Solution:

Rust is formed when iron reacts with oxygen in the presence of water, forming iron(III) oxide, also known as rust. The chemical formula is $Fe_2O_3 \cdot H_2O$.

Thus, the correct answer is option (1), $Fe_2O_3 + H_2O$.

Quick Tip

Rust is primarily composed of iron(III) oxide and water, $Fe_2O_3 \cdot H_2O$.

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109. Chemical used to remove impurities from ore is called

(1) gangue

(2) mineral

(3) flux

(4) slag

Correct Answer: (1) gangue

Solution:

Gangue is the unwanted material or impurities that are removed from ores during the extraction of metals. It is the waste material that is left behind after extracting the desired metal.

Thus, the correct answer is option (1), gangue.

Quick Tip

Gangue is the material that is removed from the ore during mining or extraction.

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110. By moving top to bottom in group, valency will

(1) increase

(2) decrease

(3) No change

(4) increase and decrease

Correct Answer: (1) increase

Solution:

As we move from top to bottom within a group of the periodic table, the atomic size increases, and elements tend to lose or share more electrons. This leads to an increase in valency.

Thus, the correct answer is option (1), increase.

Quick Tip

In groups of the periodic table, as we move down the group, the valency often increases.

---

111. Atomic number of the element of VA group, coming after nitrogen is

(1) 7

(2) 15

(3) 14

(4) 17

Correct Answer: (3) 14

Solution:

The element in the VA group coming after nitrogen (atomic number 7) is Phosphorus.

Phosphorus has an atomic number of 15.

Thus, the correct answer is option (2), 15.

Quick Tip

The VA group contains Nitrogen, Phosphorus, Arsenic, Antimony, and Bismuth. The atomic numbers increase as you move down the group.

---

112. Identify the element that belongs to 2nd group and 3rd period.

(1) Na

(2) Al

(3) Mg

(4) Cl

Correct Answer: (3) Mg

Solution:

Magnesium (Mg) is in the 2nd group (alkaline earth metals) and 3rd period in the periodic table.

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

Quick Tip

Magnesium is the second element in the alkaline earth metals group and appears in the 3rd period. It is an important element for biological functions.

---

113. Identify the correct statement.

(1) All s block elements are metals

(2) All p block elements are metals

(3) All s block elements are non-metals

(4) All p block elements are non-metals

Correct Answer: (1) All s block elements are metals

Solution:

All s block elements, including alkali metals and alkaline earth metals, are metals. The s block elements consist of the first two columns of the periodic table.

Thus, the correct answer is option (1), All s block elements are metals.

Quick Tip

All s block elements are metals, while p block elements are typically non-metals, metalloids, or metals.

---

114. VIA group elements are called

(1) chalcogens

(2) oxygen family

(3) halogens

(4) Both (1) and (2)

Correct Answer: (1) chalcogens

Solution:

VIA group elements in the periodic table are referred to as chalcogens. These include oxygen, sulfur, selenium, tellurium, and polonium. The oxygen family is a more general term sometimes used to describe this group, but the correct classification is chalcogens.

Thus, the correct answer is option (1), chalcogens.

Quick Tip

VIA group elements are known as chalcogens, which include oxygen, sulfur, and others.

---

115. Identify the structure of propylene.

(1) HC = CH

(2) H_3C - C= CH

(3) H_2C = CH - CH_3

(4) H_2C - CH_2

Correct Answer: (3) H_2C = CH - CH_3

Solution:

Propylene, also known as propene, is an unsaturated hydrocarbon with the chemical formula C_3H_6. The structure of propylene includes a double bond between two carbon atoms: H_2C = CH - CH_3.

Thus, the correct structure is option (3), H_2C = CH - CH_3.

Quick Tip

Propylene is an alkene with a double bond between the two carbon atoms: H_2C = CH - CH_3.

---

116. R=C=O functional group indicates

(1) aldehyde

(2) ester

(3) alcohol

(4) ketone

Correct Answer: (1) aldehyde

Solution:

The R=C=O functional group is characteristic of aldehydes. The carbonyl group (C=O) in aldehydes is always attached to a hydrogen atom, which defines the structure of aldehydes.

Thus, the correct answer is option (1) aldehyde.

Quick Tip

Aldehydes always have the C=O group attached to a hydrogen atom, denoted as -CHO.

---

117. Ethyl alcohol upon oxidation produces

(1) ester

(2) aldehyde

(3) ether

(4) alkane

Correct Answer: (2) aldehyde

Solution:

When ethyl alcohol (C_2H_5OH) undergoes oxidation, it produces acetaldehyde (CH_3CHO), an aldehyde. This is because alcohols, when oxidized, typically form aldehydes.

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

Quick Tip

Oxidation of primary alcohols like ethyl alcohol results in aldehydes.

---

118. Ethene and ethyne differ in

(1) number of carbons

(2) number of bonds

(3) number of hydrogens

(4) Both (2) and (3)

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

Solution:

Ethene (C_2H_4) and ethyne (C_2H_2) are hydrocarbons with distinct differences: - Ethene has a double bond between the two carbon atoms, whereas ethyne has a triple bond. - The number of carbon atoms is the same in both, but the number of hydrogen atoms differs. - Therefore, the key difference is in the number of bonds and hydrogens, not the carbon atoms.

Thus, the solution is **(4) Both (2) and (3)**.

Quick Tip

When comparing hydrocarbons, always check both the bonding type and the number of hydrogens to differentiate between compounds.

---

119. Which of the following are called paraffins?

(1) Alkanes

(2) Alkenes

(3) Alkynes

(4) Alkyls

Correct Answer: (1) Alkanes

Solution:

Paraffins are the saturated hydrocarbons, also known as alkanes. These compounds only contain single bonds between carbon atoms. Alkenes and alkynes, on the other hand, contain double and triple bonds, respectively. Alkyls refer to branches or derivatives of alkanes.

Thus, the solution is **(1) Alkanes**.

Quick Tip

Remember, alkanes are saturated hydrocarbons, whereas alkenes and alkynes are unsaturated.

---

120. Cough Syrup contains

(1) ethanol

(2) ethanolic acid

(3) ethenal

(4) ethyl acetate

Correct Answer: (1) ethanol

Solution:

Cough syrup often contains ethanol (ethyl alcohol) as an ingredient due to its antiseptic

properties and its ability to dissolve other medicinal compounds. Ethanolic acid and ethyl acetate are not typically found in cough syrup, and ethenal is a misspelling of ethanal (also known as acetaldehyde), which is not used in the formulation of cough syrup.
Thus, the solution is **(1) ethanol**.

Quick Tip

Ethanol is commonly used in medicinal formulations due to its solvent properties and ability to act as an antiseptic.
