

Mathematics (Basic) 2025, Set 430/4/1

Q.P. Code 430/4/1 · Series H4EFG · 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

If $\text{HCF}(x, 20) = 2$ and $\text{LCM}(x, 20) = 60$, then the value of x is:

- (A) 3 (B) 6
(C) 20 (D) 10

SOLUTION

$\text{HCF} \times \text{LCM} = x \times 20$, so $2 \times 60 = 20x$ and $x = 6$. (Check: $\text{HCF}(6, 20) = 2 \checkmark$ and $\text{LCM}(6, 20) = 60 \checkmark$.)

Answer: (B) 6

Q2 · COORDINATE GEOMETRY · 1 MARK

The distance between the points $(-6, 9)$ and $(2, 7)$ is:

- (A) $2\sqrt{17}$ (B) $4\sqrt{17}$
(C) $2\sqrt{5}$ (D) $2\sqrt{15}$

SOLUTION

$$d = \sqrt{(2 + 6)^2 + (7 - 9)^2} = \sqrt{64 + 4} = \sqrt{68} = 2\sqrt{17}.$$

Answer: (A) $2\sqrt{17}$

Q3 · ARITHMETIC PROGRESSIONS · 1 MARK

If n^{th} term of an A.P. is $5n - 6$, then its common difference is:

- (A) -6 (B) $5n$
(C) 5 (D) 6

SOLUTION

$$a_{n+1} - a_n = (5(n+1) - 6) - (5n - 6) = 5.$$

Answer: (C) 5

Q4 · POLYNOMIALS · 1 MARK

One of the zeroes of the polynomial $p(x) = kx^2 - 9x + 3$ is $\left(-\frac{3}{2}\right)$. The value of k is:

- (A) $\frac{22}{3}$ (B) $-\frac{14}{3}$
(C) $\frac{14}{3}$ (D) $-\frac{22}{3}$

SOLUTION

A zero makes the polynomial 0: $k\left(-\frac{3}{2}\right)^2 - 9\left(-\frac{3}{2}\right) + 3 = 0$.

$$\frac{9k}{4} + \frac{27}{2} + 3 = 0, \text{ so } \frac{9k}{4} = -\frac{33}{2} \text{ and } k = -\frac{22}{3}.$$

Answer: (D) $-\frac{22}{3}$

Q5 · PROBABILITY · 1 MARK

Three coins are tossed together. The probability that only one coin shows tail, is:

- (A) $\frac{1}{2}$ (B) $\frac{3}{8}$
(C) $\frac{7}{8}$ (D) 1

SOLUTION

There are $2^3 = 8$ outcomes. Exactly one tail: THH, HTH, HHT , which is 3. $P = \frac{3}{8}$.

Answer: (B) $\frac{3}{8}$

Q6 · SURFACE AREAS AND VOLUMES · 1 MARK

Two right circular cylinders of equal volumes have their heights in the ratio 1 : 2. The ratio of their radii is:

- (A) $\sqrt{2} : 1$ (B) 1 : 2
(C) 1 : 4 (D) $1 : \sqrt{2}$

SOLUTION

$$\pi r_1^2 h_1 = \pi r_2^2 h_2, \text{ so } \frac{r_1^2}{r_2^2} = \frac{h_2}{h_1} = \frac{2}{1} \text{ and } r_1 : r_2 = \sqrt{2} : 1.$$

Answer: (A) $\sqrt{2} : 1$

Q7 · TRIGONOMETRY · 1 MARK

If $\sqrt{2} \sin \theta = 1$, then $\cot \theta \times \operatorname{cosec} \theta$ is equal to:

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

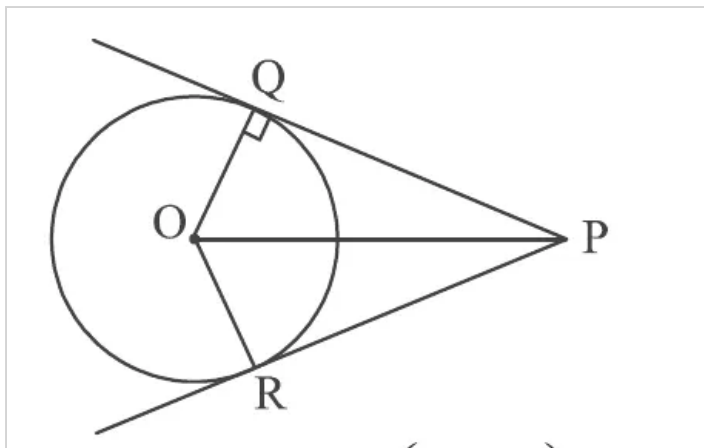
SOLUTION

$$\sin \theta = \frac{1}{\sqrt{2}}, \text{ so } \theta = 45^\circ. \cot 45^\circ \times \operatorname{cosec} 45^\circ = 1 \times \sqrt{2} = \sqrt{2}.$$

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

Q8 · CIRCLES · 1 MARK

PQ and PR are tangents to the circle of radius 3 cm and centre O . If length of each tangent is 4 cm, perimeter of $\triangle OQP$ is:



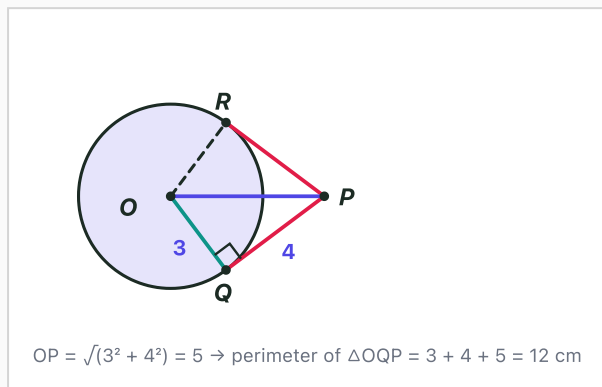
(A) 5 cm

(B) 12 cm

(C) 9 cm

(D) 8 cm

SOLUTION



$OQ \perp PQ$, so $OP = \sqrt{3^2 + 4^2} = 5 \text{ cm}$.

Perimeter of $\triangle OQP = OQ + QP + OP = 3 + 4 + 5 = 12 \text{ cm}$.

Answer: (B) 12 cm

Q9 · POLYNOMIALS · 1 MARK

α, β are zeroes of the polynomial $2x^2 + 5x + 1$. The value of $\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$ is:

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

(B) 5

(C) $\frac{5}{4}$

(D) -5

SOLUTION

$$\alpha + \beta = -\frac{5}{2} \text{ and } \alpha\beta = \frac{1}{2}. \frac{1}{\alpha} + \frac{1}{\beta} = \frac{\alpha + \beta}{\alpha\beta} = \frac{-5/2}{1/2} = -5.$$

Answer: (D) -5

Q10 · ARITHMETIC PROGRESSIONS · 1 MARK

The 20th term of the A.P.: $10\sqrt{2}, 6\sqrt{2}, 2\sqrt{2}, \dots$ is:

(A) $-76 + 10\sqrt{2}$

(B) $-62\sqrt{2}$

(C) $-66\sqrt{2}$

(D) $86\sqrt{2}$

SOLUTION

$$a = 10\sqrt{2} \text{ and } d = 6\sqrt{2} - 10\sqrt{2} = -4\sqrt{2}. a_{20} = 10\sqrt{2} + 19(-4\sqrt{2}) = 10\sqrt{2} - 76\sqrt{2} = -66\sqrt{2}.$$

Answer: (C) $-66\sqrt{2}$

Q11 · TRIGONOMETRY · 1 MARK

If $\sec \theta - \tan \theta = 2$, then $\sec \theta + \tan \theta$ is equal to:

(A) $\frac{1}{2}$

(B) $\sqrt{2}$

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

(D) 2

SOLUTION

$$(\sec \theta + \tan \theta)(\sec \theta - \tan \theta) = \sec^2 \theta - \tan^2 \theta = 1. \text{ So } \sec \theta + \tan \theta = \frac{1}{2}.$$

Answer: (A) $\frac{1}{2}$

Q12 · PROBABILITY · 1 MARK

A card is drawn at random from a well shuffled deck of 52 playing cards. The probability that drawn card shows number '9' is:

(A) $\frac{1}{26}$

(B) $\frac{4}{13}$

(C) $\frac{1}{52}$

(D) $\frac{1}{13}$

SOLUTION

$$\text{There are 4 nines in the deck. } P = \frac{4}{52} = \frac{1}{13}.$$

Answer: (D) $\frac{1}{13}$

Q13 · AREAS RELATED TO CIRCLES · 1 MARK

The length of arc subtending an angle of 210° at the centre of the circle, is $\frac{44}{3}$ cm. The radius of the circle is:

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

(B) 4 cm

(C) 8 cm

(D) $\frac{1}{4}$ cm

SOLUTION

$$\text{Arc} = \frac{210}{360} \times 2\pi r = \frac{7}{12} \times 2 \times \frac{22}{7} r = \frac{11}{3} r = \frac{44}{3}, \text{ so } r = 4 \text{ cm.}$$

Answer: (B) 4 cm

Q14 · LINEAR EQUATIONS · 1 MARK

The value of m for which lines $14x + my = 20$ and $-3x + 2y = 16$ are parallel, is:

(A) $-\frac{3}{14}$
(C) $-\frac{28}{3}$

(B) $-\frac{7}{3}$
(D) $-\frac{3}{28}$

SOLUTION

Parallel lines need $\frac{14}{-3} = \frac{m}{2} \neq \frac{20}{16}$. So $m = -\frac{28}{3}$ (then $\frac{m}{2} = -\frac{14}{3} \neq \frac{5}{4} \checkmark$).

Answer: (C) $-\frac{28}{3}$

Q15 · SURFACE AREAS AND VOLUMES · 1 MARK

The curved surface area of a cone with base radius 7 cm, is 550 cm^2 . The slant height of the cone is:

(A) 25 cm

(B) 14 cm

(C) 20 cm

(D) 24 cm

SOLUTION

$\pi r l = 550$: $\frac{22}{7} \times 7 \times l = 22l = 550$, so $l = 25 \text{ cm}$.

Answer: (A) 25 cm

Q16 · TRIGONOMETRY · 1 MARK

If $\sin A = \frac{2}{3}$, then $\cos A$ is equal to:

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

(B) $\frac{\sqrt{5}}{3}$
(D) $\frac{1}{\sqrt{3}}$

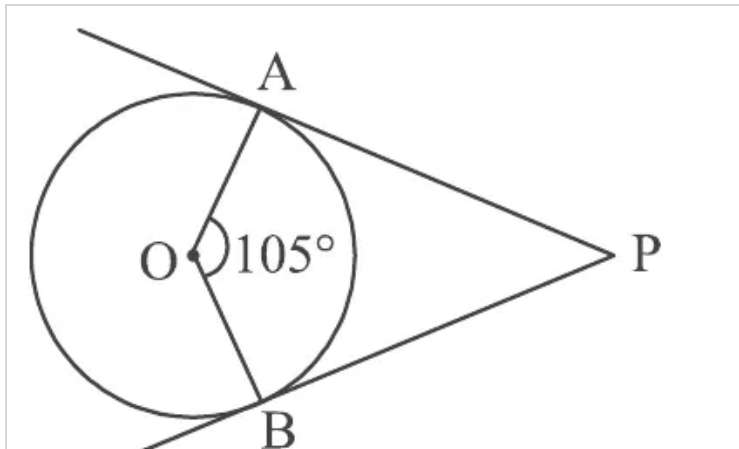
SOLUTION

$$\cos A = \sqrt{1 - \sin^2 A} = \sqrt{1 - \frac{4}{9}} = \frac{\sqrt{5}}{3}.$$

Answer: (B) $\frac{\sqrt{5}}{3}$

Q17 · CIRCLES · 1 MARK

PA and PB are tangents to a circle with centre O . If $\angle AOB = 105^\circ$ then $\angle OAP + \angle APB$ is equal to:



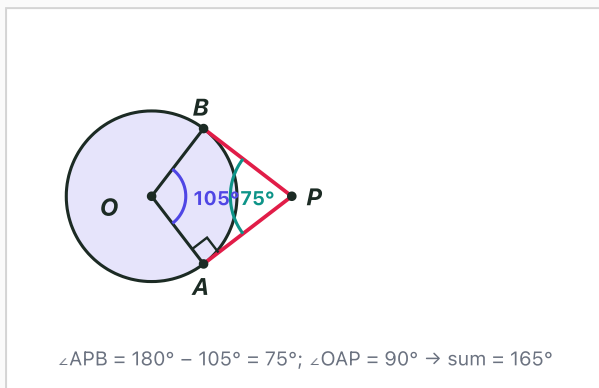
(A) 75°

(B) 175°

(C) 180°

(D) 165°

SOLUTION



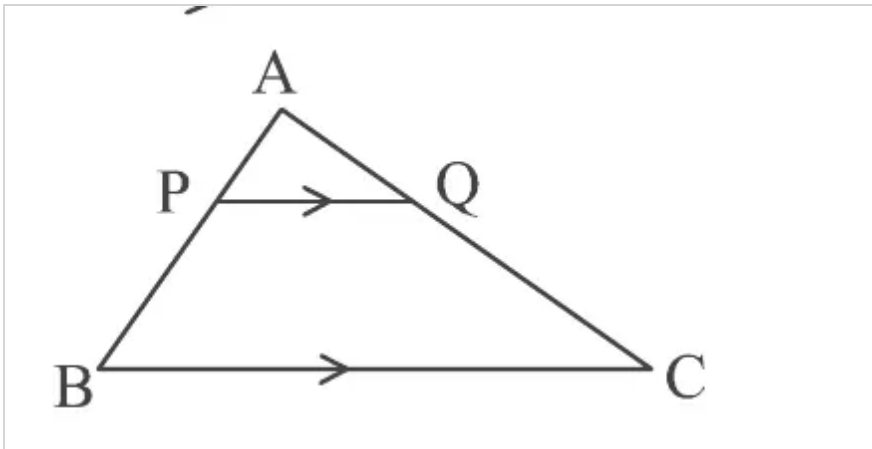
$OA \perp PA$, so $\angle OAP = 90^\circ$. In the quadrilateral $OAPB$: $\angle APB = 360^\circ - 90^\circ - 90^\circ - 105^\circ = 75^\circ$.

$\angle OAP + \angle APB = 90^\circ + 75^\circ = 165^\circ$.

Answer: (D) 165°

Q18 · TRIANGLES · 1 MARK

In $\triangle ABC$, $PQ \parallel BC$. It is given that $AP = 2.4$ cm, $PB = 3.6$ cm and $BC = 5.4$ cm. PQ is equal to:



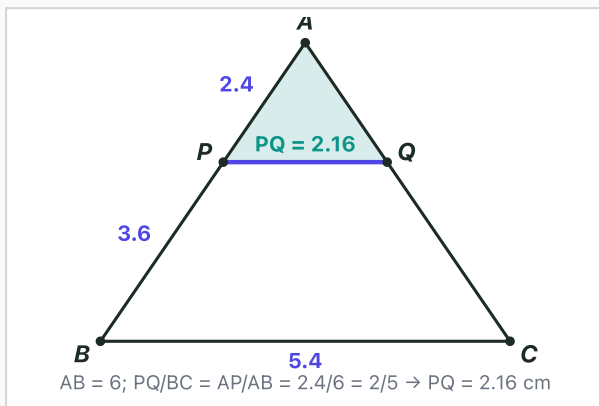
(A) 2.7 cm

(B) 1.8 cm

(C) 3.6 cm

(D) 2.16 cm

SOLUTION



$AB = AP + PB = 2.4 + 3.6 = 6$ cm. $PQ \parallel BC$ gives $\triangle APQ \sim \triangle ABC$, so $\frac{PQ}{BC} = \frac{AP}{AB}$.

$$PQ = 5.4 \times \frac{2.4}{6} = 2.16 \text{ cm.}$$

Answer: (D) 2.16 cm

Q19 · STATISTICS · 1 MARK

Assertion (A): Median marks of students in a class test is 16. It means half of the class got marks less than 16.

Reason (R): Median divides the distribution in two equal parts.

(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) The median is the middle value: half of the data lie below it and half above. True.

(A) That is exactly what a median of 16 means: half of the class scored less than 16. True, and R explains it.

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

Q20 · PROBABILITY · 1 MARK

Assertion (A): If E is an event such that $P(E) = \frac{1}{999}$, then $P(\bar{E}) = 0.001$.

Reason (R): $P(E) + P(\bar{E}) = 1$.

(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) The probabilities of an event and its complement add up to 1. True.

(A) $P(\bar{E}) = 1 - \frac{1}{999} = \frac{998}{999} \approx 0.999$, not 0.001 (that is close to $P(E)$ itself). False.

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

Section B: Very short answer

5 questions, 2 marks each.

Q21 · REAL NUMBERS · 2 MARKS

Show that 45^n can not end with the digit 0, n being a natural number. Write the prime number ' a ' which on multiplying with 45^n makes the product end with the digit 0.

SOLUTION

$45^n = (3 \times 3 \times 5)^n = 3^{2n} \times 5^n$. A number ends in 0 only if it is divisible by both 2 and 5. 45^n has no factor 2, so it cannot end with 0.

Multiplying by the prime $a = 2$ gives the factors 2 and 5 together, so 2×45^n ends with 0.

Answer: Shown; $a = 2$

Q22 · COORDINATE GEOMETRY · 2 MARKS

Point $P(x, 0)$ divides the line segment joining the points $(2, 8)$ and $(-3, -5)$ in a certain ratio. Find the ratio and hence find the value of x .

SOLUTION

Let P divide the segment in the ratio $k : 1$. The y -coordinate of P is 0: $\frac{-5k + 8}{k + 1} = 0$, so $k = \frac{8}{5}$. The ratio is 8 : 5.

$$x = \frac{8(-3) + 5(2)}{13} = \frac{-24 + 10}{13} = -\frac{14}{13}.$$

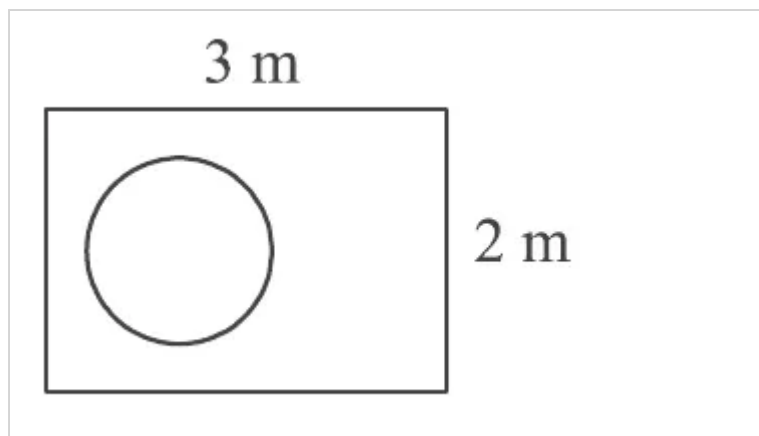
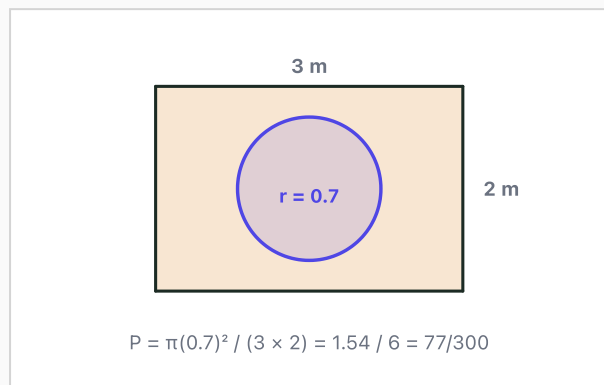
Answer: Ratio 8 : 5; $x = -\frac{14}{13}$

Q23 · PROBABILITY · 2 MARKS

(a) A coin is dropped at random on the rectangular region shown in the figure (a rectangle 3 m by 2 m with a circle of radius 0.7 m inside). What is the probability that it will land inside the circle with radius 0.7 m?

OR

(b) A die is thrown twice. What is the probability that (i) difference between two numbers obtained is 3? (ii) sum of the numbers obtained is 8?

**SOLUTION**

(a) Area of the circle = $\frac{22}{7} \times 0.7 \times 0.7 = 1.54 \text{ m}^2$. Area of the rectangle = $3 \times 2 = 6 \text{ m}^2$. $P = \frac{1.54}{6} = \frac{77}{300}$.

(b) There are 36 equally likely outcomes. (i) Difference 3: (1, 4), (4, 1), (2, 5), (5, 2), (3, 6), (6, 3), which is 6: $P = \frac{6}{36} = \frac{1}{6}$.

(ii) Sum 8: (2, 6), (6, 2), (3, 5), (5, 3), (4, 4), which is 5: $P = \frac{5}{36}$.

Answer: (a) $\frac{77}{300}$ (b) (i) $\frac{1}{6}$ (ii) $\frac{5}{36}$

Q24 · CIRCLES · 2 MARKS

(a) Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line segment joining the points of contact at the centre.

OR

(b) Prove that the tangents drawn at the ends of a diameter of a circle are parallel.

SOLUTION

(a) Let PA and PB be tangents from P to a circle with centre O . $OA \perp PA$ and $OB \perp PB$, so $\angle OAP = \angle OBP = 90^\circ$.

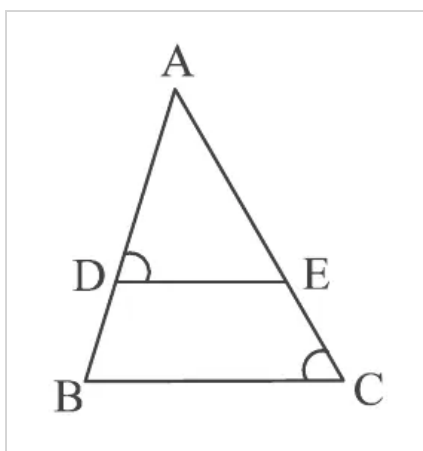
In the quadrilateral $OAPB$: $\angle APB + \angle PBO + \angle BOA + \angle OAP = 360^\circ$, so $\angle APB + \angle AOB = 180^\circ$. The two angles are supplementary.

(b) Let AB be a diameter with the tangents PQ at A and RS at B . $\angle OAP = \angle OBR = 90^\circ$ (radius and tangent). These are alternate (co-interior) angles that add to 180° with the transversal AB , so $PQ \parallel RS$.

Answer: Proved (both parts)

Q25 • TRIANGLES • 2 MARKS

In the given figure, $\angle ADE = \angle ACB$ and $\frac{AD}{DB} = \frac{AE}{EC}$. Prove that $\triangle ABC$ is an isosceles triangle.



SOLUTION

$\frac{AD}{DB} = \frac{AE}{EC}$, so $DE \parallel BC$ (converse of the basic proportionality theorem).

Then $\angle ADE = \angle ABC$ (corresponding angles). It is given that $\angle ADE = \angle ACB$, so $\angle ABC = \angle ACB$.

The sides opposite equal angles are equal: $AC = AB$, so $\triangle ABC$ is isosceles.

Answer: Proved

Section C: Short answer

6 questions, 3 marks each.

Q26 • POLYNOMIALS • 3 MARKS

Find the zeroes of the polynomial $p(x) = 6x^2 + 13x - 5$ and verify the relationship between its zeroes and the coefficients.

SOLUTION

$6x^2 + 13x - 5 = (3x - 1)(2x + 5)$, so the zeroes are $\frac{1}{3}$ and $-\frac{5}{2}$.

Sum = $\frac{1}{3} - \frac{5}{2} = -\frac{13}{6}$ and $-\frac{13}{6} \checkmark$. Product = $\frac{1}{3} \times \left(-\frac{5}{2}\right) = -\frac{5}{6}$ and $\frac{-5}{6} \checkmark$.

Answer: Zeroes $\frac{1}{3}$ and $-\frac{5}{2}$; relations verified

Q27 · ARITHMETIC PROGRESSIONS · 3 MARKS

(a) Find the sum of the A.P. $7, 10\frac{1}{2}, 14, \dots, 84$.

OR

(b) If the sum of first n terms of an A.P. is given by $S_n = \frac{n}{2}(2n + 8)$, then find its first term and common difference. Hence, find its 15th term.

SOLUTION

(a) $a = 7$ and $d = 10\frac{1}{2} - 7 = \frac{7}{2}$. $84 = 7 + (n - 1) \times \frac{7}{2}$ gives $n - 1 = 22$ and $n = 23$.

$$S_{23} = \frac{23}{2}(7 + 84) = \frac{23 \times 91}{2} = \frac{2093}{2} = 1046.5.$$

(b) $S_n = n(n + 4) = n^2 + 4n$. $a = S_1 = 5$ and $S_2 = 12$, so $a_2 = 7$ and $d = 2$.

$$a_{15} = 5 + 14 \times 2 = 33.$$

Answer: (a) $\frac{2093}{2}$ **(b)** $a = 5, d = 2, a_{15} = 33$

Q28 · REAL NUMBERS · 3 MARKS

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

SOLUTION

Suppose $\sqrt{3} = \frac{p}{q}$ with p, q co-prime and $q \neq 0$. $3q^2 = p^2$, so 3 divides p^2 and so 3 divides p . Write $p = 3m$.

$3q^2 = 9m^2$ gives $q^2 = 3m^2$, so 3 divides q . Then 3 divides both p and q , contradicting that they are co-prime. So $\sqrt{3}$ is irrational.

Answer: Proved

Q29 · COORDINATE GEOMETRY · 3 MARKS

(a) If points $A(-5, y)$, $B(2, -2)$, $C(8, 4)$ and $D(x, 5)$ taken in order, form a parallelogram $ABCD$, then find the values of x and y . Hence, find lengths of sides of the parallelogram.

OR

(b) $A(6, -3)$, $B(0, 5)$ and $C(-2, 1)$ are vertices of $\triangle ABC$. Points $P(3, 1)$ and $Q(2, -1)$ lie on sides AB and AC respectively. Check whether $\frac{AP}{PB} = \frac{AQ}{QC}$.

SOLUTION

(a) The diagonals of a parallelogram bisect each other: the mid-point of BD equals the mid-point of AC .

$$\left(\frac{2+x}{2}, \frac{-2+5}{2}\right) = \left(\frac{-5+8}{2}, \frac{y+4}{2}\right).$$

$$\frac{2+x}{2} = \frac{3}{2} \text{ gives } x = 1, \text{ and } \frac{3}{2} = \frac{y+4}{2} \text{ gives } y = -1.$$

$AB = \sqrt{(2+5)^2 + (-2+1)^2} = \sqrt{50} = 5\sqrt{2}$ and $BC = \sqrt{(8-2)^2 + (4+2)^2} = \sqrt{72} = 6\sqrt{2}$. The sides are $5\sqrt{2}$ and $6\sqrt{2}$.

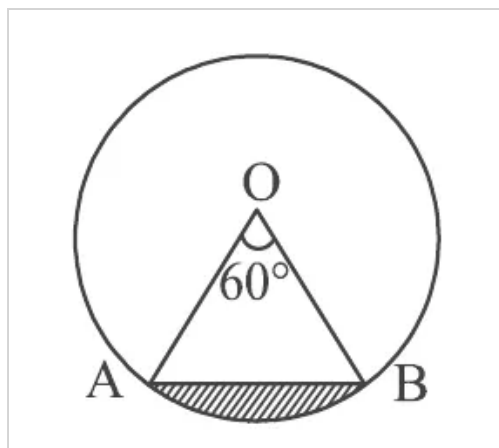
(b) $AP = \sqrt{(3-6)^2 + (1+3)^2} = 5$ and $PB = \sqrt{(3-0)^2 + (1-5)^2} = 5$, so $\frac{AP}{PB} = 1$.

$AQ = \sqrt{(2-6)^2 + (-1+3)^2} = 2\sqrt{5}$ and $QC = \sqrt{(2+2)^2 + (-1-1)^2} = 2\sqrt{5}$, so $\frac{AQ}{QC} = 1$. Hence $\frac{AP}{PB} = \frac{AQ}{QC}$ ✓.

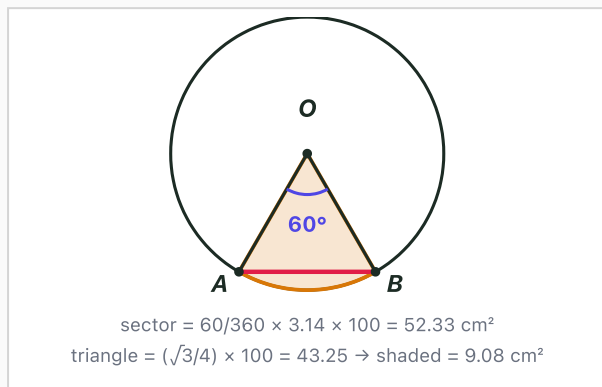
Answer: (a) $x = 1, y = -1$; sides $5\sqrt{2}$ and $6\sqrt{2}$ (b) yes, both ratios are 1

Q30 · AREAS RELATED TO CIRCLES · 3 MARKS

A chord of a circle of radius 10 cm subtends an angle of 60° at the centre O . Find the area of the shaded region. (Use $\sqrt{3} = 1.73$, $\sqrt{2} = 1.41$ and $\pi = 3.14$)



SOLUTION



$$\text{Area of the sector } OAB = \frac{60}{360} \times 3.14 \times 10^2 = \frac{314}{6} \approx 52.33 \text{ cm}^2.$$

$$OA = OB \text{ and } \angle AOB = 60^\circ, \text{ so } \triangle OAB \text{ is equilateral with side } 10: \text{ area} = \frac{\sqrt{3}}{4} \times 10^2 = \frac{173}{4} = 43.25 \text{ cm}^2.$$

$$\text{Shaded segment} = 52.33 - 43.25 = 9.08 \text{ cm}^2.$$

$$\text{Answer: } \frac{314}{6} - \frac{173}{4} \approx 9.08 \text{ cm}^2$$

Q31 · CIRCLES · 3 MARKS

Prove that the opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle.

SOLUTION

Let $ABCD$ circumscribe a circle with centre O , touching AB, BC, CD, DA at P, Q, R, S . Join O to A, B, C, D and to P, Q, R, S .

Tangents from a point are equal and radii are equal, so $\triangle OAP \cong \triangle OAS$ and $\angle AOP = \angle AOS$. In the same way $\angle BOP = \angle BOQ, \angle COQ = \angle COR, \angle DOR = \angle DOS$.

The eight angles round O add up to 360° : $2(\angle AOP + \angle BOP + \angle COQ + \angle DOR) = 360^\circ$. So $\angle AOB + \angle COD = 180^\circ$, and likewise $\angle BOC + \angle AOD = 180^\circ$.

Section D: Long answer

4 questions, 5 marks each.

Q32 · QUADRATIC EQUATIONS · 5 MARKS

(a) It is given that $p^2x^2 + (p^2 - q^2)x - q^2 = 0$; ($p \neq 0$). (i) Show that the discriminant (D) of the above equation is a perfect square. (ii) Find the roots of the equation.

OR

(b) Three consecutive positive integers are such that the sum of the square of smallest and product of other two is 67. Find the numbers, using quadratic equation.

SOLUTION

(a)(i) $D = (p^2 - q^2)^2 - 4(p^2)(-q^2) = (p^2 - q^2)^2 + 4p^2q^2 = (p^2 + q^2)^2$, a perfect square.

(ii) $x = \frac{-(p^2 - q^2) \pm (p^2 + q^2)}{2p^2}$. With $+$: $x = \frac{2q^2}{2p^2} = \frac{q^2}{p^2}$. With $-$: $x = \frac{-2p^2}{2p^2} = -1$.

(b) Let the integers be $x, x + 1, x + 2$. $x^2 + (x + 1)(x + 2) = 67$ gives $2x^2 + 3x - 65 = 0$, that is $(2x + 13)(x - 5) = 0$.

x is positive, so $x = 5$ (reject $-\frac{13}{2}$). The numbers are 5, 6, 7. (Check: $25 + 42 = 67 \checkmark$.)

Answer: (a) roots $\frac{q^2}{p^2}$ and -1 (b) 5, 6, 7

Q33 · STATISTICS · 5 MARKS

Find 'mean' and 'mode' of the following data:

Class	15-20	20-25	25-30	30-35	35-40	40-45
Frequency	6	16	17	4	5	2

SOLUTION

$N = 6 + 16 + 17 + 4 + 5 + 2 = 50$. Class marks: 17.5, 22.5, 27.5, 32.5, 37.5, 42.5. Take $a = 27.5$ and $h = 5$: $u = -2, -1, 0, 1, 2, 3$.

$\sum f_i u_i = -12 - 16 + 0 + 4 + 10 + 6 = -8$. Mean $= 27.5 + \frac{-8}{50} \times 5 = 27.5 - 0.8 = 26.7$.

The modal class is 25 - 30 (highest frequency 17): $f_1 = 17, f_0 = 16, f_2 = 4$. Mode $= 25 + \frac{17 - 16}{34 - 16 - 4} \times 5 = 25 + \frac{5}{14} \approx 25.36$.

Answer: Mean = 26.7; mode ≈ 25.36

Q34 · TRIANGLES · 5 MARKS

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

OR

(b) In a $\triangle ABC$, P and Q are points on AB and AC respectively such that $PQ \parallel BC$. Prove that the median AD , drawn from A to BC , bisects PQ .

SOLUTION

(a) ****Given:**** in $\triangle ABC$, $DE \parallel BC$. ****To prove:**** $\frac{AD}{DB} = \frac{AE}{EC}$. ****Construction:**** join BE and CD ; draw $DG \perp AC$ and $EF \perp AB$.

$$\frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle BDE)} = \frac{\frac{1}{2} \cdot AD \cdot EF}{\frac{1}{2} \cdot DB \cdot EF} = \frac{AD}{DB} \text{ and } \frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle CED)} = \frac{\frac{1}{2} \cdot AE \cdot DG}{\frac{1}{2} \cdot EC \cdot DG} = \frac{AE}{EC}.$$

$\triangle BDE$ and $\triangle CED$ 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) Let AD meet PQ at R . Since $PQ \parallel BC$, $PR \parallel BD$, so $\triangle ARP \sim \triangle ADB$ and $\frac{AR}{AD} = \frac{PR}{BD}$. (i)

Similarly $\triangle ARQ \sim \triangle ADC$ and $\frac{AR}{AD} = \frac{RQ}{DC}$. (ii)

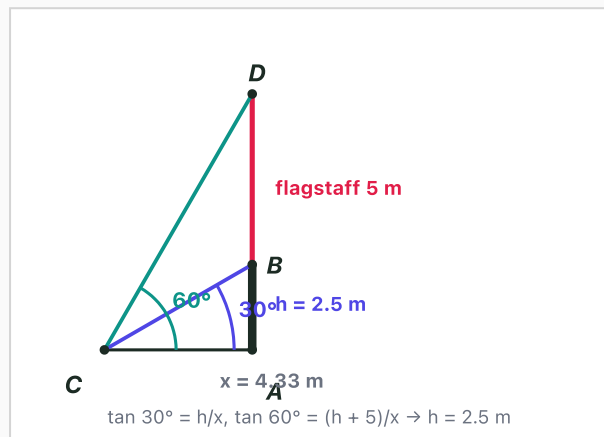
From (i) and (ii): $\frac{PR}{BD} = \frac{RQ}{DC}$. AD is a median, so $BD = DC$ and hence $PR = RQ$: AD bisects PQ .

Answer: Proved (both parts)

Q35 · TRIGONOMETRY · 5 MARKS

From a point on the ground, the angle of elevation of the top of a pedestal is 30° and that of the top of the flagstaff fixed on the pedestal is 60° . If the length of the flagstaff is 5 m, then find the height of the pedestal and its distance from the point of observation on ground. (Use $\sqrt{3} = 1.73$)

SOLUTION



Let the pedestal be $AB = h$ and the distance from the point of observation C be $AC = x$. The flagstaff goes from B to D with $BD = 5$.

In $\triangle ABC$: $\tan 30^\circ = \frac{h}{x}$, so $x = h\sqrt{3}$. (i)

In $\triangle ADC$: $\tan 60^\circ = \frac{h+5}{x}$, so $h+5 = x\sqrt{3}$. (ii)

Substituting (i) in (ii): $h+5 = 3h$, so $h = 2.5 \text{ m}$. Then $x = 2.5 \times 1.73 = 4.325 \approx 4.33 \text{ m}$.

Answer: Pedestal height = 2.5 m; distance $\approx$ 4.33 m

Section E: Case studies

3 case studies, 4 marks each.

Q36 · LINEAR EQUATIONS · 4 MARKS

Case study 1. A telecommunication company came up with two plans – plan A and plan B for its customers. The plans are represented by linear equations where 't' represents the time (in minutes) bought and 'C' represents the cost. The equations are: Plan A: $3C = 20t$; Plan B: $3C = 10t + 300$.

Based on the above information, answer the following questions:

- (i) If you purchase plan B, how much initial amount do you have to pay? [1]
 - (ii) Charu purchased plan A. How many minutes she bought for ₹ 250? [1]
 - (iii) (a) At how many minutes, do both the plans charge the same amount? What is that amount? [2]
- OR
- (iii) (b) Which plan is better if you want to buy 60 minutes? Give reason for your answer. [2]

SOLUTION

(i) Initial amount means $t = 0$: $3C = 300$, so $C = ₹100$.

(ii) $3 \times 250 = 20t$, so $t = \frac{750}{20} = 37.5$ minutes.

(iii)(a) Equal charges: $20t = 10t + 300$ gives $t = 30$ minutes. $C = \frac{20 \times 30}{3} = ₹200$.

(iii)(b) At $t = 60$: plan A costs $C = \frac{20 \times 60}{3} = ₹400$ and plan B costs $C = \frac{600 + 300}{3} = ₹300$. Plan B is better because it saves ₹ 100.

Answer: (i) ₹ 100 (ii) 37.5 min (iii)(a) 30 min, ₹ 200 (iii)(b) plan B (₹ 300 against ₹ 400)

Q37 · SURFACE AREAS AND VOLUMES · 4 MARKS

Case study 2. Playing in a ball pool is good entertainment for kids. Suhana bought 600 new balls of diameter 7 cm to fill in the pool for her kids. The cuboidal box containing 600 balls has dimensions 42 cm $\times$ 91 cm $\times$ 50 cm (l $\times$ b $\times$ h).

Based on above information, answer the following questions:

- (i) Find the volume of one ball. [1]
- (ii) 10 balls are painted with neon colours. Determine the area of painted surface. [1]
- (iii) (a) Find the volume of empty space in the box. [2]

OR

- (iii) (b) The lowermost layer of the balls covers the base of the box edge to edge when balls are placed evenly adjacent to each other. (A) How much area is covered by one ball? (B) How many balls are there in lowermost layer? [2]

SOLUTION

(i) Radius = $\frac{7}{2}$ cm. Volume = $\frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times \frac{7}{2} = \frac{539}{3} \approx 179.67$ cm³.

(ii) Surface of one ball = $4\pi r^2 = 4 \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} = 154$ cm². For 10 balls: 1540 cm².

(iii)(a) Volume of the box = $42 \times 91 \times 50 = 191100$ cm³. Volume of 600 balls = $600 \times \frac{539}{3} = 107800$ cm³. Empty space = $191100 - 107800 = 83300$ cm³.

(iii)(b) Each ball sits in a square of side 7 cm: area covered = $7 \times 7 = 49 \text{ cm}^2$. In the base $42 \times 91 \text{ cm}$: $\frac{42}{7} \times \frac{91}{7} = 6 \times 13 = 78$ balls.

Answer: (i) $\frac{539}{3} \text{ cm}^3$ (ii) 1540 cm^2 (iii)(a) 83300 cm^3 (iii)(b) 49 cm^2 , 78 balls

Q38 · TRIGONOMETRY · 4 MARKS

Case study 3. Rahim and Nadeem are two friends whose plots are adjacent to each other. Rahim's son made a drawing of the plots with necessary details. It is decided that Rahim will fence the triangular plot ABC and Nadeem will fence along the sides AF, FE and BE. Observe the diagram carefully and answer the following questions: (Use $\sqrt{2} = 1.41$ and $\sqrt{3} = 1.73$). Figure data: BH = 40 m, HD = 10 m, DG = 40 m, GF = 38 m, FE = 53 m, AF = 53.58 m; the angles are 60° at C, 45° at B above AB and 30° at B below AB, 45° at A below AB.

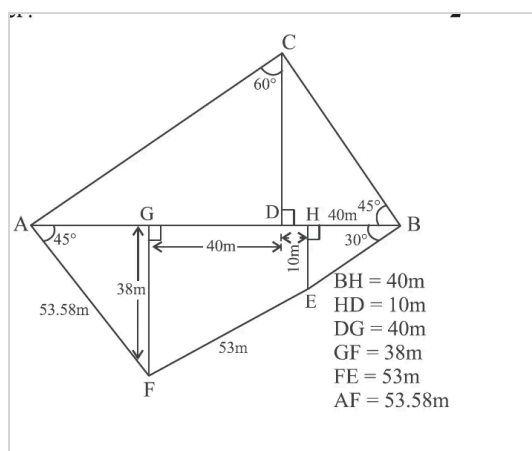
(i) Find length BC. [1]

(ii) Find length AG. [1]

(iii) (a) Calculate perimeter of $\triangle ABC$. [2]

OR

(iii) (b) Calculate length of (AF + FE + EB). [2]



SOLUTION

(i) $BD = BH + HD = 40 + 10 = 50 \text{ m}$. In the right triangle CDB with $\angle B = 45^\circ$: $\cos 45^\circ = \frac{BD}{BC} = \frac{50}{BC}$, so $BC = 50 \times 1.41 = 70.5 \text{ m}$.

(ii) In the right triangle AGF with $\angle A = 45^\circ$: $\tan 45^\circ = \frac{GF}{AG} = \frac{38}{AG} = 1$, so $AG = 38 \text{ m}$.

(iii)(a) $AD = AG + GD = 38 + 40 = 78 \text{ m}$. In the right triangle ADC with $\angle C = 60^\circ$: $\sin 60^\circ = \frac{AD}{AC}$, so $AC = \frac{78}{\frac{\sqrt{3}}{2}} = \frac{156}{1.73} \approx 90.2 \text{ m}$ (CBSE's key takes 89.96 m). $AB = AD + DB = 78 + 50 = 128 \text{ m}$.

Perimeter of $\triangle ABC = AB + BC + AC \approx 128 + 70.5 + 90 \approx 288.5 \text{ m}$ (the key gives 288.46 m).

(iii)(b) In the right triangle BHE with $\angle B = 30^\circ$: $\cos 30^\circ = \frac{BH}{BE} = \frac{40}{BE}$, so $BE = \frac{80}{\sqrt{3}} \approx 46.1 \text{ m}$. $AF + FE + EB = 53.58 + 53 + 46.13 \approx 152.7 \text{ m}$.

Answer: (i) 70.5 m (ii) 38 m (iii)(a) about 288.5 m (iii)(b) about 152.7 m

Common mistake: The figure is not fully consistent: $AD = 78 \text{ m}$ from the labels, but a 45° angle at B and a 60° angle at C would make $AD = 50\sqrt{3} \approx 86.6 \text{ m}$. The answers above follow the key, which uses $AD = 78 \text{ m}$ and angle C = 60° .

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.