

Mathematics (Basic) 2023, Set 430/1/1

Q.P. Code 430/1/1 · Series WX1YZ/1 · 80 marks · 3 hours · March 2023. Questions are from the official CBSE paper. Step-by-step solutions are written by CogniGuru and checked against CBSE's published answer key. Where the key itself disagrees with the arithmetic, the solution says so.

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Section A: Multiple choice

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

Q1 · REAL NUMBERS · 1 MARK

The prime factorisation of natural number 288 is:

(A) $2^4 \times 3^3$

(B) $2^4 \times 3^2$

(C) $2^5 \times 3^2$

(D) $2^5 \times 3^1$

SOLUTION

$$288 = 2 \times 144 = 2 \times 2^4 \times 3^2 = 2^5 \times 3^2. \text{ (Check: } 32 \times 9 = 288 \checkmark.)$$

Answer: (C) $2^5 \times 3^2$

Q2 · TRIGONOMETRY · 1 MARK

If $2 \cos \theta = 1$, then the value of θ is:

(A) 45°

(B) 60°

(C) 30°

(D) 90°

SOLUTION

$$\cos \theta = \frac{1}{2}, \text{ so } \theta = 60^\circ.$$

Answer: (B) 60°

Q3 · PROBABILITY · 1 MARK

A card is drawn at random from a well-shuffled deck of 52 cards. The probability of getting a red card is:

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

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

(C) $\frac{1}{4}$

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

SOLUTION

$$\text{There are 26 red cards out of 52: } P = \frac{26}{52} = \frac{1}{2}.$$

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

Q4 · QUADRATIC EQUATIONS · 1 MARK

The discriminant of the quadratic equation $2x^2 - 5x - 3 = 0$ is:

- (A) 1 (B) 49
(C) 7 (D) 19

SOLUTION

$$D = (-5)^2 - 4(2)(-3) = 25 + 24 = 49.$$

Answer: (B) 49

Q5 · COORDINATE GEOMETRY · 1 MARK

The distance between the points $(3, 0)$ and $(0, -3)$ is:

- (A) $2\sqrt{3}$ units (B) 6 units
(C) 3 units (D) $3\sqrt{2}$ units

SOLUTION

$$d = \sqrt{3^2 + 3^2} = \sqrt{18} = 3\sqrt{2} \text{ units.}$$

Answer: (D) $3\sqrt{2}$ units

Q6 · ARITHMETIC PROGRESSIONS · 1 MARK

The seventh term of an A.P. whose first term is 28 and common difference -4 , is:

- (A) 0 (B) 4
(C) 52 (D) 56

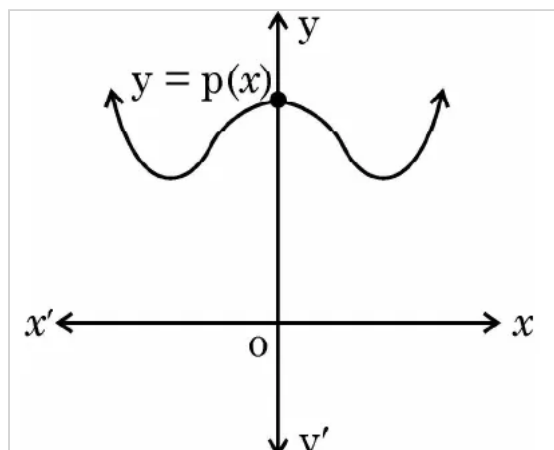
SOLUTION

$$a_7 = 28 + 6(-4) = 4.$$

Answer: (B) 4

Q7 · POLYNOMIALS · 1 MARK

The graph of $y = p(x)$ is shown in the figure for some polynomial $p(x)$. The number of zeroes of $p(x)$ is/are:



- (A) 0 (B) 1
(C) 2 (D) 3

SOLUTION

The zeroes are where the graph meets the x -axis. This curve lies above the x -axis and never touches it, so there are 0 zeroes.

Answer: (A) 0

Q8 · TRIANGLES · 1 MARK

The sides of two similar triangles are in the ratio 4 : 7. The ratio of their perimeters is:

- (A) 4 : 7 (B) 12 : 21
(C) 16 : 49 (D) 7 : 4

SOLUTION

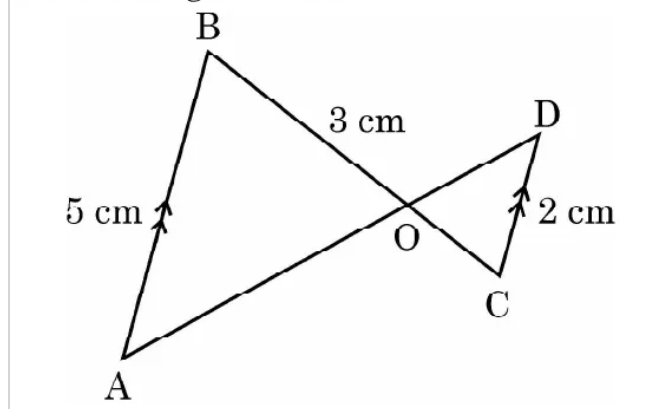
The perimeters of similar triangles are in the same ratio as the sides: 4 : 7. (The areas would be in the ratio 16 : 49.)

Answer: (A) 4 : 7

Q9 · TRIANGLES · 1 MARK

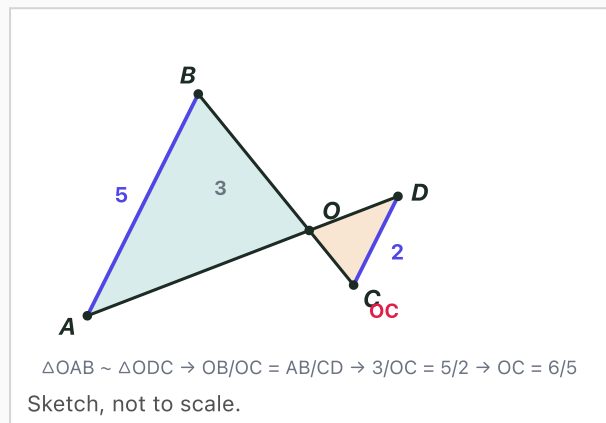
In the given figure, $AB \parallel CD$. If $AB = 5$ cm, $CD = 2$ cm and $OB = 3$ cm, then the length of OC is:

then the length of OC is



- (A) $\frac{15}{2}$ cm (B) $\frac{10}{3}$ cm
(C) $\frac{6}{5}$ cm (D) $\frac{3}{5}$ cm

SOLUTION



$AB \parallel CD$, so $\triangle OAB \sim \triangle ODC$ (vertically opposite angles and alternate angles).

$$\frac{OB}{OC} = \frac{AB}{CD}; \frac{3}{OC} = \frac{5}{2}, \text{ so } OC = \frac{6}{5} \text{ cm.}$$

Answer: (C) $\frac{6}{5}$ cm

Q10 · POLYNOMIALS · 1 MARK

The sum and the product of zeroes of the polynomial $p(x) = x^2 + 5x + 6$ are respectively:

- (A) 5, -6 (B) -5, 6
(C) 2, 3 (D) -2, -3

SOLUTION

Sum = $-\frac{b}{a} = -5$ and product = $\frac{c}{a} = 6$. (The zeroes are -2 and -3.)

Answer: (B) -5, 6

Q11 · PROBABILITY · 1 MARK

A die is thrown once. Find the probability of getting a number less than 7.

- (A) $\frac{5}{6}$ (B) 1
(C) $\frac{1}{6}$ (D) 0

SOLUTION

Every number on a die (1 to 6) is less than 7, so it is a sure event: $P = 1$.

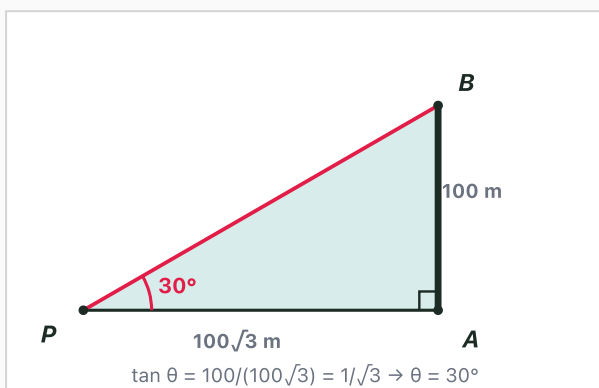
Answer: (B) 1

Q12 · TRIGONOMETRY · 1 MARK

The angle subtended by a vertical pole of height 100 m at a point on the ground $100\sqrt{3}$ m from the base, has measure of:

- (A) 90° (B) 60°
(C) 45° (D) 30°

SOLUTION



$$\tan \theta = \frac{100}{100\sqrt{3}} = \frac{1}{\sqrt{3}}, \text{ so } \theta = 30^\circ.$$

Answer: (D) 30°

Q13 · SURFACE AREAS AND VOLUMES · 1 MARK

The volume of a cone of radius ' r ' and height ' $3r$ ' is:

- (A) $\frac{1}{3}\pi r^3$ (B) $3\pi r^3$
(C) $9\pi r^3$ (D) πr^3

SOLUTION

$$V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi r^2 (3r) = \pi r^3.$$

Answer: (D) πr^3

Q14 · CIRCLES · 1 MARK

The distance between two parallel tangents of a circle of diameter 7 cm is:

- (A) 7 cm (B) 14 cm
(C) $\frac{7}{2}$ cm (D) 28 cm

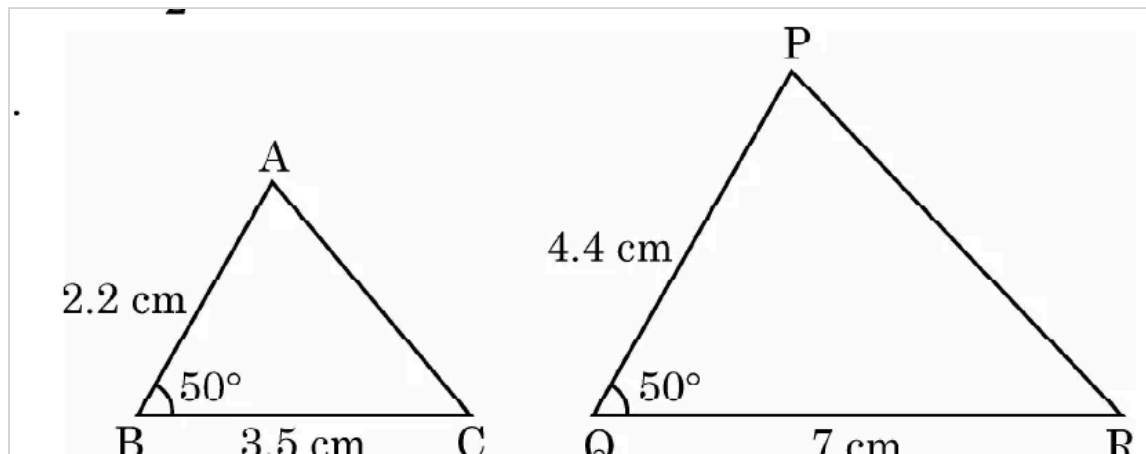
SOLUTION

Two parallel tangents touch the circle at the two ends of a diameter, so the distance between them is the diameter, 7 cm.

Answer: (A) 7 cm

Q15 · TRIANGLES · 1 MARK

In the above figure, the criterion of similarity by which $\triangle ABC \sim \triangle PQR$ is:



- (A) SSA (Side – Side – Angle) Similarity (B) ASA (Angle – Side – Angle) Similarity
(C) SAS (Side – Angle – Side) Similarity (D) AA (Angle – Angle) Similarity

SOLUTION

$\frac{AB}{PQ} = \frac{2.2}{4.4} = \frac{1}{2}$ and $\frac{BC}{QR} = \frac{3.5}{7} = \frac{1}{2}$; two sides in proportion, with the included angles $\angle B = \angle Q = 50^\circ$ equal. That is SAS similarity.

Answer: (C) SAS (Side – Angle – Side) Similarity

Q16 · LINEAR EQUATIONS · 1 MARK

The larger of two supplementary angles exceeds the smaller by 18 degrees. What is the measure of larger angle?

- (A) 81° (B) 99°
(C) 36° (D) 54°

SOLUTION

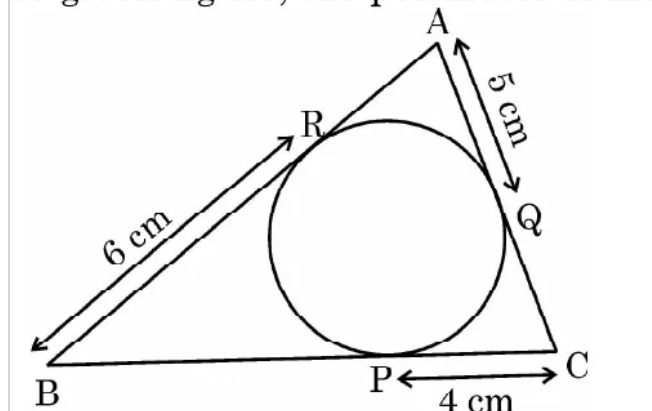
$x + y = 180$ and $x - y = 18$ give $x = 99$ and $y = 81$. The larger angle is 99° .

Answer: (B) 99°

Q17 · CIRCLES · 1 MARK

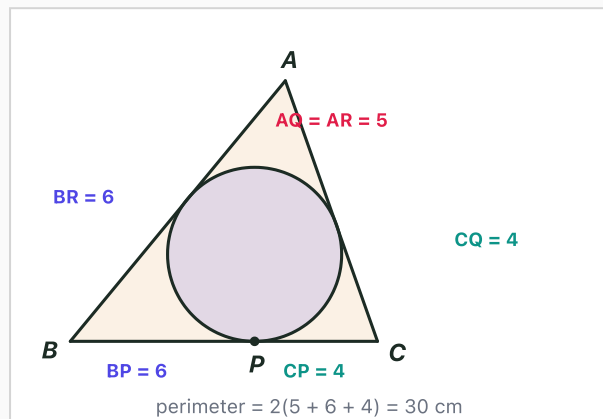
In the given figure, the perimeter of $\triangle ABC$ is:

he given figure, the perimeter of $\triangle A$



- (A) 30 cm (B) 15 cm
(C) 45 cm (D) 60 cm

SOLUTION



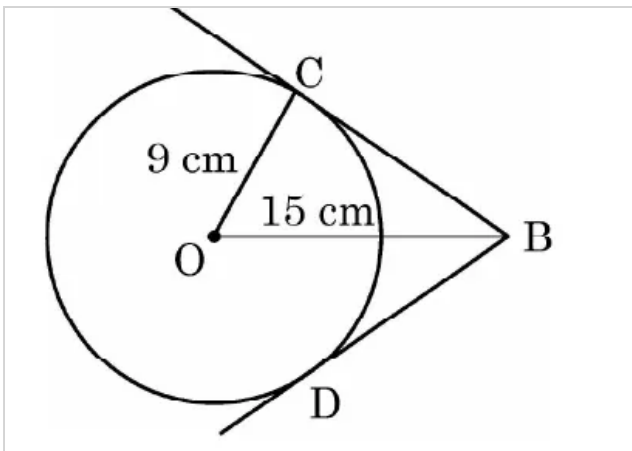
Tangents from a point to a circle are equal: $BP = BR = 6$, $AR = AQ = 5$ and $CP = CQ = 4$.

The perimeter is $2(6 + 5 + 4) = 30$ cm.

Answer: (A) 30 cm

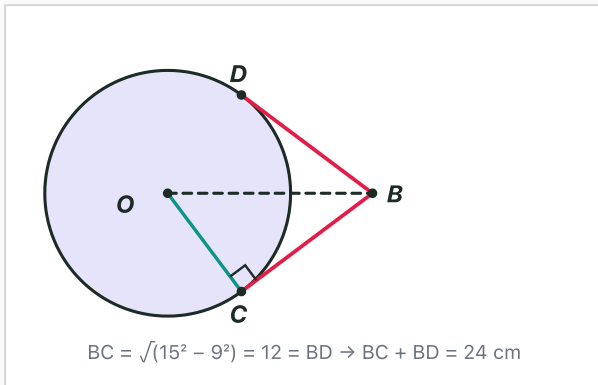
Q18 · CIRCLES · 1 MARK

In the given figure, BC and BD are tangents to the circle with centre O and radius 9 cm. If $OB = 15$ cm, then the length $(BC + BD)$ is:



- (A) 18 cm (B) 12 cm
(C) 24 cm (D) 36 cm

SOLUTION



$OC \perp BC$, so $BC = \sqrt{15^2 - 9^2} = \sqrt{144} = 12$ cm. $BD = BC = 12$ cm (equal tangents), so $BC + BD = 24$ cm.

Answer: (C) 24 cm

Q19 · CIRCLES · 1 MARK

Assertion (A): A tangent to a circle is perpendicular to the radius through the point of contact.

Reason (R): The lengths of tangents drawn from the external point to a circle are 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) This is the standard tangent–radius theorem. True. (R) Equal tangent lengths from an external point. True.

But (R) is a different theorem and does not explain (A); the perpendicularity comes from the radius being the shortest distance from the centre to the tangent line.

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

Q20 · LINEAR EQUATIONS · 1 MARK

Assertion (A): The system of linear equations $3x + 5y - 4 = 0$ and $15x + 25y - 25 = 0$ is inconsistent.

Reason (R): The pair of linear equations $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ is inconsistent if $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$.

(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) Parallel lines (no solution) need equal first two ratios and a different third ratio. True.

(A) $\frac{3}{15} = \frac{1}{5}$, $\frac{5}{25} = \frac{1}{5}$ and $\frac{-4}{-25} = \frac{4}{25} \neq \frac{1}{5}$. So the lines are parallel and the system is inconsistent, exactly by the rule in (R). True.

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

Section B: Very short answer

5 questions, 2 marks each.

Q21 · COORDINATE GEOMETRY · 2 MARKS

(a) Find the coordinates of the point which divides the line segment joining the points $(7, -1)$ and $(-3, 4)$ internally in the ratio $2 : 3$.

OR

(b) Find the value(s) of y for which the distance between the points $A(3, -1)$ and $B(11, y)$ is 10 units.

SOLUTION

(a) $x = \frac{2(-3) + 3(7)}{5} = \frac{15}{5} = 3$ and $y = \frac{2(4) + 3(-1)}{5} = \frac{5}{5} = 1$. The point is $(3, 1)$.

(b) $AB^2 = 100$: $(11 - 3)^2 + (y + 1)^2 = 100$, so $(y + 1)^2 = 36$ and $y + 1 = \pm 6$, giving $y = 5$ or $y = -7$.

Answer: (a) $(3, 1)$ (b) $y = 5$ or -7

Q22 · TRIGONOMETRY · 2 MARKS

Evaluate: $\tan^2 60^\circ - 2 \operatorname{cosec}^2 30^\circ - 2 \tan^2 30^\circ$.

SOLUTION

$$(\sqrt{3})^2 - 2(2)^2 - 2\left(\frac{1}{\sqrt{3}}\right)^2 = 3 - 8 - \frac{2}{3} = -\frac{17}{3}.$$

Answer: $-\frac{17}{3}$

Q23 · REAL NUMBERS · 2 MARKS

Find the LCM and HCF of 92 and 510, using prime factorisation.

SOLUTION

$$92 = 2^2 \times 23 \text{ and } 510 = 2 \times 3 \times 5 \times 17.$$

$$\text{HCF} = 2 \text{ and } \text{LCM} = 2^2 \times 3 \times 5 \times 17 \times 23 = 23460. \text{ (Check: } 2 \times 23460 = 46920 = 92 \times 510 \checkmark.)$$

Answer: HCF = 2, LCM = 23460

Q24 · LINEAR EQUATIONS · 2 MARKS

(a) Solve for x and y : $x + y = 6$, $2x - 3y = 4$.

OR

(b) Find out whether the following pair of linear equations are consistent or inconsistent: $5x - 3y = 11$, $-10x + 6y = 22$.

SOLUTION

(a) From the first, $y = 6 - x$. Then $2x - 18 + 3x = 4$ gives $5x = 22$, so $x = \frac{22}{5}$ and $y = \frac{8}{5}$.

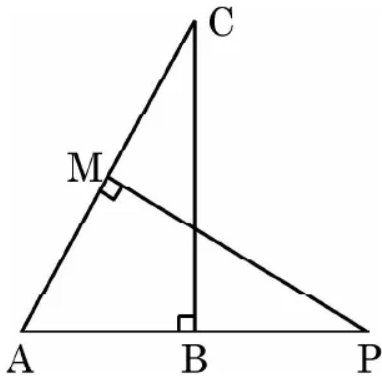
(b) $\frac{a_1}{a_2} = \frac{5}{-10} = -\frac{1}{2}$, $\frac{b_1}{b_2} = \frac{-3}{6} = -\frac{1}{2}$ and $\frac{c_1}{c_2} = \frac{-11}{-22} = \frac{1}{2}$ (writing both as $ax + by + c = 0$) = $\frac{1}{2}$. The first two are equal and the third differs: the lines are parallel and the pair is inconsistent.

Answer: (a) $x = \frac{22}{5}$, $y = \frac{8}{5}$ (b) inconsistent

Q25 · TRIANGLES · 2 MARKS

In the given figure, ABC and AMP are two right triangles, right angled at B and M , respectively. Prove that $\triangle ABC \sim \triangle AMP$.

. Prove that $\triangle ABC \sim \triangle AMP$.



SOLUTION

In $\triangle ABC$ and $\triangle AMP$: $\angle ABC = \angle AMP = 90^\circ$ (given) and $\angle BAC = \angle MAP$ (common angle).

By AA similarity, $\triangle ABC \sim \triangle AMP$.

Answer: Proved

Section C: Short answer

6 questions, 3 marks each.

Q26 · TRIGONOMETRY · 3 MARKS

(a) Prove that $\sec \theta(1 - \sin \theta)(\sec \theta + \tan \theta) = 1$.

OR

(b) Prove that $\frac{1 + \sec \theta}{\sec \theta} = \frac{\sin^2 \theta}{1 - \cos \theta}$.

SOLUTION

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

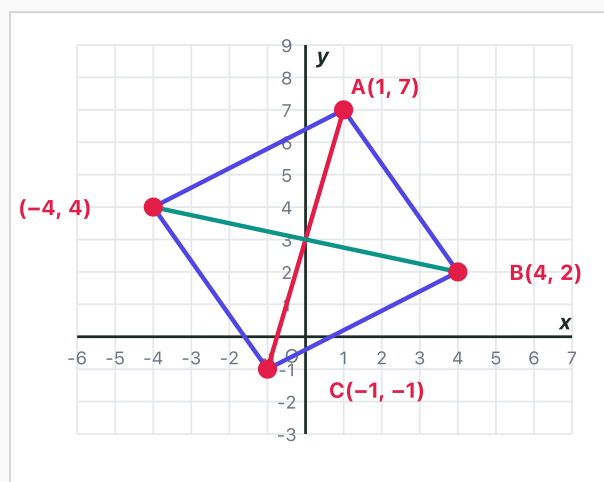
$$(b) \text{ LHS} = \frac{1 + \frac{1}{\cos \theta}}{\frac{1}{\cos \theta}} = \cos \theta + 1. \text{ Multiply and divide by } (1 - \cos \theta): \frac{(1 + \cos \theta)(1 - \cos \theta)}{1 - \cos \theta} = \frac{1 - \cos^2 \theta}{1 - \cos \theta} = \frac{\sin^2 \theta}{1 - \cos \theta} = \text{RHS.}$$

Answer: Proved (both parts)

Q27 · COORDINATE GEOMETRY · 3 MARKS

Show that the points $A(1, 7)$, $B(4, 2)$, $C(-1, -1)$ and $D(-4, 4)$ are vertices of the square $ABCD$.

SOLUTION



$$AB = \sqrt{(4-1)^2 + (2-7)^2} = \sqrt{34}, BC = \sqrt{(4+1)^2 + (2+1)^2} = \sqrt{34}, CD = \sqrt{(-4+1)^2 + (4+1)^2} = \sqrt{34} \text{ and } DA = \sqrt{(-4-1)^2 + (4-7)^2} = \sqrt{34}. \text{ All four sides are equal.}$$

$$\text{Diagonals: } AC = \sqrt{(1+1)^2 + (7+1)^2} = \sqrt{68} \text{ and } BD = \sqrt{(4+4)^2 + (2-4)^2} = \sqrt{68}. \text{ They are equal.}$$

A quadrilateral with four equal sides and equal diagonals is a square.

Answer: Shown

Q28 · CIRCLES · 3 MARKS

Prove that the tangents drawn from an external point to a circle are equal in length.

SOLUTION

****Given:**** a circle with centre O and tangents PQ and PR from the external point P . ****To prove:**** $PQ = PR$.

****Construction:**** join OP , OQ , OR .

In $\triangle OPQ$ and $\triangle OPR$: OP is common, $OQ = OR$ (radii) and $\angle OQP = \angle ORP = 90^\circ$ (radius and tangent).

So $\triangle OPQ \cong \triangle OPR$ (RHS) and $PQ = PR$ by CPCT.

Answer: Proved

Q29 · POLYNOMIALS · 3 MARKS

If α, β are zeroes of the quadratic polynomial $x^2 + 3x + 2$, find a quadratic polynomial whose zeroes are $\alpha + 1, \beta + 1$.

SOLUTION

$$\alpha + \beta = -3 \text{ and } \alpha\beta = 2.$$

$$\text{New sum} = (\alpha + 1) + (\beta + 1) = \alpha + \beta + 2 = -1. \text{ New product} = (\alpha + 1)(\beta + 1) = \alpha\beta + (\alpha + \beta) + 1 = 2 - 3 + 1 = 0.$$

The polynomial is $x^2 + x$ (or $k(x^2 + x)$). (Check: the zeroes of $x^2 + 3x + 2$ are -1 and -2 , so the new zeroes are 0 and -1 ✓.)

Answer: $x^2 + x$

Q30 · REAL NUMBERS · 3 MARKS

Prove that $3 + 7\sqrt{2}$ is an irrational number, given that $\sqrt{2}$ is an irrational number.

SOLUTION

Suppose $3 + 7\sqrt{2} = \frac{p}{q}$ with integers p, q and $q \neq 0$. Then $\sqrt{2} = \frac{p - 3q}{7q}$, a rational number.

This contradicts the given fact that $\sqrt{2}$ is irrational. So $3 + 7\sqrt{2}$ is irrational.

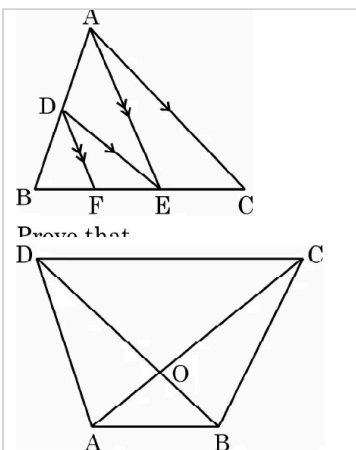
Answer: Proved

Q31 · TRIANGLES · 3 MARKS

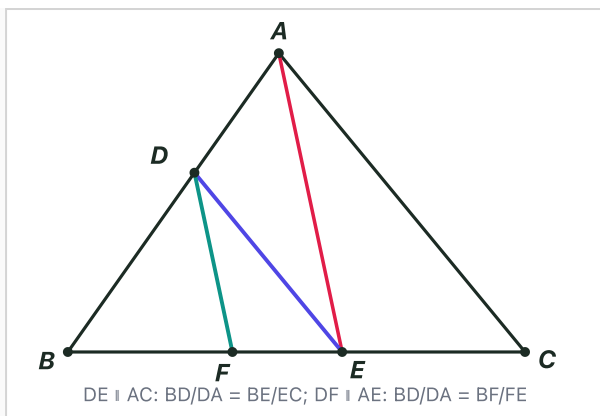
(a) In the given figure, $DE \parallel AC$ and $DF \parallel AE$. Prove that $\frac{BF}{FE} = \frac{BE}{EC}$.

OR

(b) The diagonals of a quadrilateral $ABCD$ intersect each other at the point O such that $\frac{AO}{BO} = \frac{CO}{OD}$. Show that quadrilateral $ABCD$ is a trapezium.



SOLUTION



(a) In $\triangle ABE$, $DF \parallel AE$, so by the basic proportionality theorem $\frac{BD}{DA} = \frac{BF}{FE}$. (i)

In $\triangle ABC$, $DE \parallel AC$, so $\frac{BD}{DA} = \frac{BE}{EC}$. (ii) From (i) and (ii): $\frac{BF}{FE} = \frac{BE}{EC}$.

(b) $\frac{AO}{BO} = \frac{CO}{OD}$ gives $\frac{OA}{OC} = \frac{OB}{OD}$, and $\angle AOB = \angle COD$ (vertically opposite angles). By SAS, $\triangle AOB \sim \triangle COD$.

So $\angle CAB = \angle ACD$, which are alternate interior angles for AB and CD with the transversal AC . Hence $AB \parallel CD$, and $ABCD$ is a trapezium.

Answer: Proved (both parts)

Section D: Long answer

4 questions, 5 marks each.

Q32 · QUADRATIC EQUATIONS · 5 MARKS

(a) The diagonal of a rectangular field is 60 m more than the shorter side. If the longer side is 80 m more than the shorter side, find the length of the sides of the field.

OR

(b) The sum of the ages of a father and his son is 45 years. Five years ago, the product of their ages (in years) was 124. Determine their present ages.

SOLUTION

(a) ****This question is flawed.**** Let the shorter side be x . The longer side is $x + 80$ and the diagonal is $x + 60$. But a diagonal is always longer than either side, so the diagonal $x + 60$ cannot be shorter than the side $x + 80$. No such rectangle exists. CBSE's marking scheme notes the error and awards full marks to everyone who attempted it.

(b) Let the father be x years old, so the son is $(45 - x)$ years old. Five years ago: $(x - 5)(40 - x) = 124$.

$-x^2 + 45x - 200 = 124$ gives $x^2 - 45x + 324 = 0$, so $(x - 36)(x - 9) = 0$. $x = 9$ is rejected (the father cannot be 9), so $x = 36$.

The father is 36 years old and the son is 9 years old. (Check: five years ago $31 \times 4 = 124$ ✓.)

Answer: (a) no such rectangle (flawed question) (b) father 36 years, son 9 years

Q33 · SURFACE AREAS AND VOLUMES · 5 MARKS

A vessel is in the form of a hemispherical bowl surmounted by a hollow cylinder of same diameter. The diameter of the hemispherical bowl is 14 cm and the total height of the vessel is 13 cm. Find the inner surface area of the vessel. Also, find the volume of the vessel.

SOLUTION

Radius $r = 7$ cm. The height of the cylinder is $13 - 7 = 6$ cm.

$$\text{Inner surface area} = 2\pi rh + 2\pi r^2 = 2\pi r(h + r) = 2 \times \frac{22}{7} \times 7 \times 13 = 44 \times 13 = 572 \text{ cm}^2.$$

$$\text{Volume} = \pi r^2 h + \frac{2}{3}\pi r^3 = \pi r^2 \left(h + \frac{2r}{3} \right) = \frac{22}{7} \times 49 \times \left(6 + \frac{14}{3} \right) = 154 \times \frac{32}{3} = \frac{4928}{3} \approx 1642.67 \text{ cm}^3.$$

Answer: Inner surface area = 572 cm²; volume = $\frac{4928}{3} \approx 1642.67 \text{ cm}^3$

Q34 · STATISTICS · 5 MARKS

The table given below shows the daily expenditure on food of 25 households in a locality:

Find the mean daily expenditure on food. Also, find the mode of the data.

Daily expenditure (₹)	100–150	150–200	200–250	250–300	300–350
Number of households	4	5	12	2	2

SOLUTION

Class marks: 125, 175, 225, 275, 325. $\sum f_i x_i = 4(125) + 5(175) + 12(225) + 2(275) + 2(325) = 500 + 875 + 2700 + 550 + 650 = 5275$.

$$\text{Mean} = \frac{5275}{25} = 211.$$

The modal class is 200 – 250 (frequency 12): $l = 200$, $f_1 = 12$, $f_0 = 5$, $f_2 = 2$, $h = 50$. Mode = $200 + \frac{12 - 5}{24 - 5 - 2} \times 50 = 200 + \frac{350}{17} = \frac{3750}{17} \approx 220.59$.

Answer: Mean = ₹211; mode $\approx$ ₹220.59

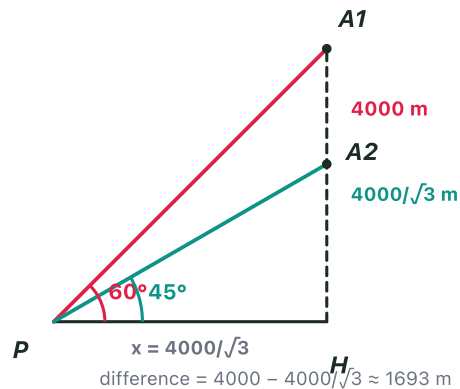
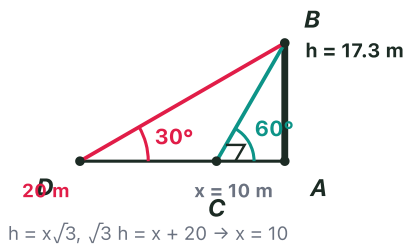
Q35 · TRIGONOMETRY · 5 MARKS

(a) A TV tower stands vertically on the bank of a canal. From a point on the other bank directly opposite the tower, the angle of elevation of the top of the tower is 60° . From another point 20 m away from this point on the line joining this point to the foot of the tower, the angle of elevation of the top of the tower is 30° . Find the height of the tower.

OR

(b) An aeroplane when flying at a height of 4000 m from the ground passes vertically above another aeroplane at an instant when the angles of elevation of the two planes from the same point on the ground are 60° and 45° respectively. Find the vertical distance between the aeroplanes at that instant. (Use $\sqrt{3} = 1.73$)

SOLUTION



(a) Let the tower be $AB = h$, the nearer point C with $AC = x$, and the farther point D with $CD = 20$. $\tan 60^\circ = \frac{h}{x}$ gives $h = x\sqrt{3}$. $\tan 30^\circ = \frac{h}{x + 20}$ gives $\sqrt{3}h = x + 20$.

Substituting: $3x = x + 20$, so $x = 10$ and $h = 10\sqrt{3} \approx 17.3$ m.

(b) Let the higher plane be at 4000 m and the lower at height h , with the observation point at horizontal distance x from the common vertical. $\tan 60^\circ = \frac{4000}{x}$ gives $x = \frac{4000}{\sqrt{3}}$. $\tan 45^\circ = \frac{h}{x} = 1$ gives $h = x = \frac{4000}{\sqrt{3}}$.

The vertical distance = $4000 - \frac{4000}{\sqrt{3}} = 4000 \left(1 - \frac{\sqrt{3}}{3}\right) = 4000(1 - 0.577) \approx 1693.33$ m with $\sqrt{3} = 1.73$ in the form $\frac{\sqrt{3}}{3}$ (the exact value is about 1690.6 m).

Answer: (a) $10\sqrt{3} \approx 17.3$ m (b) about 1693.33 m

Section E: Case studies

3 case studies, 4 marks each.

Q36 · ARITHMETIC PROGRESSIONS · 4 MARKS

Case study 1. Aahana being a plant lover decides to convert her balcony into beautiful garden full of plants. She bought few plants with pots for her balcony. She placed the pots in such a way that number of pots in the first row is 2, second row is 5, third row is 8 and so on.

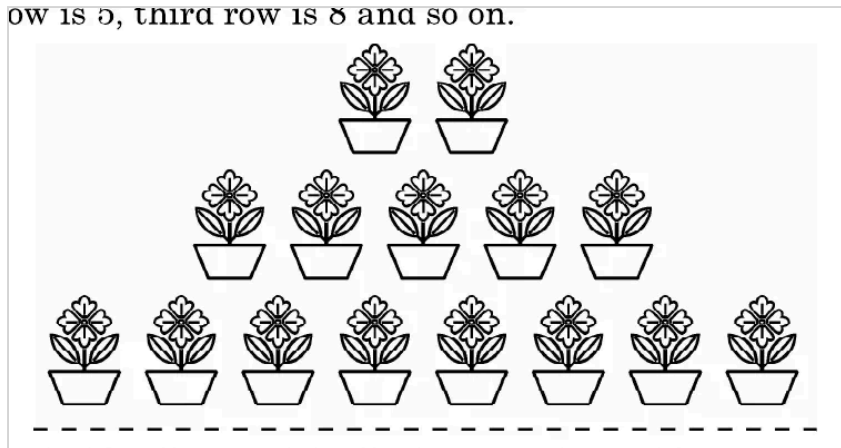
Based on the above information, answer the following questions:

- (i) Find the number of pots placed in the 10th row. [1]
- (ii) Find the difference in the number of pots placed in 5th row and 2nd row. [1]
- (iii) If Aahana wants to place 100 pots in total, then find the total number of rows formed in the arrangement. [2]

OR

- (iii) If Aahana has sufficient space for 12 rows, then how many total number of pots are placed by her with the same arrangement? [2]

ow is 5, third row is 8 and so on.

**SOLUTION**

The pots per row are 2, 5, 8, ..., an A.P. with $a = 2$ and $d = 3$.

(i) $a_{10} = 2 + 9 \times 3 = 29$.

(ii) $a_5 - a_2 = 3d = 9$.

(iii) $S_n = \frac{n}{2}[2(2) + (n-1)3] = 100$ gives $3n^2 + n - 200 = 0$, that is $(3n+25)(n-8) = 0$ and $n = 8$ (the root $-\frac{25}{3}$ is rejected): 8 rows.

(iii) OR: $S_{12} = \frac{12}{2}[2(2) + 11 \times 3] = 6 \times 37 = 222$ pots.

Answer: (i) 29 (ii) 9 (iii) 8 rows (OR) 222 pots

Q37 · AREAS RELATED TO CIRCLES · 4 MARKS

Case study 2. Interschool Rangoli Competition was organized by one of the reputed schools of Odisha. The theme of the Rangoli Competition was Diwali celebrations where students were supposed to make mathematical designs. Students from various schools participated and made beautiful Rangoli designs. One such design is given below. Rangoli is in the shape of square marked as ABCD, side of square being 40 cm. At each corner of a square, a quadrant of circle of radius 10 cm is drawn (in which diyas are kept). Also a circle of diameter 20 cm is drawn inside the square.

Based on the above information, answer the following questions:

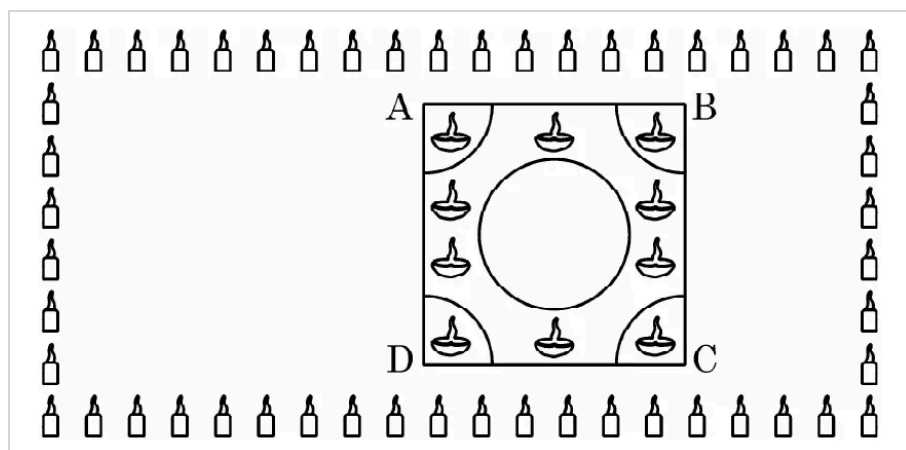
(i) What is the area of square ABCD? [1]

(ii) Find the area of the circle. [1]

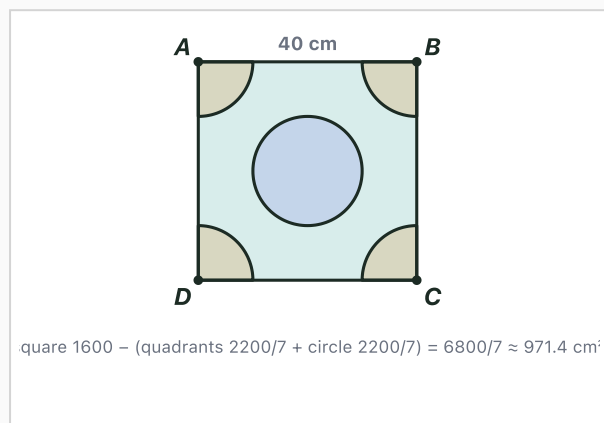
(iii) If the circle and the four quadrants are cut off from the square ABCD and removed, then find the area of remaining portion of square ABCD. [2]

OR

(iii) Find the combined area of 4 quadrants and the circle, removed. [2]



SOLUTION



(i) Area of the square = $40^2 = 1600 \text{ cm}^2$.

(ii) Area of the circle (radius 10) = $\frac{22}{7} \times 10 \times 10 = \frac{2200}{7} \approx 314.29 \text{ cm}^2$.

(iii) The four quadrants of radius 10 together make one full circle: $4 \times \frac{1}{4} \pi r^2 = \frac{2200}{7} \text{ cm}^2$. Removed area = $\frac{2200}{7} + \frac{2200}{7} = \frac{4400}{7} \text{ cm}^2$. Remaining = $1600 - \frac{4400}{7} = \frac{6800}{7} \approx 971.43 \text{ cm}^2$.

(iii) OR: the combined area removed is $\frac{4400}{7} \approx 628.57 \text{ cm}^2$.

Answer: (i) 1600 cm^2 (ii) $\frac{2200}{7} \text{ cm}^2$ (iii) remaining $\frac{6800}{7} \approx 971.43 \text{ cm}^2$ (OR) removed $\frac{4400}{7} \approx 628.57 \text{ cm}^2$

Q38 · PROBABILITY · 4 MARKS

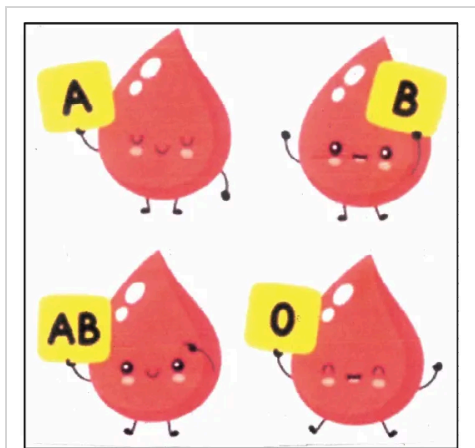
Case study 3. Blood group describes the type of blood a person has. It is a classification of blood based on the presence or absence of inherited antigenic substances on the surface of red blood cells. Blood types predict whether a serious reaction will occur in a blood transfusion. In a sample of 50 people, 21 had type O blood, 22 had type A, 5 had type B and rest had type AB blood group.

Based on the above, answer the following questions:

- (i) What is the probability that a person chosen at random had type O blood? [1]
- (ii) What is the probability that a person chosen at random had type AB blood group? [1]
- (iii) What is the probability that a person chosen at random had neither type A nor type B blood group? [2]

OR

- (iii) What is the probability that person chosen at random had either type A or type B or type O blood group? [2]

**SOLUTION**

The people with type AB = $50 - (21 + 22 + 5) = 2$.

(i) $P(\text{type O}) = \frac{21}{50}$.

(ii) $P(\text{type AB}) = \frac{2}{50} = \frac{1}{25}$.

(iii) Neither A nor B means type O or AB: $P = \frac{21 + 2}{50} = \frac{23}{50}$. (OR) A or B or O: $P = \frac{21 + 22 + 5}{50} = \frac{48}{50} = \frac{24}{25}$.

Answer: (i) $\frac{21}{50}$ (ii) $\frac{1}{25}$ (iii) $\frac{23}{50}$ (OR) $\frac{24}{25}$

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