

Mathematics (Standard) 2023, Set 30/2/1

Q.P. Code 30/2/1 · Series WX1YZ/2 · 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 · QUADRATIC EQUATIONS · 1 MARK

Which of the following quadratic equations has sum of its roots as 4?

(A) $2x^2 - 4x + 8 = 0$

(B) $-x^2 + 4x + 4 = 0$

(C) $\sqrt{2}x^2 - \frac{4}{\sqrt{2}}x + 1 = 0$

(D) $4x^2 - 4x + 4 = 0$

SOLUTION

Sum of roots = $-\frac{b}{a}$.

(A) $-\frac{-4}{2} = 2$. (B) $-\frac{4}{-1} = 4$ ✓. (C) $\frac{4/\sqrt{2}}{\sqrt{2}} = 2$. (D) $\frac{4}{4} = 1$.

Answer: (B) $-x^2 + 4x + 4 = 0$

Q2 · AREAS RELATED TO CIRCLES · 1 MARK

What is the length of the arc of the sector of a circle with radius 14 cm and of central angle 90° ?

(A) 22 cm

(B) 44 cm

(C) 88 cm

(D) 11 cm

SOLUTION

Arc = $\frac{90}{360} \times 2 \times \frac{22}{7} \times 14 = \frac{1}{4} \times 88 = 22$ cm.

Answer: (A) 22 cm

Q3 · TRIANGLES · 1 MARK

If $\triangle ABC \sim \triangle PQR$ with $\angle A = 32^\circ$ and $\angle R = 65^\circ$, then the measure of $\angle B$ is:

(A) 32°

(B) 65°

(C) 83°

(D) 97°

SOLUTION

Similar triangles have equal corresponding angles: $A \leftrightarrow P$, $B \leftrightarrow Q$, $C \leftrightarrow R$. So $\angle C = \angle R = 65^\circ$.

$\angle B = 180^\circ - 32^\circ - 65^\circ = 83^\circ$.

Answer: (C) 83°

Q4 · REAL NUMBERS · 1 MARK

If 'p' and 'q' are natural numbers and 'p' is the multiple of 'q', then what is the HCF of 'p' and 'q'?

- (A) pq (B) p
(C) q (D) $p + q$

SOLUTION

$p = kq$ for some natural number k , so q divides both p and q . No larger number divides q .

So $\text{HCF}(p, q) = q$. (Example: $\text{HCF}(12, 4) = 4$.)

Answer: (C) q

Q5 · COORDINATE GEOMETRY · 1 MARK

The coordinates of the vertex A of a rectangle $ABCD$ whose three vertices are given as $B(0, 0)$, $C(3, 0)$ and $D(0, 4)$ are:

- (A) $(4, 0)$ (B) $(0, 3)$
(C) $(3, 4)$ (D) $(4, 3)$

SOLUTION

Three corners are $B(0, 0)$, $C(3, 0)$ and $D(0, 4)$. The sides BC (along the x -axis) and BD (along the y -axis) meet at a right angle at B , so B is a corner between C and D .

The fourth corner is opposite B : it has the x -coordinate of C and the y -coordinate of D , so it is $(3, 4)$. Check: the diagonal from B to $(3, 4)$ has mid-point $(1.5, 2)$, which is also the mid-point of CD ✓.

Answer: (C) $(3, 4)$

Common mistake: CBSE's key gives $(3, 4)$. (The letters $ABCD$ as printed do not go round the rectangle in order, but the fourth vertex is the same.)

Q6 · LINEAR EQUATIONS · 1 MARK

If the pair of equations $3x - y + 8 = 0$ and $6x - ry + 16 = 0$ represent coincident lines, then the value of ' r ' is:

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

SOLUTION

Coincident lines need $\frac{3}{6} = \frac{-1}{-r} = \frac{8}{16}$.

$\frac{1}{2} = \frac{1}{r}$, so $r = 2$.

Answer: (D) 2

Q7 · PROBABILITY · 1 MARK

A bag contains 100 cards numbered 1 to 100. A card is drawn at random from the bag. What is the probability that the number on the card is a perfect cube?

(A) $\frac{1}{20}$
(C) $\frac{1}{25}$

(B) $\frac{3}{50}$
(D) $\frac{7}{100}$

SOLUTION

Perfect cubes from 1 to 100: $1^3 = 1$, $2^3 = 8$, $3^3 = 27$, $4^3 = 64$. That is 4 cubes ($5^3 = 125$ is too big).

$$P = \frac{4}{100} = \frac{1}{25}.$$

Answer: (C) $\frac{1}{25}$

Q8 · LINEAR EQUATIONS · 1 MARK

The pair of equations $x = a$ and $y = b$ graphically represents lines which are:

- (A) parallel
(C) coincident

- (B) intersecting at (b, a)
(D) intersecting at (a, b)

SOLUTION

$x = a$ is a vertical line and $y = b$ is a horizontal line, so they are perpendicular and meet at one point.

The point has $x = a$ and $y = b$: (a, b) .

Answer: (D) intersecting at (a, b)

Q9 · POLYNOMIALS · 1 MARK

If one zero of the polynomial $6x^2 + 37x - (k - 2)$ is reciprocal of the other, then what is the value of k ?

- (A) -4
(C) 6

- (B) -6
(D) 4

SOLUTION

Zeroes that are reciprocals have product 1. Product = $\frac{-(k-2)}{6} = 1$.

$-(k-2) = 6$, so $k-2 = -6$ and $k = -4$.

Answer: (A) -4

Q10 · SURFACE AREAS AND VOLUMES · 1 MARK

What is the total surface area of a solid hemisphere of diameter ' d '?

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

(B) $2\pi d^2$
(D) $\frac{3}{4}\pi d^2$

SOLUTION

Total surface area of a solid hemisphere = $3\pi r^2$ with $r = \frac{d}{2}$.

$$3\pi \times \frac{d^2}{4} = \frac{3}{4}\pi d^2.$$

Answer: (D) $\frac{3}{4}\pi d^2$

Common mistake: Using the radius in the answer. The question asks in terms of the diameter d .

Q11 · PROBABILITY · 1 MARK

If three coins are tossed simultaneously, what is the probability of getting at most one tail?

- (A) $\frac{3}{8}$ (B) $\frac{4}{8}$
(C) $\frac{5}{8}$ (D) $\frac{7}{8}$

SOLUTION

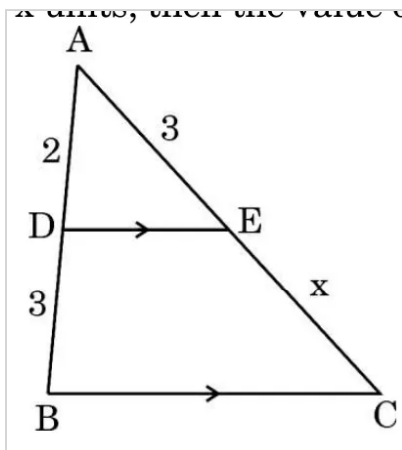
At most one tail means 0 or 1 tail: HHH, HHT, HTH, THH – 4 outcomes out of 8.

$$P = \frac{4}{8}.$$

Answer: (B) $\frac{4}{8}$

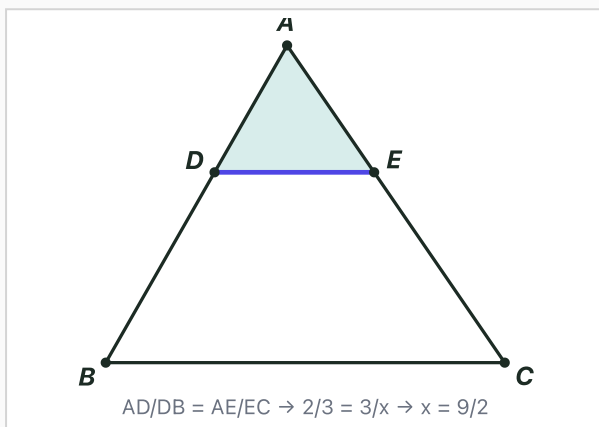
Q12 · TRIANGLES · 1 MARK

In the given figure, $DE \parallel BC$. If $AD = 2$ units, $DB = AE = 3$ units and $EC = x$ units, then the value of x is:



- (A) 2 (B) 3
(C) 5 (D) $\frac{9}{2}$

SOLUTION



$$AD/DB = AE/EC \rightarrow 2/3 = 3/x \rightarrow x = 9/2$$

$$DE \parallel BC, \text{ so } \frac{AD}{DB} = \frac{AE}{EC}; \frac{2}{3} = \frac{3}{x}.$$

$$x = \frac{9}{2}.$$

Answer: (D) $\frac{9}{2}$

Q13 · AREAS RELATED TO CIRCLES · 1 MARK

The hour-hand of a clock is 6 cm long. The angle swept by it between 7 : 20 a.m. and 7 : 55 a.m. is:

- (A) $\left(\frac{35}{4}\right)^\circ$ (B) $\left(\frac{35}{2}\right)^\circ$
 (C) 35° (D) 70°

SOLUTION

Between 7:20 and 7:55 is 35 minutes. The hour hand moves 30° in 60 minutes, that is 0.5° per minute.

$$\text{Angle} = 35 \times \frac{1}{2} = \frac{35}{2} \text{ degrees.}$$

Answer: (B) $\left(\frac{35}{2}\right)^\circ$

Common mistake: Using 6° per minute (the minute hand). The hour hand turns only half a degree per minute.

Q14 · POLYNOMIALS · 1 MARK

The zeroes of the polynomial $p(x) = x^2 + 4x + 3$ are given by:

- (A) 1, 3 (B) -1, 3
 (C) 1, -3 (D) -1, -3

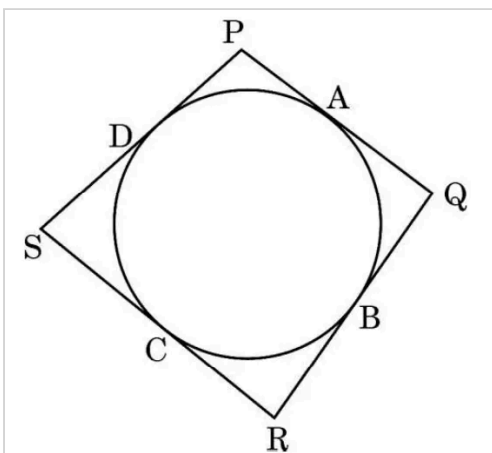
SOLUTION

$$x^2 + 4x + 3 = (x + 1)(x + 3), \text{ so the zeroes are } -1 \text{ and } -3.$$

Answer: (D) -1, -3

Q15 · CIRCLES · 1 MARK

In the given figure, the quadrilateral $PQRS$ circumscribes a circle. Here $PA + CS$ is equal to:



- (A) QR (B) PR
 (C) PS (D) PQ

SOLUTION

Tangents from a point are equal: $PA = PD$ (from P) and $CS = DS$ (from S).

$$PA + CS = PD + DS = PS.$$

Answer: (C) PS

Q16 · POLYNOMIALS · 1 MARK

If α and β are the zeroes of the quadratic polynomial $p(x) = x^2 - ax - b$, then the value of $\alpha^2 + \beta^2$ is:

(A) $a^2 - 2b$

(B) $a^2 + 2b$

(C) $b^2 - 2a$

(D) $b^2 + 2a$

SOLUTION

$$\alpha + \beta = a \text{ and } \alpha\beta = -b.$$

$$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta = a^2 + 2b.$$

Answer: (B) $a^2 + 2b$

Q17 · COORDINATE GEOMETRY · 1 MARK

The area of the triangle formed by the line $\frac{x}{a} + \frac{y}{b} = 1$ with the coordinate axes is:

(A) ab

(B) $\frac{1}{2}ab$

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

(D) $2ab$

SOLUTION

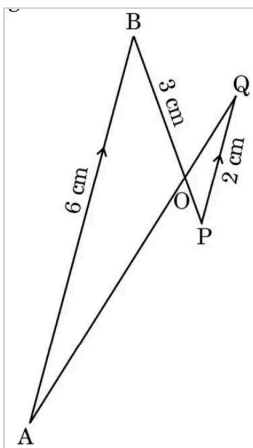
The line meets the axes at $(a, 0)$ and $(0, b)$. With the origin it forms a right triangle with legs $|a|$ and $|b|$.

$$\text{Area} = \frac{1}{2}|ab|.$$

Answer: (B) $\frac{1}{2}ab$

Q18 · TRIANGLES · 1 MARK

In the given figure, $AB \parallel PQ$. If $AB = 6$ cm, $PQ = 2$ cm and $OB = 3$ cm, then the length of OP is:



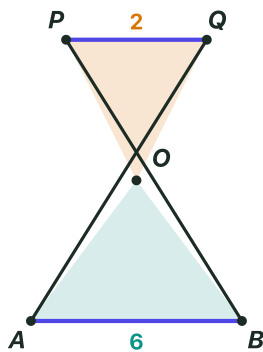
(A) 9 cm

(B) 3 cm

(C) 4 cm

(D) 1 cm

SOLUTION



$\triangle OAB \sim \triangle OQP$: $OP/OB = PQ/AB = 1/3$, so $OP = 1$ cm

Not to scale.

$AB \parallel PQ$, so $\triangle OAB \sim \triangle OQP$ (alternate angles and vertically opposite angles at O).

$$\frac{OP}{OB} = \frac{PQ}{AB} = \frac{2}{6} = \frac{1}{3}, \text{ so } OP = \frac{3}{3} = 1 \text{ cm.}$$

Answer: (D) 1 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 an 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) is the standard tangent–radius theorem. True. (R) is also a standard theorem. True.

But the perpendicularity in A is not proved from the equal lengths in R, so R does not explain A.

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

Q20 · POLYNOMIALS · 1 MARK

Assertion (A): The polynomial $p(x) = x^2 + 3x + 3$ has two real zeroes.

Reason (R): A quadratic polynomial can have at most two real zeroes.

- (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) $D = 9 - 12 = -3 < 0$, so $p(x)$ has no real zeroes. A is false.

(R) A quadratic has at most two real zeroes. True.

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

Section B: Very short answer

5 questions, 2 marks each.

Q21 · REAL NUMBERS · 2 MARKS

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

SOLUTION

Suppose $2 + \sqrt{3}$ is rational, equal to $\frac{p}{q}$ with integers p, q and $q \neq 0$.

$\sqrt{3} = \frac{p}{q} - 2 = \frac{p - 2q}{q}$. As p, q are integers, $\frac{p - 2q}{q}$ is rational, so $\sqrt{3}$ would be rational.

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

Answer: Proved

Q22 · TRIGONOMETRY · 2 MARKS

(a) If $4 \cot^2 45^\circ - \sec^2 60^\circ + \sin^2 60^\circ + p = \frac{3}{4}$, then find the value of p .

OR

(b) If $\cos A + \cos^2 A = 1$, then find the value of $\sin^2 A + \sin^4 A$.

SOLUTION

(a) $4 \times 1 - 4 + \frac{3}{4} + p = \frac{3}{4}$, so $p = 0$.

(b) $\cos A = 1 - \cos^2 A = \sin^2 A$.

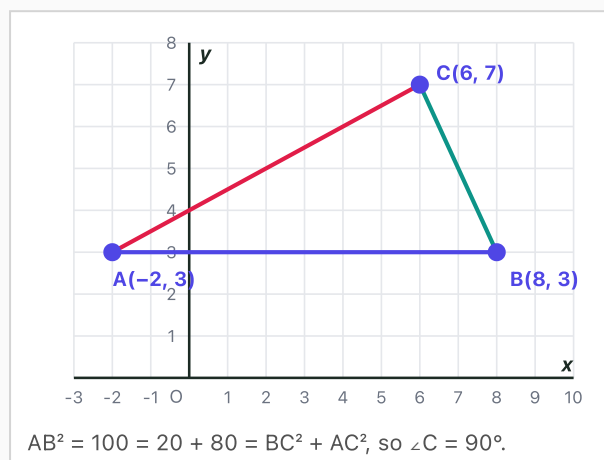
$\sin^2 A + \sin^4 A = \cos A + \cos^2 A = 1$.

Answer: (a) $p = 0$ (b) 1

Q23 · COORDINATE GEOMETRY · 2 MARKS

Show that the points $(-2, 3)$, $(8, 3)$ and $(6, 7)$ are the vertices of a right-angled triangle.

SOLUTION



Let $A(-2, 3)$, $B(8, 3)$, $C(6, 7)$. $AB^2 = 10^2 = 100$.

$BC^2 = (8 - 6)^2 + (3 - 7)^2 = 4 + 16 = 20$ and $AC^2 = (6 + 2)^2 + (7 - 3)^2 = 64 + 16 = 80$.

$BC^2 + AC^2 = 100 = AB^2$, so by the converse of Pythagoras the triangle is right-angled at C .

Answer: Shown: right angle at C

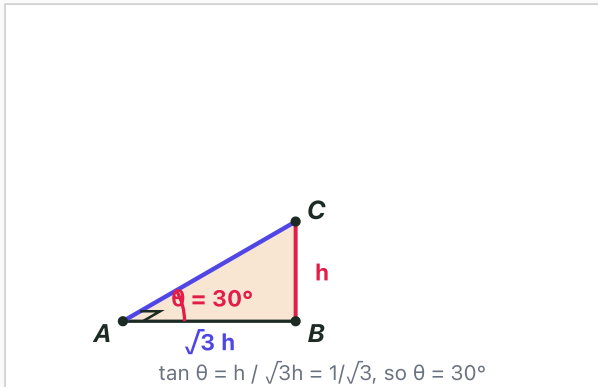
Q24 · APPLICATIONS OF TRIGONOMETRY · 2 MARKS

(a) The length of the shadow of a tower on the plane ground is $\sqrt{3}$ times the height of the tower. Find the angle of elevation of the sun.

OR

(b) The angle of elevation of the top of a tower from a point on the ground which is 30 m away from the foot of the tower, is 30° . Find the height of the tower.

SOLUTION



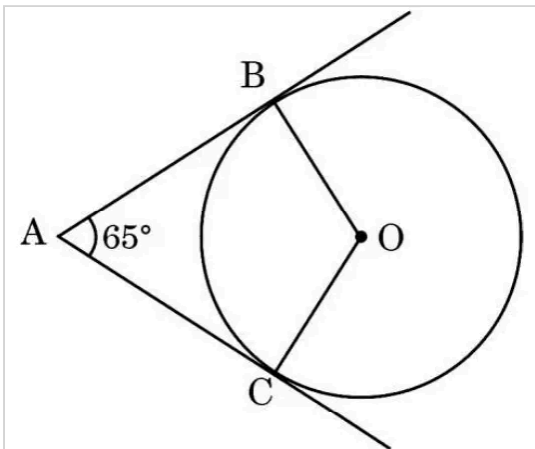
(a) Let the height be h , so the shadow is $\sqrt{3}h$. $\tan \theta = \frac{h}{\sqrt{3}h} = \frac{1}{\sqrt{3}}$, so $\theta = 30^\circ$.

(b) $\tan 30^\circ = \frac{h}{30}$, so $h = \frac{30}{\sqrt{3}} = 10\sqrt{3}$ m.

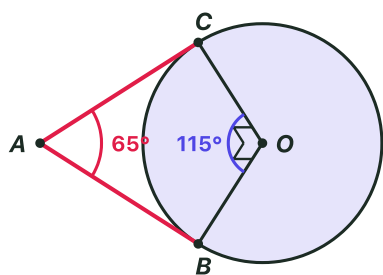
Answer: (a) 30° (b) $10\sqrt{3}$ m

Q25 · CIRCLES · 2 MARKS

In the given figure, O is the centre of the circle. AB and AC are tangents drawn to the circle from point A . If $\angle BAC = 65^\circ$, then find the measure of $\angle BOC$.



SOLUTION



quadrilateral ABOC: $\angle BOC = 360^\circ - 90^\circ - 90^\circ - 65^\circ = 115^\circ$

$OB \perp AB$ and $OC \perp AC$ (radius and tangent), so $\angle OBA = \angle OCA = 90^\circ$.

In quadrilateral ABOC: $\angle BAC + \angle BOC = 180^\circ$, so $\angle BOC = 180^\circ - 65^\circ = 115^\circ$.

Answer: $\angle BOC = 115^\circ$

Section C: Short answer

6 questions, 3 marks each.

Q26 · REAL NUMBERS · 3 MARKS

(a) Find by prime factorisation the LCM of the numbers 18180 and 7575. Also, find the HCF of the two numbers.

OR

(b) Three bells ring at intervals of 6, 12 and 18 minutes. If all the three bells rang at 6 a.m., when will they ring together again?

SOLUTION

(a) $18180 = 2^2 \times 3^2 \times 5 \times 101$ and $7575 = 3 \times 5^2 \times 101$.

LCM (greatest powers) $= 2^2 \times 3^2 \times 5^2 \times 101 = 90900$. HCF (smallest powers) $= 3 \times 5 \times 101 = 1515$.

(b) They ring together again after the LCM of 6, 12, 18, which is 36 minutes.

So they ring together next at 6:36 a.m.

Answer: (a) LCM = 90900, HCF = 1515 (b) 6:36 a.m.

Q27 · TRIGONOMETRY · 3 MARKS

Prove that: $\left(\frac{1}{\cos \theta} - \cos \theta \right) \left(\frac{1}{\sin \theta} - \sin \theta \right) = \frac{1}{\tan \theta + \cot \theta}$

SOLUTION

$$\text{LHS} = \frac{1 - \cos^2 \theta}{\cos \theta} \times \frac{1 - \sin^2 \theta}{\sin \theta} = \frac{\sin^2 \theta}{\cos \theta} \times \frac{\cos^2 \theta}{\sin \theta} = \sin \theta \cos \theta.$$

$$\text{RHS} = \frac{1}{\frac{\sin \theta}{\cos \theta} + \frac{\cos \theta}{\sin \theta}} = \frac{\sin \theta \cos \theta}{\sin^2 \theta + \cos^2 \theta} = \sin \theta \cos \theta.$$

LHS = RHS.

Answer: Proved

Q28 · COORDINATE GEOMETRY · 3 MARKS

If $Q(0, 1)$ is equidistant from $P(5, -3)$ and $R(x, 6)$, find the values of x .

SOLUTION

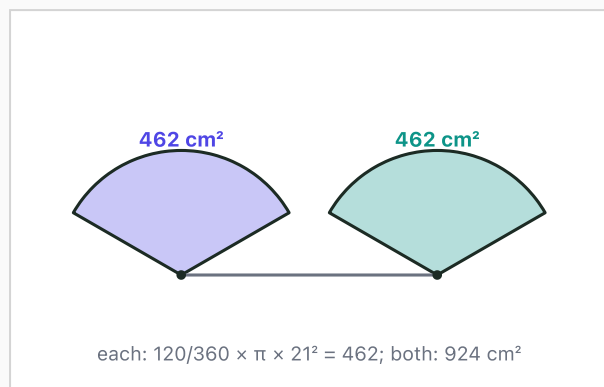
$$PQ = QR, \text{ so } PQ^2 = QR^2: (5 - 0)^2 + (-3 - 1)^2 = (x - 0)^2 + (6 - 1)^2.$$

$$25 + 16 = x^2 + 25, \text{ so } x^2 = 16 \text{ and } x = 4 \text{ or } x = -4.$$

Answer: $x = 4$ or $x = -4$

Q29 · AREAS RELATED TO CIRCLES · 3 MARKS

A car has two wipers which do not overlap. Each wiper has a blade of length 21 cm sweeping through an angle of 120° . Find the total area cleaned at each sweep of the two blades.

SOLUTION

Each blade sweeps a sector of radius 21 cm and angle 120° : area = $\frac{120}{360} \times \frac{22}{7} \times 21 \times 21 = \frac{1}{3} \times 1386 = 462 \text{ cm}^2$.

Two blades (no overlap): $2 \times 462 = 924 \text{ cm}^2$.

Answer: 924 cm^2

Q30 · LINEAR EQUATIONS · 3 MARKS

(a) If the system of linear equations $2x + 3y = 7$ and $2ax + (a + b)y = 28$ has infinitely many solutions, find the values of a and b .

OR

(b) If $217x + 131y = 913$ and $131x + 217y = 827$, then solve the equations for the values of x and y .

SOLUTION

(a) Infinitely many solutions need $\frac{2}{2a} = \frac{3}{a+b} = \frac{7}{28}$.

$\frac{1}{a} = \frac{1}{4}$ gives $a = 4$. $\frac{3}{a+b} = \frac{1}{4}$ gives $a + b = 12$, so $b = 8$.

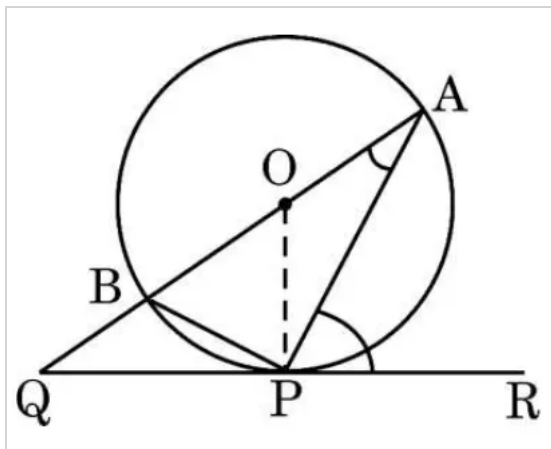
(b) Add: $348(x + y) = 1740$, so $x + y = 5$. Subtract: $86(x - y) = 86$, so $x - y = 1$.

Hence $x = 3$ and $y = 2$.

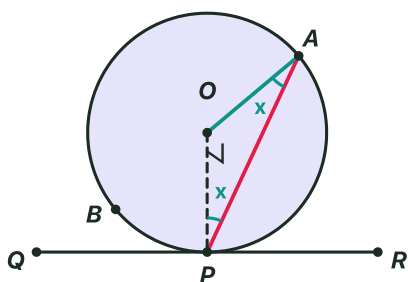
Answer: (a) $a = 4, b = 8$ (b) $x = 3, y = 2$

Q31 · CIRCLES · 3 MARKS

In the given figure, O is the centre of the circle and QPR is a tangent to it at P . Prove that $\angle QAP + \angle APR = 90^\circ$.



SOLUTION



$$OA = OP \rightarrow \angle OPA = \angle OAP = \angle QAP; \angle OPA + \angle APR = 90^\circ$$

The chord from Q through the centre is drawn as in the figure.

$OA = OP$ (radii), so in $\triangle OAP$: $\angle OPA = \angle OAP$ (i)

$OP \perp QR$ (radius and tangent), so $\angle OPA + \angle APR = 90^\circ$ (ii)

$\angle OAP$ is the same as $\angle QAP$ (as Q, O, A are in a line). So from (i), (ii): $\angle QAP + \angle APR = 90^\circ$.

Answer: Proved

Section D: Long answer

4 questions, 5 marks each.

Q32 · ARITHMETIC PROGRESSIONS · 5 MARKS

How many terms of the arithmetic progression 45, 39, 33, ... must be taken so that their sum is 180? Explain the double answer.

SOLUTION

$$a = 45 \text{ and } d = -6. S_n = \frac{n}{2}[2 \times 45 + (n-1)(-6)] = 180.$$

$$\frac{n}{2}[96 - 6n] = 180, \text{ so } n(48 - 3n) = 180, \text{ that is } 3n^2 - 48n + 180 = 0 \text{ and } n^2 - 16n + 60 = 0.$$

$$(n-6)(n-10) = 0, \text{ so } n = 6 \text{ or } n = 10.$$

Why two answers: the terms are 45, 39, 33, 27, 21, 15, 9, 3, -3, -9, ... The sum of the 7th, 8th, 9th and 10th terms is $9 + 3 - 3 - 9 = 0$, because some terms are positive and some are negative. So the sum is 180 after 6 terms and again after 10 terms.

Answer: $n = 6$ or $n = 10$ (the terms 7 to 10 add up to 0)

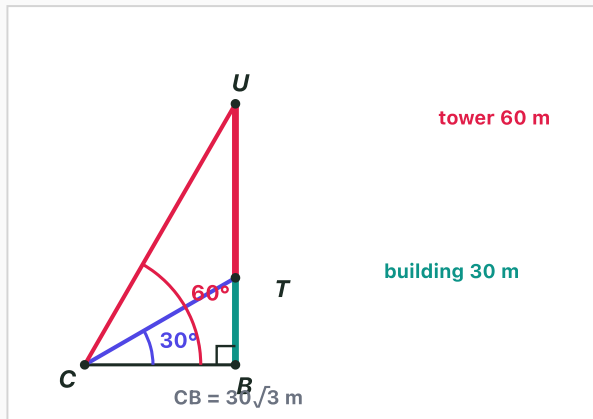
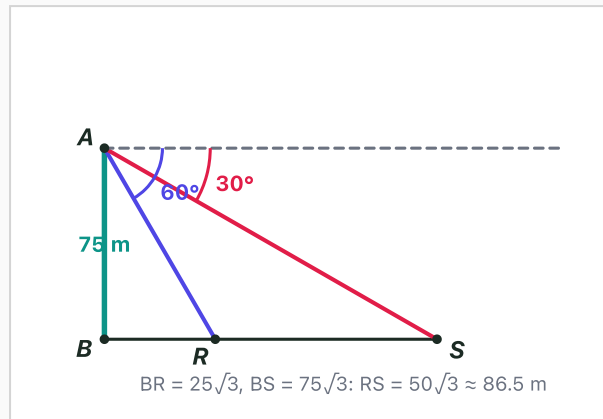
Q33 · APPLICATIONS OF TRIGONOMETRY · 5 MARKS

(a) As observed from the top of a 75 m high lighthouse from the sea-level, the angles of depression of two ships are 30° and 60° . If one ship is exactly behind the other on the same side of the lighthouse, find the distance between the two ships. (Use $\sqrt{3} = 1.73$)

OR

(b) From a point on the ground, the angle of elevation of the bottom and top of a transmission tower fixed at the top of 30 m high building are 30° and 60° , respectively. Find the height of the transmission tower. (Use $\sqrt{3} = 1.73$)

SOLUTION



(a) Let $PQ = 75$ m be the lighthouse, with ships R (60° , nearer) and S (30° , farther) on the same side.

$$\tan 60^\circ = \frac{75}{PR}, \text{ so } PR = \frac{75}{\sqrt{3}} = 25\sqrt{3} \text{ m. } \tan 30^\circ = \frac{75}{PS}, \text{ so } PS = 75\sqrt{3} \text{ m.}$$

$$RS = PS - PR = 75\sqrt{3} - 25\sqrt{3} = 50\sqrt{3} = 50 \times 1.73 = 86.5 \text{ m.}$$

(b) Let the building be $AB = 30$ m, the tower $BP = h$, and the point on the ground C . $\tan 30^\circ = \frac{30}{AC}$, so $AC = 30\sqrt{3}$ m.

$$\tan 60^\circ = \frac{30 + h}{AC} = \sqrt{3}, \text{ so } 30 + h = 30\sqrt{3} \times \sqrt{3} = 90 \text{ and } h = 60 \text{ m.}$$

Answer: (a) 86.5 m (b) 60 m

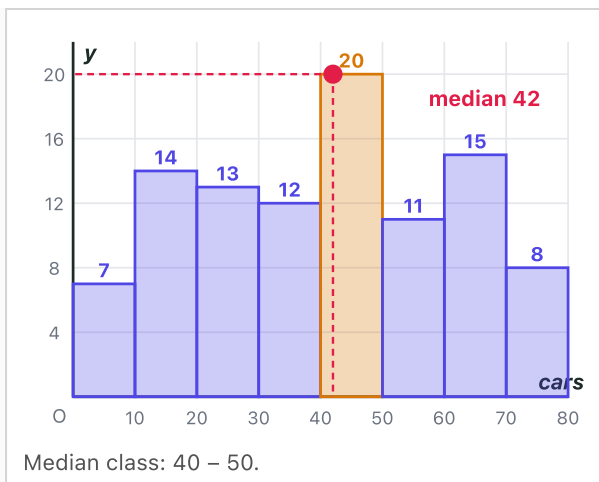
Common mistake: In (a), adding the distances. The ships are on the same side, one behind the other, so subtract.

Q34 · STATISTICS · 5 MARKS

A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarised it in the table given below. Find the mean and median of the following data.

Number of cars	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Frequency (periods)	7	14	13	12	20	11	15	8

SOLUTION



Class marks x_i : 5, 15, 25, 35, 45, 55, 65, 75. $f_i x_i$: 35, 210, 325, 420, 900, 605, 975, 600. $\sum f_i = 100$ and $\sum f_i x_i = 4070$.

$$\text{Mean} = \frac{4070}{100} = 40.7.$$

Cumulative frequencies: 7, 21, 34, 46, 66, 77, 92, 100. $\frac{N}{2} = 50$, so the median class is 40 – 50: $l = 40$, $cf = 46$, $f = 20$, $h = 10$.

$$\text{Median} = 40 + \frac{50 - 46}{20} \times 10 = 40 + 2 = 42.$$

Answer: Mean = 40.7 and Median = 42

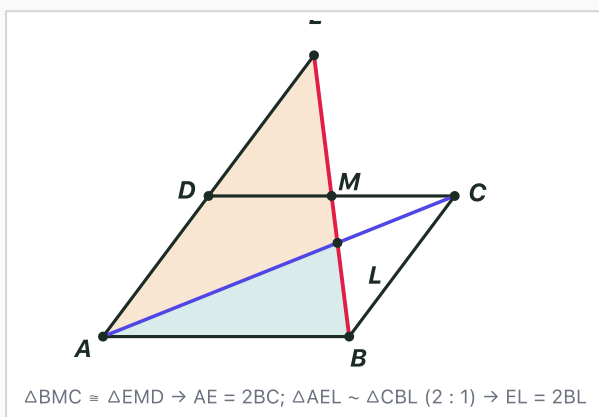
Q35 · TRIANGLES · 5 MARKS

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

OR

(b) Through the mid-point M of the side CD of a parallelogram $ABCD$, the line BM is drawn intersecting AC in L and AD (produced) in E . Prove that $EL = 2BL$.

SOLUTION



(a) D and M are mid-points of BC and QR , so $BC = 2BD$ and $QR = 2QM$. Given $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AD}{PM}$, we get $\frac{AB}{PQ} = \frac{BD}{QM} = \frac{AD}{PM}$.

So $\triangle ABD \sim \triangle PQM$ (SSS), giving $\angle B = \angle Q$.

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

(b) In $\triangle BMC$ and $\triangle EMD$: $MC = MD$ (M is the mid-point), $\angle CMB = \angle DME$ (vertically opposite) and $\angle MBC = \angle MED$ (alternate angles, $BC \parallel AE$). So $\triangle BMC \cong \triangle EMD$ and $BC = DE$.

$AD = BC$ (parallelogram), so $AD = DE$ and $AE = 2BC$.

Now $AE \parallel BC$, so $\triangle AEL \sim \triangle CBL$: $\frac{EL}{BL} = \frac{AE}{BC} = \frac{2BC}{BC} = 2$, so $EL = 2BL$.

Answer: (a) $\triangle ABC \sim \triangle PQR$ (b) $EL = 2BL$

Section E: Case studies

3 case studies, 4 marks each.

Q36 · AREAS RELATED TO CIRCLES · 4 MARKS

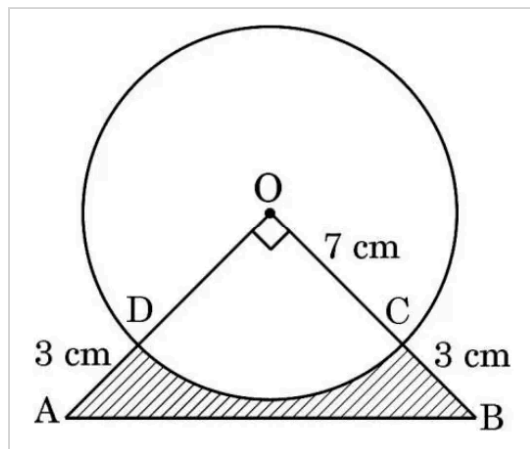
Case study 1. In an annual day function of a school, the organizers wanted to give a cash prize along with a memento to their best students. Each memento is made as shown in the figure and its base $ABCD$ is shown from the front side. The rate of silver plating is ₹ 20 per cm^2 .

Based on the above, answer the following questions:

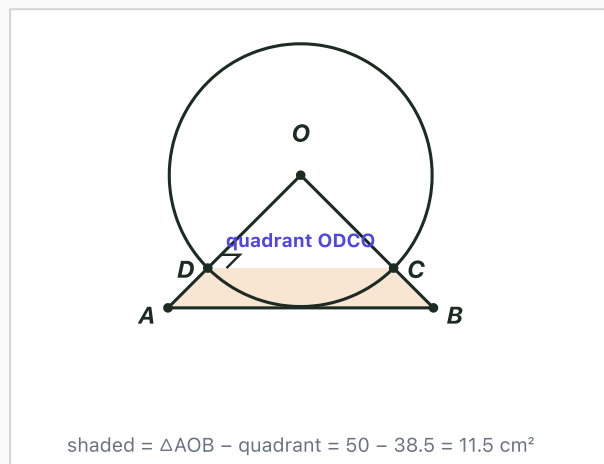
- (i) What is the area of the quadrant $ODCO$? [1]
- (ii) Find the area of $\triangle AOB$. [1]
- (iii) (a) What is the total cost of silver plating the shaded part $ABCD$? [2]

OR

- (iii) (b) What is the length of arc CD ? [2]



SOLUTION



- (i) Quadrant of radius 7 cm: $\frac{1}{4} \times \frac{22}{7} \times 7 \times 7 = \frac{77}{2} = 38.5 \text{ cm}^2$.

(ii) $OA = OB = 7 + 3 = 10$ cm with $\angle AOB = 90^\circ$: area $= \frac{1}{2} \times 10 \times 10 = 50$ cm².

(iii)(a) Shaded area $= 50 - 38.5 = 11.5$ cm². Cost $= 11.5 \times 20 = ₹230$.

(iii)(b) Arc $CD = \frac{90}{360} \times 2 \times \frac{22}{7} \times 7 = 11$ cm.

Answer: (i) 38.5 cm² (ii) 50 cm² (iii)(a) ₹ 230 (iii)(b) 11 cm

Q37 · SURFACE AREAS AND VOLUMES · 4 MARKS

Case study 2. In a coffee shop, coffee is served in two types of cups. One is cylindrical in shape with diameter 7 cm and height 14 cm and the other is hemispherical with diameter 21 cm.

Based on the above, answer the following questions:

(i) Find the area of the base of the cylindrical cup. [1]

(ii) (a) What is the capacity of the hemispherical cup? [2]

OR

(ii) (b) Find the capacity of the cylindrical cup. [2]

(iii) What is the curved surface area of the cylindrical cup? [1]



SOLUTION

Cylindrical cup: $r = 3.5$ cm, $h = 14$ cm. Hemispherical cup: $r = 10.5$ cm.

(i) Base area $= \pi r^2 = \frac{22}{7} \times 3.5 \times 3.5 = 38.5$ cm².

(ii)(a) Capacity of the hemisphere $= \frac{2}{3} \pi r^3 = \frac{2}{3} \times \frac{22}{7} \times 10.5^3 = 2425.5$ cm³.

(ii)(b) Capacity of the cylinder $= \pi r^2 h = 38.5 \times 14 = 539$ cm³.

(iii) Curved surface area $= 2 \pi r h = 2 \times \frac{22}{7} \times 3.5 \times 14 = 308$ cm².

Answer: (i) 38.5 cm² (ii)(a) 2425.5 cm³ (ii)(b) 539 cm³ (iii) 308 cm²

Q38 · PROBABILITY · 4 MARKS

Case study 3. Computer-based learning (CBL) refers to any teaching methodology that makes use of computers for information transmission. At an elementary school level, computer applications can be used to display multimedia lesson plans. A survey was done on 1000 elementary and secondary schools of Assam and they were classified by the number of computers they had.

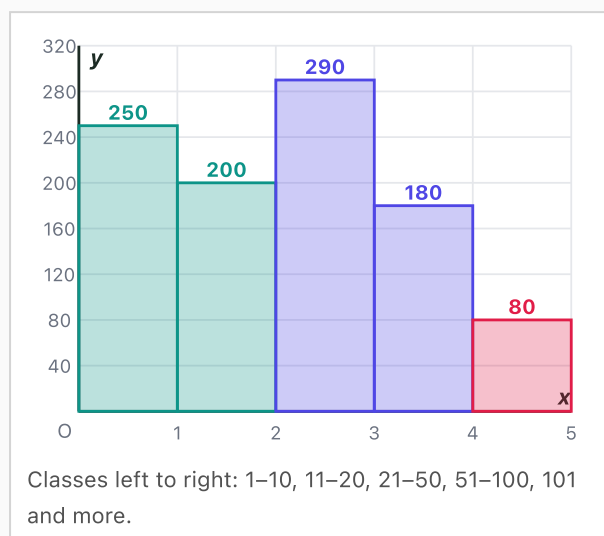
One school is chosen at random. Then:

- (i) Find the probability that the school chosen at random has more than 100 computers. [1]
(ii) (a) Find the probability that the school chosen at random has 50 or fewer computers. [2]

OR

- (ii) (b) Find the probability that the school chosen at random has no more than 20 computers. [2]
(iii) Find the probability that the school chosen at random has 10 or less than 10 computers. [1]

Number of computers	1 – 10	11 – 20	21 – 50	51 – 100	101 and more
Number of schools	250	200	290	180	80

SOLUTION

Total schools = $250 + 200 + 290 + 180 + 80 = 1000$.

(i) More than 100 computers: 80 schools. $P = \frac{80}{1000} = 0.08$.

(ii)(a) 50 or fewer: $250 + 200 + 290 = 740$. $P = \frac{740}{1000} = 0.74$.

(ii)(b) No more than 20: $250 + 200 = 450$. $P = \frac{450}{1000} = 0.45$.

(iii) 10 or less: 250 schools. $P = \frac{250}{1000} = 0.25$.

Answer: (i) 0.08 (ii)(a) 0.74 (ii)(b) 0.45 (iii) 0.25

Stuck on a step? CogniGuru's AI tutor explains any doubt one minute at a time, in English or Hindi.

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