

Mathematics (Standard) 2026, Set 30/4/1

Q.P. Code 30/4/1 · Series 4MNKL · 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 · QUADRATIC EQUATIONS · 1 MARK

If the quadratic equation $9x^2 + 8kx + 16 = 0$ has real and equal roots, then the value of k is:

- (A) 3 (B) -3
(C) -4 (D) $\frac{3}{2}$

SOLUTION

Equal roots need $D = 0$: $(8k)^2 - 4(9)(16) = 64k^2 - 576 = 0$, so $k^2 = 9$ and $k = \pm 3$.

Both 3 and -3 are in the options, so options (A) and (B) are both correct. CBSE's key accepts either.

Answer: (A) 3 or (B) -3

Common mistake: Picking only one sign. The equation gives $k^2 = 9$, so k can be 3 or -3, and both are among the options.

Q2 · TRIANGLES · 1 MARK

It is given that $\triangle ABC \sim \triangle EDF$. Which of the following is ****not**** true?

- (A) $\frac{\text{Perimeter of } \triangle ABC}{\text{Perimeter of } \triangle EDF} = \frac{AB}{ED}$ (B) $\frac{AB}{ED} = \frac{AC}{EF}$
(C) $\angle A = \angle D, \angle C = \angle F$ (D) $\frac{AB + BC}{AC} = \frac{DE + DF}{EF}$

SOLUTION

The correspondence is $A \leftrightarrow E, B \leftrightarrow D, C \leftrightarrow F$.

(A), (B) and (D) are true: the perimeters and all pairs of corresponding sides are in the same ratio, and $AB + BC$ matches $ED + DF$ while AC matches EF .

(C) says $\angle A = \angle D$, but $\angle A$ corresponds to $\angle E$, so this is not true (the true statement is $\angle A = \angle E, \angle C = \angle F$).

Answer: (C) $\angle A = \angle D, \angle C = \angle F$

Q3 · ARITHMETIC PROGRESSIONS · 1 MARK

The n^{th} term of an A.P. is $\sqrt{2}n + 1$. Its common difference is:

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

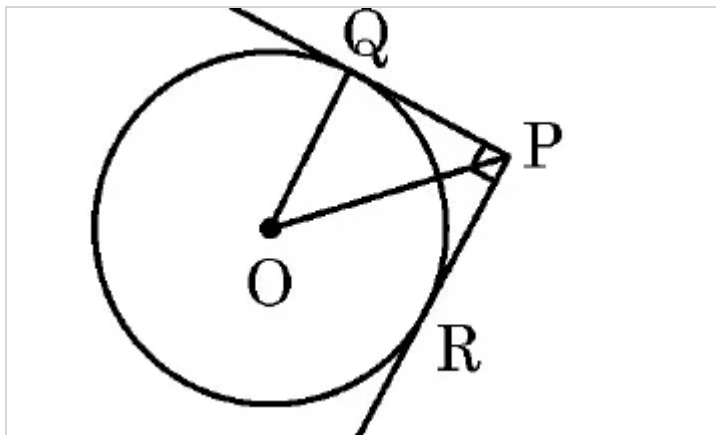
SOLUTION

$$a_{n+1} - a_n = (\sqrt{2}(n+1) + 1) - (\sqrt{2}n + 1) = \sqrt{2}.$$

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

Q4 · CIRCLES · 1 MARK

If PQ and PR are tangents to the circle with centre O and radius 4 cm such that $\angle QPR = 90^\circ$, then the length OP is:



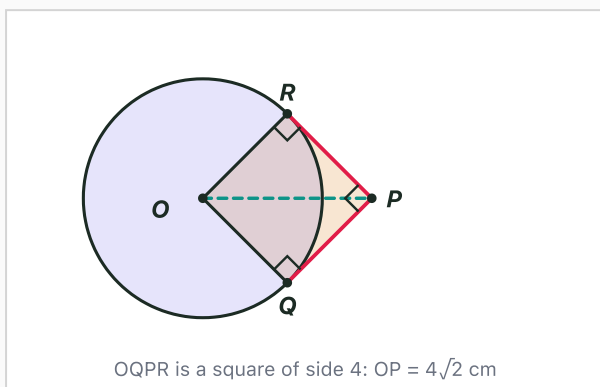
(A) 4 cm

(B) $4\sqrt{2}$ cm

(C) 8 cm

(D) $2\sqrt{2}$ cm

SOLUTION



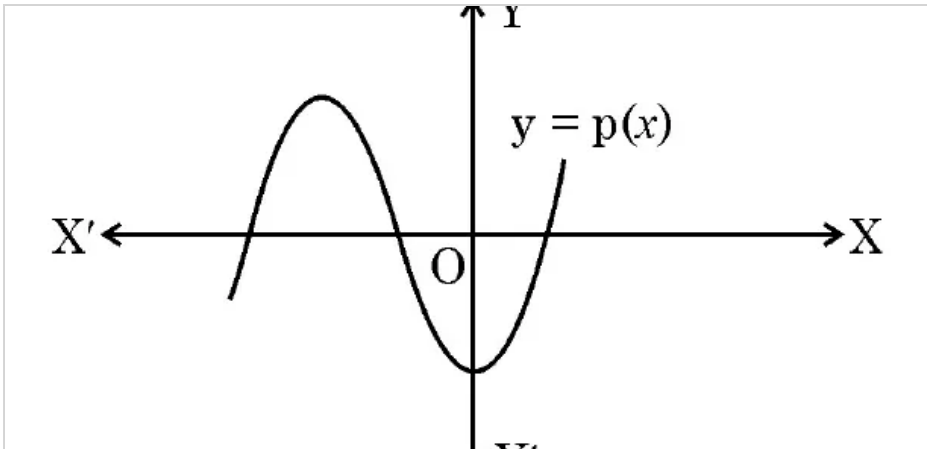
$OQ \perp PQ$, $OR \perp PR$ and $\angle QPR = 90^\circ$, so $OQPR$ has four right angles. $OQ = OR = 4$ and $PQ = PR$, so it is a square of side 4.

OP is its diagonal: $OP = 4\sqrt{2}$ cm.

Answer: (B) $4\sqrt{2}$ cm

Q5 · POLYNOMIALS · 1 MARK

Observe the graph of polynomial $p(x)$. Number of zeroes of $p(x)$ is:



- (A) 5 (B) 4
(C) 6 (D) 3

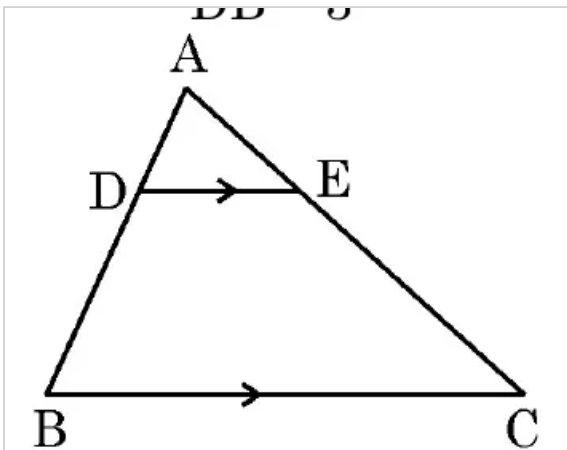
SOLUTION

The zeroes are the points where the graph meets the x -axis. The curve crosses the axis three times (up, down, up), so there are 3 zeroes.

Answer: (D) 3

Q6 · TRIANGLES · 1 MARK

In the given figure, $DE \parallel BC$. If $\frac{AD}{DB} = \frac{1}{3}$ and $AC = 6$ cm, then length AE is:



- (A) 1.5 cm (B) 1 cm
(C) 2 cm (D) 3 cm

SOLUTION

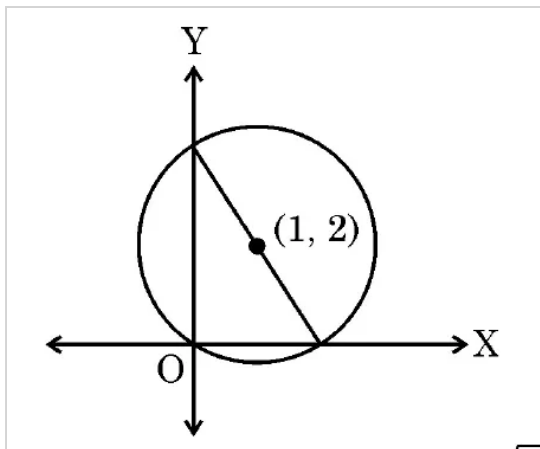
$DE \parallel BC$, so $\frac{AD}{DB} = \frac{AE}{EC} = \frac{1}{3}$. So $AE : AC = 1 : 4$.

$$AE = \frac{6}{4} = 1.5 \text{ cm.}$$

Answer: (A) 1.5 cm

Q7 · COORDINATE GEOMETRY · 1 MARK

In the given figure, a circle is centred at $(1, 2)$. The diameter of the circle is:



- (A) 4
(B) $2\sqrt{2}$
(C) $\sqrt{5}$
(D) $2\sqrt{5}$

SOLUTION

The circle passes through the origin, so the radius is the distance from the centre $(1, 2)$ to $(0, 0)$: $\sqrt{1^2 + 2^2} = \sqrt{5}$.

Diameter = $2\sqrt{5}$.

Answer: (D) $2\sqrt{5}$

Q8 · LINEAR EQUATIONS · 1 MARK

The value of k for which the system of linear equations $\frac{x}{2} + \frac{y}{3} = 5$ and $2x + ky = 7$ is inconsistent, is:

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

SOLUTION

The first equation is $3x + 2y = 30$. Inconsistent (parallel lines) needs $\frac{3}{2} = \frac{2}{k} \neq \frac{30}{7}$.

$\frac{3}{2} = \frac{2}{k}$ gives $k = \frac{4}{3}$, and then $\frac{2}{k} = \frac{3}{2} \neq \frac{30}{7} \checkmark$.

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

Q9 · AREAS RELATED TO CIRCLES · 1 MARK

A circle is divided into 16 identical sectors. If radius of the circle is 7 cm, area of each sector is:

- (A) $\frac{77}{4} \text{ cm}^2$
(B) 77 cm^2
(C) 154 cm^2
(D) $\frac{77}{8} \text{ cm}^2$

SOLUTION

Area of the circle = $\frac{22}{7} \times 7 \times 7 = 154 \text{ cm}^2$. Each of 16 sectors: $\frac{154}{16} = \frac{77}{8} \text{ cm}^2$.

Answer: (D) $\frac{77}{8} \text{ cm}^2$

Q10 · PROBABILITY · 1 MARK

Two different dice are rolled together. The probability that both the obtained numbers are less than 4, is:

(A) $\frac{2}{9}$
(C) $\frac{1}{4}$

(B) $\frac{7}{36}$
(D) $\frac{2}{3}$

SOLUTION

Each die must show 1, 2 or 3: $3 \times 3 = 9$ outcomes out of 36. $P = \frac{9}{36} = \frac{1}{4}$.

Answer: (C) $\frac{1}{4}$

Q11 · TRIGONOMETRY · 1 MARK

When $\sin A = \frac{1}{3}$, the value of $\cot A$ is:

(A) $\frac{2\sqrt{2}}{3}$
(C) $\frac{1}{2\sqrt{2}}$

(B) $2\sqrt{2}$
(D) 3

SOLUTION

Opposite = 1, hypotenuse = 3, adjacent = $\sqrt{9-1} = 2\sqrt{2}$. $\cot A = \frac{\text{adjacent}}{\text{opposite}} = 2\sqrt{2}$.

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

Q12 · TRIGONOMETRY · 1 MARK

$\frac{1 + \tan^2 A}{1 + \cot^2 A}$ equals to:

(A) $\tan^2 A$
(C) $-\tan^2 A$

(B) -1
(D) $\cot^2 A$

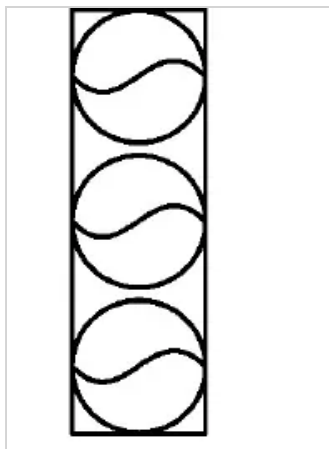
SOLUTION

$1 + \tan^2 A = \sec^2 A$ and $1 + \cot^2 A = \operatorname{cosec}^2 A$. The ratio is $\frac{\sec^2 A}{\operatorname{cosec}^2 A} = \frac{\sin^2 A}{\cos^2 A} = \tan^2 A$.

Answer: (A) $\tan^2 A$

Q13 · SURFACE AREAS AND VOLUMES · 1 MARK

Three tennis balls are just packed in a cylindrical jar. If radius of each ball is r , volume of air inside the jar is:



- (A) $2\pi r^3$ (B) $3\pi r^3$
(C) $5\pi r^3$ (D) $4\pi r^3$

SOLUTION

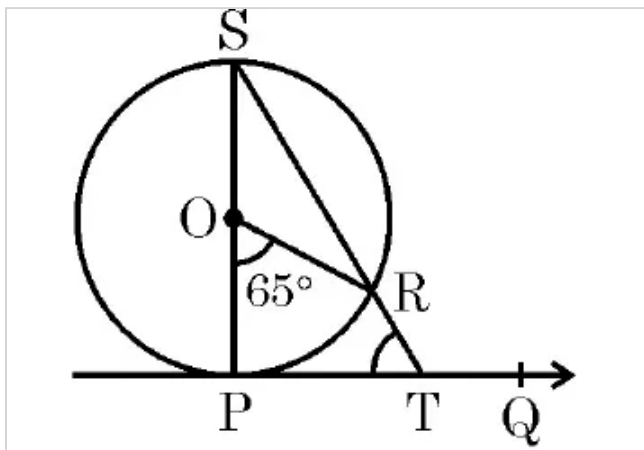
The jar has radius r and height $3 \times 2r = 6r$: volume $\pi r^2 \times 6r = 6\pi r^3$.

The three balls: $3 \times \frac{4}{3}\pi r^3 = 4\pi r^3$. Air = $6\pi r^3 - 4\pi r^3 = 2\pi r^3$.

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

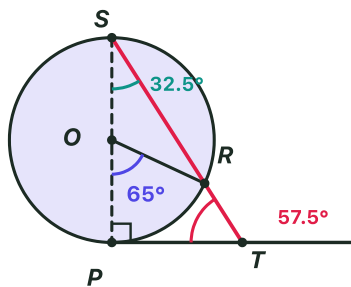
Q14 · CIRCLES · 1 MARK

PQ is tangent to a circle with centre O . If $\angle POR = 65^\circ$, then $m\angle PTR$ is:



- (A) 65° (B) 58.5°
(C) 57.5° (D) 45°

SOLUTION



$$\angle PSR = \frac{1}{2} \times 65^\circ = 32.5^\circ; \angle PTR = 90^\circ - 32.5^\circ = 57.5^\circ$$

SP is a diameter, and the angle at the circle is half the angle at the centre on the same arc PR : $\angle PSR = \frac{65^\circ}{2} = 32.5^\circ$.

$SP \perp PT$ (radius and tangent), so in the right triangle SPT : $\angle PTR = 90^\circ - 32.5^\circ = 57.5^\circ$.

Answer: (C) 57.5°

Q15 · COORDINATE GEOMETRY · 1 MARK

The distance between the points $(a \cos \theta + b \sin \theta, 0)$ and $(0, a \sin \theta - b \cos \theta)$ is:

(A) $\sqrt{a^2 + b^2}$

(B) $a^2 - b^2$

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

(D) $a^2 + b^2$

SOLUTION

$$d^2 = (a \cos \theta + b \sin \theta)^2 + (a \sin \theta - b \cos \theta)^2.$$

$$= a^2 \cos^2 \theta + 2ab \sin \theta \cos \theta + b^2 \sin^2 \theta + a^2 \sin^2 \theta - 2ab \sin \theta \cos \theta + b^2 \cos^2 \theta = a^2 + b^2. \text{ So } d = \sqrt{a^2 + b^2}.$$

Answer: (A) $\sqrt{a^2 + b^2}$

Q16 · SURFACE AREAS AND VOLUMES · 1 MARK

An ice-cream cone of radius r and height h is completely filled by two spherical scoops of ice-cream. If radius of each spherical scoop is $\frac{r}{2}$, then $h : 2r$ equals:

(A) 1 : 8

(B) 1 : 2

(C) 1 : 1

(D) 2 : 1

SOLUTION

$$\text{Two scoops: } 2 \times \frac{4}{3}\pi \left(\frac{r}{2}\right)^3 = \frac{8}{3}\pi \times \frac{r^3}{8} = \frac{\pi r^3}{3}.$$

$$\text{The cone: } \frac{1}{3}\pi r^2 h. \text{ Setting them equal, } h = r, \text{ so } h : 2r = r : 2r = 1 : 2.$$

Answer: (B) 1 : 2

Q17 · AREAS RELATED TO CIRCLES · 1 MARK

Arc PQ subtends an angle θ at the centre of the circle with radius 6.3 cm. If length of arc $PQ = 11$ cm, then the value of θ is:

- (A) 10° (B) 60°
(C) 45° (D) 100°

SOLUTION

$$\text{Arc} = \frac{\theta}{360} \times 2\pi r: 11 = \frac{\theta}{360} \times 2 \times \frac{22}{7} \times 6.3 = \frac{\theta}{360} \times 39.6.$$
$$\theta = \frac{11 \times 360}{39.6} = 100^\circ.$$

Answer: (D) 100°

Q18 · STATISTICS · 1 MARK

Mean and Median of a frequency distribution are 43 and 40 respectively. The value of mode is:

- (A) 34 (B) 43
(C) 38.5 (D) 41.5

SOLUTION

$$\text{Mode} = 3 \text{ Median} - 2 \text{ Mean} = 3(40) - 2(43) = 120 - 86 = 34.$$

Answer: (A) 34

Q19 · PROBABILITY · 1 MARK

Assertion (A): If probability of happening of an event is $0.2p$, $p > 0$, then p can't be more than 5.

Reason (R): $P(\bar{E}) = 1 - P(E)$ for an event E .

- (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 probability cannot exceed 1, so $0.2p \leq 1$ and $p \leq 5$. True.

(R) The complement rule is true. But the bound on p comes from probability being at most 1, not from the complement rule, so R does not explain A.

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

Q20 · REAL NUMBERS · 1 MARK

Assertion (A): $(\sqrt{3} + \sqrt{5})$ is an irrational number.

Reason (R): Sum of the any two irrational numbers is always irrational.

- (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) $\sqrt{3} + \sqrt{5}$ is irrational (if it were rational $= r$, then squaring $8 + 2\sqrt{15} = r^2$ would make $\sqrt{15}$ rational, which it is not). True.

(R) False: $\sqrt{2}$ and $-\sqrt{2}$ are irrational but their sum is 0, a rational number.

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

Section B: Very short answer

5 questions, 2 marks each.

Q21 · QUADRATIC EQUATIONS · 2 MARKS

Verify that roots of the quadratic equation $(p - q)x^2 + (q - r)x + (r - p) = 0$ are equal when $q + r = 2p$.

SOLUTION

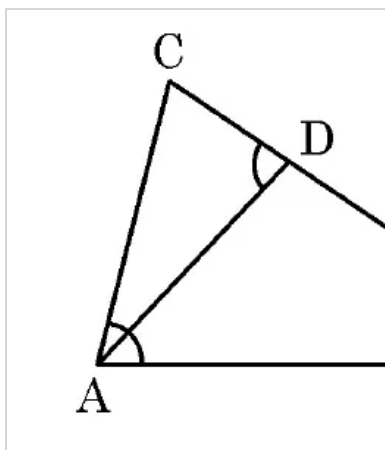
$D = (q - r)^2 - 4(p - q)(r - p)$. Expand: $(q - r)^2 - 4(pr - p^2 - qr + pq) = q^2 - 2qr + r^2 - 4pr + 4p^2 + 4qr - 4pq = q^2 + 2qr + r^2 + 4p^2 - 4pr - 4pq = (q + r - 2p)^2$.

If $q + r = 2p$, then $D = 0$, so the roots are real and equal.

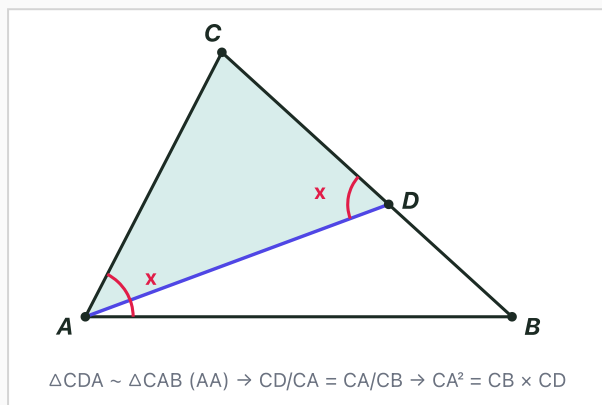
Answer: Verified

Q22 · TRIANGLES · 2 MARKS

D is a point on the side BC of $\triangle ABC$ such that $\angle CAB = \angle CDA$. Show that $CA^2 = CB \times CD$.



SOLUTION



In $\triangle CDA$ and $\triangle CAB$: $\angle C$ is common and $\angle CDA = \angle CAB$ (given).

So $\triangle CDA \sim \triangle CAB$ by AA, and $\frac{CD}{CA} = \frac{CA}{CB}$.

Cross-multiplying, $CA^2 = CB \times CD$.

Answer: Shown

Q23 · TRIGONOMETRY · 2 MARKS

(a) Prove that: $\sqrt{\frac{1+\sin A}{1-\sin A}} = \sec A + \tan A$

OR

(b) Evaluate: $\frac{3 \cos^2 30^\circ - 6 \operatorname{cosec}^2 30^\circ}{\tan^2 60^\circ}$

SOLUTION

(a) Multiply the top and bottom by $(1 + \sin A)$: $\sqrt{\frac{(1 + \sin A)^2}{1 - \sin^2 A}} = \sqrt{\frac{(1 + \sin A)^2}{\cos^2 A}} = \frac{1 + \sin A}{\cos A} = \sec A + \tan A$.

(b) $\cos 30^\circ = \frac{\sqrt{3}}{2}$, $\operatorname{cosec} 30^\circ = 2$, $\tan 60^\circ = \sqrt{3}$.

$$\frac{3 \times \frac{3}{4} - 6 \times 4}{3} = \frac{\frac{9}{4} - 24}{3} = \frac{-\frac{87}{4}}{3} = -\frac{29}{4}.$$

Answer: (a) proved (b) $-\frac{29}{4}$

Q24 · REAL NUMBERS · 2 MARKS

(a) Prove that $2 + 3\sqrt{5}$ is an irrational number given that $\sqrt{5}$ is irrational number.

OR

(b) If the HCF of 210 and 55 is expressed as $210 \times 5 + 55m$, then find the value of m .

SOLUTION

(a) Suppose $2 + 3\sqrt{5} = \frac{p}{q}$ with integers p, q and $q \neq 0$. Then $\sqrt{5} = \frac{p - 2q}{3q}$, a ratio of integers, so $\sqrt{5}$ would be rational. That contradicts the given fact, so $2 + 3\sqrt{5}$ is irrational.

(b) $210 = 2 \times 3 \times 5 \times 7$ and $55 = 5 \times 11$, so HCF = 5. $5 = 1050 + 55m$ gives $55m = -1045$ and $m = -19$.

Answer: (a) proved (b) $m = -19$

Q25 · POLYNOMIALS · 2 MARKS

α and β are the zeroes of the polynomial $5x^2 - 16x - 10$. Find the value of $\frac{\alpha}{\beta} + \frac{\beta}{\alpha}$.

SOLUTION

$$\alpha + \beta = \frac{16}{5} \text{ and } \alpha\beta = \frac{-10}{5} = -2.$$

$$\frac{\alpha}{\beta} + \frac{\beta}{\alpha} = \frac{(\alpha + \beta)^2 - 2\alpha\beta}{\alpha\beta} = \frac{\frac{256}{25} + 4}{-2} = \frac{\frac{356}{25}}{-2} = -\frac{178}{25}.$$

Answer: $-\frac{178}{25}$

Section C: Short answer

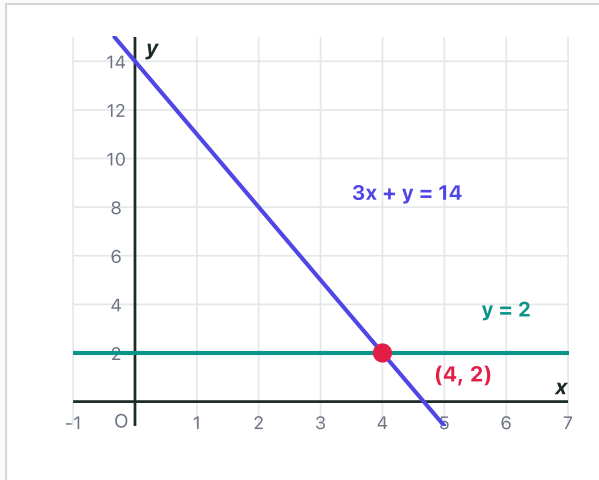
6 questions, 3 marks each.

Q26 · LINEAR EQUATIONS · 3 MARKS

(a) In a class test, Veer scored 6 more than twice as many marks as Kevin scored. If one of them had scored 4 more marks, their total score would have been 40. Find the marks obtained by Veer and Kevin.

OR

(b) Solve the linear equations $3x + y = 14$ and $y = 2$ graphically.

SOLUTION

(a) Let Veer have V and Kevin K . $V = 2K + 6$ and $V + K + 4 = 40$ (one of them having 4 more adds 4 to the total).

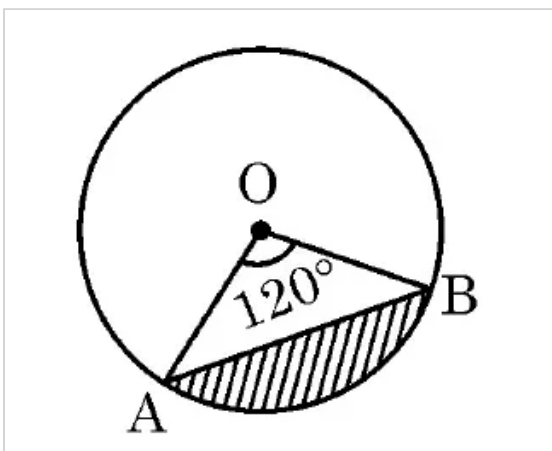
$2K + 6 + K = 36$, so $3K = 30$ and $K = 10$, $V = 26$. (Check: $26 = 2 \times 10 + 6$ ✓ and $26 + 10 + 4 = 40$ ✓.)

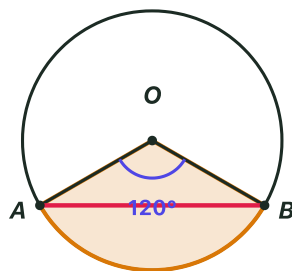
(b) $3x + y = 14$: points $(4, 2)$, $(3, 5)$ and $(2, 8)$. $y = 2$ is the horizontal line through $(0, 2)$. They meet at $(4, 2)$: $x = 4$, $y = 2$.

Answer: (a) Veer 26, Kevin 10 (b) $x = 4, y = 2$

Q27 · AREAS RELATED TO CIRCLES · 3 MARKS

Chord AB of a circle with centre O and radius 21 mm subtends an angle of 120° at the centre. Find the perimeters of the shaded region. (Use $\sqrt{3} = 1.73$)

**SOLUTION**



arc $AB = \frac{1}{6} \times 2\pi \times 21 = 44$ mm
 chord $= 21\sqrt{3} = 36.33$ mm $\rightarrow$ perimeter 80.33 mm

The shaded region is the minor segment, bounded by the minor arc AB and the chord AB .

$$\text{Arc } AB = \frac{120}{360} \times 2 \times \frac{22}{7} \times 21 = 44 \text{ mm.}$$

Chord: draw $OC \perp AB$; it bisects the angle and the chord, so $\angle AOC = 60^\circ$ and $AC = 21 \sin 60^\circ = \frac{21\sqrt{3}}{2}$.

$$AB = 21\sqrt{3} = 21 \times 1.73 = 36.33 \text{ mm.}$$

$$\text{Perimeter} = 44 + 36.33 = 80.33 \text{ mm.}$$

Answer: $44 + 21\sqrt{3} \approx 80.33$ mm

Q28 · TRIGONOMETRY · 3 MARKS

Prove that: $\frac{\sin \theta - \cos \theta + 1}{\sin \theta + \cos \theta - 1} = \frac{1}{\sec \theta - \tan \theta}$

SOLUTION

Divide the top and bottom of the LHS by $\cos \theta$: $\frac{\tan \theta - 1 + \sec \theta}{\tan \theta + 1 - \sec \theta}$.

Write $1 = \sec^2 \theta - \tan^2 \theta$ in the top: $\tan \theta + \sec \theta - (\sec^2 \theta - \tan^2 \theta) = (\sec \theta + \tan \theta)(1 - \sec \theta + \tan \theta)$.

So the LHS = $\frac{(\sec \theta + \tan \theta)(1 - \sec \theta + \tan \theta)}{\tan \theta + 1 - \sec \theta} = \sec \theta + \tan \theta$.

Multiply and divide by $(\sec \theta - \tan \theta)$: $\frac{\sec^2 \theta - \tan^2 \theta}{\sec \theta - \tan \theta} = \frac{1}{\sec \theta - \tan \theta} = \text{RHS.}$

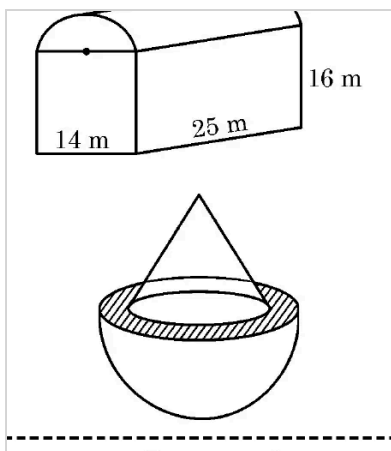
Answer: Proved

Q29 · SURFACE AREAS AND VOLUMES · 3 MARKS

(a) To protect plants from heat, a shed of iron rods covered with green cloth is made. The lower part of the shed is a cuboid mounted by semi-cylinder as shown in the figure. Find the area of the cloth required to make this shed, if dimensions of the cuboid are $14\text{ m} \times 25\text{ m} \times 16\text{ m}$.

OR

(b) The internal and external radii of a hollow hemisphere are $5\sqrt{2}\text{ cm}$ and 10 cm respectively. A cone of height $5\sqrt{7}\text{ cm}$ and radius $5\sqrt{2}\text{ cm}$ is surmounted on the hemisphere as shown in the figure. Find the total surface area of the object in terms of π . (Use $\sqrt{2} = 1.4$)



SOLUTION

(a) The cloth covers the four walls and the semi-cylindrical roof with its two semicircular ends (the floor is not covered).

Four walls: $2(14 \times 16 + 25 \times 16) = 2(224 + 400) = 1248\text{ m}^2$.

The semi-cylinder has radius 7 m and length 25 m . Curved area $= \pi r l = \frac{22}{7} \times 7 \times 25 = 550\text{ m}^2$. The two semicircular ends: $\pi r^2 = \frac{22}{7} \times 49 = 154\text{ m}^2$. Roof $= 704\text{ m}^2$.

Total cloth $= 1248 + 704 = 1952\text{ m}^2$.

(b) Cone slant height $l = \sqrt{(5\sqrt{2})^2 + (5\sqrt{7})^2} = \sqrt{50 + 175} = 15\text{ cm}$.

The surface of the object: the outer curved area of the hemisphere $2\pi R^2$, the cone's curved area $\pi r l$, and the ring-shaped rim of the hollow hemisphere $\pi(R^2 - r^2)$.

$= \pi(2 \times 100 + 5\sqrt{2} \times 15 + 100 - 50) = \pi(200 + 75\sqrt{2} + 50) = \pi(250 + 105) = 355\pi\text{ cm}^2$ (with $\sqrt{2} = 1.4$).

Answer: (a) 1952 m^2 (b) $355\pi\text{ cm}^2$

Q30 · PROBABILITY · 3 MARKS

A bag contains 30 balls out of which 'm' number of balls are blue in colour.

(i) Find the probability that a ball drawn at random from the bag is not blue.

(ii) If 6 more blue balls are added in the bag, then the probability of drawing a blue ball will be $\frac{5}{4}$ times the probability of drawing a blue ball in the first case. Find the value of m .

SOLUTION

(i) $P(\text{not blue}) = \frac{30 - m}{30} = 1 - \frac{m}{30}$.

(ii) Now there are 36 balls and $m + 6$ blue, so $P(\text{blue}) = \frac{m + 6}{36}$. The condition: $\frac{m + 6}{36} = \frac{5}{4} \times \frac{m}{30} = \frac{m}{24}$.

$24(m + 6) = 36m$, so $24m + 144 = 36m$ and $m = 12$. (Check: $\frac{18}{36} = \frac{1}{2}$ and $\frac{5}{4} \times \frac{12}{30} = \frac{1}{2} \checkmark$.)

Answer: (i) $\frac{30 - m}{30}$ (ii) $m = 12$

Q31 · REAL NUMBERS · 3 MARKS

Find the greatest number less than 10,000 which is exactly divisible by 48, 60 and 65.

SOLUTION

$48 = 2^4 \times 3$, $60 = 2^2 \times 3 \times 5$, $65 = 5 \times 13$. LCM = $2^4 \times 3 \times 5 \times 13 = 3120$.

Numbers divisible by all three are multiples of 3120: 3120, 6240, 9360, 12480, ... The greatest below 10000 is $3 \times 3120 = 9360$.

Answer: 9360

Section D: Long answer

4 questions, 5 marks each.

Q32 · QUADRATIC EQUATIONS · 5 MARKS

(a) A person on tour has ₹ 5,400 for his expenses. If he extends his tour by 5 days, he has to cut down his daily expenses by ₹ 180. Find the original duration of the tour and daily expense.

OR

(b) The total cost of certain piece of cloth was ₹ 2,100. During special sale time, the shopkeeper offered 2 m extra cloth for free thus reducing the price of cloth per metre by ₹ 120. What was the original per metre price of cloth and its length?

SOLUTION

(a) Let the tour be x days: daily expense $\frac{5400}{x}$, and after the extension $\frac{5400}{x+5}$. $\frac{5400}{x} - \frac{5400}{x+5} = 180$.

$5400 \times 5 = 180x(x+5)$, so $x^2 + 5x - 150 = 0$ and $(x+15)(x-10) = 0$. Days cannot be negative: $x = 10$.

The tour was 10 days and the daily expense ₹ $\frac{5400}{10} = 540$.

(b) Let the length be x m, so the price per metre is $\frac{2100}{x}$. With 2 m extra the price is $\frac{2100}{x+2}$, and $\frac{2100}{x} - \frac{2100}{x+2} = 120$.

$2100 \times 2 = 120x(x+2)$, so $x^2 + 2x - 35 = 0$ and $(x+7)(x-5) = 0$. $x = 5$ m (reject -7).

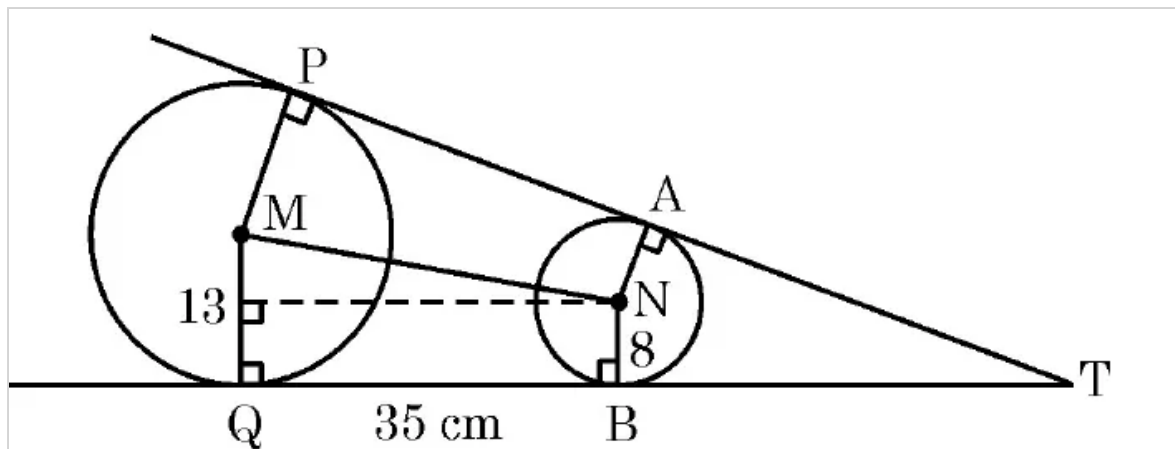
The original price per metre is $\frac{2100}{5} = ₹420$. (Check: $\frac{2100}{7} = 300$ and $420 - 300 = 120 \checkmark$.)

Answer: (a) 10 days, ₹ 540 a day (b) ₹ 420 per metre, 5 m

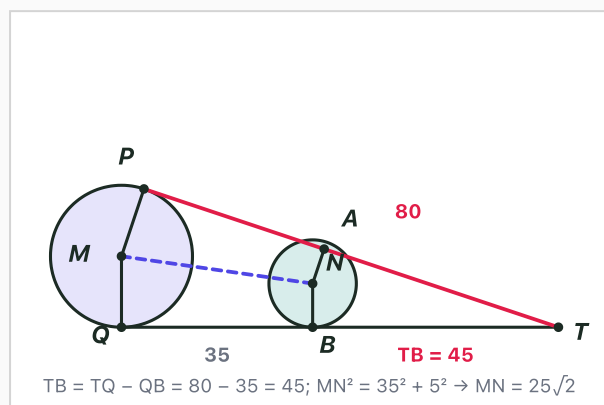
Q33 · CIRCLES · 5 MARKS

In the given figure, TP and TQ are tangents to a circle with centre M , touching another circle with centre N at A and B respectively. It is given that $MQ = 13$ cm, $NB = 8$ cm, $BQ = 35$ cm and $TP = 80$ cm.

- Name the quadrilateral $MQBN$. [1]
- Is MN parallel to PA ? Justify your answer. [1]
- Find length TB . [1]
- Find length MN . [2]



SOLUTION



(i) $MQ \perp QT$ and $NB \perp QT$ (radius to the point of contact), so $MQ \parallel NB$. MN is not parallel to QB (the radii differ), so exactly one pair of opposite sides is parallel: $MQBN$ is a trapezium.

(ii) No. $PM \perp PA$ and $NA \perp PA$, so $PM \parallel NA$. If $MN \parallel PA$ too, then $PMNA$ would be a parallelogram and $PM = NA$, but $PM = 13 \neq 8 = NA$.

(iii) Tangents from T to the circle with centre M are equal: $TQ = TP = 80$ cm. $TB = TQ - QB = 80 - 35 = 45$ cm.

(iv) Draw $NS \perp MQ$ with S on MQ . Then $NS = QB = 35$ and $MS = MQ - NB = 13 - 8 = 5$. $MN^2 = NS^2 + MS^2 = 1225 + 25 = 1250$, so $MN = 25\sqrt{2}$ cm.

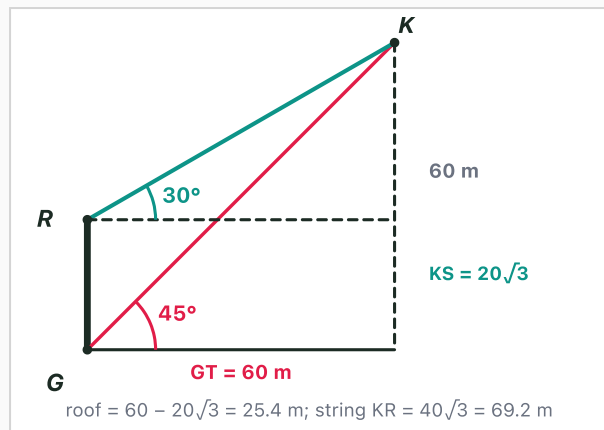
(Note: the data are not fully consistent; if M, N, T were assumed collinear, similar triangles would give $TB = 56$ cm, which CBSE's key also accepts.)

Answer: (i) trapezium (ii) no (iii) 45 cm (iv) $25\sqrt{2}$ cm

Q34 · TRIGONOMETRY · 5 MARKS

A kite is flying at a height of 60 m above the ground level. Ravi, standing at the roof of the house is holding the string straight and observes the angle of elevation of kite as 30° . From the bottom of the same building, the angle of elevation of kite is 45° . Find the length of the string and height of roof from the ground. (Use $\sqrt{3} = 1.73$)

SOLUTION



Let the kite be K , the roof R and the foot of the building G . From G : $\tan 45^\circ = \frac{60}{GT} = 1$, so the kite is $GT = 60\text{ m}$ away horizontally.

From the roof, the horizontal distance is the same 60 m . The kite is KS above the roof level: $\tan 30^\circ = \frac{KS}{60}$, so $KS = \frac{60}{\sqrt{3}} = 20\sqrt{3} = 34.6\text{ m}$.

Height of the roof $= 60 - 20\sqrt{3} = 60 - 34.6 = 25.4\text{ m}$.

String: $\sin 30^\circ = \frac{KS}{KR}$, so $KR = 2 \times 20\sqrt{3} = 40\sqrt{3} = 69.2\text{ m}$.

Answer: String $= 40\sqrt{3} \approx 69.2\text{ m}$; roof height $\approx 25.4\text{ m}$

Q35 · STATISTICS · 5 MARKS

(a) The median of the following data is 50 and sum of all frequencies is 90. Find the values of p and q .

OR

(b) Find mean and mode of the following distribution (classes $0 - 15, 15 - 30, 30 - 45, 45 - 60, 60 - 75, 75 - 90, 90 - 105$ with frequencies 4, 8, 11, 14, 10, 7, 6).

Class	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Frequency	p	15	25	20	q	8	10

SOLUTION

(a) Cumulative frequencies: $p, p + 15, p + 40, p + 60, p + q + 60, p + q + 68, p + q + 78$. Total $p + q + 78 = 90$, so $p + q = 12$.

The median is 50, which is the lower limit of the class $50 - 60$, so that is the median class: $l = 50, cf = p + 40, f = 20, h = 10, \frac{N}{2} = 45$. $50 + \frac{45 - (p + 40)}{20} \times 10 = 50$ gives $45 - p - 40 = 0$, so $p = 5$.

$q = 12 - 5 = 7$.

(b) $N = 60$. Take $a = 52.5, h = 15$: $u = \frac{x - 52.5}{15} = -3, -2, -1, 0, 1, 2, 3$ for the class marks 7.5, 22.5, 37.5, 52.5, 67.5, 82.5, 97.5. $\sum f_i u_i = -12 - 16 - 11 + 0 + 10 + 14 + 18 = 3$.

Mean $= 52.5 + \frac{3}{60} \times 15 = 52.5 + 0.75 = 53.25$.

Modal class $45 - 60$ ($f_1 = 14, f_0 = 11, f_2 = 10$): $\text{Mode} = 45 + \frac{14 - 11}{28 - 11 - 10} \times 15 = 45 + \frac{45}{7} \approx 51.4$.

Answer: (a) $p = 5, q = 7$ (b) mean = 53.25, mode ≈ 51.4

Section E: Case studies

3 case studies, 4 marks each.

Q36 · TRIANGLES · 4 MARKS

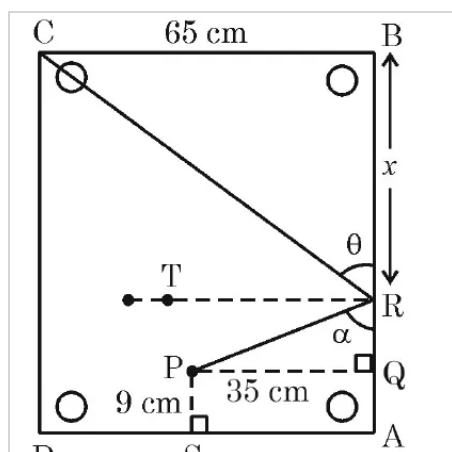
Case study 1. Carom board is a very popular game. The board is a square of side length 65 cm. It has circular pockets in each corner. Ansh strikes a disc, kept at position P with a striker. The disc, hits the boundary of the board at R and goes straight to pocket at corner C. It is given that $PS = 9$ cm, $PQ = 35$ cm, $BR = x$, $\angle PRQ = \alpha$ and $\angle CRB = \theta$.

Based on the above information, answer the following questions:

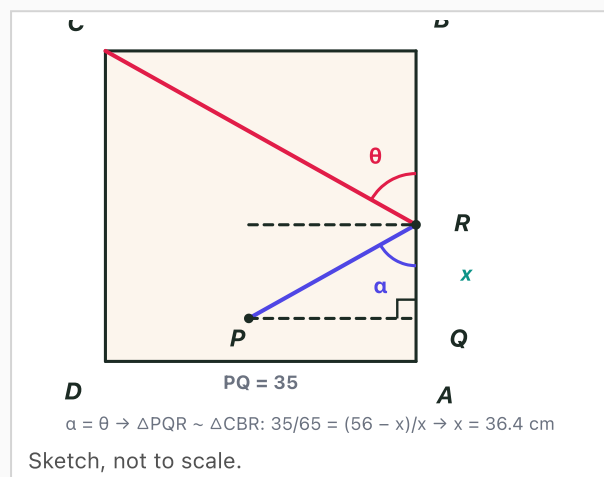
- Using law of reflection i.e. $\angle PRT = \angle CRT$, prove that $\theta = \alpha$. [1]
- Prove that $\triangle PQR \sim \triangle CBR$ given that PQ is perpendicular to AB. [1]
- (a) Find the value of x using similarity of triangles. [2]

OR

- (b) If $\frac{\text{Area } \triangle PQR}{\text{Area } \triangle CBR} = \frac{PQ^2}{CB^2}$, then find the value of x . [2]



SOLUTION



- $TR \perp AB$, so $\angle PRT = 90^\circ - \alpha$ and $\angle CRT = 90^\circ - \theta$ (the angles on a straight line at R with the normal TR). The law of reflection gives $\angle PRT = \angle CRT$, so $\alpha = \theta$.
- In $\triangle PQR$ and $\triangle CBR$: $\angle PRQ = \alpha = \theta = \angle CRB$ and $\angle PQR = \angle CBR = 90^\circ$. So $\triangle PQR \sim \triangle CBR$ by AA.

(iii)(a) $QR = AB - AQ - BR = 65 - 9 - x = 56 - x$ (since $AQ = PS = 9$). From the similarity, $\frac{PQ}{CB} = \frac{QR}{BR}$:
 $\frac{35}{65} = \frac{56 - x}{x}$.

$35x = 65(56 - x) = 3640 - 65x$, so $100x = 3640$ and $x = 36.4$ cm.

(iii)(b) The triangles are similar, so the ratio of their areas is the square of the ratio of corresponding sides:

$\frac{\text{Area } \triangle PQR}{\text{Area } \triangle CBR} = \left(\frac{QR}{BR}\right)^2$. Equating with $\frac{PQ^2}{CB^2}$ gives $\frac{QR}{BR} = \frac{PQ}{CB} = \frac{35}{65}$, so $\frac{56 - x}{x} = \frac{35}{65}$ and $x = 36.4$ cm.

Answer: (i) $\theta = \alpha$ (ii) $\triangle PQR \sim \triangle CBR$ (iii) $x = 36.4$ cm

Q37 · ARITHMETIC PROGRESSIONS · 4 MARKS

Case study 2. 'Kolam' is a decorative art which is made with rice flour in South Indian States. It is drawn on grid pattern of dots. One such art work is shown below. Observe the given figure carefully. There are 4 dots in first square, 8 dots in second square, 12 dots in third square and so on.

Based on the above, answer the following questions:

- (i) Show that number of dots given above form an A.P. Write the first term and common difference. [1]
- (ii) Write n th term of the A.P. formed. [1]
- (iii) (a) The pattern is expanded on a large ground. If total 220 dots are used, then find the number of squares formed. [2]

OR

- (iii) (b) Is it possible to complete n number of squares using 100 dots? If yes, then find the value of n . [2]

SOLUTION

(i) The numbers of dots 4, 8, 12, ... have a constant difference $8 - 4 = 12 - 8 = 4$, so they form an A.P. with $a = 4$ and $d = 4$.

(ii) $a_n = 4 + (n - 1) \times 4 = 4n$.

(iii)(a) $S_n = \frac{n}{2}[2 \times 4 + (n - 1) \times 4] = 2n(n + 1) = 220$, so $n^2 + n - 110 = 0$ and $(n + 11)(n - 10) = 0$. $n = 10$ squares (reject -11).

(iii)(b) $2n(n + 1) = 100$ gives $n^2 + n - 50 = 0$, with $D = 1 + 200 = 201$, which is not a perfect square, so $n = \frac{-1 \pm \sqrt{201}}{2}$ is not a natural number. It is not possible.

Answer: (i) A.P., $a = 4, d = 4$ (ii) $a_n = 4n$ (iii)(a) 10 squares (iii)(b) not possible

Q38 · COORDINATE GEOMETRY · 4 MARKS

Case study 3. Observe the map of Jaipur city placed on a Cartesian plane. Taking Rambagh Palace as origin, the location of some places are given below: Point A: $(-4, 2)$ Rajasthan High Court; Point B: $(4, -4)$ Birla Mandir; Point C: $(4, 3)$ Heera Bagh; Point D: $(-5, -2)$ Amar Jawan Jyoti.

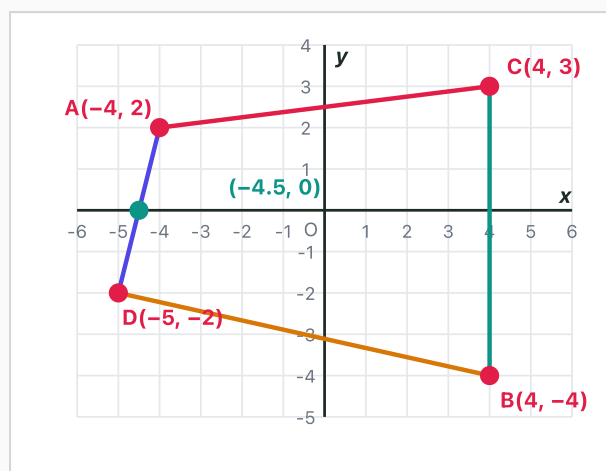
Based on the above, answer the following questions:

- (i) Advocate Rehana stays at Heera Bagh. How much distance she has to cover daily to go to the court and coming back home? [1]
- (ii) There is a crossing on X-axis which divides AD in a certain ratio. Find the ratio. [1]
- (iii) (a) Is Birla Mandir equidistant from Heera Bagh and Amar Jawan Jyoti? Justify your answer. [2]

OR

- (iii) (b) Using section formula, show that points A, O and B are not collinear. [2]

SOLUTION



(i) $AC = \sqrt{(4 + 4)^2 + (3 - 2)^2} = \sqrt{65}$. She goes to the court and back: $2\sqrt{65}$ units.

(ii) Let the crossing $P(x, 0)$ divide AD in the ratio $K : 1$ with $A(-4, 2)$ and $D(-5, -2)$. The y -coordinate:
 $\frac{K(-2) + 2}{K + 1} = 0$ gives $K = 1$. The ratio is $1 : 1$.

(iii)(a) $BC = \sqrt{0 + 7^2} = 7$ and $BD = \sqrt{(4 + 5)^2 + (-4 + 2)^2} = \sqrt{85}$. Since $7 \neq \sqrt{85}$, Birla Mandir is not equidistant from Heera Bagh and Amar Jawan Jyoti.

(iii)(b) Suppose O divides AB in the ratio $K : 1$, with $A(-4, 2)$ and $B(4, -4)$. x : $\frac{4K - 4}{K + 1} = 0$ gives $K = 1$. y :
 $\frac{-4K + 2}{K + 1} = 0$ gives $K = \frac{1}{2}$.

The two values of K differ, so O does not lie on AB : A, O, B are not collinear.

Answer: (i) $2\sqrt{65}$ units (ii) $1 : 1$ (iii)(a) no ($7 \neq \sqrt{85}$) (iii)(b) not collinear

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