

Mathematics (Basic) 2024, Set 430/5/1

Q.P. Code 430/5/1 · Series 15 · 80 marks · 3 hours · March 2024. 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

HCF $\times$ LCM for the numbers 40 and 30 is:

- (A) 12 (B) 120
(C) 1200 (D) 40

SOLUTION

HCF $\times$ LCM equals the product of the two numbers: $40 \times 30 = 1200$.

Answer: (C) 1200

Q2 · QUADRATIC EQUATIONS · 1 MARK

The roots of the quadratic equation $x^2 + 3x - 10 = 0$ are:

- (A) 5, 2 (B) -5, 2
(C) 5, -2 (D) -5, -2

SOLUTION

$x^2 + 3x - 10 = (x + 5)(x - 2) = 0$, so $x = -5$ or $x = 2$.

Answer: (B) -5, 2

Q3 · LINEAR EQUATIONS · 1 MARK

The pair of linear equations $2kx + 5y = 7$ and $6x + 5y = 11$ have a unique solution, if:

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

SOLUTION

A unique solution needs $\frac{2k}{6} \neq \frac{5}{5} = 1$, so $2k \neq 6$ and $k \neq 3$.

Answer: (A) $k \neq 3$

Q4 · STATISTICS · 1 MARK

If the mean and mode of a frequency distribution are 28 and 16 respectively, then its median is:

- (A) 22 (B) 23.5
(C) 24 (D) 24.5

SOLUTION

Mode = 3 Median – 2 Mean: $16 = 3M - 56$, so $M = 24$.

Answer: (C) 24

Q5 · PROBABILITY · 1 MARK

A die is rolled once. What is the probability of getting an odd prime number?

- (A) $\frac{1}{6}$ (B) $\frac{1}{3}$
(C) $\frac{2}{3}$ (D) $\frac{3}{4}$

SOLUTION

The odd primes on a die are 3 and 5 (2 is even, 1 is not prime). $P = \frac{2}{6} = \frac{1}{3}$.

Answer: (B) $\frac{1}{3}$

Q6 · AREAS RELATED TO CIRCLES · 1 MARK

If the area of a sector of a circle is $\frac{1}{8}$ of the area of the circle, then the central angle of the sector is:

- (A) 30° (B) 45°
(C) 60° (D) 90°

SOLUTION

$\frac{\theta}{360} = \frac{1}{8}$, so $\theta = 45^\circ$.

Answer: (B) 45°

Q7 · REAL NUMBERS · 1 MARK

Prime factorisation of 424 is:

- (A) $2 \times 53 \times 4$ (B) $2 \times 53 \times 2$
(C) $2^3 \times 53$ (D) $2^4 \times 53$

SOLUTION

$424 = 2 \times 212 = 2 \times 2 \times 106 = 2 \times 2 \times 2 \times 53 = 2^3 \times 53$.

Answer: (C) $2^3 \times 53$

Q8 · REAL NUMBERS · 1 MARK

If x is a whole number, then 8^x ends with an even digit, except for which value of x ?

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

SOLUTION

8^x ends in 8, 4, 2, 6 for $x = 1, 2, 3, 4, \dots$, all even. But $8^0 = 1$, which is odd. So the exception is $x = 0$.

Answer: (D) 0

Q9 · TRIGONOMETRY · 1 MARK

A tree casts a shadow 7 m long on the ground, when the angle of elevation of the Sun is 45° . The height of the tree is:

- (A) $7\sqrt{3}$ m (B) $\frac{7}{3}\sqrt{3}$ m
(C) 7 m (D) 3.5 m

SOLUTION

$\tan 45^\circ = \frac{\text{height}}{7} = 1$, so the height is 7 m.

Answer: (C) 7 m

Q10 · TRIGONOMETRY · 1 MARK

$\left(\frac{5}{\cot^2 \theta} - \frac{5}{\cos^2 \theta} \right)$ is equal to:

- (A) 1 (B) 5
(C) -5 (D) 0

SOLUTION

$\frac{5}{\cot^2 \theta} = 5 \tan^2 \theta$ and $\frac{5}{\cos^2 \theta} = 5 \sec^2 \theta$. The value is $5(\tan^2 \theta - \sec^2 \theta) = 5 \times (-1) = -5$.

Answer: (C) -5

Q11 · TRIGONOMETRY · 1 MARK

If $\tan^2 \theta = 3$, where θ is an acute angle, then the value of θ is:

- (A) 30° (B) 60°
(C) 0° (D) 45°

SOLUTION

$\tan \theta = \sqrt{3}$ (acute angle), so $\theta = 60^\circ$.

Answer: (B) 60°

Q12 · AREAS RELATED TO CIRCLES · 1 MARK

The length of an arc of a circle with radius 12 cm is 10π cm. The central angle subtended by this arc at the centre, is:

- (A) 120° (B) 6°
(C) 75° (D) 150°

SOLUTION

$$10\pi = \frac{\theta}{360} \times 2\pi \times 12 = \frac{\theta}{360} \times 24\pi, \text{ so } \theta = \frac{10 \times 360}{24} = 150^\circ.$$

Answer: (D) 150°

Q13 · CIRCLES · 1 MARK

If the angle between the two radii of a circle is 130° , then the angle between the tangents at the ends of these radii, is:

- (A) 50° (B) 60°
(C) 90° (D) 130°

SOLUTION

The angle between the tangents and the angle between the radii add up to 180° : $180^\circ - 130^\circ = 50^\circ$.

Answer: (A) 50°

Q14 · QUADRATIC EQUATIONS · 1 MARK

The discriminant of the quadratic equation $x^2 - 4x + 3 = 0$ is:

- (A) 28 (B) -8
(C) 4 (D) 2

SOLUTION

$$D = b^2 - 4ac = 16 - 12 = 4.$$

Answer: (C) 4

Q15 · COORDINATE GEOMETRY · 1 MARK

The mid-point of the line segment AB joining $A(-2, 8)$ and $B(-6, 4)$ is:

- (A) (2, 6) (B) (-4, 12)
(C) (-4, 6) (D) (4, -6)

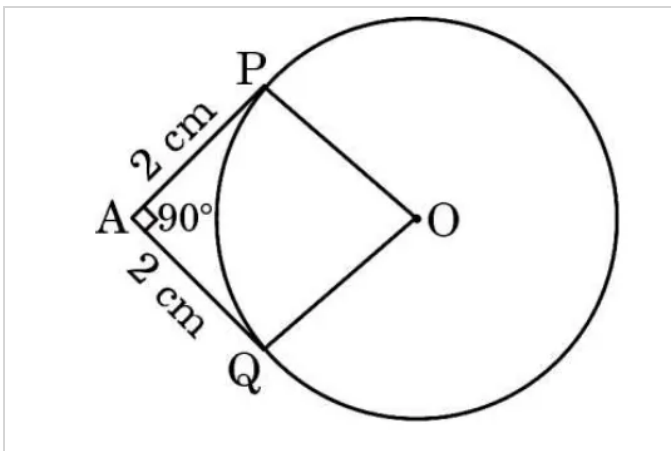
SOLUTION

$$\left(\frac{-2 - 6}{2}, \frac{8 + 4}{2} \right) = (-4, 6).$$

Answer: (C) (-4, 6)

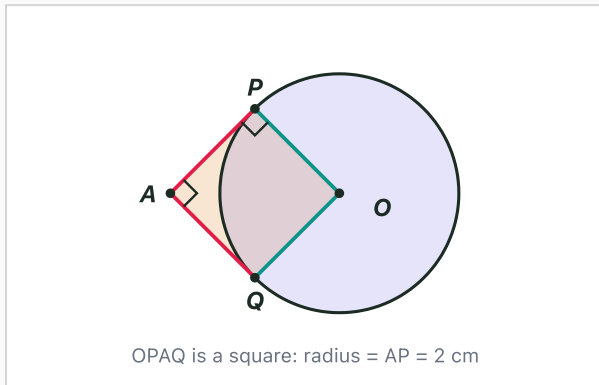
Q16 · CIRCLES · 1 MARK

AP and AQ are tangents drawn from an external point A to a circle with centre O and inclined to each other at an angle of 90° . If the length of each tangent is 2 cm, then the radius of the circle is:



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

SOLUTION



$OP \perp AP$ and $OQ \perp AQ$, and $\angle PAQ = 90^\circ$, so $OPAQ$ has four right angles. $OP = OQ$ (radii) and $AP = AQ = 2$, so it is a square of side 2 and the radius is 2 cm.

Answer: (B) 2 cm

Q17 · TRIANGLES · 1 MARK

It is given that $\triangle ABC \sim \triangle DEF$. If $\angle A = 55^\circ$, $\angle E = 45^\circ$, then $\angle C$ is:

- (A) 80°
(B) 90°
(C) 55°
(D) 45°

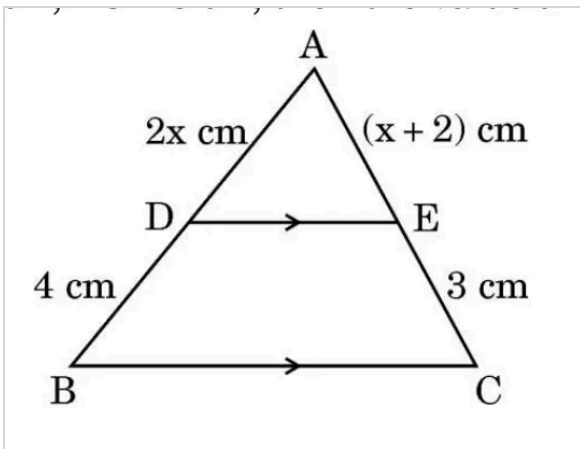
SOLUTION

$A \leftrightarrow D$, $B \leftrightarrow E$, $C \leftrightarrow F$, so $\angle B = \angle E = 45^\circ$. $\angle C = 180^\circ - 55^\circ - 45^\circ = 80^\circ$.

Answer: (A) 80°

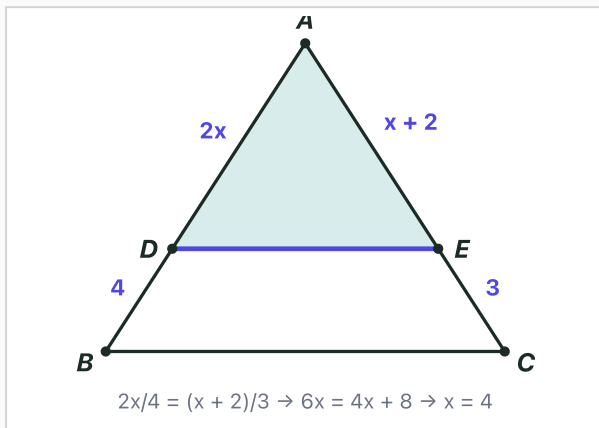
Q18 · TRIANGLES · 1 MARK

In the given figure, in $\triangle ABC$, $DE \parallel BC$. If $AD = 2x$ cm, $AE = (x + 2)$ cm, $DB = 4$ cm, $EC = 3$ cm, then the value of x is:



- (A) 3
(B) 2
(C) 6
(D) 4

SOLUTION



$$DE \parallel BC, \text{ so } \frac{AD}{DB} = \frac{AE}{EC}: \frac{2x}{4} = \frac{x + 2}{3}. 6x = 4x + 8, \text{ so } x = 4.$$

Answer: (D) 4

Q19 · PROBABILITY · 1 MARK

Assertion (A): The probability of getting number 8 on rolling a die is zero (0).

Reason (R): The probability of an impossible event is zero (0).

- (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) An impossible event has no favourable outcomes, so $P = 0$. True.

(A) A die has no face 8, so getting 8 is impossible and $P = 0$. True, and (R) is exactly why.

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

Q20 · ARITHMETIC PROGRESSIONS · 1 MARK

Assertion (A): Common difference of the A.P. $5, 1, -3, -7, \dots$ is 4.

Reason (R): Common difference of the A.P. $a_1, a_2, a_3, \dots, a_n$ is obtained by $d = a_n - a_{n-1}$.

(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 common difference is any term minus the previous term. True.

(A) By (R), $d = 1 - 5 = -4$, not 4. False.

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

Section B: Very short answer

5 questions, 2 marks each.

Q21 · TRIGONOMETRY · 2 MARKS

Evaluate: $\sin^2 30^\circ + \cos^2 45^\circ - \cos 0^\circ \cdot \tan 45^\circ$.

SOLUTION

$$\left(\frac{1}{2}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2 - 1 \times 1 = \frac{1}{4} + \frac{1}{2} - 1 = -\frac{1}{4}.$$

Answer: $-\frac{1}{4}$

Q22 · COORDINATE GEOMETRY · 2 MARKS

(a) Find the ratio in which the point $(3, y)$ divides the line segment joining the points $(-2, -5)$ and $(6, 3)$. Also, find the value of y .

OR

(b) Find a point on y -axis which is equidistant from the points $A(6, 5)$ and $B(-4, 3)$.

SOLUTION

(a) Let the ratio be $k : 1$. The x -coordinate: $\frac{6k - 2}{k + 1} = 3$, so $6k - 2 = 3k + 3$ and $k = \frac{5}{3}$. The ratio is $5 : 3$.

$$y = \frac{k \times 3 + 1 \times (-5)}{k + 1} = \frac{5 - 5}{\frac{8}{3}} = 0.$$

(b) Let the point be $P(0, y)$. $PA^2 = PB^2$: $(0 - 6)^2 + (y - 5)^2 = (0 + 4)^2 + (y - 3)^2$, so $36 + y^2 - 10y + 25 = 16 + y^2 - 6y + 9$ and $36 = 4y$, $y = 9$. $P = (0, 9)$.

Answer: (a) ratio $5 : 3$, $y = 0$ (b) $(0, 9)$

Q23 · QUADRATIC EQUATIONS · 2 MARKS

If $\frac{2}{3}$ is a root of the quadratic equation $kx^2 - x - 2 = 0$, then find the value of k .

SOLUTION

$$\text{Substituting } x = \frac{2}{3}: k \times \frac{4}{9} - \frac{2}{3} - 2 = 0, \text{ so } \frac{4k}{9} = \frac{8}{3}.$$

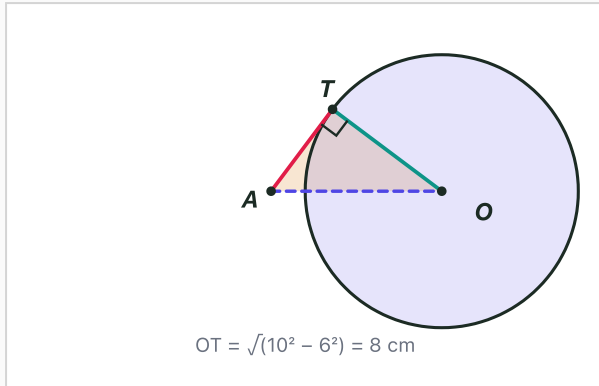
$$k = \frac{8}{3} \times \frac{9}{4} = 6.$$

Answer: $k = 6$

Q24 · CIRCLES · 2 MARKS

The length of a tangent drawn to a circle from a point A , at a distance of 10 cm from the centre of the circle, is 6 cm. Find the radius of the circle.

SOLUTION



The radius to the point of contact is perpendicular to the tangent, so $r = \sqrt{OA^2 - AT^2} = \sqrt{100 - 36} = 8 \text{ cm}$.

Answer: 8 cm

Q25 · POLYNOMIALS · 2 MARKS

(a) If α, β are zeroes of the quadratic polynomial $2x^2 + 7x + 5$, then find the value of $\alpha^2 + \beta^2 + \alpha\beta$.

OR

(b) If one zero of the quadratic polynomial $6x^2 + 37x - (p - 2)$ is reciprocal of the other, then find the value of p .

SOLUTION

(a) $\alpha + \beta = -\frac{7}{2}$ and $\alpha\beta = \frac{5}{2}$. $\alpha^2 + \beta^2 + \alpha\beta = (\alpha + \beta)^2 - \alpha\beta = \frac{49}{4} - \frac{5}{2} = \frac{39}{4}$.

(b) The zeroes are α and $\frac{1}{\alpha}$, so their product is $1 = \frac{-(p-2)}{6}$. Then $p - 2 = -6$ and $p = -4$.

Answer: (a) $\frac{39}{4}$ (b) $p = -4$

Section C: Short answer

6 questions, 3 marks each.

Q26 · REAL NUMBERS · 3 MARKS

Prove that $6 + 3\sqrt{2}$ is an irrational number, given that $\sqrt{2}$ is an irrational number.

SOLUTION

Suppose $6 + 3\sqrt{2} = x$ is rational. Then $\sqrt{2} = \frac{x-6}{3}$, which is rational.

This contradicts the given fact that $\sqrt{2}$ is irrational. So $6 + 3\sqrt{2}$ is irrational.

Answer: Proved

Q27 · POLYNOMIALS · 3 MARKS

Find the zeroes of the quadratic polynomial $6x^2 - 7x - 3$ and verify the relationship between the zeroes and the coefficients of the polynomial.

SOLUTION

$6x^2 - 7x - 3 = (2x - 3)(3x + 1)$, so the zeroes are $\frac{3}{2}$ and $-\frac{1}{3}$.

Sum = $\frac{3}{2} - \frac{1}{3} = \frac{7}{6} = -\frac{-7}{6}$ ✓. Product = $\frac{3}{2} \times \left(-\frac{1}{3}\right) = -\frac{1}{2} = \frac{-3}{6}$ ✓.

Answer: Zeroes $\frac{3}{2}, -\frac{1}{3}$; verified

Q28 · TRIGONOMETRY · 3 MARKS

Prove that: $(\sin \theta + \operatorname{cosec} \theta)^2 + (\cos \theta + \sec \theta)^2 = 7 + \tan^2 \theta + \cot^2 \theta$.

SOLUTION

LHS = $\sin^2 \theta + \operatorname{cosec}^2 \theta + 2 \sin \theta \operatorname{cosec} \theta + \cos^2 \theta + \sec^2 \theta + 2 \cos \theta \sec \theta$.

= $(\sin^2 \theta + \cos^2 \theta) + (1 + \cot^2 \theta) + (1 + \tan^2 \theta) + 2 + 2 = 7 + \tan^2 \theta + \cot^2 \theta = \text{RHS}$.

Answer: Proved

Q29 · CIRCLES · 3 MARKS

(a) Prove that the parallelogram circumscribing a circle is a rhombus.

OR

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

SOLUTION

(a) Let the parallelogram $ABCD$ touch the circle at P, Q, R, S on AB, BC, CD, DA . Tangents from a point are equal: $AP = AS, PB = BQ, CR = CQ, DR = DS$.

Adding: $AB + CD = AD + BC$. In a parallelogram $AB = CD$ and $AD = BC$, so $2AB = 2AD$ and $AB = AD$. All sides are equal: $ABCD$ is a rhombus.

(b) Let PA and PB be tangents from P to a circle with centre O . Join OA, OB and OP . In $\triangle AOP$ and $\triangle BOP$: $OA = OB$ (radii), OP is common and $\angle OAP = \angle OBP = 90^\circ$ (radius and tangent).

So $\triangle AOP \cong \triangle BOP$ (RHS) and $PA = PB$ by CPCT.

Answer: Proved (both parts)

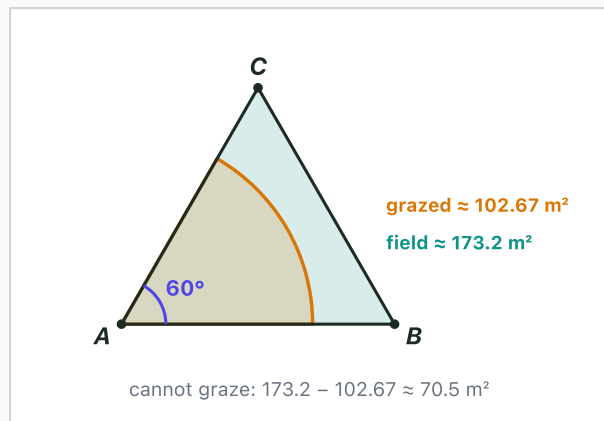
Q30 · AREAS RELATED TO CIRCLES · 3 MARKS

(a) A horse is tied with a 14 m long rope at one corner of an equilateral triangular field having side 20 m. Find the area of the field where the horse cannot graze.

OR

(b) The length of the minute hand of a clock is 14 cm. Find the area swept by the minute hand between 8:00 am and 8:05 am.

SOLUTION



(a) The corner angle is 60° , so the horse grazes a 60° sector of radius 14 m: $\frac{60}{360} \times \frac{22}{7} \times 14 \times 14 = \frac{308}{3} \approx 102.67 \text{ m}^2$.

The field has area $\frac{\sqrt{3}}{4} \times 20^2 = 100\sqrt{3} \approx 173.2 \text{ m}^2$. The part it cannot graze = $173.2 - 102.67 \approx 70.5 \text{ m}^2$. (The key uses 173 and gets 70.33 m^2 .)

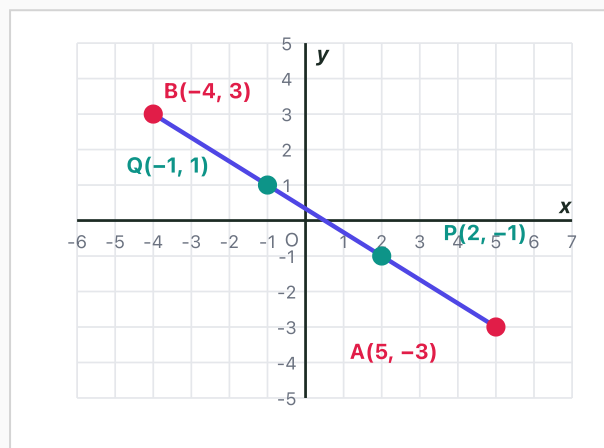
(b) In 60 minutes the hand turns 360° , so in 5 minutes it turns 30° . Area = $\frac{30}{360} \times \frac{22}{7} \times 14 \times 14 = \frac{154}{3} \approx 51.33 \text{ cm}^2$.

Answer: (a) $\approx 70.5 \text{ m}^2$ (b) $\frac{154}{3} \approx 51.33 \text{ cm}^2$

Q31 · COORDINATE GEOMETRY · 3 MARKS

Find the coordinates of the points of trisection of the line segment joining the points $A(5, -3)$ and $B(-4, 3)$.

SOLUTION



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

$$Q \text{ with } AQ : QB = 2 : 1 : \left(\frac{2(-4) + 1(5)}{3}, \frac{2(3) + 1(-3)}{3} \right) = (-1, 1).$$

Answer: $(2, -1)$ and $(-1, 1)$

Section D: Long answer

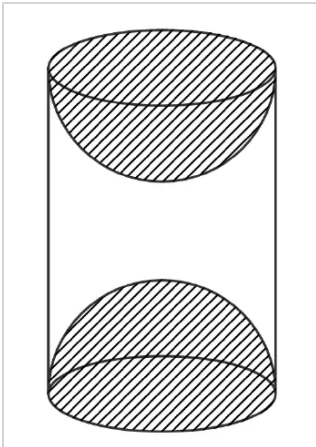
4 questions, 5 marks each.

Q32 · SURFACE AREAS AND VOLUMES · 5 MARKS

(a) A toy is in the form of a cone of radius 7 cm mounted on a hemisphere of same radius. The total height of the toy is 31 cm. Find the surface area of the toy.

OR

(b) A wooden article was made by scooping out a hemisphere from each end of a solid cylinder. If the height of the cylinder is 15 cm and its base is of radius 4.2 cm, then find the total surface area of the article.



SOLUTION

(a) Cone height = $31 - 7 = 24$ cm, slant height $l = \sqrt{7^2 + 24^2} = 25$ cm.

Surface area = curved area of the hemisphere + curved area of the cone = $2\pi r^2 + \pi rl = \pi r(2r + l) = \frac{22}{7} \times 7 \times (14 + 25) = 22 \times 39 = 858 \text{ cm}^2$.

(b) Radius 4.2 cm, cylinder height 15 cm. The surface is the curved area of the cylinder and the two hemispherical hollows: $2\pi rh + 2 \times 2\pi r^2 = 2\pi r(h + 2r)$.

$$= 2 \times \frac{22}{7} \times 4.2 \times (15 + 8.4) = 26.4 \times 23.4 = 617.76 \text{ cm}^2.$$

Answer: (a) 858 cm^2 (b) 617.76 cm^2

Q33 · LINEAR EQUATIONS · 5 MARKS

The ratio of monthly incomes of two persons is 9 : 7 and the ratio of their expenditures is 4 : 3. If each of them manages to save ₹ 2,000 per month, then find their monthly incomes.

SOLUTION

Let the incomes be $9x$ and $7x$ and the expenditures $4y$ and $3y$. Saving = income – expenditure: $9x - 4y = 2000$ (i) and $7x - 3y = 2000$ (ii).

(i) $\times 3$: $27x - 12y = 6000$. (ii) $\times 4$: $28x - 12y = 8000$. Subtracting, $x = 2000$.

The incomes are $9 \times 2000 = ₹18,000$ and $7 \times 2000 = ₹14,000$. (Check: $y = 4000$, expenditures ₹ 16000 and ₹ 12000, savings ₹ 2000 each $\checkmark$.)

Answer: ₹ 18,000 and ₹ 14,000

Q34 · TRIANGLES · 5 MARKS

(a) Sides AB , BC and median AD of $\triangle ABC$ are respectively proportional to sides PQ , QR and median PM of $\triangle PQR$. Show that $\triangle ABC \sim \triangle PQR$.

OR

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

SOLUTION

(a) Given $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AD}{PM}$. AD and PM are medians, so $BC = 2BD$ and $QR = 2QM$: $\frac{AB}{PQ} = \frac{BD}{QM} = \frac{AD}{PM}$.

So $\triangle ABD \sim \triangle PQM$ (SSS) and $\angle B = \angle Q$. In $\triangle ABC$ and $\triangle PQR$: $\frac{AB}{PQ} = \frac{BC}{QR}$ and $\angle B = \angle Q$, so $\triangle ABC \sim \triangle PQR$ by SAS.

(b) **Given:** $DE \parallel BC$ in $\triangle ABC$. **To prove:** $\frac{AD}{DB} = \frac{AE}{EC}$. **Construction:** join BE and DC ; draw $DM \perp AC$ and $EN \perp AB$.

$\frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle BDE)} = \frac{AD}{DB}$ and $\frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle CDE)} = \frac{AE}{EC}$. The triangles BDE and CDE stand on the same base DE between the same parallels, so their areas are equal. Hence $\frac{AD}{DB} = \frac{AE}{EC}$.

Answer: Proved (both parts)

Q35 · STATISTICS · 5 MARKS

The following frequency distribution table gives the monthly consumption of electricity of 70 consumers of a locality. Find the median of the data.

Monthly consumption (in units)	65–85	85–105	105–125	125–145	145–165	165–185	185–205
Number of consumers	7	8	7	20	14	9	5

SOLUTION

Cumulative frequencies: 7, 15, 22, 42, 56, 65, 70. $N = 70$ and $\frac{N}{2} = 35$.

The cumulative frequency passes 35 in 125 – 145: $l = 125$, $cf = 22$, $f = 20$, $h = 20$.

Median = $125 + \frac{35 - 22}{20} \times 20 = 125 + 13 = 138$ units.

Answer: 138 units

Section E: Case studies

3 case studies, 4 marks each.

Q36 · PROBABILITY · 4 MARKS

Case study 1. Family structure: In a recent survey of this year, 51% of the families in the United States of America had no children, 20% had one child, 19% had two children, 7% had three children and 3% had four or more children. A family is selected at random.

Based on the above information, answer the following questions:

- (i) Find the probability that the selected family has two or three children. [1]
 (ii) Find the probability that the selected family has more than one child. [1]
 (iii) (a) Find the probability that the selected family has less than three children. [2]

OR

- (iii) (b) Find the probability that the selected family has more than two children. [2]

**SOLUTION**

Out of 100 families: 51 have 0, 20 have 1, 19 have 2, 7 have 3 and 3 have 4 or more children.

$$(i) P(2 \text{ or } 3) = \frac{19 + 7}{100} = \frac{26}{100} = \frac{13}{50}.$$

$$(ii) P(\text{more than one}) = \frac{19 + 7 + 3}{100} = \frac{29}{100}.$$

$$(iii)(a) P(\text{less than } 3) = \frac{51 + 20 + 19}{100} = \frac{90}{100} = \frac{9}{10}. \quad (b) P(\text{more than } 2) = \frac{7 + 3}{100} = \frac{1}{10}.$$

Answer: (i) $\frac{13}{50}$ (ii) $\frac{29}{100}$ (iii)(a) $\frac{9}{10}$ (iii)(b) $\frac{1}{10}$

Q37 · ARITHMETIC PROGRESSIONS · 4 MARKS

Case study 2. Sumant's mother started a new shoe shop. To display the shoes, she put 3 pairs of shoes in the 1st row, 5 pairs in the 2nd row, 7 pairs in the 3rd row and so on.

Based on the above information, answer the following questions:

- (i) How many pairs of shoes are displayed in the 6th row? [1]
- (ii) What is the difference of pairs of shoes in the 1st row and the 6th row? [1]
- (iii) (a) Find the total number of pairs of shoes displayed in the first 15 rows. [2]

OR

- (iii) (b) If the pairs of shoes displayed in the 4th row are 'on sale' at price of ₹ 500 for each pair, then find the total amount (money) earned by Sumant's mother if all shoes displayed in the 4th row are sold out. [2]



SOLUTION

The pairs per row are 3, 5, 7, ..., an A.P. with $a = 3$ and $d = 2$.

- (i) $a_6 = 3 + 5 \times 2 = 13$ pairs.
- (ii) The difference between the 6th and 1st rows is $13 - 3 = 10$ pairs.
- (iii)(a) $S_{15} = \frac{15}{2}[2(3) + 14 \times 2] = \frac{15}{2} \times 34 = 255$ pairs.
- (iii)(b) $a_4 = 3 + 3 \times 2 = 9$ pairs, earning $9 \times 500 = ₹4,500$.

Answer: (i) 13 (ii) 10 (iii)(a) 255 pairs (iii)(b) ₹ 4,500

Q38 · TRIGONOMETRY · 4 MARKS

Case study 3. Two poles of different heights stand on level ground and at a distance of 40 m. Both poles are supported by wires attached from the top of each pole to the bottom of the other. A coupling is placed at point C, where the two wires cross (as shown in the figure; the angle at A to the top Q of the taller pole is 60° and the angle at P to the top B of the shorter pole is 30°).

Based on the above information, answer the following questions:

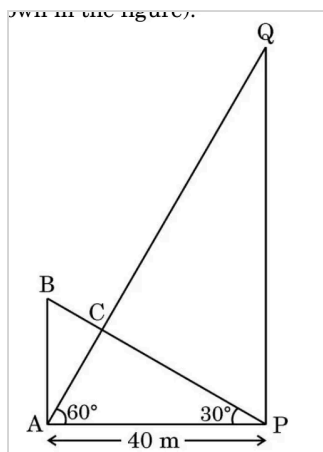
(i) Find the height of pole AB. [1]

(ii) Find the height of pole PQ. [1]

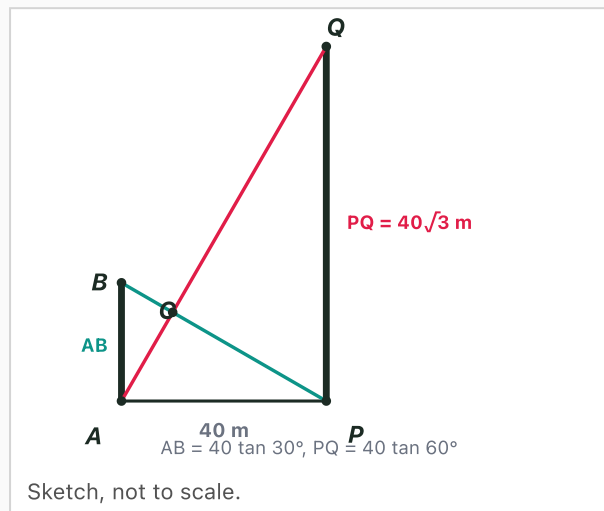
(iii) (a) If the angle of elevation of the top of the pole PQ from the top of the pole AB is 30° , find the distance BQ. [2]

OR

(iii) (b) If the coupling is at a height of 20 m from the ground, how far down the wire from the smaller pole AB is the coupling? [2]



SOLUTION



(i) In the right triangle ABP ($\angle P = 30^\circ$, $AP = 40$): $\tan 30^\circ = \frac{AB}{40}$, so $AB = \frac{40}{\sqrt{3}} = \frac{40\sqrt{3}}{3}$ m.

(ii) In the right triangle APQ ($\angle A = 60^\circ$): $\tan 60^\circ = \frac{PQ}{40}$, so $PQ = 40\sqrt{3}$ m.

(iii)(a) Draw $BM \perp PQ$ with $BM = AP = 40$. In $\triangle BQM$: $\cos 30^\circ = \frac{BM}{BQ}$, so $BQ = \frac{40}{\sqrt{3}/2} = \frac{80}{\sqrt{3}} = \frac{80\sqrt{3}}{3}$ m.

(iii)(b) Let CD be the perpendicular from C to the ground, $CD = 20$ m. In the right triangle ACD ($\angle A = 60^\circ$):

$\sin 60^\circ = \frac{CD}{AC}$, so $AC = \frac{20}{\sqrt{3}/2} = \frac{40}{\sqrt{3}} = \frac{40\sqrt{3}}{3}$ m, the distance of C along the wire from A .

Answer: (i) $\frac{40\sqrt{3}}{3}$ m (ii) $40\sqrt{3}$ m (iii)(a) $\frac{80\sqrt{3}}{3}$ m (iii)(b) $\frac{40\sqrt{3}}{3}$ m

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