

Mathematics (Standard) 2025, Set 30/4/1

Q.P. Code 30/4/1 · 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.

Free paper, 1-minute analysis and quiz: cognicraftedu.com/cbse-class-10-papers/maths-standard/2025/30-4-1

Section A: Multiple choice

20 questions, 1 mark each. MCQs (Q1 to Q18) and assertion-reason (Q19, Q20).

Q1 · REAL NUMBERS · 1 MARK

If $x = ab^3$ and $y = a^3b$, where a and b are prime numbers, then $[\text{HCF}(x, y) - \text{LCM}(x, y)]$ is equal to:

- (A) $1 - a^3b^3$ (B) $ab(1 - ab)$
 (C) $ab - a^4b^4$ (D) $ab(1 - ab)(1 + ab)$

SOLUTION

$x = a \cdot b^3$ and $y = a^3 \cdot b$. HCF takes the smaller power of each prime: $\text{HCF} = a^1b^1 = ab$.

LCM takes the greater power: $\text{LCM} = a^3b^3$.

$\text{HCF} - \text{LCM} = ab - a^3b^3 = ab(1 - a^2b^2) = ab(1 - ab)(1 + ab)$.

Answer: (D) $ab(1 - ab)(1 + ab)$

Common mistake: Stopping at $ab(1 - a^2b^2)$. Option (D) has this factorised further using $1 - a^2b^2 = (1 - ab)(1 + ab)$.

Q2 · REAL NUMBERS · 1 MARK

$(1 + \sqrt{3})^2 - (1 - \sqrt{3})^2$ is:

- (A) a positive rational number. (B) a negative integer.
 (C) a positive irrational number. (D) a negative irrational number.

SOLUTION

Use $a^2 - b^2 = (a + b)(a - b)$ with $a = 1 + \sqrt{3}$ and $b = 1 - \sqrt{3}$.

$a + b = 2$ and $a - b = 2\sqrt{3}$, so the value is $2 \times 2\sqrt{3} = 4\sqrt{3}$.

$4\sqrt{3}$ is positive, and irrational because $\sqrt{3}$ is irrational.

Answer: (C) a positive irrational number

Q3 · QUADRATIC EQUATIONS · 1 MARK

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

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

SOLUTION

Equal roots need $D = b^2 - 4ac = 0$: $1 - 4a^2 = 0$, so $a^2 = \frac{1}{4}$ and $a = \pm\frac{1}{2}$.

The equal root is $x = -\frac{b}{2a} = -\frac{1}{2a}$. For this to be positive, a must be negative.

So $a = -\frac{1}{2}$, and then $x = -\frac{1}{2 \times (-1/2)} = 1 > 0 \checkmark$.

Answer: (D) $-\frac{1}{2}$

Common mistake: Choosing $a = \frac{1}{2}$. Then the root is -1 , which is equal but not positive.

Q4 · COORDINATE GEOMETRY · 1 MARK

The distance of a point A from x -axis is 3 units. Which of the following cannot be coordinates of the point A ?

(A) $(1, 3)$

(B) $(-3, -3)$

(C) $(-3, 3)$

(D) $(3, 1)$

SOLUTION

The distance of a point from the x -axis is $|y|$, the absolute value of its y -coordinate. So we need $|y| = 3$.

$(1, 3)$: $y = 3 \checkmark$. $(-3, -3)$: $|y| = 3 \checkmark$. $(-3, 3)$: $y = 3 \checkmark$. $(3, 1)$: $|y| = 1 \neq 3 \times$.

Answer: (D) $(3, 1)$

Common mistake: Using the x -coordinate. The distance from the x -axis is the y -coordinate.

Q5 · PROBABILITY · 1 MARK

The number of red balls in a bag is 10 more than the number of black balls. If the probability of drawing a red ball at random from this bag is $\frac{3}{5}$, then the total number of balls in the bag is:

(A) 50

(B) 60

(C) 80

(D) 40

SOLUTION

Let the black balls be b . Red balls $= b + 10$ and total $= 2b + 10$.

$\frac{b + 10}{2b + 10} = \frac{3}{5}$, so $5b + 50 = 6b + 30$ and $b = 20$.

Total $= 2 \times 20 + 10 = 50$. (Check: red $= 30$ and $\frac{30}{50} = \frac{3}{5} \checkmark$.)

Answer: (A) 50

Q6 · LINEAR EQUATIONS · 1 MARK

The value of ' p ' for which the equations $px + 3y = p - 3$, $12x + py = p$ has infinitely many solutions is:

(A) -6 only

(B) 6 only

(C) ± 6

(D) Any real number except ± 6

SOLUTION

Infinitely many solutions need $\frac{p}{12} = \frac{3}{p} = \frac{p-3}{p}$.

From the first two: $p^2 = 36$, so $p = \pm 6$.

From the last two: $\frac{3}{p} = \frac{p-3}{p}$ gives $3 = p - 3$, so $p = 6$.

Only $p = 6$ satisfies all three. (For $p = -6$ the third ratio is $\frac{-9}{-6} = \frac{3}{2}$, not $-\frac{1}{2}$.)

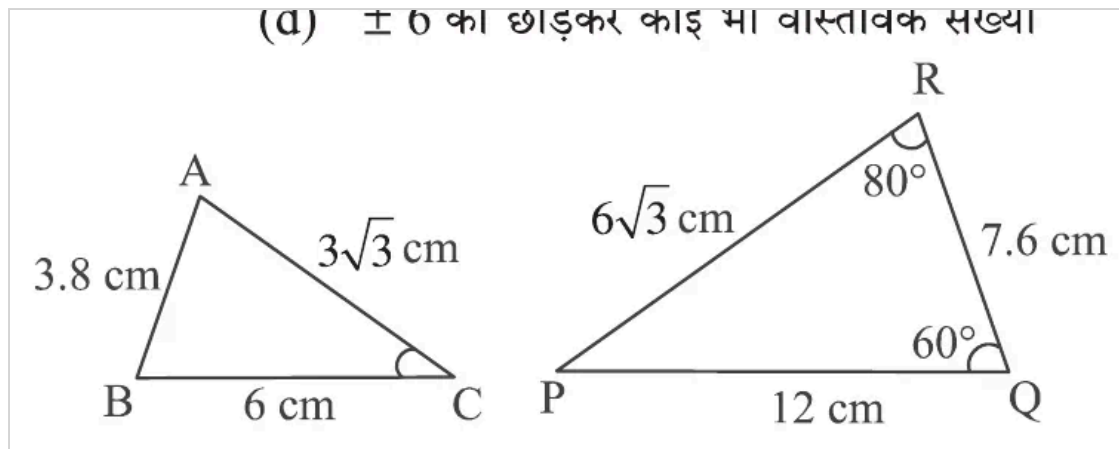
Answer: (B) 6 only

Common mistake: Stopping at $p = \pm 6$. Use the third ratio to reject $p = -6$.

Q7 · TRIANGLES · 1 MARK

$\triangle ABC$ and $\triangle PQR$ are shown in the adjoining figures. The measure of $\angle C$ is:

(d) ± 6 का छाड़कर काइ भा वास्तविक सख्या



(A) 140°

(B) 80°

(C) 60°

(D) 40°

SOLUTION

Compare the sides: $\frac{AB}{RQ} = \frac{3.8}{7.6} = \frac{1}{2}$, $\frac{AC}{RP} = \frac{3\sqrt{3}}{6\sqrt{3}} = \frac{1}{2}$ and $\frac{BC}{PQ} = \frac{6}{12} = \frac{1}{2}$.

All three ratios are equal, so $\triangle ABC \sim \triangle RQP$ (SSS), with $A \leftrightarrow R$, $B \leftrightarrow Q$ and $C \leftrightarrow P$.

So $\angle C = \angle P = 180^\circ - 80^\circ - 60^\circ = 40^\circ$.

Answer: (D) 40°

Common mistake: Matching C with R just because they are in the same corner of the figure. Match the sides by their ratios first.

Q8 · TRIGONOMETRY · 1 MARK

$\tan 2A = 3 \tan A$ is true, when the measure of $\angle A$ is:

(A) 90°

(B) 60°

(C) 45°

(D) 30°

SOLUTION

Let $\tan A = u$. $\tan 2A = \frac{2u}{1-u^2}$, so $\frac{2u}{1-u^2} = 3u$.

For $u \neq 0$: $2 = 3(1-u^2)$, so $u^2 = \frac{1}{3}$ and $u = \frac{1}{\sqrt{3}}$.

$\tan A = \frac{1}{\sqrt{3}}$ gives $A = 30^\circ$. Check: $\tan 60^\circ = \sqrt{3} = 3 \times \frac{1}{\sqrt{3}}$ ✓.

Answer: (D) 30°

Common mistake: Using $\tan 2A = 2 \tan A$. The double-angle formula is $\frac{2 \tan A}{1 - \tan^2 A}$. Or simply test the options.

Q9 · TRIGONOMETRY · 1 MARK

Which of the following statements is true?

(A) $\sin 20^\circ > \sin 70^\circ$

(B) $\sin 20^\circ > \cos 20^\circ$

(C) $\cos 20^\circ > \cos 70^\circ$

(D) $\tan 20^\circ > \tan 70^\circ$

SOLUTION

Between 0° and 90° , sine and tangent increase with the angle, and cosine decreases.

(A) $\sin 20^\circ < \sin 70^\circ$, so (A) is false. (D) $\tan 20^\circ < \tan 70^\circ$, so (D) is false.

(B) $\cos 20^\circ = \sin 70^\circ > \sin 20^\circ$, so (B) is false.

(C) $\cos 20^\circ > \cos 70^\circ$ is true, because cosine falls as the angle grows.

Answer: (C) $\cos 20^\circ > \cos 70^\circ$

Q10 · APPLICATIONS OF TRIGONOMETRY · 1 MARK

A 30 m long rope is tightly stretched and tied from the top of pole to the ground. If the rope makes an angle of 60° with the ground, the height of the pole is:

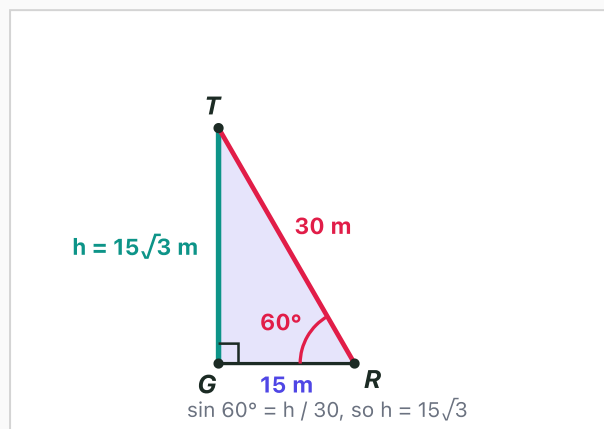
(A) $10\sqrt{3}$ m

(B) $30\sqrt{3}$ m

(C) 15 m

(D) $15\sqrt{3}$ m

SOLUTION



The pole, the ground and the rope form a right triangle. The rope is the hypotenuse (30 m) and the pole is opposite the 60° angle.

$$\sin 60^\circ = \frac{h}{30}, \text{ so } h = 30 \times \frac{\sqrt{3}}{2} = 15\sqrt{3} \text{ m.}$$

Answer: (D) $15\sqrt{3}$ m

Common mistake: Using $\tan 60^\circ$ or $\cos 60^\circ$. The rope is the hypotenuse, so the height is found with sine.

Q11 · SURFACE AREAS AND VOLUMES · 1 MARK

On the top face of the wooden cube of side 7 cm, hemispherical depressions of radius 0.35 cm are to be formed by taking out the wood. The maximum number of depressions that can be formed is:

(A) 400

(B) 100

(C) 20

(D) 10

SOLUTION

Each depression has diameter $2 \times 0.35 = 0.7$ cm.

Along one edge of 7 cm, at most $\frac{7}{0.7} = 10$ depressions fit side by side.

On the square face: $10 \times 10 = 100$.

Answer: (B) 100

Common mistake: Dividing the face area by the circle area ($\frac{49}{\pi \times 0.35^2} \approx 127$). Circles cannot fill a square without gaps, so count them along the sides.

Q12 · STATISTICS · 1 MARK

The cumulative frequency for calculating median is obtained by adding the frequencies of all the:

- (A) classes up to the median class (B) classes following the median class
(C) classes preceding the median class (D) all classes

SOLUTION

In the median formula, cf is the cumulative frequency of the class just before the median class. It counts the frequencies of the classes preceding the median class.

The median class itself is not included. Its own frequency is f in the formula.

Answer: (C) classes preceding the median class

Q13 · STATISTICS · 1 MARK

If mean and median of given set of observations are 10 and 11 respectively, then the value of mode is:

- (A) 10.5 (B) 8
(C) 13 (D) 21

SOLUTION

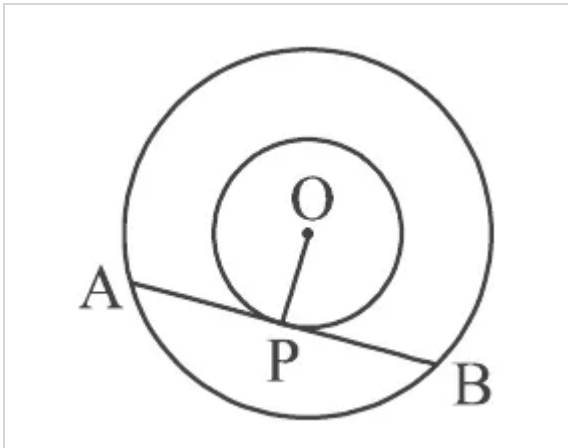
The empirical relation is $\text{Mode} = 3 \times \text{Median} - 2 \times \text{Mean}$.

$$\text{Mode} = 3 \times 11 - 2 \times 10 = 33 - 20 = 13.$$

Answer: (C) 13

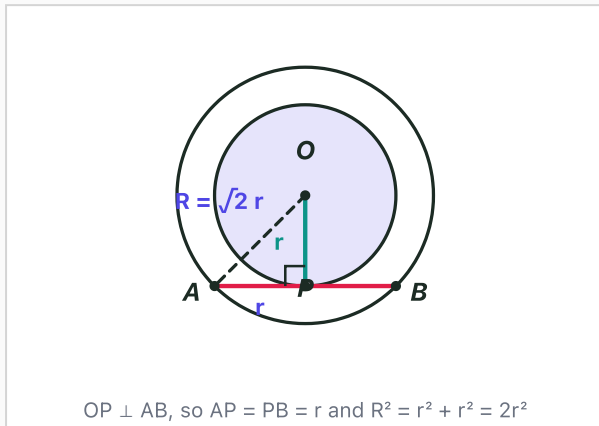
Q14 · CIRCLES · 1 MARK

In the adjoining figure, AB is the chord of the larger circle touching the smaller circle. The centre of both the circles is O . If $AB = 2r$ and $OP = r$, then the radius of larger circle is:



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

SOLUTION



AB touches the smaller circle at P , so $OP \perp AB$. The perpendicular from the centre bisects a chord: $AP = \frac{AB}{2} = r$.

In right triangle OPA : $OA^2 = OP^2 + AP^2 = r^2 + r^2 = 2r^2$.

The radius of the larger circle is $OA = \sqrt{2}r$.

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

Q15 · CIRCLES · 1 MARK

A parallelogram having one of its sides 5 cm circumscribes a circle. The perimeter of parallelogram is:

- (A) 20 cm (B) less than 20 cm
 (C) more than 20 cm but less than 40 cm (D) 40 cm

SOLUTION

A parallelogram that circumscribes a circle is a rhombus (opposite sides are equal, and $AB + CD = AD + BC$ forces all four sides to be equal).

All sides are 5 cm, so the perimeter is $4 \times 5 = 20$ cm.

Answer: (A) 20 cm

Q16 · TRIANGLES · 1 MARK

E and F are points on the sides AB and AC respectively of a $\triangle ABC$ such that $\frac{AE}{EB} = \frac{AF}{FC} = \frac{1}{2}$. Which of the following relation is true?

- (A) $EF = 2BC$ (B) $BC = 2EF$
(C) $EF = 3BC$ (D) $BC = 3EF$

SOLUTION

$\frac{AE}{EB} = \frac{AF}{FC}$, so by the converse of the Basic Proportionality Theorem $EF \parallel BC$.

So $\triangle AEF \sim \triangle ABC$. $\frac{AE}{EB} = \frac{1}{2}$ means AE is 1 part out of 3 parts of AB : $\frac{AE}{AB} = \frac{1}{3}$.

$\frac{EF}{BC} = \frac{AE}{AB} = \frac{1}{3}$, so $BC = 3EF$.

Answer: (D) $BC = 3EF$

Common mistake: Using $\frac{1}{2}$ as the ratio $EF : BC$. The ratio 1 : 2 is $AE : EB$, so $EF : BC$ is 1 : 3.

Q17 · POLYNOMIALS · 1 MARK

Which of the following statements is true for a polynomial $p(x)$ of degree 3?

- (A) $p(x)$ has at most two distinct zeroes. (B) $p(x)$ has at least two distinct zeroes.
(C) $p(x)$ has exactly three distinct zeroes. (D) $p(x)$ has at most three distinct zeroes.

SOLUTION

A polynomial of degree n has at most n zeroes. For degree 3, at most 3 distinct zeroes.

It can have fewer: for example x^3 has only one zero and $x^3 - x$ has three. So "at most two", "at least two" and "exactly three" are not always true.

Answer: (D) $p(x)$ has at most three distinct zeroes.

Q18 · PROBABILITY · 1 MARK

A pair of dice is thrown. The probability that sum of numbers appearing on top faces is at most 10 is:

- (A) $\frac{1}{11}$ (B) $\frac{10}{11}$
(C) $\frac{5}{6}$ (D) $\frac{11}{12}$

SOLUTION

Two dice have $6 \times 6 = 36$ equally likely outcomes.

The sum is more than 10 only for a sum of 11: (5, 6), (6, 5), or 12: (6, 6). That is 3 outcomes.

$$P(\text{sum} \leq 10) = 1 - \frac{3}{36} = \frac{33}{36} = \frac{11}{12}.$$

Answer: (D) $\frac{11}{12}$

Common mistake: Counting only the sum 11 and forgetting the sum 12.

Q19 · REAL NUMBERS · 1 MARK

Assertion (A): 4^n ends with digit 0 for some natural number n .

Reason (R): For a number ' x ' having 2 and 5 as its prime factors, x^n always ends with digit 0 for every natural number n .

(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) $4^n = 2^{2n}$ has only the prime factor 2, so it is not divisible by 5 and can never end in 0. (Its last digit is 4 or 6.) The assertion is false.

(R) If x has 2 and 5 among its prime factors, then x is a multiple of 10, and so is every power x^n . It ends in 0. The reason is true.

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

Q20 · CIRCLES · 1 MARK

Assertion (A): Tangents drawn at the end points of a diameter of a circle are always parallel to each other.

Reason (R): The lengths of tangents drawn to a circle from a point outside the circle are always equal.

(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) Each tangent is perpendicular to the diameter at its end, so the two tangents make equal alternate angles of 90° with the diameter: they are parallel. True.

(R) Two tangents from an external point are equal in length. True.

The parallel tangents in (A) come from "tangent $\perp$ radius", not from the equal-length property. So R does not explain A.

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

Section B: Very short answer

5 questions, 2 marks each.

Q21 · LINEAR EQUATIONS · 2 MARKS

Solve the following system of equations algebraically: $30x + 44y = 10$; $40x + 55y = 13$.

SOLUTION

Multiply the first equation by 4 and the second by 3 to make the x coefficients equal: $120x + 176y = 40$... (i) and $120x + 165y = 39$... (ii).

Subtract (ii) from (i): $11y = 1$, so $y = \frac{1}{11}$.

Put in the first equation: $30x + 44 \times \frac{1}{11} = 10$, so $30x + 4 = 10$ and $x = \frac{6}{30} = \frac{1}{5}$.

Check in the second: $40 \times \frac{1}{5} + 55 \times \frac{1}{11} = 8 + 5 = 13$ ✓.

Answer: $x = \frac{1}{5}, y = \frac{1}{11}$

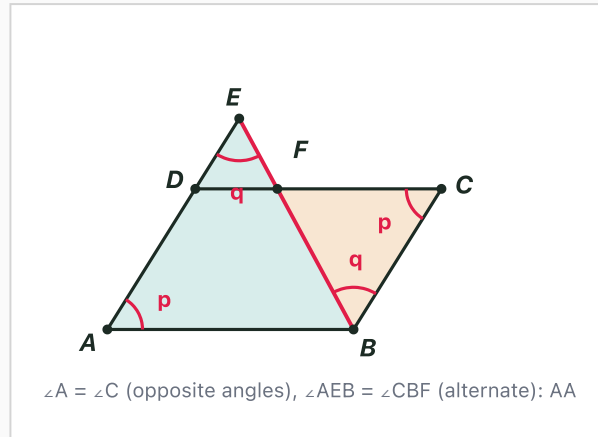
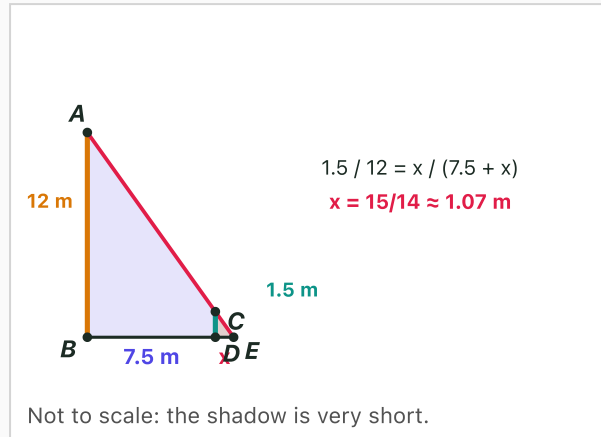
Q22 · TRIANGLES · 2 MARKS

(A) A 1.5 m tall boy is walking away from the base of a lamp post which is 12 m high, at the speed of 2.5 m/sec. Find the length of his shadow after 3 seconds.

OR

(B) In parallelogram $ABCD$, side AD is produced to a point E and BE intersects CD at F . Prove that $\triangle ABE \sim \triangle CFB$.

SOLUTION



(A) In 3 seconds the boy walks $2.5 \times 3 = 7.5$ m from the base of the post. Let his shadow be x m long.

$\triangle ABE \sim \triangle CDE$ (AA: both have a right angle and share the angle at E), so $\frac{CD}{AB} = \frac{DE}{BE}$.

$$\frac{1.5}{12} = \frac{x}{7.5 + x}, \text{ so } 12x = 1.5(7.5 + x) = 11.25 + 1.5x \text{ and } 10.5x = 11.25.$$

$$x = \frac{11.25}{10.5} = \frac{15}{14} \approx 1.07 \text{ m.}$$

(B) In $\triangle ABE$ and $\triangle CFB$: $\angle A = \angle C$ (opposite angles of a parallelogram).

$AE \parallel BC$ and BE is a transversal, so $\angle AEB = \angle CBF$ (alternate angles).

So $\triangle ABE \sim \triangle CFB$ by AA similarity.

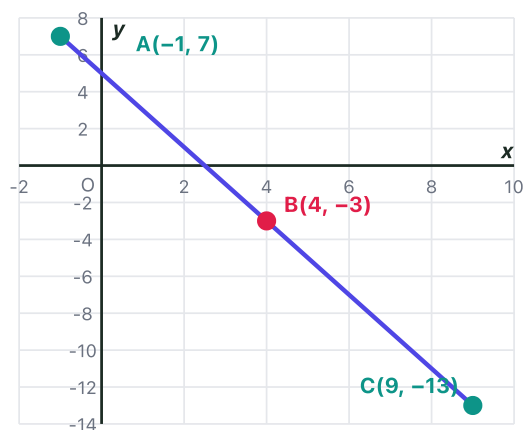
Answer: (A) about 1.07 m (B) proved

Common mistake: In (A), writing $\frac{1.5}{12} = \frac{x}{7.5}$. The big triangle's base is the boy's distance plus the shadow, $7.5 + x$.

Q23 · COORDINATE GEOMETRY · 2 MARKS

Find the coordinates of the point C which lies on the line AB produced such that $AC = 2BC$, where coordinates of points A and B are $(-1, 7)$ and $(4, -3)$ respectively.

SOLUTION



B is the mid-point of AC, so $C = (2 \times 4 - (-1), 2 \times (-3) - 7) = (9, -13)$.

C is on AB produced (beyond B) with $AC = 2BC$. Since $AC = AB + BC$, we get $AB = BC$, so B is the mid-point of AC.

Let $C = (x, y)$. Mid-point of AC = $\left(\frac{-1+x}{2}, \frac{7+y}{2}\right) = (4, -3)$.

$\frac{-1+x}{2} = 4$ gives $x = 9$, and $\frac{7+y}{2} = -3$ gives $y = -13$.

Answer: $C = (9, -13)$

Common mistake: Using the section formula with ratio 2 : 1 internally. C lies outside the segment, beyond B.

Q24 · TRIGONOMETRY · 2 MARKS

(A) Find the value of x for which $(\sin A + \operatorname{cosec} A)^2 + (\cos A + \sec A)^2 = x + \tan^2 A + \cot^2 A$.

OR

(B) Evaluate the following: $\frac{3 \sin 30^\circ - 4 \sin^3 30^\circ}{2 \sin^2 50^\circ + 2 \cos^2 50^\circ}$

SOLUTION

(A) Expand: $\sin^2 A + \operatorname{cosec}^2 A + 2 + \cos^2 A + \sec^2 A + 2$.

$\sin^2 A + \cos^2 A = 1$, $\operatorname{cosec}^2 A = 1 + \cot^2 A$ and $\sec^2 A = 1 + \tan^2 A$.

LHS = $1 + (1 + \cot^2 A) + (1 + \tan^2 A) + 4 = 7 + \tan^2 A + \cot^2 A$. So $x = 7$.

(B) Numerator: $3 \times \frac{1}{2} - 4 \times \left(\frac{1}{2}\right)^3 = \frac{3}{2} - \frac{1}{2} = 1$.

Denominator: $2(\sin^2 50^\circ + \cos^2 50^\circ) = 2 \times 1 = 2$. The value is $\frac{1}{2}$.

Answer: (A) $x = 7$ (B) $\frac{1}{2}$

Q25 · PROBABILITY · 2 MARKS

Two friends Anil and Ashraf were born in the December month in the year 2010. Find the probability that:

- they share same date of birth.
- they have different dates of birth.

SOLUTION

December has 31 days, so Ashraf's birthday can be any of 31 dates, all equally likely.

(i) For the same date as Anil, only 1 date works: $P = \frac{1}{31}$.

(ii) $P(\text{different}) = 1 - \frac{1}{31} = \frac{30}{31}$.

Answer: (i) $\frac{1}{31}$ (ii) $\frac{30}{31}$

Common mistake: Using 365 or 30 for the number of days. The month is December, so 31.

Section C: Short answer

6 questions, 3 marks each.

Q26 · REAL NUMBERS · 3 MARKS

(A) Prove that $\sqrt{2}$ is an irrational number.

OR

(B) Let x and y be two distinct prime numbers and $p = x^2y^3$, $q = xy^4$, $r = x^5y^2$. Find the HCF and LCM of p , q and r . Further check if $\text{HCF}(p, q, r) \times \text{LCM}(p, q, r) = p \times q \times r$ or not.

SOLUTION

(A) Suppose $\sqrt{2}$ is rational: $\sqrt{2} = \frac{p}{q}$ with integers $p, q, q \neq 0$, having no common factor.

Squaring: $2q^2 = p^2$. So 2 divides p^2 , and as 2 is prime, 2 divides p . Write $p = 2a$.

Then $4a^2 = 2q^2$, so $q^2 = 2a^2$. So 2 divides q^2 and hence q .

Now 2 is a common factor of p and q , which contradicts our assumption. So $\sqrt{2}$ is irrational.

(B) $p = x^2y^3$, $q = x^1y^4$, $r = x^5y^2$. HCF takes the smallest powers: $\text{HCF} = x^1y^2$. LCM takes the greatest powers: $\text{LCM} = x^5y^4$.

$\text{HCF} \times \text{LCM} = x^6y^6$, while $p \times q \times r = x^{2+1+5}y^{3+4+2} = x^8y^9$.

These are not equal, so $\text{HCF}(p, q, r) \times \text{LCM}(p, q, r) \neq p \times q \times r$.

Answer: (A) proved (B) $\text{HCF} = xy^2$, $\text{LCM} = x^5y^4$; the product rule does not hold for three numbers

Common mistake: In (B), assuming $\text{HCF} \times \text{LCM} = \text{product}$. That rule is only for two numbers.

Q27 · LINEAR EQUATIONS · 3 MARKS

The monthly incomes of two persons are in the ratio 9 : 7 and their monthly expenditures are in the ratio 4 : 3. If each saved ₹ 5,000, express the given situation algebraically as a system of linear equations in two variables. Hence, find their respective monthly incomes.

SOLUTION

Let the incomes be ₹ $9x$ and ₹ $7x$, and the expenditures ₹ $4y$ and ₹ $3y$.

Savings = income – expenditure = 5000 for each: $9x - 4y = 5000$... (i) and $7x - 3y = 5000$... (ii).

Multiply (i) by 3 and (ii) by 4: $27x - 12y = 15000$ and $28x - 12y = 20000$. Subtract: $x = 5000$.

Incomes: $9x = 9 \times 5000 = ₹45,000$ and $7x = 7 \times 5000 = ₹35,000$.

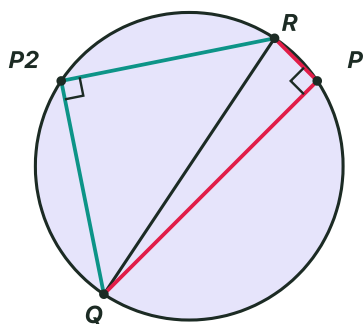
Check: $y = 10000$, so expenditures are 40000 and 30000, and the savings are 5000 each ✓.

Answer: $9x - 4y = 5000$, $7x - 3y = 5000$; incomes ₹ 45,000 and ₹ 35,000

Q28 · COORDINATE GEOMETRY · 3 MARKS

$P(x, y)$, $Q(-2, -3)$ and $R(2, 3)$ are the vertices of a right triangle PQR right angled at P . Find the relationship between x and y . Hence, find all possible values of x for which $y = 2$.

SOLUTION



$Q(-2, -3)$, $R(2, 3)$; $P(\pm 3, 2)$ lie on $x^2 + y^2 = 13$
A right angle at P means P is on the circle with diameter QR .

Right angle at P , so by Pythagoras $PQ^2 + PR^2 = QR^2$.

$PQ^2 = (x + 2)^2 + (y + 3)^2$, $PR^2 = (x - 2)^2 + (y - 3)^2$ and $QR^2 = 4^2 + 6^2 = 52$.

Adding: $(x^2 + 4x + 4 + y^2 + 6y + 9) + (x^2 - 4x + 4 + y^2 - 6y + 9) = 52$, which gives $2x^2 + 2y^2 + 26 = 52$.

So $x^2 + y^2 = 13$.

For $y = 2$: $x^2 = 13 - 4 = 9$, so $x = 3$ or $x = -3$.

Answer: $x^2 + y^2 = 13$; $x = \pm 3$

Common mistake: Giving only $x = 3$. The equation $x^2 = 9$ has two roots, and both points are on the circle.

Q29 · TRIGONOMETRY · 3 MARKS

(A) Prove that $\frac{\cos A + \sin A - 1}{\cos A - \sin A + 1} = \operatorname{cosec} A - \cot A$

OR

(B) If $\cot \theta + \cos \theta = p$ and $\cot \theta - \cos \theta = q$, prove that $p^2 - q^2 = 4\sqrt{pq}$.

SOLUTION

(A) Divide the numerator and denominator of the LHS by $\sin A$: $\frac{\cot A + 1 - \operatorname{cosec} A}{\cot A - 1 + \operatorname{cosec} A}$.

In the numerator write $1 = \operatorname{cosec}^2 A - \cot^2 A$: $\cot A - \operatorname{cosec} A + (\operatorname{cosec} A - \cot A)(\operatorname{cosec} A + \cot A)$.

$= (\operatorname{cosec} A - \cot A)[-1 + \operatorname{cosec} A + \cot A]$, and the bracket is the same as the denominator. So $\text{LHS} = \operatorname{cosec} A - \cot A = \text{RHS}$.

(B) $p^2 - q^2 = (p + q)(p - q) = (2 \cot \theta)(2 \cos \theta) = 4 \cot \theta \cos \theta$.

$pq = \cot^2 \theta - \cos^2 \theta = \cos^2 \theta (\operatorname{cosec}^2 \theta - 1) = \cos^2 \theta \cot^2 \theta$, so $4\sqrt{pq} = 4 \cos \theta \cot \theta$.

Both sides are $4 \cot \theta \cos \theta$, so $p^2 - q^2 = 4\sqrt{pq}$.

Answer: Both proved

Q30 · POLYNOMIALS · 3 MARKS

α and β are zeroes of a quadratic polynomial $px^2 + qx + 1$. Form a quadratic polynomial whose zeroes are $\frac{2}{\alpha}$ and $\frac{2}{\beta}$.

SOLUTION

For $px^2 + qx + 1$: $\alpha + \beta = -\frac{q}{p}$ and $\alpha\beta = \frac{1}{p}$.

Sum of the new zeroes = $\frac{2}{\alpha} + \frac{2}{\beta} = \frac{2(\alpha + \beta)}{\alpha\beta} = 2 \times \left(-\frac{q}{p}\right) \times p = -2q$.

Product of the new zeroes = $\frac{2}{\alpha} \times \frac{2}{\beta} = \frac{4}{\alpha\beta} = 4p$.

The polynomial is $x^2 - (\text{sum})x + \text{product} = x^2 + 2qx + 4p$.

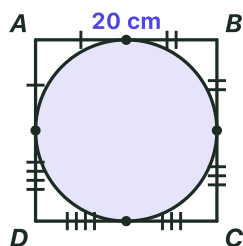
Answer: $x^2 + 2qx + 4p$

Common mistake: Forgetting the minus sign in "sum = $-2q$ ", which turns into $+2qx$ in the polynomial.

Q31 · CIRCLES · 3 MARKS

Rectangle $ABCD$ circumscribes the circle of radius 10 cm. Prove that $ABCD$ is a square. Hence, find the perimeter of $ABCD$.

SOLUTION



side = diameter = 20 cm, perimeter = $4 \times 20 = 80$ cm

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

Add the four: $AP + BP + CR + DR = AS + BQ + CQ + DS$, so $AB + CD = AD + BC$ (i)

In a rectangle $AB = CD$ and $BC = AD$. Then (i) gives $2AB = 2AD$, so $AB = AD$.

All four sides are equal and each angle is 90° , so $ABCD$ is a square.

The side of the square equals the diameter of the circle: $2 \times 10 = 20$ cm. Perimeter = $4 \times 20 = 80$ cm.

Answer: $ABCD$ is a square; perimeter = 80 cm

Section D: Long answer

4 questions, 5 marks each.

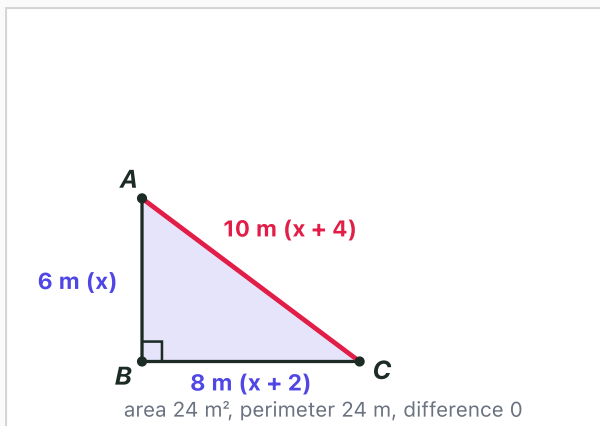
Q32 · QUADRATIC EQUATIONS · 5 MARKS

(A) The sides of a right triangle are such that the longest side is 4 m more than the shortest side and the third side is 2 m less than the longest side. Find the length of each side of the triangle. Also, find the difference between the numerical values of the area and the perimeter of the given triangle.

OR

(B) Express the equation $\frac{x-2}{x-3} + \frac{x-4}{x-5} = \frac{10}{3}$; ($x \neq 3, 5$) as a quadratic equation in standard form. Hence, find the roots of the equation so formed.

SOLUTION



(A) Let the shortest side be x m. The longest side (hypotenuse) is $(x + 4)$ m and the third side is $(x + 4) - 2 = (x + 2)$ m.

Pythagoras: $(x + 4)^2 = x^2 + (x + 2)^2$, so $x^2 + 8x + 16 = 2x^2 + 4x + 4$ and $x^2 - 4x - 12 = 0$.

$(x - 6)(x + 2) = 0$. A length cannot be negative, so $x = 6$. The sides are 6 m, 8 m and 10 m.

Area = $\frac{1}{2} \times 6 \times 8 = 24 \text{ m}^2$ and perimeter = $6 + 8 + 10 = 24 \text{ m}$. Difference = $24 - 24 = 0$.

(B) Put over a common denominator: $\frac{(x-2)(x-5) + (x-4)(x-3)}{(x-3)(x-5)} = \frac{10}{3}$.

Numerator: $(x^2 - 7x + 10) + (x^2 - 7x + 12) = 2x^2 - 14x + 22$. Denominator: $x^2 - 8x + 15$.

Cross-multiply: $3(2x^2 - 14x + 22) = 10(x^2 - 8x + 15)$, so $6x^2 - 42x + 66 = 10x^2 - 80x + 150$ and $4x^2 - 38x + 84 = 0$, that is $2x^2 - 19x + 42 = 0$.

Factorise: $2x^2 - 12x - 7x + 42 = 2x(x - 6) - 7(x - 6) = (x - 6)(2x - 7) = 0$. So $x = 6$ or $x = \frac{7}{2}$, both allowed ($\neq 3, 5$).

Answer: (A) sides 6 m, 8 m, 10 m; difference 0 (B) $2x^2 - 19x + 42 = 0$; $x = 6$ or $\frac{7}{2}$

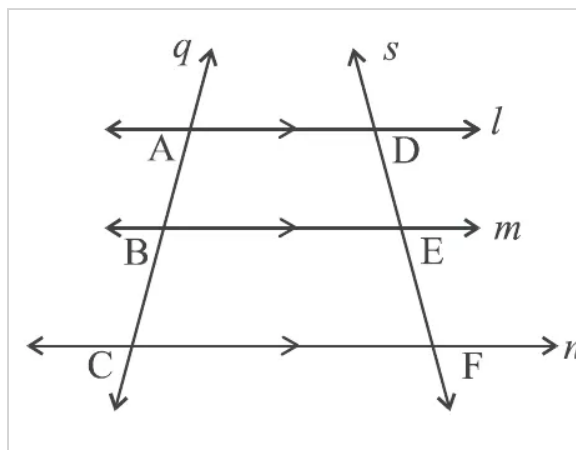
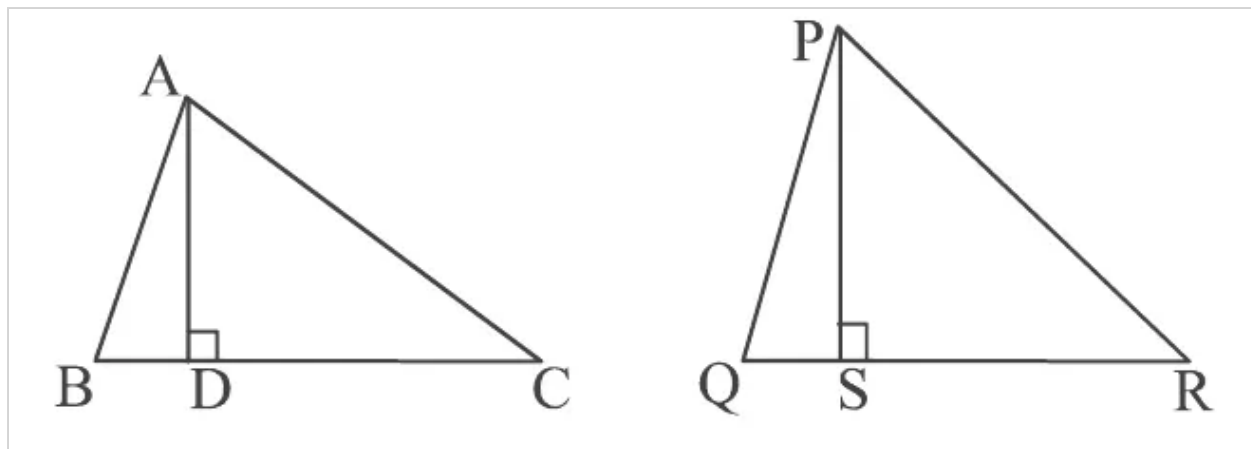
Common mistake: In (A), taking the third side as $x + 2$ and the longest side as $x + 2$ too. The longest is $x + 4$ and the third side is 2 less than it.

Q33 · TRIANGLES · 5 MARKS

(A) The corresponding sides of $\triangle ABC$ and $\triangle PQR$ are in the ratio 3 : 5. $AD \perp BC$ and $PS \perp QR$ as shown in the following figures: (i) Prove that $\triangle ADC \sim \triangle PSR$. (ii) If $AD = 4$ cm, find the length of PS . (iii) Using (ii) find $\text{ar}(\triangle ABC) : \text{ar}(\triangle PQR)$.

OR

(B) State basic proportionality theorem. Use it to prove the following: If three parallel lines l, m, n are intersected by transversals q and s as shown in the adjoining figure, then $\frac{AB}{BC} = \frac{DE}{EF}$.



SOLUTION

(A)(i) $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR} = \frac{3}{5}$, so $\triangle ABC \sim \triangle PQR$ (SSS) and $\angle C = \angle R$.

In $\triangle ADC$ and $\triangle PSR$: $\angle ADC = \angle PSR = 90^\circ$ and $\angle C = \angle R$. So $\triangle ADC \sim \triangle PSR$ (AA).

(ii) $\frac{AD}{PS} = \frac{AC}{PR} = \frac{3}{5}$, so $\frac{4}{PS} = \frac{3}{5}$ and $PS = \frac{20}{3}$ cm.

(iii) $\frac{\text{ar}(\triangle ABC)}{\text{ar}(\triangle PQR)} = \frac{\frac{1}{2} \times BC \times AD}{\frac{1}{2} \times QR \times PS} = \frac{BC}{QR} \times \frac{AD}{PS} = \frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$. The ratio is 9 : 25.

(B) Basic Proportionality Theorem: if a line is drawn parallel to one side of a triangle to meet the other two sides in distinct points, it divides those sides in the same ratio.

Proof of the result: join AF , meeting line m at G . In $\triangle ACF$, $BG \parallel CF$, so $\frac{AB}{BC} = \frac{AG}{GF}$ (i)

In $\triangle FDA$, $GE \parallel AD$, so $\frac{FE}{ED} = \frac{FG}{GA}$, that is $\frac{DE}{EF} = \frac{AG}{GF}$ (ii)

From (i) and (ii): $\frac{AB}{BC} = \frac{DE}{EF}$.

Answer: (A) $PS = \frac{20}{3}$ cm; ratio 9 : 25 (B) proved

Common mistake: Saying the areas are in the ratio 3 : 5. The ratio of areas of similar triangles is the square of the ratio of the sides: 9 : 25.

Q34 · SURFACE AREAS AND VOLUMES · 5 MARKS

A wooden cubical die is formed by forming hemispherical depressions on each face of the cube such that face 1 has one depression, face 2 has two depressions and so on. The sum of number of hemispherical depressions on opposite faces is always 7. If the edge of the cubical die measures 5 cm and each hemispherical depression is of diameter 1.4 cm, find the total surface area of the die so formed.

SOLUTION

Number of depressions = $1 + 2 + 3 + 4 + 5 + 6 = 21$. Radius of each $r = \frac{1.4}{2} = 0.7$ cm.

Making a depression removes a flat circle πr^2 from the face but adds the curved surface of a hemisphere $2\pi r^2$. So each depression adds $2\pi r^2 - \pi r^2 = \pi r^2$.

TSA of the cube = $6 \times 5^2 = 150$ cm².

Net addition for 21 depressions = $21 \times \pi r^2 = 21 \times \frac{22}{7} \times 0.7 \times 0.7 = 3 \times 22 \times 0.49 = 32.34$ cm².

Total surface area of the die = $150 + 32.34 = 182.34$ cm².

Answer: 182.34 cm²

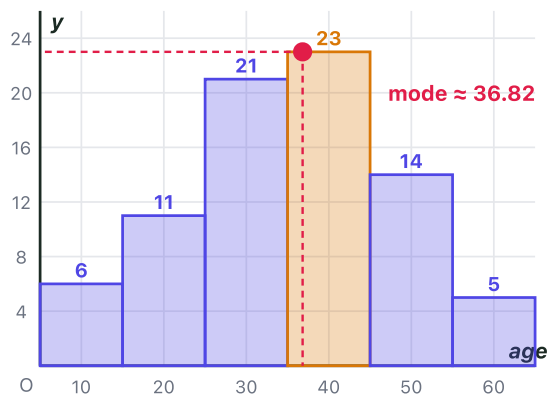
Common mistake: Adding the hemisphere surface but forgetting to subtract the circular opening removed from the face.

Q35 · STATISTICS · 5 MARKS

The following table shows the number of patients of different age group who were discharged from the hospital in a particular month. Find the 'mean' and the 'mode' of the above data.

Age (in years)	Number of Patients Discharged
5 – 15	6
15 – 25	11
25 – 35	21
35 – 45	23
45 – 55	14
55 – 65	5
Total	80

SOLUTION



The modal class is 35 – 45 (frequency 23).

Class marks x_i : 10, 20, 30, 40, 50, 60. Frequencies f_i : 6, 11, 21, 23, 14, 5 with $\sum f_i = 80$.

Products $f_i x_i$: 60, 220, 630, 920, 700, 300. Their sum is $\sum f_i x_i = 2830$.

$$\text{Mean} = \frac{2830}{80} = \frac{283}{8} = 35.375 \approx 35.38 \text{ years.}$$

Highest frequency is 23, so the modal class is 35 – 45: $l = 35$, $f_1 = 23$, $f_0 = 21$, $f_2 = 14$, $h = 10$.

$$\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 35 + \frac{23 - 21}{46 - 21 - 14} \times 10 = 35 + \frac{20}{11} = \frac{405}{11} \approx 36.82 \text{ years.}$$

Answer: Mean $\approx$ 35.38 years and Mode $\approx$ 36.82 years

Section E: Case studies

3 case studies, 4 marks each.

Q36 · AREAS RELATED TO CIRCLES · 4 MARKS

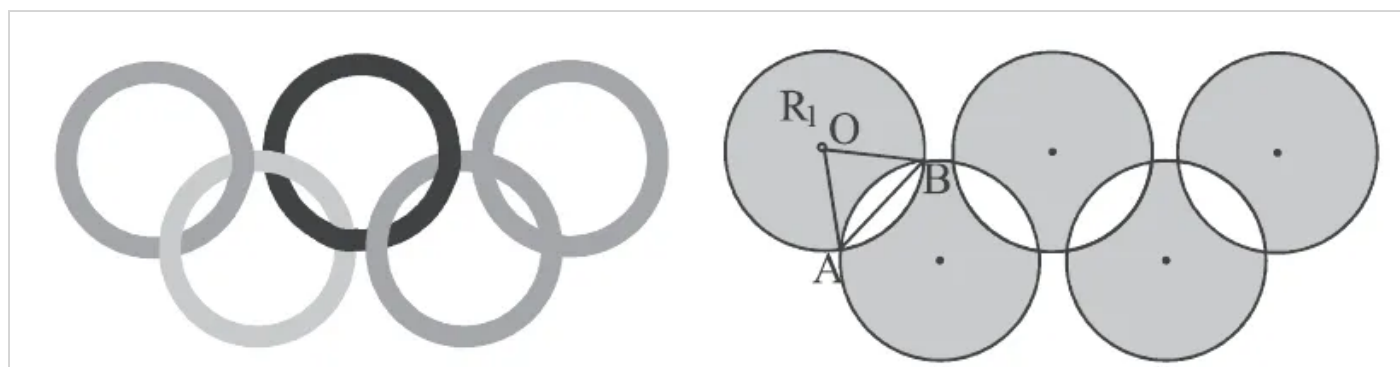
Case study 1. The Olympic symbol comprising five interlocking rings represents the union of the five continents of the world and the meeting of athletes from all over the world at the Olympic games. In order to spread awareness about Olympic games, students of Class-X took part in various activities organised by the school. One such group of students made 5 circular rings in the school lawn with the help of ropes. Each circular ring required 44 m of rope. Also, in the shaded regions as shown in the figure, students made rangoli showcasing various sports and games. It is given that $\triangle OAB$ is an equilateral triangle and all unshaded regions are congruent.

Based on above information, answer the following questions:

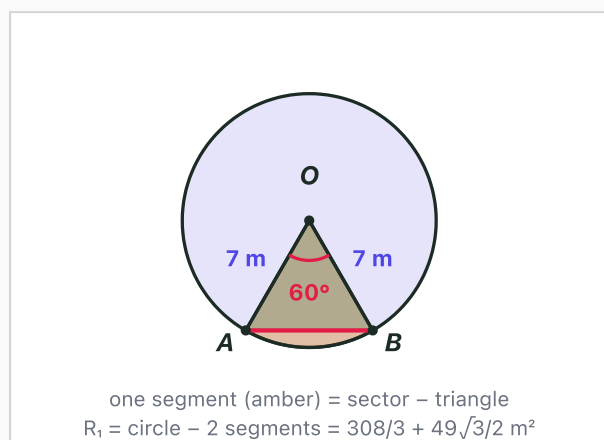
- (i) Find the radius of each circular ring. [1]
- (ii) What is the measure of $\angle AOB$? [1]
- (iii) (a) Find the area of shaded region R_1 . [2]

OR

- (iii) (b) Find the length of rope around the unshaded regions. [2]



SOLUTION



(i) The rope around a ring is its circumference: $2\pi r = 44$, so $2 \times \frac{22}{7} \times r = 44$ and $r = 7 \text{ m}$.

(ii) $\triangle OAB$ is equilateral, so each angle is 60° . $\angle AOB = 60^\circ$.

(iii)(a) The white lens where two rings overlap is made of two equal segments standing on the chord AB . The shaded region R_1 is the whole circle minus these 2 segments. One segment = sector of 60° - equilateral triangle OAB :

$$\frac{60}{360} \times \frac{22}{7} \times 7 \times 7 - \frac{\sqrt{3}}{4} \times 7 \times 7 = \frac{77}{3} - \frac{49\sqrt{3}}{4}.$$

$$R_1 = \pi r^2 - 2 \times (\text{segment}) = 154 - 2 \left(\frac{77}{3} - \frac{49\sqrt{3}}{4} \right) = 154 - \frac{154}{3} + \frac{49\sqrt{3}}{2} = \frac{308}{3} + \frac{49\sqrt{3}}{2} \text{ m}^2.$$

With $\sqrt{3} = 1.73$: $R_1 \approx 102.67 + 42.39 \approx 145.05 \text{ m}^2$.

(iii)(b) The unshaded regions are bounded by 8 equal arcs of 60° each. One arc = $\frac{60}{360} \times 2\pi r = \frac{1}{6} \times 44 = \frac{22}{3} \text{ m}$.

Rope around the unshaded regions = $8 \times \frac{22}{3} = \frac{176}{3} \text{ m} \approx 58.67 \text{ m}$.

Answer: (i) 7 m (ii) 60° (iii)(a) $\frac{308}{3} + \frac{49\sqrt{3}}{2} \approx 145.05 \text{ m}^2$ (iii)(b) $\frac{176}{3} \approx 58.67 \text{ m}$

Common mistake: In (iii)(a), forgetting to subtract the triangle when finding a segment: segment = sector – triangle.

Q37 · ARITHMETIC PROGRESSIONS · 4 MARKS

Case study 2. Cable cars at hill stations are one of the major tourist attractions. On a hill station, the length of cable car ride from base point to top most point on the hill is 5000 m. Poles are installed at equal intervals on the way to provide support to the cables on which car moves. The distance of first pole from base point is 200 m and subsequent poles are installed at equal interval of 150 m. Further, the distance of last pole from the top is 300 m.

Based on above information, answer the following questions using Arithmetic Progression:

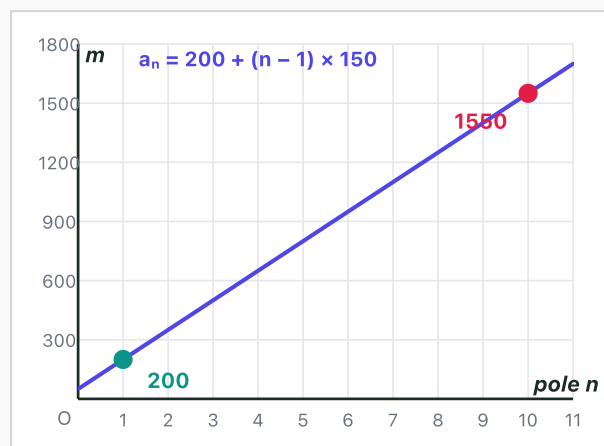
- (i) Find the distance of 10th pole from the base. [1]
- (ii) Find the distance between 15th pole and 25th pole. [1]
- (iii) (a) Find the time taken by cable car to reach 15th pole from the top if it is moving at the speed of 5 m/sec and coming from top. [2]

OR

- (iii) (b) Find the total number of poles installed along the entire journey. [2]

Figure: A picture of cable cars hanging from a cable supported by poles on a hillside.

SOLUTION



The distances of the poles from the base form an AP: 200, 350, 500, ... with $a = 200$ and $d = 150$.

(i) $a_{10} = a + 9d = 200 + 9 \times 150 = 1550 \text{ m}$.

(ii) Between the 15th and 25th pole there are 10 intervals: $a_{25} - a_{15} = 10d = 10 \times 150 = 1500 \text{ m}$.

(iii)(a) Coming from the top, the last pole is 300 m from the top, and each earlier pole is 150 m farther. The 15th pole counted from the top is at $300 + 14 \times 150 = 2400 \text{ m}$ from the top.

Time = $\frac{\text{distance}}{\text{speed}} = \frac{2400}{5} = 480 \text{ seconds} = 8 \text{ minutes}$.

(iii)(b) The last pole is 300 m from the top, so it is $5000 - 300 = 4700 \text{ m}$ from the base. Let this be the n th pole:
 $200 + (n - 1) \times 150 = 4700$.

$(n - 1) \times 150 = 4500$, so $n - 1 = 30$ and $n = 31$ poles.

Answer: (i) 1550 m (ii) 1500 m (iii)(a) 480 s (8 min) (iii)(b) 31 poles

Common mistake: In (iii)(b), using 5000 as the last pole's distance. The last pole is 300 m before the top, at 4700 m.

Q38 · APPLICATIONS OF TRIGONOMETRY · 4 MARKS

Case study 3. A drone was used to facilitate movement of an ambulance on the straight highway to a point P on the ground where there was an accident. The ambulance was travelling at the speed of 60 km/h. The drone stopped at a point Q, 100 m vertically above the point P. The angle of depression of the ambulance was found to be 30° at a particular instant.

Based on above information, answer the following questions:

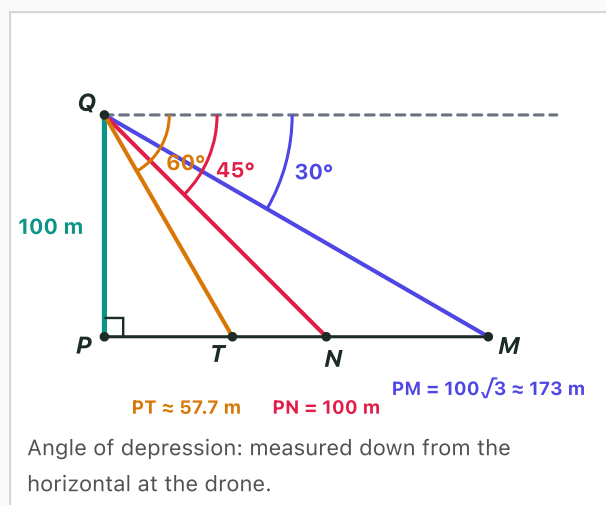
- (i) Represent the above situation with the help of a diagram. [1]
- (ii) Find the distance between the ambulance and the site of accident (P) at the particular instant. (Use $\sqrt{3} = 1.73$) [1]
- (iii) (a) Find the time (in seconds) in which the angle of depression changes from 30° to 45° . [2]

OR

- (iii) (b) How long (in seconds) will the ambulance take to reach point P from a point T on the highway such that angle of depression of the ambulance at T is 60° from the drone? [2]

Figure: A picture of a drone hovering above a road, with a police car and an ambulance driving towards the accident site.

SOLUTION



(i) Q is 100 m directly above P. The ambulance is at M on the road, and the angle of depression from Q to M is 30° (see the diagram above; it is the same as $\angle QMP$).

(ii) In right triangle QPM: $\tan 30^\circ = \frac{QP}{PM} = \frac{100}{d} = \frac{1}{\sqrt{3}}$, so $d = 100\sqrt{3} = 100 \times 1.73 = 173$ m.

(iii)(a) At 45° the ambulance is at N with $\tan 45^\circ = \frac{100}{PN} = 1$, so $PN = 100$ m. It has moved $173 - 100 = 73$ m.

Speed = 60 km/h = $60 \times \frac{5}{18} = \frac{50}{3}$ m/s. Time = $\frac{73}{50/3} = \frac{219}{50} \approx 4.4$ seconds.

(iii)(b) At T the angle of depression is 60° : $\tan 60^\circ = \frac{100}{PT} = \sqrt{3}$, so $PT = \frac{100}{\sqrt{3}} = \frac{100\sqrt{3}}{3} \approx 57.7$ m.

Time = $\frac{100\sqrt{3}/3}{50/3} = 2\sqrt{3} \approx 3.5$ seconds.

Answer: (ii) 173 m (iii)(a) ≈ 4.4 s (iii)(b) $2\sqrt{3} \approx 3.5$ s

Common mistake: Using $60 \times \frac{18}{5}$ instead of $60 \times \frac{5}{18}$ to change km/h into m/s.

Mock quiz, 1-minute analysis and more papers: cognicraftedu.com/cbse-class-10-papers/maths-standard/2025/30-4-1

Questions are from the official CBSE paper. Solutions are written by CogniGuru.