

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

Q.P. Code 30/1/1 · Series NL1KM · 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 HCF of 960 and 432 is:

- (A) 48 (B) 54
(C) 72 (D) 36

SOLUTION

$$960 = 2^6 \times 3 \times 5 \text{ and } 432 = 2^4 \times 3^3.$$

$$\text{HCF} = \text{common primes at the smaller powers} = 2^4 \times 3 = 48.$$

Answer: (A) 48

Q2 · REAL NUMBERS · 1 MARK

The natural number 2 is:

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

SOLUTION

2 has exactly two factors, 1 and 2, so it is prime (the only even prime).

Answer: (A) a prime number

Q3 · REAL NUMBERS · 1 MARK

For any natural number n , 6^n ends with the digit:

- (A) 0 (B) 6
(C) 3 (D) 2

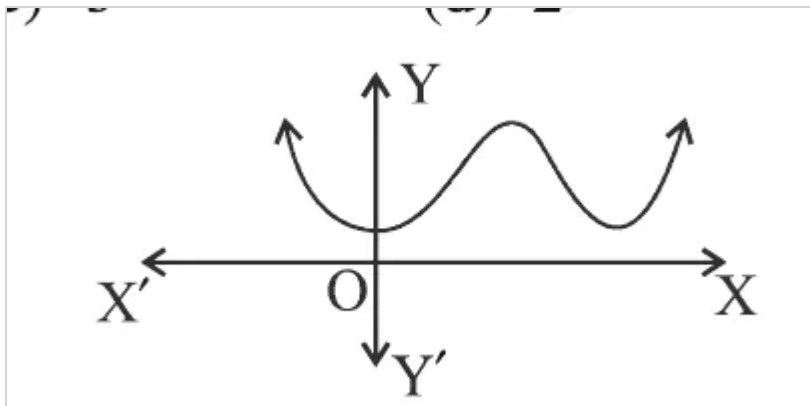
SOLUTION

$6 \times 6 = 36$, $36 \times 6 = 216$, and any number ending in 6 times 6 ends in 6. So 6^n always ends in 6.

Answer: (B) 6

Q4 · POLYNOMIALS · 1 MARK

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



- (A) 0 (B) 1
(C) 2 (D) 4

SOLUTION

The zeroes of $f(x)$ are the x -values where the graph meets the x -axis. This curve stays above the x -axis everywhere and never touches it, so there are no zeroes.

Answer: (A) 0

Q5 · LINEAR EQUATIONS · 1 MARK

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

SOLUTION

Coincident lines lie on top of each other, so every point of the line satisfies both equations: infinitely many solutions.

Answer: (D) an infinite number of solutions

Q6 · ARITHMETIC PROGRESSIONS · 1 MARK

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

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

SOLUTION

$$d = 2\sqrt{2} - \sqrt{2} = \sqrt{2}.$$

Answer: (A) $\sqrt{2}$

Q7 · TRIANGLES · 1 MARK

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

SOLUTION

$$\frac{DE}{AB} = 2, \text{ so the scale factor is } 2 \text{ and } EF = 2 \times BC = 2 \times 8 = 16 \text{ cm.}$$

Answer: (D) 16 cm

Q8 · COORDINATE GEOMETRY · 1 MARK

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

SOLUTION

Mid-point = $\left(\frac{5+6}{2}, \frac{-4+4}{2}\right) = \left(\frac{11}{2}, 0\right)$. Its y -coordinate is 0, so it lies on the x -axis.

Answer: (A) x -axis

Q9 · TRIGONOMETRY · 1 MARK

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

SOLUTION

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

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

Q10 · TRIGONOMETRY · 1 MARK

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) $\frac{1}{2}$

SOLUTION

$$\sin^2 A + 2 \cos^2 A = (\sin^2 A + \cos^2 A) + \cos^2 A = 1 + \cos^2 A = 1 + \frac{1}{4} = \frac{5}{4}.$$

Answer: (B) $\frac{5}{4}$

Q11 · TRIGONOMETRY · 1 MARK

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°

SOLUTION

$$\tan \theta = \frac{\text{height}}{\text{distance}} = \frac{30}{10\sqrt{3}} = \sqrt{3}, \text{ so } \theta = 60^\circ.$$

Answer: (D) 60°

Q12 · CIRCLES · 1 MARK

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°

SOLUTION

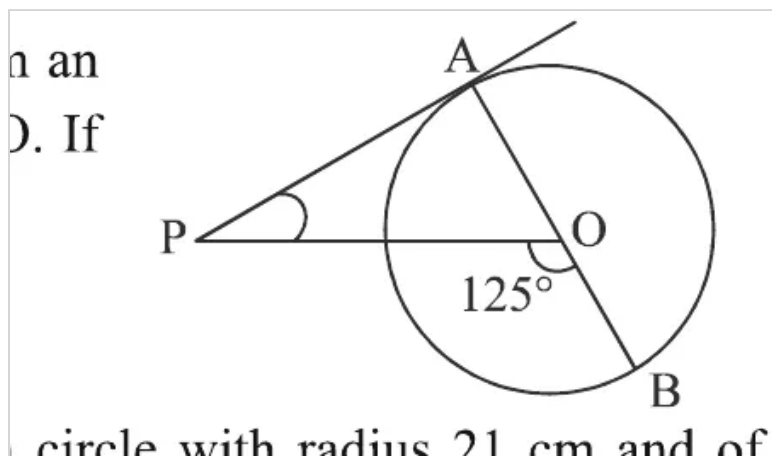
$OP \perp TP$ and $OQ \perp TQ$, so in the quadrilateral $OPTQ$ the angles at P and Q are 90° .

$\angle PTQ = 360^\circ - 90^\circ - 90^\circ - 120^\circ = 60^\circ$. (The angle between the tangents and the angle at the centre add to 180° .)

Answer: (A) 60°

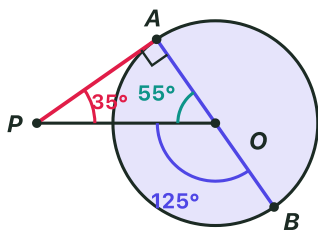
Q13 · CIRCLES · 1 MARK

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°

SOLUTION



$$\angle POA = 180^\circ - 125^\circ = 55^\circ; \angle OAP = 90^\circ \rightarrow \angle APO = 35^\circ$$

A, O, B are on one straight line (a diameter), so $\angle POA = 180^\circ - 125^\circ = 55^\circ$.

$OA \perp PA$ (radius and tangent), so in $\triangle OAP$: $\angle APO = 180^\circ - 90^\circ - 55^\circ = 35^\circ$.

Answer: (D) 35°

Q14 • AREAS RELATED TO CIRCLES • 1 MARK

The length of the arc of a 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

SOLUTION

$$\text{Arc} = \frac{60}{360} \times 2\pi r = \frac{1}{6} \times 2 \times \frac{22}{7} \times 21 = 22 \text{ cm.}$$

Answer: (A) 22 cm

Q15 • AREAS RELATED TO CIRCLES • 1 MARK

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°

SOLUTION

The hour hand turns 360° in 12 hours, which is 30° per hour, or 0.5° per minute.

From 7:00 to 8:10 is 70 minutes, so the angle is $70 \times 0.5 = 35^\circ$. (The 7 cm length is not needed for the angle.)

Answer: (C) 35°

Q16 • SURFACE AREAS AND VOLUMES • 1 MARK

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) $\frac{3}{4}\pi d^2$

SOLUTION

Diameter $2d$ means the radius is d . Total surface area of a solid hemisphere $= 3\pi r^2 = 3\pi d^2$.

Answer: (A) $3\pi d^2$

Q17 · STATISTICS · 1 MARK

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

SOLUTION

Mode = 3 Median – 2 Mean, so $21 = 3M - 24$ and $M = 15$.

Answer: (C) 15

Q18 · PROBABILITY · 1 MARK

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

SOLUTION

$P(3) = \frac{1}{6}$, so $P(\text{not } 3) = 1 - \frac{1}{6} = \frac{5}{6}$.

Answer: (C) $\frac{5}{6}$

Q19 · PROBABILITY · 1 MARK

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 $\frac{5}{7}$.

- (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) A leap year has $366 = 52 \text{ weeks} + 2 \text{ days}$. The two extra days are one of 7 equally likely pairs, and 2 of them contain a Monday (Sun–Mon and Mon–Tue). So $P = \frac{2}{7}$. True.

(R) A non-leap year has 52 weeks + 1 day, so $P(53 \text{ Mondays}) = \frac{1}{7}$, not $\frac{5}{7}$. False.

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

Q20 · POLYNOMIALS · 1 MARK

Assertion (A): The polynomial $p(y) = y^2 + 4y + 3$ has two zeroes.

Reason (R): A quadratic polynomial can have at most two zeroes.

- (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) $y^2 + 4y + 3 = (y + 1)(y + 3)$, so the zeroes are -1 and -3 : two zeroes. True.

(R) A polynomial of degree 2 has at most 2 zeroes. True. But R is a general limit, it does not show that this particular polynomial has two (we needed to factorise), so it is not the explanation.

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

Section B: Very short answer

5 questions, 2 marks each.

Q21 • POLYNOMIALS • 2 MARKS

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

SOLUTION

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

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

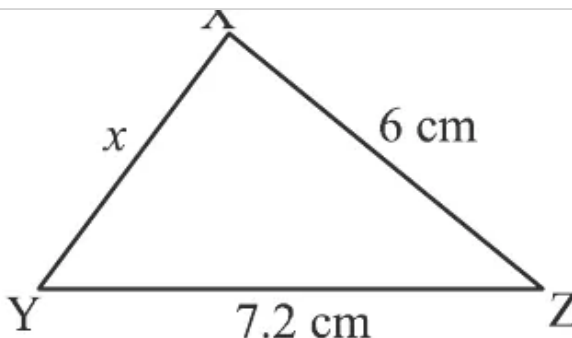
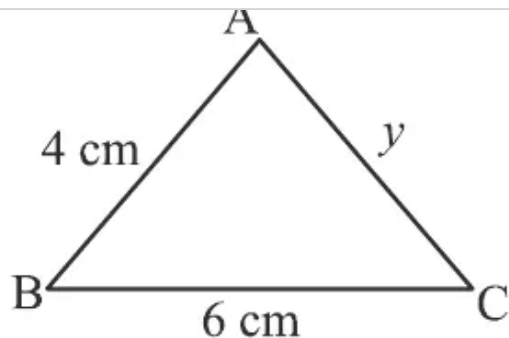
Answer: -3

Q22 • TRIANGLES • 2 MARKS

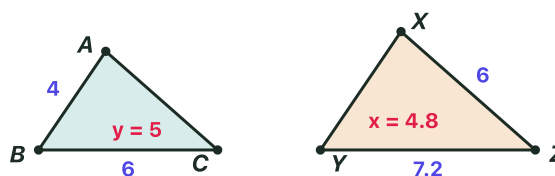
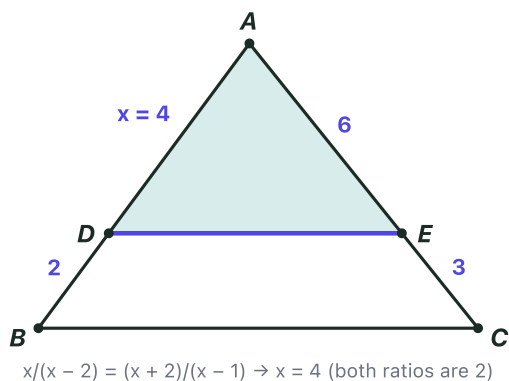
(a) In $\triangle ABC$, $DE \parallel BC$. If $AD = x$, $DB = x - 2$, $AE = x + 2$ and $EC = x - 1$, then find the value of x .

OR

(b) In the figure given, $\triangle ABC \sim \triangle XYZ$, with $AB = 4$ cm, $BC = 6$ cm, $AC = y$ and $XY = x$, $XZ = 6$ cm, $YZ = 7.2$ cm. Find the values of x and y .



SOLUTION



$$\text{ratio } BC/YZ = 6/7.2 = 5/6 \rightarrow x = 4 \times 6/5 = 4.8, y = 6 \times 5/6 = 5$$

(a) $DE \parallel BC$, so $\frac{AD}{DB} = \frac{AE}{EC}$; $\frac{x}{x-2} = \frac{x+2}{x-1}$.

$$x(x-1) = (x+2)(x-2), \text{ so } x^2 - x = x^2 - 4 \text{ and } x = 4.$$

(b) Similar triangles have proportional sides: $\frac{AB}{XY} = \frac{BC}{YZ} = \frac{AC}{XZ}$, that is $\frac{4}{x} = \frac{6}{7.2} = \frac{y}{6}$.

$$\frac{6}{7.2} = \frac{5}{6}. \text{ So } x = 4 \times \frac{6}{5} = 4.8 \text{ cm and } y = 6 \times \frac{5}{6} = 5 \text{ cm.}$$

Answer: (a) $x = 4$ (b) $x = 4.8 \text{ cm}, y = 5 \text{ cm}$

Q23 · COORDINATE GEOMETRY · 2 MARKS

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.

SOLUTION

The distance from the centre to the point equals the radius: $(x-7+9)^2 + (2x-11)^2 = (5\sqrt{2})^2 = 50$.

$$(x+2)^2 + (2x-11)^2 = 50, \text{ so } x^2 + 4x + 4 + 4x^2 - 44x + 121 = 50 \text{ and } 5x^2 - 40x + 75 = 0, \text{ that is } x^2 - 8x + 15 = 0.$$

$$(x-3)(x-5) = 0, \text{ so } x = 3 \text{ or } x = 5.$$

Answer: $x = 3$ or $x = 5$

Q24 · TRIGONOMETRY · 2 MARKS

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

OR

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

SOLUTION

(a) $\tan \theta = \frac{24}{7}$: the hypotenuse is $\sqrt{24^2 + 7^2} = 25$, so $\sin \theta = \frac{24}{25}$ and $\cos \theta = \frac{7}{25}$.

$$\sin \theta + \cos \theta = \frac{24+7}{25} = \frac{31}{25}.$$

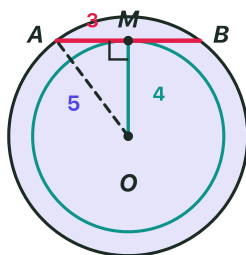
$$(b) \frac{(1+\sin \theta)(1-\sin \theta)}{(1+\cos \theta)(1-\cos \theta)} = \frac{1-\sin^2 \theta}{1-\cos^2 \theta} = \frac{\cos^2 \theta}{\sin^2 \theta} = \cot^2 \theta = \frac{49}{64}.$$

Answer: (a) $\frac{31}{25}$ (b) $\frac{49}{64}$

Q25 · CIRCLES · 2 MARKS

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.

SOLUTION



$$AM = \sqrt{5^2 - 4^2} = 3 \text{ cm} \rightarrow AB = 2 \times 3 = 6 \text{ cm}$$

Let the chord AB of the larger circle touch the smaller circle at M . The radius to the point of contact is perpendicular to the tangent, so $OM \perp AB$ and $OM = 4$ cm.

The perpendicular from the centre bisects the chord. In the right triangle OMA : $AM = \sqrt{5^2 - 4^2} = 3$ cm.

$$AB = 2 \times 3 = 6 \text{ cm.}$$

Answer: 6 cm

Section C: Short answer

6 questions, 3 marks each.

Q26 · REAL NUMBERS · 3 MARKS

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

SOLUTION

Suppose $\sqrt{3}$ is rational: $\sqrt{3} = \frac{p}{q}$ with p, q co-prime integers, $q \neq 0$.

Squaring, $3q^2 = p^2$, so 3 divides p^2 and therefore 3 divides p . Write $p = 3a$.

Then $9a^2 = 3q^2$, so $q^2 = 3a^2$; 3 divides q^2 and so 3 divides q .

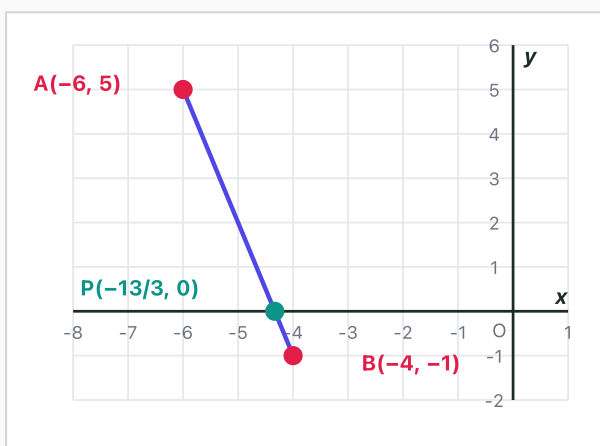
Now 3 divides both p and q , which contradicts that they are co-prime. So $\sqrt{3}$ is irrational.

Answer: Proved

Q27 · COORDINATE GEOMETRY · 3 MARKS

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.

SOLUTION



A point on the x -axis has $y = 0$. Let it divide the segment from $A(-6, 5)$ to $B(-4, -1)$ in the ratio $k : 1$.

$$y = \frac{k(-1) + 1(5)}{k + 1} = 0, \text{ so } -k + 5 = 0 \text{ and } k = 5. \text{ The ratio is } 5 : 1.$$

$$x = \frac{5(-4) + 1(-6)}{5 + 1} = \frac{-26}{6} = -\frac{13}{3}. \text{ The point is } \left(-\frac{13}{3}, 0\right).$$

Answer: Ratio 5 : 1; point $\left(-\frac{13}{3}, 0\right)$

Q28 · TRIGONOMETRY · 3 MARKS

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

OR

(b) Prove that $\frac{\tan A}{1 + \sec A} - \frac{\tan A}{1 - \sec A} = 2 \operatorname{cosec} A$.

SOLUTION

(a) $\frac{x-h}{a} = \cos \theta$ and $\frac{y-k}{b} = \sin \theta$.

$$\text{LHS} = \cos^2 \theta + \sin^2 \theta = 1 = \text{RHS}.$$

(b) $\text{LHS} = \tan A \cdot \frac{(1 - \sec A) - (1 + \sec A)}{(1 + \sec A)(1 - \sec A)} = \tan A \cdot \frac{-2 \sec A}{1 - \sec^2 A}$.

$$1 - \sec^2 A = -\tan^2 A, \text{ so LHS} = \frac{-2 \tan A \sec A}{-\tan^2 A} = \frac{2 \sec A}{\tan A} = \frac{2}{\cos A} \cdot \frac{\cos A}{\sin A} = 2 \operatorname{cosec} A = \text{RHS}.$$

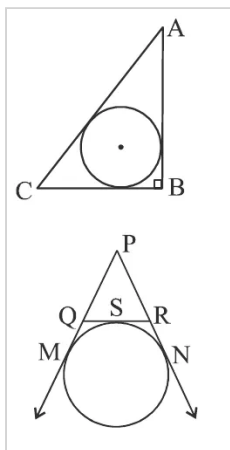
Answer: Proved (both parts)

Q29 · CIRCLES · 3 MARKS

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

OR

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



SOLUTION



Tangents from a point are equal: $AD = AF = 4 - x$ and $CE = CF = 3 - x$. $AF + CF = AC$ gives $(4 - x) + (3 - x) = 5$, so $x = 1$.

$\angle B = 90^\circ$ and $BD = BE$, so $BDIE$ is a square and the radius equals $x = 1$ cm. (Check with areas: $\frac{1}{2} \times 3 \times 4 = 6 = \frac{1}{2}r(3 + 4 + 5) = 6r$, so $r = 1$ ✓.)

$$2PM = PM + PN = (PQ + QM) + (PR + RN) = PQ + PR + QS + RS = PQ + PR + QR. \text{ So } PM = \frac{1}{2}(PQ + QR + PR).$$

Answer: (a) 1 cm (b) proved

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 $\pi = \frac{22}{7}$)

Diagram of a capsule-shaped pill. The pill consists of a central cylindrical part and two hemispherical ends. The radius of the hemispheres is labeled as $r = 3.5 \text{ cm}$. The height of the central cylinder is labeled as $\text{cylinder} = 13 \text{ cm}$. The total height of the pill is labeled as $\text{height} = 20 \text{ cm}$.

$$V = \pi r^2 \cdot 13 + (4/3)\pi r^3 = 4081/6 \approx 680.2 \text{ cm}^3$$

Radius of the cylinder and of each hemisphere = $\frac{7}{2}$ cm. The two hemispheres take $\frac{7}{2} + \frac{7}{2} = 7$ cm of the height, so the cylinder is $20 - 7 = 13$ cm tall.

$$\text{Volume} = \pi r^2 h + 2 \times \frac{2}{3} \pi r^3 = \pi r^2 \left(13 + \frac{4}{3} \times \frac{7}{2} \right) = \pi r^2 \left(13 + \frac{14}{3} \right).$$

$$= \frac{22}{7} \times \frac{49}{4} \times \frac{53}{3} = \frac{77}{2} \times \frac{53}{3} = \frac{4081}{6} \approx 680.17 \text{ cm}^3.$$

Answer: $\frac{4081}{6} \approx 680.17 \text{ cm}^3$

Common mistake: Taking the cylinder as $20 - 7 = 13$ only after adding the two radii. Using 20 cm or $20 - 3.5$ for the cylinder overcounts.

Q31 · PROBABILITY · 3 MARKS

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?
- (ii) different number appears on both the dice?

SOLUTION

Writing (number on the first die, number on the second): $(1, 1), (1, 2), \dots, (1, 6); (2, 1), \dots, (2, 6); (3, 1), \dots, (3, 6); (4, 1), \dots, (4, 6); (5, 1), \dots, (5, 6); (6, 1), \dots, (6, 6)$. That is 36 equally likely outcomes.

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

(ii) Different numbers: $P = 1 - \frac{1}{6} = \frac{5}{6}$.

Answer: (i) $\frac{1}{6}$ (ii) $\frac{5}{6}$

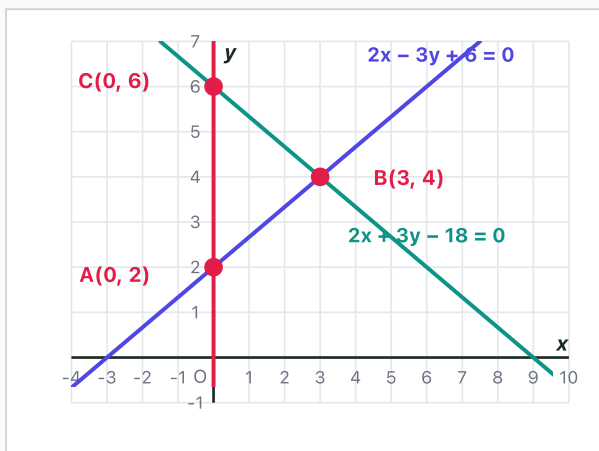
Section D: Long answer

4 questions, 5 marks each.

Q32 · LINEAR EQUATIONS · 5 MARKS

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.

SOLUTION



Line 1, $2x - 3y + 6 = 0$: points $(0, 2)$ and $(-3, 0)$; also $(3, 4)$. Line 2, $2x + 3y - 18 = 0$: points $(0, 6)$ and $(9, 0)$; also $(3, 4)$. Line 3, $x = 0$, is the y -axis.

The lines meet in pairs at $A(0, 2)$ (line 1 and the y -axis), $C(0, 6)$ (line 2 and the y -axis) and $B(3, 4)$ (lines 1 and 2).

Taking AC on the y -axis as the base: $AC = 6 - 2 = 4$. The height is the distance of B from the y -axis, which is 3.

Area = $\frac{1}{2} \times 4 \times 3 = 6$ square units.

Answer: Vertices $(0, 2), (3, 4), (0, 6)$; area = 6 square units

Q33 · QUADRATIC EQUATIONS · 5 MARKS

(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.

OR

(b) The sum of the areas of two squares is 640 m². If the difference in their perimeters is 64 m, find the sides of the two squares.

SOLUTION

(a) Let the faster train go at x km/h; the slower goes at $(x - 10)$ km/h. $\frac{200}{x - 10} - \frac{200}{x} = 1$.

$200x - 200(x - 10) = x(x - 10)$, so $2000 = x^2 - 10x$ and $x^2 - 10x - 2000 = 0$.

$(x - 50)(x + 40) = 0$. Speed cannot be negative, so $x = 50$. The faster train goes at 50 km/h and the slower at 40 km/h.

(b) Let the sides be x and y ($x > y$). $x^2 + y^2 = 640$ and $4x - 4y = 64$, so $y = x - 16$.

$x^2 + (x - 16)^2 = 640$ gives $2x^2 - 32x + 256 = 640$, so $x^2 - 16x - 192 = 0$ and $(x - 24)(x + 8) = 0$.

$x = 24$ (reject -8) and $y = 24 - 16 = 8$. The sides are 24 m and 8 m. (Check: $576 + 64 = 640$ ✓.)

Answer: (a) 50 km/h and 40 km/h (b) 24 m and 8 m

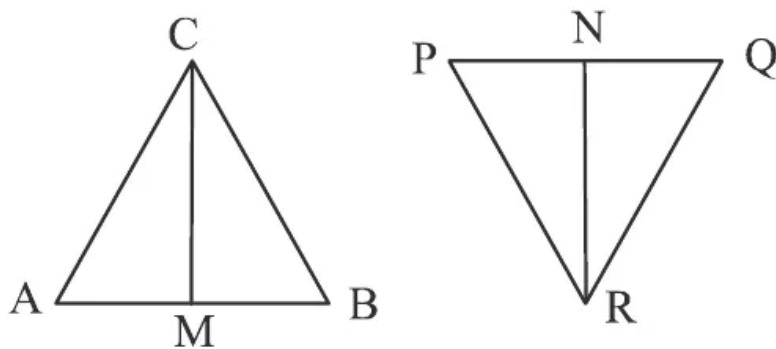
Q34 · TRIANGLES · 5 MARKS

(a) State and prove Basic Proportionality Theorem.

OR

(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) $\triangle CMB \sim \triangle RNQ$.

OI



SOLUTION

(a) ****Statement:**** 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.

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

(b)(i) $\triangle ABC \sim \triangle PQR$ gives $\angle A = \angle P$ and $\frac{AB}{PQ} = \frac{AC}{PR}$. CM and RN are medians, so $AB = 2AM$ and $PQ = 2PN$, and $\frac{2AM}{2PN} = \frac{AC}{PR}$, that is $\frac{AM}{PN} = \frac{AC}{PR}$.

So $\triangle AMC \sim \triangle PNR$ by SAS.

(ii) $\angle B = \angle Q$ and $\frac{AB}{PQ} = \frac{BC}{QR}$ gives $\frac{2MB}{2NQ} = \frac{BC}{QR}$, so $\frac{MB}{NQ} = \frac{BC}{QR}$. Hence $\triangle CMB \sim \triangle RNQ$ by SAS.

Answer: (a) proved (b) both proved

Q35 · STATISTICS · 5 MARKS

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

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

SOLUTION

Sum of frequencies: $1 + x + 5 + 7 + y + 3 + 1 = 17 + x + y = 25$, so $x + y = 8$. (i)

Class marks: 5, 15, 25, 35, 45, 55, 65. $\sum f_i x_i = 5 + 15x + 125 + 245 + 45y + 165 + 65 = 605 + 15x + 45y$.

Mean = $\frac{605 + 15x + 45y}{25} = 35$, so $15x + 45y = 875 - 605 = 270$ and $x + 3y = 18$. (ii)

(ii) – (i): $2y = 10$, so $y = 5$ and $x = 3$.

Answer: $x = 3$ and $y = 5$

Section E: Case studies

3 case studies, 4 marks each.

Q36 · ARITHMETIC PROGRESSIONS · 4 MARKS

Case study 1. 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. 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 bucket? [1]

(ii) What is the distance covered to pick up the second potato and drop it in bucket? [1]

(iii) (a) What is the total distance the competitor has to run? [2]

OR

(iii) (b) If average speed of competitor is 5 m/s, then find the average time taken by competitor to put all the potatoes in the bucket. [2]

SOLUTION

(i) The first potato is 5 m away, so the round trip is $5 + 5 = 10$ m.

(ii) The second potato is $5 + 3 = 8$ m away, so the round trip is $8 + 8 = 16$ m.

(iii)(a) The round trips are 10, 16, 22, ..., an A.P. with $a = 10$ and $d = 6$ for 10 terms. $S_{10} = \frac{10}{2}[2(10) + 9(6)] = 5 \times 74 = 370$ m.

$$(iii)(b) \text{ Time} = \frac{\text{distance}}{\text{speed}} = \frac{370}{5} = 74 \text{ seconds.}$$

Answer: (i) 10 m (ii) 16 m (iii)(a) 370 m (iii)(b) 74 s

Q37 · TRIGONOMETRY · 4 MARKS

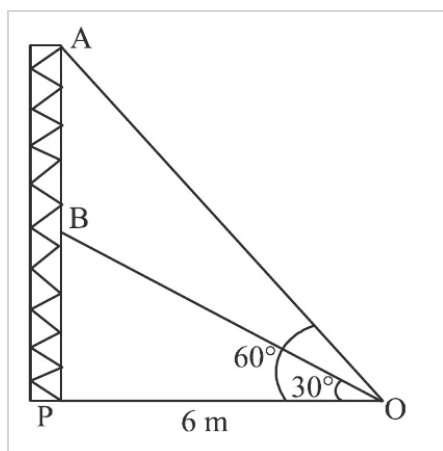
Case study 2. Radio towers are used for transmitting a range of communication services including radio and television. The tower will either act as an antenna itself or support one or more antennas on its structure. On a similar concept, a radio station tower was built in two sections 'A' and 'B'. Tower is supported by wires from a point 'O'. Distance between the base of the tower and point 'O' is 6 m. From point 'O', the angle of elevation of the top of the section 'B' is 30° and the angle of elevation of the top of section 'A' is 60° .

Based on the above information, answer the following questions:

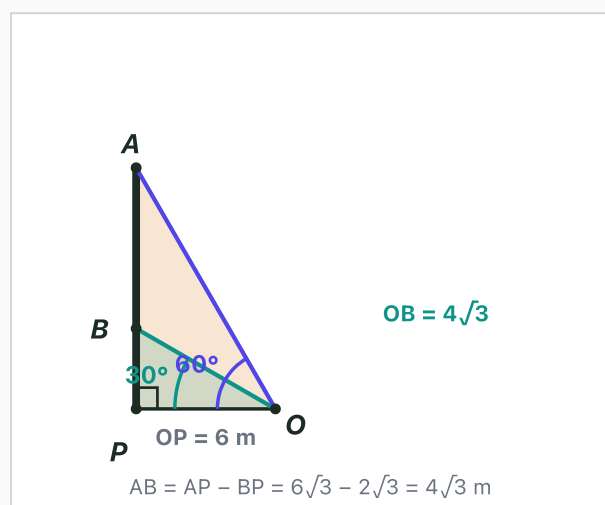
- (i) Find the length of the wire from the point 'O' to the top of section 'B'. [1]
- (ii) Find the length of the wire from the point 'O' to the top of section 'A'. [1]
- (iii) (a) Find the distance AB. [2]

OR

- (iii) (b) Find the area of $\triangle OPB$. [2]



SOLUTION



(i) In the right triangle OPB : $\cos 30^\circ = \frac{OP}{OB}$, so $\frac{\sqrt{3}}{2} = \frac{6}{OB}$ and $OB = \frac{12}{\sqrt{3}} = 4\sqrt{3} \text{ m}$.

(ii) In the right triangle OPA : $\cos 60^\circ = \frac{OP}{OA}$, so $\frac{1}{2} = \frac{6}{OA}$ and $OA = 12 \text{ m}$.

$$(iii)(a) \tan 30^\circ = \frac{BP}{6} \text{ gives } BP = 2\sqrt{3} \text{ m. } \tan 60^\circ = \frac{AP}{6} \text{ gives } AP = 6\sqrt{3} \text{ m. } AB = AP - BP = 6\sqrt{3} - 2\sqrt{3} = 4\sqrt{3} \text{ m.}$$

$$(iii)(b) \text{ Area of } \triangle OPB = \frac{1}{2} \times OP \times BP = \frac{1}{2} \times 6 \times 2\sqrt{3} = 6\sqrt{3} \text{ m}^2.$$

Answer: (i) $4\sqrt{3}$ m (ii) 12 m (iii)(a) $4\sqrt{3}$ m (iii)(b) $6\sqrt{3}$ m²

Q38 · AREAS RELATED TO CIRCLES · 4 MARKS

Case study 3. A brooch is crafted from silver wire in the shape of a circle with a diameter of 35 cm. The wire is also used to create 5 diameters, dividing the circle into 10 equal sectors as shown in figure.

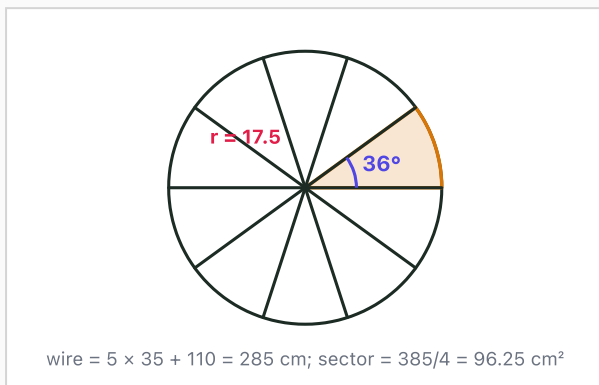
Based on the above information, answer the following questions:

- (i) What is the radius of circle? [1]
- (ii) What is the circumference of the brooch? [1]
- (iii) (a) What is the total length of silver wire required? [2]

OR

- (iii) (b) What is the area of each sector of the brooch? [2]

SOLUTION



$$(i) r = \frac{35}{2} = 17.5 \text{ cm.}$$

$$(ii) \text{ Circumference} = 2\pi r = 2 \times \frac{22}{7} \times \frac{35}{2} = 110 \text{ cm.}$$

$$(iii)(a) \text{ The wire forms the circle (110 cm) and five diameters (} 5 \times 35 = 175 \text{ cm): } 110 + 175 = 285 \text{ cm.}$$

$$(iii)(b) \text{ Each sector has central angle } \frac{360^\circ}{10} = 36^\circ. \text{ Area} = \frac{36}{360} \times \frac{22}{7} \times \frac{35}{2} \times \frac{35}{2} = \frac{385}{4} = 96.25 \text{ cm}^2.$$

Answer: (i) 17.5 cm (ii) 110 cm (iii)(a) 285 cm (iii)(b) 96.25 cm²

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