

Mathematics (Basic) 2025, Set 430/2/1

Q.P. Code 430/2/1 · Series EGFH2 · 80 marks · 3 hours · March 2025. 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 value of $(\text{HCF} - \text{LCM})$ for the two numbers 3 and 5 is:

- (A) 2 (B) 4
(C) 14 (D) -14

SOLUTION

3 and 5 are co-prime: $\text{HCF} = 1$ and $\text{LCM} = 15$. $\text{HCF} - \text{LCM} = 1 - 15 = -14$.

Answer: (D) -14

Q2 · REAL NUMBERS · 1 MARK

The number 2^n , where n is a natural number, cannot end with the digit:

- (A) 4 (B) 6
(C) 2 (D) 0

SOLUTION

A number ending in 0 is divisible by 5, but 2^n has only the prime factor 2. So 2^n can never end in 0. (It can end in 2, 4, 8, 6.)

Answer: (D) 0

Q3 · LINEAR EQUATIONS · 1 MARK

If $(0, 0)$ is the solution of the equation $x + y = c - 1$, then the value of c is:

- (A) 0 (B) 1
(C) -1 (D) any real number

SOLUTION

Substituting $x = 0, y = 0$: $0 + 0 = c - 1$, so $c = 1$.

Answer: (B) 1

Q4 · QUADRATIC EQUATIONS · 1 MARK

The value of a for which $ax^2 + 3x + 1 = 0$ has real and equal roots is:

- (A) $\frac{4}{9}$ (B) $\frac{9}{4}$
(C) $\frac{3}{2}$ (D) $\frac{2}{3}$

SOLUTION

Equal roots need $D = b^2 - 4ac = 0$: $9 - 4a = 0$, so $a = \frac{9}{4}$.

Answer: (B) $\frac{9}{4}$

Q5 · QUADRATIC EQUATIONS · 1 MARK

Which of the following equations is a quadratic equation?

- (A) $x^2 = (x + 1)^2$ (B) $(x - 1)(x + 2) = 2x + 1$
(C) $(x + 2)^3 = 2x(x^2 - 1)$ (D) $\sqrt{x} = x^2$

SOLUTION

(A) $x^2 = x^2 + 2x + 1$ reduces to $2x + 1 = 0$: linear. (B) $x^2 + x - 2 = 2x + 1$ gives $x^2 - x - 3 = 0$: quadratic.

(C) $x^3 + 6x^2 + 12x + 8 = 2x^3 - 2x$ is cubic in form (the x^3 terms do not cancel, leaving degree 3). (D) has $\sqrt{x}$, not a polynomial.

Answer: (B) $(x - 1)(x + 2) = 2x + 1$

Q6 · COORDINATE GEOMETRY · 1 MARK

The distance of the point $(2, 3)$ from the origin is:

- (A) 2 (B) 3
(C) 5 (D) $\sqrt{13}$

SOLUTION

$$\sqrt{2^2 + 3^2} = \sqrt{13}.$$

Answer: (D) $\sqrt{13}$

Q7 · COORDINATE GEOMETRY · 1 MARK

The mid-point of the line segment joining points $(1, 3)$ and $(1, -3)$ lies:

- (A) at the origin (B) in the second quadrant
(C) on x -axis (D) on y -axis

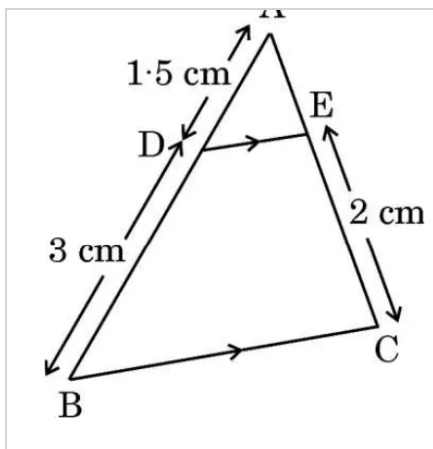
SOLUTION

Mid-point = $\left(\frac{1+1}{2}, \frac{3-3}{2}\right) = (1, 0)$. Its y -coordinate is 0, so it lies on the x -axis.

Answer: (C) on x -axis

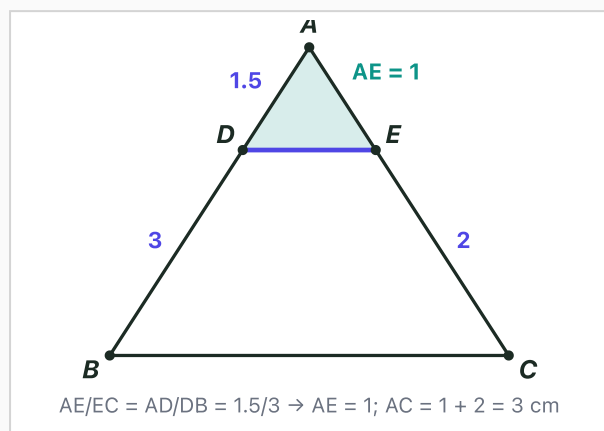
Q8 · TRIANGLES · 1 MARK

In the given figure, if $DE \parallel BC$, $AD = 1.5$ cm, $DB = 3$ cm and $EC = 2$ cm, the length of AC is:



- (A) 1.5 cm (B) 3 cm
(C) 3.5 cm (D) 4.5 cm

SOLUTION



$DE \parallel BC$, so $\frac{AD}{DB} = \frac{AE}{EC}$: $\frac{1.5}{3} = \frac{AE}{2}$, so $AE = 1$ cm.

$AC = AE + EC = 1 + 2 = 3$ cm.

Answer: (B) 3 cm

Q9 · CIRCLES · 1 MARK

In two concentric circles, a tangent to the smaller circle will intersect the larger circle at:

- (A) zero point (B) one point
(C) two points (D) three points

SOLUTION

The tangent to the smaller circle lies inside the larger circle at its point of contact, so it must leave the larger circle in both directions: it cuts the larger circle at two points (it is a chord of the larger circle).

Answer: (C) two points

Q10 · TRIGONOMETRY · 1 MARK

The value of $\frac{2 \tan 60^\circ}{1 - \tan^2 60^\circ}$ is:

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

SOLUTION

$$\tan 60^\circ = \sqrt{3}: \frac{2\sqrt{3}}{1-3} = \frac{2\sqrt{3}}{-2} = -\sqrt{3}. \text{ (This is } \tan 120^\circ \text{.)}$$

Answer: (D) $-\sqrt{3}$

Q11 · TRIGONOMETRY · 1 MARK

The value of $(\sin^2 A + \cos^2 A) + (\sec^2 A - \tan^2 A) - (\cot^2 A - \operatorname{cosec}^2 A)$ is:

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

SOLUTION

Each bracket is a known identity: $\sin^2 A + \cos^2 A = 1$, $\sec^2 A - \tan^2 A = 1$, $\cot^2 A - \operatorname{cosec}^2 A = -1$. The value is $1 + 1 - (-1) = 3$.

Answer: (C) 3

Q12 · TRIGONOMETRY · 1 MARK

The length of the shadow of a tower when the sun's altitude changes from 30° to 60° will:

- (A) become shorter (B) become longer
(C) remain same (D) be doubled

SOLUTION

The shadow length is $\frac{h}{\tan \theta}$. A higher sun means a larger $\tan \theta$, so the shadow gets shorter: from $h\sqrt{3}$ at 30° to $\frac{h}{\sqrt{3}}$ at 60° .

Answer: (A) become shorter

In the given figure, the shaded region represents:



Answer: (C) minor segment

(A) $\frac{1}{4}\pi r^2$

(C) $\frac{\pi r}{2}$

(B) $\frac{1}{4}\pi r^2 + 2r$

(D) $\frac{\pi r}{2} + 2r$

Answer: (D) $\frac{\pi r}{2} + 2r$

(A) 1:1
(B) 3:1
(C) 1:3
(D) 3:2

Answer: (B) 3 : 1

Q16 · STATISTICS · 1 MARK

In the formula of mode given by $\text{mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$, f_1 denotes the:

- (A) frequency of the modal class
(B) frequency of class preceding modal class
(C) frequency of class succeeding modal class
(D) cumulative frequency of modal class

SOLUTION

In the mode formula f_1 is the frequency of the modal class, f_0 the frequency of the class before it, and f_2 the frequency of the class after it.

Answer: (A) frequency of the modal class

Q17 · STATISTICS · 1 MARK

For a distribution, if mean = median = a, then its mode is:

- (A) $3a$
(B) $2a$
(C) a
(D) 0

SOLUTION

Mode = $3 \text{ Median} - 2 \text{ Mean} = 3a - 2a = a$.

Answer: (C) a

Q18 · PROBABILITY · 1 MARK

The total number of outcomes in the experiment of simultaneous throw of three dice is:

- (A) 6
(B) 18
(C) 36
(D) 216

SOLUTION

Each die has 6 outcomes, so three dice give $6 \times 6 \times 6 = 216$.

Answer: (D) 216

Q19 · REAL NUMBERS · 1 MARK

Assertion (A): The prime numbers which divide 36 also divide 6.

Reason (R): Any number which divides p^2 also divides p .

- (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) $36 = 2^2 \times 3^2$ and $6 = 2 \times 3$. The primes 2 and 3 divide both. True.

(R) 8 divides $4^2 = 16$ but 8 does not divide 4. False (it is true only for prime divisors).

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

Q20 · TRIANGLES · 1 MARK

Assertion (A): All congruent triangles are similar.

Reason (R): In congruent triangles, the ratio of corresponding sides is 1 : 1.

(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

(R) Congruent triangles have equal corresponding sides, so the ratio is 1 : 1. True.

(A) Equal corresponding angles and sides in the ratio 1 : 1 make the triangles similar (scale factor 1). True, and R is exactly the reason.

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

Section B: Very short answer

5 questions, 2 marks each.

Q21 · LINEAR EQUATIONS · 2 MARKS

(a) Find the value of c for which the following pair of linear equations has infinitely many solutions: $cx + 3y = c - 3$, $12x + cy = c$.

OR

(b) Solve for x and y : $3x + 2y = 65$, $2x + 3y = 60$.

SOLUTION

(a) Infinitely many solutions need $\frac{c}{12} = \frac{3}{c} = \frac{c-3}{c}$.

$\frac{c}{12} = \frac{3}{c}$ gives $c^2 = 36$, so $c = \pm 6$. $\frac{3}{c} = \frac{c-3}{c}$ gives $c - 3 = 3$, so $c = 6$. Both hold only for $c = 6$.

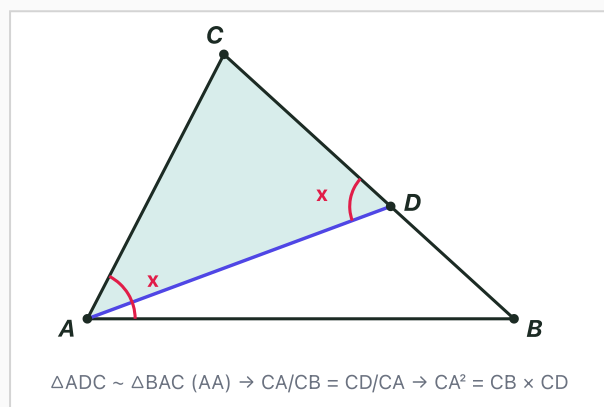
(b) Adding: $5x + 5y = 125$, so $x + y = 25$. Subtracting: $x - y = 5$. So $x = 15$ and $y = 10$. (Check: $45 + 20 = 65$ ✓, $30 + 30 = 60$ ✓.)

Answer: (a) $c = 6$ (b) $x = 15, y = 10$

Q22 · TRIANGLES · 2 MARKS

D is a point on side BC of $\triangle ABC$ such that $\angle ADC = \angle BAC$. Prove that $(CA)^2 = CB \cdot CD$.

SOLUTION



In $\triangle ADC$ and $\triangle BAC$: $\angle ADC = \angle BAC$ (given) and $\angle C$ is common.

So $\triangle ADC \sim \triangle BAC$ by AA, and $\frac{CA}{CB} = \frac{CD}{CA}$. Hence $(CA)^2 = CB \cdot CD$.

Answer: Proved

Q23 · CIRCLES · 2 MARKS

Prove that the tangent drawn at any point of the circle is perpendicular to the radius through the point of contact.

SOLUTION

****Given:**** a circle with centre O and a tangent ℓ at the point A . ****To prove:**** $OA \perp \ell$.

Take any other point B on ℓ . A tangent touches the circle only at A , so B lies outside the circle and $OB > \text{radius} = OA$.

This is true for every point $B \neq A$ of ℓ , so OA is the shortest distance from O to ℓ . The shortest distance from a point to a line is the perpendicular, so $OA \perp \ell$.

Answer: Proved

Q24 · TRIGONOMETRY · 2 MARKS

Evaluate: $\frac{\cos 45^\circ}{\sec 30^\circ + \operatorname{cosec} 30^\circ}$

SOLUTION

$$\cos 45^\circ = \frac{1}{\sqrt{2}}, \sec 30^\circ = \frac{2}{\sqrt{3}}, \operatorname{cosec} 30^\circ = 2.$$

$$\frac{\frac{1}{\sqrt{2}}}{\frac{2}{\sqrt{3}} + 2} = \frac{\sqrt{3}}{\sqrt{2}(2 + 2\sqrt{3})} = \frac{\sqrt{3}}{2\sqrt{2} + 2\sqrt{6}}.$$

Rationalise by multiplying top and bottom by $(2\sqrt{6} - 2\sqrt{2})$: the denominator becomes $24 - 8 = 16$ and the numerator $\sqrt{3}(2\sqrt{6} - 2\sqrt{2}) = 6\sqrt{2} - 2\sqrt{6}$. The value is $\frac{6\sqrt{2} - 2\sqrt{6}}{16} = \frac{3\sqrt{2} - \sqrt{6}}{8}$.

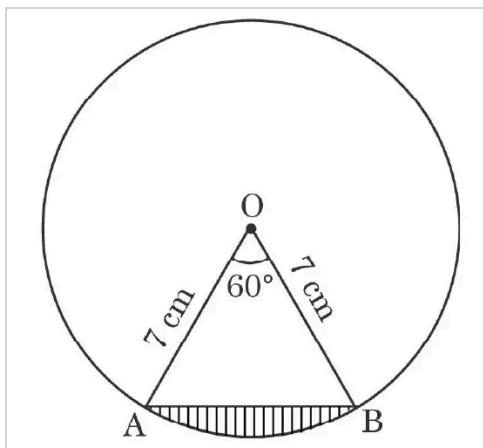
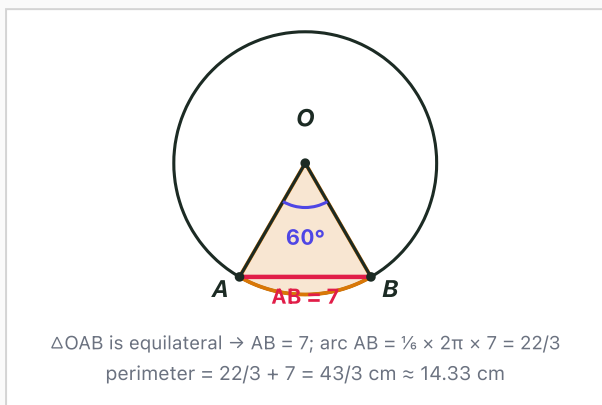
Answer: $\frac{3\sqrt{2} - \sqrt{6}}{8} \approx 0.224$

Q25 · AREAS RELATED TO CIRCLES · 2 MARKS

(a) The area of a smaller circle is equal to the area of a sector of a larger circle with central angle 120° . The radii of the smaller and larger circles are r and R respectively. Find $r : R$.

OR

(b) In the given figure, O is the centre of a circle of radius 7 cm. AB is a chord of the circle. Find the perimeter of the shaded region.

**SOLUTION**

$$(a) \pi r^2 = \frac{120}{360} \pi R^2, \text{ so } \frac{r^2}{R^2} = \frac{1}{3} \text{ and } r : R = 1 : \sqrt{3}.$$

(b) $OA = OB = 7$ and $\angle AOB = 60^\circ$, so $\triangle OAB$ is equilateral and $AB = 7$ cm.

$$\text{Minor arc } AB = \frac{60}{360} \times 2 \times \frac{22}{7} \times 7 = \frac{22}{3} \text{ cm. Perimeter of the shaded region (arc + chord)} = \frac{22}{3} + 7 = \frac{43}{3} \approx 14.33 \text{ cm.}$$

$$\text{Answer: (a) } 1 : \sqrt{3} \quad (b) \frac{43}{3} \approx 14.33 \text{ cm}$$

Section C: Short answer

6 questions, 3 marks each.

Q26 · REAL NUMBERS · 3 MARKS

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

OR

(b) State the "Fundamental Theorem of Arithmetic" and use it to find LCM of 36 and 54.

SOLUTION

(a) Suppose $\sqrt{5} = \frac{p}{q}$ with p, q co-prime and $q \neq 0$. $5q^2 = p^2$, so 5 divides p^2 and so 5 divides p . Write $p = 5m$.

$5q^2 = 25m^2$ gives $q^2 = 5m^2$, so 5 divides q . Then p and q have a common factor 5, contradicting that they are co-prime. So $\sqrt{5}$ is irrational.

(b) **Fundamental Theorem of Arithmetic:** every composite number can be written as a product of primes, and this factorisation is unique apart from the order of the primes.

$36 = 2^2 \times 3^2$ and $54 = 2 \times 3^3$. LCM $= 2^2 \times 3^3 = 108$.

Answer: (a) proved (b) LCM = 108

Q27 · POLYNOMIALS · 3 MARKS

Find the zeroes of the polynomial $p(x) = 3x^2 - 2x - 1$ and verify the relationship between the zeroes of $p(x)$ and the coefficients of $p(x)$.

SOLUTION

$3x^2 - 2x - 1 = (3x + 1)(x - 1)$, so the zeroes are $x = -\frac{1}{3}$ and $x = 1$.

Sum of zeroes $= -\frac{1}{3} + 1 = \frac{2}{3}$, and $-\frac{\text{coefficient of } x}{\text{coefficient of } x^2} = -\frac{-2}{3} = \frac{2}{3} \checkmark$.

Product $= -\frac{1}{3} \times 1 = -\frac{1}{3}$, and $\frac{\text{constant term}}{\text{coefficient of } x^2} = \frac{-1}{3} \checkmark$.

Answer: Zeroes $-\frac{1}{3}$ and 1; both relations verified

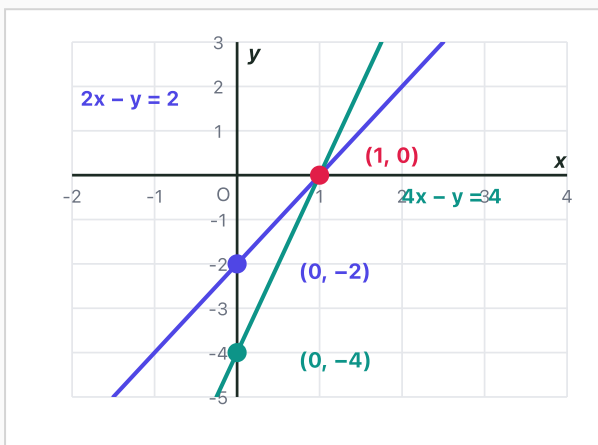
Q28 · LINEAR EQUATIONS · 3 MARKS

(a) Solve graphically the following pair of linear equations: $2x - y = 2$ and $4x - y = 4$. Also, write the coordinates of the points where the lines represented by these equations cut the y -axis.

OR

(b) An academy offering cricket coaching bought 10 bats and 5 balls for ₹ 32,500. Later, the academy bought 2 bats and 8 balls for ₹ 10,000. If there is no change in the cost of the bat and of the ball, find the cost of 1 bat and 1 ball.

SOLUTION



(a) $2x - y = 2$: points $(0, -2)$, $(1, 0)$, $(2, 2)$. $4x - y = 4$: points $(0, -4)$, $(1, 0)$, $(2, 4)$.

The lines meet at $(1, 0)$, so $x = 1$ and $y = 0$. They cut the y -axis at $(0, -2)$ and $(0, -4)$.

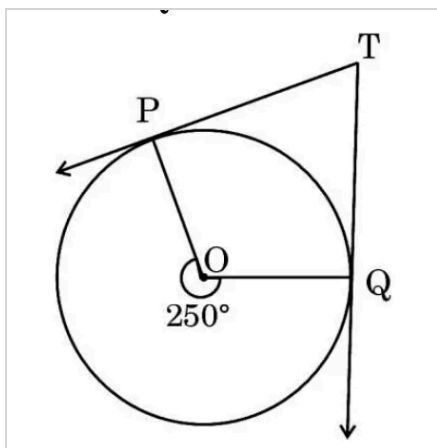
(b) Let a bat cost ₹ x and a ball ₹ y . $10x + 5y = 32500$, that is $2x + y = 6500$ (i), and $2x + 8y = 10000$ (ii).

(i) - (ii): $-7y = -3500$, so $y = 500$. Then $2x = 6500 - 500 = 6000$ and $x = 3000$. A bat costs ₹ 3000 and a ball ₹ 500.

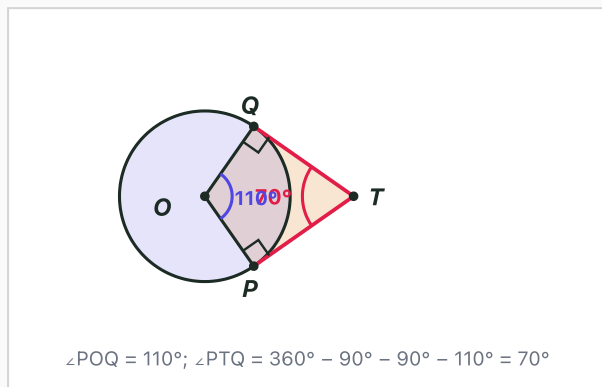
Answer: (a) $(1, 0)$; y -intercepts $(0, -2)$ and $(0, -4)$ **(b)** bat ₹ 3000, ball ₹ 500

Q29 · CIRCLES · 3 MARKS

In the given figure, TP and TQ are tangents at points P and Q of the circle respectively. If reflex $\angle POQ = 250^\circ$, find the measure of each angle of quadrilateral $POQT$.



SOLUTION



$$\angle POQ = 360^\circ - 250^\circ = 110^\circ.$$

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

In the quadrilateral $OPTQ$ the angles add up to 360° : $\angle PTQ = 360^\circ - 90^\circ - 90^\circ - 110^\circ = 70^\circ$.

Answer: $\angle POQ = 110^\circ$, $\angle OPT = \angle OQT = 90^\circ$, $\angle PTQ = 70^\circ$

Q30 · TRIGONOMETRY · 3 MARKS

Prove the following trigonometric identity: $\frac{\cos \theta}{1 + \sin \theta} + \frac{1 + \sin \theta}{\cos \theta} = 2 \sec \theta$.

SOLUTION

$$\text{LHS} = \frac{\cos^2 \theta + (1 + \sin \theta)^2}{(1 + \sin \theta) \cos \theta}.$$

The numerator is $\cos^2 \theta + 1 + 2 \sin \theta + \sin^2 \theta = 2 + 2 \sin \theta = 2(1 + \sin \theta)$.

$$\text{LHS} = \frac{2(1 + \sin \theta)}{(1 + \sin \theta) \cos \theta} = \frac{2}{\cos \theta} = 2 \sec \theta = \text{RHS}.$$

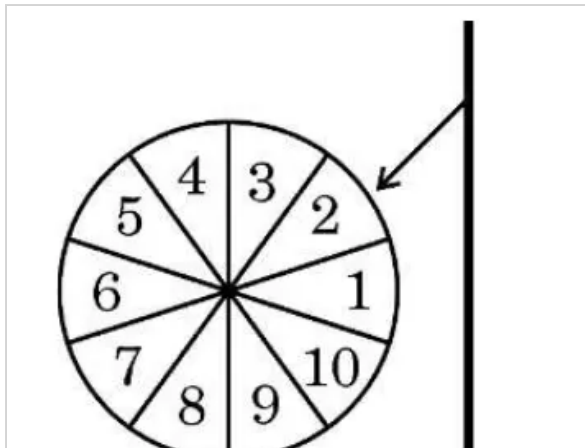
Answer: Proved

Q31 · PROBABILITY · 3 MARKS

A game of chance consists of spinning a wheel which comes to rest at one of the numbers from 1 to 10 (as shown in the given figure) with equal probabilities.

What is the probability that the wheel stops at:

- (i) a prime number greater than 2?
- (ii) an odd number less than 9?
- (iii) a multiple of 4?

**SOLUTION**

There are 10 equally likely outcomes.

(i) Primes greater than 2: 3, 5, 7, which is 3 numbers. $P = \frac{3}{10}$.

(ii) Odd numbers less than 9: 1, 3, 5, 7, which is 4 numbers. $P = \frac{4}{10} = \frac{2}{5}$.

(iii) Multiples of 4: 4, 8, which is 2 numbers. $P = \frac{2}{10} = \frac{1}{5}$.

Answer: (i) $\frac{3}{10}$ (ii) $\frac{2}{5}$ (iii) $\frac{1}{5}$

Section D: Long answer

4 questions, 5 marks each.

Q32 · QUADRATIC EQUATIONS · 5 MARKS

(a) The sum of areas of two squares is 2650 cm^2 . If the sum of their perimeters is 280 cm, find the sides of the two given squares.

OR

(b) Express the equation $\frac{1}{x} - \frac{1}{x-2} = 3$ ($x \neq 0, 2$) as a quadratic equation in standard form. Hence, find the roots of the quadratic equation so obtained.

SOLUTION

(a) Let the sides be x and y . $x^2 + y^2 = 2650$ (i) and $4x + 4y = 280$, so $x + y = 70$ (ii).

Substituting $y = 70 - x$: $x^2 + (70 - x)^2 = 2650$ gives $2x^2 - 140x + 4900 = 2650$, so $x^2 - 70x + 1125 = 0$.

$(x - 25)(x - 45) = 0$, so $x = 25$ or 45 and $y = 45$ or 25 . The sides are 25 cm and 45 cm (both roots are valid: they are just the two squares).

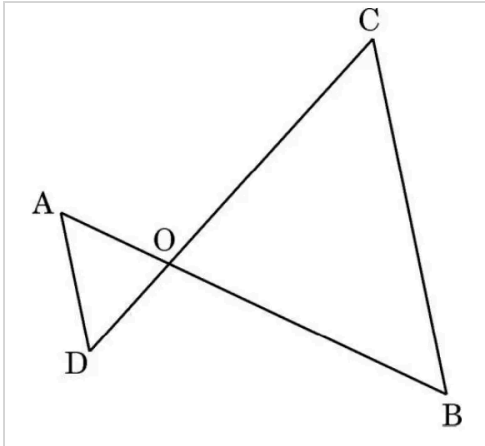
(b) $\frac{(x-2)-x}{x(x-2)} = 3$ gives $-2 = 3x(x-2)$, so $3x^2 - 6x + 2 = 0$.

$$D = 36 - 24 = 12. x = \frac{6 \pm \sqrt{12}}{6} = 1 \pm \frac{\sqrt{3}}{3}.$$

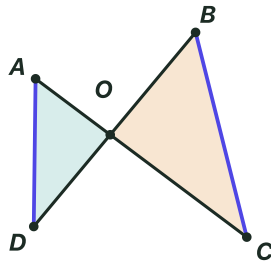
Answer: (a) 25 cm and 45 cm (b) $3x^2 - 6x + 2 = 0$; roots $1 + \frac{\sqrt{3}}{3}$ and $1 - \frac{\sqrt{3}}{3}$

Q33 · TRIANGLES · 5 MARKS

State the SAS criteria of similarity of two triangles. In the given figure, it is given that $OA \cdot OC = OB \cdot OD$. Use the SAS criteria to prove that $AD \parallel CB$.



SOLUTION



$$OA/OB = OD/OC \rightarrow \triangle OAD \sim \triangle OBC \rightarrow \angle A = \angle B \rightarrow AD \parallel CB$$

Sketch, not to scale.

****SAS similarity:**** if one angle of a triangle equals one angle of another triangle and the sides including these angles are proportional, the two triangles are similar.

****Proof:**** $OA \cdot OC = OB \cdot OD$ gives $\frac{OA}{OB} = \frac{OD}{OC}$.

In $\triangle OAD$ and $\triangle OBC$: $\angle AOD = \angle BOC$ (vertically opposite angles) and the sides including them are proportional, $\frac{OA}{OB} = \frac{OD}{OC}$.

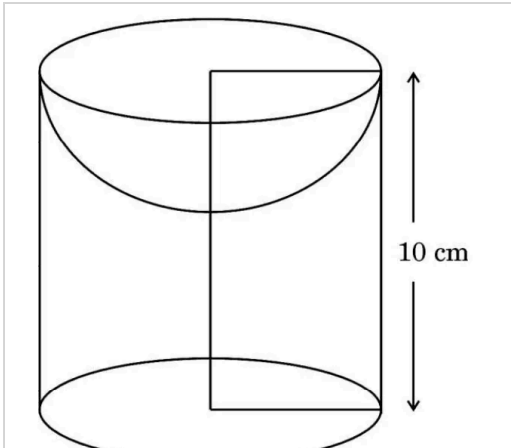
So $\triangle OAD \sim \triangle OBC$ by SAS, and $\angle OAD = \angle OBC$, that is $\angle A = \angle B$.

These are alternate interior angles for the lines AD and CB , so $AD \parallel CB$.

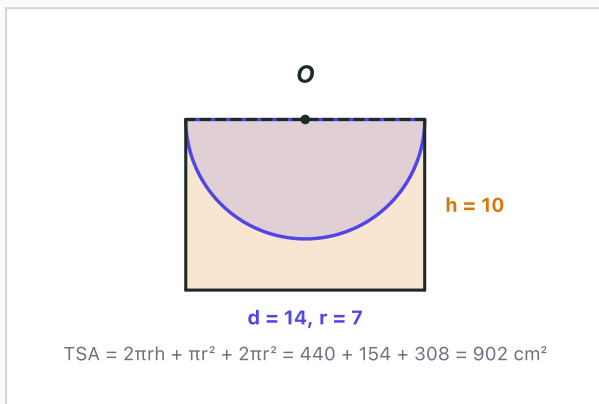
Answer: Proved

Q34 · SURFACE AREAS AND VOLUMES · 5 MARKS

A wooden article was made by scooping out a hemisphere (of same diameter) from one end of a solid cylinder as shown in the given figure. If the height of the cylinder is 10 cm and the diameter of the cylinder is 14 cm, find the total surface area of the remaining wooden article. (Use $\pi = \frac{22}{7}$)



SOLUTION



Radius $r = 7$ cm for both the cylinder and the hemisphere; cylinder height $h = 10$ cm.

The surface of the remaining article is the curved side of the cylinder, the bottom base, and the inside surface of the hemispherical hollow (the top face is completely removed because the hemisphere has the same diameter).

Curved side $= 2\pi rh = 2 \times \frac{22}{7} \times 7 \times 10 = 440 \text{ cm}^2$. Bottom base $= \pi r^2 = \frac{22}{7} \times 49 = 154 \text{ cm}^2$. Hemispherical hollow $= 2\pi r^2 = 308 \text{ cm}^2$.

Total surface area $= 440 + 154 + 308 = 902 \text{ cm}^2$.

Answer: 902 cm²

Q35 · STATISTICS · 5 MARKS

(a) The lengths of 40 leaves of a plant are measured, correct to the nearest millimetre and data obtained is represented in the following table. Find the median length (in mm) of the leaves.

OR

(b) A class teacher has the following absentees record of 30 students of a class. If the mean number of days a student was absent is 12, find the values of x and y .

Length in (mm)	100–120	120–140	140–160	160–180	180–200
Number of leaves	8	9	12	5	6

SOLUTION

(a) Cumulative frequencies: 8, 17, 29, 34, 40. $\frac{N}{2} = 20$ lies in 140 – 160: $l = 140$, $cf = 17$, $f = 12$, $h = 20$.

$$\text{Median} = 140 + \frac{20 - 17}{12} \times 20 = 140 + 5 = 145 \text{ mm.}$$

(b) The table has classes 0 – 4, 4 – 8, 8 – 12, 12 – 16, 16 – 20, 20 – 24 with number of absent students 1, 8, x , 6, 5, y (class marks 2, 6, 10, 14, 18, 22).

The total is 30: $1 + 8 + x + 6 + 5 + y = 20 + x + y = 30$, so $x + y = 10$. (i)

$$\sum f_i x_i = 2 + 48 + 10x + 84 + 90 + 22y = 224 + 10x + 22y. \text{ Mean} = 12: 224 + 10x + 22y = 360, \text{ so } 5x + 11y = 68. \text{ (ii)}$$

From (i) $x = 10 - y$: $50 - 5y + 11y = 68$, so $6y = 18$ and $y = 3$, $x = 7$.

Answer: (a) 145 mm (b) $x = 7$, $y = 3$

Section E: Case studies

3 case studies, 4 marks each.

Q36 · TRIGONOMETRY · 4 MARKS

Case study 1. Kite festival is a popular festival in India which takes place during Makar Sankranti. The festival is celebrated by people flying kites from their rooftops. Reena and Ravi are also flying kites to enjoy the festival. The height of Reena's kite is 60 m above the ground. The string attached to the kite is temporarily tied to a point on the ground, and the inclination of the string with the ground is 30° . Ravi is flying a kite from a 10 m high building. His kite is also flying 60 m above the ground and the length of the string used by Ravi is same as that of Reena's. θ is the angle of elevation of Ravi's kite from a point on the rooftop.

Based on the above information, answer the following questions:

(i) Find the length of string used by Reena. [1]

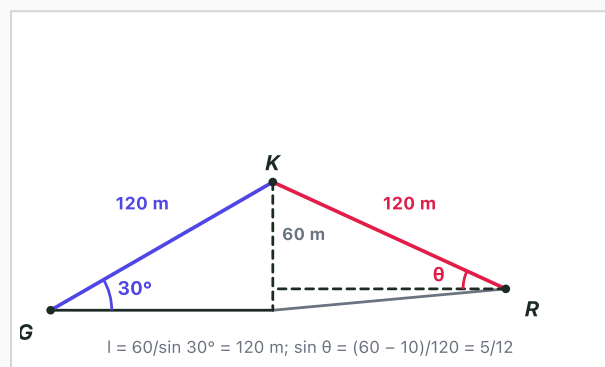
(ii) Find the value of $\sin \theta$. [1]

(iii) (a) If θ changes to 60° , without changing the length of the string, what will be the height of Ravi's kite above the ground? (Use $\sqrt{3} = 1.7$) [2]

OR

(iii) (b) What would have been the height of Ravi's kite above the ground, if the string had an inclination of 30° with the ground, assuming that the length of the string does not change? [2]

SOLUTION



(i) $\sin 30^\circ = \frac{60}{l}$, so $l = \frac{60}{1/2} = 120 \text{ m.}$

(ii) Ravi's string is also 120 m. His kite is $60 - 10 = 50 \text{ m}$ above his rooftop: $\sin \theta = \frac{50}{120} = \frac{5}{12}.$

(iii)(a) At $\theta = 60^\circ$ the height above the rooftop is $120 \sin 60^\circ = 60\sqrt{3} = 60 \times 1.7 = 102 \text{ m.}$ Height above the ground $= 102 + 10 = 112 \text{ m.}$

(iii)(b) At 30° the height above the rooftop is $120 \times \frac{1}{2} = 60$ m, so the height above the ground is $60 + 10 = 70$ m.

Answer: (i) 120 m (ii) $\frac{5}{12}$ (iii)(a) 112 m (iii)(b) 70 m

Q37 · ARITHMETIC PROGRESSIONS · 4 MARKS

Case study 2. A woman borrowed ₹ 10,00,000 from her friend and promised to return the borrowed money in monthly instalments beginning from the next month. After one month, she returned ₹ 10,000, the next month she returned ₹ 15,000, the third month she returned ₹ 20,000 and so on, thereby increasing the monthly instalment uniformly.

Based on the above information, answer the following questions:

- (i) Find the amount of instalment paid in the tenth month. [1]
- (ii) In which instalment did she pay ₹ 40,000? [1]
- (iii) (a) If she returned ₹ 11,50,000 in all, how many instalments did she pay? [2]

OR

- (iii) (b) By which instalment has she returned a total amount of ₹ 3,25,000? [2]

SOLUTION

The instalments form an A.P. with $a = 10000$ and $d = 5000$.

(i) $a_{10} = 10000 + 9 \times 5000 = 55000$. She paid ₹ 55,000.

(ii) $40000 = 10000 + (n - 1) \times 5000$, so $n - 1 = 6$ and $n = 7$: the 7th instalment.

(iii)(a) $S_n = \frac{n}{2}[2(10000) + (n - 1)5000] = 1150000$ gives $n[20000 + 5000(n - 1)] = 2300000$, so $n^2 + 3n - 460 = 0$ and $(n - 20)(n + 23) = 0$. $n = 20$ (reject -23).

(iii)(b) $\frac{n}{2}[20000 + 5000(n - 1)] = 325000$ gives $n^2 + 3n - 130 = 0$ and $(n - 10)(n + 13) = 0$. $n = 10$: by the 10th instalment.

Answer: (i) ₹ 55,000 (ii) 7th (iii)(a) 20 instalments (iii)(b) the 10th instalment

Q38 · COORDINATE GEOMETRY · 4 MARKS

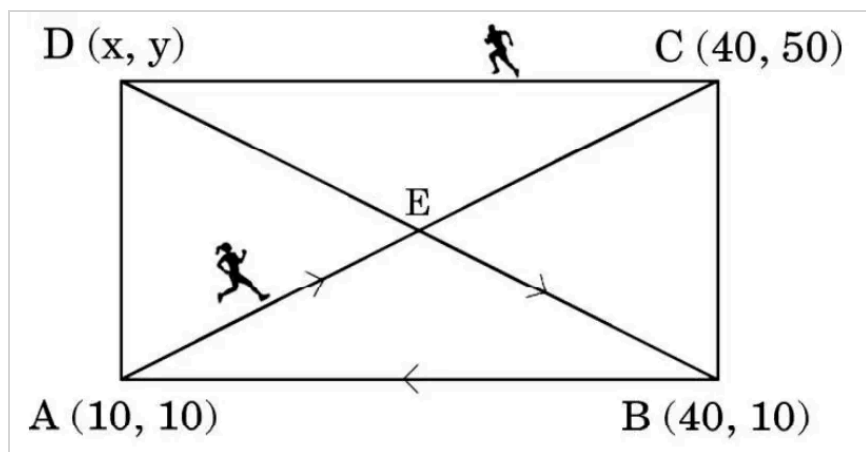
Case study 3. A field is in the form of a rectangle. The coordinates of the rectangular field ABCD are A(10, 10), B(40, 10), C(40, 50) and D(x, y). Anil and Anita, two friends decided to have a race. Anita started from point A and moved to point E along the diagonal AC, where E is the point of intersection of both the diagonals of ABCD. From point E, she moved to point B along the other diagonal DB and then moved back to point A along BA. While Anil started from point C and ran to point A via D along the boundary of the field.

Based on the above information, answer the following questions:

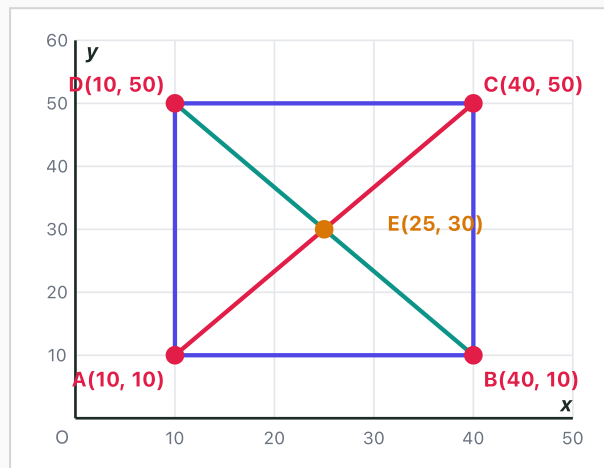
- (i) Find the coordinates of point E. [1]
- (ii) Find the distance between the points B and C. [1]
- (iii) (a) Find the coordinates of point D and the distance BD. [2]

OR

- (iii) (b) Find the total distance travelled by Anita. [2]



SOLUTION



- (i) The diagonals of a rectangle bisect each other, so E is the mid-point of AC : $\left(\frac{10 + 40}{2}, \frac{10 + 50}{2}\right) = (25, 30)$.
- (ii) $BC = \sqrt{(40 - 10)^2 + (50 - 10)^2} = 40$.
- (iii)(a) E is also the mid-point of BD : $\frac{x + 40}{2} = 25$ and $\frac{y + 10}{2} = 30$, so $x = 10$ and $y = 50$. $D = (10, 50)$. $BD = \sqrt{(40 - 10)^2 + (10 - 50)^2} = \sqrt{900 + 1600} = 50$.
- (iii)(b) $AE = \sqrt{15^2 + 20^2} = 25$, $EB = \sqrt{15^2 + 20^2} = 25$, $BA = 30$. Total = $25 + 25 + 30 = 80$ units.

Answer: (i) (25, 30) (ii) 40 (iii)(a) D(10, 50), BD = 50 (iii)(b) 80 units

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