

Mathematics (Standard) 2026, Set 30/2/1

Q.P. Code 30/2/1 · Series 2LKNN · 80 marks · 3 hours · 2026. Questions are from the official CBSE paper. Step-by-step solutions are written by CogniGuru and checked against CBSE's published answer key. Where the key itself disagrees with the arithmetic, the solution says so.

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Section A: Multiple choice

20 questions, 1 mark each. MCQs (Q1 to Q18) and assertion-reason (Q19, Q20).

Q1 · REAL NUMBERS · 1 MARK

The LCM of 960 and 240 is:

- (A) 960 (B) 240
(C) 60 (D) 15

SOLUTION

$960 = 4 \times 240$, so 240 divides 960.

When one number is a multiple of the other, the LCM is the larger number: 960. (The HCF is 240.)

Answer: (A) 960

Q2 · REAL NUMBERS · 1 MARK

The natural number 1 is:

- (A) a prime number (B) a composite number
(C) prime as well as composite (D) neither prime nor composite

SOLUTION

A prime has exactly two factors and a composite number has more than two. 1 has only one factor (itself), so it is neither.

Answer: (D) neither prime nor composite

Q3 · REAL NUMBERS · 1 MARK

For any natural number n , 5^n ends with the digit:

- (A) 0 (B) 5
(C) 3 (D) 2

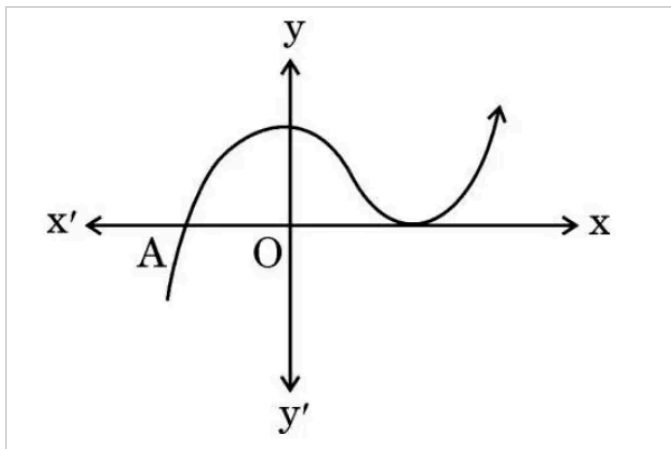
SOLUTION

5, 25, 125, 625, ... : a number ending in 5 times 5 always ends in 5. So 5^n ends with 5.

Answer: (B) 5

Q4 · POLYNOMIALS · 1 MARK

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



- (A) 0 (B) 1
(C) 2 (D) 3

SOLUTION

The zeroes are the x -values where the curve meets the x -axis.

It crosses at A on the left, and it touches the axis once more at the bottom of the dip on the right. That is 2 distinct points (A and the touching point).

Answer: (C) 2

Common mistake: Counting the peak or counting the touching point twice. Each meeting point counts once, so there are two distinct zeroes.

Q5 · POLYNOMIALS · 1 MARK

If α and β are two zeroes of a polynomial $f(x) = px^2 - 2x + 3p$ and $\alpha + \beta = \alpha\beta$, then value of p is:

- (A) $-\frac{2}{3}$ (B) $\frac{2}{3}$
(C) $\frac{1}{3}$ (D) $-\frac{1}{3}$

SOLUTION

$$\alpha + \beta = -\frac{-2}{p} = \frac{2}{p} \text{ and } \alpha\beta = \frac{3p}{p} = 3.$$

$$\alpha + \beta = \alpha\beta \text{ gives } \frac{2}{p} = 3, \text{ so } p = \frac{2}{3}.$$

Answer: (B) $\frac{2}{3}$

Q6 · LINEAR EQUATIONS · 1 MARK

If the pair of linear equations $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ is consistent and dependent, then:

- (A) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ (B) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} = \frac{c_1}{c_2}$
(C) $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ (D) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

SOLUTION

Dependent (coincident) lines have infinitely many solutions, which needs all three ratios equal: $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$. (Option

(A) is a unique solution and (C) is parallel lines, no solution.)

Answer: (D) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Q7 · ARITHMETIC PROGRESSIONS · 1 MARK

Which of the following sequences is **not** an A.P.?

(A) $2, \frac{5}{2}, 3, \frac{7}{2}, \dots$

(B) $-1.2, -3.2, -5.2, -7.2, \dots$

(C) $\sqrt{2}, \sqrt{8}, \sqrt{18}, \dots$

(D) $1^2, 3^2, 5^2, 7^2, \dots$

SOLUTION

(A) common difference $\frac{1}{2}$ ✓. (B) common difference -2 ✓. (C) $\sqrt{2}, 2\sqrt{2}, 3\sqrt{2}$: common difference $\sqrt{2}$ ✓.

(D) $1, 9, 25, 49$: differences $8, 16, 24$ are not equal. Not an A.P.

Answer: (D) $1^2, 3^2, 5^2, 7^2, \dots$

Q8 · TRIANGLES · 1 MARK

In triangles ABC and PQR , $\angle A = \angle Q$ and $\angle B = \angle R$, then $AB : AC$ is equal to:

(A) $PQ : PR$

(B) $PQ : QR$

(C) $QR : QP$

(D) $PR : QR$

SOLUTION

$\angle A = \angle Q$ and $\angle B = \angle R$, so the correspondence is $A \leftrightarrow Q, B \leftrightarrow R, C \leftrightarrow P$, and $\triangle ABC \sim \triangle QRP$.

AB matches QR and AC matches QP , so $AB : AC = QR : QP$.

Answer: (C) $QR : QP$

Q9 · COORDINATE GEOMETRY · 1 MARK

The distance of the point $A(4a, 3a)$ from x -axis is:

(A) $3a$

(B) $-3a$

(C) $4a$

(D) $-4a$

SOLUTION

The distance from the x -axis is the absolute value of the y -coordinate, $|3a|$, which is $3a$ (taking $a > 0$, as the options expect). Option (B) and (D) are negative, and $4a$ is the distance from the y -axis.

Answer: (A) $3a$

Q10 · TRIGONOMETRY · 1 MARK

If $\cos A = \frac{4}{5}$, then the value of $\tan A$ is:

- (A) $\frac{3}{5}$
(C) $\frac{4}{3}$

- (B) $\frac{3}{4}$
(D) $\frac{5}{3}$

SOLUTION

Adjacent = 4, hypotenuse = 5, so opposite = $\sqrt{25 - 16} = 3$ (the 3-4-5 triangle). $\tan A = \frac{3}{4}$.

Answer: (B) $\frac{3}{4}$

Q11 · TRIGONOMETRY · 1 MARK

If $2 \sin A = 1$, then the value of $\tan A + \cot A$ is:

- (A) $\sqrt{3}$
(C) $\frac{\sqrt{3}}{2}$

- (B) $\frac{4}{\sqrt{3}}$
(D) 1

SOLUTION

$\sin A = \frac{1}{2}$, so $A = 30^\circ$.

$$\tan 30^\circ + \cot 30^\circ = \frac{1}{\sqrt{3}} + \sqrt{3} = \frac{1+3}{\sqrt{3}} = \frac{4}{\sqrt{3}}.$$

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

Q12 · TRIGONOMETRY · 1 MARK

From a point on the ground, which is 60 m away from the foot of a vertical tower, the angle of elevation of the top of the tower is found to be 45° . The height (in metres) of the tower is:

- (A) $10\sqrt{3}$
(C) 60

- (B) $30\sqrt{3}$
(D) 30

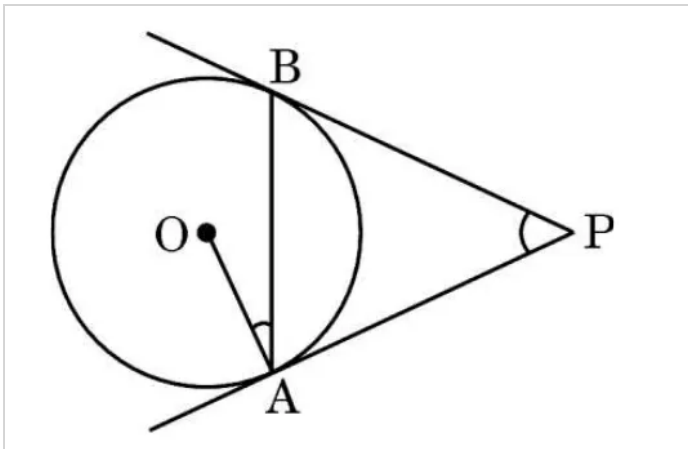
SOLUTION

$\tan 45^\circ = \frac{\text{height}}{60} = 1$, so the height is 60 m.

Answer: (C) 60

Q13 · CIRCLES · 1 MARK

In the given figure, PA and PB are tangents to a circle centred at O . If $\angle OAB = 15^\circ$, then $\angle APB$ equals:



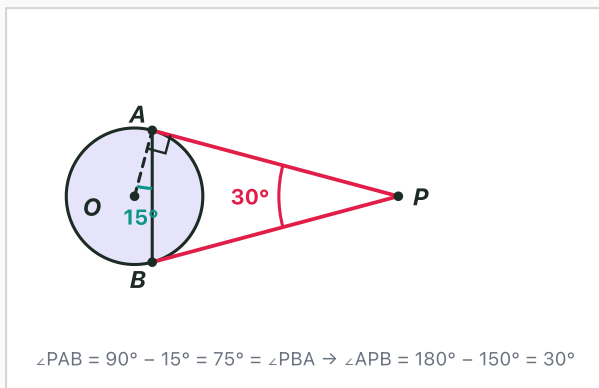
(A) 30°

(B) 15°

(C) 45°

(D) 10°

SOLUTION



$OA \perp PA$, so $\angle PAB = 90^\circ - \angle OAB = 90^\circ - 15^\circ = 75^\circ$.

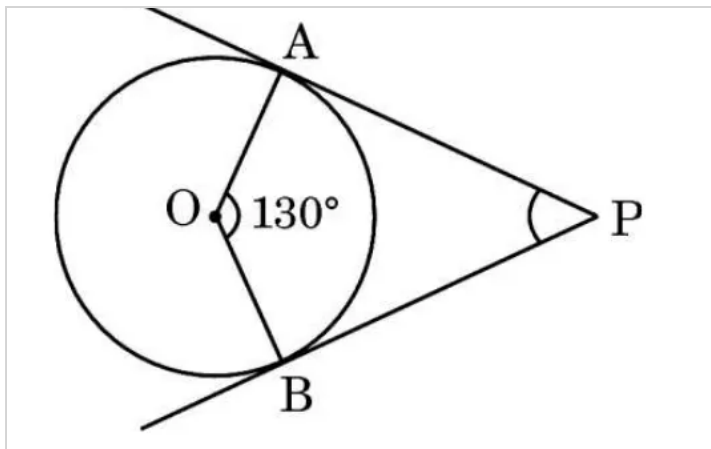
Tangents from P are equal, so $PA = PB$ and $\angle PBA = \angle PAB = 75^\circ$.

$\angle APB = 180^\circ - 75^\circ - 75^\circ = 30^\circ$.

Answer: (A) 30°

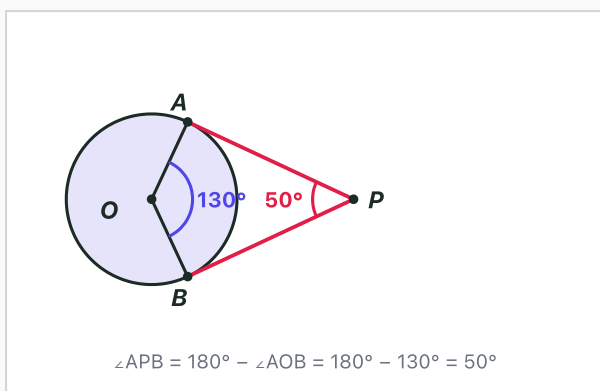
Q14 · CIRCLES · 1 MARK

In the given figure, PA and PB are tangents to a circle centred at O . If $\angle AOB = 130^\circ$, then $\angle APB$ is equal to:



- (A) 130° (B) 50°
(C) 120° (D) 90°

SOLUTION



$OA \perp PA$ and $OB \perp PB$, so in the quadrilateral $OAPB$: $\angle APB = 360^\circ - 90^\circ - 90^\circ - 130^\circ = 50^\circ$. (The angle at the centre and the angle between the tangents add up to 180° .)

Answer: (B) 50°

Q15 · AREAS RELATED TO CIRCLES · 1 MARK

Area of a segment of a circle of radius r and central angle 60° is:

- (A) $\frac{\pi r^2}{2} - \frac{1}{2}r^2$ (B) $\frac{2\pi r}{4} - \frac{\sqrt{3}}{4}r^2$
(C) $\frac{\pi r^2}{6} - \frac{\sqrt{3}}{4}r^2$ (D) $\frac{2\pi r}{4} - r^2 \sin 60^\circ$

SOLUTION

Segment = sector – triangle. Sector = $\frac{60}{360}\pi r^2 = \frac{\pi r^2}{6}$.

The triangle with two sides r and angle 60° is equilateral: area $\frac{\sqrt{3}}{4}r^2$.

Segment = $\frac{\pi r^2}{6} - \frac{\sqrt{3}}{4}r^2$.

Answer: (C) $\frac{\pi r^2}{6} - \frac{\sqrt{3}}{4}r^2$

Q16 · SURFACE AREAS AND VOLUMES · 1 MARK

A hemispherical bowl is made of steel of thickness 1 cm. The outer radius of the bowl is 6 cm. The volume of steel used (in cm^3) is:

- (A) 182π (B) $\frac{182}{3}\pi$
(C) $\frac{682}{3}\pi$ (D) $\frac{364}{3}\pi$

SOLUTION

Outer radius $R = 6$ cm and inner radius $r = 6 - 1 = 5$ cm.

$$\text{Steel} = \frac{2}{3}\pi(R^3 - r^3) = \frac{2}{3}\pi(216 - 125) = \frac{2}{3}\pi \times 91 = \frac{182}{3}\pi \text{ cm}^3.$$

Answer: (B) $\frac{182}{3}\pi$

Q17 · STATISTICS · 1 MARK

The mean and median of a frequency distribution are 43 and 43.4 respectively. The mode of the distribution is:

- (A) 43.4 (B) 42.4
(C) 44.2 (D) 49.3

SOLUTION

$$\text{Mode} = 3 \text{ Median} - 2 \text{ Mean} = 3(43.4) - 2(43) = 130.2 - 86 = 44.2.$$

Answer: (C) 44.2

Q18 · PROBABILITY · 1 MARK

The probability for a randomly selected number out of 1, 2, 3, 4, ..., 25 to be a composite number is:

- (A) $\frac{15}{25}$ (B) $\frac{10}{25}$
(C) $\frac{11}{25}$ (D) $\frac{9}{25}$

SOLUTION

Primes up to 25: 2, 3, 5, 7, 11, 13, 17, 19, 23, which is 9. The number 1 is neither prime nor composite.

$$\text{Composite numbers} = 25 - 9 - 1 = 15, \text{ so } P = \frac{15}{25}.$$

Answer: (A) $\frac{15}{25}$

Common mistake: Counting 1 as composite (giving 16) or as prime. It is neither.

Q19 · SURFACE AREAS AND VOLUMES · 1 MARK

Assertion (A): The surface area of the cuboid formed by joining two cubes of sides 4 cm each, end-to-end, is 160 cm^2 .

Reason (R): The surface area of a cuboid of dimensions $l \times b \times h$ is $(lb + bh + hl)$.

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

SOLUTION

(A) The cuboid is $8 \times 4 \times 4$: surface area $= 2(32 + 16 + 32) = 2 \times 80 = 160 \text{ cm}^2$. True. (Also: 10 outer faces of 16 cm^2 each $= 160 \text{ cm}^2$.)

(R) The correct formula is $2(lb + bh + hl)$; the factor 2 is missing. False.

Answer: (C) A is true, R is false

Q20 · ARITHMETIC PROGRESSIONS · 1 MARK

Assertion (A): The mean of first n natural numbers is $\frac{n-1}{2}$.

Reason (R): The sum of first n natural numbers is $\frac{n(n+1)}{2}$.

(A) Both A and R are true and R is the correct explanation of A

(C) A is true, but R is false

(B) Both A and R are true, but R is not the correct explanation of A

(D) A is false, but R is true

SOLUTION

(R) $1 + 2 + \dots + n = \frac{n(n+1)}{2}$. True.

(A) Mean $= \frac{n(n+1)}{2} \div n = \frac{n+1}{2}$, not $\frac{n-1}{2}$. False. (For $n = 3$: mean of 1, 2, 3 is $2 = \frac{3+1}{2}$.)

Answer: (D) A is false, R is true

Section B: Very short answer

5 questions, 2 marks each.

Q21 · POLYNOMIALS · 2 MARKS

If α, β are the zeroes of the quadratic polynomial $px^2 + qx + r$, then find the value of $\alpha^3\beta + \beta^3\alpha$.

SOLUTION

$$\alpha + \beta = -\frac{q}{p} \text{ and } \alpha\beta = \frac{r}{p}.$$

$$\alpha^3\beta + \beta^3\alpha = \alpha\beta(\alpha^2 + \beta^2) = \alpha\beta[(\alpha + \beta)^2 - 2\alpha\beta].$$

$$= \frac{r}{p} \left[\frac{q^2}{p^2} - \frac{2r}{p} \right] = \frac{r}{p} \times \frac{q^2 - 2pr}{p^2} = \frac{r(q^2 - 2pr)}{p^3}.$$

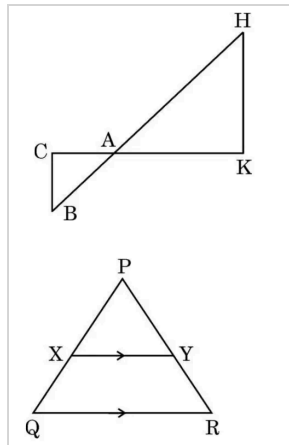
Answer: $\frac{r}{p^3}(q^2 - 2pr)$

Q22 · TRIANGLES · 2 MARKS

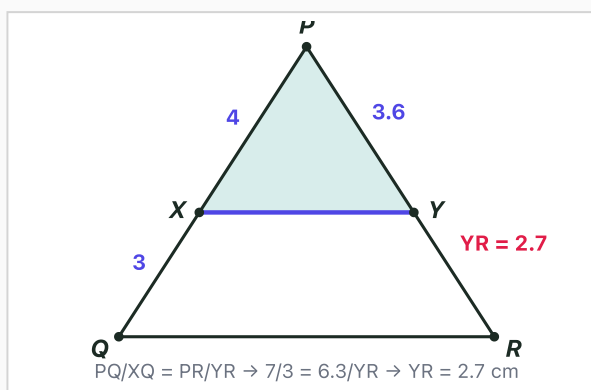
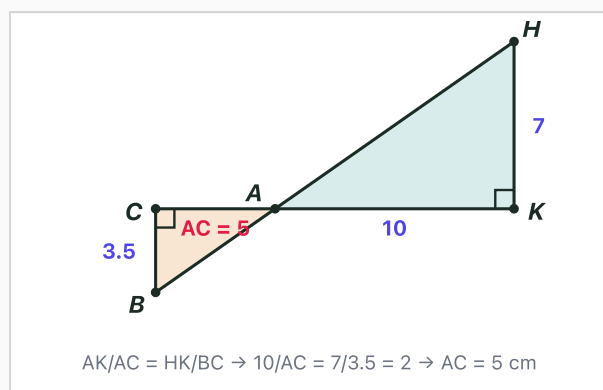
(a) In the given figure, $\triangle AHK \sim \triangle ABC$. If $AK = 10$ cm, $BC = 3.5$ cm and $HK = 7$ cm, find the length of AC .

OR

(b) In the given figure, $XY \parallel QR$, $\frac{PQ}{XQ} = \frac{7}{3}$ and $PR = 6.3$ cm. Find the length of YR .



SOLUTION



(a) $\triangle AHK \sim \triangle ABC$, so $\frac{AK}{AC} = \frac{HK}{BC} : \frac{10}{AC} = \frac{7}{3.5} = 2$, so $AC = 5$ cm.

(b) $XY \parallel QR$, so $\frac{PQ}{XQ} = \frac{PR}{YR}$ (a line parallel to a side cuts the other two sides in the same ratio, so the whole-to-part ratios are equal).

$$\frac{7}{3} = \frac{6.3}{YR}, \text{ so } YR = \frac{6.3 \times 3}{7} = 2.7 \text{ cm.}$$

Answer: (a) 5 cm (b) 2.7 cm

Q23 · COORDINATE GEOMETRY · 2 MARKS

If the points $A(4, 5)$, $B(m, 6)$, $C(4, 3)$ and $D(1, n)$ taken in this order are the vertices of a parallelogram $ABCD$, then find the values of m and n .

SOLUTION

The diagonals of a parallelogram bisect each other, so the mid-points of AC and BD coincide.

$$\text{Mid-point of } AC = \left(\frac{4+4}{2}, \frac{5+3}{2} \right) = (4, 4). \text{ Mid-point of } BD = \left(\frac{m+1}{2}, \frac{6+n}{2} \right).$$

$$\frac{m+1}{2} = 4 \text{ gives } m = 7, \text{ and } \frac{6+n}{2} = 4 \text{ gives } n = 2.$$

Answer: $m = 7$ and $n = 2$

Q24 · TRIGONOMETRY · 2 MARKS

(a) If $\tan \theta + \frac{1}{\tan \theta} = 2$, find the value of $\tan^2 \theta + \frac{1}{\tan^2 \theta}$.

OR

(b) Prove that: $\sqrt{\frac{1 - \sin \theta}{1 + \sin \theta}} = \sec \theta - \tan \theta$.

SOLUTION

(a) Square both sides: $\tan^2 \theta + 2 + \frac{1}{\tan^2 \theta} = 4$, so $\tan^2 \theta + \frac{1}{\tan^2 \theta} = 2$.

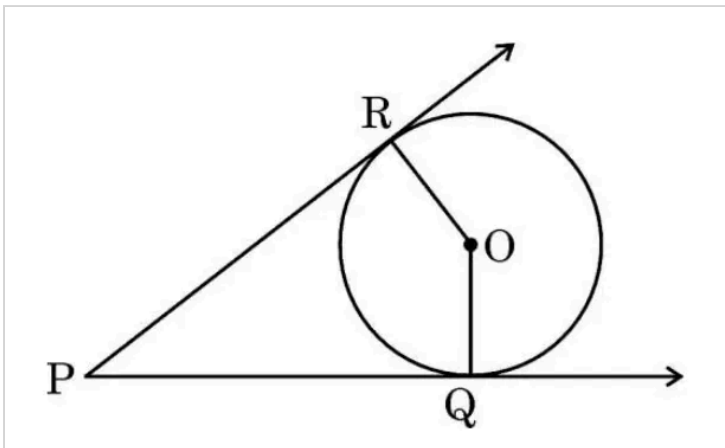
(b) Multiply the top and bottom inside the root by $(1 - \sin \theta)$: $\text{LHS} = \sqrt{\frac{(1 - \sin \theta)^2}{1 - \sin^2 \theta}} = \sqrt{\frac{(1 - \sin \theta)^2}{\cos^2 \theta}}$.

$= \frac{1 - \sin \theta}{\cos \theta} = \sec \theta - \tan \theta = \text{RHS}$.

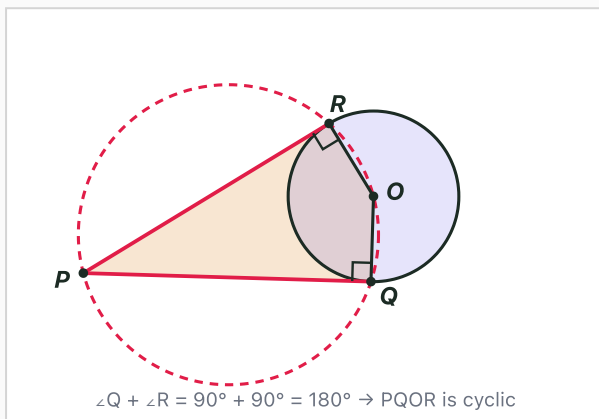
Answer: (a) 2 (b) proved

Q25 · CIRCLES · 2 MARKS

In the given figure, O is the centre of the circle. PQ and PR are tangents. Show that the quadrilateral $PQOR$ is cyclic.



SOLUTION



The radius is perpendicular to the tangent at the point of contact: $\angle PQO = 90^\circ$ and $\angle PRO = 90^\circ$.

$\angle PQO + \angle PRO = 180^\circ$. A pair of opposite angles of $PQOR$ is supplementary, so the quadrilateral $PQOR$ is cyclic.

Answer: Shown

Section C: Short answer

6 questions, 3 marks each.

Q26 · REAL NUMBERS · 3 MARKS

Prove that $\sqrt{5}$ is an irrational number.

SOLUTION

Suppose $\sqrt{5} = \frac{p}{q}$ with p, q co-prime integers and $q \neq 0$.

$5q^2 = p^2$, so 5 divides p^2 and therefore 5 divides p . Write $p = 5a$.

$25a^2 = 5q^2$, so $q^2 = 5a^2$; 5 divides q^2 and so 5 divides q .

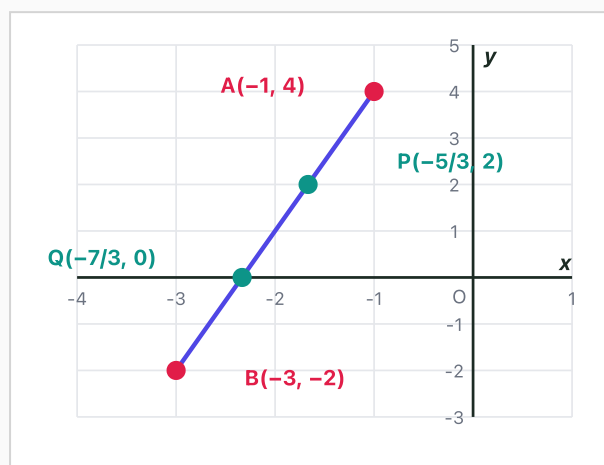
5 divides both p and q , contradicting that they are co-prime. So $\sqrt{5}$ is irrational.

Answer: Proved

Q27 · COORDINATE GEOMETRY · 3 MARKS

Find the coordinates of the points of trisection of the line segment joining the points $A(-1, 4)$ and $B(-3, -2)$.

SOLUTION



Let P and Q be the points of trisection, with $AP : PB = 1 : 2$ and $AQ : QB = 2 : 1$.

$$P = \left(\frac{1(-3) + 2(-1)}{3}, \frac{1(-2) + 2(4)}{3} \right) = \left(-\frac{5}{3}, 2 \right).$$

$$Q = \left(\frac{2(-3) + 1(-1)}{3}, \frac{2(-2) + 1(4)}{3} \right) = \left(-\frac{7}{3}, 0 \right). \text{ (Check: } Q \text{ is the mid-point of } PB \text{ ✓.)}$$

Answer: $\left(-\frac{5}{3}, 2\right)$ and $\left(-\frac{7}{3}, 0\right)$

Q28 · TRIGONOMETRY · 3 MARKS

(a) Prove that: $\frac{\sec^3 \theta}{\sec^2 \theta - 1} + \frac{\operatorname{cosec}^3 \theta}{\operatorname{cosec}^2 \theta - 1} = \sec \theta \cdot \operatorname{cosec} \theta (\sec \theta + \operatorname{cosec} \theta)$.

OR

(b) If $\frac{\sec \alpha}{\operatorname{cosec} \beta} = p$ and $\frac{\tan \alpha}{\operatorname{cosec} \beta} = q$, then prove that $(p^2 - q^2) \sec^2 \alpha = p^2$.

SOLUTION

$$(a) \sec^2 \theta - 1 = \tan^2 \theta \text{ and } \operatorname{cosec}^2 \theta - 1 = \cot^2 \theta. \text{ LHS} = \frac{\sec^3 \theta}{\tan^2 \theta} + \frac{\operatorname{cosec}^3 \theta}{\cot^2 \theta}.$$

$$\frac{\sec^3 \theta}{\tan^2 \theta} = \frac{1}{\cos^3 \theta} \times \frac{\cos^2 \theta}{\sin^2 \theta} = \frac{1}{\cos \theta \sin^2 \theta} \text{ and, in the same way, } \frac{\operatorname{cosec}^3 \theta}{\cot^2 \theta} = \frac{1}{\sin \theta \cos^2 \theta}.$$

$$\text{Sum} = \frac{1}{\sin \theta \cos \theta} \left(\frac{1}{\sin \theta} + \frac{1}{\cos \theta} \right) = \sec \theta \operatorname{cosec} \theta (\operatorname{cosec} \theta + \sec \theta) = \text{RHS.}$$

$$(b) p^2 - q^2 = \frac{\sec^2 \alpha - \tan^2 \alpha}{\operatorname{cosec}^2 \beta} = \frac{1}{\operatorname{cosec}^2 \beta}.$$

$$(p^2 - q^2) \sec^2 \alpha = \frac{\sec^2 \alpha}{\operatorname{cosec}^2 \beta} = \left(\frac{\sec \alpha}{\operatorname{cosec} \beta} \right)^2 = p^2.$$

Answer: Proved (both parts)

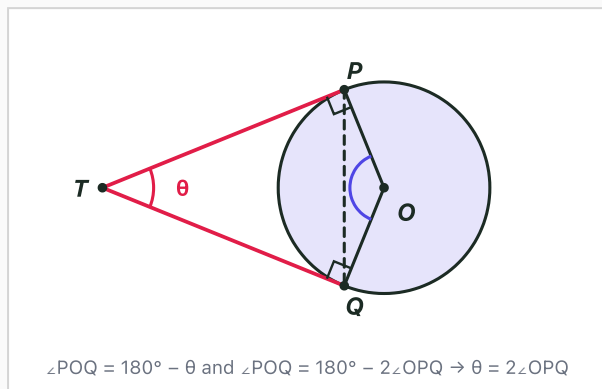
Q29 · CIRCLES · 3 MARKS

(a) Prove that the lengths of tangents drawn from an external point to a circle are equal.

OR

(b) Two tangents TP and TQ are drawn to a circle with centre O from an external point T . Prove that $\angle PTQ = 2\angle OPQ$.

SOLUTION



(a) ****Given:**** a circle with centre O and tangents TP, TQ from the external point T (touching at P and Q). ****To prove:**** $TP = TQ$. Join OP, OQ and OT .

The radius is perpendicular to the tangent: $\angle OPT = \angle OQT = 90^\circ$. In the right triangles OPT and OQT : $OP = OQ$ (radii), OT is common and the angles at P, Q are 90° .

So $\triangle OPT \cong \triangle OQT$ (RHS) and $TP = TQ$.

(b) $OP = OQ$ (radii), so $\angle OPQ = \angle OQP$. In $\triangle OPQ$: $\angle POQ = 180^\circ - 2\angle OPQ$. (i)

In the quadrilateral $OPTQ$ the angles at P and Q are 90° , so $\angle POQ + \angle PTQ = 180^\circ$, that is $\angle POQ = 180^\circ - \angle PTQ$. (ii)

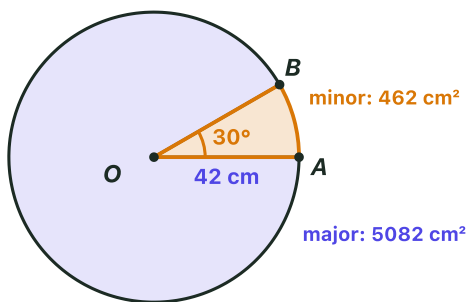
From (i) and (ii): $180^\circ - 2\angle OPQ = 180^\circ - \angle PTQ$, so $\angle PTQ = 2\angle OPQ$.

Answer: Proved (both parts)

Q30 · AREAS RELATED TO CIRCLES · 3 MARKS

Find the area of the sector of a circle of radius 42 cm and of central angle 30° . Also, find the area of the corresponding major sector. (Use $\pi = \frac{22}{7}$)

SOLUTION



$$30/360 \times 22/7 \times 42^2 = 462; 330/360 \times 22/7 \times 42^2 = 5082$$

$$\text{Minor sector} = \frac{30}{360} \times \frac{22}{7} \times 42 \times 42 = \frac{1}{12} \times 5544 = 462 \text{ cm}^2.$$

$$\text{The major sector has central angle } 360^\circ - 30^\circ = 330^\circ: \frac{330}{360} \times \frac{22}{7} \times 42 \times 42 = \frac{11}{12} \times 5544 = 5082 \text{ cm}^2.$$

(Check: $462 + 5082 = 5544$, the whole circle $\checkmark$.)

Answer: Minor sector = 462 cm²; major sector = 5082 cm²

Q31 · PROBABILITY · 3 MARKS

Two dice are thrown at the same time. Determine the probability that the (i) sum of the numbers on the two dice is 5, and (ii) difference of the numbers on the two dice is 3.

SOLUTION

There are $6 \times 6 = 36$ equally likely outcomes.

(i) Sum 5: (1, 4), (4, 1), (2, 3), (3, 2), which is 4 outcomes. $P = \frac{4}{36} = \frac{1}{9}$.

(ii) Difference 3: (1, 4), (4, 1), (2, 5), (5, 2), (3, 6), (6, 3), which is 6 outcomes. $P = \frac{6}{36} = \frac{1}{6}$.

Answer: (i) $\frac{1}{9}$ (ii) $\frac{1}{6}$

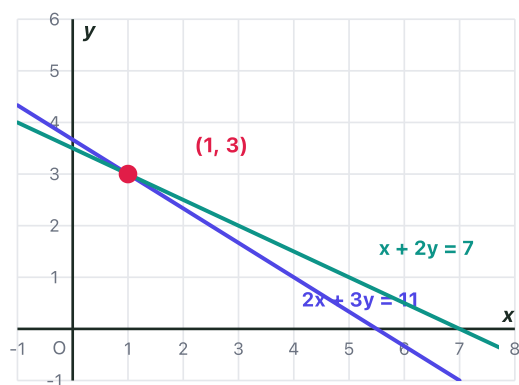
Section D: Long answer

4 questions, 5 marks each.

Q32 · LINEAR EQUATIONS · 5 MARKS

Aarush bought 2 pencils and 3 chocolates for ₹ 11 and Tanish bought 1 pencil and 2 chocolates for ₹ 7 from the same shop. Represent this situation in the form of a pair of linear equations. Find the price of 1 pencil and 1 chocolate, graphically.

SOLUTION



Let a pencil cost ₹ x and a chocolate cost ₹ y . The equations are $2x + 3y = 11$ and $x + 2y = 7$.

Line 1, $2x + 3y = 11$: $y = \frac{11 - 2x}{3}$ gives the points $(1, 3)$, $(4, 1)$ and $(-2, 5)$.

Line 2, $x + 2y = 7$: $y = \frac{7 - x}{2}$ gives the points $(1, 3)$, $(3, 2)$ and $(5, 1)$.

The two lines meet at $(1, 3)$, so $x = 1$ and $y = 3$. (Check: $2 + 9 = 11$ ✓ and $1 + 6 = 7$ ✓.)

Answer: A pencil costs ₹ 1 and a chocolate costs ₹ 3

Q33 · QUADRATIC EQUATIONS · 5 MARKS

(a) A person on a tour has ₹ 4,200 for expenses. If he extends his tour for 3 days, he has to cut down his daily expenses by ₹ 70. Find the original duration of the tour.

OR

(b) The area of a right-angled triangle is 600 cm^2 . If the base of the triangle exceeds the altitude by 10 cm, find all the three dimensions of the triangle.

SOLUTION

(a) Let the tour be x days. Daily expense = $\frac{4200}{x}$, and after the extension $\frac{4200}{x+3}$. $\frac{4200}{x} - \frac{4200}{x+3} = 70$.

$4200 \times 3 = 70x(x+3)$, so $x^2 + 3x - 180 = 0$ and $(x+15)(x-12) = 0$. Days cannot be negative, so $x = 12$.

(Check: $\frac{4200}{12} = 350$ and $\frac{4200}{15} = 280$; the difference is 70 ✓.)

(b) Let the altitude be x cm and the base $(x+10)$ cm. $\frac{1}{2}x(x+10) = 600$, so $x^2 + 10x - 1200 = 0$ and $(x+40)(x-30) = 0$.

$x = 30$ (reject -40). Altitude = 30 cm, base = 40 cm and hypotenuse = $\sqrt{30^2 + 40^2} = 50$ cm.

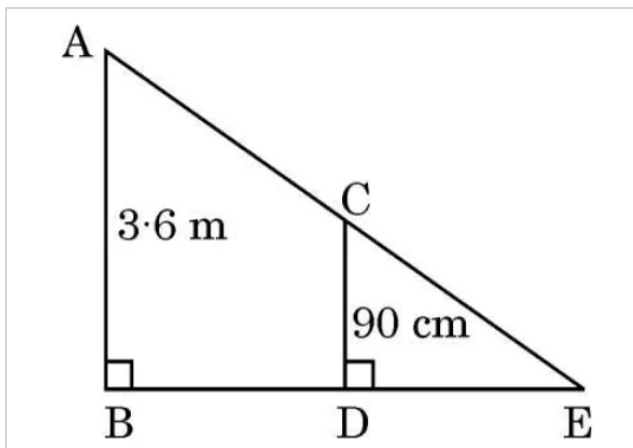
Answer: (a) 12 days (b) 30 cm, 40 cm and 50 cm

Q34 · TRIANGLES · 5 MARKS

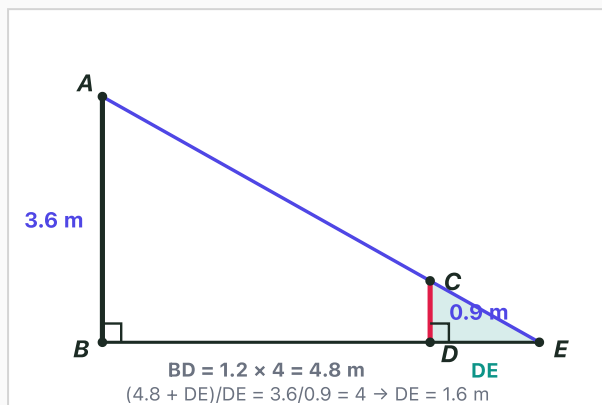
(a) Prove that if a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, then the other two sides are divided in the same ratio.

OR

(b) As shown in the given figure, a girl of height 90 cm is walking away from the base of a lamp post at a speed of 1.2 m/s. If the lamp is 3.6 m above the ground, find the length of her shadow after 4 seconds.



SOLUTION



(a) ****Given:**** in $\triangle ABC$, $DE \parallel BC$ with D on AB and E on AC . ****To prove:**** $\frac{AD}{DB} = \frac{AE}{EC}$. ****Construction:**** join BE and CD , and draw $DM \perp AC$ and $EN \perp AB$.

$$\frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle BDE)} = \frac{\frac{1}{2} \cdot AD \cdot EN}{\frac{1}{2} \cdot DB \cdot EN} = \frac{AD}{DB} \text{ and } \frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle CDE)} = \frac{\frac{1}{2} \cdot AE \cdot DM}{\frac{1}{2} \cdot EC \cdot DM} = \frac{AE}{EC}.$$

$\triangle BDE$ and $\triangle CDE$ have the same base DE and lie between the same parallels DE and BC , so their areas are equal. Hence $\frac{AD}{DB} = \frac{AE}{EC}$.

(b) She walks $BD = 1.2 \times 4 = 4.8$ m. Let her shadow be DE . $AB \parallel CD$ (both vertical), so $\triangle ABE \sim \triangle CDE$ (AA).

$$\frac{BE}{DE} = \frac{AB}{CD} : \frac{4.8 + DE}{DE} = \frac{3.6}{0.9} = 4, \text{ so } 4.8 + DE = 4DE \text{ and } DE = 1.6 \text{ m.}$$

Answer: (a) proved (b) the shadow is 1.6 m long

Q35 · STATISTICS · 5 MARKS

An SBI health insurance agent found the following data for distribution of ages of 100 policy holders. The health insurance policies are given to persons of age 15 years and onwards, but less than 60 years.

Find the modal age and median age of the policy holders.

Age (in yrs)	15–20	20–25	25–30	30–35	35–40	40–45	45–50	50–55	55–60
Number of policy holders	2	4	18	21	33	11	3	6	2

SOLUTION

Cumulative frequencies: 2, 6, 24, 45, 78, 89, 92, 98, 100.

Modal class: the highest frequency is 33, so it is 35 – 40: $l = 35$, $f_1 = 33$, $f_0 = 21$, $f_2 = 11$, $h = 5$.

$$\text{Mode} = 35 + \frac{33 - 21}{2(33) - 21 - 11} \times 5 = 35 + \frac{12}{34} \times 5 = \frac{625}{17} \approx 36.76 \text{ years.}$$

Median: $\frac{n}{2} = 50$ lies in the class 35 – 40 (the previous cf is 45, the next is 78): $l = 35$, $cf = 45$, $f = 33$.

$$\text{Median} = 35 + \frac{50 - 45}{33} \times 5 = 35 + \frac{25}{33} = \frac{1180}{33} \approx 35.76 \text{ years.}$$

(The marking scheme gives these as 36.7 and 35.7 years, approximately; rounding to one decimal place they are 36.8 and 35.8.)

Answer: Modal age $\approx$ 36.76 years; median age $\approx$ 35.76 years

Section E: Case studies

3 case studies, 4 marks each.

Q36 · ARITHMETIC PROGRESSIONS · 4 MARKS

Case study 1. Your elder brother wants to buy a car and plans to take a loan from a bank for his car. He repays his total loan of ₹ 1,18,000 by paying every month, starting with the first instalment of ₹ 1,000 and he increases the instalment by ₹ 100 every month.

Based on the information given above, answer the following questions:

- (i) Find the amount paid by him in the 30th instalment. [1]
- (ii) If the total number of instalments is 40, what is the amount paid in the last instalment? [1]
- (iii) (a) What amount does he still have to pay after the 30th instalment? [2]

OR

- (iii) (b) Find the ratio of the tenth instalment to the last instalment. [2]

SOLUTION

The instalments form an A.P. with $a = 1000$ and $d = 100$.

$$(i) a_{30} = 1000 + 29 \times 100 = 3900.$$

$$(ii) a_{40} = 1000 + 39 \times 100 = 4900.$$

$$(iii)(a) S_{30} = \frac{30}{2}[2(1000) + 29 \times 100] = 15 \times 4900 = 73500. \text{ Left to pay} = 118000 - 73500 = ₹44500.$$

$$(iii)(b) a_{10} = 1000 + 900 = 1900. \frac{a_{10}}{a_{40}} = \frac{1900}{4900} = \frac{19}{49}.$$

(Check: $S_{40} = 20(2000 + 3900) = 118000$, the full loan ✓.)

Answer: (i) ₹ 3900 (ii) ₹ 4900 (iii)(a) ₹ 44500 (iii)(b) 19 : 49

Q37 · TRIGONOMETRY · 4 MARKS

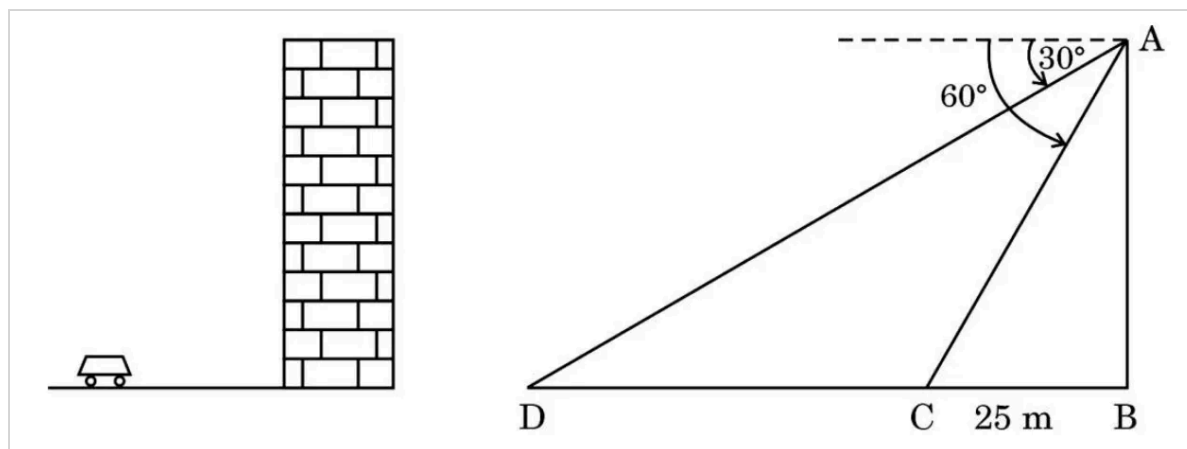
Case study 2. Tejas is standing at the top of a building and observes a car at an angle of depression of 30° as it approaches the base of the building at a uniform speed. 6 seconds later, the angle of depression increases to 60° , and at that moment, the car is 25 m away from the building.

Based on the information given above, answer the following questions:

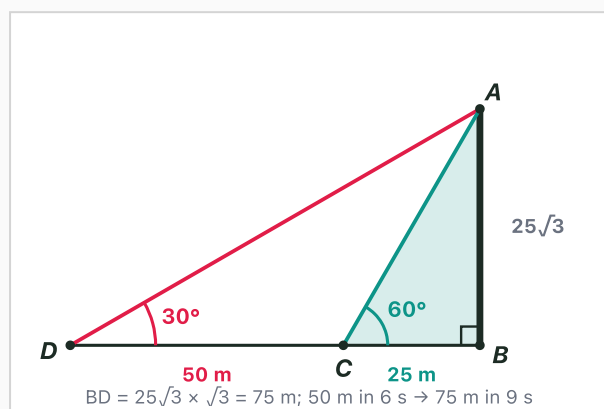
- (i) What is the height of the building? [1]
- (ii) What is the distance between the two positions of the car? [1]
- (iii) (a) What would be the total time taken by the car to reach the foot of the building from the starting point? [2]

OR

- (iii) (b) What is the distance of the observer from the car when it makes an angle of 60° ? [2]



SOLUTION



- (i) The angle of depression 60° equals the angle of elevation at C . In $\triangle ABC$: $\tan 60^\circ = \frac{AB}{25}$, so $AB = 25\sqrt{3}$ m.
- (ii) In $\triangle ABD$: $\tan 30^\circ = \frac{25\sqrt{3}}{BD} = \frac{1}{\sqrt{3}}$, so $BD = 75$ m. Distance between the positions = $75 - 25 = 50$ m.
- (iii)(a) 50 m takes 6 s, so 75 m takes $\frac{6}{50} \times 75 = 9$ s.
- (iii)(b) $\cos 60^\circ = \frac{BC}{AC}$, so $\frac{1}{2} = \frac{25}{AC}$ and $AC = 50$ m.

Answer: (i) $25\sqrt{3}$ m (ii) 50 m (iii)(a) 9 s (iii)(b) 50 m

Q38 · SURFACE AREAS AND VOLUMES · 4 MARKS

Case study 3. On a Sunday your parents took you to a fair. You could see lot of toys displayed and you wanted them to buy a Rubik's cube and a strawberry ice-cream for you.

Based on the information given above, answer the following questions:

- (i) Find the length of the diagonal of Rubik's cube if each edge measures 6 cm. [1]
- (ii) Find the volume of Rubik's cube if the length of the edge is 7 cm. [1]
- (iii) (a) What is the curved surface area of hemisphere (ice-cream) if the base radius is 7 cm? [2]

OR

- (iii) (b) If two cubes of edges 4 cm are joined end-to-end, then find the surface area of the resulting cuboid. [2]

SOLUTION

(i) The diagonal of a cube of edge a is $a\sqrt{3}$, so it is $6\sqrt{3}$ cm.

(ii) Volume = $7^3 = 343$ cm³.

(iii)(a) Curved surface area of a hemisphere = $2\pi r^2 = 2 \times \frac{22}{7} \times 7 \times 7 = 308$ cm².

(iii)(b) The cuboid is $8 \times 4 \times 4$: surface area = $2(8 \times 4 + 4 \times 4 + 8 \times 4) = 2 \times 80 = 160$ cm².

Answer: (i) $6\sqrt{3}$ cm (ii) 343 cm³ (iii)(a) 308 cm² (iii)(b) 160 cm²

Stuck on a step? CogniGuru's AI tutor explains any doubt one minute at a time, in English or Hindi.

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Questions are from the official CBSE paper. Solutions are written by CogniGuru.