CBSE Class 10 Mathematics Standard 2026 Question Paper with Solutions

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

General Instructions

Read the following instructions very carefully and strictly follow them:

1. *This question paper hass **38** questions. **All** questions are compulsory.*
2. *This question paper contains **five** sections - Section **A, B, C, D** and **E**.*
3. ***Section A** - Questions no. **1** to **18** are Multiple Choice Type Questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each.*
4. ***Section B** - Questions no. **21** to **25** are Very-Short Answer (VSA) Type Questions, carrying 2 marks each.*
5. ***Section C** - Questions no. **26** to **31** are Short-Answer (SA) Type Questions, carrying 3 marks each.*
6. ***Section D** - Questions no. **32** to **35** are Long-Answer (LA) Type Question, carrying 5 marks each.*
7. ***Section E** - Questions no. **36** to **38** are case study based questions carrying 4 marks each. Internal choice is provided in 2 marks questions in each case study.*
8. *There is no overall choice given in the question paper. However, an internal choice has been provided in 2 questions in Sections B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.*
9. *Use of calculator is **not** allowed.*
10. *Please write down the serial number of the question in the answer-book at the given place before attempting it.*
11. *15 minute time has been allotted to read this question paper. The question paper will be distributed at 10:15 a.m. From 10:15 a.m. to 10:30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.*

1. The HCF of 960 and 432 is :
(a) 48
(b) 54
(c) 72
(d) 36

Correct Answer: (a) 48

Solution:
Step 1: Understanding the Concept:
The Highest Common Factor (HCF) is the largest positive integer that divides each of the integers without leaving a remainder.
We can find it using prime factorization or the Euclid's Division Algorithm.
Step 2: Key Formula or Approach:
Euclid's Division Lemma states: $a = bq + r$, where $0 \leq r < b$.
We repeat the division until the remainder becomes zero.
Step 3: Detailed Explanation:
Using Euclid's Division Algorithm:
1. Divide 960 by 432:

$$960 = 432 \times 2 + 96$$

2. Now, divide the previous divisor (432) by the remainder (96):

$$432 = 96 \times 4 + 48$$

3. Now, divide the previous divisor (96) by the remainder (48):

$$96 = 48 \times 2 + 0$$

Since the remainder is now 0, the last divisor is the HCF.
Therefore, $HCF(960, 432) = 48$.
Step 4: Final Answer:
The HCF of 960 and 432 is 48.

> Quick Tip
>
> For larger numbers, Euclid's Algorithm is much faster than prime factorization.
> Always continue dividing until the remainder reaches zero; the last non-zero divisor is your answer.

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2. The natural number 2 is :
(a) a prime number
(b) a composite number
(c) prime as well as composite
(d) neither prime nor composite

Correct Answer: (a) a prime number

Solution:
Step 1: Understanding the Concept:
A prime number is a natural number greater than 1 that has no positive divisors other than 1 and itself.
A composite number is a natural number greater than 1 that has more than two factors.
Step 2: Detailed Explanation:

The factors of the number 2 are 1 and 2.
Since it has exactly two distinct factors (1 and itself), it fits the definition of a prime number perfectly.
It is the only even prime number.
Step 3: Final Answer:
The number 2 is a prime number.

> 💡 Quick Tip
>
> Remember that 2 is the smallest prime number and the **only** even prime number.
> The number 1 is neither prime nor composite.

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3. For any natural number n, 6^n ends with the digit :
(a) 0
(b) 6
(c) 3
(d) 2

Correct Answer: (b) 6

Solution:
Step 1: Understanding the Concept:
We need to determine the last digit (unit's digit) of 6^n for various values of n.
Step 2: Detailed Explanation:
Let's calculate the powers of 6 for the first few natural numbers:
For $n = 1$, $6^1 = 6$
For $n = 2$, $6^2 = 36$
For $n = 3$, $6^3 = 216$
For $n = 4$, $6^4 = 1296$
Notice that in every case, the unit's digit is 6.
When we multiply any number ending in 6 by 6, the resulting product will also end in 6 because $6 \times 6 = 36$.
Step 3: Final Answer:
For any natural number n, the unit's digit of 6^n is always 6.

> 💡 Quick Tip
>
> Numbers with base digits 0, 1, 5, or 6 always end with the same digit when raised to any positive integer power.
> For example, 5^n always ends in 5, and 6^n always ends in 6.

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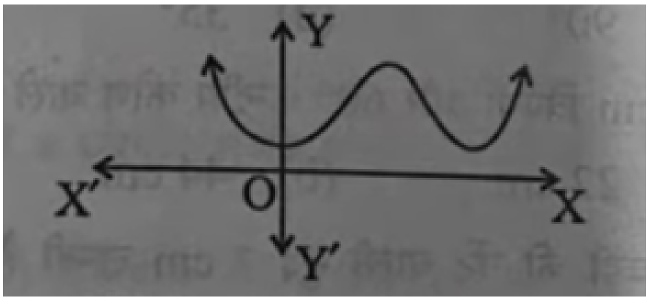
4. The graph of $y = f(x)$ is given. The number of zeroes of $f(x)$ is :



(a) 0
(b) 1
(c) 2
(d) 3

Correct Answer: (d) 3

Solution:
Step 1: Understanding the Concept:
The "zeroes" of a function $y = f(x)$ are the values of x for which the function's value becomes zero.
Graphically, these correspond to the points where the curve intersects or touches the x-axis.
Step 2: Detailed Explanation:
Observe the provided graph:
1. The curve crosses the x-axis on the left side of the origin.
2. The curve passes through the origin O.
3. The curve crosses the x-axis again on the right side of the origin.
Total points of intersection with the x-axis = 3.
Step 3: Final Answer:
The number of zeroes of $f(x)$ is 3.

Quick Tip

To find the number of zeroes, simply count how many times the graph crosses or touches the horizontal x-axis.
Do not count intersections with the vertical y-axis.

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5. If a pair of linear equations in two variables is represented by two coincident lines, then the pair of equations has :
(a) a unique solution
(b) two solutions
(c) no solution
(d) an infinite number of solutions

Correct Answer: (d) an infinite number of solutions

Solution:
Step 1: Understanding the Concept:

A solution to a pair of linear equations is a point that lies on both lines representing the equations.

Step 2: Detailed Explanation:

Coincident lines are lines that lie exactly on top of each other.

Since every point on one line is also on the other line, there are infinitely many points that satisfy both equations.

This happens when the equations are proportional, satisfying:

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

Step 3: Final Answer:

Coincident lines represent a consistent system with an infinite number of solutions.

> Quick Tip
>
> - Intersecting lines: Unique solution.
> - Parallel lines: No solution.
> - Coincident lines: Infinite solutions.

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6. The common difference of the AP : $\sqrt{2}, 2\sqrt{2}, 3\sqrt{2}, 4\sqrt{2}, \ldots$ is :

(a) $\sqrt{2}$

(b) 1

(c) $2\sqrt{2}$

(d) $-\sqrt{2}$

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

Solution:

Step 1: Understanding the Concept:

In an Arithmetic Progression (AP), the common difference (d) is the difference between any term and its preceding term.

Step 2: Key Formula or Approach:

$$d = a_n - a_{n-1}$$

Step 3: Detailed Explanation:

Given terms: $a_1 = \sqrt{2}$, $a_2 = 2\sqrt{2}$, $a_3 = 3\sqrt{2}$.

Calculate the difference:

$$d = a_2 - a_1 = 2\sqrt{2} - \sqrt{2}$$

$$d = \sqrt{2}(2 - 1) = \sqrt{2}$$

Check for next terms:

$$d = a_3 - a_2 = 3\sqrt{2} - 2\sqrt{2} = \sqrt{2}$$

The difference is constant.
Step 4: Final Answer:
The common difference is $\sqrt{2}$.

> 💡 Quick Tip
>
> When dealing with radicals in AP, treat the square root as a variable (like x).
> $x, 2x, 3x, \ldots$ clearly has a difference of x.

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7. If $\triangle ABC$ and $\triangle DEF$ are similar such that $2AB = DE$ and $BC = 8$ cm, then EF is equal to :
(a) 4 cm
(b) 8 cm
(c) 12 cm
(d) 16 cm

Correct Answer: (d) 16 cm

Solution:
Step 1: Understanding the Concept:
In similar triangles, the ratios of the lengths of corresponding sides are equal.
Step 2: Key Formula or Approach:
Since $\triangle ABC \sim \triangle DEF$:

$$\frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF}$$

Step 3: Detailed Explanation:
We are given $2AB = DE$. This can be written as:

$$\frac{AB}{DE} = \frac{1}{2}$$

We are also given $BC = 8$ cm.
Using the side ratio property:

$$\frac{AB}{DE} = \frac{BC}{EF}$$

$$\frac{1}{2} = \frac{8}{EF}$$

By cross-multiplication:

$$EF = 2 \times 8 = 16 \text{ cm}$$

Step 4: Final Answer:
The length of EF is 16 cm.

Quick Tip

Always identify which side corresponds to which. For $\triangle ABC \sim \triangle DEF$, AB matches DE, and BC matches EF.
If one side of the second triangle is double the first, all sides follow the same scale factor.

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8. The mid-point of the line segment joining the points (5, -4) and (6, 4) lies on :
(a) x-axis
(b) y-axis
(c) origin
(d) neither x-axis nor y-axis

Correct Answer: (a) x-axis

Solution:
Step 1: Understanding the Concept:
The coordinates of the mid-point of a line segment connecting two points (x_1, y_1) and (x_2, y_2) are found using the midpoint formula.
Step 2: Key Formula or Approach:
Mid-point $M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
Step 3: Detailed Explanation:
Given points: $(5, -4)$ and $(6, 4)$.
Let $x_1 = 5, y_1 = -4$ and $x_2 = 6, y_2 = 4$.

$$x\text{-coordinate} = \frac{5+6}{2} = \frac{11}{2} = 5.5$$

$$y\text{-coordinate} = \frac{-4+4}{2} = \frac{0}{2} = 0$$

The mid-point is $(5.5, 0)$.
Any point with a y-coordinate of zero lies on the x-axis.
Step 4: Final Answer:
The mid-point lies on the x-axis.

Quick Tip

If the y-coordinates are additive inverses (like -4 and 4), their sum is 0, so the mid-point will always lie on the x-axis.
Similarly, if x-coordinates sum to 0, it lies on the y-axis.

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9. Given that $\sin\theta = \frac{a}{b}$, then $\cos\theta$ is equal to :
(a) $\frac{b}{\sqrt{b^2-a^2}}$
(b) $\frac{b}{a}$

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

Correct Answer: (c) $\frac{\sqrt{b^2-a^2}}{b}$

Solution:
Step 1: Understanding the Concept:
Trigonometric identities connect different ratios of the same angle. The fundamental identity is $\sin^2\theta + \cos^2\theta = 1$.
Step 2: Key Formula or Approach:

$$\cos\theta = \sqrt{1 - \sin^2\theta}$$

Step 3: Detailed Explanation:
Given $\sin\theta = \frac{a}{b}$.
Substitute into the identity:

$$\cos^2\theta = 1 - \left(\frac{a}{b}\right)^2$$

$$\cos^2\theta = 1 - \frac{a^2}{b^2}$$

$$\cos^2\theta = \frac{b^2 - a^2}{b^2}$$

Taking the square root:

$$\cos\theta = \frac{\sqrt{b^2 - a^2}}{\sqrt{b^2}} = \frac{\sqrt{b^2 - a^2}}{b}$$

Step 4: Final Answer:
$\cos\theta = \frac{\sqrt{b^2-a^2}}{b}$.

> Quick Tip
>
> Think of a right triangle where Opposite = a and Hypotenuse = b.
> Using Pythagoras: Base = $\sqrt{b^2 - a^2}$.
> Since $\cos\theta = \frac{\text{Base}}{\text{Hypotenuse}}$, the result is $\frac{\sqrt{b^2-a^2}}{b}$.

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10. If $\cos A = \frac{1}{2}$, then the value of $\sin^2 A + 2\cos^2 A$ is :
(a) $\frac{3}{2}$
(b) $\frac{5}{4}$
(c) -1
(d) $\frac{1}{2}$

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

Solution:
Step 1: Understanding the Concept:
We need to evaluate an expression using given trigonometric values. We can either use identities or find the angle.
Step 2: Key Formula or Approach:
We know $\sin^2 A = 1 - \cos^2 A$.
Step 3: Detailed Explanation:
Substitute $\sin^2 A = 1 - \cos^2 A$ into the expression:

$$\sin^2 A + 2\cos^2 A = (1 - \cos^2 A) + 2\cos^2 A$$

$$= 1 + \cos^2 A$$

Given $\cos A = \frac{1}{2}$.

$$\cos^2 A = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

Substituting this value:

$$\text{Value} = 1 + \frac{1}{4} = \frac{5}{4}$$

Step 4: Final Answer:
The value is $\frac{5}{4}$.

Quick Tip

Always simplify the expression using identities first. Replacing $\sin^2 A$ with $1 - \cos^2 A$ reduced the number of substitutions needed.

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11. A car is moving away from the base of a 30 m high tower. The angle of elevation of the top of the tower from the car at an instant, when the car is $10\sqrt{3}$ m away from the base of the tower, is :
(a) 30°
(b) 45°
(c) 90°
(d) 60°

Correct Answer: (d) 60°

Solution:
Step 1: Understanding the Concept:
This problem relates the height of a tower and the distance of a point from its base to the angle of elevation using trigonometry.
Step 2: Key Formula or Approach:
In a right-angled triangle:

$$\tan\theta = \frac{\text{Perpendicular (Height)}}{\text{Base (Distance)}}$$

Step 3: Detailed Explanation:
Let the angle of elevation be θ.
Height of tower $(P) = 30$ m.
Distance from base $(B) = 10\sqrt{3}$ m.

$$\tan\theta = \frac{30}{10\sqrt{3}}$$

$$\tan\theta = \frac{3}{\sqrt{3}}$$

Rationalizing the denominator:

$$\tan\theta = \frac{3\sqrt{3}}{3} = \sqrt{3}$$

We know that $\tan 60^\circ = \sqrt{3}$.
Therefore, $\theta = 60^\circ$.
Step 4: Final Answer:
The angle of elevation is 60°.

> Quick Tip
>
> Remember standard tan values:
> $\tan 30^\circ = 1/\sqrt{3}$, $\tan 45^\circ = 1$, $\tan 60^\circ = \sqrt{3}$.

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12. If TP and TQ are two tangents to a circle with centre O from an external point T so that $\angle POQ = 120^\circ$, then $\angle PTQ$ is equal to :
(a) 60°
(b) 70°
(c) 80°
(d) 90°

Correct Answer: (a) 60°

Solution:
Step 1: Understanding the Concept:
The radius of a circle is perpendicular to the tangent at the point of contact. Also, the sum of angles in a quadrilateral is 360°.
Step 2: Detailed Explanation:
In quadrilateral $OPTQ$:
1. $\angle OPT = 90^\circ$ (Radius $\perp$ Tangent)
2. $\angle OQT = 90^\circ$ (Radius $\perp$ Tangent)
3. $\angle POQ = 120^\circ$ (Given)
Sum of angles:

$$\angle OPT + \angle POQ + \angle OQT + \angle PTQ = 360^\circ$$

$$90^\circ + 120^\circ + 90^\circ + \angle PTQ = 360^\circ$$

$$300^\circ + \angle PTQ = 360^\circ$$

$$\angle PTQ = 60^\circ$$

Step 3: Final Answer:
The angle $\angle PTQ$ is 60°.

Quick Tip

In a circle, the angle between two tangents ($\angle PTQ$) and the angle subtended by the radii at the center ($\angle POQ$) are always supplementary.
Meaning: $\angle PTQ + \angle POQ = 180^\circ$.

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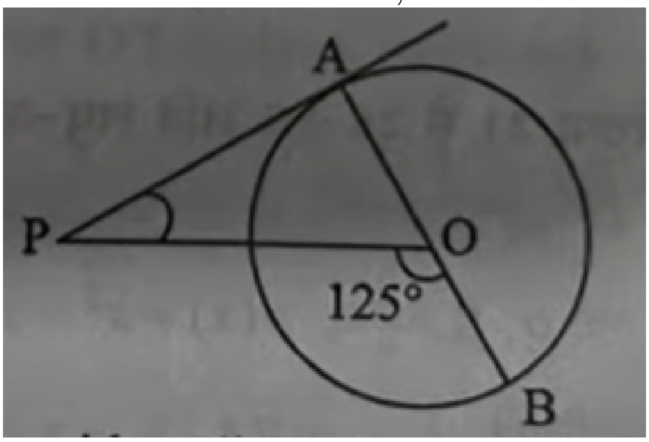
13. In the given figure, PA is a tangent from an external point P to a circle with centre O. If $\angle POB = 125^\circ$, then $\angle APO$ is equal to :



(a) 25°
(b) 65°
(c) 90°
(d) 35°

Correct Answer: (d) 35°

Solution:
Step 1: Understanding the Concept:
We use the properties of tangents and linear pairs of angles. The radius OA is perpendicular to tangent PA.
Step 2: Detailed Explanation:
From the figure, points P, O, and B lie on a straight line.
Therefore, $\angle AOP + \angle POB = 180^\circ$ (Linear Pair).

$$\angle AOP = 180^\circ - 125^\circ = 55^\circ$$

In $\triangle OAP$:
$\angle OAP = 90^\circ$ (Radius is perpendicular to the tangent at point of contact).
Using the Angle Sum Property of a triangle:

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

$$\angle APO + 90^\circ + 55^\circ = 180^\circ$$

$$\angle APO = 180^\circ - 145^\circ = 35^\circ$$

Step 3: Final Answer:
$\angle APO = 35^\circ$.

Quick Tip

Always remember that $\angle OAP$ is a right angle. This simplifies circular geometry problems into right-angled triangle problems.

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14. The length of the arc of the sector of a circle with radius 21 cm and of central angle 60°, is :
(a) 22 cm
(b) 44 cm
(c) 88 cm
(d) 11 cm

Correct Answer: (a) 22 cm

Solution:
Step 1: Understanding the Concept:
The length of an arc is a fraction of the total circumference of the circle, determined by the central angle.
Step 2: Key Formula or Approach:
Length of arc $(l) = \frac{\theta}{360^\circ} \times 2\pi r$
Step 3: Detailed Explanation:
Given: $r = 21$ cm, $\theta = 60^\circ$.
Using $\pi = \frac{22}{7}$:

$$l = \frac{60}{360} \times 2 \times \frac{22}{7} \times 21$$

$$l = \frac{1}{6} \times 2 \times \frac{22}{7} \times 21$$

$$l = \frac{1}{6} \times 2 \times 22 \times 3$$

$$l = \frac{132}{6} = 22 \text{ cm}$$

Step 4: Final Answer:
The length of the arc is 22 cm.

> Quick Tip
>
> Note that 60/360 is 1/6. If the radius is a multiple of 7, the calculation becomes very easy with $\pi = 22/7$.

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15. The hour hand of a clock is 7 cm long. The angle swept by it between 7:00 a.m. and 8:10 a.m. is :
(a) $\left(\frac{35}{4}\right)^\circ$
(b) $\left(\frac{35}{2}\right)^\circ$
(c) 35°
(d) 70°

Correct Answer: (c) 35°

Solution:
Step 1: Understanding the Concept:
The hour hand of a clock covers 360° in 12 hours. We need to find its rate of movement per minute.
Step 2: Key Formula or Approach:
Angle covered in 12 hours (720 minutes) $= 360^\circ$.
Angle covered in 1 minute $= \frac{360}{720} = 0.5^\circ$.
Step 3: Detailed Explanation:
Time elapsed from 7:00 a.m. to 8:10 a.m. = 1 hour 10 minutes.
Total minutes $= 60 + 10 = 70$ minutes.
Angle swept $= 70 \times 0.5^\circ$

$$\text{Angle} = 35^\circ$$

Step 4: Final Answer:
The angle swept by the hour hand is 35°.

> Quick Tip
>
> Rate of Hour Hand: 0.5° per minute.
> Rate of Minute Hand: 6° per minute.
> Multiply the total elapsed minutes by the rate to find the angle.

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16. The total surface area of a solid hemisphere of diameter $2d$ is :

(a) $3\pi d^2$
(b) $2\pi d^2$
(c) $\frac{1}{2}\pi d^2$
(d) $\frac{3}{4}\pi d^2$

Correct Answer: (a) $3\pi d^2$

Solution:
Step 1: Understanding the Concept:
The total surface area (TSA) of a solid hemisphere consists of the curved surface area ($2\pi r^2$) and the area of the flat circular base (πr^2).
Step 2: Key Formula or Approach:
TSA of solid hemisphere = $3\pi r^2$
Step 3: Detailed Explanation:
Given: Diameter = $2d$.
Radius $(r) = \frac{\text{Diameter}}{2} = \frac{2d}{2} = d$.
Substitute $r = d$ into the formula:

$$TSA = 3\pi(d)^2 = 3\pi d^2$$

Step 4: Final Answer:
The total surface area is $3\pi d^2$.

> Quick Tip
>
> Always check if the formula uses radius or diameter. The most common mistake is using $2d$ directly as the radius.
> Solid hemisphere TSA is $3\pi r^2$, while a hollow one (just curved surface) is $2\pi r^2$.

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17. If the mean and mode of a data are 12 and 21 respectively, then its median is :
(a) 6
(b) 13.5
(c) 15
(d) 14

Correct Answer: (c) 15

Solution:
Step 1: Understanding the Concept:
For a moderately skewed frequency distribution, there is an empirical relationship between the three measures of central tendency: Mean, Median, and Mode.
Step 2: Key Formula or Approach:
The empirical formula is given by:

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

Step 3: Detailed Explanation:

Given:
Mean = 12
Mode = 21
Substituting these values into the formula:

$$21 = 3(\text{Median}) - 2(12)$$

$$21 = 3(\text{Median}) - 24$$

$$21 + 24 = 3(\text{Median})$$

$$45 = 3(\text{Median})$$

$$\text{Median} = \frac{45}{3} = 15$$

Step 4: Final Answer:
The median of the given data is 15.

> Quick Tip
>
> Remember the formula as "Mode = 3 Median - 2 Mean".
> Mnemonic: Median is the longer word, so it gets the larger multiplier (3), and Mean is shorter, so it gets the smaller multiplier (2).

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18. A die is thrown once. Probability of getting a number other than 3 is :
(a) $\frac{1}{6}$
(b) $\frac{3}{6}$
(c) $\frac{5}{6}$
(d) 1

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

Solution:
Step 1: Understanding the Concept:
Probability of an event E is the ratio of the number of favorable outcomes to the total number of possible outcomes in the sample space.
Step 2: Detailed Explanation:
Sample Space for a single throw of a die $S = \{1, 2, 3, 4, 5, 6\}$.
Total number of outcomes $n(S) = 6$.
Let E be the event of getting a number other than 3.
Favorable outcomes $E = \{1, 2, 4, 5, 6\}$.
Number of favorable outcomes $n(E) = 5$.
Probability $P(E) = \frac{n(E)}{n(S)} = \frac{5}{6}$.
Step 3: Final Answer:

The probability of getting a number other than 3 is $\frac{5}{6}$.

Quick Tip

Alternatively, use the complement rule: $P(\text{not } A) = 1 - P(A)$.
Probability of getting 3 is 1/6.
Probability of getting a number other than 3 = $1 - 1/6 = 5/6$.

Directions : Question numbers 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below :

(a) Both, Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(b) Both, Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

19. Assertion (A) : The probability that a leap year has 53 Mondays is $\frac{2}{7}$.
Reason (R) : The probability that a non-leap year has 53 Mondays is $\frac{5}{7}$.

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

Solution:
Step 1: Understanding the Concept:
A non-leap year has 365 days (52 weeks + 1 day), and a leap year has 366 days (52 weeks + 2 days).
The occurrence of the 53rd Monday depends on the remaining days.
Step 2: Detailed Explanation:
Assertion (A):
Leap year = 366 days = 52 weeks + 2 days.
The extra 2 days can be: (Sun, Mon), (Mon, Tue), (Tue, Wed), (Wed, Thu), (Thu, Fri), (Fri, Sat), (Sat, Sun).
Total outcomes = 7.
Favorable outcomes for Monday = (Sun, Mon), (Mon, Tue) = 2.
$P(\text{53 Mondays in leap year}) = \frac{2}{7}$.
Assertion (A) is true.
Reason (R):
Non-leap year = 365 days = 52 weeks + 1 day.
The extra 1 day can be: Mon, Tue, Wed, Thu, Fri, Sat, or Sun.
Total outcomes = 7.
Favorable outcome for Monday = Mon = 1.
$P(\text{53 Mondays in non-leap year}) = \frac{1}{7}$.
Reason (R) says $\frac{5}{7}$, which is false.
Step 3: Final Answer:

Assertion is true but Reason is false.

> Quick Tip
>
> In probability problems related to days of the week in a year, focus only on the remainder days (365 % 7 = 1; 366 % 7 = 2).

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20. Assertion (A) : The polynomial $p(y) = y^2 + 4y + 3$ has two zeroes.
Reason (R) : A quadratic polynomial can have at most two zeroes.

Correct Answer: (a) Both, Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

Solution:
Step 1: Understanding the Concept:
Zeroes of a polynomial are values of the variable for which the polynomial evaluates to zero. The Fundamental Theorem of Algebra states that a polynomial of degree n has at most n zeroes.
Step 2: Detailed Explanation:
Assertion (A):
The given polynomial $p(y) = y^2 + 4y + 3$ is a quadratic polynomial (degree 2).
Check discriminant $D = b^2 - 4ac = 4^2 - 4(1)(3) = 16 - 12 = 4 > 0$.
Since $D > 0$, it has two distinct real zeroes ($y = -1, -3$).
Assertion (A) is true.
Reason (R):
It is a standard property that any quadratic polynomial $ax^2 + bx + c$ can have at most two zeroes.
Reason (R) is true.
Since the reason correctly establishes that the maximum number of zeroes for such a function is two, and the assertion provides an example of such a function, R explains A.
Step 3: Final Answer:
Both statements are true and Reason explains Assertion.

> Quick Tip
>
> The number of zeroes of a polynomial is less than or equal to its degree.
> For a quadratic polynomial, the number of real zeroes can be 0, 1, or 2 based on the discriminant.

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21. If α, β are the zeroes of the polynomial $p(x) = x^2 - 3x - 1$, then find the value of $\frac{1}{\alpha} + \frac{1}{\beta}$.

Correct Answer: -3

Solution:
Step 1: Understanding the Concept:
For a quadratic polynomial $ax^2 + bx + c$, the sum of zeroes is $\alpha + \beta = -\frac{b}{a}$ and the product of zeroes is $\alpha\beta = \frac{c}{a}$.
Step 2: Key Formula or Approach:
Identify a, b, c from $p(x) = x^2 - 3x - 1$:
$a = 1, b = -3, c = -1$.
Step 3: Detailed Explanation:
Sum of zeroes $\alpha + \beta = -\frac{-3}{1} = 3$.
Product of zeroes $\alpha\beta = \frac{-1}{1} = -1$.
We need to find $\frac{1}{\alpha} + \frac{1}{\beta}$.
Taking the LCM:

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

Substituting the values:

$$\frac{1}{\alpha} + \frac{1}{\beta} = \frac{3}{-1} = -3$$

Step 4: Final Answer:
The value of $\frac{1}{\alpha} + \frac{1}{\beta}$ is -3.

> Quick Tip
>
> Don't waste time finding individual values of α and β.
> Always express the required symmetric expression in terms of $(\alpha + \beta)$ and $(\alpha\beta)$.

22(A). In $\triangle ABC, DE \parallel BC$. If $AD = x, DB = x - 2, AE = x + 2$ and $EC = x - 1$, then find the value of x.

Correct Answer: 4

Solution:
Step 1: Understanding the Concept:
According to the Basic Proportionality Theorem (Thales Theorem), if a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, the other two sides are divided in the same ratio.
Step 2: Key Formula or Approach:
In $\triangle ABC$, since $DE \parallel BC$:

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

Step 3: Detailed Explanation:
Substitute the given values:

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

Cross-multiplying:

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

Using identity $(a+b)(a-b) = a^2 - b^2$:

$$x^2 - x = x^2 - 4$$

Subtracting x^2 from both sides:

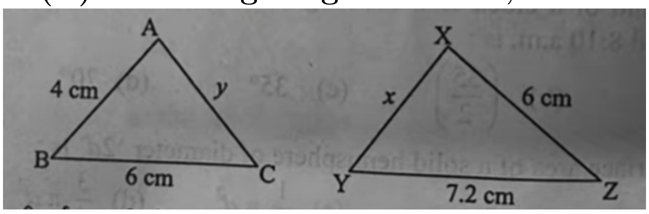
$$-x = -4$$

$$x = 4$$

Step 4: Final Answer:
The value of x is 4.

> 💡 Quick Tip
>
> Always cross-verify your result.
> If $x = 4$, ratios are $4/2 = 2$ and $6/3 = 2$. The answer is correct.

22(B). In the figure given above, $\triangle ABC \sim \triangle XYZ$, then find the values of x and y.



Correct Answer: $x = 4.8, y = 5$

Solution:
Step 1: Understanding the Concept:
If two triangles are similar, their corresponding sides are in the same ratio.
Step 2: Key Formula or Approach:
Given $\triangle ABC \sim \triangle XYZ$:

$$\frac{AB}{XY} = \frac{BC}{YZ} = \frac{AC}{XZ}$$

Step 3: Detailed Explanation:
Substitute the given values:

$$\frac{4}{x} = \frac{6}{7.2} = \frac{y}{6}$$

First, calculate the constant ratio from the known middle term:

$$\frac{6}{7.2} = \frac{60}{72} = \frac{5}{6}$$

To find x:

$$\frac{4}{x} = \frac{5}{6} \implies 5x = 24 \implies x = \frac{24}{5} = 4.8$$

To find y:

$$\frac{y}{6} = \frac{5}{6} \implies y = 5$$

Step 4: Final Answer:
The value of x is 4.8 and the value of y is 5.

> Quick Tip
>
> Simplify the numerical ratio (6/7.2) as much as possible first to make finding other unknowns easier.

---

23. The coordinates of the centre of a circle are $(x-7, 2x)$. Find the value(s) of 'x', if the circle passes through the point $(-9, 11)$ and has radius $5\sqrt{2}$ units.

Correct Answer: $x = 3, 5$

Solution:
Step 1: Understanding the Concept:
The distance from the centre of a circle to any point on its circumference is equal to the radius.
Step 2: Key Formula or Approach:
Distance formula: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.
Here, $d = \text{radius} = 5\sqrt{2}$.
Step 3: Detailed Explanation:
Let the centre be $C(x-7, 2x)$ and the point be $P(-9, 11)$.

$$CP = 5\sqrt{2}$$

$$\sqrt{((x-7)-(-9))^2 + (2x-11)^2} = 5\sqrt{2}$$

$$\sqrt{(x+2)^2 + (2x-11)^2} = 5\sqrt{2}$$

Squaring both sides:

$$(x+2)^2 + (2x-11)^2 = (5\sqrt{2})^2$$

$$x^2 + 4x + 4 + 4x^2 - 44x + 121 = 50$$

$$5x^2 - 40x + 125 = 50$$

$$5x^2 - 40x + 75 = 0$$

Dividing by 5:

$$x^2 - 8x + 15 = 0$$

Factorizing the quadratic equation:

$$(x-3)(x-5) = 0$$

$$x = 3 \text{ or } x = 5$$

Step 4: Final Answer:
The possible values of x are 3 and 5.

> Quick Tip
>
> When you square an equation to remove a root, always verify the result.
> Quadratic equations in coordinate geometry often yield two possible answers as a circle can pass through points at the same distance in different orientations.

24(A). If $\tan\theta = \frac{24}{7}$, then find the value of $\sin\theta + \cos\theta$.

Correct Answer: $\frac{31}{25}$

Solution:
Step 1: Understanding the Concept:
Trigonometric ratios are related to the sides of a right-angled triangle.
$\tan\theta = \frac{\text{Perpendicular}}{\text{Base}}$.
Step 2: Key Formula or Approach:
By Pythagoras Theorem: $H = \sqrt{P^2 + B^2}$.
$\sin\theta = \frac{P}{H}, \cos\theta = \frac{B}{H}$.
Step 3: Detailed Explanation:
Given $\tan\theta = \frac{24}{7}$. Let $P = 24k, B = 7k$.
Calculating Hypotenuse (H):

$$H = \sqrt{(24)^2 + (7)^2} = \sqrt{576 + 49} = \sqrt{625} = 25$$

Now, $\sin\theta = \frac{P}{H} = \frac{24}{25}$ and $\cos\theta = \frac{B}{H} = \frac{7}{25}$.
Value of $\sin\theta + \cos\theta$:

$$\frac{24}{25} + \frac{7}{25} = \frac{31}{25}$$

Step 4: Final Answer:
The value is $\frac{31}{25}$.

> 💡 Quick Tip
>
> Memorize common Pythagorean triplets like (7, 24, 25). It allows you to skip lengthy calculations during exams.

24(B). If $\cot\theta = \frac{7}{8}$, then find the value of $\frac{(1+\sin\theta)(1-\sin\theta)}{(1+\cos\theta)(1-\cos\theta)}$.

Correct Answer: $\frac{49}{64}$

Solution:
Step 1: Understanding the Concept:
Use algebraic identities and trigonometric identities to simplify the expression before substituting values.
Step 2: Key Formula or Approach:
1. $(a+b)(a-b) = a^2 - b^2$.
2. $1 - \sin^2\theta = \cos^2\theta$.
3. $1 - \cos^2\theta = \sin^2\theta$.
4. $\frac{\cos^2\theta}{\sin^2\theta} = \cot^2\theta$.
Step 3: Detailed Explanation:
Simplify the given expression:

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

Using trigonometric identities:

$$= \frac{\cos^2\theta}{\sin^2\theta} = \cot^2\theta$$

Substitute the given value $\cot\theta = \frac{7}{8}$:

$$\cot^2\theta = \left(\frac{7}{8}\right)^2 = \frac{49}{64}$$

Step 4: Final Answer:
The value of the expression is $\frac{49}{64}$.

> 💡 Quick Tip
>
> Always look for identity patterns like $(1+\sin\theta)(1-\sin\theta)$. Reducing the expression to $\cot^2\theta$ makes the calculation much faster than substituting $\sin\theta$ and $\cos\theta$ values.

---

25. Two concentric circles are of radii 5 cm and 4 cm. Find the length of the chord of the larger circle which touches the smaller circle.

Correct Answer: 6 cm

Solution:
Step 1: Understanding the Concept:
A tangent to the inner circle is a chord of the outer circle. The radius of the inner circle is perpendicular to this chord at the point of contact and bisects the chord.
Step 2: Key Formula or Approach:
Let $R = 5$ cm (outer radius) and $r = 4$ cm (inner radius).
The half-length of the chord x is given by Pythagoras theorem: $x = \sqrt{R^2 - r^2}$.
Step 3: Detailed Explanation:
In the right triangle formed by the radius of the inner circle (r), the segment of the chord (x), and the radius of the outer circle (R):

$$R^2 = r^2 + x^2$$

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

$$25 = 16 + x^2$$

$$x^2 = 9 \implies x = 3 \text{ cm}$$

The total length of the chord is $2x = 2 \times 3 = 6$ cm.
Step 4: Final Answer:
The length of the chord is 6 cm.

> Quick Tip
>
> This is another application of the (3, 4, 5) triplet. Identifying the right triangle helps solve such geometry problems quickly.

---

26. Prove that $\sqrt{3}$ is an irrational number.

Correct Answer: Proof

Solution:
Step 1: Understanding the Concept:
We use the method of contradiction. We assume $\sqrt{3}$ is rational and then show that this leads to a logical inconsistency.
Step 2: Detailed Explanation:
Suppose $\sqrt{3}$ is a rational number.
Then, $\sqrt{3} = \frac{p}{q}$ where p, q are integers, $q \neq 0$, and p, q are co-prime (no common factors).
Squaring both sides:

$$3 = \frac{p^2}{q^2} \implies p^2 = 3q^2$$

This means p^2 is divisible by 3. By theorem, if a prime p divides a^2, then p divides a. So, p is divisible by 3.

Let $p = 3k$ for some integer k.
Substitute $p = 3k$ in $p^2 = 3q^2$:

$$(3k)^2 = 3q^2 \implies 9k^2 = 3q^2 \implies 3k^2 = q^2$$

This means q^2 is divisible by 3, so q is also divisible by 3.
Thus, p and q have at least 3 as a common factor.
This contradicts our assumption that p and q are co-prime.
Step 3: Final Answer:
Our assumption is wrong; therefore, $\sqrt{3}$ is irrational.

> Quick Tip
>
> The core of this proof relies on the property: "If a prime number p divides a^2, then p divides a".
> This structure works for any prime square root like $\sqrt{2}, \sqrt{5}, \ldots$.

---

27. Find the ratio in which the x-axis divides the line segment joining the points $(-6, 5)$ and $(-4, -1)$. Also, find the point of intersection.

Correct Answer: Ratio 5 : 1, Point $(-\frac{13}{3}, 0)$

Solution:
Step 1: Understanding the Concept:
Any point on the x-axis has a y-coordinate of 0. We use the section formula to find the ratio.
Step 2: Key Formula or Approach:
Section formula for y-coordinate: $y = \frac{m_1 y_2 + m_2 y_1}{m_1 + m_2}$.
Step 3: Detailed Explanation:
Let the ratio be $k : 1$. The points are $(x_1, y_1) = (-6, 5)$ and $(x_2, y_2) = (-4, -1)$.
Since it lies on the x-axis, $y = 0$:

$$0 = \frac{k(-1) + 1(5)}{k + 1}$$

$$0 = -k + 5 \implies k = 5$$

So the ratio is 5 : 1.
Now find the x-coordinate:

$$x = \frac{kx_2 + 1x_1}{k + 1} = \frac{5(-4) + 1(-6)}{5 + 1}$$

$$x = \frac{-20 - 6}{6} = \frac{-26}{6} = -\frac{13}{3}$$

Step 4: Final Answer:
The ratio is 5 : 1 and the point of intersection is $(-\frac{13}{3}, 0)$.

Quick Tip

If the x-axis divides a segment, set $y = 0$. If the y-axis divides a segment, set $x = 0$.

28(A). If $x = h + a\cos\theta, y = k + b\sin\theta$, then prove that : $\left(\frac{x-h}{a}\right)^2 + \left(\frac{y-k}{b}\right)^2 = 1$.

Correct Answer: Proof

Solution:
Step 1: Understanding the Concept:
Isolate the trigonometric terms $(\sin\theta, \cos\theta)$ and use the Pythagorean identity $\sin^2\theta + \cos^2\theta = 1$.
Step 2: Detailed Explanation:
From the given equations:

$$x = h + a\cos\theta \implies x - h = a\cos\theta \implies \frac{x-h}{a} = \cos\theta$$

$$y = k + b\sin\theta \implies y - k = b\sin\theta \implies \frac{y-k}{b} = \sin\theta$$

Squaring and adding these two results:

$$\left(\frac{x-h}{a}\right)^2 + \left(\frac{y-k}{b}\right)^2 = \cos^2\theta + \sin^2\theta$$

Using the identity $\cos^2\theta + \sin^2\theta = 1$:

$$\left(\frac{x-h}{a}\right)^2 + \left(\frac{y-k}{b}\right)^2 = 1$$

Step 3: Final Answer:
Hence proved.

Quick Tip

This is the standard parametric form of an ellipse. Squaring and adding to eliminate the parameter (θ) is a common technique.

28(B). Prove that : $\frac{\tan A}{1+\sec A} - \frac{\tan A}{1-\sec A} = 2\csc A$.

Correct Answer: Proof

Solution:
Step 1: Understanding the Concept:
Combine the fractions using a common denominator and simplify using identities like $\sec^2 A - \tan^2 A = 1$.

Step 2: Detailed Explanation:
LHS $= \tan A \left[\frac{1}{1+\sec A} - \frac{1}{1-\sec A}\right]$.
Taking common denominator $(1+\sec A)(1-\sec A) = 1-\sec^2 A$:

$$\text{LHS} = \tan A \left[\frac{1-\sec A-(1+\sec A)}{1-\sec^2 A}\right]$$

$$\text{LHS} = \tan A \left[\frac{-2\sec A}{-\tan^2 A}\right]$$

(Note: $1-\sec^2 A = -\tan^2 A$)

$$\text{LHS} = \frac{2\sec A}{\tan A}$$

Expressing in terms of $\sin A$ and $\cos A$:

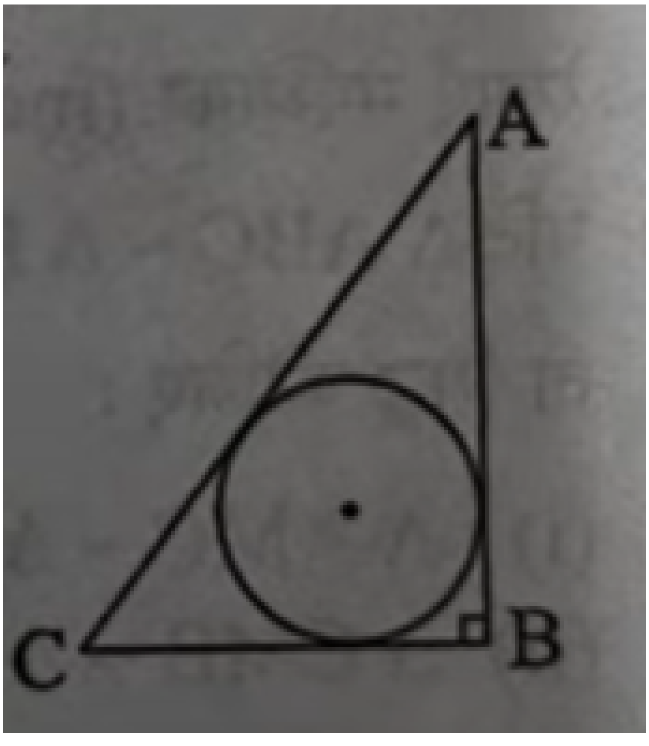
$$\text{LHS} = \frac{2\cdot(1/\cos A)}{\sin A/\cos A} = \frac{2}{\sin A} = 2\csc A$$

Step 3: Final Answer:
LHS = RHS. Hence proved.

Quick Tip

Factor out the common term ($\tan A$) at the beginning to simplify the arithmetic within the brackets.

29(A). In the given figure, $\triangle ABC$ is a right triangle in which $\angle B = 90°, AB = 4$ cm and $BC = 3$ cm. Find the radius of the circle inscribed in the triangle ABC.



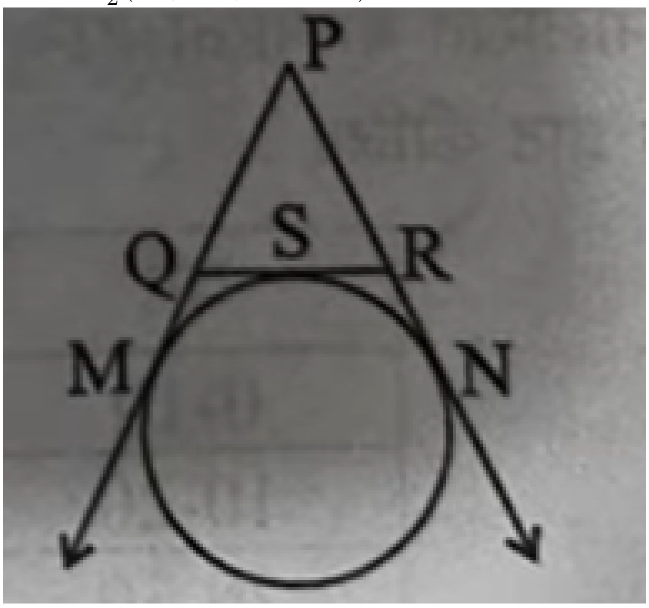
Correct Answer: 1 cm

Solution:
Step 1: Understanding the Concept:
The inradius r of a right-angled triangle can be calculated using the formula $r = \frac{Area}{s}$ or for right triangles $r = \frac{P+B-H}{2}$.
Step 2: Detailed Explanation:
Sides are $AB = 4, BC = 3$.
By Pythagoras theorem, $AC = \sqrt{4^2 + 3^2} = 5$ cm.
Semi-perimeter $s = \frac{3+4+5}{2} = 6$ cm.
Area of $\triangle ABC = \frac{1}{2} \times 3 \times 4 = 6$ cm^2.
Radius $r = \frac{Area}{s} = \frac{6}{6} = 1$ cm.
Step 3: Final Answer:
The radius of the inscribed circle is 1 cm.

Quick Tip

For any right-angled triangle, the inradius is simply $\frac{\text{sum of legs - hypotenuse}}{2}$.
Here: $\frac{3+4-5}{2} = \frac{2}{2} = 1$.

29(B). In the given figure, if a circle touches the side QR of a $\triangle PQR$ at S and extended sides PQ and PR at M and N respectively, then prove that :
$PM = \frac{1}{2}(PQ + QR + PR)$**.**



Correct Answer: Proof

Solution:
Step 1: Understanding the Concept:
Lengths of tangents drawn from an external point to a circle are equal.
Step 2: Detailed Explanation:

From point P: $PM = PN$.
From point Q: $QM = QS$.
From point R: $RN = RS$.
Perimeter of $\triangle PQR = PQ + QR + PR$

$$= PQ + (QS + RS) + PR$$

Substituting the tangent equalities:

$$= PQ + QM + RN + PR$$

Observe that $PQ + QM = PM$ and $PR + RN = PN$.
Perimeter $= PM + PN$.
Since $PM = PN$:
Perimeter $= 2PM$.
Therefore, $PM = \frac{1}{2}(PQ + QR + PR)$.
Step 3: Final Answer:
Hence proved.

Quick Tip

The perimeter of a triangle is equal to twice the length of the tangent drawn from a vertex to the opposite excircle.

---

30. A solid is in the form of a cylinder with hemispherical ends. The total height of the solid is 20 cm and the diameter of the cylinder is 7 cm. Find the total volume of the solid. (Use $\pi = \frac{22}{7}$)

Correct Answer: 680.17 cm^3 (approx)

Solution:
Step 1: Understanding the Concept:
The total volume is the sum of the volume of the cylindrical part and the volumes of the two hemispherical ends (which together form a complete sphere).
Step 2: Detailed Explanation:
Given:
Diameter $= 7$ cm $\implies$ Radius $r = 3.5 = \frac{7}{2}$ cm.
Total height $= 20$ cm.
Height of cylindrical part $(h) =$ Total height $-2 \times r = 20 - 7 = 13$ cm.
Total Volume = Volume of Cylinder + Volume of Sphere.

$$V = \pi r^2 h + \frac{4}{3}\pi r^3 = \pi r^2 \left[h + \frac{4}{3}r\right]$$

$$V = \frac{22}{7} \times \left(\frac{7}{2}\right)^2 \left[13 + \frac{4}{3} \times \frac{7}{2}\right]$$

$$V = \frac{22}{7} \times \frac{49}{4} \left[13 + \frac{14}{3}\right]$$

$$V = \frac{77}{2} \times \left[\frac{39 + 14}{3}\right] = \frac{77}{2} \times \frac{53}{3}$$

$$V = \frac{4081}{6} \approx 680.17 \text{ cm}^3$$

Step 3: Final Answer:
The total volume of the solid is 680.17 cm^3.

> Quick Tip
>
> Treating the two hemispheres as one sphere simplifies the calculation significantly.

31(i). Two dice of different colours are thrown at the same time. Write down all the possible outcomes. What is the probability that: (i) same number appears on both the dice?

Correct Answer: $1_{\overline{6}}$

Solution:
Step 1: Understanding the Concept:
When two dice are thrown simultaneously, each die has 6 possible outcomes.
The total number of outcomes for the experiment is the product of the number of outcomes of each die.
A "same number" outcome is often called a "doublet".
Step 2: Key Formula or Approach:
Total possible outcomes $= 6 \times 6 = 36$.
Probability of an event $P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of possible outcomes}}$.
Step 3: Detailed Explanation:
The possible outcomes are represented as ordered pairs (x, y) where $x, y \in \{1, 2, 3, 4, 5, 6\}$:
$S = \{(1, 1), (1, 2), \ldots, (1, 6), (2, 1), \ldots, (6, 6)\}$.
Total outcomes $n(S) = 36$.
The outcomes where the same number appears on both dice (favorable outcomes) are:
$E = \{(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6)\}$.
Number of favorable outcomes $n(E) = 6$.
The probability is:

$$P(\text{same number}) = \frac{6}{36} = \frac{1}{6}$$

Step 4: Final Answer:
The probability that the same number appears on both dice is $\frac{1}{6}$.

💡 Quick Tip

For any number of dice n, the total outcomes are 6^n.
The probability of getting a doublet is always 1/6 regardless of the total outcomes in terms of pairs.

31(ii). Two dice of different colours are thrown at the same time. What is the probability that: (ii) different number appears on both the dice?

Correct Answer: $5_{\overline{6}}$

Solution:
Step 1: Understanding the Concept:
The event of getting "different numbers" is the complement of the event of getting "the same number".
The sum of the probabilities of an event and its complement is always 1.
Step 2: Key Formula or Approach:
Complementary event formula: $P(E') = 1 - P(E)$.
Step 3: Detailed Explanation:
From the previous part, the probability of getting the same number on both dice is $P(E) = \frac{1}{6}$.
The event of getting different numbers on both dice is E'.
Using the formula for complementary events:

$$P(E') = 1 - P(E)$$

$$P(E') = 1 - \frac{1}{6} = \frac{5}{6}$$

Alternatively, the number of favorable outcomes is $36 - 6 = 30$.

$$P(E') = \frac{30}{36} = \frac{5}{6}$$

Step 4: Final Answer:
The probability that a different number appears on both dice is $\frac{5}{6}$.

💡 Quick Tip

Using the complement rule $1 - P(E)$ is usually faster than counting all outcomes where numbers are different.

---

32. Determine graphically, the coordinates of vertices of a triangle whose equations are $2x - 3y + 6 = 0$; $2x + 3y - 18 = 0$ and $x = 0$. Also, find the area of this triangle.

Correct Answer: Vertices: (0, 2), (0, 6), (3, 4); Area = 6 sq units

Solution:
Step 1: Understanding the Concept:
To find the vertices graphically, we plot the given linear equations on a coordinate plane.
The intersection points of these lines form the vertices of the triangle.
The line $x = 0$ represents the y-axis.
Step 2: Key Formula or Approach:
Area of a triangle with vertices $(x_1, y_1), (x_2, y_2), (x_3, y_3)$:

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

Or graphically: Area $= \frac{1}{2} \times \text{base} \times \text{height}$.
Step 3: Detailed Explanation:
1. For line $L_1 : 2x - 3y + 6 = 0$:
When $x = 0, y = 2$. Point $A(0, 2)$.
When $y = 0, x = -3$. Point $(-3, 0)$.
2. For line $L_2 : 2x + 3y - 18 = 0$:
When $x = 0, y = 6$. Point $B(0, 6)$.
When $y = 0, x = 9$. Point $(9, 0)$.
3. The third line is $x = 0$, which is the y-axis.
4. Intersection of L_1 and L_2:
Adding the two equations: $(2x - 3y + 6) + (2x + 3y - 18) = 0 \implies 4x - 12 = 0 \implies x = 3$.
Substituting $x = 3$ in L_2: $2(3) + 3y = 18 \implies 3y = 12 \implies y = 4$. Point $C(3, 4)$.
The triangle formed by L_1, L_2, and $x = 0$ has vertices $A(0, 2), B(0, 6)$, and $C(3, 4)$.
On the graph, the base along the y-axis is the distance between $(0, 2)$ and $(0, 6)$, which is $|6 - 2| = 4$ units.
The height is the perpendicular distance from point $C(3, 4)$ to the y-axis, which is the x-coordinate of C, i.e., 3 units.

$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 4 \times 3 = 6 \text{ sq units}$$

Step 4: Final Answer:
The coordinates of the vertices are (0, 2), (0, 6), and (3, 4). The area of the triangle is 6 sq units.

> Quick Tip
>
> When one side of the triangle lies on an axis, using $\frac{1}{2} \times \text{base} \times \text{height}$ is much simpler than the coordinate formula.
> Always re-verify intersection points algebraically to ensure your graphical plotting is accurate.

33(A). A faster train takes one hour less than a slower train for a journey of 200 km. If the speed of the slower train is 10 km/hr less than that of the faster train, find the speeds of the two trains.

Correct Answer: Faster train = 50 km/hr, Slower train = 40 km/hr

Solution:
Step 1: Understanding the Concept:
This problem involves the relationship between distance, speed, and time.
Time is given by the ratio of distance to speed.
We set up a quadratic equation based on the difference in travel times.
Step 2: Key Formula or Approach:

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

Let the speed of the faster train be x km/hr.
Then the speed of the slower train is $(x - 10)$ km/hr.
Step 3: Detailed Explanation:
Distance = 200 km.
Time taken by faster train (T_1) = $\frac{200}{x}$.
Time taken by slower train (T_2) = $\frac{200}{x-10}$.
According to the problem, $T_2 - T_1 = 1$.

$$\frac{200}{x-10} - \frac{200}{x} = 1$$

$$200\left[\frac{x-(x-10)}{x(x-10)}\right] = 1$$

$$200\left[\frac{10}{x^2-10x}\right] = 1$$

$$2000 = x^2 - 10x \implies x^2 - 10x - 2000 = 0$$

Factoring the quadratic equation:

$$x^2 - 50x + 40x - 2000 = 0$$

$$x(x-50) + 40(x-50) = 0$$

$$(x-50)(x+40) = 0$$

Since speed cannot be negative, $x = 50$.
Speed of faster train = 50 km/hr.
Speed of slower train = $50 - 10 = 40$ km/hr.
Step 4: Final Answer:
The speeds of the two trains are 50 km/hr and 40 km/hr.

Quick Tip

In time-distance problems, always subtract the shorter time from the longer time to set the difference equal to a positive value.
Checking the options or doing a quick mental check: $200/40 = 5$ hours and $200/50 = 4$ hours. The difference is 1 hour, which confirms our result.

33(B). The sum of the areas of two squares is 640 m^2. If the difference in their perimeters is 64 m, find the sides of the two squares.

Correct Answer: 24 m and 8 m

Solution:
Step 1: Understanding the Concept:
Area of a square with side s is s^2.
Perimeter of a square with side s is $4s$.
We use the given conditions to form equations and solve for the side lengths.
Step 2: Key Formula or Approach:
Let the sides of the two squares be x and y meters.
Sum of areas: $x^2 + y^2 = 640$.
Difference of perimeters: $4x - 4y = 64$.
Step 3: Detailed Explanation:
From the perimeter condition:
$4(x - y) = 64 \implies x - y = 16 \implies x = y + 16$.
Substitute $x = y + 16$ into the area equation:

$$(y + 16)^2 + y^2 = 640$$

$$y^2 + 32y + 256 + y^2 = 640$$

$$2y^2 + 32y - 384 = 0$$

Dividing by 2:

$$y^2 + 16y - 192 = 0$$

Factoring:

$$y^2 + 24y - 8y - 192 = 0$$

$$y(y + 24) - 8(y + 24) = 0$$

$$(y - 8)(y + 24) = 0$$

As side length cannot be negative, $y = 8$.
Then, $x = 8 + 16 = 24$.
Step 4: Final Answer:
The sides of the two squares are 24 m and 8 m.

Quick Tip

Simplifying the perimeter equation first reduces the degree of calculation in the area substitution step.

34(A). State and prove Basic Proportionality Theorem.

Correct Answer: Proof based on Thales Theorem

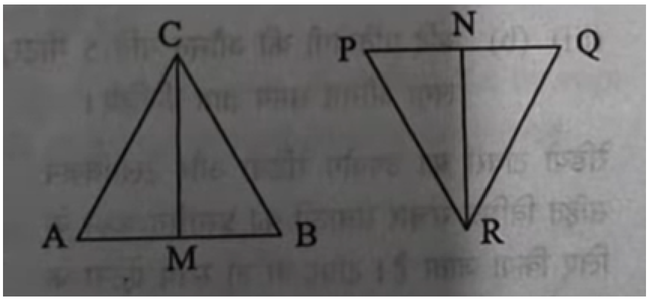
Solution:
Step 1: Understanding the Concept:
Basic Proportionality Theorem (BPT) or Thales Theorem states: "If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, the other two sides are divided in the same ratio."
Step 2: Key Formula or Approach:
Given: $\triangle ABC$ where $DE \parallel BC$.
To prove: $\frac{AD}{DB} = \frac{AE}{EC}$.
Step 3: Detailed Explanation:
Construction: Join BE and CD. Draw $DM \perp AC$ and $EN \perp AB$.
Proof:
Area $(\triangle ADE) = \frac{1}{2} \times AD \times EN$.
Area $(\triangle BDE) = \frac{1}{2} \times DB \times EN$.
Ratio 1: $\frac{\text{Area}(\triangle ADE)}{\text{Area}(\triangle BDE)} = \frac{AD}{DB}$.
Similarly,
Area $(\triangle ADE) = \frac{1}{2} \times AE \times DM$.
Area $(\triangle CDE) = \frac{1}{2} \times EC \times DM$.
Ratio 2: $\frac{\text{Area}(\triangle ADE)}{\text{Area}(\triangle CDE)} = \frac{AE}{EC}$.
Since $\triangle BDE$ and $\triangle CDE$ are on the same base DE and between the same parallels $DE \parallel BC$, their areas are equal.
Area $(\triangle BDE) = \text{Area}(\triangle CDE)$.
Equating Ratios 1 and 2:

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

Step 4: Final Answer:
Hence, the Basic Proportionality Theorem is proved.

> Quick Tip
>
> The key to proving BPT is recognizing that the altitudes of triangles sharing a line as a base are the same if the vertices lie on a line parallel to that base.

34(B). In the given figure, CM and RN are respectively the medians of $\triangle ABC$ and $\triangle PQR$. If $\triangle ABC \sim \triangle PQR$, then prove that: (i) $\triangle AMC \sim \triangle PNR$ (ii) $\triangle CMB \sim \triangle RNQ$.



Correct Answer: Proof based on similarity criteria

Solution:
Step 1: Understanding the Concept:
Since $\triangle ABC \sim \triangle PQR$, their corresponding angles are equal and the ratio of their corresponding sides is constant.
Medians bisect the opposite sides.
Step 2: Key Formula or Approach:
From similarity: $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR}$ and $\angle A = \angle P$.
Since M and N are midpoints: $AB = 2AM$ and $PQ = 2PN$.
Step 3: Detailed Explanation:
(i) To prove $\triangle AMC \sim \triangle PNR$:
We have $\frac{AB}{PQ} = \frac{AC}{PR}$.
Substitute $AB = 2AM$ and $PQ = 2PN$:
$\frac{2AM}{2PN} = \frac{AC}{PR} \implies \frac{AM}{PN} = \frac{AC}{PR}$.
Also, $\angle A = \angle P$ (given by $\triangle ABC \sim \triangle PQR$).
By SAS similarity criterion: $\triangle AMC \sim \triangle PNR$.
(ii) To prove $\triangle CMB \sim \triangle RNQ$:
Similarly, $\frac{AB}{PQ} = \frac{BC}{QR}$.
Substitute $AB = 2MB$ and $PQ = 2NQ$:
$\frac{2MB}{2NQ} = \frac{BC}{QR} \implies \frac{MB}{NQ} = \frac{BC}{QR}$.
Also, $\angle B = \angle Q$ (corresponding angles of similar triangles).
By SAS similarity criterion: $\triangle CMB \sim \triangle RNQ$.
Step 4: Final Answer:
Both parts are proved using the SAS similarity criterion.

Quick Tip

The ratio of any two corresponding linear dimensions (sides, altitudes, medians, perimeters) of similar triangles is equal.

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35. The mean of the following frequency distribution is 35. Find the values of x and y, if the sum of frequencies is 25:

Class	Frequency
0-10	1
10-20	x
20-30	5
30-40	7
40-50	y
50-60	3
60-70	1

Correct Answer: x = 4, y = 7

Solution:
Step 1: Understanding the Concept:
The mean of a grouped distribution is $\frac{\sum f_i x_i}{\sum f_i}$, where x_i is the class mark.
We have two unknowns, so we need two equations: one from the total frequency and one from the mean.
Step 2: Key Formula or Approach:
Class Marks x_i: 5, 15, 25, 35, 45, 55, 65.
Sum of frequencies $\sum f_i = 25$.
Step 3: Detailed Explanation:
1. From total frequency:
$1 + x + 5 + 4 + y + 3 + 1 = 25$.
$x + y + 14 = 25 \implies x + y = 11$ (Equation 1).
2. From Mean calculation:
Mean $= \frac{1(5)+x(15)+5(25)+4(35)+y(45)+3(55)+1(65)}{25} = 35$.
$5 + 15x + 125 + 140 + 45y + 165 + 65 = 25 \times 35$.
$15x + 45y + 500 = 875$.
$15x + 45y = 375$.
Divide by 15: $x + 3y = 25$ (Equation 2).
Subtract Equation 1 from Equation 2:
$(x + 3y) - (x + y) = 25 - 11 \implies 2y = 14 \implies y = 7$.
Substitute $y = 7$ in Equation 1:
$x + 7 = 11 \implies x = 4$.
Step 4: Final Answer:
The values are x = 4 and y = 7.

💡 Quick Tip

Always simplify the mean equation as much as possible before solving the system of equations.
Checking frequency sum $1 + 4 + 5 + 4 + 7 + 3 + 1 = 25$. Calculation is correct.

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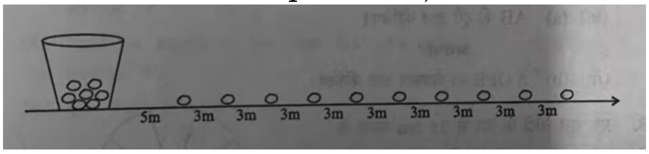
36. In a potato race, a bucket is placed at the starting point, which is 5 m from the first potato. The other potatoes are arranged 3 m apart in a straight line, with a total of 10 potatoes, as shown in the figure:



A competitor starts from the bucket, picks up the nearest potato, runs back to the bucket to drop it in, then returns to pick up the next potato. This process continues until all the potatoes are in the bucket.
Based on the above information, answer the following questions:
(i) What is the distance covered to pick up the first potato and drop it in the bucket?

Correct Answer: 10 m

Solution:
Step 1: Understanding the Concept:
The distance covered for each potato is twice the distance of the potato from the bucket (one way to pick it up and one way to come back and drop it).
Step 2: Detailed Explanation:
The first potato is at a distance of 5 m from the bucket.
Distance covered to reach the potato = 5 m.
Distance covered to return to the bucket = 5 m.
Total distance $= 5 + 5 = 10$ m.
Step 3: Final Answer:
The distance covered for the first potato is 10 m.

💡 Quick Tip

In return-trip problems, always multiply the one-way distance by 2.

36(ii). What is the distance covered to pick up the second potato and drop it in the bucket?

Correct Answer: 16 m

Solution:

Step 1: Understanding the Concept:
The potatoes are spaced 3 m apart. We add this distance to the previous potato's position to find the new distance from the bucket.
Step 2: Detailed Explanation:
First potato distance = 5 m.
Second potato distance = $5 + 3 = 8$ m.
Total distance covered for the second potato = $2 \times 8 = 16$ m.
Step 3: Final Answer:
The distance covered for the second potato is 16 m.

> Quick Tip
>
> The distances covered for each subsequent potato form an Arithmetic Progression (AP).

36(iii)(a). What is the total distance the competitor has to run?

Correct Answer: 370 m

Solution:
Step 1: Understanding the Concept:
The distances covered for 10 potatoes form an AP.
Distance for 1st potato = 10 m.
Distance for 2nd potato = 16 m.
Distance for 3rd potato = 22 m.
This is an AP with $a = 10, d = 6, n = 10$.
Step 2: Key Formula or Approach:
Sum of first n terms of an AP: $S_n = \frac{n}{2}[2a + (n-1)d]$.
Step 3: Detailed Explanation:

$$S_{10} = \frac{10}{2}[2(10) + (10-1)6]$$

$$S_{10} = 5[20 + 9 \times 6]$$

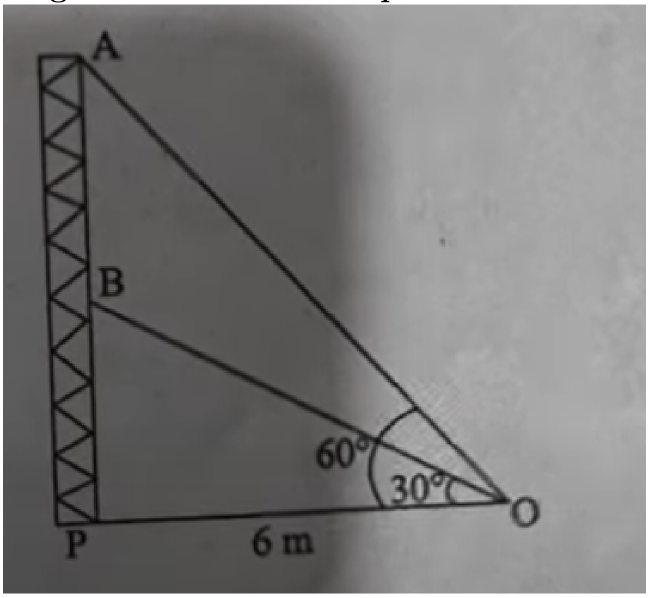
$$S_{10} = 5[20 + 54]$$

$$S_{10} = 5[74] = 370 \text{ m}$$

Step 4: Final Answer:
The total distance covered is 370 m.

> Quick Tip
>
> Identify the AP parameters correctly before using the summation formula.

37(i). A radio station tower was built in two sections 'A' and 'B'. Tower is supported by wires from a point 'O'. Distance between base of tower P and point 'O' is 6 m. From point 'O', angle of elevation of top of section 'B' is 30°. Find the length of the wire from point 'O' to the top of section 'B'.



Correct Answer: $4\sqrt{3}$ m ≈ 6.93 m

Solution:
Step 1: Understanding the Concept:
The wire forms the hypotenuse of a right-angled triangle where the ground distance is the base.
Step 2: Key Formula or Approach:
In $\triangle OPB$, $\cos 30° = \frac{\text{Base}}{\text{Hypotenuse}} = \frac{OP}{OB}$.
Step 3: Detailed Explanation:
Given: $OP = 6$ m, $\angle POB = 30°$.

$$\cos 30° = \frac{6}{OB}$$

$$\frac{\sqrt{3}}{2} = \frac{6}{OB} \implies OB = \frac{12}{\sqrt{3}}$$

$$OB = 4\sqrt{3} \text{ m}$$

Taking $\sqrt{3} \approx 1.732$, $OB \approx 6.93$ m.
Step 4: Final Answer:
The length of the wire is $4\sqrt{3}$ m.

Quick Tip

Use trigonometry ratios based on what side is given and what is required (Base given, Hypotenuse required $\implies$ use cos).

37(ii). Find the length of the wire from point 'O' to the top of section 'A', if the angle of elevation is $60°$.

Correct Answer: 12 m

Solution:
Step 1: Understanding the Concept:
Similar to part (i), we use the cosine ratio for the larger triangle formed by the wire to the top of section A.
Step 2: Detailed Explanation:
In $\triangle OPA$, $\angle POA = 60°$ and $OP = 6$ m.

$$\cos 60° = \frac{OP}{OA}$$

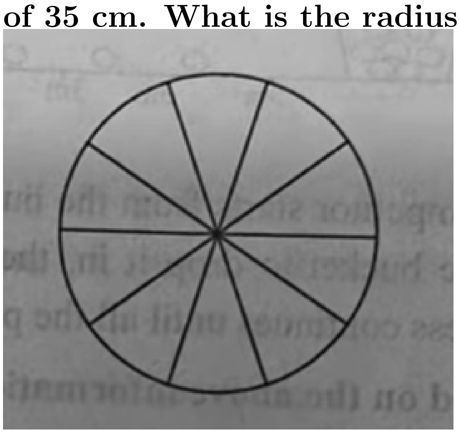
$$\frac{1}{2} = \frac{6}{OA} \implies OA = 12 \text{ m}$$

Step 3: Final Answer:
The length of the wire is 12 m.

Quick Tip

Standard values like $\cos 60° = 0.5$ are extremely useful for quick mental calculations.

38(i). A brooch is crafted from silver wire in the shape of a circle with a diameter of 35 cm. What is the radius of the circle?



Correct Answer: 17.5 cm

Solution:
Step 1: Understanding the Concept:
Radius is half of the diameter of a circle.
Step 2: Detailed Explanation:
Given: Diameter $d = 35$ cm.

$$\text{Radius } r = \frac{d}{2} = \frac{35}{2} = 17.5 \text{ cm}$$

Step 3: Final Answer:
The radius of the circle is 17.5 cm.

> **Quick Tip**
>
> Always check units in case study problems. While 35 mm is standard for this problem in textbooks, here it says cm.

38(ii). What is the circumference of the brooch?

Correct Answer: 110 cm

Solution:
Step 1: Understanding the Concept:
Circumference of a circle is the total distance around its edge.
Step 2: Key Formula or Approach:
$C = \pi d$ or $2\pi r$.
Step 3: Detailed Explanation:

$$C = \frac{22}{7} \times 35 = 22 \times 5 = 110 \text{ cm}$$

Step 4: Final Answer:
The circumference of the brooch is 110 cm.

> **Quick Tip**
>
> Using πd is faster than $2\pi r$ if diameter is given directly.

38(iii)(a). What is the total length of silver wire required if 5 diameters are also made of wire?

Correct Answer: 285 cm

Solution:
Step 1: Understanding the Concept:
The total wire needed includes the outer circular boundary and the 5 internal diameter segments.
Step 2: Detailed Explanation:
Total wire = Circumference + 5 $\times$ Diameter.
Circumference = 110 cm.
Wire for diameters = $5 \times 35 = 175$ cm.
Total wire = $110 + 175 = 285$ cm.

Step 3: Final Answer:
The total length of silver wire required is 285 cm.

> 💡 Quick Tip
>
> Read the question carefully to ensure you count all internal wire structures, not just the perimeter.

38(iii)(b). What is the area of each sector of the brooch if the circle is divided into 10 equal sectors?

Correct Answer: 96.25 sq cm

Solution:
Step 1: Understanding the Concept:
The area of each sector is one-tenth of the total area of the circle.
Step 2: Key Formula or Approach:
Total Area $= \pi r^2$.
Area of each sector $= \frac{\text{Total Area}}{10}$.
Step 3: Detailed Explanation:
Radius $r = \frac{35}{2}$ cm.
Total Area $= \frac{22}{7} \times \frac{35}{2} \times \frac{35}{2} = 11 \times 5 \times \frac{35}{2} = \frac{1925}{2} = 962.5$ sq cm.
Area of each sector $= \frac{962.5}{10} = 96.25$ sq cm.
Step 4: Final Answer:
The area of each sector of the brooch is 96.25 sq cm.

> 💡 Quick Tip
>
> Dividing the total area by the number of sectors is much faster than calculating the sector angle $(360/10 = 36^\circ)$ and using the sector area formula.
