Solutions—CBSE Board Question Paper (Basic) 2024

Section A

1. (*b*) For the polynomial $ax^2 + bx + c$, the product of its zeros is $\frac{c}{a}$.

Hence, for the polynomial $kx^2 - 4x - 7$, the product of its zeros is $\frac{-7}{k}$

Equating it to 2, we get $\frac{-7}{k} = 2$ or $k = -\frac{7}{2}$.

2. (*d*) Since $a_{10} = a + 9d$, we have

$$-19 = 8 + 9d \quad \Rightarrow \quad d = -3.$$

3. (*d*) The mid-point of the line segment joining the points (–1, 3) and $\left(8, \frac{3}{2}\right)$ is

$$\left(\frac{-1+8}{2}, \frac{3+\frac{3}{2}}{2}\right) \textit{ i.e., } \left(\frac{7}{2}, \frac{9}{4}\right).$$

4. (*b*) Given, $\sin\theta = \frac{1}{3}$, we have $\cos\theta = \sqrt{1-\sin^2\theta} = \sqrt{1-\frac{1}{9}} = \frac{\sqrt{8}}{3}$

So, $\sec\theta = \frac{3}{\sqrt{8}}$ or $\frac{3}{2\sqrt{2}}$.

5. (*a*) By prime factorisation,

$$132 = 2 \times 2 \times 3 \times 11 \quad \text{and} \quad 77 = 7 \times 11$$

$\therefore$ HCF of 132 and 77 is 11.

6. (*b*) The roots of $4x^2 - 5x + k = 0$ are real and equal, if

$(-5)^2 - 4 \times 4 \times k = 0$ [$\because$ For real and equal roots, $b^2 - 4ac = 0$]

$\Rightarrow \quad 25 = 16k$

$\Rightarrow \quad k = \frac{25}{16}$.

7. (*d*) P(losing the game) = 1 – P(winning the game) [$\because$ P(E′) = 1 – P(E)]

Given that P(winning the game) = p, therefore

P(losing the game) = $1 - p$.

8. (*a*) The required distance is given by

$$\sqrt{[2-(-2)]^2 + [-3-3]^2}$$

$$= \sqrt{16+36} = \sqrt{52} \text{ or } 2\sqrt{13} \text{ units.}$$

9. (*c*) Here, $\sin^2\theta + \sin\theta + \cos^2\theta = 2$

$\Rightarrow \quad 1 + \sin\theta = 2$ [$\because \sin^2\theta + \cos^2\theta = 1$]

$\Rightarrow \quad \sin\theta = 1 \Rightarrow \sin\theta = \sin 90°$ or $\theta = 90°$.

10. (*d*) P(a red queen) = $\frac{2}{52} = \frac{1}{26}$.

11. (*b*) By the definition of median, the value of x is the median of the data.

12. (*c*) Volume of the sphere = $\frac{4}{3}\pi\left(\frac{7}{2}\right)^3$ cu cm

$$= \frac{4}{3} \times \frac{22}{7} \times \frac{7^3}{2^3} \text{ cu cm} = \frac{539}{3} \text{ cu cm.}$$

13. (*a*) The empirical relationship between the three measures of central tendency is

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

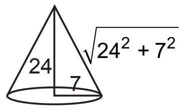
So, $3 \times 23 = \text{Mode} + 2 \times 21$

$\Rightarrow$ Mode = 27.

14. (*d*) Slant height of the cone $= \sqrt{24^2 + 7^2}$ cm

$= \sqrt{625}$ cm

$= 25$ cm.



15. (*c*) Since –3 is one of the zeros of $(\alpha - 1)x^2 + \alpha x + 1$, we have

$(\alpha - 1)(-3)^2 + \alpha(-3) + 1 = 0$

$\Rightarrow \quad 9(\alpha - 1) - 3\alpha + 1 = 0 \;\Rightarrow\; 6\alpha = 8 \;\text{ or }\; \alpha = \frac{4}{3}.$

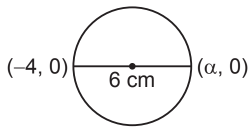
16. (*c*) Let the other end on *x*-axis be $(\alpha, 0)$. Then,

Distance between (–4, 0) and $(\alpha, 0)$ is 6 cm.

$\therefore \quad \alpha - (-4) = 6$

$\Rightarrow \quad \alpha = 2$

Hence, the required point is (2, 0).



17. (*b*) The pair of linear equations will have no solution, when

$$\frac{5}{2} = \frac{2}{k} \neq \frac{-7}{1}$$

$\Rightarrow \quad k = \frac{4}{5}.$

18. (*c*) $\text{P(a doublet)} = \frac{6}{36} = \frac{1}{6}.$

19. (*c*) If the sum of any pair of opposite angles of a quadrilateral is 180°, then the quadrilateral is cyclic. Since tangent to a circle is perpendicular to the radius through the point of contact,

$\angle OAP + \angle OBP = 180°$

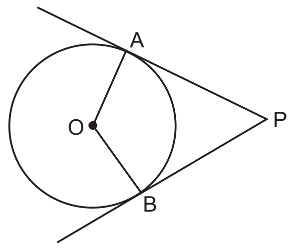
Hence, OAPB is a cyclic quadrilateral.

Therefore, Assertion (A) is true.

Opposite angles of a cyclic quadrilateral are not necessarily equal.

Therefore, Reason (R) is false.

Thus, option(*c*) is the correct option.



20. (*a*) For the given polynomial $p(x) = x^2 - 2x - 3$, we have

$p(-1) = (-1)^2 - 2(-1) - 3 = 1 + 2 - 3 = 0$

$\Rightarrow \quad p(-1) = 0$, *i.e.*, –1 is a zero of $p(x)$.

Similarly, $p(3) = (3)^2 - 2(3) - 3 = 9 - 6 - 3 = 0$

$\Rightarrow p(3) = 0$, *i.e.*, 3 is a zero of $p(x)$.

Thus, –1 and 3 are the zeros of the given polynomial.

Therefore, Assertion (A) is true.

Also, $p(-1) = 0 \Rightarrow (-1, 0)$ is a point on the graph of $p(x)$

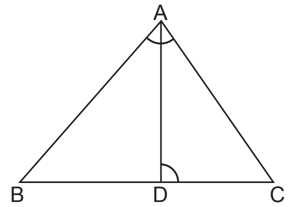
and $\quad p(3) = 0 \Rightarrow (3, 0)$ is also a point on the graph of $p(x)$.

Since (–1, 0) and (3, 0) both lie on x-axis, the graph of the polynomial $p(x)$ intersects x-axis at (–1, 0) and (3, 0). Clearly at $x = -1$ and at $x = 3$, $p(x)$ becomes zero, so these are the two zeros of $p(x)$.

Hence the statement given in Reason (R) is also true and the correct explanation of Assertion (A). Thus, option (a) is the correct option.

Section B

21. In Δs BAC and ADC, we have



$\angle BAC = \angle ADC$ [Given]

and $\angle C = \angle C$ [Common]

So, by *AA similarity criterion*, $\Delta BAC \sim \Delta ADC$

$\Rightarrow \quad \dfrac{AC}{DC} = \dfrac{BC}{AC}$

or $\quad AC^2 = BC \times DC$ **Proved**.

22. (A) Given equations are:

$x + 2y = 9$ ...(1)

and $y - 2x = 2$ ...(2)

Multiplying eq. (1) by 2, we have

$\Rightarrow \quad 2x + 4y = 18$ ...(3)

On adding (2) and (3), we get

$\Rightarrow \quad 5y = 20$ or $y = 4$

Substituting the value of y in eq. (1), we get

$$x + 2 \times 4 = 9 \Rightarrow x + 8 = 9 \text{ or } x = 1$$

Thus, $x = 1$ and $y = 4$ is the required solution.

OR

(B) The given equation are:

$x + y + 1 = 0$ ...(1)

and $x - y = 1$ ...(2)

Putting $x = -4$ and $y = 3$ in eq. (1), we have

$-4 + 3 + 1 = 0$

∴ The point (–4, 3) lies on eq. (1)

Putting $x = -4$ and $y = 3$ in eq. (2), we have

$$-4 - 3 = -7 \neq 1$$

∴ The point (–4, 3) does not lie on eq. (2)

Hence, the point (–4, 3) does not lie on both the lines.

23. (A) Let, on the contrary, $6 - 4\sqrt{5}$ be a rational number. Then,

$$6 - 4\sqrt{5} = \frac{p}{q}, \text{ where } p \text{ and } q \text{ both are integers and } q \neq 0.$$

$\Rightarrow \quad 4\sqrt{5} = 6 - \dfrac{p}{q} = \dfrac{6q - p}{q}$

$\Rightarrow \quad \sqrt{5} = \dfrac{6q - p}{4q}$

Now, $\frac{6q-p}{4q}$ is a rational number and $\sqrt{5}$ is an irrational number, which is a contradiction.

Hence, $6-4\sqrt{5}$ is an irrational number.

OR

(B) We have, $11 \times 19 \times 23 + 3 \times 11 = 11 \times [19 \times 23 + 3]$

$= 11 \times 440$

Since the given number can be resolve into two factors, $11 \times 19 \times 23 + 3 \times 11$ is **not** a prime number.

24. Putting A = 30° and B = 45° in the given expression, we have

sin 30° cos 45° + cos 30° sin 45°

$$= \frac{1}{2} \times \frac{1}{\sqrt{2}} + \frac{\sqrt{3}}{2} \times \frac{1}{\sqrt{2}} = \frac{1+\sqrt{3}}{2\sqrt{2}}.$$

25. Let the bag contains x yellow balls. Then,

Number of red balls in the bag = 4; and

Total number of balls in the bag = $4 + 5 + x$

$\therefore$ P(a red ball) = $\frac{4}{4+5+x}$ or $\frac{4}{9+x}$

Since probability of drawing a red ball is $\frac{1}{5}$, we have

$$\frac{4}{9+x} = \frac{1}{5}$$

$\Rightarrow$ $x = 11$

So, P(a yellow ball) = $\frac{11}{20}$.

Section C

26. Given that the two alarm clocks ring their alarms at regular intervals of 20 minutes and 25 minutes. Clearly, the LCM of 20 and 25 is 100, the two clocks beep together after 100 minutes, *i.e.*, 1 hour 40 minutes.

Since the two clocks first beep together at 12 noon, therefore they will beep again together next time at 12 noon + 1 hour 40 minutes, *i.e.*, 1:40 p.m.

27. Let the two supplementary angles be x and y, where $x > y$.

As per the question,

$x - y = 18°$ ...(1)

and $x + y = 180°$ ...(2) [$\because$ Sum of two supplementary angles is 180°.]

on adding these equations, we get

$2x = 198° \Rightarrow x = 99°$

Putting $x = 99°$ in eq. (2), we get $y = 81°$

Hence, the measures of two angles are 81° and 99°.

28. Let A(–2, 2) and B(7, –4) be the given points and P and Q be the points of trisection of the line segment AB. Then,

P divides $\overline{AB}$ in the ratio 1 : 2

So, $P\left(\frac{1\times 7+2\times(-2)}{1+2}, \frac{1\times(-4)+2\times 2}{1+2}\right) = P\left(\frac{7-4}{3}, \frac{-4+4}{3}\right)$, *i.e.*, P(1, 0)

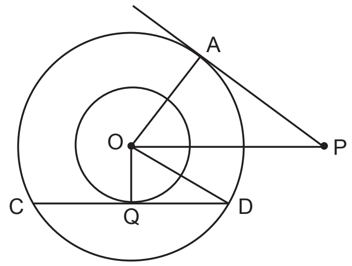
Q divides $\overline{AB}$ in the ratio 2 : 1

So, $Q\left(\dfrac{2\times 7+1\times(-2)}{2+1}, \dfrac{2\times(-4)+1\times 2}{2+1}\right) = Q\left(\dfrac{14-2}{3}, \dfrac{-8+2}{3}\right)$, *i.e.*, Q (4, –2).

Thus, P(1, 0) and Q(4, –2) are the coordinates of the points of trisection.

29. (A) In right-angled triangle OAP, we have

OA = r cm, PA = 16 cm and OP = 20 cm



$\therefore \quad OP^2 = OA^2 + OP^2$

$\Rightarrow \quad 20^2 = r^2 + 16^2$

$\Rightarrow \quad 400 = r^2 + 256$

$\Rightarrow \quad r^2 = 144$ or $r = 12$

$\Rightarrow \quad OD = OA = 12$ cm

In right-angled triangle OQD, we have

$OQ^2 + QD^2 = OD^2$

$\Rightarrow \quad 6^2 + QD^2 = 12^2$

$\Rightarrow \quad QD^2 = 144 - 36 = 108$

$\therefore \quad QD = \sqrt{108} = 6\sqrt{3}$ cm

Hence, CD = 2 × QD = 2 × $6\sqrt{3}$ cm = $12\sqrt{3}$ cm.

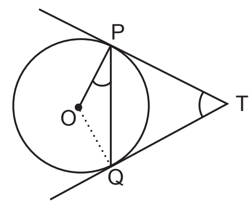
OR

(B) Join O and Q.

In ΔOPQ, $\quad OP = OQ \Rightarrow \angle OQP = \angle OPQ$

and $\quad \angle POQ = 180° - (\angle OPQ + \angle OQP)$

$\Rightarrow \quad \angle POQ = 180° - 2\angle OPQ \quad \ldots(1)$



Also, in quad. OPTQ,

$\angle POQ + \angle PTQ = 180°$

$\Rightarrow \quad \angle POQ = 180° - \angle PTQ \quad \ldots(2)$

From (1) and (2), we have

$180° - 2\angle OPQ = 180° - \angle PTQ$

$\Rightarrow \quad 2\angle OPQ = \angle PTQ$

Hence, $\quad \angle PTQ = 2\angle OPQ$ **Proved.**

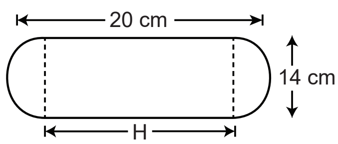
30. (A) Surface area of the solid

$= 2\pi r H + 2 \times 2\pi r^2$, where H = 20 – 14 = 6 cm

$= 2\pi(7)(6) + 4\pi(7)^2$

$= 2 \times \dfrac{22}{7} \times 42 + 4 \times \dfrac{22}{7} \times 7 \times 7$

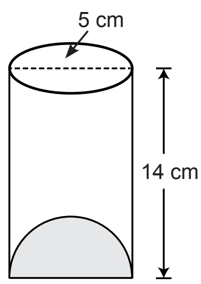
$= 264 + 616 = 880$ sq cm.



OR

(B) Here, inner radius (r) = 5 cm and height (h) = 14 cm

$\therefore$ Capacity of the glass



$= \pi r^2 h - \dfrac{2}{3}\pi r^3 = \left[\pi(5)^2(14) - \dfrac{2}{3}\pi(5)^3\right]$

$= \left[3.14 \times 350 - \dfrac{2}{3} \times 3.14 \times 125\right]$

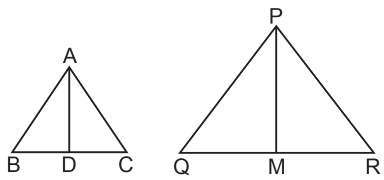
$= \left(1099 - \dfrac{785}{3}\right) = \dfrac{2512}{3}$ or $837\dfrac{1}{3}$ cu cm.

31. We have,
$$\text{R.H.S.} = \frac{1-\cos\theta}{1+\cos\theta} = \frac{1-\cos\theta}{1+\cos\theta}\times\frac{1-\cos\theta}{1-\cos\theta}$$
$$= \frac{(1-\cos\theta)^2}{1-\cos^2\theta} = \frac{(1-\cos\theta)^2}{\sin^2\theta}$$
$$= \left(\frac{1}{\sin\theta}-\frac{\cos\theta}{\sin\theta}\right)^2$$
$$= (\text{cosec }\theta - \cot\theta)^2 = (\cot\theta - \text{cosec }\theta)^2 = \text{L.H.S.}$$

Section D

32. (A) See the solution of Q. No. 33 Sample Question Paper (Basic) 2024–25.

OR



(B) It is given that $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AD}{PM}$

$\Rightarrow$ $$\frac{AB}{PQ} = \frac{\frac{1}{2}BC}{\frac{1}{2}QR} = \frac{AD}{PM}$$

$\Rightarrow$ $$\frac{AB}{PQ} = \frac{BD}{QM} = \frac{AD}{PM}$$

[$\because$ D and M are the mid-points of BC and QR respectively.]

$\Rightarrow$ $\Delta ABD \sim \Delta PQM$

$\therefore$ $\angle B = \angle Q$

Now, in Δs ABC and PQR, we have
$$\frac{AB}{PQ} = \frac{BC}{QR} \text{ and } \angle B = \angle Q$$

So, by *SAS similarity criterion*, $\Delta ABC \sim \Delta PQR$.

33. The given A.P. is 27, 24, 21, ...

For this A.P., first term, $a = 27$ and common difference, $d = -3$

Let first n terms give the sum 105. Then,
$$S_n = \frac{n}{2}[2a + (n-1)d]$$
$\Rightarrow$ $105 = \frac{n}{2}[2 \times 27 + (n-1)(-3)]$ [$\because S_n = 105$]

$\Rightarrow$ $210 = n(54 - 3n + 3)$

$\Rightarrow$ $3n^2 - 57n + 210 = 0$

$\Rightarrow$ $n^2 - 19n + 70 = 0$

$\Rightarrow$ $(n-14)(n-5) = 0$

$\Rightarrow$ $n = 5$ or $n = 14$

Thus, sum of first 5 terms or sum of first 14 terms of the A.P. is 105.

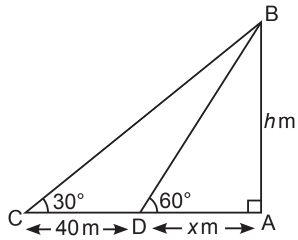
Let pth term of the A.P. be zero. Then,
$$a_p = a + (p-1)d$$
$\Rightarrow$ $0 = 27 + (p-1)(-3)$

$\Rightarrow$ $3(p-1) = 27$

or $p = 10$

Hence, 10th term of the A.P. is zero.

34. (A) Let AB be the tower and AC and AD be its shadows when the angles of elevation of the sun are 30° and 60° respectively. Then, CD = 40 metres.



Let AB = h metres and AD = x metres.

Then, in right-angled ΔDAB, we have

$$\tan 60° = \frac{AB}{AD}$$

$$\Rightarrow \quad \sqrt{3} = \frac{h}{x}$$

$$\Rightarrow \quad h = \sqrt{3}x \qquad ...(1)$$

Also, in right-angled ΔCAB, we have

$$\tan 30° = \frac{AB}{AC}$$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{h}{x+40}$$

$$\Rightarrow \quad h = \frac{x+40}{\sqrt{3}} \qquad ...(2)$$

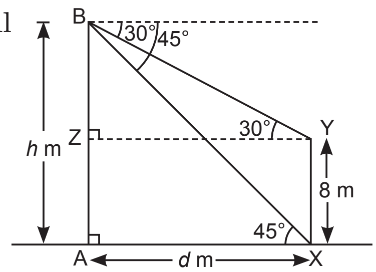
From (1) and (2), we get $x = 20$

$$\Rightarrow \quad h = \sqrt{3} \times 20 = 1.73 \times 20 = 34.6 \text{ metres}$$

Hence, the height of the tower is 34.6 m and the length of the original shadow is 20 metres.

OR

(B) Let AB be the multi-storeyed building and XY be the 8 m tall building. AX be the distance between the two buildings.



Then, AB = h metres and AX = d metres.

Here, $\angle$BXA = 45° and $\angle$BYZ = 30°

In right-angled ΔBAX, we have

$$\frac{AB}{AX} = \tan 45° = 1$$

$$\Rightarrow \quad AB = AX \text{ or } h = d \qquad ...(1)$$

In right-angled ΔBZY, we have

$$\frac{BZ}{ZY} = \tan 30°$$

$$\Rightarrow \quad \frac{h-8}{d} = \frac{1}{\sqrt{3}} \Rightarrow \frac{h-8}{h} = \frac{1}{\sqrt{3}} \qquad [\because d = h, \text{ from (1)}]$$

$$\Rightarrow \quad h = \sqrt{3}h - 8\sqrt{3}$$

$$\Rightarrow \quad h(\sqrt{3}-1) = 8\sqrt{3}$$

$$\Rightarrow \quad h = \frac{8 \times 1.73}{0.73} = 19 \text{ m (approx)}$$

Also, from (1), d = 19 m (approx)

Thus, the height of the multi-storeyed building is 19 metres (approx) and its distance from the other building is also 19 metres (approx).

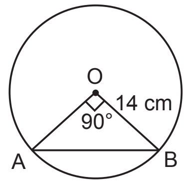
35. Area of minor segment = Area of sector OABO – Area of ΔAOB

$$= \frac{90}{360} \times \pi(14)^2 - \frac{1}{2} \times 14 \times 14 \quad [\because \Delta \text{ AOB is right-angled triangle.}]$$

$$= \frac{1}{4} \times \frac{22}{7} \times 14 \times 14 - \frac{1}{2} \times 14 \times 14$$

$$= \left(\frac{22}{28} - \frac{1}{2}\right) \times 14 \times 14$$

$$= \frac{8}{28} \times 14 \times 14 = 56 \text{ sq cm}$$



Area of major segment = Area of circle – Area of minor segment

$$= [\pi(14)^2 - 56] = \frac{22}{7} \times 14 \times 14 - 56$$

$$= 616 - 56 = 560 \text{ sq cm}$$

Section E

36. (*i*) Here, $R + r = 14$ m ...(1)

and $\pi R^2 + \pi r^2 = 130\,\pi$, *i.e.*, $R^2 + r^2 = 130$ ...(2)

which is the required equation in R and r.

(*ii*) From (1), putting $R = 14 - r$ in (2), we have

$$(14 - r)^2 + r^2 = 130$$

$\Rightarrow$ $196 + r^2 - 28r + r^2 = 130$

$\Rightarrow$ $2r^2 - 28r + 66 = 0$

or $r^2 - 14r + 33 = 0$

(*iii*) (A) $r^2 - 14r + 33 = 0$

$\Rightarrow$ $r^2 - 11r - 3r + 33 = 0$

$\Rightarrow$ $r(r - 11) - 3(r - 11) = 0$

$\Rightarrow$ $r = 3$ or $r = 11$

Since $R > r$, $r = 3$

$\therefore$ Corresponding area $= \pi(3)^2 = 9 \times \frac{22}{7}$ sq m $= \frac{198}{7}$ sq m.

OR

(B) From (1), we have

$$R = (14 - 3) = 11 \text{ m}$$

$\therefore$ Corresponding area $= \pi\,(11)^2 = \frac{22}{7} \times 121$ sq m

$$= \frac{2662}{7} \text{ sq m.}$$

37. (*i*) Cumulative frequency table of the given data is:

Length (in mm)	70–80	80–90	90–100	100–110	110–120	120–130	130–140
Number of Leaves	3	5	9	12	5	4	2
Cumulative Frequency	3	8	17	29	34	38	40

$\therefore$ Sum of frequencies (N) = 3 + 5 + 9 + 12 + 5 + 4 + 2 = 40

So, $\frac{N}{2} = 20$. Since cumulative frequency just greater than 20 is 29, so *median class* is 100–110.

(*ii*) The leaves whose length is 10 cm, *i.e.*, 100 mm or greater are:

12 + 5 + 4 + 2, *i.e.*, 23 leaves.

(*iii*) (A) $\text{Median} = l + \dfrac{\frac{N}{2} - c}{f} \times h$

$= 100 + \dfrac{20 - 17}{12} \times 10 = 102.5.$

Thus, median length of the leaves is 102.5 mm.

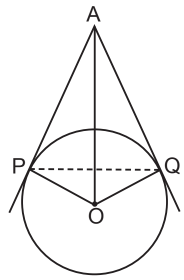
OR

(B) Here, frequency of the class 100–110 is the maximum, so *modal class* is 100–110.

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

$= 100 + \dfrac{12 - 9}{24 - 9 - 5} \times 10 = 100 + 3 = 103.$

38. (*i*) Given AP = 30 cm and $\angle$PAQ = 60°



$\therefore$ In ΔAPQ, AP = AQ $\Rightarrow$ $\angle$AQP = $\angle$APQ

Since $\angle$PAQ = 60°, we have

$\angle$AQP = $\angle$APQ = 60°

$\therefore$ ΔAPQ is an equilateral triangle.

Hence, PQ = 30 cm.

(*ii*) We have $\angle$POQ + $\angle$PAQ = 180°

$\Rightarrow \quad \angle POQ = 180° - \angle PAQ$

$= 180° - 60° = 120°.$

Thus, $m\ \angle$POQ = 120°.

(*iii*) (A) Since ΔAPO is a right triangle.

So, $\dfrac{AP}{AO} = \cos 30°$

$\Rightarrow$ AO = AP × sec 30° $= 30 \times \dfrac{2}{\sqrt{3}} = 20\sqrt{3}$ cm.

OR

(B) Radius of the mirror = OP = AO sin 30° = $20\sqrt{3} \times \dfrac{1}{2} = 10\sqrt{3}$ cm.

Solutions—CBSE Board Question Paper (Standard) 2024

Section A

1. (*b*) Here, $\frac{k\sqrt{2}}{2} = \sqrt{2}$

$\Rightarrow \quad k = 2.$

2. (*d*) Required probability = 1 – 0.79 = 0.21.

3. (*c*) For real and equal roots, $b^2 - 4ac = 0$

$\Rightarrow \quad b^2 = 4ac$ or $ac = \frac{b^2}{4}.$

4. (*c*) $S_n = \frac{n}{2}[2a + (n-1)d] = \frac{n}{2}[a + a_n]$

$\Rightarrow \quad \frac{2093}{2} = \frac{n}{2} \times 91 \Rightarrow n = 23.$

5. (*d*) Here, $p = 2 \times 3 \times 3 \times a^2 \times b^4$ and $q = 2 \times 2 \times 5 \times a^3 \times b^2$

So, $\text{LCM}(p, q) = 2 \times 2 \times 5 \times 3 \times 3 \times a^3 \times b^4$, *i.e.*, $180a^3b^4$.

6. (*a*) Here, D is the mid-point of BC. So, $D\left(\frac{6+0}{2}, \frac{4+0}{2}\right)$, *i.e.*, D(3, 2)

$\therefore$ Length AD = $\sqrt{(5-3)^2 + (-6-2)^2} = \sqrt{4+64} = \sqrt{68}$ units.

7. (*c*) Since $\sec^2\theta - \tan^2\theta = 1$, we have

$(\sec\theta - \tan\theta)(\sec\theta + \tan\theta) = 1$

$\Rightarrow \quad \sec\theta + \tan\theta = \frac{1}{\sec\theta - \tan\theta} = \frac{1}{m}.$

8. (*b*) After removing all even numbers we are left with 5 numbers, out of which 7 is the only prime number.

$\therefore$ Required probability = $\frac{1}{5}$.

9. (*d*) $\sum_{i=1}^{n} f_i (x_i - \bar{x}) = f_1 (x_1 - \bar{x}) + f_2 (x_2 - \bar{x}) + \ldots + f_n (x_n - \bar{x})$

$= f_1 x_1 + f_2 x_2 + \ldots + f_n x_n - \bar{x} (f_1 + f_2 + \ldots + f_n)$

$= \bar{x}\sum_{i=1}^{n} f_i - \bar{x} \sum_{i=1}^{n} f_i = 0.$

10. (*a*) Sum of zeros of the polynomial $x^2 + px + q$

$= \frac{-(p)}{1} = -p$

Sum of zeros of the polynomial $4x^2 - 5x - 6$

$= \frac{-(-5)}{4} = \frac{5}{4}$

As zeros of $x^2 + px + q$ are twice the zeros of $4x^2 - 5x - 6$,

we have $\quad -p = 2\left(\frac{5}{4}\right)$

i.e., $\quad p = -\frac{5}{2}.$

11. (*b*) Here, $\sqrt{(3-x)^2+(-5+5)^2} = 15$

$\Rightarrow \quad 3 - x = \pm 15$

$\Rightarrow \quad x = -12, 18$

12. (*a*) Given, $\cos(\alpha + \beta) = 0 \Rightarrow \alpha + \beta = 90°$

$\Rightarrow \quad \frac{\alpha+\beta}{2} = 45° \Rightarrow \cos\left(\frac{\alpha+\beta}{2}\right) = \cos 45° = \frac{1}{\sqrt{2}}.$

13. (*c*) Surface area of a sphere of radius 'r' $= 4\pi r^2$; and

Sum of the surface areas of two identical hemispheres of radius 'r' $= 2 \times 3\pi r^2 = 6\pi r^2$

$\therefore$ Required ratio is $4\pi r^2 : 6\pi r^2 = 4 : 6$, *i.e.,* $2 : 3$.

14. (*b*) The midde most observation of a data arranged in order is called median of the data.

15. (*d*) Volume of the largest cone $= \frac{1}{3}\pi(1)^2(2)$ cu cm

$= \frac{2}{3}\pi$ cu cm.

16. (*a*) Here, (1, 1), (1, 2), (2, 1), (1, 4), (2, 3), (3, 2) and (4, 1) are favourable outcomes.

$\therefore$ Required probability $= \frac{7}{36}$

17. (*c*) Let the other end be (α, β). Then, (2, 0) is the mid-point of (6, 0) and (α, β).

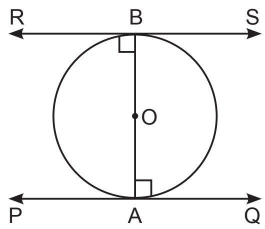
$\therefore \quad \frac{\alpha+6}{2} = 2$ and $\frac{\beta+0}{2} = 0$

$\Rightarrow \quad \alpha = -2$ and $\beta = 0$

So, the required point is (–2, 0).

18. (*d*) The two lines are inclinding to each other towards the right end (in first quadrant). So when we produce, the two lines will intersect at some point. Therefore, the pair of linear equations is inconsistent but can be made consistent by extending these lines.

19. (*b*) In the figure, tangents PQ and RS respectively are drawn at the end points A and B of the diameter AB of a circle.



Since $\angle ABR = \angle BAQ = 90°$ and these are the alternate angles, the tangents are parallel. Therefore Assertion (A) is true.

The statement given in Reason (R) is also true but it is not the correct explanation of Assertion (A).

Thus, option (*b*) is the correct answer.

20. (*d*) When two zeros of a quadratic polynomial are same, the graph of the polynomial touches (or intersects) x-axis at only one point. Therefore, in this case the quadratic polynomial have only one zero. So, the Assertion (A) is false.

The statement given in Reason (R) is a true statement.

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

Section B

21. Let $\quad 7x - 2y = 5 \quad$ ...(1)

and $\quad 8x + 7y = 15 \quad$ ...(2)

From eq. (1), $\quad y = \frac{7x-5}{2}$; and

From eq. (2), $\quad y = \frac{15-8x}{7}$

Therefore, $\frac{7x-5}{2} = \frac{15-8x}{7}$

$\Rightarrow$ $49x - 35 = 30 - 16x$

$\Rightarrow$ $65x = 65 \quad \Rightarrow x = 1$

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

$$y = \frac{15-8\times1}{7} = 1$$

Thus, $x = 1$ and $y = 1$ is the required solution.

Verification:

Putting $x = 1, y = 1$ in eq. (1), we have L.H.S. = 7(1) – 2(1) = 5 = R.H.S.

Putting $x = 1, y = 1$ in eq. (2), we have L.H.S. = 8(1) + 7(1) = 15 = R.H.S.

22. When a black card is lost, there are 51 cards (25 black and 26 red).

$\therefore$ Total number of possible outcomes = 51

Since there is only one queen of heart in the deck of cards.

$\therefore$ Number of favourable outcomes = 1

So, P(queen of heart) = $\frac{1}{51}$.

23. (A) We have, $\cos 45° = \frac{1}{\sqrt{2}}$, $\sin 30° = \frac{1}{2}$ and $\cos 30° = \frac{\sqrt{3}}{2}$

$$\therefore\ 2\sqrt{2}\cos 45° \sin 30° + 2\sqrt{3}\cos 30° = 2\sqrt{2}\times\frac{1}{\sqrt{2}}\times\frac{1}{2}+2\sqrt{3}\times\frac{\sqrt{3}}{2}$$

$$= 1 + 3 = 4.$$

OR

(B) Given, A = 60° and B = 30°. Then,

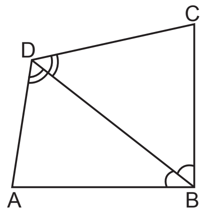
L.H.S. = sin (A + B) = sin (60° + 30°) = sin 90° = 1

R.H.S. = sin A cos B + cos A sin B = sin 60° cos 30° + cos 60° sin 30°

$$= \frac{\sqrt{3}}{2}\times\frac{\sqrt{3}}{2}+\frac{1}{2}\times\frac{1}{2} = \frac{3}{4}+\frac{1}{4} = 1$$

Hence, sin (A + B) = sin A cos B + cos A sin B.

24. (*i*) In Δs ABD and CBD,



$\angle ABD = \angle CBD$ [$\because$ BD bisects $\angle$B]

and $\angle ADB = \angle CDB$ [$\because$ BD bisects $\angle$D]

$\therefore$ By *AA similarity criterion*, $\Delta ABD \sim \Delta CBD$.

(*ii*) $\Delta ABD \sim \Delta CBD$ implies $\frac{AB}{BC} = \frac{BD}{BD}$

$\Rightarrow$ $\frac{AB}{BC} = 1$

or $AB = BC$.

25. (A) Let, on contrary, $5-2\sqrt{3}$ be a rational number. Then,

$5-2\sqrt{3} = \frac{p}{q}$, where $p, q \in$ I and $q \neq 0$.

$\Rightarrow$ $2\sqrt{3} = 5 - \frac{p}{q}$

$\Rightarrow$ $\sqrt{3} = \frac{5q-p}{2q}$

Now, R.H.S. of the above expression is a rational number and hence $\sqrt{3}$ is a rational number.

But this contradicts the fact that $\sqrt{3}$ is irrational.

Hence, $5-2\sqrt{3}$ is an irrational number.

OR

(B) We have, $5 \times 11 \times 17 + 3 \times 11 = (5 \times 17 + 3) \times 11$

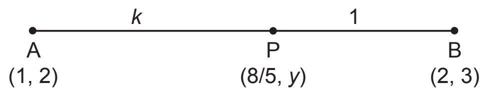
$= 88 \times 11$

Thus, the given number is factorised into 88 and 11.

$\therefore$ $5 \times 11 \times 17 + 3 \times 11$ is a composite number.

Section C

26. (A) Let the ratio be $k : 1$. Then,



$$\frac{8}{5} = \frac{k \times 2 + 1 \times 1}{k+1} = \frac{2k+1}{k+1} \quad \ldots(1)$$

$$\text{and } y = \frac{k \times 3 + 1 \times 2}{k+1} = \frac{3k+2}{k+1} \quad \ldots(2)$$

From (1), we have

$8k + 8 = 10k + 5 \Rightarrow 2k = 3$ or $k = \frac{3}{2}$

Thus, the required ratio is 3 : 2.

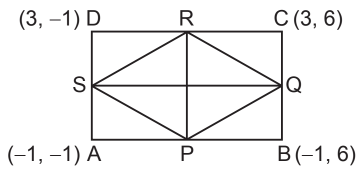
Putting $k = \frac{3}{2}$ in (2), we have

$$y = \frac{3 \times \frac{3}{2} + 2}{\frac{3}{2} + 1} = \frac{\frac{9}{2} + 2}{\frac{5}{2}} = \frac{\frac{13}{2}}{\frac{5}{2}} = \frac{13}{5}$$

Thus, $y = \frac{13}{5}$.

OR

(B) By mid-point formula, the coordinates of P, Q, R and S respectively are:



$$P = \left(\frac{-1-1}{2}, \frac{-1+6}{2}\right) = \left(-1, \frac{5}{2}\right)$$

$$Q = \left(\frac{-1+3}{2}, \frac{6+6}{2}\right) = (1, 6)$$

$$R = \left(\frac{3+3}{2}, \frac{6-1}{2}\right) = \left(3, \frac{5}{2}\right)$$

$$S = \left(\frac{-1+3}{2}, \frac{-1-1}{2}\right) = (1, -1)$$

If diagonals PR and SQ of quad. PQRS bisect each other, then their mid-points must be the same.

$\therefore$ Mid-point of PR $= \left(\frac{-1+3}{2}, \left(\frac{5}{2} + \frac{5}{2}\right)\Big/2\right) = \left(1, \frac{5}{2}\right)$; and

Mid-point of SQ $= \left(\frac{1+1}{2}, \frac{6-1}{2}\right) = \left(1, \frac{5}{2}\right)$

Since the mid-point of PR and SQ is same, PR bisects SQ.

27. Here, same number of teachers are to be seated in each room. For this we need to find the HCF of 48, 80 and 144.

Therefore, by prime factorisation, we have

$$48 = 2 \times 2 \times 2 \times 2 \times 3$$

$$80 = 2 \times 2 \times 2 \times 2 \times 5$$

$$144 = 2 \times 2 \times 2 \times 2 \times 3 \times 3$$

$\therefore$ HCF(48, 80, 144) $= 2 \times 2 \times 2 \times 2 = 16$

So, 16 teachers are to be seated in each room.

Also, the teachers are from the same subject. Therefore,

Number of rooms for French teachers $= \frac{48}{16} = 3$

Number of rooms for Hindi teachers $= \frac{80}{16} = 5$

Number of rooms for English teachers $= \frac{144}{16} = 9$

Hence, total number of rooms required = 3 + 5 + 9 = 17.

28. We have, L.H.S. = $\frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta} = \frac{\tan\theta}{1-\frac{1}{\tan\theta}} + \frac{\frac{1}{\tan\theta}}{1-\tan\theta}$

$$= \frac{\tan^2\theta}{\tan\theta-1} - \frac{\frac{1}{\tan\theta}}{\tan\theta-1}$$

$$= \frac{\tan^2\theta - \frac{1}{\tan\theta}}{\tan\theta-1}$$

$$= \frac{\tan^3\theta-1}{\tan\theta(\tan\theta-1)} = \frac{(\tan\theta-1)(\tan^2\theta+\tan\theta+1)}{\tan\theta(\tan\theta-1)}$$

$$= \frac{\tan^2\theta+\tan\theta+1}{\tan\theta}$$

$$= \frac{\sec^2\theta+\tan\theta}{\tan\theta} = 1 + \frac{\sec^2\theta}{\tan\theta} = 1 + \frac{1}{\sin\theta\cos\theta}$$

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

29. Let x years and y years be the present ages of Rashmi and Nazma respectively. Then, According to condition,

$x - 3 = 3(y - 3)$ and $x + 10 = 2(y + 10)$

$\Rightarrow x - 3y + 6 = 0$ ...(1) $\Rightarrow x - 2y - 10 = 0$ ...(2)

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

$\Rightarrow y - 16 = 0$ or $y = 16$

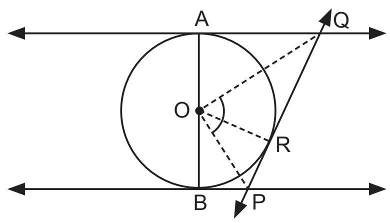
Putting $y = 16$ in (1), we get

$x - 48 + 6 = 0 \Rightarrow x - 42 = 0$

or $x = 42$

So, Rashmi's age is 42 years and Nazma's age is 16 years.

30. (A) Join O to R.



In Δs AOQ and ROQ

OA = OR [Radii of same circle]

OQ = OQ [Common]

and QA = QR [Tangents from Q]

So, $\Delta AOQ \sim \Delta ROQ$

$\Rightarrow \angle AOQ = \angle ROQ$ ...(1)

Similarly, $\angle BOP = \angle ROP$ ...(2)

(1) + (2) gives

$\angle AOQ + \angle BOP = \angle ROQ + \angle ROP = \angle POQ$ ...(3)

But $\angle AOQ + \angle BOP = 180° - \angle POQ$ ...(4)

From (3) and (4), we have

$$180° - \angle POQ = \angle POQ$$

$\Rightarrow$ $2\angle POQ = 180°$ or $\angle POQ = 90°$ **Proved**.

OR

(B) In quad OPDQ, we have

$\angle OPD = \angle OQD = 90°$ [Tangent is $\perp$ to radius]

Also, $\angle PDQ = 90°$ [Given]

and $OP = OQ$ [Radii of same circle]

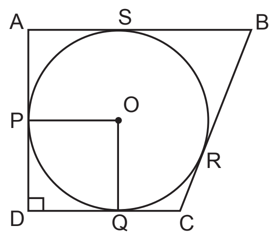
$\therefore$ OPDQ is a square and $DQ = r = 8$ cm

Again, $BR = BS$ and $CQ = CR$

Now, $CR = BC - BR = BC - BS = 30 - 24 = 6$ cm

$\Rightarrow$ $CQ = CR = 6$ cm

Hence, $DC = DQ + QC = (8 + 6)$ cm $= 14$ cm.



31. Let the outer and inner radii of the cylinder be R cm and r cm respectively. Then,

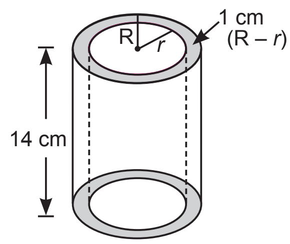
$R - r = 1$ cm ...(1)

Volume of the metal used in making the hollow cylinder $= \pi R^2(14) - \pi r^2(14)$

$\therefore$ $14\pi(R^2 - r^2) = 176$

$\Rightarrow$ $R^2 - r^2 = \dfrac{176 \times 7}{22 \times 14}$

$\Rightarrow$ $R^2 - r^2 = 4 \Rightarrow R + r = 4$ ...(2) [$\because$ $R - r = 1$, from (1)]



Solving (1) and (2) simultaneously, we get R = 2.5 cm and r = 1.5 cm.

Thus, outer radius of the cylinder is 2.5 cm and inner radius is 1.5 cm.

Section D

32. (*i*) Length of arc AB $= \left(\dfrac{60°}{360°} \times 2 \times \dfrac{22}{7} \times 21\right)$ cm

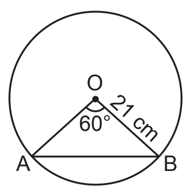
$= 22$ cm.

(*ii*) Area of minor segment = Area of minor sector OABO – Area of ΔOAB

$= \dfrac{60°}{360°} \times \dfrac{22}{7} \times (21)^2 - \dfrac{\sqrt{3}}{4}(21)^2$

$= 231 - 190.7$ [Using $\sqrt{3} = 1.73$]

$= 40.30$ sq cm.



33. (A) Let the first term of the A.P. be a and d be its common difference. Then,

$a + a_8 = 32$ and $a.a_8 = 60$

$\Rightarrow$ $a + [a + 7d] = 32$ and $a[a + 7d] = 60$

$\Rightarrow$ $a + 7d = 32 - a$ ...(1) and $a(32 - a) = 60$ ...(2)

From (2), we have $a^2 - 32a + 60 = 0$

$(a - 30)(a - 2) = 0 \Rightarrow a = 2$ or $= 30$

Putting $a = 2$ in (1), we have $d = 4$ In this case, A.P. is: 2, 6, 10, ...

Putting $a = 30$ in (1), we have $d = -4$ In this case, A.P. is: 30, 26, 22, ...

For first A.P, sum of first 20 terms, $S_{20} = \dfrac{20}{2}[2 \times 2 + 19 \times 4] = 800$

For second A.P., sum of first 20 terms, $S_{20} = \dfrac{20}{2}[2 \times 30 - 19 \times 4] = -160$.

OR

(B) Let a and d respectively be the first term and the common difference of the A.P. Then,

$$S_9 = 153 \quad \text{and} \quad S_{40} - S_{34} = 687$$

$$\Rightarrow \quad \frac{9}{2}[2a + 8d] = 153 \quad \text{and} \quad \frac{40}{2}[2a+39d] - \frac{34}{2}[2a+33d] = 687$$

$$\Rightarrow \quad 2a + 8d = 34 \quad \text{and} \quad (40a + 780d - 34a - 561d) = 687$$

$$\Rightarrow \quad a + 4d = 17 \quad \text{and} \quad 6a + 219d = 687$$

Solving the above equations simultaneously, we get

$$a = 5 \text{ and } d = 3$$

Further,

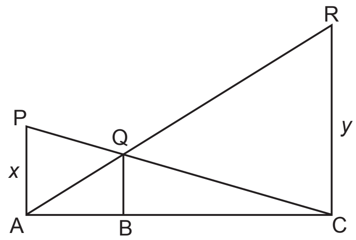
Sum of all 40 items, $S_{40} = \frac{40}{2}[2 \times 5 + 39 \times 3]$

$$= 20[10 + 117] = 20 \times 127 = 2540.$$

34. (A) See the solution of Q. No. 33 Sample Question Paper (Basic) 2024–25.

OR

(B) From the figure, we find $\Delta CBQ \sim \Delta CAP$ and $\Delta ABQ \sim \Delta ACR$.
Therefore,



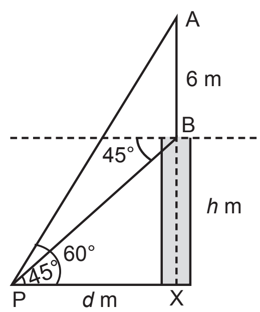
$$\frac{y}{x} = \frac{CB}{CA} \quad \text{and} \quad \frac{y}{z} = \frac{AB}{AC}$$

$$\Rightarrow \quad \frac{1}{x} = \frac{CB}{CA}\cdot\frac{1}{y} \quad \text{and} \quad \frac{1}{z} = \frac{AB}{AC}\cdot\frac{1}{y}$$

$$\Rightarrow \quad \frac{1}{x} + \frac{1}{z} = \left(\frac{CB}{CA} + \frac{AB}{AC}\right)\frac{1}{y} \Rightarrow \frac{1}{x} + \frac{1}{z} = \left(\frac{AC}{AC}\right)\frac{1}{y} \quad [\because CB + AB = AC]$$

$$\Rightarrow \quad \frac{1}{x} + \frac{1}{z} = \frac{1}{y}$$ **Proved.**

35. Let h metres be the height of the tower and d metres be the distance of point P from the foot of the tower. Then,



In right-angled PXA, we have

$$\frac{AX}{PX} = \tan 60°$$

$$\Rightarrow \quad \frac{6+h}{d} = \sqrt{3} \quad ...(1)$$

In right-angled PXB, we have

$$\frac{BX}{PX} = \tan 45°$$

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

$$\Rightarrow \quad d = h$$

From (1), $\frac{6+h}{h} = \sqrt{3}$ $[\because d = h]$

$$\Rightarrow \quad h(\sqrt{3} - 1) = 6 \text{ or } h = 3(\sqrt{3}+1)$$

Thus, $h = 3(\sqrt{3}+1) = 8.19$ m and $d = 8.19$ m

Hence, the height of the tower is 8.19 m and the distance of point P from the foot of the tower is also 8.19 m.

Section E

36. (*i*) Given, original length of each side of the tile = x units

Therefore, $128(x+1)^2 - 200x^2 = 0$ ...(1)

which is the required quadratic equation.

(*ii*) From (1), we have

$$128(x^2+2x+1) - 200x^2 = 0$$

$$\Rightarrow 128x^2 + 256x + 128 - 200x^2 = 0$$

$$\Rightarrow 72x^2 - 256x - 128 = 0$$

$$\Rightarrow 9x^2 - 32x - 16 = 0.$$

(*iii*) (A) $9x^2 - 32x - 16 = 0$

$$\Rightarrow 9x^2 - 36x + 4x - 16 = 0$$

$$\Rightarrow 9x(x-4) + 4(x-4) = 0$$

$$\Rightarrow (x-4)(9x+4) = 0 \Rightarrow x = 4. \quad \left[\because x = -\frac{4}{9} \text{ is not an admissible value.}\right]$$

OR

(B) $9x^2 - 32x - 16 = 0$ gives

$$x = \frac{32 \pm \sqrt{(32)^2 + 4\times 9\times 16}}{2\times 9} \quad \left[\because x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}\right]$$

$$= \frac{32 \pm \sqrt{1024+576}}{18}$$

$$= \frac{32 \pm \sqrt{1600}}{18} = \frac{32 \pm 40}{18} = 4, -\frac{4}{9}$$

Thus, $x = 4$ or $x = \frac{-4}{9}$.

37. Cumulative frequency table of the given data is:

Number Announced	0–15	15–30	30–45	45–60	60–75
Number of Times	8	9	10	12	9
Cumulative Frequency	8	17	27	39	48

(*i*) From the table, we have N = 8 + 9 + 10 + 12 + 9 = 48

Therefore, $\frac{N}{2} = 24$

Hence, *median class* is 30–45.

(*ii*) Out of 75 balls numbered 1 through 75, their are 37 even numbered balls.

So, P(even numbered ball) = $\frac{37}{75}$

(*iii*) (A) Corresponding to median class 30–45, we have

$$l = 30,\ c = 17,\ f = 10 \text{ and } h = 15$$

$$\therefore \quad \text{Median} = l + \frac{\frac{N}{2} - c}{f} \times h$$

$$= 30 + \frac{24-17}{10} \times 15$$

$$= 30 + \frac{7}{10} \times 15 = 40.5.$$

OR

(B) Here, *modal class* is 45–60 corresponding to this class, we have

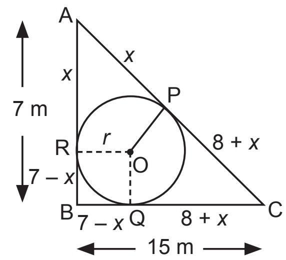
$$l = 45,\ f_1 = 12,\ f_0 = 10,\ f_2 = 9 \text{ and } h = 15$$

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

$$= 45 + \frac{12 - 10}{24 - 10 - 9} \times 15$$

$$= 45 + \frac{30}{5} = 45 + 6 = 51.$$

38. (*i*) Here, $AR = AP = x$ m



(*ii*) Quad. BQOR is a square.

(*iii*) (A) We have,

$$BR = AB - AR = 7 - x$$

$$\therefore \quad BQ = 7 - x \qquad [\because BQ = BR]$$

Since $CQ = BC - BQ$

$$= 15 - (7 - x) = 8 + x$$

$$\therefore \quad PC = 8 + x \qquad [\because PC = CQ]$$

Now, $AC^2 = AB^2 + BC^2$

$$\Rightarrow \quad (8 + 2x)^2 = 49 + 225$$

$$\Rightarrow \quad 64 + 4x^2 + 32x = 274$$

$$\Rightarrow \quad 4x^2 + 32x - 210 = 0$$

or $2x^2 + 16x - 105 = 0$

$$\Rightarrow \quad x = \frac{-16 \pm \sqrt{256 + 840}}{4} = \frac{-16 \pm 33.1}{4} = \frac{17.1}{4} = 4.3 \text{ m (approx).}$$

OR

(B) $r = BQ = 7 - x = (7 - 4.3)$ m $= 2.7$ m.

[**Note:** If AB = 8 m, then

$$(7 + x) + x = 17$$

$$\Rightarrow \quad x = 5$$

Hence, $r = 8 - x = (8 - 5)$ m or 3 m.]