



CBSE Class X Mathematics Basic Set 3 (430/4/3)



Time Allowed :3 Hours	Maximum Marks :80	Total Questions :38
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General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 38 questions. All questions are compulsory.
2. Question Paper is divided into 5 Sections – Section A, B, C, D and E.
3. In Section–A question number 1 to 18 are Multiple Choice Questions (MCQs) and question number 19 20 are Assertion-Reason based questions of 1 mark each
4. In Section–B question number 21 to 25 are Very Short Answer (VSA) type questions of 2 marks each.
5. In Section–C question number 26 to 31 are Short Answer (SA) type ques- tions carrying 3 marks each.
6. In Section–D question number 32 to 35 are Long Answer (LA) type ques- tions carrying 5 marks each.
7. In Section–E question number 36 to 38 are Case Study based questions carrying 4 marks each. Internal choice is provided in 2 marks question in each case-study.
8. There is no overall choice. However, an internal choice has been pro- vided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.
9. Draw neat figures wherever required. Take $p = \frac{22}{7}$ wherever required if not stated.
10. Use of calculators is NOT allowed.

Section - A

Select and write the most appropriate option out of the four options given for each of the questions 1-20. There is no negative mark for the incorrect response.

1. A lamp post 9 m high casts a shadow $3\sqrt{3}$ m long on the ground. The Sun's elevation at this moment is:

- (a) 60°
- (b) 90°
- (c) 45°
- (d) 30°

Correct Answer: (a) 60° .

Solution: This is a right-angled triangle problem, where the height of the lamp post is one leg and the length of the shadow is the other leg. We can use the tangent function to find the angle of elevation.

$$\tan(\theta) = \frac{\text{opposite}}{\text{adjacent}} = \frac{9}{3\sqrt{3}} = \sqrt{3}$$

The angle whose tangent is $\sqrt{3}$ is 60° . Hence, the correct answer is (a) 60° .

💡 Quick Tip

For problems involving right triangles, use trigonometric ratios like tangent to find the angle of elevation.

2. The region between a chord and either of the two arcs of a circle is called:

- (a) an arc
- (b) a sector
- (c) a segment
- (d) a semicircle

Correct Answer: (c) a segment.

Solution: A chord divides a circle into two regions: - The region between a chord and its associated arc is called a segment. - A sector, on the other hand, is the region enclosed by two radii and the arc.

Hence, the correct answer is (c) a segment.

💡 Quick Tip

Remember the difference: A segment is defined by a chord, while a sector is defined by two radii.

3. The area of the sector of a circle with radius 6 cm which subtends an angle of 60° at the centre of the circle is:

- (a) $\frac{152}{7} \text{ cm}^2$
- (b) $\frac{122}{7} \text{ cm}^2$
- (c) $\frac{132}{7} \text{ cm}^2$
- (d) 132 cm^2

Correct Answer: (c) $\frac{132}{7} \text{ cm}^2$.

Solution:

The formula for the area of a sector of a circle is:

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



where: - θ is the angle subtended by the sector at the center of the circle, - r is the radius of the circle.

Given: - $r = 6$ cm, - $\theta = 60^\circ$.

Substitute the given values into the formula:

$$\text{Area of sector} = \frac{60^\circ}{360^\circ} \times \pi \times (6)^2 = \frac{1}{6} \times \pi \times 36 = \frac{36\pi}{6} = 6\pi$$

Using $\pi = \frac{22}{7}$:

$$\text{Area of sector} = 6 \times \frac{22}{7} = \frac{132}{7} \text{ cm}^2$$

Thus, the area of the sector is $\frac{132}{7} \text{ cm}^2$.

💡 Quick Tip

The area of the sector depends directly on both the radius and the angle subtended by the sector. Larger angles or larger radii result in a larger area of the sector.

4 The roots of the quadratic equation $x^2 - 4 = 0$ are:

- (a) 2 only
- (b) -2, 2
- (c) 4 only
- (d) -4, 4

Correct Answer: (b) -2, 2.

Solution: We can solve the equation $x^2 - 4 = 0$ by factoring:

$$x^2 - 4 = (x - 2)(x + 2) = 0$$

Setting each factor equal to 0 gives the solutions:

$$x - 2 = 0 \implies x = 2$$

$$x + 2 = 0 \implies x = -2$$

Hence, the roots are $x = -2$ and $x = 2$.

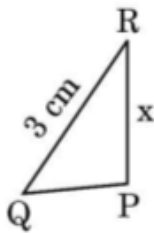
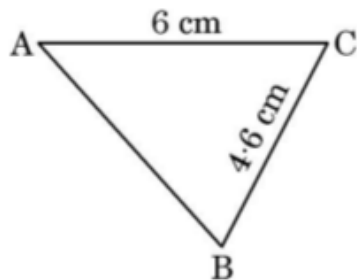
The correct answer is (b) -2, 2.

💡 Quick Tip

To solve a quadratic equation like $x^2 - a^2 = 0$, factor it as $(x - a)(x + a) = 0$ and solve for x .

5. In the given figure, if $\triangle ABC \sim \triangle QPR$, then the value of x is:





- (a) 5.3 cm
- (b) 4.6 cm
- (c) 2.3 cm
- (d) 4 cm

Correct Answer: (c) 2.3 cm.

Solution: By the property of similar triangles, corresponding sides are proportional:

$$\frac{AB}{QP} = \frac{BC}{PR} = \frac{AC}{QR}.$$

From the figure:

$$\frac{AB}{QP} = \frac{8}{6} = \frac{x}{4}.$$

Cross-multiplying:

$$6x = 8 \times 4 \implies 6x = 32 \implies x = \frac{32}{6} = 2.3 \text{ cm}.$$

💡 Quick Tip

In similar triangles, the ratio of corresponding sides remains the same. Use this property to find unknown sides.

6. A fair die is thrown once. The probability of getting a composite number less than 5 is:

- (a) $\frac{1}{3}$
- (b) $\frac{2}{3}$
- (c) 0
- (d) $\frac{1}{6}$

Correct Answer: (d) $\frac{1}{6}$.

Solution:

A fair die has six faces with the numbers 1, 2, 3, 4, 5, and 6. To find the probability of getting a composite number less than 5, we first identify the composite numbers in this range.



The composite numbers less than 5 are:

$$\text{Composite numbers} = 4$$

The total number of possible outcomes when a die is thrown is 6 (the faces of the die). The number of favorable outcomes (composite numbers less than 5) is 1, as only 4 is composite in this range.

Thus, the probability is given by:

$$\text{Probability} = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}} = \frac{1}{6}$$

Hence, the correct answer is $\frac{1}{6}$.

💡 Quick Tip

A composite number is a positive integer that has more than two positive divisors. For this question, we only need to consider numbers less than 5, and 4 is the only composite number in this range.

7. What should be added to the polynomial $x^2 - 5x + 4$, so that 3 is a zero of the resulting polynomial?

- (a) 1
- (b) 2
- (c) 4
- (d) 5

Correct Answer: (b) 2.

Solution:

We are given the polynomial:

$$P(x) = x^2 - 5x + 4$$

We need to find the value to be added to this polynomial so that 3 becomes a zero of the resulting polynomial.

A zero of a polynomial is a value of x that satisfies the equation $P(x) = 0$. To find what needs to be added, we substitute $x = 3$ into the polynomial $P(x)$ and solve for the constant that should be added.

Substituting $x = 3$:

$$P(3) = (3)^2 - 5(3) + 4$$

$$P(3) = 9 - 15 + 4 = -2$$

To make 3 a zero of the polynomial, we need to add 2 to the result:

$$P(3) + 2 = -2 + 2 = 0$$

Thus, we need to add 2 to the polynomial $x^2 - 5x + 4$ for 3 to become a zero.

Therefore, the correct answer is (b) 2.



💡 Quick Tip

To make a specific value a zero of the polynomial, substitute that value into the polynomial and find the constant to be added to make the result zero.

8. A tangent to a circle is a line that touches the circle at:

- (a) one point only
- (b) two points
- (c) three points
- (d) infinite number of points

Correct Answer: (a) one point only.

Solution: A tangent to a circle intersects the circle at exactly one point. This property defines a tangent line. Unlike secants, which intersect the circle at two points, a tangent never enters the circle's interior and thus touches it at only one point.

💡 Quick Tip

Always remember that a tangent touches the circle at exactly one point and is perpendicular to the radius at the point of contact.

9. The distance between the points $(2, -1)$ and $(-1, -5)$ is:

- (a) 15 units
- (b) 5 units
- (c) 25 units
- (d) 41 units

Correct Answer: (b) 5 units.

Solution: The distance between two points (x_1, y_1) and (x_2, y_2) is given by the formula:

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

Substituting the given points $(2, -1)$ and $(-1, -5)$:

$$\begin{aligned}\text{Distance} &= \sqrt{((-1) - 2)^2 + ((-5) - (-1))^2} \\ &= \sqrt{(-3)^2 + (-4)^2} = \sqrt{9 + 16} = \sqrt{25} = 5\end{aligned}$$

Hence, the correct answer is (b) 5 units.



💡 Quick Tip

Use the distance formula to find the distance between two points. Plug in the coordinates and calculate the square root of the sum of squared differences.

10. If $1080 = 2^x \times 3^y \times 5^z$, then $(x - y)$ is equal to:

- (a) 6
- (b) -1
- (c) 1
- (d) 0

Correct Answer: (b) -1 .

Solution: Prime factorize 1080:

$$1080 = 2^3 \times 3^3 \times 5^1$$

Thus:

$$x = 3, y = 3, z = 1$$

$$x - y = 3 - 3 = 0$$

Hence, the correct answer is (d) 0.

💡 Quick Tip

Prime factorize the number and equate powers to solve for x , y , and z .

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

- (a) $(x - 2)^2 + 1 = 2x - 3$
- (b) $(2x - 1)(x - 3) = (x + 5)(x - 1)$
- (c) $x(x + 1) + 8 = (x + 2)(x - 2)$
- (d) $2x + \frac{3}{x} = 5$

Correct Answer: (c) $x(x + 1) + 8 = (x + 2)(x - 2)$.

Solution: Let's analyze each option:

- (a) $(x - 2)^2 + 1 = 2x - 3$: This simplifies to a quadratic equation.
- (b) $(2x - 1)(x - 3) = (x + 5)(x - 1)$: This simplifies to a quadratic equation.
- (c) $x(x + 1) + 8 = (x + 2)(x - 2)$: This simplifies to a linear equation, $x = -12$.
- (d) $2x + \frac{3}{x} = 5$: This is not a quadratic equation because it involves a rational expression where x appears in the denominator.

Hence, the correct answer is (c) $x(x + 1) + 8 = (x + 2)(x - 2)$.



💡 Quick Tip

A quadratic equation has the form $ax^2 + bx + c = 0$. Any equation involving a denominator or simplifying to a linear equation is not quadratic.

12. The number of quadratic polynomials having zeroes -1 and 3 is:

- (a) 1
- (b) 2
- (c) 3
- (d) more than 3

Correct Answer: (d) more than 3.

Solution: The general form of a quadratic polynomial with roots α and β is:

$$a(x - \alpha)(x - \beta)$$

Given that the roots are $\alpha = -1$ and $\beta = 3$, the quadratic polynomial is:

$$a(x + 1)(x - 3)$$

Expanding the expression:

$$a(x^2 - 2x - 3)$$

Thus, the quadratic polynomial is:

$$a(x^2 - 2x - 3)$$

where a can be any non-zero constant. Therefore, there are infinitely many quadratic polynomials with these roots, as a can take any value. Hence, the correct answer is (d) more than 3.

💡 Quick Tip

The number of quadratic polynomials with given roots is infinite, as the constant a can take any non-zero value.

13. The following distribution gives the daily income of 50 workers of a factory:

Income (in RS)	Number of workers
400 - 424	12
425 - 449	14
450 - 474	8
475 - 499	6
500 - 524	10

The lower limit of the modal class is:



- (a) 425
- (b) 449
- (c) 424.5
- (d) 425.5

Correct Answer: (c) 424.5.

Solution: The modal class is the class with the highest frequency. Here, the highest frequency is 14, which corresponds to the income class 425 – 449. The lower limit of the modal class is 424.5.

Hence, the correct answer is (c) 424.5.

💡 Quick Tip

The modal class is the class with the highest frequency. Identify it, and the lower limit will be the starting value of that class minus 0.5.

14 The common difference of an A.P., if $a_{23} - a_{19} = 32$, is:

- (a) 8
- (b) – 8
- (c) – 4
- (d) 4

Correct Answer: (a) 8.

Solution: In an arithmetic progression, the n -th term is given by:

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

Given $a_{23} - a_{19} = 32$, we have:

$$[a + (23 - 1)d] - [a + (19 - 1)d] = 32$$

$$[a + 22d] - [a + 18d] = 32$$

$$22d - 18d = 32$$

$$4d = 32 \implies d = 8$$

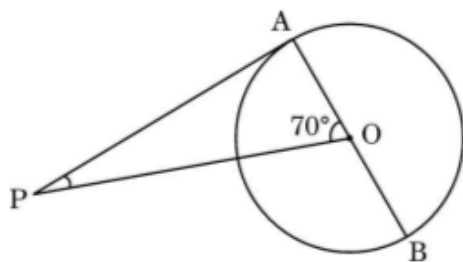
Hence, the correct answer is (a) 8.

💡 Quick Tip

To find the common difference d , subtract the terms of the A.P. and solve for d .



15. In the given figure, PA is a tangent from an external point P to a circle with centre O . If $\angle AOP = 70^\circ$, then the measure of $\angle APO$ is:



- (a) 70°
- (b) 90°
- (c) 110°
- (d) 20°

Correct Answer: (d) 20° .

Solution: The angle between the radius of a circle and a tangent at the point of contact is always 90° . Therefore,

$$\angle OAP = 90^\circ.$$

In $\triangle OAP$, the sum of the angles is 180° :

$$\angle OAP + \angle AOP + \angle APO = 180^\circ.$$

Substituting the known values:

$$90^\circ + 70^\circ + \angle APO = 180^\circ,$$

$$160^\circ + \angle APO = 180^\circ,$$

$$\angle APO = 180^\circ - 160^\circ = 20^\circ.$$

Hence, the correct answer is (d) 20° .

💡 Quick Tip

Remember that the angle between a tangent and the radius at the point of contact is always 90° . Use the angle sum property of a triangle to solve such problems.

16. If $5 \tan A = 3$, then the value of $\cot A$ is:

- (a) $\frac{3}{5}$
- (b) $\frac{5}{3}$
- (c) $\frac{4}{5}$
- (d) $\frac{4}{3}$

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

Solution:

We are given that:

$$5 \tan A = 3$$

This implies:

$$\tan A = \frac{3}{5}$$

Now, we know that:

$$\cot A = \frac{1}{\tan A}$$

Substituting the value of $\tan A$ from above:

$$\cot A = \frac{1}{\frac{3}{5}} = \frac{5}{3}$$

Thus, the value of $\cot A$ is $\frac{5}{3}$.

Therefore, the correct answer is (b) $\frac{5}{3}$.

💡 Quick Tip

Remember, $\cot A = \frac{1}{\tan A}$, so you can easily find $\cot A$ by taking the reciprocal of $\tan A$.

17. The midpoint of the line segment joining the points $(-6, -4)$ and $(0, 4)$ is:

- (a) $(-6, 0)$
- (b) $(-3, 0)$
- (c) $(-6, 8)$
- (d) $(-6, 4)$

Correct Answer: (b) $(-3, 0)$.

Solution:

The formula for the midpoint M of a line segment joining two points (x_1, y_1) and (x_2, y_2) is:

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

Substitute the given points $(-6, -4)$ and $(0, 4)$:

$$M = \left(\frac{-6 + 0}{2}, \frac{-4 + 4}{2} \right) = \left(\frac{-6}{2}, \frac{0}{2} \right) = (-3, 0)$$

Thus, the midpoint is $(-3, 0)$.

💡 Quick Tip

To find the midpoint, simply average the x-coordinates and y-coordinates of the two points.



18. The mode and mean of a data are 7 and 8 respectively. Then, the median of the data is:

- (a) $\frac{23}{3}$
- (b) $\frac{13}{3}$
- (c) $\frac{1}{13}$
- (d) 33

Correct Answer: (a) $\frac{23}{3}$.

Solution:

For a set of data, the relationship between the mode, mean, and median is given by the empirical relationship:

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

Substitute the given values for the mean and mode:

$$\text{Median} = \frac{3 \times 8 - 7}{2} = \frac{24 - 7}{2} = \frac{17}{2} = \frac{23}{3}$$

Thus, the median of the data is $\frac{23}{3}$.

💡 Quick Tip

The empirical relationship between the mode, mean, and median helps in estimating the median when the mode and mean are known.

19. Two statements are given below. They are Assertion (A) and Reason (R). Read both statements and choose the correct option:

Assertion (A): The pair of linear equations $5x + 2y + 6 = 0$ and $7x + 6y + 18 = 0$ have infinitely many solutions.

Reason (R): The condition for infinitely many solutions is:

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}.$$

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A).
- (B) Both (A) and (R) are correct, but (R) is not the correct explanation of (A).
- (C) (A) is true, but (R) is wrong.
- (D) (A) is wrong, but (R) is true.

Correct Answer: (D) Assertion (A) is false, but Reason (R) is true.

Solution: For the given equations: - $a_1 = 5$, $b_1 = 2$, $c_1 = 6$, - $a_2 = 7$, $b_2 = 6$, $c_2 = 18$.

Calculate ratios:

$$\frac{a_1}{a_2} = \frac{5}{7}, \quad \frac{b_1}{b_2} = \frac{2}{6} = \frac{1}{3}, \quad \frac{c_1}{c_2} = \frac{6}{18} = \frac{1}{3}.$$

Since $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$, the condition for infinitely many solutions is not satisfied. Hence, Assertion (A) is false.



However, Reason (R) correctly states the condition for infinitely many solutions. Therefore, Reason (R) is true.

💡 Quick Tip

For a pair of linear equations to have infinitely many solutions, the ratios of coefficients must satisfy:

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}.$$

20. Two statements are given below. They are Assertion (A) and Reason (R). Read both statements and choose the correct option:

Assertion (A): The probability of getting number 8 on rolling a die is zero (0)

Reason (R): The probability of an impossible event is zero (0).

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A).
- (B) Both (A) and (R) are correct, but (R) is not the correct explanation of (A).
- (C) (A) is true, but (R) is wrong.
- (D) (A) is wrong, but (R) is true.

Correct Answer: (A) Both Assertion and Reason are true, and Reason explains Assertion.

Solution: A standard die has numbers from 1 to 6. Since 8 is not on the die, it is an impossible event, so:

$$P(8) = 0.$$

By definition, the probability of an impossible event is zero. Hence, both the Assertion and Reason are correct, and Reason explains the Assertion.

💡 Quick Tip

The probability of any event outside the possible outcomes is always zero.

Section - B

Q. Nos. 21 to 25 are very short answer questions. This section comprises Very Short Answer (VSA) type questions of 2 marks each.

21. Evaluate:

$$5 \sin^2 60^\circ + 3 \cos^2 30^\circ - \sec^2 45^\circ$$



Solution:

We will evaluate the trigonometric functions separately and substitute their values:

$$\begin{aligned} - \sin 60^\circ &= \frac{\sqrt{3}}{2}, \text{ so } \sin^2 60^\circ = \left(\frac{\sqrt{3}}{2}\right)^2 = \frac{3}{4}. & - \cos 30^\circ &= \frac{\sqrt{3}}{2}, \text{ so } \cos^2 30^\circ = \left(\frac{\sqrt{3}}{2}\right)^2 = \frac{3}{4}. \\ \sec 45^\circ &= \frac{1}{\cos 45^\circ} = \frac{1}{\frac{\sqrt{2}}{2}} = \sqrt{2}, \text{ so } \sec^2 45^\circ = (\sqrt{2})^2 = 2. \end{aligned}$$

Now substitute these values into the expression:

$$5 \left(\frac{3}{4}\right) + 3 \left(\frac{3}{4}\right) - 2 = \frac{15}{4} + \frac{9}{4} - 2$$

Simplifying:

$$\frac{15}{4} + \frac{9}{4} - 2 = \frac{24}{4} - 2 = 6 - 2 = 4$$

Thus, the value of the expression is 4.

💡 Quick Tip

When evaluating trigonometric expressions, substitute the known values of trigonometric functions and simplify step-by-step.

22(a). If a, b are the zeroes of the polynomial $8x^2 + 14x + 3$, find the value of $\frac{1}{a} + \frac{1}{b}$.

Solution: The given polynomial is $8x^2 + 14x + 3$. For a quadratic polynomial $ax^2 + bx + c$, the sum and product of roots are:

$$a + b = -\frac{b}{a}, \quad ab = \frac{c}{a}.$$

Here:

$$a + b = -\frac{14}{8} = -\frac{7}{4}, \quad ab = \frac{3}{8}.$$

We need to find $\frac{1}{a} + \frac{1}{b}$:

$$\frac{1}{a} + \frac{1}{b} = \frac{a + b}{ab}.$$

Substitute the values:

$$\frac{1}{a} + \frac{1}{b} = \frac{-\frac{7}{4}}{\frac{3}{8}}.$$

Simplify:

$$\frac{1}{a} + \frac{1}{b} = -\frac{7}{4} \times \frac{8}{3} = -\frac{56}{12} = -\frac{14}{3}.$$

💡 Quick Tip

For a quadratic equation, you can use the relationships $a + b = -\frac{b}{a}$ and $ab = \frac{c}{a}$ to calculate expressions involving the roots.

OR



22(b). Find a quadratic polynomial whose zeroes are -9 and 6 .

Solution: A quadratic polynomial with roots α and β is given by:

$$f(x) = k(x - \alpha)(x - \beta).$$

Here, $\alpha = -9$ and $\beta = 6$:

$$f(x) = k(x + 9)(x - 6).$$

Simplify:

$$f(x) = k(x^2 - 6x + 9x - 54).$$

$$f(x) = k(x^2 + 3x - 54).$$

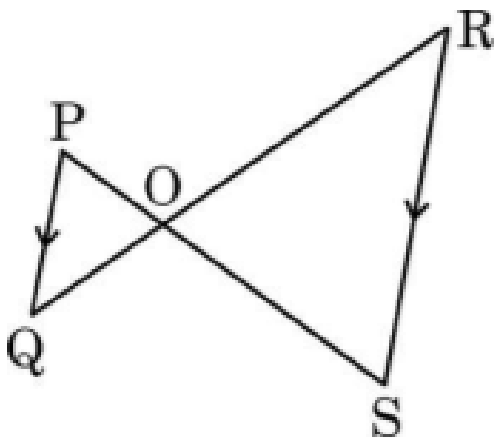
For $k = 1$, the polynomial becomes:

$$f(x) = x^2 + 3x - 54.$$

💡 Quick Tip

If the roots of a quadratic equation are given, the polynomial can be written as $k(x - \alpha)(x - \beta)$, where k is any constant.

23(a). In the given figure, $PQ \parallel RS$. Prove that $OP \times OR = OQ \times OS$.



Solution: Since $PQ \parallel RS$, the line OS acts as a transversal. Therefore:

$$\angle OPS = \angle ORS \quad (\text{Corresponding angles})$$

and

$$\angle OQS = \angle OSP \quad (\text{Corresponding angles}).$$

In $\triangle OPS$ and $\triangle ORS$, using the property of similar triangles:

$$\frac{OP}{OQ} = \frac{OR}{OS}.$$

Cross-multiplying the above gives:

$$OP \times OS = OQ \times OR.$$

Thus, the relation $OP \times OR = OQ \times OS$ is proved.

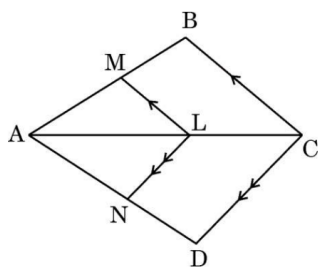
💡 Quick Tip

In similar triangles, corresponding sides are proportional. Use this property to prove relationships involving products of segments.

OR

23(b). In the given figure, $LM \parallel CB$ and $LN \parallel CD$. Prove that:

$$\frac{AM}{AN} = \frac{AB}{AD}.$$



Solution: - Given: $LM \parallel CB$ and $LN \parallel CD$. - To prove: $\frac{AM}{AN} = \frac{AB}{AD}$.

Proof: - Since $LM \parallel CB$, by the Basic Proportionality Theorem (Thales' Theorem), in $\triangle ABC$, the line LM divides AB and AC proportionally:

$$\frac{AM}{AB} = \frac{AL}{AC}. \quad (1)$$

- Similarly, since $LN \parallel CD$, in $\triangle ABD$, the line LN divides AB and AD proportionally:

$$\frac{AM}{AN} = \frac{AL}{AD}. \quad (2)$$

Thus, the required relation is:

$$\frac{AM}{AN} = \frac{AB}{AD}.$$

💡 Quick Tip

The Basic Proportionality Theorem states that if a line is drawn parallel to one side of a triangle, it divides the other two sides in the same ratio.

24. Given that $\text{HCF}(306, 1314) = 18$, find $\text{LCM}(306, 1314)$.

Solution: Using the relationship:

$$\text{HCF} \times \text{LCM} = \text{Product of the numbers}.$$

Substitute the values:

$$18 \times \text{LCM} = 306 \times 1314.$$



$$\text{LCM} = \frac{306 \times 1314}{18} = \frac{402084}{18} = 22338.$$

💡 Quick Tip

Use the HCF-LCM relationship for quick calculations. Always verify by rechecking the product.

25. Prove that $XY \parallel PQ$, where XY and PQ are tangents drawn at the endpoints of the diameter AB of a circle.

Solution: - Tangents to a circle are perpendicular to the radius at the point of contact.

Thus:

$$\angle OAX = 90^\circ \quad \text{and} \quad \angle OBP = 90^\circ,$$

where O is the center of the circle.

Since these angles are equal, the tangents XY and PQ are parallel:

$$XY \parallel PQ.$$

💡 Quick Tip

Tangents at the ends of a diameter are always parallel.

Section - C

Q. Nos. 26 to 31 are short answer questions. This section comprises Short Answer (SA) type questions of 3 marks each

26. Prove that $2 + 5\sqrt{3}$ is an irrational number, if it is given that $\sqrt{3}$ is irrational.

Solution:

Assume, for the sake of contradiction, that $2 + 5\sqrt{3}$ is a rational number. This means that $2 + 5\sqrt{3} = \frac{p}{q}$, where p and q are integers, and $q \neq 0$.

Now, subtract 2 from both sides:

$$5\sqrt{3} = \frac{p}{q} - 2$$

Simplify the right-hand side:

$$5\sqrt{3} = \frac{p - 2q}{q}$$

Now, divide both sides by 5:

$$\sqrt{3} = \frac{p - 2q}{5q}$$

The right-hand side is a ratio of two integers, which means that $\sqrt{3}$ is a rational number. However, we are given that $\sqrt{3}$ is irrational. This is a contradiction.

Since our assumption that $2 + 5\sqrt{3}$ is rational leads to a contradiction, we conclude that $2 + 5\sqrt{3}$ must be irrational.



💡 Quick Tip

To prove that a number is irrational, assume it is rational and show that this leads to a contradiction.

27(a). Using the quadratic formula, find the real roots of the equation $2x^2 + 2x + 9 = 0$, if they exist.

Solution: The general form of a quadratic equation is:

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

Here, $a = 2, b = 2, c = 9$. The quadratic formula is:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Substitute the values:

$$x = \frac{-2 \pm \sqrt{(2)^2 - 4(2)(9)}}{2(2)}.$$

$$x = \frac{-2 \pm \sqrt{4 - 72}}{4}.$$

$$x = \frac{-2 \pm \sqrt{-68}}{4}.$$

Since the discriminant $b^2 - 4ac = -68 < 0$, the roots are not real.

💡 Quick Tip

If the discriminant $(b^2 - 4ac) < 0$, the quadratic equation has no real roots.

27(b). Find the values of k for which the quadratic equation $kx^2 - 2kx + 6 = 0$ has real and equal roots. Also, find the roots.

Solution: For a quadratic equation $ax^2 + bx + c = 0$, the condition for real and equal roots is:

$$b^2 - 4ac = 0 \quad (\text{Discriminant is zero}).$$

The given equation is:

$$kx^2 - 2kx + 6 = 0.$$

Here:

$$a = k, b = -2k, c = 6.$$

Substitute into the discriminant condition:

$$b^2 - 4ac = 0.$$

$$(-2k)^2 - 4(k)(6) = 0.$$



Simplify:

$$4k^2 - 24k = 0.$$

Factorize:

$$4k(k - 6) = 0.$$

Solve for k :

$$k = 0 \quad \text{or} \quad k = 6.$$

Since $k = 0$ would make the equation non-quadratic, we discard $k = 0$. Thus, $k = 6$.

Finding the roots: Substitute $k = 6$ into the quadratic equation:

$$6x^2 - 2(6)x + 6 = 0.$$

Simplify:

$$6x^2 - 12x + 6 = 0.$$

Divide through by 6:

$$x^2 - 2x + 1 = 0.$$

Factorize:

$$(x - 1)(x - 1) = 0.$$

Thus, the roots are:

$$x = 1, 1.$$

Final Answer: The value of k is 6, and the roots of the equation are $x = 1$ and $x = 1$ (real and equal roots).

💡 Quick Tip

For real and equal roots, always use the discriminant condition $b^2 - 4ac = 0$ to find the value of parameters in a quadratic equation.

28. Prove that:

$$\frac{1 + \sec \theta}{\sec \theta} = \frac{\sin^2 \theta}{1 - \cos \theta}$$

Solution:

We start with the left-hand side (LHS) of the equation:

$$\text{LHS} = \frac{1 + \sec \theta}{\sec \theta}$$

Using the identity $\sec \theta = \frac{1}{\cos \theta}$, we can rewrite this as:

$$= \frac{1 + \frac{1}{\cos \theta}}{\frac{1}{\cos \theta}} = \frac{\cos \theta + 1}{1}$$

Thus, we have:

$$\text{LHS} = \cos \theta + 1$$



Next, we simplify the right-hand side (RHS). We need to show that it is equivalent to the LHS:

$$\text{RHS} = \frac{\sin^2 \theta}{1 - \cos \theta}$$

Using the Pythagorean identity $\sin^2 \theta = 1 - \cos^2 \theta$, we can substitute $\sin^2 \theta$ into the expression:

$$\text{RHS} = \frac{1 - \cos^2 \theta}{1 - \cos \theta}$$

Now, factor the numerator:

$$\text{RHS} = \frac{(1 - \cos \theta)(1 + \cos \theta)}{1 - \cos \theta}$$

The $(1 - \cos \theta)$ terms cancel out:

$$\text{RHS} = 1 + \cos \theta$$

Thus, we see that:

$$\text{LHS} = \text{RHS}$$

Therefore, we have proven the given identity.

 Quick Tip

Remember the identity $\sin^2 \theta + \cos^2 \theta = 1$ when simplifying trigonometric expressions.

29. From a well-shuffled deck of 52 playing cards, all black queens and red kings are removed. One card is selected at random from the remaining cards. Find the probability that the selected card is :

- (i) a red king,
- (ii) not a black card,
- (iii) an ace of hearts.

Solution: The total number of cards in a deck is 52.

(i) Probability of a red king: There are 2 red kings (one in hearts and one in diamonds):

$$P(\text{red king}) = \frac{2}{52} = \frac{1}{26}.$$

(ii) Probability of not a black card: There are 26 red cards (hearts and diamonds):

$$P(\text{not a black card}) = \frac{26}{52} = \frac{1}{2}.$$

(iii) Probability of an ace of hearts: There is only 1 ace of hearts:

$$P(\text{ace of hearts}) = \frac{1}{52}.$$

 Quick Tip

For probability, use the formula $P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}}$.



30. A chord of a circle of radius 10 cm subtends a right angle at the centre of the circle. Find the area of the corresponding (i) minor sector, (ii) major sector. (Use $\pi = 3.14$).

Solution: Given: Radius $r = 10$ cm and the angle subtended at the centre $\theta = 90^\circ$.

The area of a sector is given by:

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

(i) Area of the minor sector:

$$\text{Area} = \frac{90^\circ}{360^\circ} \times 3.14 \times (10)^2.$$

$$\text{Area} = \frac{1}{4} \times 3.14 \times 100 = 78.5 \text{ cm}^2.$$

(ii) Area of the major sector: The angle for the major sector is:

$$360^\circ - 90^\circ = 270^\circ.$$

$$\text{Area} = \frac{270^\circ}{360^\circ} \times 3.14 \times (10)^2.$$

$$\text{Area} = \frac{3}{4} \times 3.14 \times 100 = 235.5 \text{ cm}^2.$$

💡 Quick Tip

For a sector, the area is proportional to the angle θ subtended at the centre: $\text{Area} = \frac{\theta}{360^\circ} \pi r^2$.

31(a). Prove that opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle.

Solution: Let the quadrilateral circumscribing a circle be $ABCD$, and let O be the centre of the inscribed circle. - A quadrilateral circumscribing a circle is a **tangential quadrilateral**, and its opposite sides are equal in sum. - Let the tangents drawn from a point to the circle be: $AP = AS, BP = BQ, CR = CQ, DR = DS$.

By the tangent properties:

$$AB + CD = BC + DA.$$

Also, angles subtended by opposite sides at the centre O add up to 180° (supplementary angles). Thus, $\angle AOB + \angle COD = 180^\circ$ and $\angle BOC + \angle DOA = 180^\circ$.

💡 Quick Tip

In a tangential quadrilateral, opposite angles formed by the centre satisfy $\angle AOB + \angle COD = 180^\circ$.

OR



31(b). If O is the centre of a circle, PQ is a chord, and the tangent PR at P makes an angle of 40° with PQ , then find the measure of $\angle POQ$.

Solution: Given: - PR is the tangent at P . - The tangent PR makes an angle $\angle QPR = 40^\circ$ with the chord PQ . - O is the centre of the circle.

Key Concept: The angle between a tangent and a chord drawn at the point of contact is equal to the angle subtended by the chord at the centre of the circle.

Using this property:

$$\angle POQ = 2 \times \angle QPR.$$

Substitute $\angle QPR = 40^\circ$:

$$\angle POQ = 2 \times 40^\circ = 80^\circ.$$

Final Answer: The measure of $\angle POQ$ is 80° .

💡 Quick Tip

The angle between the tangent and chord at the point of contact equals the angle subtended by the chord at the centre of the circle.

Section - D

Q. Nos. 32 to 35 are long answer questions. This section comprises Long Answer (LA) type questions of 5 marks each.

32(a). If BD and QM are medians of triangles ABC and PQR , respectively, where $\triangle ABC \sim \triangle PQR$, prove that:

$$\frac{AB}{PQ} = \frac{BD}{QM}.$$

Solution: Given: $\triangle ABC \sim \triangle PQR$, and BD and QM are medians of $\triangle ABC$ and $\triangle PQR$, respectively.

Since $\triangle ABC \sim \triangle PQR$, we know that the corresponding sides are proportional:

$$\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR}.$$

In similar triangles, the medians to the corresponding sides are also proportional. Therefore:

$$\frac{BD}{QM} = \frac{AB}{PQ}.$$

Final Answer: Thus, $\frac{AB}{PQ} = \frac{BD}{QM}$ is proved.

💡 Quick Tip

In similar triangles, not only the sides but also the medians, altitudes, and angle bisectors are proportional to the corresponding sides.

OR



32(b). CD and GH are respectively the bisectors of $\angle ACB$ and $\angle EGF$, such that D and H lie on sides AB and FE of $\triangle ABC$ and $\triangle FEG$, respectively. If $\triangle ABC \sim \triangle FEG$, show that: (i) $\frac{CD}{GH} = \frac{AC}{FG}$, (ii) $\triangle DCB \sim \triangle HGE$.

Solution:

(i) **Proving** $\frac{CD}{GH} = \frac{AC}{FG}$: Since $\triangle ABC \sim \triangle FEG$, the corresponding sides are proportional:

$$\frac{AB}{FE} = \frac{AC}{FG} = \frac{BC}{EG}.$$

Angle bisectors divide the opposite sides proportionally. Therefore, the corresponding angle bisectors CD and GH will also be proportional:

$$\frac{CD}{GH} = \frac{AC}{FG}.$$

(ii) **Proving** $\triangle DCB \sim \triangle HGE$: Since $\triangle ABC \sim \triangle FEG$, we have:

$$\angle ACB = \angle EGF \quad \text{and} \quad \frac{BC}{EG} = \frac{AC}{FG}.$$

Also, CD and GH are bisectors of $\angle ACB$ and $\angle EGF$, respectively. Therefore, the corresponding triangles $\triangle DCB$ and $\triangle HGE$ are similar:

$$\triangle DCB \sim \triangle HGE.$$

Final Answer: Thus, (i) $\frac{CD}{GH} = \frac{AC}{FG}$ and (ii) $\triangle DCB \sim \triangle HGE$ are proved.

💡 Quick Tip

In similar triangles, angle bisectors and the triangles formed by them also maintain proportionality with corresponding sides.

33. (a) Two cubes each of volume 125 cm^3 are joined end to end. Find the volume and the surface area of the resulting cuboid.

Solution:

Let the side of each cube be s .

Since the volume of a cube is given by $V = s^3$, we have:

$$s^3 = 125 \quad \Rightarrow \quad s = \sqrt[3]{125} = 5 \text{ cm}.$$

Now, when two cubes are joined end to end, the resulting cuboid will have the following dimensions: - Length $L = 2s = 2 \times 5 = 10 \text{ cm}$, - Breadth $B = s = 5 \text{ cm}$, - Height $H = s = 5 \text{ cm}$. Thus, the volume V_{cuboid} of the resulting cuboid is:

$$V_{\text{cuboid}} = L \times B \times H = 10 \times 5 \times 5 = 250 \text{ cm}^3.$$

Next, the surface area A_{cuboid} of the cuboid is given by the formula:

$$A_{\text{cuboid}} = 2(LB + BH + HL).$$

Substituting the values of $L = 10 \text{ cm}$, $B = 5 \text{ cm}$, and $H = 5 \text{ cm}$:

$$A_{\text{cuboid}} = 2(10 \times 5 + 5 \times 5 + 5 \times 10) = 2(50 + 25 + 50) = 2 \times 125 = 250 \text{ cm}^2.$$



Thus, the volume of the cuboid is 250 cm^3 and the surface area is 250 cm^2 .

💡 Quick Tip

When two cubes are joined end to end, the volume is the sum of the volumes of the two cubes, and the surface area can be calculated based on the dimensions of the resulting cuboid.

OR

33. (b) A solid is in the shape of a cone surmounted on a hemisphere with both their diameters being equal to 7 cm and the height of the cone is equal to its radius. Find the volume of the solid.

Solution:

Given: - The radius of the hemisphere and cone is $r = \frac{7}{2} = 3.5 \text{ cm}$, - The height of the cone is $h = 3.5 \text{ cm}$.

We need to find the volume of the solid, which is the sum of the volumes of the hemisphere and the cone.

Volume of the hemisphere: The volume $V_{\text{hemisphere}}$ of a hemisphere is given by:

$$V_{\text{hemisphere}} = \frac{2}{3}\pi r^3.$$

Substituting $r = 3.5 \text{ cm}$:

$$V_{\text{hemisphere}} = \frac{2}{3}\pi(3.5)^3 = \frac{2}{3}\pi \times 42.875 = 28.583 \text{ cm}^3.$$

Volume of the cone: The volume V_{cone} of a cone is given by:

$$V_{\text{cone}} = \frac{1}{3}\pi r^2 h.$$

Substituting $r = 3.5 \text{ cm}$ and $h = 3.5 \text{ cm}$:

$$V_{\text{cone}} = \frac{1}{3}\pi(3.5)^2 \times 3.5 = \frac{1}{3}\pi \times 12.25 \times 3.5 = 14.4375 \text{ cm}^3.$$

Total volume of the solid: The total volume V_{total} is the sum of the volumes of the hemisphere and the cone:

$$V_{\text{total}} = V_{\text{hemisphere}} + V_{\text{cone}} = 28.583 + 14.4375 = 43.0205 \text{ cm}^3.$$

Thus, the volume of the solid is approximately 43.02 cm^3 .

💡 Quick Tip

When a cone is surmounted on a hemisphere, the total volume is the sum of the individual volumes of the cone and the hemisphere.



34. If the sum of the first 7 terms of an A.P. is 91 and that of the first 17 terms is 561, then find the sum of the first n terms and hence find the n^{th} term.

Solution:

The formula for the sum of the first n terms of an A.P. is:

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

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

From the given information, we have:

$$S_7 = 91 \quad \text{and} \quad S_{17} = 561$$

For $n = 7$:

$$S_7 = \frac{7}{2} [2a + (7 - 1)d] = 91$$

$$\frac{7}{2} [2a + 6d] = 91$$

$$7(2a + 6d) = 182$$

$$2a + 6d = 26 \quad (\text{i})$$

For $n = 17$:

$$S_{17} = \frac{17}{2} [2a + (17 - 1)d] = 561$$

$$\frac{17}{2} [2a + 16d] = 561$$

$$17(2a + 16d) = 1122$$

$$2a + 16d = 66 \quad (\text{ii})$$

Now, solve the two equations:

From equation (i): $2a + 6d = 26$

From equation (ii): $2a + 16d = 66$

Subtract equation (i) from equation (ii):

$$(2a + 16d) - (2a + 6d) = 66 - 26$$

$$10d = 40$$

$$d = 4$$

Substitute $d = 4$ into equation (i):

$$2a + 6(4) = 26$$

$$2a + 24 = 26$$

$$2a = 2$$

$$a = 1$$

Now that we have $a = 1$ and $d = 4$, we can find the sum of the first n terms:

$$S_n = \frac{n}{2} [2(1) + (n - 1)4]$$



$$S_n = \frac{n}{2} [2 + 4n - 4]$$

$$S_n = \frac{n}{2} [4n - 2]$$

$$S_n = 2n^2 - n$$

Finally, the n^{th} term of the A.P. is given by:

$$a_n = a + (n - 1)d = 1 + (n - 1)4 = 4n - 3$$

Thus, the sum of the first n terms is $2n^2 - n$, and the n^{th} term is $4n - 3$.

💡 Quick Tip

The sum of an A.P. and the n^{th} term can be derived using the standard formulas for the sum and general term of an arithmetic progression.

35. A statue, 1.6 m tall, stands on the top of a pedestal. From a point on the ground, the angle of elevation of the top of the statue is 60° and from the same point, the angle of elevation of the top of the pedestal is 45° . Find the height of the pedestal.

Solution:

Let the height of the pedestal be $AB = h$. Let the distance from the point of observation to the base of the pedestal be $AP = x$. Thus, the total distance from the point of observation to the top of the statue will be $AC = x + h + 1.6$ (since the statue height is 1.6 m).

Using the tangent formula for angle of elevation, we start with the right triangle $\triangle ABP$ and $\triangle APC$:

1. **For $\triangle ABP$ (angle 45°):**

$$\tan 45^\circ = \frac{AB}{AP} = \frac{h}{x}$$

Since $\tan 45^\circ = 1$, we have:

$$1 = \frac{h}{x} \Rightarrow h = x \quad (\text{Equation 1})$$

2. **For $\triangle APC$ (angle 60°):**

$$\tan 60^\circ = \frac{AC}{AP} = \frac{1.6 + h}{x}$$

Since $\tan 60^\circ = \sqrt{3}$, we have:

$$\sqrt{3} = \frac{1.6 + h}{x} \Rightarrow x = \frac{1.6 + h}{\sqrt{3}} \quad (\text{Equation 2})$$

Substitute Equation 1 into Equation 2:

$$x = \frac{1.6 + x}{\sqrt{3}}$$



Multiply both sides by $\sqrt{3}$:

$$\sqrt{3} \cdot x = 1.6 + x$$

$$\sqrt{3} \cdot x - x = 1.6$$

$$x(\sqrt{3} - 1) = 1.6$$

Now, solve for x :

$$x = \frac{1.6}{\sqrt{3} - 1}$$

Using the approximation $\sqrt{3} \approx 1.732$:

$$x = \frac{1.6}{1.732 - 1} = \frac{1.6}{0.732} \approx 2.1856$$

Now substitute $x = 2.1856$ back into Equation 1:

$$h = x = 2.1856$$

Thus, the height of the pedestal is approximately 2.19 m.

💡 Quick Tip

The height of the pedestal is calculated by using the tangent formula for angles of elevation and applying the results from the two right triangles formed.

Section - E

This section comprises 3 case study based questions of 4 marks each.

36. Deepankar bought 3 notebooks and 2 pens for <80 and his friend Suryansh bought 4 notebooks and 3 pens for <110 from the school bookshop.

(i) If the price of one notebook be x and the price of one pen be y , write the given situation algebraically.

Solution: The given situation can be expressed as two linear equations:

$$3x + 2y = 80, \quad 4x + 3y = 110.$$

(ii)(a) What is the price of one notebook?

Solution: We solve the equations $3x + 2y = 80$ and $4x + 3y = 110$ using elimination.

Step 1: Multiply the first equation by 3 and the second equation by 2 to align y :

$$9x + 6y = 240, \quad 8x + 6y = 220.$$

Step 2: Subtract the second equation from the first:

$$(9x + 6y) - (8x + 6y) = 240 - 220.$$

$$x = 20.$$



Final Answer: The price of one notebook is <20 .

OR

(ii)(b) What is the price of one pen?

Solution: Substitute $x = 20$ into the first equation:

$$3(20) + 2y = 80.$$

$$60 + 2y = 80.$$

$$2y = 20 \implies y = 10.$$

Final Answer: The price of one pen is <10 .

(iii) What is the total amount to be paid by Suryansh, if he purchases 6 notebooks and 3 pens?

Solution: The price of one notebook is 20 and one pen is 10. The total cost is:

$$\text{Cost} = 6x + 3y.$$

Substitute $x = 20$ and $y = 10$:

$$\text{Cost} = 6(20) + 3(10).$$

$$\text{Cost} = 120 + 30 = 150.$$

Final Answer: The total amount to be paid by Suryansh is <150 .

💡 Quick Tip

For solving linear equations, use substitution or elimination methods. Verify the solution by substituting back into the equations.

37. Mutual Fund: A mutual fund is a type of investment vehicle that pools money from multiple investors to invest in securities like stocks, bonds, or other securities. Mutual funds are operated by professional money managers, who allocate the fund's assets and attempt to produce capital gains or income for the fund's investors.

Net Asset Value (NAV) represents a fund's per share market value. It is the price at which the investors buy fund shares from a fund company and sell them to a fund company.

The following table shows the Net Asset Value (NAV) per unit of mutual fund of ICICI mutual funds:

NAV (in $<$)	Number of mutual funds
0 – 5	13
5 – 10	16
10 – 15	22
15 – 20	18
20 – 25	11



Based on the above information, answer the following questions:

(i) What is the upper limit of modal class of the data?

Solution: The modal class is the class interval with the highest frequency. From the table, the highest frequency is 22, corresponding to the class 10–15.

The upper limit of the modal class is:

$$15.$$

(ii) What is the median class of the data?

Solution: To determine the median class, calculate the total frequency:

$$13 + 16 + 22 + 18 + 11 = 80.$$

The median position is:

$$\frac{80}{2} = 40.$$

Now, calculate the cumulative frequency:

$$0-5 : 13$$

$$5-10 : 13 + 16 = 29$$

$$10-15 : 29 + 22 = 51$$

Since the cumulative frequency 51 includes the 40th position, the median class is:

$$10-15.$$

(iii)(a) What is the mode NAV of mutual funds?

Solution: The mode occurs in the modal class 10–15. Using the formula for mode:

$$\text{Mode} = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h,$$

where: - $L = 10$ (lower limit of modal class), - $f_1 = 22$ (frequency of modal class), - $f_0 = 16$ (frequency of class preceding modal class), - $f_2 = 18$ (frequency of class succeeding modal class), - $h = 5$ (class width).

Substitute the values:

$$\text{Mode} = 10 + \frac{22 - 16}{2(22) - 16 - 18} \times 5.$$

$$\text{Mode} = 10 + \frac{6}{44 - 34} \times 5.$$

$$\text{Mode} = 10 + \frac{6}{10} \times 5.$$

$$\text{Mode} = 10 + 3 = 13.$$

The mode NAV is:

$$13.$$

OR



(iii)(b) What is the median NAV of mutual funds?

Solution: The median class is 10–15. The formula for median is:

$$\text{Median} = L + \frac{\frac{N}{2} - CF}{f} \times h,$$

where: - $L = 10$ (lower limit of median class), - $N = 80$ (total frequency), - $CF = 29$ (cumulative frequency before median class), - $f = 22$ (frequency of median class), - $h = 5$ (class width).

Substitute the values:

$$\text{Median} = 10 + \frac{40 - 29}{22} \times 5.$$

$$\text{Median} = 10 + \frac{11}{22} \times 5.$$

$$\text{Median} = 10 + 2.5 = 12.5.$$

The median NAV is:

12.5.

💡 Quick Tip

The modal class has the highest frequency. Use formulas for mode and median to calculate exact values based on grouped data.

38. Resident Welfare Association (RWA) of Gulmohar Society in Delhi, have installed three electric poles A , B , and C in the society's common park. Despite these three poles, some parts of the park are still in the dark. So, RWA decides to have one more electric pole D in the park.

(i) What is the position of the pole C ?

Solution:

To find the position of the pole C , we are given that the coordinates of point C are $(5, 4)$ (as mentioned in the problem statement). The coordinates of any point on a plane represent its position relative to the origin.

Thus, the position of the pole C is given by its coordinates:

$$C(5, 4)$$

(ii) What is the distance of the pole B from the corner O of the park?

Solution:

The coordinates of pole B are $(6, 6)$ and the origin O is at $(0, 0)$. To find the distance BO , we use the distance formula:

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

Substituting the coordinates of $B(6, 6)$ and $O(0, 0)$:

$$d = \sqrt{(6 - 0)^2 + (6 - 0)^2} = \sqrt{6^2 + 6^2} = \sqrt{36 + 36} = \sqrt{72}$$



Thus, the distance BO is:

$$BO = \sqrt{72} \text{ units}$$

(iii)(a) Find the position of the fourth pole D so that the four points A, B, C , and D form a parallelogram $ABCD$.

(iii) (a) Given points: $A(2, 7)$, $B(6, 6)$, $C(5, 4)$. **Let $D(x, y)$ be the fourth point.** We are asked to find the position of point D such that $ABCD$ forms a parallelogram.

Solution: In a parallelogram, the diagonals bisect each other. Thus, the midpoint of diagonal AC must be the same as the midpoint of diagonal BD .

- Coordinates of $A(2, 7)$, $B(6, 6)$, and $C(5, 4)$ are given. - Let $D = (x, y)$ be the fourth point. First, calculate the midpoint of diagonal AC :

$$\text{Midpoint of } AC = \left(\frac{2+5}{2}, \frac{7+4}{2} \right) = \left(\frac{7}{2}, \frac{11}{2} \right) = (3.5, 5.5).$$

Now, calculate the midpoint of diagonal BD (where $B = (6, 6)$ and $D = (x, y)$):

$$\text{Midpoint of } BD = \left(\frac{6+x}{2}, \frac{6+y}{2} \right).$$

Since the midpoints of diagonals AC and BD must be the same, we equate the corresponding coordinates:

For the x-coordinate:

$$\frac{6+x}{2} = 3.5 \implies 6+x = 7 \implies x = 1.$$

For the y-coordinate:

$$\frac{6+y}{2} = 5.5 \implies 6+y = 11 \implies y = 5.$$

Thus, the position of point D is:

$$D(1, 5).$$

💡 Quick Tip

To find a missing vertex of a parallelogram, use the property that diagonals bisect each other.

OR

iii(b): Find the distance between poles A and C .

Solution: To find the distance AC , we will use the distance formula:

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

Substitute the coordinates of points $A(2, 7)$ and $C(5, 4)$ into the formula:

$$d = \sqrt{(5-2)^2 + (4-7)^2} = \sqrt{(3)^2 + (-3)^2} = \sqrt{9+9} = \sqrt{18}.$$

Thus, the distance between points A and C is:

$$AC = \sqrt{18} = 3\sqrt{2} \text{ units.}$$



💡 Quick Tip

The distance between two points (x_1, y_1) and (x_2, y_2) is given by the formula:

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