

Mathematics (Standard) 2024, Set 30/5/1

Q.P. Code 30/5/1 · Series C5ABD/5 · 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 · ARITHMETIC PROGRESSIONS · 1 MARK

The next (4th) term of the A.P. $\sqrt{18}$, $\sqrt{50}$, $\sqrt{98}$, ... is:

- (A) $\sqrt{128}$ (B) $\sqrt{140}$
(C) $\sqrt{162}$ (D) $\sqrt{200}$

SOLUTION

Simplify: $\sqrt{18} = 3\sqrt{2}$, $\sqrt{50} = 5\sqrt{2}$, $\sqrt{98} = 7\sqrt{2}$. The common difference is $2\sqrt{2}$.

The next term is $7\sqrt{2} + 2\sqrt{2} = 9\sqrt{2} = \sqrt{162}$.

Answer: (C) $\sqrt{162}$

Common mistake: Looking at the numbers under the root (18, 50, 98). They are not an A.P.; the simplified terms $3\sqrt{2}$, $5\sqrt{2}$, $7\sqrt{2}$ are.

Q2 · TRIGONOMETRY · 1 MARK

If $\frac{x}{3} = 2 \sin A$ and $\frac{y}{3} = 2 \cos A$, then the value of $x^2 + y^2$ is:

- (A) 36 (B) 9
(C) 6 (D) 18

SOLUTION

$x = 6 \sin A$ and $y = 6 \cos A$.

$x^2 + y^2 = 36(\sin^2 A + \cos^2 A) = 36$.

Answer: (A) 36

Q3 · TRIGONOMETRY · 1 MARK

If $4 \sec \theta - 5 = 0$, then the value of $\cot \theta$ is:

- (A) $\frac{3}{4}$ (B) $\frac{4}{5}$
(C) $\frac{5}{3}$ (D) $\frac{4}{3}$

SOLUTION

$\sec \theta = \frac{5}{4}$, so $\cos \theta = \frac{4}{5}$. Take hypotenuse 5 and adjacent side 4.

The opposite side is $\sqrt{25 - 16} = 3$, so $\cot \theta = \frac{\text{adjacent}}{\text{opposite}} = \frac{4}{3}$.

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

Q4 · LINEAR EQUATIONS · 1 MARK

Which out of the following type of straight lines will be represented by the system of equations $3x + 4y = 5$ and $6x + 8y = 7$?

- (A) Parallel (B) Intersecting
(C) Coincident (D) Perpendicular to each other

SOLUTION

$$\frac{a_1}{a_2} = \frac{3}{6} = \frac{1}{2}, \frac{b_1}{b_2} = \frac{4}{8} = \frac{1}{2} \text{ and } \frac{c_1}{c_2} = \frac{5}{7}.$$

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}, \text{ so the lines are parallel.}$$

Answer: (A) Parallel

Q5 · QUADRATIC EQUATIONS · 1 MARK

The ratio of the sum and product of the roots of the quadratic equation $5x^2 - 6x + 21 = 0$ is:

- (A) 5 : 21 (B) 2 : 7
(C) 21 : 5 (D) 7 : 2

SOLUTION

$$\text{Sum of roots} = -\frac{-6}{5} = \frac{6}{5} \text{ and product of roots} = \frac{21}{5}.$$

$$\text{Ratio} = \frac{6}{5} : \frac{21}{5} = 6 : 21 = 2 : 7.$$

Answer: (B) 2 : 7

Q6 · STATISTICS · 1 MARK

For the data 2, 9, $x + 6$, $2x + 3$, 5, 10, 5; if the mean is 7, then the value of x is:

- (A) 9 (B) 6
(C) 5 (D) 3

SOLUTION

$$\text{Sum} = 7 \times 7 = 49, \text{ and the sum is } 2 + 9 + (x + 6) + (2x + 3) + 5 + 10 + 5 = 40 + 3x.$$

$$40 + 3x = 49, \text{ so } x = 3.$$

Answer: (D) 3

Q7 · PROBABILITY · 1 MARK

One ticket is drawn at random from a bag containing tickets numbered 1 to 40. The probability that the selected ticket has a number which is a multiple of 7 is:

(A) $\frac{1}{7}$
(C) $\frac{1}{5}$

(B) $\frac{1}{8}$
(D) $\frac{7}{40}$

SOLUTION

Multiples of 7 up to 40: 7, 14, 21, 28, 35. That is 5 numbers.

$$P = \frac{5}{40} = \frac{1}{8}.$$

Answer: (B) $\frac{1}{8}$

Q8 · AREAS RELATED TO CIRCLES · 1 MARK

The perimeter of the sector of a circle of radius 21 cm which subtends an angle of 60° at the centre of circle, is:

(A) 22 cm
(C) 64 cm

(B) 43 cm
(D) 462 cm

SOLUTION

$$\text{Arc length} = \frac{60}{360} \times 2 \times \frac{22}{7} \times 21 = 22 \text{ cm.}$$

$$\text{Perimeter} = \text{arc} + 2r = 22 + 42 = 64 \text{ cm.}$$

Answer: (C) 64 cm

Common mistake: Stopping at the arc length. The perimeter of a sector also includes the two radii.

Q9 · AREAS RELATED TO CIRCLES · 1 MARK

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

(A) 120°
(C) 75°

(B) 6°
(D) 150°

SOLUTION

$$\text{Arc length} = \frac{\theta}{360} \times 2\pi r: 10\pi = \frac{\theta}{360} \times 2\pi \times 12 = \frac{\theta}{360} \times 24\pi.$$

$$\theta = \frac{10 \times 360}{24} = 150^\circ.$$

Answer: (D) 150°

Q10 · REAL NUMBERS · 1 MARK

The greatest number which divides 281 and 1249, leaving remainder 5 and 7 respectively, is:

(A) 23
(C) 138

(B) 276
(D) 69

SOLUTION

The numbers that are exactly divisible are $281 - 5 = 276$ and $1249 - 7 = 1242$.

The greatest number is $\text{HCF}(276, 1242)$. $1242 = 4 \times 276 + 138$ and $276 = 2 \times 138$, so the HCF is 138.

Answer: (C) 138

Common mistake: Finding the HCF of 281 and 1249 directly. Subtract the remainders first.

Q11 · ARITHMETIC PROGRESSIONS · 1 MARK

The number of terms in the A.P. 3, 6, 9, 12, ..., 111 is:

- (A) 36 (B) 40
(C) 37 (D) 30

SOLUTION

$a = 3, d = 3$ and $a_n = 111$: $3 + (n - 1) \times 3 = 111$, so $n - 1 = 36$ and $n = 37$.

Answer: (C) 37

Q12 · CIRCLES · 1 MARK

A chord of a circle of radius 10 cm subtends a right angle at its centre. The length of the chord (in cm) is:

- (A) $5\sqrt{2}$ (B) $10\sqrt{2}$
(C) $\frac{5}{\sqrt{2}}$ (D) 5

SOLUTION

The two radii and the chord form a right triangle with legs 10 and 10.

Chord = $\sqrt{10^2 + 10^2} = 10\sqrt{2}$ cm.

Answer: (B) $10\sqrt{2}$

Q13 · REAL NUMBERS · 1 MARK

The LCM of three numbers 28, 44, 132 is:

- (A) 258 (B) 231
(C) 462 (D) 924

SOLUTION

$28 = 2^2 \times 7, 44 = 2^2 \times 11, 132 = 2^2 \times 3 \times 11$.

$\text{LCM} = 2^2 \times 3 \times 7 \times 11 = 924$.

Answer: (D) 924

Q14 · REAL NUMBERS · 1 MARK

If the product of two co-prime numbers is 553, then their HCF is:

- (A) 1 (B) 553
(C) 7 (D) 79

SOLUTION

Co-prime numbers have no common factor other than 1, so their HCF is 1.

Answer: (A) 1

Q15 · POLYNOMIALS · 1 MARK

If α and β are the zeroes of the polynomial $p(x) = kx^2 - 30x + 45k$ and $\alpha + \beta = \alpha\beta$, then the value of k is:

(A) $-\frac{2}{3}$

(B) $-\frac{3}{2}$

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

(D) $\frac{2}{3}$

SOLUTION

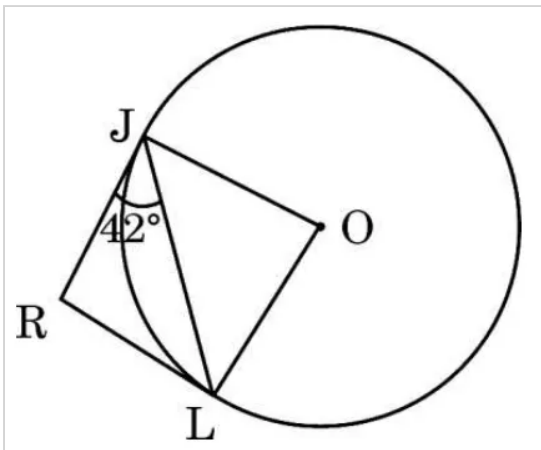
$$\alpha + \beta = \frac{30}{k} \text{ and } \alpha\beta = \frac{45k}{k} = 45.$$

$$\frac{30}{k} = 45, \text{ so } k = \frac{30}{45} = \frac{2}{3}.$$

Answer: (D) $\frac{2}{3}$

Q16 · CIRCLES · 1 MARK

In the given figure, RJ and RL are two tangents to the circle. If $\angle RJL = 42^\circ$, then the measure of $\angle JOL$ is:



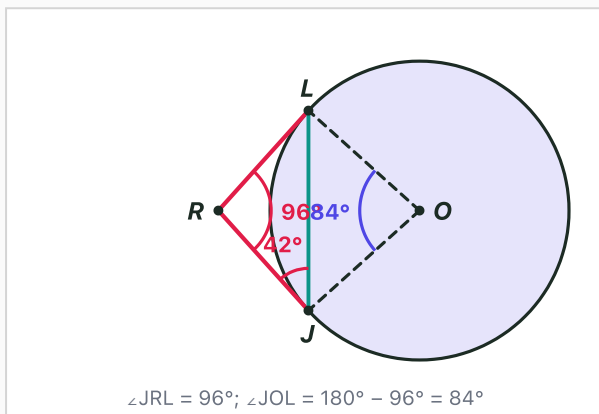
(A) 42°

(B) 84°

(C) 96°

(D) 138°

SOLUTION



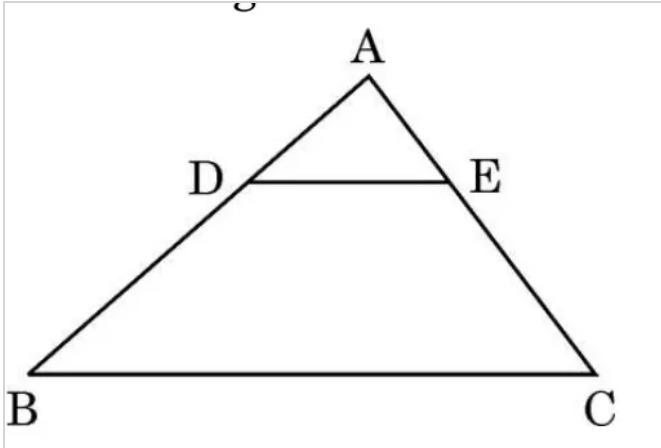
Tangents from R are equal: $RJ = RL$, so $\angle RLJ = \angle RJL = 42^\circ$ and $\angle JRL = 180^\circ - 84^\circ = 96^\circ$.

$OJ \perp RJ$ and $OL \perp RL$, so in quadrilateral $ORJL$: $\angle JOL = 360^\circ - 90^\circ - 90^\circ - 96^\circ = 84^\circ$.

Answer: (B) 84°

Q17 · TRIANGLES · 1 MARK

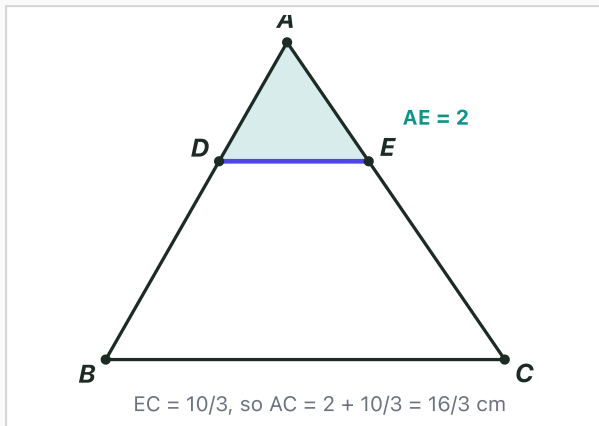
In the given figure, in $\triangle ABC$, $DE \parallel BC$. If $AD = 2.4$ cm, $DB = 4$ cm and $AE = 2$ cm, then the length of AC is:



- (A) $\frac{10}{3}$ cm
(C) $\frac{16}{3}$ cm

- (B) $\frac{3}{10}$ cm
(D) 1.2 cm

SOLUTION



$$DE \parallel BC, \text{ so } \frac{AD}{DB} = \frac{AE}{EC}; \frac{2.4}{4} = \frac{2}{EC}, \text{ so } EC = \frac{8}{2.4} = \frac{10}{3} \text{ cm.}$$

$$AC = AE + EC = 2 + \frac{10}{3} = \frac{16}{3} \text{ cm.}$$

Answer: (C) $\frac{16}{3}$ cm

Common mistake: Giving $EC = \frac{10}{3}$ (option A). The question asks for AC , which is $AE + EC$.

Q18 · TRIANGLES · 1 MARK

If a vertical pole of length 7.5 m casts a shadow 5 m long on the ground and at the same time, a tower casts a shadow 24 m long, then the height of the tower is:

- (A) 20 m
(C) 60 m

- (B) 40 m
(D) 36 m

SOLUTION

At the same time the Sun makes the same angle, so the pole and the tower with their shadows form similar triangles.

$$\frac{\text{pole}}{\text{shadow}} = \frac{\text{tower}}{\text{shadow}} : \frac{7.5}{5} = \frac{h}{24}, \text{ so } h = 1.5 \times 24 = 36 \text{ m.}$$

Answer: (D) 36 m

Q19 · TRIANGLES · 1 MARK

Assertion (A): $ABCD$ is a trapezium with $DC \parallel AB$. E and F are points on AD and BC respectively, such that $EF \parallel AB$. Then $\frac{AE}{ED} = \frac{BF}{FC}$.

Reason (R): Any line parallel to parallel sides of a trapezium divides the non-parallel sides proportionally.

- (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) A line parallel to the two parallel sides cuts the slanting sides in the same ratio. This is a standard result, so R is true.

(A) is exactly this result applied to EF , so A is true and R explains A.

Answer: (A) Both true, and R explains A

Q20 · POLYNOMIALS · 1 MARK

Assertion (A): Degree of a zero polynomial is not defined.

Reason (R): Degree of a non-zero constant polynomial is 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

(A) The zero polynomial has no non-zero term, so its degree is not defined. True.

(R) A non-zero constant such as $5 = 5x^0$ has degree 0. True.

R is about non-zero constants and does not explain why the degree of the zero polynomial is undefined. So R is not the explanation of A.

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

Section B: Very short answer

5 questions, 2 marks each.

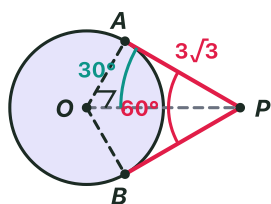
Q21 · CIRCLES · 2 MARKS

(a) If two tangents inclined at an angle of 60° are drawn to a circle of radius 3 cm, then find the length of each tangent.

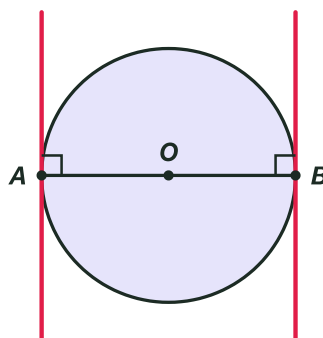
OR

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

SOLUTION



OP bisects $\angle P$: $\tan 30^\circ = \frac{3}{AP}$, so $AP = 3\sqrt{3}$ cm



Both make 90° with AB, so they are parallel

(a) Let the tangents PA and PB meet at P with $\angle APB = 60^\circ$. PO bisects the angle, so $\angle OPA = 30^\circ$. $OA \perp PA$.

In $\triangle OAP$: $\tan 30^\circ = \frac{OA}{AP} = \frac{3}{AP} = \frac{1}{\sqrt{3}}$, so $AP = 3\sqrt{3}$ cm.

(b) Let AB be a diameter with tangents PQ at A and XY at B . A tangent is perpendicular to the radius at the point of contact: $\angle OAP = \angle OBY = 90^\circ$.

These are alternate interior angles on the transversal AB , and they are equal. So $PQ \parallel XY$.

Answer: (a) $3\sqrt{3}$ cm (b) proved

Q22 · TRIGONOMETRY · 2 MARKS

Evaluate: $\frac{2 \tan 30^\circ \cdot \sec 60^\circ \cdot \tan 45^\circ}{1 - \sin^2 60^\circ}$

SOLUTION

$$\text{Numerator: } 2 \times \frac{1}{\sqrt{3}} \times 2 \times 1 = \frac{4}{\sqrt{3}}.$$

$$\text{Denominator: } 1 - \left(\frac{\sqrt{3}}{2}\right)^2 = 1 - \frac{3}{4} = \frac{1}{4}.$$

$$\text{Value} = \frac{4}{\sqrt{3}} \times 4 = \frac{16}{\sqrt{3}} = \frac{16\sqrt{3}}{3}.$$

$$\text{Answer: } \frac{16}{\sqrt{3}} = \frac{16\sqrt{3}}{3}$$

Q23 · POLYNOMIALS · 2 MARKS

If α, β are zeroes of the polynomial $p(x) = 5x^2 - 6x + 1$, then find the value of $\alpha + \beta + \alpha\beta$.

SOLUTION

$$\alpha + \beta = -\frac{-6}{5} = \frac{6}{5} \text{ and } \alpha\beta = \frac{1}{5}.$$

$$\alpha + \beta + \alpha\beta = \frac{6}{5} + \frac{1}{5} = \frac{7}{5}.$$

$$\text{Answer: } \frac{7}{5}$$

Q24 · COORDINATE GEOMETRY · 2 MARKS

(a) Find the ratio in which the point $P(-4, 6)$ divides the line segment joining the points $A(-6, 10)$ and $B(3, -8)$.

OR

(b) Prove that the points $(3, 0)$, $(6, 4)$ and $(-1, 3)$ are the vertices of an isosceles triangle.

SOLUTION

(a) Let P divide AB in the ratio $k : 1$. $x = \frac{3k - 6}{k + 1} = -4$, so $3k - 6 = -4k - 4$ and $7k = 2$, giving $k = \frac{2}{7}$.

The ratio is $2 : 7$. (Check with y : $\frac{-8k + 10}{k + 1} = \frac{-16/7 + 10}{9/7} = \frac{54/7}{9/7} = 6 \checkmark$.)

(b) Let $A(3, 0)$, $B(6, 4)$, $C(-1, 3)$. $AB = \sqrt{9 + 16} = 5$, $BC = \sqrt{49 + 1} = \sqrt{50}$, $CA = \sqrt{16 + 9} = 5$.

$AB = CA$, so two sides are equal: $\triangle ABC$ is isosceles.

Answer: (a) $2 : 7$ (b) proved ($AB = CA = 5$)

Q25 · PROBABILITY · 2 MARKS

A carton consists of 60 shirts of which 48 are good, 8 have major defects and 4 have minor defects. Nigam, a trader, will accept the shirts which are good but Anmol, another trader, will only reject the shirts which have major defects. One shirt is drawn at random from the carton. Find the probability that it is acceptable to Anmol.

SOLUTION

Anmol rejects only the shirts with major defects, so he accepts $60 - 8 = 52$ shirts (the 48 good and the 4 with minor defects).

$$P = \frac{52}{60} = \frac{13}{15}.$$

Answer: $\frac{13}{15}$

Common mistake: Using 48, which is what Nigam accepts. Anmol accepts the good shirts and the minor-defect ones too.

Section C: Short answer

6 questions, 3 marks each.

Q26 · REAL NUMBERS · 3 MARKS

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

OR

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

SOLUTION

(a) Suppose $\sqrt{3} = \frac{p}{q}$ with p, q co-prime and $q \neq 0$. Then $3q^2 = p^2$, so 3 divides p . Write $p = 3a$: $9a^2 = 3q^2$, so $q^2 = 3a^2$ and 3 divides q .

Both p and q are divisible by 3: a contradiction. So $\sqrt{3}$ is irrational.

(b) $(\sqrt{2} + \sqrt{3})^2 = 2 + 3 + 2\sqrt{6} = 5 + 2\sqrt{6}$. Suppose it is rational, $= \frac{a}{b}$ with integers a, b and $b \neq 0$.

Then $\sqrt{6} = \frac{a - 5b}{2b}$, which is rational. But $\sqrt{6}$ is irrational (given), a contradiction. So $5 + 2\sqrt{6}$ is irrational.

Answer: (a) proved (b) proved

Q27 · ARITHMETIC PROGRESSIONS · 3 MARKS

(a) If the sum of the first 14 terms of an A.P. is 1050 and the first term is 10, then find the 20th term and the n th term.

OR

(b) The first term of an A.P. is 5, the last term is 45 and the sum of all the terms is 400. Find the number of terms and the common difference of the A.P.

SOLUTION

$$(a) S_{14} = \frac{14}{2}[2 \times 10 + 13d] = 1050, \text{ so } 20 + 13d = 150 \text{ and } d = 10.$$

$$a_{20} = 10 + 19 \times 10 = 200 \text{ and } a_n = 10 + (n - 1) \times 10 = 10n.$$

$$(b) S_n = \frac{n}{2}(a + l) = \frac{n}{2}(5 + 45) = 25n = 400, \text{ so } n = 16.$$

$$a_{16} = 5 + 15d = 45, \text{ so } d = \frac{40}{15} = \frac{8}{3}.$$

Answer: (a) $a_{20} = 200, a_n = 10n$ (b) $n = 16, d = \frac{8}{3}$

Q28 · CIRCLES · 3 MARKS

Prove that the parallelogram circumscribing a circle is a rhombus.

SOLUTION

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

$$\text{Add: } (AP + BP) + (CR + DR) = (AS + DS) + (BQ + CQ), \text{ so } AB + CD = AD + BC.$$

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

Answer: Proved

Q29 · TRIGONOMETRY · 3 MARKS

Prove that: $\frac{\tan A}{1 - \cot A} + \frac{\cot A}{1 - \tan A} = 1 + \sec A \operatorname{cosec} A$

SOLUTION

$$\frac{\tan A}{1 - \cot A} = \frac{\sin^2 A}{\cos A(\sin A - \cos A)} \text{ and } \frac{\cot A}{1 - \tan A} = \frac{\cos^2 A}{\sin A(\cos A - \sin A)} = -\frac{\cos^2 A}{\sin A(\sin A - \cos A)}.$$

$$\text{Sum} = \frac{1}{\sin A - \cos A} \left[\frac{\sin^2 A}{\cos A} - \frac{\cos^2 A}{\sin A} \right] = \frac{\sin^3 A - \cos^3 A}{\sin A \cos A(\sin A - \cos A)}.$$

$$\text{Using } a^3 - b^3 = (a - b)(a^2 + ab + b^2): = \frac{1 + \sin A \cos A}{\sin A \cos A} = \frac{1}{\sin A \cos A} + 1 = 1 + \sec A \operatorname{cosec} A = \text{RHS}.$$

Answer: Proved

Q30 · PROBABILITY · 3 MARKS

Three unbiased coins are tossed simultaneously. Find the probability of getting: (i) at least one head. (ii) exactly one tail. (iii) two heads and one tail.

SOLUTION

8 equally likely outcomes: $HHH, HHT, HTH, HTT, THH, THT, TTH, TTT$.

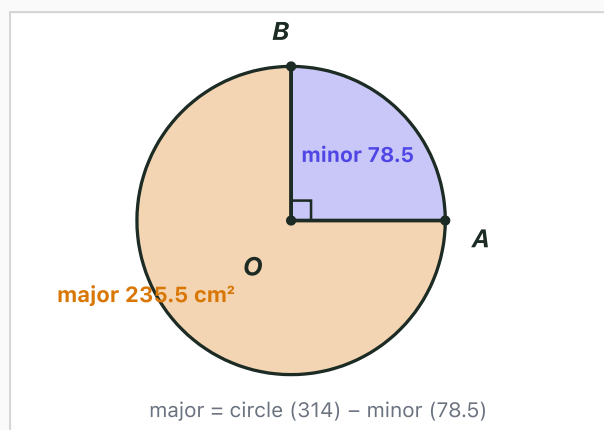
(i) At least one head: all except TTT : $\frac{7}{8}$.

(ii) Exactly one tail: HHT, HTH, THH : $\frac{3}{8}$. (iii) Two heads and one tail: the same three outcomes: $\frac{3}{8}$.

Answer: (i) $\frac{7}{8}$ (ii) $\frac{3}{8}$ (iii) $\frac{3}{8}$

Q31 · AREAS RELATED TO CIRCLES · 3 MARKS

An arc of a circle of radius 10 cm subtends a right angle at the centre of the circle. Find the area of the corresponding major sector. (Use $\pi = 3.14$)

SOLUTION

Area of the circle = $3.14 \times 10 \times 10 = 314 \text{ cm}^2$.

Area of the minor sector = $\frac{90}{360} \times 314 = 78.5 \text{ cm}^2$.

Area of the major sector = $314 - 78.5 = 235.5 \text{ cm}^2$.

Answer: 235.5 cm^2

Common mistake: Giving the minor sector (78.5 cm^2). The question asks for the major sector.

Section D: Long answer

4 questions, 5 marks each.

Q32 · QUADRATIC EQUATIONS · 5 MARKS

(a) Find the value of ' k ' for which the quadratic equation $(k+1)x^2 - 6(k+1)x + 3(k+9) = 0$, $k \neq -1$ has real and equal roots.

OR

(b) The age of a man is twice the square of the age of his son. Eight years hence, the age of the man will be 4 years more than three times the age of his son. Find their present ages.

SOLUTION

(a) Real and equal roots need $D = 0$: $36(k+1)^2 - 4(k+1) \times 3(k+9) = 0$.

$12(k+1)[3(k+1) - (k+9)] = 0$, that is $12(k+1)(2k-6) = 0$. As $k \neq -1$, $2k-6 = 0$ and $k = 3$.

(b) Let the son's age be x years. The man's age is $2x^2$.

Eight years later: $2x^2 + 8 = 3(x+8) + 4$, so $2x^2 - 3x - 20 = 0$ and $(2x+5)(x-4) = 0$.

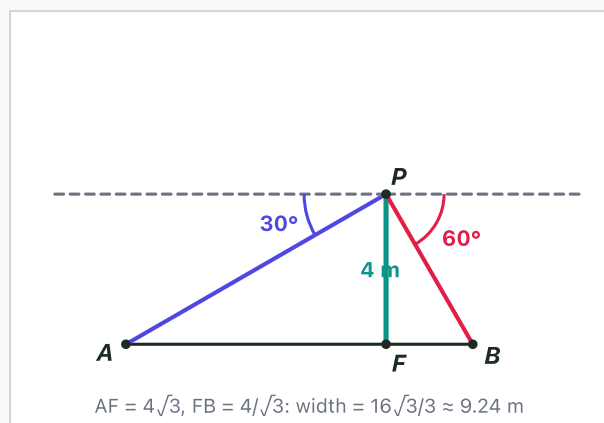
Age is positive, so $x = 4$. The son is 4 years old and the man is $2 \times 16 = 32$ years old.

Answer: (a) $k = 3$ (b) son 4 years, man 32 years

Q33 · APPLICATIONS OF TRIGONOMETRY · 5 MARKS

From a point on a bridge across the river, the angles of depressions of the banks on opposite sides of the river are 30° and 60° respectively. If the bridge is at a height of 4 m from the banks, find the width of the river.

SOLUTION



Let P be the point on the bridge, $PF = 4$ m, and let the banks be A and B , with $\angle$ of depression 30° to A and 60° to B .

In $\triangle PFA$: $\tan 30^\circ = \frac{4}{AF} = \frac{1}{\sqrt{3}}$, so $AF = 4\sqrt{3}$ m.

In $\triangle PFB$: $\tan 60^\circ = \frac{4}{FB} = \sqrt{3}$, so $FB = \frac{4}{\sqrt{3}}$ m.

Width of the river = $AF + FB = 4\sqrt{3} + \frac{4}{\sqrt{3}} = \frac{12 + 4}{\sqrt{3}} = \frac{16}{\sqrt{3}} = \frac{16\sqrt{3}}{3}$ m ≈ 9.24 m.

Answer: $\frac{16\sqrt{3}}{3}$ m ≈ 9.24 m

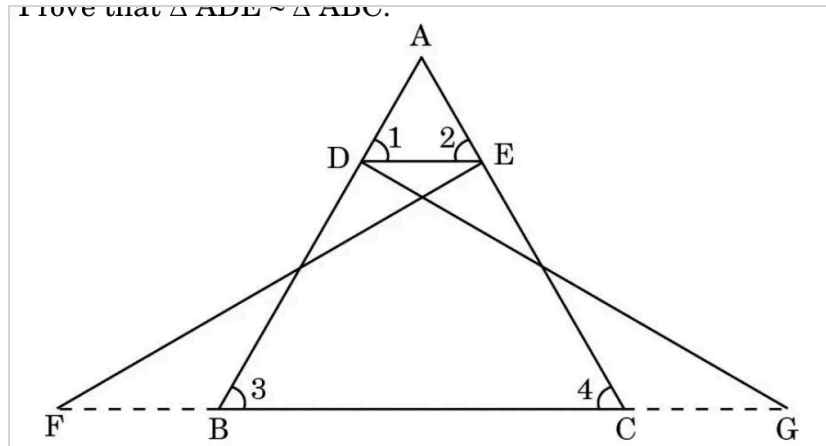
Q34 · TRIANGLES · 5 MARKS

(a) In the given figure, $\triangle FEC \cong \triangle GDB$ and $\angle 1 = \angle 2$. Prove that $\triangle ADE \sim \triangle ABC$.

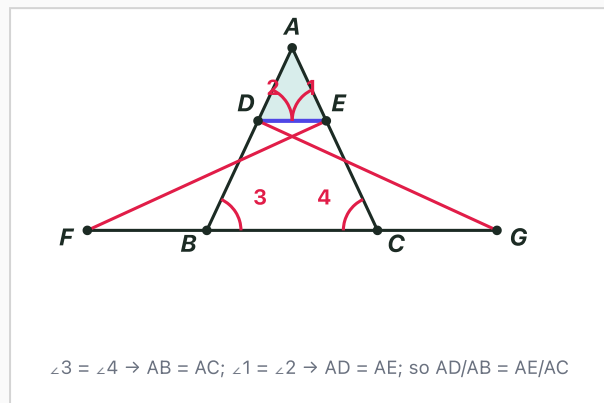
OR

(b) Sides AB and AC and median AD of a $\triangle ABC$ are respectively proportional to sides PQ and PR and median PM of another $\triangle PQR$. Show that $\triangle ABC \sim \triangle PQR$.

PROVE THAT $\triangle ADE \sim \triangle ABC$.



SOLUTION



(a) $\triangle FEC \cong \triangle GDB$, so their corresponding angles are equal: $\angle 3 = \angle 4$ (at B and C).

In $\triangle ABC$, $\angle 3 = \angle 4$, so $AB = AC$ (i) In $\triangle ADE$, $\angle 1 = \angle 2$, so $AD = AE$ (ii)

Divide (ii) by (i): $\frac{AD}{AB} = \frac{AE}{AC}$. By the converse of the Basic Proportionality Theorem, $DE \parallel BC$.

So $\angle 1 = \angle 3$ and $\angle 2 = \angle 4$ (corresponding angles), and $\triangle ADE \sim \triangle ABC$ (AA).

(b) Produce AD to E so that $AD = DE$ and join EC . Produce PM to L so that $PM = ML$ and join LR . $\triangle ABD \cong \triangle ECD$ (SAS), so $AB = EC$. Similarly $PQ = LR$.

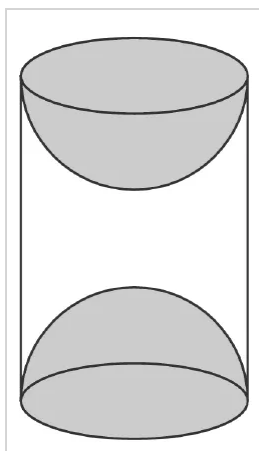
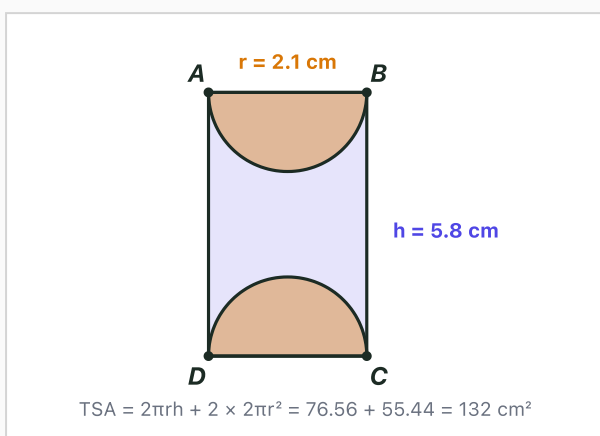
Given $\frac{AB}{PQ} = \frac{AC}{PR} = \frac{AD}{PM}$, we get $\frac{EC}{LR} = \frac{AC}{PR} = \frac{2AD}{2PM} = \frac{AE}{PL}$. So $\triangle AEC \sim \triangle PLR$ (SSS), giving $\angle 2 = \angle 4$ (as marked in the proof). Similarly $\angle 1 = \angle 3$.

Adding both: $\angle BAC = \angle QPR$. With $\frac{AB}{PQ} = \frac{AC}{PR}$, $\triangle ABC \sim \triangle PQR$ (SAS).

Answer: (a) $\triangle ADE \sim \triangle ABC$ (b) $\triangle ABC \sim \triangle PQR$

Q35 · SURFACE AREAS AND VOLUMES · 5 MARKS

A wooden article was made by scooping out a hemisphere from each end of a solid cylinder, as shown in the figure. If the height of the cylinder is 5.8 cm and its base is of radius 2.1 cm, find the total surface area of the article.

**SOLUTION**

After scooping, the flat ends are gone. The surface is the curved surface of the cylinder plus the curved surfaces of the two hemispherical hollows.

$$\text{Curved surface of the cylinder} = 2\pi rh = 2 \times \frac{22}{7} \times 2.1 \times 5.8 = 76.56 \text{ cm}^2.$$

$$\text{Two hemispheres: } 2 \times 2\pi r^2 = 4 \times \frac{22}{7} \times 2.1 \times 2.1 = 55.44 \text{ cm}^2.$$

$$\text{Total surface area} = 76.56 + 55.44 = 132 \text{ cm}^2.$$

Answer: 132 cm²

Common mistake: Adding the two flat circles of the cylinder. They are completely scooped out, so they are not part of the surface.

Section E: Case studies

3 case studies, 4 marks each.

Q36 · LINEAR EQUATIONS · 4 MARKS

Case study 1. Essel World is one of India's largest amusement parks that offers a diverse range of thrilling rides, water attractions and entertainment options for visitors of all ages. The park is known for its iconic "Water Kingdom" section, making it a popular destination for family outings and fun-filled adventure. The ticket charges for the park are ₹ 150 per child and ₹ 250 per adult. On a day, the cashier of the park found that 300 tickets were sold and an amount of ₹ 55,000 was collected.

Based on the above, answer the following questions:

(i) If the number of children visited be x and the number of adults visited be y , then write the given situation algebraically. [1]

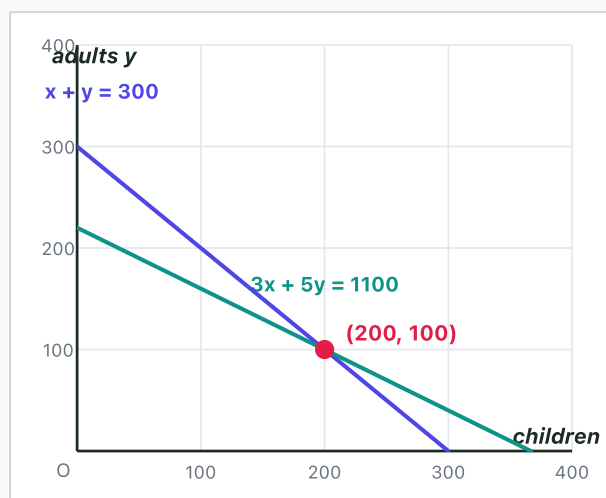
(ii) (a) How many children visited the amusement park that day? [2]

OR

(ii) (b) How many adults visited the amusement park that day? [2]

(iii) How much amount will be collected if 250 children and 100 adults visit the amusement park? [1]

Figure: A photo of a roller coaster ride at an amusement park.

SOLUTION

(i) Total tickets: $x + y = 300$ (i) Total money: $150x + 250y = 55000$, that is $3x + 5y = 1100$ (ii)

(ii)(a) From (i), $y = 300 - x$. Put in (ii): $3x + 5(300 - x) = 1100$, so $3x + 1500 - 5x = 1100$, $-2x = -400$ and $x = 200$. 200 children visited.

(ii)(b) $y = 300 - 200 = 100$. 100 adults visited.

(iii) $250 \times 150 + 100 \times 250 = 37500 + 25000 = ₹62,500$.

Answer: (i) $x + y = 300$, $150x + 250y = 55000$ (ii)(a) 200 (ii)(b) 100 (iii) ₹ 62,500

Q37 · COORDINATE GEOMETRY · 4 MARKS

Case study 2. A garden is in the shape of a square. The gardener grew saplings of Ashoka tree on the boundary of the garden at the distance of 1 m from each other. He wants to decorate the garden with rose plants. He chose a triangular region inside the garden to grow rose plants. In the above situation, the gardener took help from the students of class 10. They made a chart for it which looks like the given figure.

Based on the above, answer the following questions:

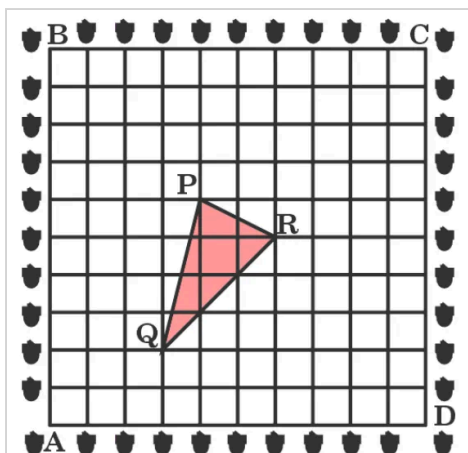
(i) If A is taken as origin, what are the coordinates of the vertices of ΔPQR ? [1]

(ii) (a) Find distances PQ and QR. [2]

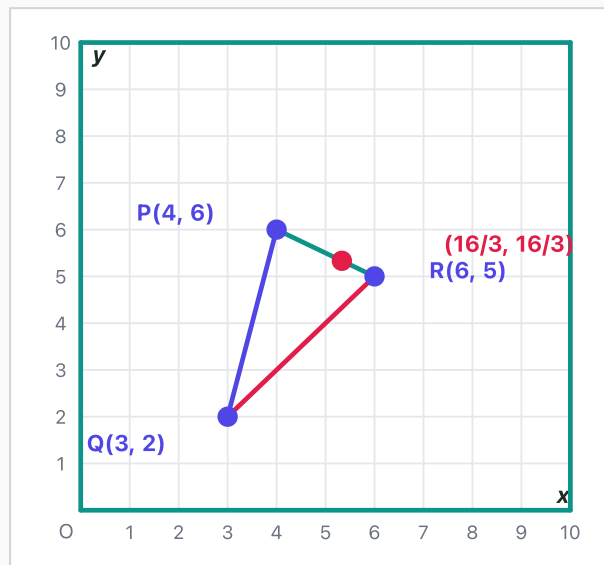
OR

(ii) (b) Find the coordinates of the point which divides the line segment joining points P and R in the ratio 2 : 1 internally. [2]

(iii) Find out if ΔPQR is an isosceles triangle. [1]



SOLUTION



(i) With A as the origin and the grid squares of side 1 m, reading off the grid: $P = (4, 6)$, $Q = (3, 2)$, $R = (6, 5)$.

(ii)(a) $PQ = \sqrt{(4-3)^2 + (6-2)^2} = \sqrt{17}$ and $QR = \sqrt{(3-6)^2 + (2-5)^2} = \sqrt{18} = 3\sqrt{2}$.

(ii)(b) Section formula for P to R in the ratio 2 : 1: $x = \frac{2 \times 6 + 1 \times 4}{3} = \frac{16}{3}$ and $y = \frac{2 \times 5 + 1 \times 6}{3} = \frac{16}{3}$. The point is $\left(\frac{16}{3}, \frac{16}{3}\right)$.

(iii) $PQ = \sqrt{17}$, $QR = \sqrt{18}$ and $PR = \sqrt{(4-6)^2 + (6-5)^2} = \sqrt{5}$. No two sides are equal, so ΔPQR is not isosceles.

Answer: (i) $P(4, 6)$, $Q(3, 2)$, $R(6, 5)$ (ii)(a) $\sqrt{17}$ and $\sqrt{18}$ (ii)(b) $\left(\frac{16}{3}, \frac{16}{3}\right)$ (iii) not isosceles

Common mistake: In (ii)(b), swapping the ratio. For 2 : 1 from P, the weight 2 goes with the coordinates of R.

Q38 · STATISTICS · 4 MARKS

Case study 3. Activities like running or cycling reduce stress and the risk of mental disorders like depression. Running helps build endurance. Children develop stronger bones and muscles and are less prone to gain weight. The physical education teacher of a school has decided to conduct an inter school running tournament in his school premises. The time taken by a group of students to run 100 m, was noted as follows:

Based on the above, answer the following questions:

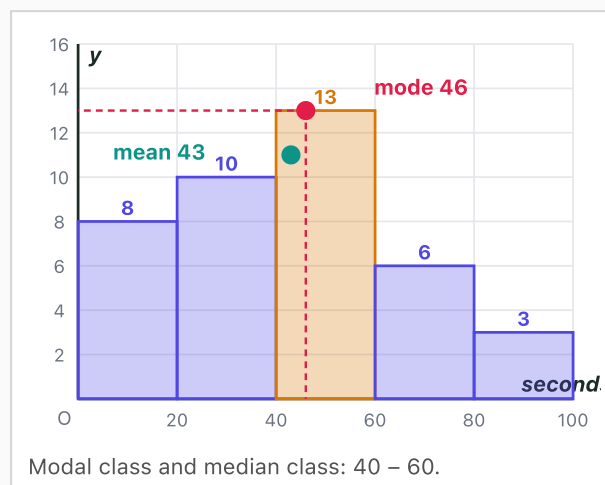
- (i) What is the median class of the above given data? [1]
(ii) (a) Find the mean time taken by the students to finish the race. [2]

OR

- (ii) (b) Find the mode of the above given data. [2]
(iii) How many students took time less than 60 seconds? [1]

Time (in seconds)	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100
Number of students	8	10	13	6	3

SOLUTION



Cumulative frequencies: 8, 18, 31, 37, 40. $N = 40$ and $\frac{N}{2} = 20$.

(i) The first cumulative frequency above 20 is 31, so the median class is 40 – 60.

(ii)(a) Class marks x_i : 10, 30, 50, 70, 90. $f_i x_i$: 80, 300, 650, 420, 270. $\sum f_i x_i = 1720$. Mean = $\frac{1720}{40} = 43$ seconds.

(ii)(b) Modal class 40 – 60: $l = 40$, $f_1 = 13$, $f_0 = 10$, $f_2 = 6$, $h = 20$. Mode = $40 + \frac{13 - 10}{26 - 10 - 6} \times 20 = 40 + \frac{3}{10} \times 20 = 46$ seconds.

(iii) Time less than 60 seconds: $8 + 10 + 13 = 31$ students.

Answer: (i) 40 – 60 (ii)(a) 43 s (ii)(b) 46 s (iii) 31

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