Solutions—CBSE Board Question Paper (Basic) 2025

SECTION A

1. (*d*) If HCF of two positive integers a and b is 1, then the two numbers are coprime and LCM of two coprime numbers is their product. Therefore, LCM of a and b is ab.

2. (*b*) We know that sum of a rational and an irrational number is an irrational number.

Here, 3 is rational while $\sqrt{2}$ is irrational.

$\therefore$ $3 + \sqrt{2}$ is an irrational number.

3. (*b*) For the quadratic equation $x^2 - 3x - 2 = 0$, we have

$$a = 1,\ b = -3 \text{ and } c = -2$$

$\therefore$ Discriminant, $D = b^2 - 4ac$

$$= (-3)^2 - 4 \times 1 \times (-2) = 9 + 8 = 17.$$

4. (*a*) We have, $x + \dfrac{1}{x} = 3$

$\Rightarrow \quad \dfrac{x^2 + 1}{x} = 3 \quad \Rightarrow \quad x^2 + 1 = 3x$

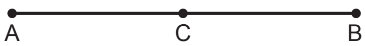
or $x^2 - 3x + 1 = 0$, which is in $ax^2 + bx + c = 0$ form.

For the above equation, $a = 1$, $b = -3$ and $c = 1$

$\therefore$ $a - b + c = 1 - (-3) + 1 = 1 + 3 + 1 = 5.$

5. (*d*) For the point (3, –5), (abscissa – ordinate) = 3 – (–5) = 8.

6. (*c*) The mid-point of a line segment divides the line segment into two equal parts, *i.e.*, in the ratio 1 : 1.

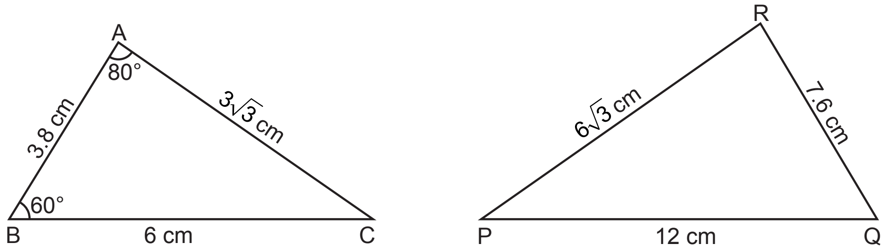


For example, in the figure C is the mid-point of line segment AB.

Since AC = BC $\Rightarrow \dfrac{AC}{BC} = 1$ or AC : BC = 1 : 1.

7. (*d*) Clearly, RHS is not the criterion for similarity of triangles. In fact, RHS is the criterion of congruence of two triangles.

8. (*c*)



In Δs ABC and PQR, we have

$$\frac{AB}{RQ} = \frac{BC}{QP} = \frac{AC}{RP} = \frac{1}{2}$$

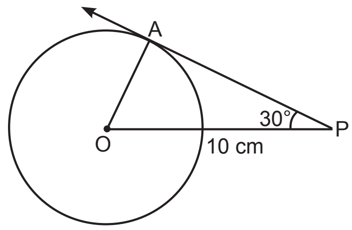
$\therefore \quad \Delta ABC \sim \Delta RQP \quad \Rightarrow \quad \angle P = \angle C$ [$\because$ Corresponding angles of similar triangles are equal.]

Now, in ΔABC, $\angle C = 180° - (\angle A + \angle B)$

$$= 180° - (80° + 60°) = 180° - 140° = 40°$$

Thus, $\quad \angle P = \angle C = 40°.$

9. (*d*) In the figure, PA is a tangent to the circle.



$\therefore \quad \angle OAP = 90°$ [∵ Tangent is ⊥ to the radius through the point of contact.]

So, in right ΔOAP, we have

$$\cos 30° = \frac{AP}{OP} \Rightarrow \frac{\sqrt{3}}{2} = \frac{AP}{10}$$

$$\Rightarrow AP = \frac{10\sqrt{3}}{2} = 5\sqrt{3} \text{ cm.}$$

10. (*c*) We have, $\sin 30° = \sin(90° - 60°)$

$= \cos 60°$ [∵ $\sin(90° - \theta) = \cos\theta$]

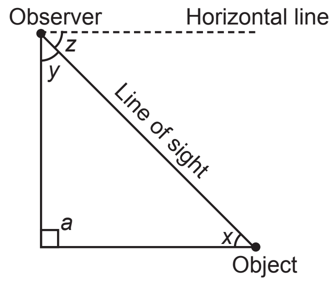
Therefore, $\sin 30° = \cos 30°$ is a false statement.

11. (*d*) We have, $\tan^2 A - \frac{1}{\cos^2 A}$

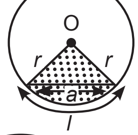
$$= \tan^2 A - \sec^2 A = \tan^2 A - (1 + \tan^2 A)$$

$$= \tan^2 A - 1 - \tan^2 A = -1.$$

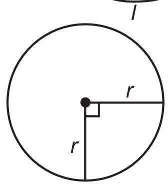
12. (*c*) In the figure, the angle formed at observer's eye with the horizontal line and line of sight, *i.e.*, angle z is the angle of depression.



13. (*c*) Perimeter of shaded region = $l + 2r$.



14. (*c*) Area of quadrant of a circle of radius $r = \frac{\pi r^2}{4}$



Area of the same circle = πr^2

$\therefore$ Required ratio = $\frac{\pi r^2}{4} : \pi r^2$

$= \frac{1}{4} : 1$ or $1 : 4$.

15. (*d*) A sphere is a solid having only curved surface. Therefore, its lateral/curved surface area and total surface both are same, *i.e.*, $4\pi r^2$.

16. (*d*) For the given distribution,

$N = \Sigma f = 2 + 3 + 7 + 6 + 6 + 6 = 30$

$\Rightarrow \quad \frac{N}{2} = 15.$

Since the cumulative frequency of the class 55–70 is 18, which is just greater than $\frac{N}{2}$. So, 55–70 is the *median class*.

$\therefore$ Class mark of median class, *i.e.*, 55–70 = $\frac{55+70}{2} = \frac{125}{2} = 62.5.$

17. (*b*) For the given distribution, the class with highest frequency, *i.e.*, 10 is 4000–5000. Therefore, 4000–5000 is the *modal class* and lower limit of this class is 4000.

18. (*d*) Getting a natural number < 7 means getting 1, 2, 3, 4, 5 or 6, *i.e.*, any of the number on the die. Therefore, in throwing a die, getting a natural number < 7 is a sure event.

19. (*a*) Assertion (A) is true:

The statement given is Assertion (A) is true. Since HCF of two numbers divides both the numbers and LCM is the least common multiple of both the numbers, the HCF must also divide the LCM.

Therefore, Assertion (A) is true.

Reason (R) is true:

'HCF of any two natural numbers divides both the numbers' is a true statement and a valid reason for Assertion (A).

Therefore, Reason (R) is true and correct explanation for Assertion (A).

Hence, option (*a*) is the correct answer.

20. (*d*) Assertion (A) is false:

The given system of equations is:

$$4x + py + 9 = 0 \quad \text{and} \quad 2x + 2y + 2 = 0$$

If the given system of equation is consistent then we must have

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \text{ for unique solution, and}$$

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2} \text{ for infinitely many solutions}$$

$$\therefore \quad \frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{4}{2} \neq \frac{p}{2} \Rightarrow p \neq 4$$

$$\text{and} \quad \frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2} \Rightarrow \frac{4}{2} = \frac{p}{2} = \frac{8}{2}$$

$$\Rightarrow 2 = \frac{p}{2} = 4$$

or $4 = p = 8$, which is not true for any value of p.

Therefore, Assertion (A) is false.

Reason (R) is true:

From the conditions for solvability of a system of linear equations, the statement given in Reason (R) is true.

Therefore, Reason (R) is true.

Hence, option (*d*) is the correct answer.

SECTION B

21. The given system of equations is:

$$\frac{x}{2} + \frac{2y}{3} = -1 \quad \ldots(1)$$

$$x - \frac{y}{3} = 3 \quad \ldots(2)$$

Multiplying eq. (1) by 6, we get

$$3x + 4y = -6 \quad \ldots(3)$$

Multiplying eq. (2) by 3, we get

$$3x - y = 9 \quad \ldots(4)$$

Subtracting eq. (4) from eq. (3), we have

$$\begin{array}{r} 3x + 4y = -6 \\ \underline{\overset{-}{}3x \mp y = \overset{-}{}9} \\ 5y = -15 \end{array} \Rightarrow y = -3$$

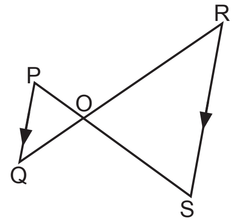
Putting $y = -3$ in eq. (4), we have

$$3x - (-3) = 9$$

$$\Rightarrow \quad 3x + 3 = 9 \Rightarrow 3x = 6 \quad \text{or} \quad x = 2$$

Thus, $x = 2$ and $y = -3$ is the required solution.

22. (*a*) In Δs POQ and SOR, we have



PQ || RS [Given]

∴ ∠OPQ = ∠OSR [Alternate angles]

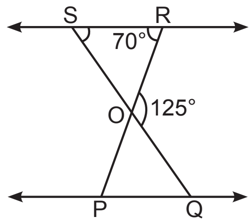
and ∠OQP = ∠ORS [Alternate angles]

also ∠POQ = ∠ROS [Vertically opposite angles]

∴ By AAA Similarity Criterion, ΔPOQ ~ ΔSOR.

OR

(*b*) In the figure, ΔOSR ~ ΔOQP, ∠ROQ = 125° and ∠ORS = 70° .



Since SOQ is line, we have

$$\angle ROS + \angle ROQ = 180°$$

$$\Rightarrow \quad \angle ROS + 125° = 180°$$

$$\Rightarrow \quad \angle ROS = 180° - 125° = 65°$$

∴ In ΔOSR, $\angle OSR = 180° - (\angle ROS + \angle ORS)$

$$= 180° - (65° + 70°)$$

$$= 180° - 135° = 45°$$

Also, $\angle OQP = \angle OSR$ [∵ Vertically opposite angles.]

$$\Rightarrow \quad \angle OQP = 45°$$

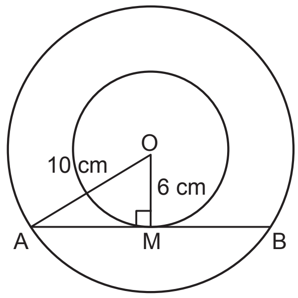
Hence, measures of ∠OSR and ∠OQP each is 45°.

23. In the figure, chord AB of larger circle touches the smaller circle at M. O is the common centre of the two circles.

∴ OM ⊥ AB [∵ Tangent is ⊥ to the radius through the point of contact.]

Also, OA = 10 cm and OM = 6 cm

In right ΔOMA, we have



$$AM = \sqrt{OA^2 - OM^2} = \sqrt{(10)^2 - (6)^2}$$

$$= \sqrt{100 - 36} = \sqrt{64} = 8 \text{ cm}$$

Since perpendicular drawn from the centre to a chord bisects the chord, M is the mid-point of AB.

∴ AB = 2 AM = 2 × 8 cm = 16 cm

Thus, length of the chord of larger circle is 16 cm.

24. (*a*) Given, $\tan(A + B) = 1$

and $\tan(A - B) = \frac{1}{\sqrt{3}}$, where $0° \le A < 90°$ and $0° \le B < 90°$

Now, $\tan(A + B) = 1$

$\Rightarrow \quad \tan(A + B) = \tan 45°$ [∵ tan 45° = 1]

$\Rightarrow \quad A + B = 45°$ ...(1)

and $\tan(A - B) = \frac{1}{\sqrt{3}}$

$\Rightarrow \quad \tan(A - B) = \tan 30°$ $\left[\because \tan 30° = \frac{1}{\sqrt{3}}\right]$

$\Rightarrow \quad A - B = 30°$ ...(2)

On adding eq. (1) and (2), we get

$$2A = 75° \quad \text{or} \quad A = 37\frac{1}{2}°$$

Putting the value of A in eq. (1), we get

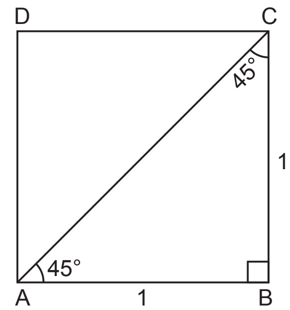
$$37\frac{1}{2}^\circ + B = 45^\circ$$

$$\Rightarrow \quad B = 45^\circ - 37\frac{1}{2}^\circ = 7\frac{1}{2}^\circ$$

Thus, $A = 37\frac{1}{2}^\circ$ and $B = 7\frac{1}{2}^\circ$ are the required values.

OR

(*b*) Draw a square ABCD with each side = 1 unit.



Join diagonal AC.

Clearly, $\angle ABC = 90^\circ$ and $\angle BAC = \angle BCA = 45^\circ$

Now, in right ΔABC,

$$\tan 45^\circ = \frac{BC}{AB}$$

$$\Rightarrow \quad \tan 45^\circ = \frac{1}{1} = 1$$

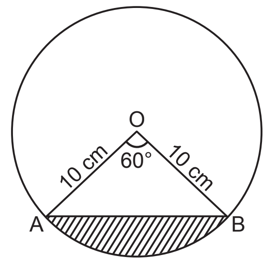
Hence, $\tan 45^\circ = 1$.

25. Let the chord AB subtend an angle 60° at the centre O of a circle whose diameter is 20 cm.

Then, $OA = OB = 10$ cm

$\Rightarrow \quad \angle OBA = \angle OAB$ [$\because$ Angles opposite to equal sides are equal.]

In ΔOAB,



$$\angle OAB + \angle OBA + \angle AOB = 180^\circ$$

$$\Rightarrow \quad 2\angle OAB + 60^\circ = 180^\circ$$

$$\Rightarrow \quad 2\angle OAB = 180^\circ - 60^\circ = 120^\circ$$

$$\Rightarrow \quad \angle OAB = 60^\circ$$

$$\therefore \quad \angle OAB = \angle OBA = 60^\circ$$

Hence, ΔOAB is an equilateral triangle of side 10 cm.

$\therefore$ Area of $\Delta OAB = \frac{\sqrt{3}}{4} \times (10)^2$ sq cm [$\because$ Area of equilateral triangle $= \frac{\sqrt{3}}{4}(\text{side})^2$]

$$= \frac{\sqrt{3}}{4} \times 100 \text{ sq cm}$$

$$= 25\sqrt{3} \text{ sq cm} = 25 \times 1.73 \text{ sq cm}$$

$$= 43.25 \text{ sq cm}$$

Also, area of sector AOB $= \frac{\pi r^2\theta}{360^\circ}$, where $\theta = 60^\circ$ and $r = 10$ cm

$$= \frac{\pi(10)^2 \times 60^\circ}{360^\circ} \text{ sq cm}$$

$$= \frac{100}{6}\pi \text{ sq cm} = \frac{100}{6} \times 3.14 \text{ sq cm} = 52.33 \text{ sq cm}$$

$\therefore$ Area of minor segment = Area of sector AOB – Area of ΔOAB

$$= 52.33 \text{ sq cm} - 43.25 \text{ sq cm}$$

$$= 9.08 \text{ sq cm.}$$

SECTION C

26. (*a*) Let us assume, to the contrary, that $\sqrt{3}$ is a rational number. Then,

$\sqrt{3} = \frac{p}{q}$, where p and q are integers having no common factor, and $q > 0$.

$\Rightarrow \quad 3 = \frac{p^2}{q^2}$ [Squaring both the sides]

$\Rightarrow \quad 3q^2 = p^2$

$\Rightarrow$ 3 divides p^2

$\Rightarrow$ 3 divides p [Since 3 is prime]

$\Rightarrow \quad p = 3n$, where n is an integer.

Also, $\quad 3q^2 = p^2$

$\Rightarrow \quad 3q^2 = (3n)^2 = 9n^2$

$\Rightarrow \quad q^2 = 3n^2$

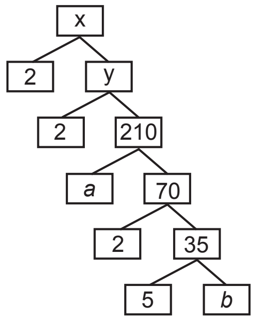
Arguing as above, we get 3 divides q.

Thus, both p and q have a common factor 3 which is a contradiction.

Hence, $\sqrt{3}$ is an irrational number.

OR

(*b*) In the factor tree, 35 is factorised into 5 and b.



Since $\quad 35 = 5 \times b$

$\Rightarrow \quad b = 35 \div 5 = 7$

Similarly, $\quad 210 = a \times 70$

$\Rightarrow \quad a = 210 \div 70 = 3$

Now, y is factorised into 2 and 210

$\therefore \quad y = 2 \times 210 = 420$

Finally, $\quad x = 2 \times y$

$\Rightarrow \quad x = 2 \times 420 = 840$

Thus, $x = 840$, $y = 420$, $a = 3$ and $b = 7$ are required values.

Hence, in the form of prime factors, the number $x = 840$ can be written as

$$840 = 2 \times 2 \times 3 \times 2 \times 5 \times 7.$$

27. Let α and β be the two zeros of the given quadratic polynomial. Then,

$$\alpha + \beta = 0 \quad \text{and} \quad \alpha\beta = -9$$

So, the required polynomials is

$$p(x) = x^2 - (\alpha + \beta)\, x + \alpha\beta$$
$$= x^2 - 0.x + (-9)$$
$$= x^2 - 9$$

Now, $x^2 - 9 = 0 \quad \Rightarrow \quad (x - 3)(x + 3) = 0$

$\Rightarrow \quad x = 3 \quad \text{or} \quad x = -3$

Thus, 3 and –3 are the two zeros of the given polynomial.

28. (*a*) The given system of equations is:

$$x + 3y = 6 \qquad \ldots(1)$$
$$2x - 3y = 12 \qquad \ldots(2)$$

To solve graphically, we draw the following tables of solutions.

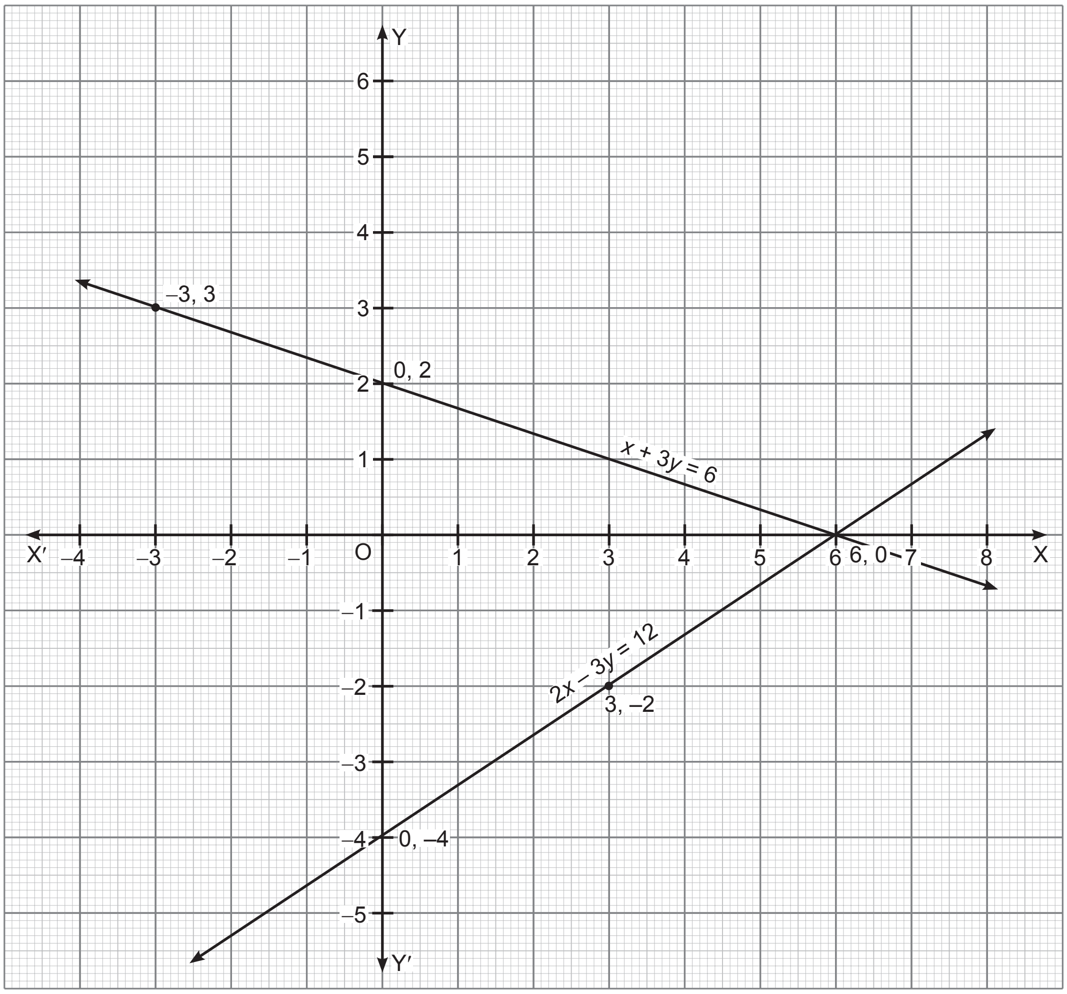
Solution table of eq. (1)

x	0	6	–3
y	2	0	3

Solution table of eq. (2)

x	0	6	3
y	–4	0	–2

We plot the above points on a graph as shown below



The two lines intersect each other at (6, 0), which is the required solution of the given equations.

OR

(*b*) Given that x and y are complementary angles, therefore

$$x + y = 90° \quad \ldots(1)$$

Also, $$\frac{x}{y} = \frac{1}{2}$$

$\Rightarrow$ $$2x = y$$

or $$2x - y = 0° \quad \ldots(2)$$

On adding eq. (1) and (2), we get

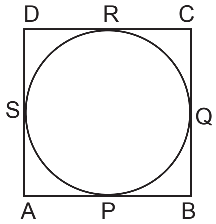
$$3x = 90° \quad \text{or} \quad x = 30°$$

Putting the value of x in eq. (1), we get

$$30° + y = 90° \quad \Rightarrow \quad y = 90° - 30° = 60°$$

Thus, $x = 30°$ and $y = 60°$ is the required solution.

29. In rectangle ABCD, we have



$$AB = DC \text{ and } AB \parallel DC$$

Also, $$AD = BC \text{ and } AD \parallel BC$$

Now, AP and AS are tangents to the circle from external point A. Therefore,

$$AS = AP$$

Similarly, we have $$BP = BQ$$

$$CR = CQ$$

and $$DR = DS$$

$$\therefore \quad AP + PB + CR + RD = AS + DS + BQ + CQ$$

$$\Rightarrow \quad AB + DC = AD + CB$$

$$\Rightarrow \quad 2AB = 2AD \Rightarrow AB = AD$$

$$\Rightarrow AB = BC = CD = DA$$

Hence, ABCD is a square.

30. We have, L.H.S. $= \dfrac{1+\cot^2 A}{1+\tan^2 A}$

$$= \frac{\text{cosec}^2 A}{\sec^2 A}$$

$$= \frac{\cos^2 A}{\sin^2 A} = \cot^2 A$$

and $$\text{R.H.S.} = \left(\frac{1-\cot A}{1-\tan A}\right)^2 = \left(\frac{1-\dfrac{\cos A}{\sin A}}{1-\dfrac{\sin A}{\cos A}}\right)^2$$

$$= \left(\frac{\dfrac{\sin A-\cos A}{\sin A}}{\dfrac{\cos A-\sin A}{\cos A}}\right)^2$$

$$= \frac{\cos^2 A(\sin A-\cos A)^2}{\sin^2 A(\cos A-\sin A)^2}$$

$$= \frac{\cos^2 A}{\sin^2 A} = \cot^2 A$$

Hence, L.H.S. = R.H.S. **Proved.**

31. When the shopkeeper draws the pen from first lot

Total number of pens in the lot = 200

Number of good pens = 180

$\therefore$ Number of defective pens = 200 – 180 = 20

Given that the customer will buy a pen if it is not defective.

or the customer will not buy the pen if it is defective.

$\therefore$ P(the customer will not buy the pen) $= \dfrac{\text{Number of defective pens}}{\text{Total number of pens in the lot}}$

$$= \frac{20}{200} = \frac{1}{10}.$$

Further,

Number of pens in another lot = 100

Number of good pens in the lot = 80

$\therefore$ Number of defective pens = 100 – 80 = 20

When the shopkeeper mixes the two lots

Total number pens in the entire lot = 300

Number of defective pens in the entire lot = 20 + 20 = 40

$\therefore$ Number of goods pens in the entire lot = 300 – 40 = 260

$$\therefore \text{P(the customer will buy the pen)} = \frac{\text{Number of good pens}}{\text{Total number of pens in the entire lot}}$$

$$= \frac{260}{300} = \frac{13}{15}.$$

SECTION D

32. (*a*) Let x and y be the two positive numbers, where $x > y$.

According to condition,

$$x^2 - y^2 = 180 \qquad \text{...(1)}$$

and $$y^2 = 8x \qquad \text{...(2)}$$

Putting $y^2 = 8x$ in eq. (1), we have

$$x^2 - 8x = 180$$

$\Rightarrow$ $$x^2 - 8x - 180 = 0$$

$\Rightarrow$ $$x^2 - 18x + 8x - 180 = 0$$

$\Rightarrow$ $$x(x - 18) + 8(x - 18) = 0$$

$\Rightarrow$ $$(x - 18)(x + 8) = 0$$

$\Rightarrow$ $$x = 18 \quad \text{or} \quad x = -8$$

$\Rightarrow$ $$x = 18$$ [$\because$ Since x and y are positive, $x = -8$ is not possible.]

From eq. (2), $$y^2 = 8 \times 18 = 144$$

$\Rightarrow$ $$y = 12$$ [Taking positive number only]

Thus, the two positive numbers are 18 and 12.

OR

(*b*) The given quadratic equation is:

$$2x^2 + kx + 3 = 0 \qquad \text{...(1)}$$

Here, $a = 2$, $b = k$ and $c = 3$

For real and equal roots, $b^2 - 4ac = 0$ or $b^2 = 4ac$

$\Rightarrow$ $$k^2 = 4 \times 2 \times 3$$

$\Rightarrow$ $$k^2 = 24 \quad \text{or} \quad k = \pm 2\sqrt{6}$$

So, the values of k for which eq. (1) has real and equal roots are $k = 2\sqrt{6}$ and $k = -2\sqrt{6}$.

Therefore, for $k = 2\sqrt{6}$, eq. (1) becomes

$$2x^2 + 2\sqrt{6}x + 3 = 0$$

By quadratic formula, we have $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

or $x = \dfrac{-b}{2a}$ [$\because$ For real and equal roots, $b^2 - 4ac = 0$]

$\Rightarrow$ $$x = \frac{-2\sqrt{6}}{2 \times 2} = \frac{-\sqrt{6}}{2}$$

For $k = -2\sqrt{6}$, eq. (1) becomes

$$2x^2 - 2\sqrt{6}x + 3 = 0$$

$\therefore \qquad x = \frac{-b}{2a} \quad \Rightarrow \quad x = \frac{2\sqrt{6}}{2 \times 2} = \frac{\sqrt{6}}{2}$

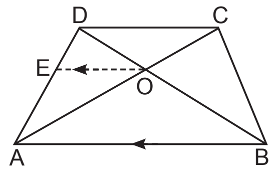
Thus, when $k = 2\sqrt{6}$, two equal roots are $\frac{-\sqrt{6}}{2}$ and $\frac{-\sqrt{6}}{2}$

and when $k = -2\sqrt{6}$ two equal roots are $\frac{\sqrt{6}}{2}$ and $\frac{\sqrt{6}}{2}$.

33. Basic Proportionality Theorem:

In a triangle a line drawn parallel to one side, to intersect the other two sides in distinct points, divides the two sides in the same ratio.

In quad. ABCD, we are given that



$$\frac{AO}{BO} = \frac{CO}{DO}$$

$$\Rightarrow \quad \frac{AO}{CO} = \frac{BO}{OD} \qquad ...(1) \qquad [\because DO = OD]$$

Draw OE || AB. Then, by BPT, we have

$$\frac{AE}{ED} = \frac{BO}{OD} \qquad ...(2)$$

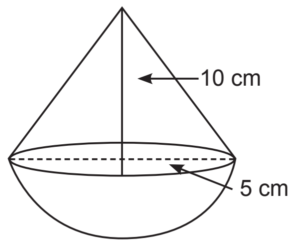
From (1) or (2), we have $\frac{AO}{CO} = \frac{AE}{ED}$

Thus, in ΔADC, OE divides the sides AC and AD in the same ratio. Therefore,

$$OE \parallel DC \quad \Rightarrow \quad AB \parallel DC. \qquad [\because OE \parallel AB]$$

Hence, quad. ABCD is a trapezium.

34. (*a*) For the given toy, we have



Radius of the conical part, $r = 5$ cm

Height of the conical part, $h = 10$ cm $\qquad [\because h = 2r]$

Given that cone and hemisphere have same radii, therefore

Radius of the hemisphere, $r = 5$ cm

$\therefore$ Volume of the toy = Volume of the cone + Volume of the hemisphere

$$= \frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3$$

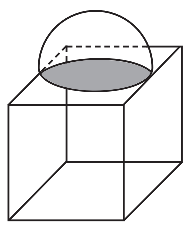
$$= \frac{1}{3}\pi r^2 (h + 2r)$$

$$= \frac{1}{3} \times \frac{22}{7} \times (5)^2[10 + 2 \times 5] \text{ cu cm}$$

$$= \frac{22 \times 25 \times 20}{21} \text{ cu cm} = 523.81 \text{ cu cm (approx).}$$

OR

(*b*) Given, radius of the hemisphere, $r = 3.5$ cm



The smallest possible length of the edge of cube so that hemisphere totally lie on the cube

$$= 2 \times r = 2 \times 3.5 \text{ cm, } i.e., \text{ 7 cm.}$$

Now,

Total surface area of the solid = Total surface area of the cube + Curved surface area of the hemisphere – Area of the base of the hemisphere

$= 6a^2 + 2\pi r^2 - \pi r^2$, where a is the edge of the cube

$$= 6a^2 + \pi r^2$$

$$= \left[6(7)^2 + \frac{22}{7} \times (3.5)^2\right] \text{ sq cm}$$

$$= (294 + 38.5) \text{ sq cm} = 332.5 \text{ sq cm.}$$

35. To find the mean lifetime, we apply 'step deviation method'.

For this, we take assumed mean, $A = 50$; class width, $h = 20$ and prepare the following table.

Lifetime (in hours)	*Frequency* (f_i)	*Class Mark* (x_i)	*Deviation* $\left(u_i = \frac{x_i - A}{h}\right)$	*Product* (f_iu_i)
0–20	10	10	–2	–20
20–40	35	30	–1	–35
40–60	50	50 = A	0	0
60–80	60	70	1	60
80–100	30	90	2	60
100–120	15	110	3	45
Total	$\Sigma f_i = 200$			$\Sigma f_iu_i = 110$

$\therefore$ Mean, $\bar{x} = A + \frac{\Sigma f_iu_i}{\Sigma f_i} \times h$

$$= 50 + \frac{110}{200} \times 20$$

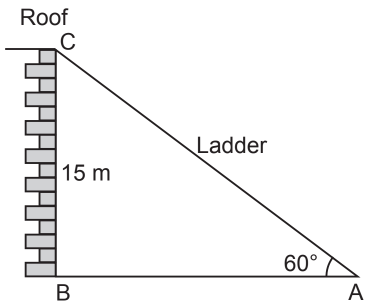
$$= 50 + \frac{110}{10} = 50 + 11 = 61$$

Thus, the mean lifetime of the electrical components is 61 hours.

SECTION E

36. (*i*) In the figure, BC is 15 m high building and AC is ladder making an angle 60° with the ground.

In right ΔABC, we have



$$\sin 60° = \frac{BC}{AC}$$

$$\Rightarrow \quad \frac{\sqrt{3}}{2} = \frac{15}{AC}$$

$$\Rightarrow \quad AC = \frac{30}{\sqrt{3}} \quad \text{or} \quad \frac{30 \times \sqrt{3}}{\sqrt{3} \times \sqrt{3}} = 10\sqrt{3} \text{ m}$$

Thus, length of the ladder is $10\sqrt{3}$ m.

(*ii*) From the figure, we have

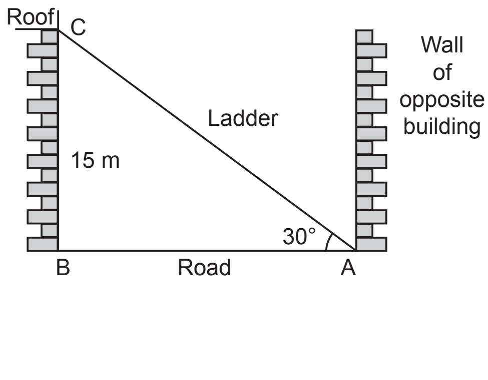
$$\tan 60° = \frac{BC}{AB}$$

$$\Rightarrow \quad \sqrt{3} = \frac{15}{AB} \quad \Rightarrow \quad AB = \frac{15}{\sqrt{3}} = \frac{15 \times \sqrt{3}}{\sqrt{3} \times \sqrt{3}} = 5\sqrt{3} \text{ m}$$

Thus, the distance of the point on the ground is $5\sqrt{3}$ m.

(*iii*) (*a*) The required diagram is represented alongside.

In the figure, we have



$$\tan 30° = \frac{BC}{BD}$$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{15}{BD} \quad \Rightarrow \quad BD = 15\sqrt{3} \text{ m}$$

Thus, width of the road is $15\sqrt{3}$ m.

OR

(*b*) From the figure,

$$\sin 30° = \frac{BC}{CD}$$

$$\Rightarrow \quad \frac{1}{2} = \frac{15}{CD} \Rightarrow CD = 30 \text{ m}$$

Thus, the length of the ladder used in this case is 30 m.

37. (*i*) According to the given information,

Radii of the spirals (in cm) starting with centre A are

50, 100, 150, …

which is clearly an A.P. with first term, $a = 50$ and

common difference, $d = 100 - 50 = 50$

$\therefore$ Radius of the 13th spiral, $a_{13} = 50 + (13 - 1) \times 50$ [Using $a_n = a + (n-1)d$]

$= 50 + 12 \times 50$

$= 50 + 600 = 650$

So, radius of the 13th spiral is 650 cm.

(*ii*) Given, radius of the *n*th spiral is 500 cm.

$\therefore \quad a_n = 500$

$\Rightarrow \quad a + (n-1)d = 500$

$\Rightarrow \quad 50 + (n-1)\, 50 = 500$

$\Rightarrow \quad (n-1)\, 50 = 500 - 50 = 450$

$\Rightarrow \quad n - 1 = \frac{450}{50} = 9 \quad \Rightarrow \quad n = 10$

(*iii*) (*a*) Number of rose flowers saplings in spirals starting with centre A are 10, 20, 30, …, which is an A.P.

To find the total number of saplings till the 11th spiral, we use the formula,

$S_n = \frac{n}{2}[2a + (n-1)d]$

Here, $a = 10$, $d = 20 - 10 = 10$, $n = 11$

$\therefore S_{11} = \frac{11}{2}[2 \times 10 + (11-1) \times 10]$

$= \frac{11}{2}[20 + 10 \times 10] = \frac{11}{2}[20 + 100]$

$= \frac{11}{2} \times 120 = 660$

Thus, there are 660 saplings till the 11th spiral.

OR

(*b*) Let *n* be the number of spirals up to which there are 450 saplings.

So, by the formula, $S_n = \frac{n}{2}[2a + (n-1)d]$, we have

$450 = \frac{n}{2}[2 \times 10 + (n-1) \times 10]$

$\Rightarrow \quad 450 = \frac{n}{2}[20 + 10n - 10]$

$\Rightarrow \quad 900 = n(10n + 10)$

$\Rightarrow \quad 10n^2 + 10n - 900 = 0$

$\Rightarrow \quad n^2 + n - 90 = 0$

$\Rightarrow \quad n^2 + 10n - 9n - 90 = 0$

$\Rightarrow \quad n(n + 10) - 9(n + 10) = 0$

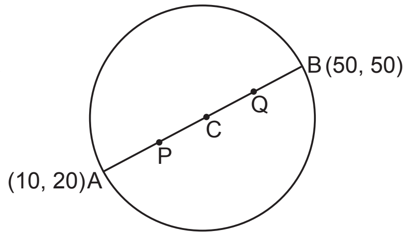
$\Rightarrow \quad (n + 10)(n - 9) = 0$

$\Rightarrow n = 9$ or $n = -10$

$\Rightarrow n = 9$ [$\because$ $n = -10$ is not possible.]

Thus, till 9th spiral, there will be a total of 450 saplings.

38. In the figure, A(10, 20) and B(50, 50) are the points where two gates in the circular park are placed. P and Q represents the points where two fountains are installed.



(*i*) Clearly, AB is the diameter of the circle with centre C.

So, C is the mid-point of AB

$\therefore$ Coordinates of C $= \left(\frac{10+50}{2}, \frac{20+50}{2}\right)$ [Using mid-point formula]

$= (30, 35)$

(*ii*) Here, AC or BC is the radius of the circular park.

$\therefore \quad AC = \sqrt{(30-10)^2 + (35-20)^2}$ [Using distance formula]

$= \sqrt{(20)^2 + (15)^2}$

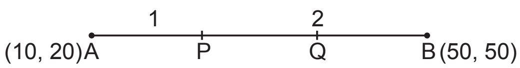
$= \sqrt{400+225} = \sqrt{625} = 25$

Thus, radius of the circular park is 25 units.

(*iii*) (*a*) Given that AP = PB = QB, *i.e.*, P and Q trisect the line segment AB.

$\therefore$ AP : PB = 1 : 2

By section formula, we have



Coordinates of P $= \left(\frac{1\times 50 + 2\times 10}{1+2}, \frac{1\times 50+2\times 20}{1+2}\right)$

$= \left(\frac{50+20}{3}, \frac{50+40}{4}\right) = \left(\frac{70}{3}, \frac{90}{3}\right) = \left(\frac{70}{3}, 30\right)$

Thus, coordinates of P are $\left(\frac{70}{3}, 30\right)$.

OR

(*b*) We have,

$AP + PQ + QB = AB$

$\Rightarrow \quad 3AP = AB$ [$\because$ AP = PQ = QB]

$\Rightarrow \quad 3AP = 2 \times AC$

$\Rightarrow \quad 3AP = 50$ [$\because$ AC = 25, from part (*ii*)]

$\Rightarrow \quad AP = \frac{50}{3}$

Since AQ = AP + PQ = 2AP, we have

$AP = 2 \times \frac{50}{3} = \frac{100}{3}$ units.

Solutions—CBSE Board Question Paper (Standard) 2025

SECTION A

1. (*d*) For the polynomial $3x^2 + 6x + k$, we have

$$a = 3,\ b = 6 \text{ and } c = k$$

$$\therefore \quad \alpha + \beta + \alpha\beta = \frac{-2}{3}$$

$$\Rightarrow \quad \frac{-b}{a} + \frac{c}{a} = \frac{-2}{3} \qquad \left[\because \alpha + \beta = -\frac{b}{a} \text{ and } \alpha\beta = \frac{c}{a}\right]$$

$$\Rightarrow \quad \frac{-6}{3} + \frac{k}{3} = \frac{-2}{3}$$

$$\Rightarrow \quad -2 + \frac{k}{3} = \frac{-2}{3}$$

$$\Rightarrow \quad \frac{k}{3} = \frac{-2}{3} + 2$$

$$\Rightarrow \quad \frac{k}{3} = \frac{4}{3} \quad \text{or} \quad k = 4.$$

2. (*b*) Since $x = 1$ and $y = 2$ is a solution of $2x - 3y + a = 0$ and $2x + 3y - b = 0$, we have

$$2(1) - 3(2) + a = 0 \ \Rightarrow\ 2 - 6 + a = 0 \ \Rightarrow\ a = 4$$

and $$2(1) + 3(2) - b = 0 \ \Rightarrow\ 2 + 6 - b = 0 \ \Rightarrow\ b = 8$$

$\therefore\ 2a = b.$

3. (*b*) The mid-point of P(–4, 5) and Q(4, 6) is $\left(\frac{-4+4}{2}, \frac{5+6}{2}\right)$, *i.e.*, $\left(0, \frac{11}{2}\right)$

Since abscissa of the mid-point is 0, the point lies on y-axis.

4. (*b*) Given, $7 + 4\sin\theta = 9$

$$\Rightarrow \quad 4\sin\theta = 9 - 7$$

$$\Rightarrow \quad 4\sin\theta = 2 \ \Rightarrow\ \sin\theta = \frac{1}{2}$$

$$\Rightarrow\ \sin\theta = \sin 30° \ \Rightarrow\ \theta = 30°. \qquad [\because \theta \text{ is an acute angle.}]$$

5. (*c*) We have, $\tan^2\theta - \left(\frac{1}{\cos\theta} \times \sec\theta\right)$

$$= \tan^2\theta - (\sec\theta \times \sec\theta)$$

$$= \tan^2\theta - \sec^2\theta = -1. \qquad [\because \sec^2\theta - \tan^2\theta = 1]$$

6. (*c*) Given, HCF (98, 28) = m and LCM (98, 28) = n

By prime factorisation, $98 = 2 \times 7 \times 7$

and $28 = 2 \times 2 \times 7$

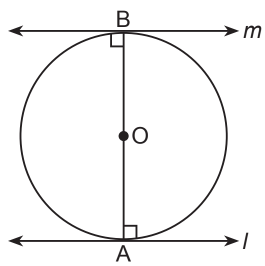
$\therefore$ HCF (98, 28) = $2 \times 7 = 14 \ \Rightarrow\ m = 14$

and LCM (98, 28) = $2 \times 2 \times 7 = 196 \ \Rightarrow\ n = 196$

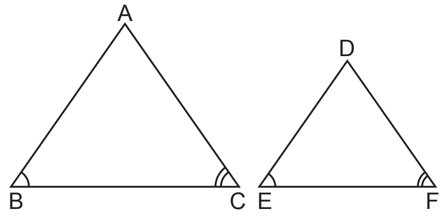
$\therefore\ n - 7m = 196 - 7 \times 14 = 196 - 98 = 98.$

7. (*a*) Here, OA ⊥ l and OB ⊥ m, the alternate angles at A and B are equal.

Therefore, $l \parallel m$, *i.e.*, the tangents are parallel.



8. (*d*) In Δs ABC and DEF, we have



$$\angle B = \angle E, \quad \angle C = \angle F$$

and AB = 3DE or $\dfrac{AB}{DE} = \dfrac{3}{1}$

$\therefore$ By AA Similarity Criterion, $\Delta ABC \sim \Delta DEF$

Since AB $\neq$ DE, AAS Congruence Criterion does not hold, therefore ΔABC is not congruent to ΔDEF.

Hence, the two triangles are similar but not congruent.

9. (*c*) We know that $(-1)^n = -1$ if n is any odd number and $(-1)^n = 1$ if n is any even number.

Given, $(-1)^n + (-1)^8 = 0$

$\Rightarrow \quad (-1)^n + 1 = 0 \qquad [\because (-1)^8 = 1]$

$\Rightarrow \quad (-1)^n = -1 \quad \Rightarrow \quad n$ is any odd number.

10. (*c*) In the given figure, the two polynomials intersect each other at two distinct points, on x-axis. Therefore, both the polynomials have two distinct zeros.

11. (*b*) Given, $S_m = 2m^2 + 3m$

Putting $m = 1$, we get

$$S_1 = 2(1)^2 + 3(1) = 2 + 3 = 5$$

Putting $m = 2$, we get

$$S_2 = 2(2)^2 + 3(2)$$
$$= 2(4) + 6 = 8 + 6 = 14$$

Using the relation, $a_n = S_n - S_{n-1}$, we have

Second term, $a_2 = S_2 - S_1$

$= 14 - 5 = 9.$

12. (*c*) Putting the values of mode and mean in the empirical formula,

$$3\text{Median} = \text{Mode} + 2\text{Mean, we have}$$

$$3\text{Median} = 15x + 2 \times 18x \qquad [\because \text{Mode} = 15x \text{ and Mean} = 18x]$$

$$= 15x + 36x = 51x$$

$\therefore \quad \text{Median} = \dfrac{51x}{3} = 17x.$

13. (*d*) There are 6 red face cards in the deck of 52 playing cards. Therefore,

$$P(a \text{ red face card}) = \frac{\text{Number of red face cards}}{\text{Total number of cards in the deck}}$$

$$= \frac{6}{52} = \frac{3}{26}.$$

14. (*d*) Up to 3 decimal places, $\sqrt{3} = 1.732$ and $\sqrt{5} = 2.236$

$\because \quad 1.732 < 1.857142 < 2.236$

$\Rightarrow \quad \sqrt{3} < 1.857142 < \sqrt{5}$

Thus, the required rational number is 1.857142.

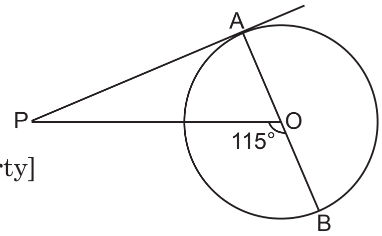
15. (*d*) Area of a sector of a circle of radius r is given by

$$A = \frac{\pi r^2 \theta}{360°}$$

$\therefore \quad 40\pi = \dfrac{\pi r^2 \times 72°}{360°} \qquad [\because \theta = 72°]$

$\Rightarrow \quad 40 = \dfrac{r^2}{5} \quad \Rightarrow \quad r^2 = 200$

or $\quad r = \sqrt{200} = 10\sqrt{2}$ units.



16. (*a*) In the figure, PA is tangent to the circle. Therefore,

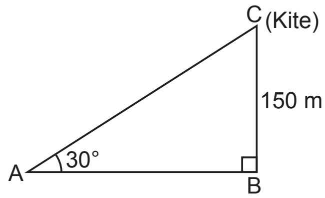
$\angle PAO = 90°$ [$\because$ Tangent is $\perp$ to radius through the point of contact.]

Since $\angle POB$ is an exterior angle of ΔPAO, we have

$\angle APO + \angle PAO = \angle POB$ [By exterior angle property]

$\Rightarrow \quad \angle APO + 90° = 115°$

$\Rightarrow \quad \angle APO = 115° - 90° = 25°.$



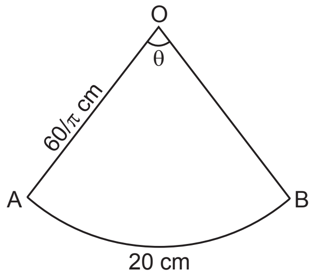
17. (*b*) In the figure, AC is the length of the string.

Therefore, in right ΔABC

$$\sin 30° = \frac{BC}{AC}$$

$$\Rightarrow \quad \frac{1}{2} = \frac{150}{AC}$$

$$\Rightarrow \quad AC = 300 \text{ m}.$$



18. (*b*) Let the wire bent in the form of an arc AB subtend an angle θ at the centre O of the circle.

$\therefore$ Arc length AB $= \dfrac{2\pi r\theta}{360°}$

$$\Rightarrow \quad 20 = \frac{2\pi \times \frac{60}{\pi} \times \theta}{360°}$$

$$\Rightarrow \quad 20 = \frac{120 \times \theta}{360°} \quad \Rightarrow \quad \theta = \frac{360° \times 20}{120°} = 60°.$$

19. (*a*) Assertion (A) is true:

From numbers 1 to 20 there are 20 numbers and any one of these numbers can be selected at random.

$\therefore$ The probability of selecting a number at random from the numbers 1 to 20 is $\frac{20}{20}$, *i.e.*, 1.

So, the event is a sure event.

Therefore, Assertion (A) is true.

Reason (R) is true:

An event is called a sure event if its probability is 1.
So, the given statement is true.
Therefore, Reason (R) is true and the correct explanation of Assertion (A).
Hence, option (*a*) is the correct answer.

20. (*c*) Assertion (A) is true:

If we join two hemispheres of same radii along their bases, then we get a sphere.
So, the given statement is true.
Therefore, Assertion (A) is true.

Reason (R) is false:

Total surface area of a sphere of radius r is $4\pi r^2$.
Therefore, Reason (R) is false.
Hence, option (*c*) is the correct answer.

SECTION B

21. (*a*) Given, $x \cos 60° + y \cos 0° + \sin 30° - \cot 45° = 5$

$\Rightarrow \quad x \times \frac{1}{2} + y \times 1 + \frac{1}{2} - 1 = 5$ $\left[\because \sin 30° = \cos 60° = \frac{1}{2} \text{ and } \cos 0° = \cot 45° = 1\right]$

$\Rightarrow \quad \frac{x}{2} + y - \frac{1}{2} = 5$

$$\Rightarrow \quad \frac{x}{2} + y = 5 + \frac{1}{2}$$

$$\Rightarrow \quad \frac{x+2y}{2} = \frac{11}{2} \quad \Rightarrow \quad x + 2y = 11$$

Thus, the value of $x + 2y$ is 11.

OR

(*b*) We have, $\dfrac{\tan^2 60°}{\sin^2 60° + \cos^2 30°}$

$$= \frac{(\sqrt{3})^2}{\left(\frac{\sqrt{3}}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2} \qquad \left[\because \tan 60° = \sqrt{3} \text{ and } \sin 60° = \cos 30° = \frac{\sqrt{3}}{2}\right]$$

$$= \frac{3}{\frac{3}{4} + \frac{3}{4}} = \frac{3}{\frac{6}{4}}$$

$$= \frac{3 \times 4}{6} = 2$$

Thus, value of the given expression is 2.

22. The given polynomial $p(x) = x^2 + \frac{4}{3}x - \frac{4}{3}$ can be rewritten as

$$p(x) = \frac{1}{3}(3x^2 + 4x - 4)$$

By factorisation, we have

$$\begin{aligned} 3x^2 + 4x - 4 &= 3x^2 + 6x - 2x - 4 \\ &= 3x(x + 2) - 2(x + 2) \\ &= (x + 2)(3x - 2) \end{aligned}$$

$$\therefore \quad p(x) = \frac{1}{3}(x + 2)(3x - 2)$$

Now, zeros of a polynomial are given by $p(x) = 0$. Therefore,

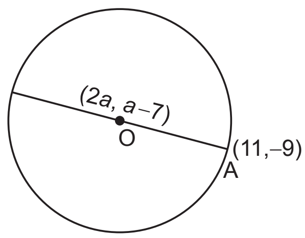
$$p(x) = 0 \quad \Rightarrow \quad \frac{1}{3}(x + 2)(3x - 2) = 0$$

$$\Rightarrow \quad x + 2 = 0 \quad \text{or} \quad 3x - 2 = 0$$

$$\Rightarrow \quad x = -2 \quad \text{or} \quad x = \frac{2}{3}$$

Thus, the zeros of the given polynomial are -2 and $\frac{2}{3}$.

23. Let A(11, –9) be a point on the circle. So, OA is the radius of the circle.



Given, diameter of the circle is $10\sqrt{2}$ units.

Therefore, radius OA = $5\sqrt{2}$ units

By distance formula, OA = $\sqrt{(2a-11)^2 + (a-7+9)^2}$

$$\Rightarrow \quad 5\sqrt{2} = \sqrt{(2a-11)^2 + (a+2)^2}$$

$$\Rightarrow \quad (5\sqrt{2})^2 = (2a - 11)^2 + (a + 2)^2$$

$$\Rightarrow \quad 50 = 4a^2 + 121 - 44a + a^2 + 4 + 4a$$

$$\Rightarrow \quad 5a^2 - 40a + 75 = 0$$

$$\Rightarrow \quad a^2 - 8a + 15 = 0$$

$$\Rightarrow \quad a^2 - 5a - 3a + 15 = 0$$

$$\Rightarrow \quad a(a - 5) - 3(a - 5) = 0$$

$$\Rightarrow \quad (a - 5)(a - 3) = 0$$

$$\Rightarrow \quad a = 3 \quad \text{or} \quad a = 5$$

Thus, the values of a are 3 or 5.

24. (*a*) Given that $\Delta ABC \sim \Delta PQR$. Therefore,

$$\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR}$$

Putting the values of AB, BC, AC and PR, we have

$$\frac{6}{PQ} = \frac{4}{QR} = \frac{8}{6}$$

$$\Rightarrow \quad \frac{6}{PQ} = \frac{4}{QR} = \frac{4}{3}$$

$$\Rightarrow \quad \frac{6}{PQ} = \frac{4}{3} \quad \text{and} \quad \frac{4}{QR} = \frac{4}{3}$$

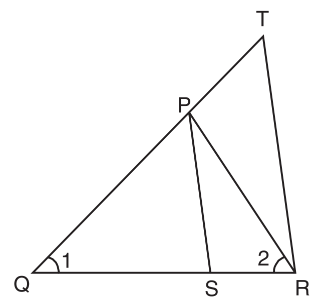
$$\Rightarrow \quad PQ = \frac{6 \times 3}{4} \quad \text{and} \quad QR = \frac{4 \times 3}{4}$$

$$\Rightarrow \quad PQ = 4.5 \quad \text{and} \quad QR = 3$$

Thus, the length of PQ + QR is (4.5 + 3) cm, *i.e.*, 7.5 cm.

OR

(*b*) We have,



$$\frac{QR}{QS} = \frac{QT}{PR} \quad \Rightarrow \quad \frac{QT}{QR} = \frac{PR}{QS}$$

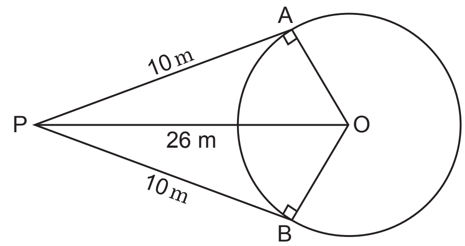
Also, $\angle 1 = \angle 2$ gives PR = QP $\Rightarrow \quad \frac{QT}{QR} = \frac{QP}{QS}$

Now, in Δs PQS and TQR, we have

$$\frac{PQ}{QS} = \frac{TQ}{QR} \quad \text{and} \quad \angle Q = \angle Q$$ [Each is equal to $\angle 1$.]

By SAS Similarity Criterion, Δ PQS ~ Δ TQR.

25. Given, PA and PB are tangents to the circle, therefore



$\angle OAP = \angle OBP = 90°$ [$\because$ Tangent is $\perp$ to the radius through the point of contact.]

$\therefore$ In right ΔOAP, we have

$$OP^2 = OA^2 + PA^2$$

$$\Rightarrow \quad (26)^2 = OA^2 + (10)^2$$

$$\Rightarrow \quad 676 = OA^2 + 100$$

$$\Rightarrow \quad OA^2 = 676 - 100 = 576$$

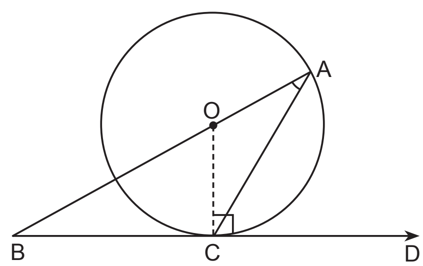
$$\Rightarrow \quad OA = 24 \text{ m}$$

Thus, radius of the circular ground is 24 m.

SECTION C

26. (*a*) Given that BCD is the tangent to the circle at C, therefore

OC $\perp$ BD [$\because$ Tangent is $\perp$ to the radius through the point of contact.]



or OC $\perp$ CD

$\Rightarrow \quad \angle OCD = 90°$

$\Rightarrow \quad \angle OCA + \angle ACD = 90°$ ...(1)

Also, in ΔOAC, OA = OC [$\because$ Radii of same circle]

$\Rightarrow \quad \angle OCA = \angle OAC$

$\therefore$ From (1), we have

$\angle OAC + \angle ACD = 90°$ [$\because \angle OCA = \angle OAC$]

or $\angle BAC + \angle ACD = 90°$ **Proved**.

OR

(*b*) Let quad. ABCD circumscribe a circle with centre O.

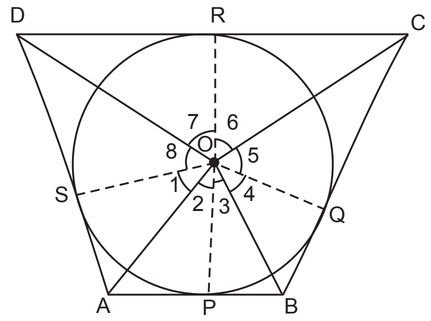
We have to prove that

$\angle AOB + \angle COD = 180°$

and $\angle BOC + \angle AOD = 180°$

Join OP, OQ, OR and OS.

Mark angles 1 to 8 as shown in the figure.



We know that the two tangents drawn from an external point to a circle subtend equal angles at the centre.

$\therefore$ $\angle 1 = \angle 2;\ \angle 3 = \angle 4;\ \angle 5 = \angle 6;\ \angle 7 = \angle 8.$

But $\angle 1 + \angle 2 + \ldots + \angle 7 + \angle 8 = 360°$

$\Rightarrow$ $2(\angle 2 + \angle 3 + \angle 6 + \angle 7) = 360°$ and $2(\angle 1 + \angle 8 + \angle 4 + \angle 5) = 360°$

$\Rightarrow$ $(\angle 2 + \angle 3) + (\angle 6 + \angle 7) = 180°$ and $(\angle 1 + \angle 8) + (\angle 4 + \angle 5) = 180°$

$\Rightarrow$ $\angle AOB + \angle COD = 180°$ and $\angle AOD + \angle BOC = 180°$ **Proved**.

27. (*a*) L.H.S. $= \dfrac{\tan\theta}{1-\cot\theta} + \dfrac{\cot\theta}{1-\tan\theta} = \dfrac{\frac{\sin\theta}{\cos\theta}}{1-\frac{\cos\theta}{\sin\theta}} + \dfrac{\frac{\cos\theta}{\sin\theta}}{1-\frac{\sin\theta}{\cos\theta}}$

$$= \frac{\frac{\sin\theta}{\cos\theta}}{\frac{\sin\theta-\cos\theta}{\sin\theta}} + \frac{\frac{\cos\theta}{\sin\theta}}{\frac{\cos\theta-\sin\theta}{\cos\theta}}$$

$$= \frac{\sin\theta}{\cos\theta} \times \frac{\sin\theta}{\sin\theta-\cos\theta} + \frac{\cos\theta}{\sin\theta} \times \frac{\cos\theta}{\cos\theta-\sin\theta}$$

$$= \frac{\sin^2\theta}{\cos(\sin\theta-\cos\theta)} - \frac{\cos^2\theta}{\sin\theta\,(\sin\theta-\cos\theta)}$$

$$= \frac{\sin^3\theta-\cos^3\theta}{\sin\theta\cos\theta(\sin\theta-\cos\theta)}$$

$$= \frac{(\sin\theta-\cos\theta)(\sin^2\theta+\cos^2\theta+\sin\theta\cos\theta)}{\sin\theta\cos\theta(\sin\theta-\cos\theta)}$$

$$= \frac{1+\sin\theta\cos\theta}{\sin\theta\cos\theta}$$

$$= \frac{1}{\sin\theta\cos\theta} + 1$$

$= \sec\theta\ \text{cosec}\,\theta + 1 =$ R.H.S.

OR

(*b*) L.H.S. $= \dfrac{\sin A+\cos A}{\sin A-\cos A} + \dfrac{\sin A-\cos A}{\sin A+\cos A}$

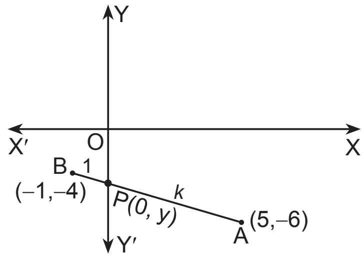
$$= \frac{(\sin A+\cos A)(\sin A+\cos A)+(\sin A-\cos A)(\sin A-\cos A)}{(\sin A-\cos A)(\sin A+\cos A)}$$

$$= \frac{2(\sin^2 A+\cos^2 A)}{\sin^2 A-\cos^2 A} = \frac{2}{\sin^2 A-\cos^2 A}$$

$$= \frac{2}{\sin^2 A-(1-\sin^2 A)}$$

$$= \frac{2}{\sin^2 A-1+\sin^2 A} = \frac{2}{2\sin^2 A-1} = \text{R.H.S.}$$

28. Let A(5, –6) and B(–1, –4) be the given points and the y-axis divides the line segment joining the points A and B, in the ratio $k : 1$, at P(0, y). Then,



By section formula, we have

$$(0, y) = \left(\frac{k \times (-1) + 1 \times 5}{k+1}, \frac{k \times (-4) + 1 \times (-6)}{k+1}\right)$$

$$(0, y) = \left(\frac{-k+5}{k+1}, \frac{-4k-6}{k+1}\right)$$

Equating x-coordinates on both sides, we get

$$0 = \frac{-k+5}{k+1} \quad \Rightarrow \quad k = 5$$

Thus, the required ratio is 5 : 1.

Also, y-coordinate of point P is given by $y = \dfrac{-4k-6}{k+1}$

$\Rightarrow$ $$y = \frac{-4 \times 5 - 6}{5+1} \qquad [\because k = 5]$$

$$= \frac{-20-6}{6} = \frac{-26}{6} \quad \text{or} \quad \frac{-13}{3}$$

Thus, the point of intersection is $\left(0, \dfrac{-13}{3}\right)$.

29. Let us assume that $\dfrac{1}{\sqrt{5}}$ is a rational number.

Then, $\dfrac{1}{\sqrt{5}} = \dfrac{p}{q}$, where p and q are some integers having no common factor, and $q > 0$.

$\Rightarrow$ $\dfrac{1}{5} = \dfrac{p^2}{q^2}$

$\Rightarrow$ $q^2 = 5p^2$ ...(1)

$\Rightarrow$ 5 divides q^2

$\Rightarrow$ 5 divides q [$\because$ 5 is a prime number.]

$\Rightarrow$ $q = 5n$, where n is some integer

Now, from (1), $q^2 = 5p^2$

$\Rightarrow$ $(5n)^2 = 5p^2$

$\Rightarrow$ $25n^2 = 5p^2$

$\Rightarrow$ $p^2 = 5n^2$

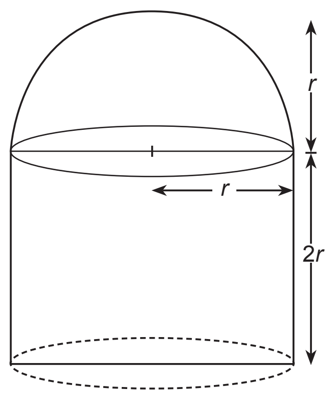
$\Rightarrow$ 5 divides p^2

$\Rightarrow$ 5 divides p [$\because$ 5 is a prime number.]

Thus, both p and q have a common factor 5 which contradicts our assumption that $\dfrac{1}{\sqrt{5}}$ is a rational number.

Hence, $\dfrac{1}{\sqrt{5}}$ is an irrational number.

30. Let r m be the radius of the hemispherical dome. Then,



height of the cylindrical part, $h = 2r$ m

$\therefore$ Volume of air in the room

= Volume of the hemispherical part + Volume of the cylindrical part

$$= \frac{2}{3}\pi r^3 + \pi r^2 h$$

$$= \frac{2}{3}\pi r^3 + \pi r^2 (2r) = \frac{2}{3}\pi r^3 + 2\pi r^3$$

$$= \frac{8}{3}\pi r^3$$

Given that volume of air in the room is $\frac{1408}{21}$ m^3.

Therefore, $\frac{8}{3}\pi r^3 = \frac{1408}{21}$

$\Rightarrow$ $\frac{8}{3} \times \frac{22}{7} \times r^3 = \frac{1408}{21}$

$\Rightarrow$ $r^3 = \frac{1408 \times 3 \times 7}{8 \times 22 \times 21} = 8$

$\Rightarrow$ $r = 2$ m

Thus, the height of the cylindrical part is 2 × 2 m, *i.e.*, 4 m.

31. When two dice are thrown simultaneously, the possible number of outcomes are 6 × 6, *i.e.*, 36.

So, total number of possible outcomes = 36.

The difference of the numbers on the two dice will be 2 if the numbers in pairs are (1, 3), (2, 4), (3, 5), (4, 6), (3, 1), (4, 2), (5, 3) and (6, 4).

So, favourable number of outcomes = 8

$\therefore$ Required probability $= \frac{\text{Favourable number of outcomes}}{\text{Total number of possible outcomes}}$

$$= \frac{8}{36} \text{ or } \frac{2}{9}.$$

SECTION D

32. Let money invested in schemes A and B respectively be ₹ x and ₹ y. Then,
According to condition,

$$8\% \text{ of } x + 9\% \text{ of } y = 1860$$

$\Rightarrow$ $\frac{8}{100}x + \frac{9}{100}y = 1860$

or $8x + 9y = 186000$ ...(1)

When the amounts are interchanged

$$9\% \text{ of } x + 8\% \text{ of } y = 1860 + 20$$

$\Rightarrow$ $\frac{9}{100}x + \frac{8}{100}y = 1880$

$\Rightarrow$ $9x + 8y = 188000$ ...(2)

On adding eqs. (1) and (2), we get

$$17x + 17y = 374000$$

$\Rightarrow$ $x + y = 22000$ ...(3)

On subtracting eq. (1) from eq. (2), we get

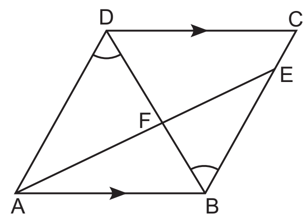
$$x - y = 2000$$ ...(4)

On solving eqs. (3) and (4), we get

$$x = 12000 \text{ and } y = 10000.$$

Thus, Vijay invested ₹ 12,000 in scheme A and ₹ 10,000 in scheme B.

33. (*a*) Consider Δs AFD and EFB



Here, $\angle AFD = \angle EFB$ [Vertically opposite angles]

and $\angle ADF = \angle EBF$ [Alternate angles]

So, by AA Similarity Criterion, we have

$$\Delta AFD \sim \Delta EFB$$

$\Rightarrow \quad \frac{FA}{DF} = \frac{EF}{BF}$

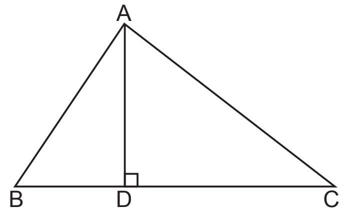
$\Rightarrow \quad FA \times FB = DF \times EF$

or $\quad DF \times EF = FB \times FA$ **Proved**.

OR

(*b*) *Given*: In ΔABC, $AD \perp BC$ and $AD^2 = BD \times DC$

To Prove: $\angle BAC = 90°$



Proof: In right ΔADB, by Pythagoras' Theorem, we have

$$AB^2 = BD^2 + AD^2 \quad ...(1)$$

Similarly, in right ΔADC, we have

$$AC^2 = CD^2 + AD^2 \quad ...(2)$$

On adding (1) and (2), we get

$$AB^2 + AC^2 = BD^2 + CD^2 + 2AD^2$$

$$= BD^2 + CD^2 + 2(BD \times CD) \quad [\because AD^2 = BD \times DC]$$

$$= (BD + CD)^2 = BC^2$$

Therefore, $AB^2 + AC^2 = BC^2$, *i.e.*, ΔABC is a right triangle right-angled at A.

Hence, $\angle BAC = 90°$ **Proved.**

34. (*a*) Let ΔABC be the right triangle right-angled at B such that its hypotenuse AC is 25 cm.

Also, let AB = x cm and BC = y cm.

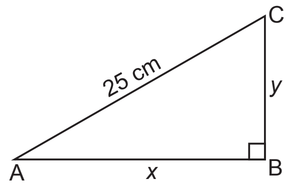
Then, according to condition,

$$AB + BC + CA = 60 \quad [\because \text{Perimeter of } \Delta ABC \text{ is 60 cm.}]$$

$\Rightarrow \quad x + y + 25 = 60$

$\Rightarrow \quad x + y = 60 - 25 = 35$

$\therefore \quad y = 35 - x$



Now, by Pythagoras' Theorem,

$$x^2 + y^2 = 25^2$$

$\Rightarrow \quad x^2 + (35 - x)^2 = 625$

$\Rightarrow \quad x^2 + 1225 + x^2 - 70x = 625$

$\Rightarrow \quad 2x^2 - 70x + 600 = 0$

$\Rightarrow \quad x^2 - 35x + 300 = 0$

$\Rightarrow \quad x^2 - 20x - 15x + 300 = 0$

$\Rightarrow \quad x(x - 20) - 15(x - 20) = 0$

$\Rightarrow \quad (x - 20)(x - 15) = 0$

$\Rightarrow \quad x = 20 \quad \text{or} \quad x = 15$

When $x = 20$, we have $y = 35 - 20 = 15$

When $x = 15$, we have $y = 35 - 15 = 20$

Thus, the lengths of the other two sides are 20 cm and 15 cm.

OR

(*b*) Let speed of the train be x km/h. Then,

Time taken by the train to travel 480 km with original speed

$$= \frac{480}{x} \text{ hours}$$

Time taken by the train to travel 480 km with reduced speed

$$= \frac{480}{x - 8} \text{ hours}$$

Given that with reduced speed the train takes 3 hours more to cover the same distance

$\therefore \quad \frac{480}{x-8} - \frac{480}{x} = 3$

$\Rightarrow \quad 480\left(\frac{1}{x-8} - \frac{1}{x}\right) = 3$

$\Rightarrow \quad \frac{x-(x-8)}{x(x-8)} = \frac{3}{480}$

$\Rightarrow \quad \frac{8}{x(x-8)} = \frac{1}{160}$

$\Rightarrow \quad x^2 - 8x = 1280$

$\Rightarrow \quad x^2 - 8x - 1280 = 0$

$\Rightarrow \quad x^2 - 40x + 32x - 1280 = 0$

$\Rightarrow \quad x(x-40) + 32(x-40) = 0$

$\Rightarrow \quad (x-40)(x+32) = 0$

$\Rightarrow \quad x = 40 \quad \text{or} \quad x = -32$

$\Rightarrow \quad x = 40$ [$\because x = -32$ is not possible.]

Thus, the speed of the train is 40 km/h.

35. Finding the missing frequency(f):

To find the missing frequency, we apply the direct method.

For this, we prepare the following table:

Daily Allowance (C.I.)	*Number of Children* (f)	*Class Mark* (x_1)	*Product* ($f_i x_i$)
11–13	7	12	84
13–15	6	14	84
15–17	9	16	144
17–19	13	18	234
19–21	f	20	$20f$
21–23	5	22	110
23–25	4	24	96
Total	$\Sigma f_i = 44 + f$		$\Sigma f_i x_i = 752 + 20f$

$\therefore \quad \text{Mean, } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$

$\Rightarrow \quad 18 = \frac{752 + 20f}{44 + f}$ [$\because$ Mean $\bar{x} = 18$]

$\Rightarrow \quad 18(44 + f) = 752 + 20f$

$\Rightarrow \quad 792 + 18f = 752 + 20f$

$\Rightarrow \quad 792 - 752 = 20f - 18f$

$\Rightarrow \quad 40 = 2f \quad \text{or} \quad f = 20$

Thus, the missing frequency f is 20.

Finding mode of the data:

With $f = 20$, the modal class, *i.e.*, the class with highest frequency is 19–21.

According to this class, we have

$$l = 19,\ f_0 = 13,\ f = 20,\ f_2 = 5 \text{ and } h = 2$$

$\therefore \quad \text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$

$$= 19 + \frac{20-13}{2\times 20-13-5} \times 2$$

$$= 19 + \frac{7}{22} \times 2$$

$$= 19 + \frac{7}{11} = 19.64 \text{ (approx)}$$

Hence, mode of the given data is 19.64.

SECTION E

36. The A.P. formed with the rounds of runs starting with first round is:
300, 350, 400, …, up to 10 terms
For this A.P., we have
First term, $a = 300$, and common difference, $d = 350 - 300 = 50$
Therefore,

(*i*) Fourth term, $a_4 = a_3 + d$

$= 400 + 50 = 450$ [$\because a_3 = 400$]

Fifth term, $a_5 = a_4 + d$

$= 450 + 50 = 500$

Sixth term, $a_6 = a_5 + d$

$= 500 + 50 = 550$

(*ii*) Distance of 8th round, $a_8 = 300 + (8 - 1)\ 50$ [$\because a_n = a + (n-1)d$]

$= 300 + 7 \times 50$

$= 300 + 350 = 650$

Thus, the distance of the 8th round is 650 m.

(*iii*) (*a*) Total distance run after completing all 10 rounds is

$$S_{10} = \frac{10}{2}[2 \times 300 + (10-1)50] \qquad \left[\because S_n = \frac{n}{2}[2a + (n-1)d]\right]$$

$= 5\ [600 + 450] = 5 \times 1050 = 5250$

Thus, the total distance run after completing all 10 rounds is 5250 m.

OR

(*b*) Total distance run in first 6 rounds is

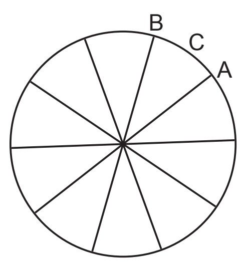
$$S_6 = \frac{6}{2}[2 \times 300 + (6-1)50]$$

$= 3[600 + 5 \times 50] = 3 \times 850 = 2550$

So, the runner runs 2550 m in first 6 rounds.

37. (*i*) There are 10 equal sectors in the brooch. Therefore,
Central angle of each sector

$$= \frac{360°}{10} = 36°. \qquad [\because \text{Sum of all angles at the centre is } 360°.]$$



(*ii*) Given, diameter of the circular brooch, $d = 35$ mm

$\therefore$ Length of the wire used in making the circle of the brooch

$= \pi \times d$

$= \frac{22}{7} \times 35$ mm $= 110$ mm

Since 5 diameters divides the circle into 10 equal parts,

The length of the arc ACB $= \frac{110}{10}$ mm, *i.e.*, 11 mm.

(*iii*) (*a*) Taking $r = \frac{35}{2}$ mm and $\theta = 36°$, we have

Area of each sector of the brooch $= \frac{\pi r^2 \theta}{360°}$

$$= \frac{\frac{22}{7} \times \frac{35}{2} \times \frac{35}{2} \times 36°}{360°}$$

$= 96.25$ sq mm.

OR

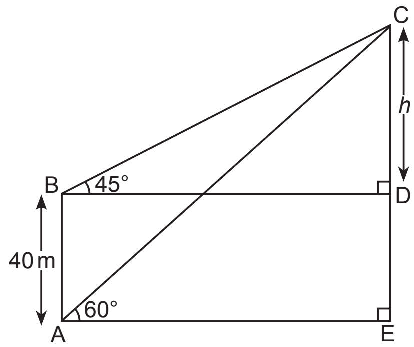
(*b*) Total length of the silver wire used

= Circumference of the circle of diameter 35 mm

+ Total length of 5 diameters 35 mm each

= 110 mm + 5 × 35 mm = 110 mm + 175 mm = 285 mm.

38. (*i*) In right ΔBDC, we have



$$\tan 45° = \frac{CD}{BD}$$

$$\Rightarrow \quad 1 = \frac{h}{BD}$$

$$\Rightarrow \quad BD = h$$

Thus, the distance BD is h m.

(*ii*) In right ΔBDC, we have

$$\sin 45° = \frac{CD}{BC}$$

$$\Rightarrow \quad \frac{1}{\sqrt{2}} = \frac{h}{BC}$$

$$\Rightarrow \quad BC = \sqrt{2}h$$

Thus, the distance BC is $\sqrt{2}h$ m.

(*iii*) (*a*) In right ΔAEC, we have

AE = BD = h m and CE = CD + DE = $(h + 40)$ m

$$\therefore \quad \tan 60° = \frac{CE}{AE}$$

$$\Rightarrow \quad \sqrt{3} = \frac{h+40}{h}$$

$$\Rightarrow \quad \sqrt{3}h = h + 40$$

$$\Rightarrow \quad (\sqrt{3} - 1)h = 40 \quad \Rightarrow \quad h = \frac{40}{\sqrt{3}-1}$$

$$= \frac{40}{1.73-1} = \frac{40}{0.73} = 54.79 \text{ m}$$

Thus, the height CE = h + 40 = 54.79 m + 40 m = 94.79 m.

OR

(*b*) In right ΔAEC, we have

$$\cos 60° = \frac{AE}{AC}$$

$$\Rightarrow \quad \frac{1}{2} = \frac{AE}{100} \qquad [\because AC = 100 \text{ m, given}]$$

$$\Rightarrow \quad 2AE = 100 \quad \text{or} \quad AE = 50 \text{ m}$$

Thus, the distance AE is 50 m.