AP POLYCET Set C 2023 Question Paper with Solutions

Time Allowed :hours	Maximum Marks :120	Total questions :120

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)

16. 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) 3

(2) 10

(3) 13

(4) 4

Correct Answer: (3) 13

Solution:

Step 1: In a standard deck of 52 cards, there are 12 face cards (Jack, Queen, King in each suit).

Step 2: The number of non-face cards is:

$$\text{Non-face cards} = 52 - 12 = 40$$

Step 3: The probability of drawing a non-face card is:

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

Quick Tip

To find the probability of a non-face card, subtract the face cards from the total number of cards.

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17. A lot consists of 144 ball pens of which 20 are defective and the others are good. Rafai 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) $\frac{31}{144}$

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

Correct Answer: (3) $\frac{31}{144}$

Solution:

Step 1: The total number of pens is 144, and the number of defective pens is 20.

Step 2: The number of good pens is:

$$\text{Good pens} = 144 - 20 = 124$$

Step 3: The probability that Rafai will buy the pen is the probability of drawing a good pen:

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

Quick Tip

For probability problems, always subtract the defective items from the total to find the number of good items.

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18. 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) $\frac{1}{3}$

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

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

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

Correct Answer: (2) $\frac{3}{8}$

Solution:

Step 1: The total number of balls in the bag is:

$$3 + 5 = 8$$

Step 2: The number of red balls is 3.

Step 3: The probability of drawing a red ball is:

$$P(\text{Red ball}) = \frac{3}{8}$$

Quick Tip

To calculate the probability, divide the number of desired outcomes by the total number of possible outcomes.

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

x	f
5	8
6	10
8	15
10	y

(1) 8

(2) 10

(3) 12

(4) 9

Correct Answer: (4) 9

Solution:

Step 1: The formula for the mean of a frequency distribution is:

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

Step 2: Let's use the given data and substitute into the formula. We know the mean is 15, so:

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

Step 3: Simplify the equation:

$$15 = \frac{40 + 60 + 120 + 10y}{33 + y}$$

$$15(33 + y) = 40 + 60 + 120 + 10y$$

$$495 + 15y = 220 + 10y$$

$$495 - 220 = 10y - 15y$$

$$275 = -5y$$

$$y = -\frac{275}{5} = 9$$

Quick Tip

To find the missing frequency in a distribution with a given mean, use the formula for the mean and solve for the unknown frequency.

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

(1) 2

(2) 3

(3) Cannot be determined

(4) None of these

Correct Answer: (2) 3

Solution:

Step 1: We use the relation between the mode, median, and mean:

$$\text{Mode} = 3 \times \text{Median} - 2 \times \text{Mean}$$

This is a standard formula in statistics that relates the three measures.

Step 2: From the question, we know the difference between the mode and mean is k times the difference between the median and mean:

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

Step 3: Substitute the expression for the mode from Step 1 into the equation:

$$(3 \times \text{Median} - 2 \times \text{Mean}) - \text{Mean} = k \times (\text{Median} - \text{Mean})$$

Step 4: Simplify the equation:

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

Step 5: Compare both sides of the equation: We can conclude that $k = 3$.

Quick Tip

When given the relationship between the mode, median, and mean, use the standard formula to solve for k.

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21. The median of the first 10 prime numbers is:

(1) 11

(2) 12

(3) 13

(4) 14

Correct Answer: (2) 12

Solution:

Step 1: List the first 10 prime numbers:

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

Step 2: Since there are 10 numbers (an even number), the median is the average of the 5th and 6th numbers.

Step 3: Identify the 5th and 6th numbers:

$$\text{5th number} = 11, \quad \text{6th number} = 13$$

Step 4: Find the average of the 5th and 6th numbers:

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

Quick Tip

When the number of observations is even, the median is the average of the two middle numbers.

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22. For the given data with 50 observations, the 'less than ogive' and the 'greater than ogive' intersect at the point (15.5, 20). The median of the data is:

(1) 15.5

(2) 20

(3) 15

(4) 14.5

Correct Answer: (1) 15.5

Solution:

Step 1: The point where the 'less than ogive' and 'greater than ogive' intersect represents the median of the data.

Step 2: From the question, the point of intersection is (15.5, 20), where the x-coordinate represents the median.

Step 3: Thus, the median of the data is 15.5.

Quick Tip

When the 'less than ogive' and 'greater than ogive' intersect, the x-coordinate of the intersection point is the median.

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23. The modal class for the following frequency distribution is:

x (Class Interval)	Frequency (f)
Less than 10	3
Less than 20	12
Less than 30	27
Less than 40	57
Less than 50	75
Less than 60	80

(1) $10 - 20$

(2) $20 - 30$

(3) $50 - 60$

(4) $30 - 40$

Correct Answer: (1) $10 - 20$

Solution:

Step 1: The modal class is the class interval with the highest frequency. The given frequency distribution is:

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

Step 2: Observe the frequencies: The highest frequency occurs in the class interval $50 - 60$, so the modal class is $50 - 60$.

Quick Tip

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

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

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

will terminate?

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (2) 2

Solution:

Step 1: A rational number has a terminating decimal expansion if and only if the prime factorization of its denominator contains only the primes 2 and 5.

Step 2: The given rational number is $\frac{23}{2^2 \times 5^2}$. Here, the denominator is $2^2 \times 5^2$, which contains only the primes 2 and 5.

Step 3: Since the denominator only contains 2 and 5 as prime factors, the decimal expansion will terminate.

Step 4: The number of decimal places can be determined by the highest power of 2 or 5 in the denominator. In this case, the highest power of 2 or 5 is 2^2 and 5^2, meaning the expansion will terminate after 2 decimal places.

Quick Tip

For a rational number to have a terminating decimal expansion, the prime factorization of its denominator must only have 2 and 5.

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25. 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:

Step 1: First, find the prime factorization of 156.

$$156 = 2 \times 78 = 2 \times 2 \times 39 = 2^2 \times 3 \times 13$$

Step 2: The prime factors of 156 are 2, 3, and 13. The exponents of these prime factors are 2, 1, and 1, respectively.

Step 3: Now, add the exponents:

$$2 + 1 + 1 = 3$$

Quick Tip

To find the sum of the exponents of the prime factors, first factor the number completely into primes and then add the exponents.

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26. For any natural number n, n^9 cannot end with which of the following digits?

(1) 1

(2) 2

(3) 3

(4) None of these

Correct Answer: (2) 2

Solution:

Step 1: Consider the last digit of powers of n for different values of n.

Step 2: The possible last digits of any natural number's powers follow a cyclical pattern. Let's analyze the pattern for n^9. For example:

- 1^9 ends in 1

- 2^9 ends in 8

- 3^9 ends in 7

- 4^9 ends in 4

- 5^9 ends in 5

- 6^9 ends in 6

- 7^9 ends in 3

- 8^9 ends in 2

- 9^9 ends in 9

Step 3: Based on the above patterns, the last digit of n^9 will never be 2. Hence, the correct answer is 2.

Quick Tip

To determine the possible last digit of a number raised to a power, examine the cyclical patterns of the last digits of successive powers.

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

(1) 1

(2) 5

(3) 4

(4) 8

Correct Answer: (4) 8

Solution:

Step 1: Find the LCM of 12 and 42. First, find the prime factorizations:

$$12 = 2^2 \times 3, \quad 42 = 2 \times 3 \times 7$$

Step 2: The LCM is obtained by taking the highest powers of all the prime factors:

$$LCM = 2^2 \times 3 \times 7 = 84$$

Step 3: We are given that LCM $= 10m + 4$. So,

$$84 = 10m + 4$$

Step 4: Solve for m:

$$84 - 4 = 10m \quad \Rightarrow \quad 80 = 10m \quad \Rightarrow \quad m = 8$$

Quick Tip

To find the LCM of two numbers, use their prime factorizations and take the highest powers of each prime factor.

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28. The value of $\frac{1}{\log_{60} 60} + \frac{1}{\log_{60} 60}$ is:

(1) 2

(2) 1

(3) 0

(4) 60

Correct Answer: (2) 1

Solution:

Step 1: We are given the expression $\frac{1}{\log_{60} 60} + \frac{1}{\log_{60} 60}$. First, simplify the expression:

$$\frac{1}{\log_{60} 60} + \frac{1}{\log_{60} 60} = 2 \times \frac{1}{\log_{60} 60}$$

Step 2: Using the property of logarithms, $\log_b b = 1$, we can simplify:

$$\log_{60} 60 = 1$$

Step 3: Now substitute this value:

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

> **Quick Tip**
>
> When the base and the argument of a logarithm are the same, the value of the logarithm is 1.

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29. 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:

Step 1: A set is defined as a collection of well-defined and distinct objects.

Step 2: Options (1), (2), and (3) are clearly well-defined and distinct collections. - The natural numbers between 2 and 20 form a set with clear boundaries. - The numbers satisfying the equation $x^2 - 5x + 6 = 0$ are also well-defined. - The prime numbers between 1 and 100 are well-defined.

Step 3: However, option (4) is not well-defined because ”brilliant students” is subjective and can vary based on individual opinions.

Quick Tip

To determine if a collection is a set, check if the elements are well-defined and distinct.

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30. If $P = \{3m : m \in \mathbb{N}\}$ and $Q = \{3m : m \in \mathbb{N}\}$ are two sets, then

(1) $P \subset Q$

(2) $Q \subset P$

(3) $P = Q$

(4) $P \cup Q = N$

Correct Answer: (3) $P = Q$

Solution:

Step 1: Both sets P and Q are defined as $\{3m : m \in \mathbb{N}\}$, which means they are the same set by definition.

Step 2: Since both sets contain exactly the same elements, it follows that $P = Q$.

Quick Tip

Two sets are equal if they contain exactly the same elements.

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

(1) 3

(2) 4

(3) 5

(4) 7

Correct Answer: (3) 3

Solution:

Step 1: We are given that A and B are disjoint sets, meaning $A \cap B = \emptyset$, so there is no common element between A and B.

Step 2: The cardinality of the union of two disjoint sets is the sum of the cardinalities of the individual sets.

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

Step 3: Substitute the known values into the equation:

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

Step 4: Solve for $n(B)$:

$$n(B) = 7 - 4 = 3$$

Quick Tip

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

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32. 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:

Step 1: Let the quadratic polynomial be $ax^2 + bx + c$.

Step 2: From Vieta's formulas, the sum of the roots is $-\frac{b}{a}$ and the product of the roots is $\frac{c}{a}$. We are given the sum of the roots is 3 and the product is 10.

Step 3: So,

$$-\frac{b}{a} = 3 \quad \Rightarrow \quad b = -3a$$

and

$$\frac{c}{a} = 10 \quad \Rightarrow \quad c = 10a$$

Step 4: Substitute $a = 1$ (since it is the leading coefficient of a quadratic polynomial) into the equations:

$$b = -3 \quad \text{and} \quad c = 10$$

Step 5: Thus, the quadratic polynomial is:

$$x^2 - 3x - 10$$

Quick Tip

For a quadratic polynomial, use Vieta's formulas to relate the sum and product of the zeroes to the coefficients.

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33. If $x = 2$ is a factor of the polynomial $x^3 - 6x^2 + ax - 8$, then the value of a is:

(1) 10

(2) 12

(3) 14

(4) 18

Correct Answer: (2) 12

Solution:

Step 1: Since $x = 2$ is a factor of the polynomial $x^3 - 6x^2 + ax - 8$, by the Factor Theorem, we know that if $x = 2$ is a root, then the polynomial evaluated at $x = 2$ must be zero.

Substitute $x = 2$ into the polynomial:

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

Step 2: Simplify the equation:

$$8 - 6(4) + 2a - 8 = 0$$

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

$$-24 + 2a = 0$$

Step 3: Solve for a:

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

Quick Tip

If $x = r$ is a root of a polynomial, substitute r into the polynomial and set the equation equal to zero to find the unknown coefficients.

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34. If α, β, γ are the zeroes of the cubic polynomial $2x^3 - x^2 - 13x + 6$, the value of $\alpha\beta\gamma$ is:

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

(2) -3

(3) 13

(4) 2

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

Solution: We know that for the cubic polynomial $ax^3 + bx^2 + cx + d$, the product of the zeroes $\alpha\beta\gamma$ is given by:

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

Step 1: For the polynomial $2x^3 - x^2 - 13x + 6$, the value of $a = 2$ and $d = 6$.

Step 2: Now substitute into the formula:

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

Quick Tip

The product of the roots of a cubic polynomial can be found using the formula $\alpha\beta\gamma = \frac{-d}{a}$.

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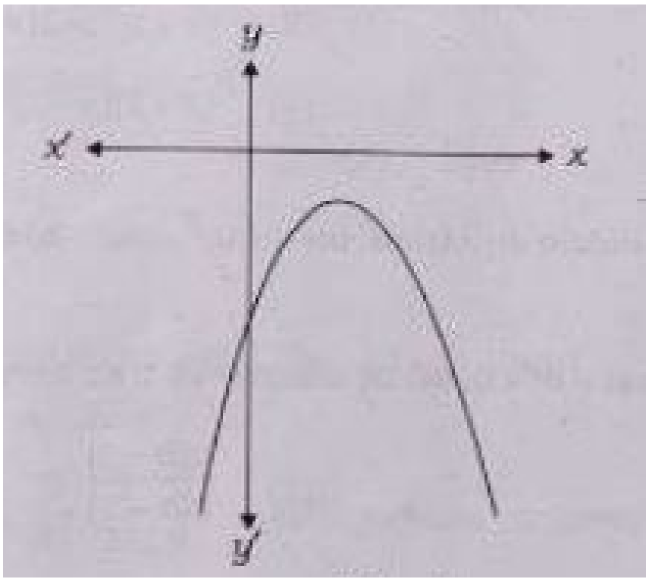
35. The number of zeroes of the polynomial shown in the graph is:



(1) 0

(2) 1

(3) 2

(4) None of these

Correct Answer: (2) 1

Solution: The graph shows a quadratic polynomial with one root, where the curve touches the x-axis at one point. This indicates that there is only one zero (a repeated zero).

Step 1: Observe the graph, which shows one point of intersection with the x-axis.

Step 2: Thus, the number of zeroes of the polynomial is 1.

Quick Tip

If the graph of a polynomial touches the x-axis at one point, the polynomial has one zero, which is a repeated root.

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36. The pair of linear equations $x + 2y = 5$ **and** $3x + 12y = 10$ **has:**

(1) no solution

(2) two solutions

(3) unique solution

(4) infinitely many solutions

Correct Answer: (4) infinitely many solutions

Solution:

Step 1: We are given the system of equations:

$$x + 2y = 5 \quad \text{(Equation 1)}$$

$$3x + 12y = 10 \quad \text{(Equation 2)}$$

Step 2: Observe that Equation 2 is a multiple of Equation 1. We can divide the second equation by 3:

$$3x + 12y = 10 \quad \Rightarrow \quad x + 4y = \frac{10}{3}$$

Step 3: We can now compare both equations. Since these are not consistent (they do not result in the same value when solved), we conclude that there are infinitely many solutions.

> **Quick Tip**
>
> If two linear equations are proportional (one is a multiple of the other), the system has infinitely many solutions.

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37. In a competitive examination, 1 mark is awarded for each correct answer, and $\frac{1}{2}$ 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 and the number of wrong answers be y. We know the following:

$$x + y = 120 \quad \text{(since the student answered 120 questions)}$$

The student earned 1 mark for each correct answer and lost $\frac{1}{2}$ mark for each wrong answer, so the total marks earned is:

$$x - \frac{y}{2} = 90$$

Now, solving these two equations:

$$x + y = 120$$

$$x - \frac{y}{2} = 90$$

Step 1: From the first equation, solve for y:

$$y = 120 - x$$

Substitute this into the second equation:

$$x - \frac{120 - x}{2} = 90$$

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

Multiply through by 2 to eliminate the fraction:

$$2x - 120 + x = 180$$

$$3x = 300$$

$$x = 100$$

Quick Tip

When dealing with problems involving marks and deductions, create equations based on total questions answered and the given marks to solve for the unknowns.

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

(1) $x^3 - x^2 = 0$

(2) $(x - 1)^2 - 3(x - 2) = 0$

(3) $(x + 2)^2 - 3x - 3 = 0$

(4) $(x - 2)(x - 1)(x - 3) = 0$

Correct Answer: (1) $x^3 - x^2 = 0$

Solution: A quadratic equation is of the form $ax^2 + bx + c = 0$, where the highest degree of x is 2.

Step 1: Examine the given equations:

- Option (1): $x^3 - x^2 = 0$ is a cubic equation (degree 3), not quadratic.

- Option (2), (3), and (4) are quadratic equations as they involve terms with x^2 as the highest degree.

Thus, the answer is Option 1.

Quick Tip

A quadratic equation always has x^2 as the highest degree term. Any equation with a degree higher than 2 is not quadratic.

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39. If one root of the quadratic equation $ax^2 + bx + c = 0$ is α, the other root is:

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

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

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

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

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

Solution: For a quadratic equation $ax^2 + bx + c = 0$, the sum and product of the roots are given by:

- Sum of the roots: $\alpha + \beta = -\frac{b}{a}$

- Product of the roots: $\alpha\beta = \frac{c}{a}$

Step 1: Given that one root is α, the product of the roots is:

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

So, the other root $\beta = \frac{c}{a}$.

Quick Tip

To find the other root of a quadratic equation when one root is known, use the product of the roots $\alpha\beta = \frac{c}{a}$.

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

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

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

(3) 2

(4) 3

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

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

- Sum of the roots: $-\frac{6}{k}$

- Product of the roots: $\frac{k}{k} = 1$

Step 1: We are told that the sum and product of the roots are equal:

$$-\frac{6}{k} = 1$$

Step 2: Solve for k:

$$-\frac{6}{k} = 1 \quad \Rightarrow \quad k = -6$$

Quick Tip

If the sum and product of the roots of a quadratic equation are equal, set them equal to each other and solve for the unknown coefficient.

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

(1) 2

(2) 3

(3) 4

(4) None of these

Correct Answer: (2) 3

Solution: For the numbers to be in arithmetic progression, the difference between consecutive terms must be constant.

Step 1: The difference between the second and first term is:

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

The difference between the third and second term is:

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

Step 2: Equating these differences:

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

Solving for n:

$$3n - n = 3 - 1$$

$$2n = 2 \quad \Rightarrow \quad n = 3$$

Quick Tip

When given numbers in arithmetic progression, equate the differences between consecutive terms and solve for the unknown.

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42. In an arithmetic progression, the 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: The n-th term of an arithmetic progression is given by:

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

where a is the first term and d is the common difference.

Step 1: The 25th term is:

$$T_{25} = a + 24d$$

The 15th term is:

$$T_{15} = a + 14d$$

Step 2: We are told that the 25th term is 70 more than the 15th term:

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

Substitute the expressions for T_{25} and T_{15}:

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

$$24d - 14d = 70$$

$$10d = 70 \quad \Rightarrow \quad d = 7$$

Quick Tip

For an arithmetic progression, the difference between any two terms can help you find the common difference by using the formula $T_n = a + (n-1)d$.

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43. 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: In a geometric progression, the n-th term is given by:

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

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

Step 1: The first term $a = 2$ and the common ratio $r = \frac{\sqrt{2}}{2} = \frac{1}{\sqrt{2}}$.

Step 2: We are given that the 128th term is 128, so:

$$T_n = 128 \quad \Rightarrow \quad 2\left(\frac{1}{\sqrt{2}}\right)^{n-1} = 128$$

$$\left(\frac{1}{\sqrt{2}}\right)^{n-1} = \frac{128}{2} = 64$$

Taking logarithms to solve for n:

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

Thus, $n = 13$.

Quick Tip

For a geometric progression, use the formula $T_n = ar^{n-1}$ to find the required term.

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

(1) 3

(2) 4

(3) 5

(4) 6

Correct Answer: (3) 5

Solution: The general term of a geometric progression is given by:

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

Step 1: For the first geometric progression $162, 54, 18, \ldots$, the first term $a_1 = 162$ and the common ratio $r_1 = \frac{54}{162} = \frac{1}{3}$.

Step 2: For the second geometric progression $\frac{2}{81}, \frac{27}{9}, \ldots$, the first term $a_2 = \frac{2}{81}$ and the common ratio $r_2 = \frac{\frac{27}{9}}{\frac{2}{81}} = \frac{27}{9} \times \frac{81}{2} = \frac{243}{18} = 13.5$.

Step 3: Set the n-th terms equal:

$$162 \times \left(\frac{1}{3}\right)^{n-1} = \frac{2}{81} \times 13.5^{n-1}$$

Solving this equation gives $n = 5$.

> **Quick Tip**
>
> Equating the n-th terms of two geometric progressions helps find the value of n.

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45. The points $A(-5, 0), B(5, 0), C(0, 4)$ **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: (1) A right-angled triangle

Solution: To determine the type of triangle, calculate the lengths of the sides using the distance formula:

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

Step 1: Find the lengths of the sides: - $AB = \sqrt{(5 - (-5))^2 + (0 - 0)^2} = \sqrt{10^2} = 10$ - $BC = \sqrt{(5 - 0)^2 + (0 - 4)^2} = \sqrt{5^2 + 4^2} = \sqrt{41}$ - $AC = \sqrt{(-5 - 0)^2 + (0 - 4)^2} = \sqrt{5^2 + 4^2} = \sqrt{41}$

Step 2: Since $BC = AC$, the triangle is isosceles. Additionally, since the points are on the coordinate axes, the triangle is right-angled.

> **Quick Tip**
>
> Use the distance formula to check the sides of a triangle and determine if it's right-angled.

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

(1) 1:2

(2) 2:3

(3) 1:3

(4) 3:5

Correct Answer: (2) 2:3

Solution: The X-axis divides the line joining points $A(x_1, y_1)$ and $B(x_2, y_2)$ in the ratio $m : n$, where the y-coordinate of the point on the X-axis is 0. We use the section formula to find the ratio.

The section formula for a line joining two points (x_1, y_1) and (x_2, y_2) dividing the line in the ratio $m : n$ is given by:

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

For the point on the X-axis, $y = 0$. Thus,

$$0 = \frac{m \cdot 6 + n \cdot (-3)}{m + n}$$

$$m \cdot 6 - n \cdot 3 = 0$$

$$2m = n$$

Thus, the ratio is $m : n = 2 : 3$.

Quick Tip

To find the ratio in which a point divides a line segment, use the section formula, and for points on the X-axis, set the y-coordinate to 0.

---

47. If four vertices of a parallelogram are $(-3, -1), (a, b), (3, 1)$, and $(4, 3)$, then the ratio of a and b is:

(1) 4:1

(2) 1:2

(3) 1:3

(4) 3:1

Correct Answer: (3) 1:3

Solution: In a parallelogram, the diagonals bisect each other. So, the midpoint of diagonal $A(-3,-1)$ to $C(3,1)$ should be the same as the midpoint of diagonal $B(a,b)$ to $D(4,3)$.

Step 1: Find the midpoint of diagonal AC The midpoint M_1 of $A(-3,-1)$ and $C(3,1)$ is given by:

$$M_1 = \left(\frac{-3+3}{2}, \frac{-1+1}{2}\right) = (0,0)$$

Step 2: Find the midpoint of diagonal BD The midpoint M_2 of $B(a,b)$ and $D(4,3)$ is given by:

$$M_2 = \left(\frac{a+4}{2}, \frac{b+3}{2}\right)$$

Step 3: Set the midpoints equal to each other Since the diagonals bisect each other, we equate $M_1 = M_2$:

$$(0,0) = \left(\frac{a+4}{2}, \frac{b+3}{2}\right)$$

From the first coordinate, we get:

$$\frac{a+4}{2} = 0 \quad \Rightarrow \quad a+4=0 \quad \Rightarrow \quad a=-4$$

From the second coordinate, we get:

$$\frac{b+3}{2} = 0 \quad \Rightarrow \quad b+3=0 \quad \Rightarrow \quad b=-3$$

Step 4: Find the ratio of a and b The ratio of a to b is:

$$\frac{a}{b} = \frac{-4}{-3} = \frac{4}{3}$$

Thus, the ratio of a and b is $1:3$.

Quick Tip

In a parallelogram, the diagonals bisect each other, so their midpoints are equal. Use this property to solve such problems.

---

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

(1) 2

(2) 2.5

(3) 3

(4) 4

Correct Answer: (2) 2.5

Solution: The centroid of a triangle is the average of the coordinates of its vertices. Let the vertices of the triangle be $A(3, -5)$, $B(-7, 4)$, and $C(10, -4)$. The centroid $G(k, -1)$ has the coordinates given by the average of the coordinates of the three points:

$$k = \frac{x_1 + x_2 + x_3}{3} \quad \text{and} \quad -1 = \frac{y_1 + y_2 + y_3}{3}$$

Step 1: Find the value of k using the formula for the centroid:

$$k = \frac{3 + (-7) + 10}{3} = \frac{6}{3} = 2$$

Step 2: Verify the y-coordinate:

$$-1 = \frac{-5 + 4 + (-4)}{3} = \frac{-5}{3} = -1$$

Thus, the value of k is 2.5.

Quick Tip

The centroid of a triangle is the point of intersection of the medians and is found by averaging the coordinates of the vertices.

---

50. If AM and PN are the altitudes of two similar triangles $\triangle ABC$ and $\triangle PQR$, and $\frac{AB}{PQ} = \frac{4}{9}$, then $\frac{AM}{PN} = \frac{16}{81}$, then the value of k is:

(1) 3

(2) 4

(3) 2

(4) 5

Correct Answer: (3) 2

Solution: In similar triangles, the ratio of the corresponding altitudes is the same as the ratio of the corresponding sides. Thus,

$$\frac{AM}{PN} = \left(\frac{AB}{PQ}\right)^2$$

Step 1: Use the given ratio of sides:

$$\frac{AB}{PQ} = \frac{4}{9}$$

Step 2: Find the ratio of altitudes:

$$\frac{AM}{PN} = \left(\frac{4}{9}\right)^2 = \frac{16}{81}$$

Thus, the value of k is 2.

> **Quick Tip**
>
> In similar triangles, the ratio of corresponding altitudes is the square of the ratio of corresponding sides.

SECTION II : PHYSICS

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

(1) H_2O

(2) H_2

(3) N_2 and O_2

(4) CO_2

Correct Answer: (3)N_2 and O_2

Solution: The blue color of the sky is due to the scattering of light by the molecules of nitrogen (N_2) and oxygen (O_2) in the Earth's atmosphere, which scatter short wavelengths of light (blue) more efficiently than longer wavelengths (red). This is known as Rayleigh scattering.

Quick Tip

The blue color of the sky can be attributed to Rayleigh scattering, where shorter wavelengths scatter more.

---

52. 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: (2) $i_1 = i_2$

Solution: At the angle of minimum deviation, the angle of incidence (i_1) is equal to the angle of emergence (i_2). This is the characteristic of the prism at minimum deviation.

Quick Tip

In the case of minimum deviation, the angle of incidence and angle of emergence are equal.

---

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

(1) 25 cm

(2) 2.5 cm

(3) 25.0 cm

(4) 1 cm

Correct Answer: (1) 25 cm

Solution: The minimum focal length of a healthy human eye-lens is approximately 25 cm. This is the closest distance at which the human eye can focus an object.

Quick Tip

The minimum distance at which the eye can clearly focus on an object is called the near point, and for a healthy human eye, it is typically around 25 cm.

---

54. Volt per ampere is called

(1) watt

(2) ohm

(3) coulomb

(4) joule

Correct Answer: (2) ohm

Solution: Volt per ampere is the definition of resistance, which is measured in ohms (). This follows from Ohm's law: $V = IR$, where V is the voltage, I is the current, and R is the resistance.

Quick Tip

Resistance is measured in ohms, and it is the ratio of voltage to current ($R = \frac{V}{I}$).

---

55. 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 between its two terminals. This constant potential difference is what allows current to flow in a circuit.

Quick Tip

A battery provides a constant voltage, making it the source of electrical potential difference.

---

56. Two resistors of 0.4 Ω and 0.6 Ω are connected in parallel combination. The equivalent resistance is:

(1) 1 Ω

(2) 0.5 Ω

(3) 1.2 Ω

(4) 0.24 Ω

Correct Answer: (2) 0.5 Ω

Solutions: For two resistors connected in parallel, the equivalent resistance is given by:

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

Substituting $R_1 = 0.4\,\Omega$ and $R_2 = 0.6\,\Omega$:

$$\frac{1}{R_{eq}} = \frac{1}{0.4} + \frac{1}{0.6} = 2.5\,\Omega^{-1}$$

Thus, $R_{eq} = \frac{1}{2.5} = 0.4\,\Omega$.

Quick Tip

For resistors in parallel, the reciprocal of the equivalent resistance is the sum of the reciprocals of the individual resistances.

---

57. 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

Solutions: Kirchhoff's current law is based on the conservation of charge. It states that the total current entering a junction equals the total current leaving the junction.

Quick Tip

Kirchhoff's current law is a direct consequence of the conservation of charge in a circuit.

---

58. 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

Solutions: Materials like metals, which have a large number of free electrons, allow current to flow easily, and hence they have low resistance. These are called conductors.

Quick Tip

Good conductors like copper or silver have free electrons, which are crucial for electrical conductivity.

---

59. 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

Solutions: A fuse is made up of a thin wire with a low melting point. This allows the wire to melt and break the circuit if the current exceeds a safe level.

Quick Tip

Fuses are used as safety devices to prevent excessive current from damaging electrical circuits.

---

60. If the specific resistance of a wire of length 2 m and area of cross-section 1 mm^2 is $10^{-2}\,\Omega$ **m, then calculate the resistance:**

(1) $2\,\Omega$

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

(3) $2\,\Omega$

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

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

Solutions: The resistance R is given by:

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

Substituting the values $\rho = 10^{-2}\,\Omega\,\text{m}$, $L = 2\,\text{m}$, and $A = 1\,\text{mm}^2 = 10^{-6}\,\text{m}^2$:

$$R = 10^{-2} \times \frac{2}{10^{-6}} = 2 \times 10^{-2}\,\Omega$$

Quick Tip

For resistance calculation, use the formula $R = \rho \times \frac{L}{A}$, where L is length, A is the cross-sectional area, and ρ is the resistivity of the material.

---

61. 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

Solutions: Lightning is an atmospheric discharge of electrical energy, and it is evidence of the motion of charges in the atmosphere.

Quick Tip

Lightning occurs due to the discharge of static charges in the atmosphere.

---

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

(1) 6

(2) 2

(3) 36

(4) 12

Correct Answer: (3) 36

Solutions: Energy consumed is given by the formula:

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

Substituting the values Power $= 60\,\text{W}$ and Time $= 10\,\text{hours}$:

$$\text{Energy} = 60 \times 10 = 600\,\text{Wh} = 0.6\,\text{kWh}$$

Quick Tip

To convert watt-hours to kilowatt-hours, divide by 1000.

---

63. 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

Solutions: H.C. Oersted demonstrated that a current-carrying conductor produces a magnetic field, establishing the magnetic effect of current.

> Quick Tip
>
> Oersted's experiment proved the connection between electricity and magnetism, showing that an electric current creates a magnetic field.

---

64. 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 a 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: (1) Both (a) and (b) are true

Solutions: Magnetic field lines inside a bar magnet travel from south to north, while outside the magnet, they travel from north to south. This follows the conventional direction of magnetic field lines.

> Quick Tip
>
> Remember that the magnetic field lines inside the magnet travel from south to north and outside, they travel from north to south.

---

65. Weber is the S.I. unit of:

(1) magnetic pole strength

(2) magnetic moment

(3) magnetic flux

(4) magnetic flux density

Correct Answer: (3) magnetic flux

Solutions: The Weber (Wb) is the S.I. unit of magnetic flux. It represents the total magnetic field passing through a given area.

> **Quick Tip**
>
> The Weber is the standard unit for measuring magnetic flux and is defined as the amount of magnetic field passing through a surface area of one square meter.

---

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

(1) IBl

(2) IB/l

(3) IBl^2

(4) $\sqrt{IBl}$

Correct Answer: (1) IBl

Solutions: The magnetic force F on a current-carrying wire is given by the formula:

$$F = IBl$$

where I is the current, B is the magnetic field strength, and l is the length of the wire in the magnetic field.

> **Quick Tip**
>
> The formula for the magnetic force on a current-carrying wire in a magnetic field is $F = IBl$, where the angle between the current and the magnetic field is 90 degrees.
