CBSE Board Examination – 2025
MATHEMATICS STANDARD
Class– 10th
(Solved)
(Delhi & Outside Delhi Sets)

Maximum Marks: 80 *Time allowed: 3 hours*

GENERAL INSTRUCTIONS:

Read the following instructions very carefully and strictly follow them:

(i) *This question paper contains **38** questions. **All** questions are **compulsory.***
(ii) *This question paper is divided into **five** sections – **A, B, C, D** and **E**.*
(iii) *In **Section A** – Question numbers **1** to **18** are multiple choice questions (MCQs) and question numbers **19** and **20** are Assertion – Reason based question of **1** mark each.*
(iv) *In **Section B** – Question numbers **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.*
(v) *In **Section C** – Question numbers **26** to **31** are short answer (SA) type questions, carrying **3** marks each.*
(vi) *In **Section D** – Question numbers **32** to **35** are long answer (LA) type questions, carrying **5** marks each.*
(vii) *In **Section E** – Question numbers **36** to **38** are **case-study based integrated** questions carrying **4** marks each. Internal choice is provided in 2 marks question in each case-study.*
(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section **B**, 2 questions in Section **C**, 2 questions in Section **D** and 3 questions of 2 marks in Section **E**.*
(ix) *Draw neat diagram wherever required. Take $\pi = \frac{22}{7}$ wherever required, if not stated.*
(x) *Use of calculators in NOT allowed.*

Delhi Set– 1 **30/4/1**

SECTION – A

This section consists of 20 questions of 1 mark each.

20×1=20

1. If $x = ab^3$ and $y = a^3b$, where a and b are prime numbers, then [HCF (x, y) – LCM (x, y)] is equal to: **1**

(a) $1 - a^3b^3$ **(b)** $ab(1 - ab)$
(c) $ab - a^4b^4$ **(d)** $ab(1 - ab)(1 + ab)$

2. $\left(1+\sqrt{3}\right)^2 - \left(1-\sqrt{3}\right)^2$ is: **1**

(a) a positive rational number.
(b) a negative integer.
(c) a positive irrational number.
(d) a negative irrational number.

3. The value of 'a' for which $ax^2 + x + a = 0$ has equal and positive roots is: **1**

(a) 2 **(b)** – 2
(c) $\frac{1}{2}$ **(d)** $-\frac{1}{2}$

4. The distance of a point A from x-axis is 3 units. Which of the following cannot be coordinates of the point A? **1**

(a) (1, 3) **(b)** (– 3, –3)
(c) (– 3, 3) **(d)** (3, 1)

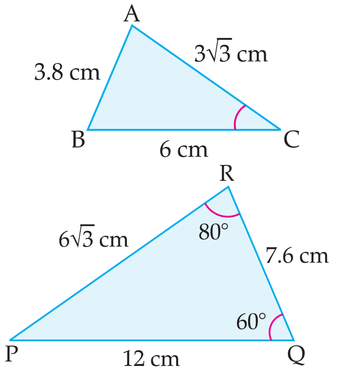
5. The number of red balls in a bag is 10 more than the number of black balls. If the probability of drawing a red ball at random from this bag is $\frac{3}{5}$, then the total number of balls in the bag is: **1**

(a) 50 **(b)** 60
(c) 80 **(d)** 40

6. The value of 'p' for which the equations $px + 3y = p - 3$, $12x + py = p$ has infinitely many solutions is: **1**

(a) – 6 only
(b) 6 only
(c) ± 6
(d) Any real number except ± 6

7. ΔABC and ΔPQR are shown in the adjoining figures. The measure of $\angle C$ is: **1**



(a) 140° **(b)** 80°
(c) 60° **(d)** 40°

8. $\tan 2A = 3 \tan A$ is true, when the measure of $\angle A$ is: **1**

(a) 90° **(b)** 60°
(c) 45° **(d)** 30°

9. Which of the following statements is true? **1**

(a) $\sin 20° > \sin 70°$ **(b)** $\sin 20° > \cos 20°$

(c) $\cos 20° > \cos 70°$ **(d)** $\tan 20° > \tan 70°$

10. A 30 m long rope is tightly stretched and tied the top of pole to the ground. If the rope makes an angle of 60° with the ground, the height of the pole is: **1**

(a) $10\sqrt{3}$ m **(b)** $30\sqrt{3}$ m

(c) 15 m **(d)** $15\sqrt{3}$ m

11. On the top face of the wooden cube of side 7 cm, hemispherical depressions of radius 0.35 cm are to be formed by taking out the wood. The maximum number of depressions that can be formed is: **1**

(a) 400 **(b)** 100

(c) 20 **(d)** 10

12. The cumulative frequency for calculating median is obtained by adding the frequencies of all the: **1**

(a) classes up to the median class

(b) classes following the median class

(c) classes preceding the median class

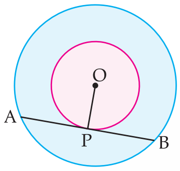
(d) all classes

13. If mean and median of given set of observations are 10 and 11 respectively, then the value of mode is: **1**

(a) 10.5 **(b)** 8

(c) 13 **(d)** 21

14. In the adjoining figure, AB is the chord of the larger circle touching the smaller circle. The centre of both the circles is O. If $AB = 2r$ and $OP = r$, then the radius of larger circle is: **1**



(a) $2r$ **(b)** $3r$

(c) $2\sqrt{2}r$ **(d)** $\sqrt{2}r$

15. A parallelogram having one of its sides 5 cm circumscribes a circle. The perimeter of parallelogram is: **1**

(a) 20 cm

(b) less than 20 cm

(c) more than 20 cm but less than 40 cm

(d) 40 cm

16. E and F are points on the sides AB and AC respectively of a ΔABC such that $\frac{AE}{EB} = \frac{AF}{FC} = \frac{1}{2}$. Which of the following relation is true? **1**

(a) $EF = 2BC$ **(b)** $BC = 2EF$

(c) $EF = 3BC$ **(d)** $BC = 3\,EF$

17. Which of the following statements is true for a polynomial $p(x)$ of degree 3? **1**

(a) $p(x)$ has at most two distinct zeroes.

(b) $p(x)$ has at least two distinct zeroes.

(c) $p(x)$ has exactly three distinct zeroes.

(d) $p(x)$ has at most three distinct zeroes.

18. A pair of dice is thrown. The probability that sum of numbers appearing on top faces is at most 10 is: **1**

(a) $\frac{1}{11}$ **(b)** $\frac{10}{11}$

(c) $\frac{5}{6}$ **(d)** $\frac{11}{12}$

Directions:

In question number 19 and 20, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option:

(a) Both, Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).

(b) Both, Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

19. **Assertion (A):** 4^n ends with digit 0 for some natural number n.

Reason (R): For a number 'x' having 2 and 5 as its prime factors, x^n always ends digit 0 for every natural number n. **1**

20. **Assertion (A):** Tangents drawn at the end points of a diameter of a circle are always parallel to each other.

Reason (R): The lengths of tangents drawn to a circle from a point outside the circle are always equal. **1**

SECTION – B

This section consists of 5 questions of 2 marks each.

21. Solve the following system of equations algebraically:

$30x + 44y = 10;\ 40x + 55y = 13$ **2**

22. **(A)** A 1.5 m tall boy is walking away from the base of a lamp post which is 12 m high, at the speed of 2.5 m/s. Find the length of his shadow after 3 seconds. **2**

OR

(B) In parallelogram $ABCD$, side AD is produced to a point E and BE intersects CD at F. Prove that $\Delta ABE \sim \Delta CFB$. **2**

23. Find the coordinates of the point C which lies on the line AB produced such that $AC = 2BC$, where coordinates of points A and B are (–1, 7) and (4, – 3) respectively. **2**

24. **(A)** Find the value of x for which

$(\sin A + \operatorname{cosec} A)^2 + (\cos A + \sec A)^2 = x + \tan^2 A + \cot^2 A$ **2**

OR

(B) Evaluate the following: **2**

$$\frac{3\sin 30° - 4\sin^3 30°}{2\sin^2 50° + 2\cos^2 50°}$$

25. Two friends Anil and Asraf were born in the December month in the year 2010. Find the probability that: **2**

(i) they share same date of birth.

(ii) they have different dates of birth.

SECTION – C

This section consists of 6 questions of 3 marks each.

26. **(A)** Prove that $\sqrt{2}$ is an irrational number. **3**

OR

(B) Let x and y be two distinct prime numbers and $p = x^2y^3$, $q = xy^4$, $r = x^5y^2$. Find the HCF and LCM of p, q and r. Further check if HCF $(p, q, r) \times$ LCM (p, q, r) $= p \times q \times r$ or not. **3**

27. The monthly incomes of two persons are in the ratio 9 : 7 and their monthly expenditures are in the ratio 4 : 3. If each saved ₹ 5,000, express the given situation algebraically as a system of linear equations in two variables. Hence, find their respective monthly incomes. **3**

28. $P(x, y)$, $Q(-2, -3)$ and $R(2, 3)$ are the vertices of a right triangle PQR right angled at P. Find the relationship between x and y. Hence, find all possible values of x for which $y = 2$. **3**

29. (A) Prove that $\dfrac{\cos A + \sin A - 1}{\cos A - \sin A + 1} = \text{cosec } A - \cot A$ **3**

OR

(B) If $\cot\theta + \cos\theta = p$ and $\cot\theta - \cos\theta = q$, prove that $p^2 - q^2 = 4\sqrt{pq}$ **3**

30. α and β are zeroes of a quadratic polynomial $px^3 + qx + 1$. Form a quadratic polynomial whose zeroes are $\dfrac{2}{\alpha}$ and $\dfrac{2}{\beta}$. **3**

31. Rectangle $ABCD$ circumscribes the circle of radius 10 cm. Prove that $ABCD$ is a square. Hence, find the perimeter of $ABCD$. **3**

SECTION – D

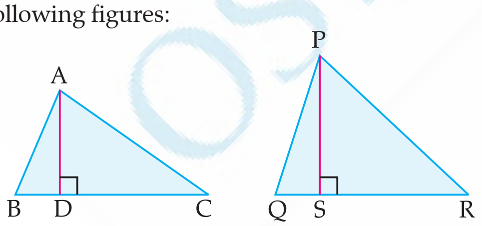
This section consists of 4 questions of 5 marks each.

32. (A) The sides of a right triangle are such that the longest side is 4 m more than the shortest side and the third side is 2 m less than the longest side. Find the length of each side of the triangle. Also, find the difference between the numerical values of the area and the perimeter of the given triangle. **5**

OR

(B) Express the equation $\dfrac{x-2}{x-3} + \dfrac{x-4}{x-5} = \dfrac{10}{3}; (x \neq 3, 5)$ as a quadratic equation in standard form. Hence, find the roots of the equation so formed. **5**

33. (A) The corresponding sides of ΔABC and ΔPQR are in the ratio 3 : 5. $AD \perp BC$ and $PS \perp QR$ as shown in the following figures: **5**



(i) Prove that $\Delta ADC \sim \Delta PSR$

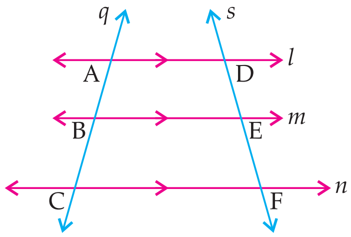
(ii) If $AD = 4$ cm, find the length of PS.

(iii) Using (ii) find ar (ΔABC) : ar(ΔPQR)

OR

(B) State basic proportionality theorem. Use it to prove the following: **5**

If three parallel lines l, m, n are intersected by transversals q and s as shown in the adjoining figure, then $\dfrac{AB}{BC} = \dfrac{DE}{EF}$



34. A wooden cubical die is formed by forming hemispherical depressions on each of the cube such that face 1 has one depression, face 2 has two depressions and so on. The sum of number of hemispherical depressions on opposite faces is always 7. If the edge of the cubical die measures 5 cm and each hemispherical depression is of diameter 1.4 cm, find the total surface area of the die so formed. **5**

35. The following table shows the number of patients of different age group who were discharged from the hospital in a particular month: **5**

Age (in years)	Number of Patients Discharged
5–15	6
15–25	11
25–35	21
35–45	23
45–55	14
55–65	5
Total	**80**

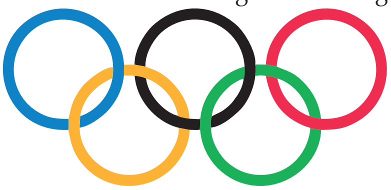
Find the 'mean' and the 'mode' of the above data.

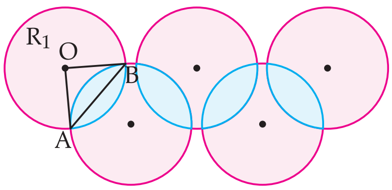
SECTION – E

This section consists of 3 Case-study based questions of 4 marks each.

36. The Olympic symbol comprising five interlocking rings represents the union of the five continents of the world and the meeting of athletes from all over the world at the Olympic games. In order to spread awareness about Olympic games, students of Class-X took part in various activities organised by the school. One such group of students made 5 circular rings in the school lawn with the help of ropes. Each circular ring required 44 m of rope.

Also, in the shaded regions as shown in the figure, students made rangoli showcasing various sports and games. It is given that ΔOAB is an equilateral triangle and all unshaded regions are congruent.





Based on above information, answer the following questions:

(i) Find the radius of each circular ring. **1**

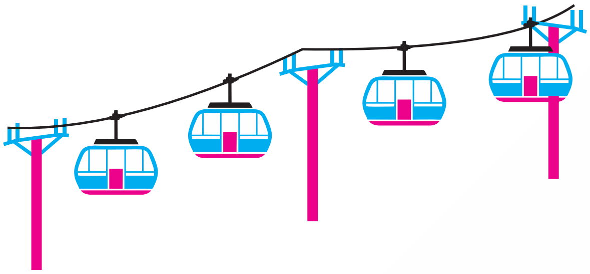
(ii) What is the measure of $\angle AOB$? **1**

(iii) (A) Find the area of shaded region R_1. **2**

OR

(B) Find the length of rope around the unshaded regions. **2**

37. Cable cars at hill stations are one of the major tourist attractions. On a hill station, the length of cable car ride from base point to top most point on the hill is 5000 m. Poles are installed at equal intervals on the way to provide support to the cable on which car moves.



The distance of first pole from base point is 200 m and subsequent poles are installed at equal interval of 150 m. Further, the distance of last pole from the top is 300 m.

Based on above information, answer the following questions using Arithmetic Progression:

(i) Find the distance of 10^{th} pole from the base. **1**

(ii) Find the distance between 15^{th} pole and 25^{th} pole. **1**

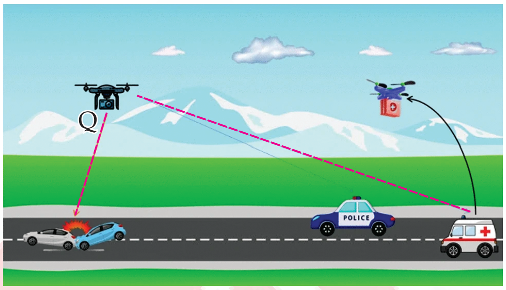
(iii) (A) Find the time taken by cable car to reach 15^{th} pole from the top if it is moving at the speed of 5 m/s and coming from top. **2**

OR

(B) Find the total number of poles installed along the entire journey. **2**

38. A drone was used to facilitate movement of an ambulance on the straight highway to a point *P* on the ground where there was an accident.

The ambulance was travelling at the speed of 60 km/h. The drone stopped at a point *Q*, 100 m vertically above the point *P*. The angle of depression of the ambulance was found to be 30° at a particular instant.



Based on above information, answer the following questions:

(i) Represent the above situation with the help of a diagram. **1**

(ii) Find the distance between the ambulance and the site of accident (*P*) at the particular instant. (Use $\sqrt{3} = 1.73$) **1**

(iii) (A) Find the time (in seconds) in which the angle of depression changes from 30° to 45°. **2**

OR

(B) How long (in seconds) will the ambulance take to reach point *P* from a point *T* on the highway such that angle of depression of the ambulance at *T* is 60° from the drone? **2**

Delhi Set– 2 **30/4/2**

Note: Except these, all other questions have been given in Delhi Set-1

SECTION – A

This section consists of 5 questions of 1 mark each.

6. The distance of which of the following points from origin is less than 5 units? **1**

(a) (3, 4) **(b)** (2, 6)

(c) (– 3, – 4) **(d)** (1, 4)

10. Which of the following is a trigonometric identity? **1**

(a) $\sin^2\theta = 1 + \cos^2\theta$ **(b)** $\text{cosec}^2\theta + \cot^2\theta = 1$

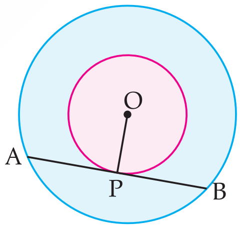
(c) $\sec^2\theta = 1 + \tan^2\theta$ **(d)** $\sin 2\theta = 2\sin\theta$

13. If mean and mode of given set of observations are 10 and 13 respectively, then the value of median is: **1**

(a) 19 **(b)** 4

(c) 11 **(d)** 43

14. In the adjoining figure, *AB* is the chord of larger circle which touches the smaller circle at *P*. If length of *AB* = diameter of inner circle = $2r$, then the diameter of larger circle is:



(a) $2r$ **(b)** $4r$

(c) $2\sqrt{2}r$ **(d)** $\sqrt{2}r$

Directions:

In question number 19, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option:

(a) Both, Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).

(b) Both, Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true but Reason (R) is false.
(d) Assertion (A) is false but Reason (R) is true.

19. **Assertion (A):** A line drawn perpendicular to the tangent at point of contact passes through the centre of the circle.
Reason (R): Lengths of tangents drawn from external point to a circle are equal.

SECTION – B

This section consists of 2 questions of 2 marks each.

22. Saima and Aryaa were born in the month of June in the year 2012. Find the probability that:
(i) they have different dates of birth.
(ii) they have same date of birth. 2

23. Solve the following system of equations algebraically:
$37x + 63y = 137$
$63x + 37y = 163$ 2

SECTION – C

This section consists of 2 questions of 3 marks each.

26. α and β zeroes of a quadratic polynomial $x^2 - ax - b$. Obtain a quadratic polynomial whose zeroes are $3\alpha + 1$ and $3\beta + 1$. 3

29. The two angles of a right angled triangle other than 90° are in the ratio 2 : 3. Express the given situation algebraically as a system of linear equations in two variables and hence solve it. 3

SECTION – D

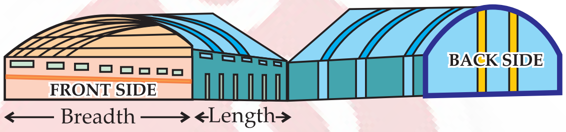
This section consists of 2 questions of 5 marks each.

32. The following table shows the number of traffic challans issued in the month of April by the traffic police:

Number of Challans	Number of Days
0–10	3
10–20	5
20–30	10
30–40	9
40–50	2
50–60	1
Total	**30**

Find the 'mean' and 'mode' of the above data. 5

35. In order to provide shelter to flood victims, a shed was constructed using tin sheets which is in the form of cuboid surmounted by a half cylinder as shown below:



The length, breadth and height of cuboidal portion are 10 m, 7 m and 3 m, respectively. The diameter of the cylindrical portion is 7 m. Find the cost of tin sheets required to make the shed at the rate of ₹ 70 per square metre, given that the shed is open from the front side and closed from the back side. 5

Delhi Set– 3 **30/4/3**

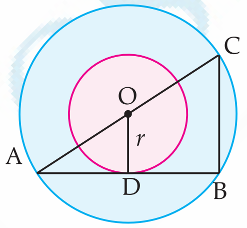
Note: Except these, all other questions have been given in Delhi Set-1 and Set-2

SECTION – A

This section consists of 6 questions of 1 mark each.

4. If mode and median of given set of observations are 13 and 11 respectively, then the value of mean is:
(a) 17 **(b)** 7
(c) 10 **(d)** 28

5. In the adjoining figure, AC is diameter of larger circle with centre O. AB is tangent to smaller circle with centre O. If $OD = r$, then BC is equal to:



(a) r **(b)** $\frac{3r}{2}$
(c) $2r$ **(d)** $4r$

9. Letters A to F are mentioned on six faces of a die such that each face has a different letter. Two such dice are thrown simultaneously. The probability that vowels turn up on both the dice is:
(a) $\frac{1}{4}$ **(b)** $\frac{1}{3}$
(c) $\frac{1}{9}$ **(d)** $\frac{1}{36}$

13. The distance of point $P(1, -1)$ from x-axis is: 1
(a) 1 **(b)** –1
(c) 0 **(d)** $\sqrt{2}$

17. $\sec A = 2 \cos A$ is true for $A =$
(a) 0° **(b)** 30°
(c) 45° **(d)** 60°

Directions:
In question number 20, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option:
(a) Both, Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).
(b) Both, Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) is true but Reason (R) is false.
(d) Assertion (A) is false but Reason (R) is true.

20. **Assertion (A):** Unit digit of 3^n cannot be an even number for any natural number n. 1
Reason (R): 2 is not a prime factor of 3^n for any natural number n.

SECTION – B

This section consists of 2 questions of 2 marks each.

24. Renu and Simran were born in the year 2000 which is a leap year. Find the probability that:

(i) both have same birthday.

(ii) both have different birthdays. **2**

25. Solve the following system of equations algebraically:

$73x - 37y = 109$

$37x - 73y = 1$ **2**

SECTION – C

This section consists of 2 questions of 3 marks each.

28. If α and β are the zeroes of the polynomial $ax^2 - x + c$. Obtain a polynomial whose zeroes are $\alpha - 3$ and $\beta - 3$. **3**

31. The perimeter of a rectangle is 70 cm. The length of the rectangle is 5 cm more than twice its breadth. Express the given situation as a system of linear equations in two variables and hence solve it. **3**

SECTION – D

This section consists of 2 questions of 5 marks each.

33. A bat manufacturing company made a huge bat for charity and got it signed by world cup winning team. The dimensions of the bat which is in the form of a cuboid with a cylindrical handle at the top are as follows:

length = 2 m, width = 0.5 m, thickness =0.1 m

diameter of cylindrical part = 0.1 m

height of cylindrical part = 0.7 m

Find the volume of wood used in the bat. Also, find the total surface area of the wooden bat. **5**

34. Following table shows the absentees record of 40 students in an academic year:

Number of Days	Number of Students
2–6	11
6–10	10
10–14	7
14–18	4
18–22	4
22–26	3
26–30	1

Find the 'mean' and the 'mode' of the above data. **5**

Outside Delhi Set– 1 **30/6/1**

SECTION – A

This section consists of 20 multiple choice questions of 1 mark each. **20×1=20**

1. $\sqrt{0.4}$ is a/an **1**

(a) natural number **(b)** integer

(c) rational number **(d)** irrational number

2. Which of the following cannot be the unit digit of 8^n, where n is a natural number? **1**

(a) 4 **(b)** 2

(c) 0 **(d)** 6

3. Which of the following quadratic equations has real and equal roots? **1**

(a) $(x + 1)^2 = 2x + 1$ **(b)** $x^2 + x = 0$

(c) $x^2 - 4 = 0$ **(d)** $x^2 + x + 1 = 0$

4. If the zeroes of the polynomial $ax^2 + bx + \frac{2a}{b}$ are reciprocal of each other, then the value of b is **1**

(a) 2 **(b)** $\frac{1}{2}$

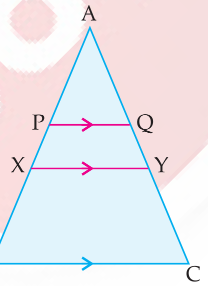
(c) -2 **(d)** $-\frac{1}{2}$

5. The distance of the point A(–3, –4) from x-axis is **1**

(a) 3 **(b)** 4

(c) 5 **(d)** 7

6. In the adjoining figure, PQ || XY || BC, AP = 2 cm, PX = 1.5 cm and BX = 4 cm. If QY = 0.75 cm, then AQ + CY = **1**



(a) 6 cm **(b)** 4.5 cm

(c) 3 cm **(d)** 5.25 cm

7. Given ΔABC ~ ΔPQR, ∠A = 30° and ∠Q = 90°. The value of (∠R + ∠B) is **1**

(a) 90° **(b)** 120°

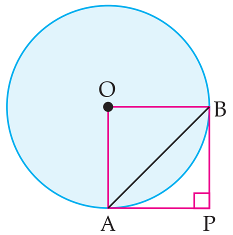
(c) 150° **(d)** 180°

8. Two coins are tossed simultaneously. The probability of getting atleast one head is **1**

(a) $\frac{1}{4}$ **(b)** $\frac{1}{2}$

(c) $\frac{3}{4}$ **(d)** 1

9. In the adjoining figure, PA and PB are tangents to a circle with centre O such that $\angle P = 90°$. If AB = $3\sqrt{2}$ cm, then the diameter of the circle is **1**



(a) $3\sqrt{2}$ cm (b) $6\sqrt{2}$ cm

(c) 3 cm (d) 6 cm

10. For a circle with centre O and radius 5 cm, which of the following statements is true ? **1**

P: Distance between every pair of parallel tangents is 5 cm.

Q: Distance between every pair of parallel tangents is 10 cm.

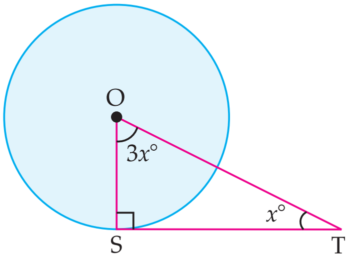
R: Distance between every pair of parallel tangents must be between 5 cm and 10 cm.

S: There does not exist a point outside the circle from where length of tangent is 5 cm.

(a) P (b) Q

(c) R (d) S

11. In the adjoining figure, TS is a tangent to a circle with centre O. The value of $2x°$ is **1**



(a) 22.5 (b) 45

(c) 67.5 (d) 90

12. If $x\left(\frac{2\tan 30°}{1+\tan^2 30°}\right) = y\left(\frac{2\tan 30°}{1-\tan^2 30°}\right)$, then $x : y$ = **1**

(a) 1 : 1 (b) 1 : 2

(c) 2 : 1 (d) 4 : 1

13. A peacock sitting on the top of a tree of height 10 m observes a snake moving on the ground. If the snake is $10\sqrt{3}$ m away from the base of the tree, then angle of depression of the snake from the eye of the peacock is **1**

(a) 30° (b) 45°

(c) 60° (d) 90°

14. If a cone of greatest possible volume is hollowed out from a solid wooden cylinder, then the ratio of the volume of remaining wood to the volume of cone hollowed out is **1**

(a) 1:1 (b) 1:3

(c) 2:1 (d) 3:1

15. If the mode of some observations is 10 and sum of mean and median is 25, then the mean and median respectively are **1**

(a) 12 and 13 (b) 13 and 12

(c) 10 and 15 (d) 15 and 10

16. If the maximum number of students has obtained 52 marks out of 80, then **1**

(a) 52 is the mean of the data.

(b) 52 is the median of the data.

(c) 52 is the mode of the data.

(d) 52 is the range of the data.

17. The system of equations $2x + 1 = 0$ and $3y - 5 = 0$ has

(a) unique solution **1**

(b) two solutions

(c) no solution

(d) infinite number of solutions

18. In a right triangle ABC, right-angled at A, if $\sin B = \frac{1}{4}$, then the value of $\sec B$ is **1**

(a) 4 (b) $\frac{\sqrt{15}}{4}$

(c) $\sqrt{15}$ (d) $\frac{4}{\sqrt{15}}$

Directions:

In Question Numbers 19 and 20, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct option from the following:

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

19. **Assertion (A):** For any two prime numbers p and q, their HCF is 1 and LCM is $p + q$. **1**

Reason (R): For any two natural numbers, HCF × LCM = product of numbers.

20. In an experiment of throwing a die, **1**

Assertion (A): Event E_1: getting a number less than 3 and Event E_2: getting a number greater than 3 are complementary events.

Reason (R): If two events E and F are complementary events, then $P(E) + P(F) = 1$.

SECTION – B

This section has 5 very short answer type questions of 2 marks each.

21. (a) Solve the following pair of equations algebraically:

$101x + 102y = 304$ **2**

$102x + 101y = 305$

OR

(b) In a pair of supplementary angles, the greater angle exceeds the smaller by 50°. Express the given situation as a system of linear equations in two variables and hence obtain the measure of each angle. **2**

22. **(a)** If $a \sec\theta + b\tan\theta = m$ and $b\sec\theta + a\tan\theta = n$, prove that $a^2 + n^2 = b^2 + m^2$

OR

(b) Use the identity: $\sin^2 A + \cos^2 A = 1$ to prove that $\tan^2 A + 1 = \sec^2 A$. Hence, find the value of $\tan A$, when $\sec A = \frac{5}{3}$, where A is an acute angle. **2**

23. Prove that abscissa of a point P which is equidistant from points with coordinates $A(7, 1)$ and $B(3, 5)$ is 2 more than its ordinate. **2**

24. P is a point on the side BC of ΔABC such that $\angle APC = \angle BAC$. Prove that $AC^2 = BC \cdot CP$. **2**

25. The number of red balls in a bag is three more than the number of black balls. If the probability of drawing a red ball at random from the given bag is $\frac{12}{23}$, find the total number of balls in the given bag. **2**

SECTION – C

This section has 6 short answer type questions of 3 marks each.

26. (a) Prove that $\sqrt{5}$ is an irrational number. **3**

OR

(b) Let p, q and r be three distinct prime numbers. **3**

Check whether $p \cdot q \cdot r + q$ is a composite number or not.

Further, give an example for 3 distinct primes p, q, r such that

(i) $p \cdot q \cdot r + 1$ is a composite number.

(ii) $p \cdot q \cdot r + 1$ is a prime number.

27. Find the zeroes of the polynomial $p(x) = 3x^2 - 4x - 4$. Hence, write a polynomial whose each of the zeroes is 2 more than zeroes of $p(x)$. **3**

28. Check whether the following pair of equations is consistent or not. If consistent, solve graphically **3**

$x + 3y = 6$

$3y - 2x = -12$

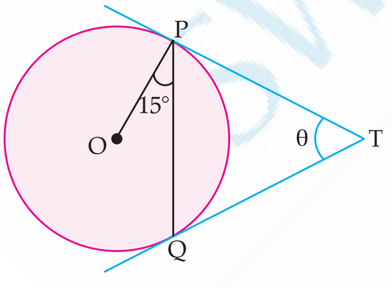
29. If the points A(6, 1), B(p, 2), C(9, 4) and D(7, q) are the vertices of a parallelogram ABCD, then find the values of p and q. Hence, check whether ABCD is a rectangle or not. **3**

30. (a) Prove that: $\frac{\cos\theta - 2\cos^3\theta}{\sin\theta - 2\sin^3\theta} + \cot\theta = 0.$ **3**

OR

(b) Given that $\sin\theta + \cos\theta = x$, prove that $\sin^4\theta + \cos^4\theta = \frac{2-(x^2-1)^2}{2}$. **3**

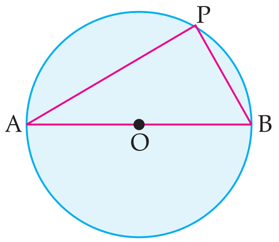
31. In the adioining figure, TP and TQ are tangents drawn to a circle with centre O. If $\angle OPQ = 15°$ and $\angle PTQ = \theta$, then find the value of $\sin 2\theta$. **3**



SECTION – D

This section has 4 long answer questions of 5 marks each.

32. (a) There is a circular park of diameter 65 m as shown in the following figure, where AB is a diameter. **5**



An entry gate is to be constructed at a point P on the boundary of the park such that distance of P from A is 35 m more than the distance of P from B. Find distance of point P from A and B respectively.

OR

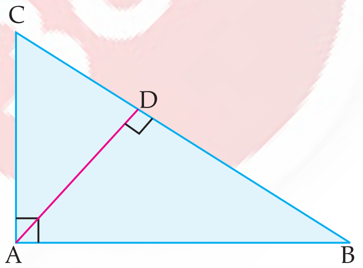
(b) Find the smallest value of p for which the quadratic equation $x^2 - 2(p+1)x + p^2 = 0$ has real roots. Hence, find the roots of the equation so obtained. **5**

33. (a) If a line drawn parallel to one side of triangle intersecting the other two sides in distinct points divides the two sides in the same ratio, then it is parallel to third side.

State and prove the converse of the above statement. **5**

OR

(b) In the adjoining figure, ΔCAB is a right triangle, right angled at A and $AD \perp BC$. Prove that $\Delta ADB \sim \Delta CDA$. Further, if BC = 10 cm and CD = 2 cm, find the length of AD. **5**



34. From one face of a solid cube of side 14 cm, the largest possible cone is carved out. Find the volume and surface area of the remaining solid. $\left(\text{Use } \pi = \frac{22}{7}, \sqrt{5} = 2.2\right)$ **5**

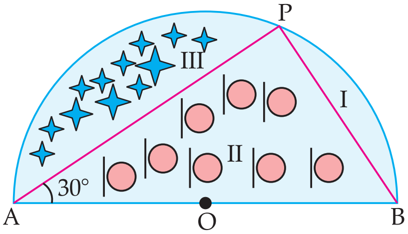
35. Following distribution shows the marks of 230 students in a particular subject. If the median marks are 46, then find the values of x and y. **5**

Marks	Number of Students
10–20	12
20–30	30
30–40	x
40–50	65
50–60	y
60–70	25
70–80	18

SECTION – E

This section has 3 case study based questions of 4 marks each.

36. Anurag purchased a farmhouse which is in the form of a semicircle of diameter 70 m. He divides it into three parts by taking a point P on the semicircle in such a way that $\angle PAB = 30°$ as shown in the following figure, where O is the centre of semicircle.



In part I, he planted saplings of Mango tree, in part II, he grew tomatoes and in part III, he grew oranges. Based on given information, answer the following questions.

(i) What is the measure of $\angle POA$? 1

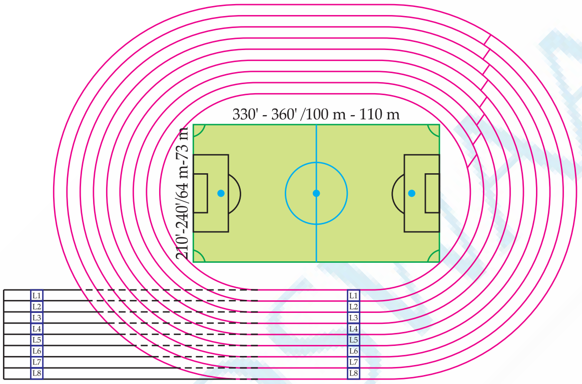
(ii) Find the length of wire needed to fence entire piece of land. 2

(iii) (a) Find the area of region in which saplings of Mango tree are planted. 1

OR

(iii) (b) Find the length of wire needed to fence the region III. 1

37. In order to organise, Annual Sports Day, a school prepared an eight lane running track with an integrated football field inside the track area as shown below :



The length of innermost lane of the track is 400 m and each subsequent lane is 7.6 m longer than the preceding lane.

Based on given information, answer the following questions, using concept of Arithmetic Progression.

(i) What is the length of the 6^{th} lane ? 1

(ii) How long is the 8^{th} lane than that of 4^{th} lane ? 1

(iii) (a) While practicing for a race, a student took one round each in first six lanes. Find the total distance covered by the student. 2

OR

(b) A student took one round each in lane 4 to lane 8. Find the total distance covered by the student. 2

38. The Statue of Unity situated in Gujarat is the world's largest Statue which stands over a 58 m high base. As part of the project, a student constructed an inclinometer and wishes to find the height of Statue of Unity using it.

He noted following observations from two places:

Situation - I:

The angle of elevation of the top of Statue from Place A which is $80\sqrt{3}$ m away from the base of the Statue is found to be 60°.

Situation - II:

The angle of elevation of the top of Statue from a Place B which is 40 m above the ground is found to be 30° and entire height of the Statue including the base is found to be 240 m.

Based on given information, answer the following questions :

(i) Represent the Situation – I with the help of a diagram. 1

(ii) Represent the Situation – II with the help of a diagram. 1

(iii) (a) Calculate the height of Statue excluding the base and also find the height including the base with the help of Situation-I. 2

OR

(b) Find the horizontal distance of Point B (Situation - II) from the Statue and the value of tan α, where α is the angle of elevation of top of base of the Statue from Point B. 2

Outside Delhi Set– 2 **30/6/2**

Note: Except these, all other questions have been given in Outside Delhi Set-1

SECTION – A

1. The system of equations $x + 5 = 0$ and $2x - 1 = 0$, has 1

(a) No solution **(b)** Unique solution

(c) Two solutions **(d)** Infinite solutions

5. Which of the following quadratic equations has real and distinct roots? 1

(a) $x^2 + 2x = 0$ **(b)** $x^2 + x + 1 = 0$

(c) $(x - 1)^2 = 1 - 2x$ **(d)** $2x^2 + x + 1 = 0$

7. The distance of point $(a, -b)$ from x-axis is 1

(a) a **(b)** $-a$

(c) b **(d)** $-b$

12. If $x = \cos 30° - \sin 30°$ and $y = \tan 60° - \cot 60°$, then **1**

(a) $x = y$ **(b)** $x > y$

(c) $x < y$ **(d)** $x > 1, y < 1$

Directions:

In Question Numbers 19, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct option from the following:

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

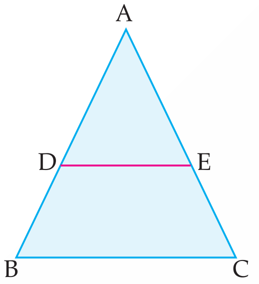
(d) Assertion (A) is false, but Reason (R) is true.

19. Assertion (A): For two prime numbers x and y ($x < y$), HCF $(x, y) = x$ and LCM $(x, y) = y$.

Reason (R): HCF $(x, y) \leq$ LCM (x, y), where x, y are any two natural numbers. **1**

SECTION – B

21. In the adjoining figure, $\frac{AD}{BD} = \frac{AE}{EC}$ and $\angle BDE = \angle CED$, prove that ΔABC is an isosceles triangle. **2**



22. A bag contains cards which are numbered from 5 to 100 such that each card bears a different number. A card is drawn at random. Find the probability that number on the card is

(i) a perfect square

(ii) a 2-digit number **2**

SECTION – C

29. Find the zeroes of the polynomial $q(x) = 8x^2 - 2x - 3$. Hence, find a polynomial whose zeroes are 2 less than the zeroes of $q(x)$. **3**

30. Check whether the following system of equations is consistent or not. If consistent, solve graphially

$x - 2y + 4 = 0$, $2x - y - 4 = 0$ **3**

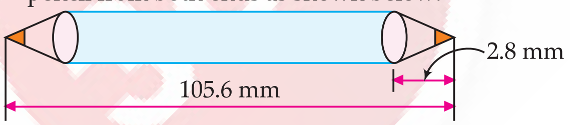
SECTION – D

32. Following data shows the number of family members living in different bungalows of a localtity:

Number of Members	0 – 2	2 – 4	4 – 6	6 – 8	8 – 10	Total
Number of Bungalows	10	p	60	q	5	120

If the median number of members is found to be 5, find the values of p and q. **5**

34. On the day of her examination, Riya sharpened her pencil from both ends as shown below: **5**



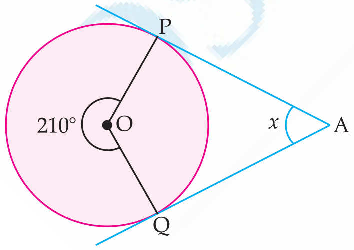
The diameter of the cylindrical and conical part of the pencil is 4.2 mm. If the height of each conical part is 2.8 mm and length of entire pencil is 105.6 mm. Find the total surface area of the pencil.

Outside Delhi Set– 3 **30/6/3**

Note: Except these, all other questions have been given in Outside Delhi Set-1 & 2

SECTION – A

2. In the adjoining figure, AP and AQ are tangents to the circle with centre O. If reflex $\angle POQ = 210°$, the value of $2x$ is **1**



(a) 30° **(b)** 60°

(c) 120° **(d)** 300°

3. If $x = 2 \sin 60° \cos 60°$ and $y = \sin^2 30° - \cos^2 30°$ and $x^2 = ky^2$, the value of k is: **1**

(a) $\sqrt{3}$ **(b)** $-\sqrt{3}$

(c) 3 **(d)** – 3

8. The system of equations $y + a = 0$ and $2x = b$ has

(a) No solution **1**

(b) $\left(-a, \frac{b}{2}\right)$ as its solution

(c) $\left(\frac{b}{2}, -a\right)$ as its solution

(d) Infinite solutions

12. Which of the following equations does not have a real root? **1**

(a) $x^2 = 0$ **(b)** $2x - 1 = 3$

(c) $x^2 + 1 = 0$ **(d)** $x^3 + x^2 = 0$

14. The distance of point P $(3a, 4a)$ from y-axis is **1**

(a) $3a$ **(b)** $-3a$

(c) $4a$ **(d)** $-4a$

Directions:

In Question Numbers 20, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**.

Choose the correct option from the following:

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

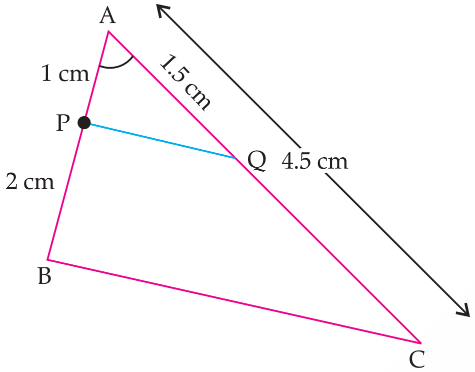
(d) Assertion (A) is false, but Reason (R) is true.

20. **Assertion (A):** For two odd prime number x and y, $(x \neq y)$, LCM $(2x, 4y) = 4xy$.

Reason (R): LCM (x, y) is a multiple of HCF (x, y). **1**

SECTION – B

23. In the adjoining figure, AP = 1 cm, BP = 2 cm, AQ = 1.5 cm and AC = 4.5 cm.



Prove that ΔAPQ ~ ΔABC. Hence find the length of PQ, If BC = 3.6 cm. **2**

24. A bag contains balls numbered 2 to 91 such that each ball bears a different number. A ball is drawn at random from the bag. Find the probability that

(i) it bears a 2-digit number

(ii) it bears a multiple of 1. **2**

SECTION – C

26. Check whether the given system of equations is consistent or not. If consistent, solve graphically. **3**

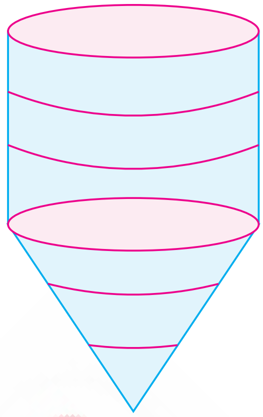
$x - 2y = 0$

$2x + y = 0$

31. Find the zeroes of the polynomial $r(x) = 4x^2 + 3x - 1$. Hence, write a polynomial whose zeroes are reciprocal of the zeroes of polynomial $r(x)$. **3**

SECTION – D

33. Fermentation tanks are designed in the form of cylinder mounted on a cone as shown below: **5**



The total height of the tank is 3.3 m and height of conical part is 1.2 m. The diameter of the cylindrical as well as conical part is 1 m. Find the capacity of the tank. If the level of liquid in the tank is 0.7 m from the top, find the surface area of the tank in contact with liquid.

34. The population of lions was noted in different regions across the world in the following table: **5**

Number of lions	Number of regions
0–100	2
100–200	5
200–300	9
300–400	12
400–500	x
500–600	20
600–700	15
700–800	9
800–900	y
900–1000	2
	100

If the median of the given data is 525, find the values of x and y.

ANSWERS

Delhi Set– 1 **30/4/1**

SECTION– A

1. **Option (d) is correct.**

Explanation: HCF can be found by taking the minimum powers of the prime factors:

$$\text{HCF}(x, y) = a^1 b^1 = ab$$

The LCM is found by taking the highest powers of the prime factors:

$$\text{LCM}(x, y) = a^3 b^3$$

Thus, HCF (x, y) – LCM (x, y)

$$= ab - a^3 b^3$$
$$= ab(1 - a^2 b^2)$$
$$= ab(1 - ab)(1 + ab)$$

2. **Option (c) is correct.**

Explanation: Here,

$$\left(1+\sqrt{3}\right)^2 = 1^2 + 2(1)(\sqrt{3}) + (\sqrt{3})^2$$
$$= 4 + 2\sqrt{3}$$
$$(1-\sqrt{3})^2 = 1^2 - 2(1)(\sqrt{3}) + (\sqrt{3})^2$$
$$= 4 - 2\sqrt{3}$$

Thus,

$$\left(1+\sqrt{3}\right)^2 - \left(1-\sqrt{3}\right)^2 = (4+2\sqrt{3}) - (4-2\sqrt{3})$$
$$= 4 + 2\sqrt{3} - 4 + 2\sqrt{3}$$
$$= 4\sqrt{3}$$

Now, $4\sqrt{3}$ is an irrational number (since $\sqrt{3}$ is irrational).

Also, $4\sqrt{3}$ is positive because $\sqrt{3} > 0$.

3. **Option (d) is correct.**

Explanation: Given equation,

$$ax^2 + x + a = 0$$

For equal roots, the discriminant must be equal to zero.

The discriminant is given by:

$$D = b^2 - 4ac$$

Substituting $a = a$, $b = 1$ and $c = a$,

$$D = (1)^2 - 4(a)(a)$$
$$D = 1 - 4a^2$$

For equal roots:

$$1 - 4a^2 = 0$$
$$4a^2 = 1$$
$$a^2 = \frac{1}{4}$$
$$a = \pm\frac{1}{2}$$

The roots of the quadratic equation using quadratic formula are given by:

$$x = \frac{-b \pm \sqrt{D}}{2a}$$

Since the roots are equal $D = 0$, therefore

$$x = \frac{-1}{2a}$$

For x to be positive:

$$\frac{-1}{2a} > 0$$

This implies:

$$a < 0$$

From $a = \pm\frac{1}{2}$, the negative value satisfies the condition:

$$a = -\frac{1}{2}$$

4. **Option (d) is correct.**

Explanation: Given that the distance from the x-axis is 3 units, the valid coordinates must have $y = \pm 3$.

$$(3, 1) \to |y| = 1$$

(Invalid, as the distance is not 3)

5. **Option (a) is correct.**

Explanation: Let the number of black balls be x.

Then, the number of red balls is $x + 10$ (as given in the problem).

The total number of balls in the bag:

$$\text{Total balls} = x + (x + 10) = 2x + 10$$

The probability of drawing a red ball is given as:

$$\frac{\text{Red balls}}{\text{Total balls}} = \frac{3}{5}$$

Substituting the values:

$$\frac{x+10}{2x+10} = \frac{3}{5}$$
$$5(x + 10) = 3(2x + 10)$$
$$5x + 50 = 6x + 30$$
$$50 - 30 = 6x - 5x$$
$$20 = x$$

So, the number of black balls is $x = 20$, and the total number of balls is:

$$2(20) + 10 = 40 + 10 = 50$$

6. **Option (c) is correct.**

Explanation: The given system of equations is:

$$px + 3y = p - 3$$
$$12x + py = p$$

For a system of linear equations to have infinitely many solutions, the two equations must be proportional, i.e.,

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$

where:
$a_1 = p, b_1 = 3, c_1 = p - 3$
$a_2 = 12, b_2 = p, c_2 = p$

Thus, $$\frac{p}{12} = \frac{3}{p} = \frac{p-3}{p}$$

Equating the first two ratios:

$$\frac{p}{12} = \frac{3}{p}$$
$$p^2 = 36$$
$$p = \pm 6$$

Equating first and last ratios

$$\frac{p}{12} = \frac{p-3}{p}$$

Since, both sides are equal for $p = 6$ or $p = -6$, this condition holds.
Hence, $p = 6$ or $p = -6$

7. **Option (d) is correct.**
Explanation: In ΔABC and ΔPQR using the Side-Angle-Side (SAS) similarity criterion.
Proportionality condition:

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

This indicates that the corresponding sides of both triangles are in proportion.
The corresponding angles must be equal. Thus, we conclude:

$$\angle C = \angle P$$

In triangle PQR, applying angle sum property, we get

$$\angle P = 180° - 80° - 60°$$
$$= 180° - 140° = 40°$$
$$\angle C = \angle P = 40°.$$

8. **Option (d) is correct.**
Explanation:

$$\tan 2A = 3 \tan A$$

By substituting $A = 30°$, we get

$$\tan(2 \times 30°) = 3 \tan 30°$$

Using $\tan 60° = \sqrt{3}$ and $\tan 30° = \frac{1}{\sqrt{3}}$:

$$\sqrt{3} = 3 \times \frac{1}{\sqrt{3}}$$

Simplifying the Right-Hand Side:

$$3 \times \frac{1}{\sqrt{3}} = \frac{3}{\sqrt{3}} = \sqrt{3}$$

Hence, $$\sqrt{3} = \sqrt{3}$$

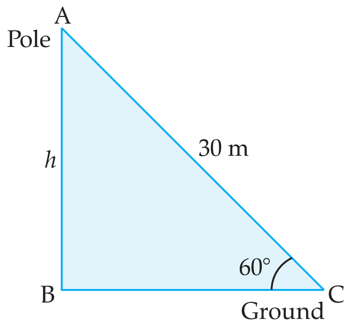
Thus, the equation holds true for $A = 30°$, verifying the given relation.

9. **Option (c) is correct.**
Explanation:
The cosine function decreases from 0° to 90°.
Therefore, $\cos 20° > \cos 70°$.

10. **Option (d) is correct.**

Explanation: $$\sin \theta = \frac{\text{perpendicular}}{\text{hypotenuse}}$$

$$= \frac{AB}{AC}$$



Let height of pole be h.

$\therefore$ $$\sin 60° = \frac{h}{30}$$

$$\frac{\sqrt{3}}{2} = \frac{h}{30}$$

$$h = 30 \times \frac{\sqrt{3}}{2}$$

$$h = 15\sqrt{3} \text{ m}$$

11. **Option (b) is correct.**
Explanation: Since, only a whole number of depressions can be formed, the largest perfect square arrangement that fits within 7 cm × 7 cm is calculated by placing circles of diameter 2 × 0.35 = 0.7 cm.

Number of circles along one side $= \frac{7}{0.7} = 10$

Total number of hemispherical depressions:

$$10 \times 10 = 100$$

12. **Option (a) is correct.**
Explanation: The cumulative frequency for calculating the median is upto by adding the frequencies of all the classes upto the median class. This is because the median class is the first class where the cumulative frequency exceeds half of the total frequency.

13. **Option (c) is correct.**
Explanation: The relation between mean, median and mode is given by:

$$\text{Mode} = 3 \times \text{Median} - 2 \times \text{Mean}$$

Given: $$\text{Mean} = 10$$
$$\text{Median} = 11$$

Substituting the values:

$$\text{Mode} = 3(11) - 2(10)$$
$$= 33 - 20 = 13$$

14. **Option (d) is correct.**
Explanation: Since, OP is the perpendicular from O to chord AB, it bisects the chord at P, i.e.,

$$AP = PB = \frac{AB}{2} = \frac{2r}{2} = r$$

Applying Pythagoras Theorem
In ΔOPA: $$OA^2 = OP^2 + AP^2$$
Substituting values:

$$R^2 = r^2 + r^2$$ [Here, $OA = R$ = radius of large circle]
$$R^2 = 2r^2$$
$$R = \sqrt{2}r$$

15. Option (a) is correct.

Explanation: Since the parallelogram circumscribes a circle, it is a rhombus.

One side of the rhombus is given as 5 cm.

All sides of a rhombus are equal, so each side is 5 cm.

The perimeter of the rhombus is:

Perimeter = 4 × side length = 4 × 5 = 20 cm

16. Option (d) is correct.

Explanation: This means that E and F divide AB and AC in the same ratio (1 : 2).

Thus, by the converse of Basic Proportionality Theorem, the line segment EF is parallel to BC.

Since, $\frac{AE}{EB} = \frac{1}{2}$, so let $AE = x$

and $EB = 2x$.

Then $AB = AE + EB = x + 2x = 3x$

Thus, $\frac{AE}{AB} = \frac{x}{3x} = \frac{1}{3}$

Similarly, since $\frac{AF}{FC} = \frac{1}{2}, \frac{AF}{AC} = \frac{1}{3}$.

Since EF || BC, by the Basic Proportionality Theorem,

$$\frac{AE}{AB} = \frac{AF}{AC} = \frac{EF}{BC}.$$

$$EF = \frac{1}{3}BC$$

$$BC = 3EF$$

17. Option (d) is correct.

Explanation: A polynomial of degree n can have at most n real roots (zeroes).

18. Option (d) is correct.

Explanation: The total number of possible outcomes $= 6 \times 6 = 36$

Outcomes where the sum is greater than 10:

Sum = 11: (5, 6), (6, 5) → 2 outcomes

Sum =12: (6, 6) → 1 outcome

Total outcomes where the sum is greater than 10 = 2 + 1 = 3

Outcomes where the sum is at most 10

=Total outcomes – Outcomes where sum greater than 10

= 36 – 3 = 33 (favourable outcomes)

The probability is given by:

$$P(\text{sum} \leq 10) = \frac{\text{favourable outcomes}}{\text{total outcomes}}$$

$$= \frac{33}{36} = \frac{11}{12}$$

19. Option (d) is correct.

Explanation: **Assertion:** For 4^n to end with 0, it must be divisible by 5. However, $4^n = 2^{2n}$ contains only the prime factor 2 and no factor of 5. Therefore, 4^n is not divisible by 5 for any natural number n.

Thus, it cannot end with the digit 0 for any natural number n.

Assertion is false.

Reason: A number ends with 0 if it is the multiple of 10, meaning it must have both 2 and 5 as prime factors.

If x has both 2 and 5 as prime factors, then x^n will always contain 10 as a factor and thus end in 0.

So, reason is true.

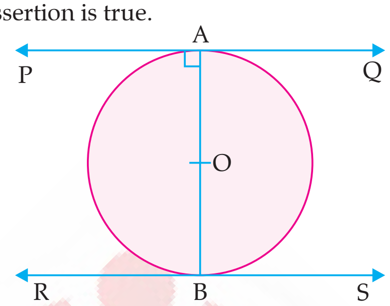
20. Option (b) is correct.

Explanation: **Assertion:**

If tangents are drawn at points A and B, we use the property that the tangent at any point on a circle is perpendicular to the radius at that point.

Since $OA \perp$ tangent at A and $OB \perp$ tangent at B, and OA and OB are collinear (as they are radii along the same diameter), the two tangents must be parallel to each other.

So, assertion is true.



Reason: Reason states that the lengths of tangents from an external point to a circle are equal. This is a general property of tangents to a circle. So, reason is true but does not justify Assertion.

SECTION– B

21. We are given the system of equations:

$$30x + 44y = 10; 40x + 55y = 13$$

Multiply the first equation by 4 and the second equation by 3 to align the coefficients of x:

$(4) \times (30x + 44y = 10) \Rightarrow 120x + 176y = 40$

$(3) \times (40x + 55y = 13) \Rightarrow 120x + 165y = 39$

Now, we subtract the second equation from the first:

$(120x + 176y) – (120x + 165y) = 40 – 39$

$120x + 176y – 120x – 165y = 1$

$$11y = 1 \Rightarrow y = \frac{1}{11}$$

Substitute $y = \frac{1}{11}$ into one of the original equations

Using the first equation:

$$30x + 44y = 10$$

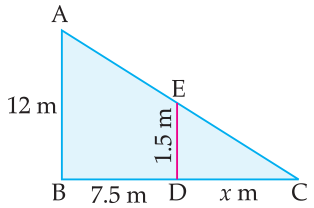
$$30x + 44 \times \frac{1}{11} = 10$$

$$30x + 4 = 10$$

$$30x = 6$$

$$x = \frac{1}{5}$$

22. (A) Given,



Height of the lamp post = 12 m

Height of the boy = 1.5 m

Speed of the boy = 2.5 m/s

Time elapsed = 3 seconds

Distance walked by the boy = speed × time

= 2.5 × 3 = 7.5 m

Let the length of the shadow of the boy after 3 seconds be x m.
Triangle(ABC) Similar to triangle (EDC)
In triangle ABC,

$$AB = \text{Height} = 12 \text{ m}$$

BC = Base = (distance of boy from lamp post + shadow) = $(7.5 + x)$

In triangle EDC
ED Height = 1.5 m
DC Base = x
Since these triangles are similar, the ratio of corresponding sides is equal:

$$\frac{AB}{BC} = \frac{ED}{DC}$$

$$\frac{12}{7.5+x} = \frac{1.5}{x}$$

$$12x = 1.5(7.5 + x)$$

$$12x = 11.25 + 1.5x$$

$$12x - 1.5x = 11.25$$

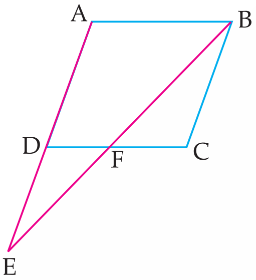
$$10.5x = 11.25$$

$$x = \frac{11.25}{10.5} = 1.07 \text{ m}$$

Thus, after 3 seconds, the length of the boy's shadow is approximately 1.07 m.

OR

(B) We are given a parallelogram $ABCD$, where side AD is extended to a point E, and BE intersects CD at F. We need to prove that $\Delta ABE \sim \Delta CFB$.



In ΔABE and ΔCFB,
$\angle BAE = \angle FCB$ (opposite angles of a parallelogram)
$\angle AEB = \angle FBC$ [Since, $AE \parallel BC$ and EB is a transversal, alternate interior angles]
Thus, $\Delta ABE \sim \Delta CFB$ (By AA criterion)

23. Since C divides AB externally in the ratio 2 : 1 (as $AC = 2BC$), we use the section formula for external division:

$$C(x, y) = \left(\frac{m_1x_2 - m_2x_1}{m_1 - m_2}, \frac{m_1y_2 - m_2y_1}{m_1 - m_2}\right)$$

where:

$$A(x_1, y_1) = (-1, 7),$$
$$B(x_2, y_2) = (4, -3),$$
$$\text{Ratio } m_1 : m_2 = 2 : 1.$$

x-Coordinate of C

$$x = \frac{2(4)-1(-1)}{2-1} = \frac{8+1}{1} = 9$$

y-Coordinate of C

$$y = \frac{2(-3)-1(7)}{2-1} = \frac{-6-7}{1} = -13$$

The coordinates of C are:

$$(9, -13)$$

24. (A)

$(\sin A + \text{cosec } A)^2 + (\cos A + \sec A)^2 = x + \tan^2 A + \cot^2 A$

$\Rightarrow \sin^2 A + \text{cosec}^2 A + 2 \sin A \text{ cosec } A + \cos^2 A + \sec^2 A + 2 \cos A \sec A = x + \tan^2 A + \cot^2 A$

$\Rightarrow \sin^2 A + \cos^2 A + \text{cosec}^2 A + \sec^2 A + 4 = x + \tan^2 A + \cot^2 A$

[Using identities, $\sin A \text{ cosec } A = 1$ and $\cos A \sec A = 1$]

$\Rightarrow 5 + 1 + \cot^2 A + 1 + \tan^2 A = x + \tan^2 A + \cot^2 A$

[Using identities, $\sin^2 A + \cos^2 A = 1$, $\text{cosec}^2 A = 1 + \cot^2 A$ and $\tan^2 A = 1 + \sec^2 A$]

$\Rightarrow 7 = x$ or, $x = 7$

OR

(B) $\dfrac{3\sin 30° - 4\sin^3 30°}{2\sin^2 50° + 2\cos^2 50°}$ $\left[\because \sin 30° = \dfrac{1}{2},\ \sin^2\theta + \cos^2\theta = 1\right]$

$$= \frac{3 \times \frac{1}{2} - 4 \times \left(\frac{1}{2}\right)^3}{2 \times 1}$$

$$= \frac{\frac{3}{2} - \frac{1}{2}}{2} = \frac{\frac{2}{2}}{2} = \frac{1}{2}$$

25. We assume that Anil and Ashraf were born in December 2010, which has 31 days. Each day is equally likely for their birth.

Since each friend could be born on any of the 31 days, the total number of possible birthdate pairs is:

$$31 \times 31 = 961$$

(i) Probability that they share the same date of birth:

For Anil and Ashraf to have the same birth date, Anil can be born on any of the 31 days and Ashraf must be born on that exact same day.

Number of favourable outcomes = 31

Total outcomes = 961

$$P(\text{same birthday}) = \frac{31}{961} = \frac{1}{31}$$

(ii) Probability that they have different birth dates

Since the total probability must sum to 1:

$$P(\text{different birthday}) = 1 - P(\text{same birthday})$$

$$= 1 - \frac{1}{31} = \frac{31}{31} - \frac{1}{31} = \frac{30}{31}$$

SECTION– C

26. (A) Assume that $\sqrt{2}$ is a rational number.

This means that it can be expressed as a fraction in the form:

$$\sqrt{2} = \frac{p}{q}$$

where:

p and q have no common factors other than 1,

$q \neq 0$.

Squaring both sides of the equation:

$$2 = \frac{p^2}{q^2}$$

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

From the equation $2q^2 = p^2$, we see that p^2 is divisible by 2.

Since 2 is a prime number, this means p must also be divisible by 2.

Let $p = 2k$ for some integer k.

Substitute $p = 2k$ in the equation

Substituting $p = 2k$ into $2q^2 = p^2$:

$$2q^2 = (2k)^2$$
$$2q^2 = 4k^2$$

Dividing both sides by 2:

$$q^2 = 2k^2$$

This shows that q^2 is also divisible by 2, which means that q must also be divisible by 2.

We have found that both p and q are divisible by 2, meaning they have a common factor of 2.

This contradicts our assumption that p and q have no common factors other than 1.

Since our assumption that $\sqrt{2}$ is rational leads to a contradiction, our assumption must be false.

Thus, $\sqrt{2}$ is irrational.

OR

(B) We are given:

$$p = x^2.y^3, q = x.y^4, r = x^5.y^2$$
$$\text{HCF}(p, q, r) = x^1.y^2 = xy^2$$
$$\text{LCM}(p, q, r) = x^5.y^4$$

HCF (p, q, r) × LCM (p, q, r)

$$\text{HCF} \times \text{LCM} = (xy^2) \times (x^5 y^4)$$
$$= x^{1+5}.y^{2+4} = x^6.y^6$$

Now, $$p \times q \times r = (x^2 y^3) \times (xy^4) \times (x^5y^2)$$
$$= x^{2+1+5}.y^{3+4+2}$$
$$= x^8.y^9$$

Since we found:

$$\text{HCF}(p, q, r) \times \text{LCM}(p, q, r) = x^6.y^6$$
$$p \times q \times r = x^8.y^9$$

$\Rightarrow$ $$\text{HCF} \times \text{LCM} \neq p \times q \times r$$

27. Let:

The monthly income of the first person = $9x$

The monthly income of the second person = $7x$

The monthly expenditure of the first person = $4y$

The monthly expenditure of the second person = $3y$

Given that both save ₹ 5,000, we use the formula:

Income – Expenditure = Savings

For the first person:

$$9x - 4y = 5000$$

For the second person:

$$7x - 3y = 5000$$

Thus, the system of equations is:

$$9x - 4y = 5000$$
$$7x - 3y = 5000$$

Multiply the first equation by 3 and the second equation by 4 to make the coefficients of y equal:

$$(9x - 4y) \times 3 = 5000 \times 3$$
$$(7x - 3y)\times 4 = 5000 \times 4$$

$\Rightarrow$ $$27x - 12y = 15000$$
$$28x - 12y = 20000$$

Subtract the equations

$$(28x - 12y) - (27x - 12y) = 20000 - 15000$$
$$x = 5000$$

Substituting $x = 5000$ in $9x - 4y = 5000$:

$$9(5000) - 4y = 5000$$
$$45000 - 4y = 5000$$
$$45000 - 5000 = 4y$$
$$40000 = 4y$$
$$y = 10000$$

The monthly incomes

First person's income = $9x = 9(5000) = 45000$

Second person's income $= 7x = 7(5000) = 35000$

The monthly incomes are:

₹ 45,000 (first person) ₹ 35,000 (second person)

28. Since ΔPQR is right-angled at $P(x, y)$,

$$PQ^2 + PR^2 = QR^2 \quad \text{...(i)}$$

Using distance formula:

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Distance between the Points: $P(x, y)$ and $Q(-2, -3)$

$$PQ^2 = (x + 2)^2 + (y + 3)^2$$

Distance between the Points: $P(x, y)$ and $R(2, 3)$

$$PR^2 = (x - 2)^2 + (y - 3)^2$$

Distance between the Points: $Q(-2, -3)$ and $R(2, 3)$

$$QR^2 = (2 + 2)^2 + (3 + 3)^2$$
$$QR^2 = 4^2 + 6^2$$
$$= 16 + 36 = 52$$

From eq. (i)

$$(x + 2)^2 + (y + 3)^2 + (x - 2)^2 + (y - 3)^2 = 52$$
$$(x^2 + 4x + 4) + (y^2 + 6y + 9) + (x^2 - 4x + 4) + (y^2 - 6y + 9) = 52$$
$$x^2 + x^2 + y^2 + y^2 + 4x - 4x + 6y - 6y + 4 + 4 + 9 + 9 = 52$$
$$2x^2 + 2y^2 + 26 = 52$$
$$2x^2 + 2y^2 = 26$$
$$x^2 + y^2 = 13$$

Thus, the relationship between x and y is:

$$x^2 + y^2 = 13$$

Possible values of x when $y = 2$

Substituting $y = 2$:

$$x^2 + 2^2 = 13$$
$$x^2 + 4 = 13$$
$$x^2 = 9$$
$$x = \pm 3$$

29. (A) $$\frac{\cos A + \sin A - 1}{\cos A - \sin + A} = \text{cosec } A - \cos A$$

$$\text{LHS} = \frac{\sin A\left[\dfrac{\cos A}{\sin A} + 1 - \dfrac{1}{\sin A}\right]}{\sin A\left[\dfrac{\cos A}{\sin A} - 1 + \dfrac{1}{\sin A}\right]}$$

$$= \frac{\cot A + 1 - \text{cosec } A}{\cot A - 1 + \text{cosec } A}$$

$$= \frac{\cot A - \text{cosec } A + (\text{cosec}^2 A - \cot^2 A)}{\cot A - 1 + \text{cosec } A}$$

$[\because 1 = \text{cosec}^2 A - \cot^2 A]$

$$= \frac{\cot A - \text{cosec } A + (\text{cosec } A - \cot A)(\text{cosec } A + \cot A)}{\cot A - 1 + \text{cosec } A}$$

$$= \frac{\text{cosec } A - \cot A(\text{cosec } A + \cot A - 1)}{\cot A - 1 + \text{cosec } A}$$

$= \text{cosec } A - \cot A$

= RHS

OR

(B) We are given the equations:

$$\cot\theta + \cos\theta = p$$
$$\cot\theta - \cos\theta = q$$

We need to prove that:

$$\text{LHS} = p^2 - q^2 = 4\sqrt{pq}$$

$$p^2 - q^2 = (\cot\theta + \cos\theta)^2 - (\cot\theta - \cos\theta)^2$$

Expanding both squares:

$= (\cot^2\theta + 2\cot\theta\cos\theta + \cos^2\theta) - (\cot^2\theta - 2\cot\theta\cos\theta + \cos^2\theta)$

$= 2\cot\theta\cos\theta + 2\cot\theta\cos\theta = 4\cot\theta\cos\theta$

Now, RHS $= pq = (\cot\theta + \cos\theta)(\cot\theta - \cos\theta)$

Using the identity $(a+b)(a-b) = a^2 - b^2$:

$$pq = \cot^2\theta - \cos^2\theta$$

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

$$= \frac{\cos^2\theta - \sin^2\theta.\cos^2\theta}{\sin^2\theta}$$

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

$$= \cot^2\theta \,.\, \cos^2\theta$$

Therefore, $\sqrt{pq} = \sqrt{\cot^2\theta.\cos^2\theta}$

$= \cot\theta \,.\, \cos\theta$

Thus:

$$4\sqrt{pq} = 4\cot\theta\cos\theta$$

Since we earlier found that:

$$p^2 - q^2 = 4\cot\theta\cos\theta$$

This proves:

$$p^2 - q^2 = 4\sqrt{pq}$$

Proved.

30. We are given that α and β are the zeroes of the quadratic polynomial: $px^2 + qx + 1$

Sum of the roots:

$$\alpha + \beta = -\frac{q}{p}$$

Product of the roots:

$$\alpha\beta = \frac{1}{p}$$

The sum of the new roots $\frac{2}{\alpha} + \frac{2}{\beta}$ is:

$$\frac{2}{\alpha} + \frac{2}{\beta} = 2\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$$

Substituting values:

$$= 2 \times \frac{-\frac{q}{p}}{\frac{1}{p}} = -2q$$

Thus:

$$\frac{2}{\alpha} + \frac{2}{\beta} = -2q$$

The product of the new roots is:

$$\frac{2}{\alpha} \times \frac{2}{\beta} = \frac{4}{\alpha\beta} = \frac{4}{\frac{1}{p}} = 4p$$

The polynomial can be expressed in terms of its roots using the formula:

x^2–(sum of roots)x + (product of roots)

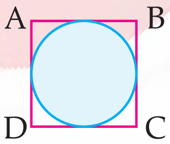
Substituting the values:

$$x^2 - (-2q)x + 4p$$
$$x^2 + 2qx + 4p$$

Thus, the required quadratic polynomial is:

$$x^2 + 2qx + 4p$$

31. We are given a rectangle *ABCD* that circumscribes a circle of radius 10 cm. This means that the circle is inscribed in the rectangle, touching all four sides.



A quadrilateral can circumscribe a circle if and only if the sum of its opposite sides is equal. Mathematically:

$$AB + CD = AD + BC$$

Since *ABCD* is a rectangle, we know that:

$$AB = CD \text{ and } AD = BC$$

Thus, the equation simplifies to:

$$2AB = 2AD$$
$$AB = AD$$

This means that the length and breadth of the rectangle are equal, which implies that *ABCD* is a square.

Since the circle is inscribed in the square, the diameter of the circle is equal to the side length of the square.

Side of square = 2× radius of circle

= 2 × 10 = 20 cm

The perimeter of *ABCD*

Since *ABCD* is a square with a side length of 20 cm, the perimeter is given by:

Perimeter = 4 × side

= 4 × 20 = 80 cm

SECTION– D

32. (A) Let the shortest side of the right triangle be x metres.

The longest side (hypotenuse) is 4 m more than the shortest side:

$$\text{Hypotenuse} = x + 4$$

The third side is 2 m less than the longest side:

$$\text{Third side} = (x + 4) - 2 = x + 2$$

Thus, the sides of the right triangle are:

$x, x + 2, x + 4$

Since it is a right triangle, we apply the Pythagoras theorem:

$$(\text{Shortest Side})^2 + (\text{Third Side})^2 = (\text{Hypotenuse})^2$$

Substituting the values:

$$x^2 + (x + 2)^2 = (x + 4)^2$$
$$x^2 + (x^2 + 4x + 4) = x^2 + 8x + 16$$
$$x^2 + x^2 + 4x + 4 = x^2 + 8x + 16$$
$$2x^2 + 4x + 4 = x^2 + 8x + 16$$
$$2x^2 + 4x + 4 - x^2 - 8x - 16 = 0$$
$$x^2 - 4x - 12 = 0$$
$$(x - 6)(x + 2) = 0$$

Thus, $x = 6$ or $x = -2$. Since length cannot be negative, we take:

$$x = 6$$

The sides of the triangle

$$\text{Shortest side} = 6 \text{ m}$$
$$\text{Third side} = 6 + 2 = 8 \text{ m}$$
$$\text{Hypotenuse} = 6 + 4 = 10 \text{ m}$$

Thus, the sides of the triangle are 6 m, 8 m and 10 m.

The perimeter is the sum of all three sides:

$$6 + 8 + 10 = 24 \text{ m}$$

The area of a right triangle is:

$$\text{Area} = \frac{1}{2} \times \text{Base} \times \text{Height}$$

Taking base = 6 m and height = 8 m:

$$\text{Area} = \frac{1}{2} \times 6 \times 8 = 24\text{m}^2$$

The difference between the numerical values of area and perimeter

$$\text{Difference} = \text{Area} - \text{Perimeter}$$
$$= 24 - 24 = 0$$

OR

(B) Given Equation

$$\frac{x-2}{x-3} + \frac{x-4}{x-5} = \frac{10}{3}, \quad x \neq 3, 5$$

$$\frac{(x-2)(x-5)+(x-4)(x-3)}{(x-3)(x-5)} = \frac{10}{3}$$

$$3[(x-2)(x-5) + (x-4)(x-3)] = 10(x-3)(x-5)$$
$$3[(x^2 - 7x + 10) + (x^2 - 7x + 12)] = 10(x^2 - 8x + 15)$$
$$3(2x^2 - 14x + 22) = 10(x^2 - 8x + 15)$$
$$6x^2 - 42x + 66 = 10x^2 - 80x + 150$$
$$6x^2 - 42x + 66 - 10x^2 + 80x - 150 = 0$$
$$-4x^2 + 38x - 84 = 0$$
$$4x^2 - 38x + 84 = 0$$

The quadratic equation in standard form is given as:

$$4x^2 - 38x + 84 = 0$$

Using the quadratic formula:

$$x = \frac{-(-38) \pm \sqrt{(-38)^2 - 4(4)(84)}}{2(4)}$$

$$x = \frac{38 \pm \sqrt{1444 - 1344}}{8}$$

$$x = \frac{38 \pm \sqrt{100}}{8}$$

$$x = \frac{38 \pm 10}{8}$$

Thus, the roots are:

$$x = \frac{38+10}{8} = \frac{48}{8} = 6$$

$$x = \frac{38-10}{8} = \frac{28}{8} = \frac{7}{2}$$

33. (A) Given: The corresponding sides of ΔABC and ΔPQR are in the ratio 3 : 5.

Therefore, $\Delta ABC \sim \Delta PQR$ with a ratio of similarity $\frac{3}{5}$

Also, the corresponding sides of ΔABC and ΔPQR are proportional:

$$\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR} = \frac{3}{5}$$

AD and PS are perpendiculars to BC and QR, respectively.

(i) Proving $\Delta ADC \sim \Delta PSR$

To prove similarity,

$$\angle ADC = \angle PSR = 90° \text{(Given)}$$
$$\angle ACD = \angle PRS \text{ (Since } \Delta ABC \sim \Delta PQR\text{, corresponding angles are equal.)}$$

Since two angles are equal, by the AA similarity criterion,

$$\Delta ADC \sim \Delta PSR.$$

(ii) Since corresponding altitudes of similar triangles are also in the same ratio as their corresponding sides:

$$\frac{AD}{PS} = \frac{3}{5}$$

Substituting $AD = 4$ cm,

$$\frac{4}{PS} = \frac{3}{5}$$

Cross-multiplying,

$$PS = \frac{4 \times 5}{3} = \frac{20}{3} \approx 6.67\text{cm}$$

(iii) We know that, the areas of similar triangles are proportional to the square of the ratio of corresponding sides,

$$\frac{ar(\Delta ABC)}{ar(\Delta PQR)} = \left(\frac{3}{5}\right)^2 = \frac{9}{25}$$

Thus,

$$\text{Area ratio} = 9 : 25.$$

OR

(B) Basic Proportionality Theorem (Thales' Theorem):

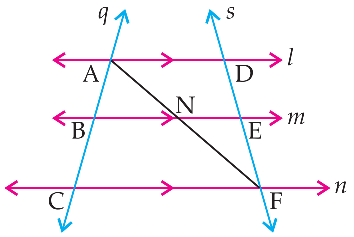
If a line is drawn parallel to one side of a triangle, intersecting the other two sides at distinct points, then it divides those two sides in the same ratio.

Mathematically,

In ΔABC, if DE is parallel to BC and intersects AB at D and AC at E, then:

$$\frac{AD}{DB} = \frac{AE}{EC}$$

Join the line segment AF which intersect BE at N This line segment creates two triangles: ΔACF and ΔADF.



In ΔACF, since line segment BN is parallel to CF, according to the BPT: $\frac{AB}{BC} = \frac{AN}{NF}$

Similarly, in ΔADF, since line segment NE is parallel to AD: Thus, $\frac{AN}{NF} = \frac{DE}{EF}$

As both ratios are equal to $\frac{AN}{NF}$, it can be concluded that: $\frac{AB}{BC} = \frac{DE}{EF}$

34. Given,

The die is a cube with an edge length of 5 cm.

Each face has hemispherical depressions:

Face 1: 1 depression

Face 2: 2 depressions

....

Face 6: 6 depressions

The sum of depressions on opposite faces is always 7.

We know that, a cube has 6 faces.

Total surface area of the cube

$= 6 \times (\text{edge length})^2$

$= 6 \times 25$

$= 150 \text{ cm}^2$.

Since, each hemispherical depression has a diameter of 1.4 cm,

So, the radius $r = 0.7$ cm.

Each depression is a hemisphere, so the curved surface area of one hemisphere

$= 2\pi r^2 = 2\pi(0.7)^2$

$= 2\pi \times 0.49$

$= 0.98\pi \text{ cm}^2$

The base of each hemisphere (a circle) is removed from the cube's face,

So, the area removed per depression

$= \pi r^2 = \pi(0.7)^2$

$= 0.49\pi \text{ cm}^2$

Thus,

Net surface area added per depression

= Curved surface area – Base area

$= 0.98\pi - 0.49\pi$

$= 0.49\pi \text{ cm}^2$

The die has faces with 1, 2, 3, 4, 5 and 6 depressions.

Total depressions $= 1 + 2 + 3 + 4 + 5 + 6 = 21$

Total surface area added by depression

= Number of depressions × Net surface area per depression

$= 21 \times 0.49\pi$

$= 10.29\pi \text{ cm}^2$

Hence,

Total surface area = Original surface area of the cube + Surface area added by depressions

$= 150 + 10.29\pi \text{ cm}^2$

$= 150 + 10.27 \times \frac{22}{7}$

$= 150 + 32.27$

$= 182.27 \text{ cm}^2$

35. The formula for the mean of grouped data is:

$$\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

where:

x_i = Midpoint of each class interval

$$= \frac{\text{Lower Bound} + \text{Upper Bound}}{2}$$

f_i = Frequency (number of patients discharged)

$\Sigma f_i x_i$ = Summation of the product of class midpoints and frequencies

Age Group (Years)	Midpoint x_i	Fre-quency f_i	$f_i x_i$
5 – 15	$\frac{5+15}{2} = 10$	6	$6 \times 10 = 60$
15 – 25	$\frac{15+25}{2} = 20$	11	$11 \times 20 = 220$
25 – 35	$\frac{25+35}{2} = 30$	21	$21 \times 30 = 630$
35 – 45	$\frac{35+45}{2} = 40$	23	$23 \times 40 = 920$
45 – 55	$\frac{45+55}{2} = 50$	14	$14 \times 50 = 700$
55 – 65	$\frac{55+65}{2} = 60$	5	$5 \times 60 = 300$
Total	-	**80**	**2830**

$$\text{Mean} = \frac{2830}{80} = 35.375$$

Thus, mean ≈ 35.38 years.

Mode: The highest frequency = 23, which corresponds to the 35 – 45 class interval.

$$\text{Mode} = L + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$

where:

L = Lower boundary of modal class = 35
f_1 = Frequency of modal class = 23
f_0 = Frequency of the class before modal class = 21
f_2 = Frequency of the class after modal class = 14
h = Class width = 10

$$\text{Mode} = 35 + \left(\frac{23 - 21}{2(23) - 21 - 14}\right) \times 10$$

$$= 35 + \left(\frac{2}{46 - 35}\right) \times 10$$

$$= 35 + \left(\frac{2}{11}\right) \times 10$$

$$= 35 + 1.82$$

$$\approx 36.82$$

Thus, Mode $\approx$ 36.82 years.

SECTION– E

36. Given,

5 interlocking rings each ring requires 44 m of rope (circumference).

ΔOAB is an equilateral triangle.

All unshaded regions are congruent.

(i) The circumference of a circle is given by:

$$C = 2\pi r$$

Given C = 44 m, we solve for r:

$$2\pi r = 44$$

$$r = \frac{44}{2\pi} = 7\text{m}$$

Thus, radius of each circular ring = 7 m.

(ii) Given that ΔOAB is an equilateral triangle, all its angles are equal.

The angle $\angle AOB$ in an equilateral triangle is:

$$\angle AOB = 60°$$

(iii) (A) Area of sector $= \frac{\theta}{360°} \times \pi r^2$

Substituting θ = 60° and r = 7:

$$\text{Area of sector } OAB = \frac{60°}{360°} \times \pi \times 7^2$$

$$= \frac{1}{6} \times \frac{22}{7} \times 49$$

$$= \frac{154}{6} = 25.67 \text{ m}^2$$

The formula for the area of an equilateral triangle is:

$$A = \frac{\sqrt{3}}{4} s^2$$

Since the side length s of the triangle is equal to r=7 m,

$$\text{Area of triangle } AOB = \frac{\sqrt{3}}{4} \times 7^2$$

$$= 21.22 \text{ m}^2$$

Area of shaded region $R_1 = \pi \times 7^2 - 2$(Area of sector AOB – Area of triangle AOB)

$$= 154 - 2(4.45)$$

$$= 145.1 \text{ m}^2$$

OR

(B) length of an arc $= \frac{\theta}{360°} \times 2\pi r$

The triangle is equilateral so the angle is 60°

$$\text{length of an arc} = \frac{60°}{360°} \times 2 \times \frac{22}{7} \times 7$$

$$= \frac{1}{6} \times 44 = 7.33$$

Length of rope around the unshaded regions:

$$8 \times 7.33 = 58.66$$

37. Given,

Total cable car ride length = 5000 m.

First pole is 200 m from the base.

Subsequent poles are installed at equal intervals of 150 m.

Last pole is 300 m from the top.

Distance from base to top = 5000 m, so the last pole is at 5000 – 300 = 4700 m from the base.

(i) The sequence of poles follows an AP, where:

First term (a) = 200 m.

Common difference (d) = 150 m

n = 10

Using the formula for the n^{th} term:

$$T_n = a + (n - 1)d$$

$$T_{10} = 200 + (10 - 1) \times 150$$

$$= 200 + 1350 = 1550 \text{ m}$$

(ii) Distance between the 15th pole and the 25th pole

Using the AP formula for the 15th and 25th terms:

$$T_{15} = 200 + (15 - 1) \times 150$$

$$= 200 + 2100 = 2300 \text{ m}$$

$$T_{25} = 200 + (25 - 1) \times 150$$

$$= 200 + 3600 = 3800 \text{ m}$$

$$\text{Distance} = T_{25} - T_{15}$$

$$= 3800 - 2300 = 1500 \text{ m}$$

(iii) (A) Time taken by cable car to reach the 15th pole from the top

Starting position = Top (5000 m).

15th pole position = 2300 m.

Distance to be covered = 5000 – 2300 = 2700 m.

Speed = 5 m/s.

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{2700}{5} = 540 \text{ s}$$

OR

(B) We need to find n such that the last pole is at 4700 m.

$$T_n = 4700$$

Using the AP formula:

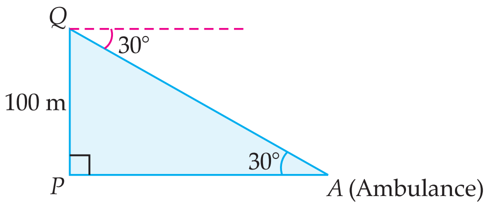
$$4700 = 200 + (n - 1) \times 150$$

$$4500 = (n - 1) \times 150$$

$$n - 1 = \frac{4500}{150} = 30$$

$$n = 31$$

38. (i)



(ii) In ΔAQP:

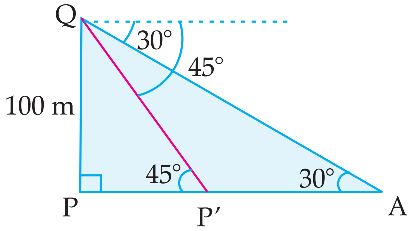
$$\tan(30°) = \frac{QP}{AP}$$

$$\frac{1}{\sqrt{3}} = \frac{100}{AP}$$

$$AP = 100 \times \sqrt{3} = 100 \times 1.73$$
$$= 173 \text{ m}$$

So, the ambulance is 173 m away from P.

(iii) (A)



When the angle of depression is 45°, using:

$$\tan(45°) = \frac{QP}{AP'}$$

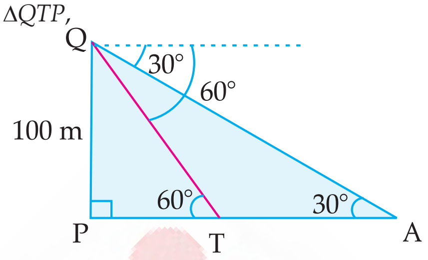
$$1 = \frac{100}{AP'}$$

$$AP' = 100 \text{ m}$$
$$\text{Distance covered} = 173 - 100 = 73 \text{ m}$$
$$\text{Speed of ambulance} = 60 \text{ km/h}$$
$$= \frac{60{,}000 \text{ m}}{3600 \text{ s}}$$
$$= 16.67 \text{ m/s.}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{73}{16.67} \approx 4.38 \text{ seconds}$$

OR

(B) In ΔQTP,



Using:

$$\tan(60°) = \frac{QP}{PT}$$

$$\sqrt{3} = \frac{100}{PT}$$

$$PT = \frac{100}{\sqrt{3}} = \frac{100}{1.73} \approx 57.8 \text{ m}$$

$$\text{Distance covered} = 57.8 \text{ m}$$

$$\text{Time} = \frac{57.8}{16.67} = 3.47 \text{ seconds}$$

Delhi Set– 2 **30/4/2**

SECTION– A

6. Option (d) is correct.

Explanation: Distance from origin:

$$d = \sqrt{(x-0)^2 + (y-0)^2} = \sqrt{x^2 + y^2}$$

Calculating the distance for each point, we get:

(a) Point (3, 4)

$$d = \sqrt{x^2 + y^2} = \sqrt{3^2 + 4^2}$$
$$= \sqrt{9 + 16} = \sqrt{25} = 5 \text{ units}$$

Since, the distance is exactly 5 units, it is not less than 5 units.

(b) Point (2, 6)

$$d = \sqrt{x^2 + y^2} = \sqrt{2^2 + 6^2}$$
$$= \sqrt{4 + 36} = \sqrt{40} > \sqrt{25}$$

Since $\sqrt{40} > 5$, this point is not less than 5 units.

(c) Point (−3, −4)

$$d = \sqrt{x^2 + y^2} = \sqrt{(-3)^2 + (-4)^2}$$
$$= \sqrt{9 + 16} = \sqrt{25} = 5 \text{ units}$$

Since, the distance is exactly 5, it is not less than 5.

(d) Point (1, 4)

$$d = \sqrt{x^2 + y^2} = \sqrt{1^2 + 4^2}$$
$$= \sqrt{1 + 16} = \sqrt{17} < \sqrt{25}$$

Since $\sqrt{17} < 5$, this point is less than 5 units.

The only point whose distance from the origin is less than 5 units is (1, 4).

10. Option (c) is correct.

Explanation: Fundamental standard identity:
$\sec^2\theta - \tan^2\theta = 1$
Rearranging this, we get: $\sec^2\theta = 1 + \tan^2\theta$
Thus, this equation is a valid trigonometric identity.
Remaining are false as:

$$\sin^2\theta = 1 - \cos^2\theta$$
$$\text{cosec}^2\theta - \cot^2\theta = 1$$
$$\sin 2\theta = 2\sin\theta\cos\theta$$

13. Option (c) is correct.

Explanation: Using the formula:

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

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

$$\Rightarrow \text{Median} = \frac{13 + 2(10)}{3}$$

$$\Rightarrow \text{Median} = \frac{33}{3}$$

$$\therefore \text{Median} = 11$$

14. Option (c) is correct.

Explanation: Length of AB = diameter of inner circle $= 2r$

Radius of the smaller (inner) circle

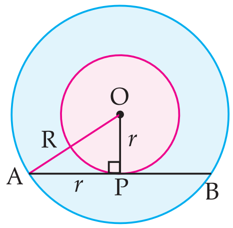
$$= OP$$

$$= \frac{\text{diameter of inner circle}}{2}$$

$$= \frac{2r}{2} = r$$

The perpendicular from the centre of the larger circle (O) to the chord (AB) bisects AB at P.

$$AP = \frac{AB}{2} = \frac{2r}{2} = r$$



Let the radius of the larger circle be R.

Using the Pythagoras Theorem in ΔOAP:

$$OA = \sqrt{OP^2 + AP^2}$$

$$\Rightarrow \quad R = \sqrt{r^2 + r^2}$$

$$\Rightarrow \quad R = \sqrt{2r^2}$$

$$\therefore \quad R = \sqrt{2}r$$

Diameter of the larger circle $= 2R = 2\sqrt{2}r$

19. Option (b) is correct.

Explanation: A fundamental property of circles states that the radius drawn to the point of contact of the tangent is always perpendicular to the tangent. Therefore, if we extend this radius, it will pass through the centre of the circle.

This confirms that Assertion (A) is true.

The lengths of tangents drawn from an external point to a circle are always equal due to the congruence of the two right-angled triangles formed by the radius, the tangent, and the line joining the external point to the center.

Reason is also true, but it does not explain the assertion.

SECTION– B

22. Saima and Aryaa were born in June 2012. Since, June has 30 days, so there are 30 possible birth dates. Each of them can be born on any of the 30 days independently.

If Saima and Aryaa can be born on any of the 30 days of June, then

Total number of possible ways to assign birthdays $= 30 \times 30 = 900$

(i) If they have different birthdays, Aryaa can be born on any of the remaining 29 days once Saima's birthday is chosen.

Number of favourable possibilities

$$= 30 \times 29 = 870$$

Probability that they have different dates of birth

$$= \frac{870}{900} = \frac{29}{30}$$

(ii) If Saima's birthday can be on any of the 30 days and Aryaa must be born on the same day as Saima.

If Aryaa's birthday must match Saima's, then

Number of favourable possibilities

$$= 30 \times 1 = 30$$

(one for each possible birthday)

Probability that they have the same date of birth

$$= \frac{30}{900} = \frac{1}{30}$$

22. Given set of equations:

$$37x + 63y = 137 \quad \text{...(i)}$$

$$63x + 37y = 163 \quad \text{...(ii)}$$

Using elimination method, multiply Eq. (i) by 37 and Eq. (ii) by 63 to eliminate y:

$$(37x + 63y) \times 37 = 137 \times 37$$

$$(63x + 37y) \times 63 = 163 \times 63$$

Expanding both equations:

$$1369x + 2331y = 5069$$

$$3969x + 2331y = 10269$$

Subtract the two equations:

$$(1369x + 2331y) - (3969x + 2331y)$$

$$= 5069 - 10269$$

$$\Rightarrow \quad -2600x = -5200$$

$$\therefore \quad x = 2$$

Substitute $x = 2$ in Eq. (i):

$$37x + 63y = 137$$

$$\Rightarrow \quad 37 \times 2 + 63y = 137$$

$$\Rightarrow \quad 74 + 63y = 137$$

$$\Rightarrow \quad 63y = 63$$

$$\therefore \quad y = 1$$

Thus, the solution to the given system of equations is (2, 1).

SECTION– C

26. α and β are the zeroes of the quadratic polynomial:

$$x^2 - ax - b \quad \text{...(i)}$$

Therefore,

x^2 – (sum of roots)x + (product of roots)

$\Rightarrow x^2 - (\alpha + \beta)x + (\alpha\beta)$ ...(ii)

Comparing (i) and (ii), we get:

$$\text{Sum of roots} = \alpha + \beta = a$$

Product of roots = $\alpha\beta = -b$

We need to find a quadratic polynomial whose new roots are: $3\alpha + 1$ and $3\beta + 1$

$$\text{Sum of roots} = 3\alpha + 1 + 3\beta + 1$$
$$= 3(\alpha + \beta) + 2$$
$$= 3a + 2$$
$$\text{Product of roots} = (3\alpha + 1)(3\beta + 1)$$
$$= 3\alpha \cdot 3\beta + 3\alpha \cdot 1 + 3\beta \cdot 1 + 1 \cdot 1$$
$$= 9\alpha\beta + 3\alpha + 3\beta + 1$$
$$= 9(\alpha\beta) + 3(\alpha + \beta) + 1$$
$$= -9b + 3a + 1$$

Substituting these values:

$x^2 -$ (sum of roots)x + (product of roots)

$\Rightarrow x^2 - (3a + 2)x + (-9b + 3a + 1)$

$\therefore$ The required quadratic polynomial is

$x^2 - (3a + 2)x + (3a - 9b + 1)$

29. In a right-angled triangle, the sum of the three angles is always 180°.

One of these angles is 90°, so the sum of the other two angles is: $\theta_1 + \theta_2 = 90°$

The two angles are in the ratio 2 : 3, we get:

$$\frac{\theta_1}{\theta_2} = \frac{2}{3}$$
$$3\theta_1 - 2\theta_2 = 0°$$

Linear equations in two variables are:

$$\theta_1 + \theta_2 = 90° \quad ...(i)$$
$$3\theta_1 - 2\theta_2 = 0° \quad ...(ii)$$

Using elimination method, multiply Eq. (i) by 2 and Eq. (ii) by 1 to eliminate y:

$$(\theta_1 + \theta_2) \times 2 = 90° \times 2$$
$$(3\theta_1 - 2\theta_2) \times 1 = 0° \times 1$$

Expanding both equations:

$$2\theta_1 + 2\theta_2 = 180°$$
$$3\theta_1 - 2\theta_2 = 0°$$

Adding the two equations:

$$2\theta_1 + 2\theta_2 + 3\theta_1 - 2\theta_2 = 180° + 0°$$
$$\Rightarrow \quad 5\theta_1 = 180°$$
$$\therefore \quad \theta_1 = 36°$$

Substitute $\theta_1 = 36°$ in Eq. (i): $\theta_1 + \theta_2 = 90°$

$$\Rightarrow \quad \theta_2 = 90° - \theta_1$$
$$\Rightarrow \quad \theta_2 = 90° - 36°$$
$$\therefore \quad \theta_1 = 54°$$

Thus, the two angles are 36° and 54°.

SECTION– D

32. Frequency distribution table is:

Number of Challans	**Midpoint (x_i)**	**Number of Days (f_i)**	$x_i f_i$
0 – 10	$\frac{0+10}{2} = 5$	3	5 × 3 = 15
10 – 20	$\frac{10+20}{2} = 15$	5 (f_0)	15 × 5 = 75
20 – 30 (Modal Class)	$\frac{20+30}{2} = 25$	10 (Maximum frequency f_1)	25 × 10 = 250
30 – 40	$\frac{30+40}{2} = 35$	9 (f_2)	35 × 9 = 315
40 – 50	$\frac{40+50}{2} = 45$	2	45 × 2 = 90
50 – 60	$\frac{50+60}{2} = 55$	1	55 × 1 = 55
		$\Sigma f_i = 30$	$\Sigma f_i x_i = 800$

$$\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{800}{30} = 26.67$$

From the table:

- L = Lower boundary of modal class = 20
- f_1 = Frequency of modal class = 10
- f_0 = Frequency of the class before modal class = 5 (preceding class frequency)
- f_2 = Frequency of the class after modal class = 9 (succeeding class frequency)
- h = Class width = 15 – 5 = 10 (class width)

$$\text{Mode} = L + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$
$$= 20 + \left(\frac{10 - 5}{2 \times 10 \;\; - 5 - 9}\right) \times 10$$
$$= 20 + \left(\frac{5}{6}\right) \times 10$$
$$= 20 + 8.33$$
$$= 28.33$$

32. The given problem involves a shed that consists of:

(1) A cuboidal portion with dimensions:

Length (l) = 10 m; Breadth (b) = 7 m; Height (h) = 3 m

(2) A half-cylinder on top:

$$\text{Radius} = \frac{\text{Diameter}}{2} = \frac{7}{2} \text{ m};$$

Length (same as cuboidal part) h' = 10 m

(3) The shed is open at the front side and closed at the back side. Since, the shed is placed on the ground, we don't count the base.

Area of walls = 2 × Area of a side wall + Area of back side wall

$$= 2 \times (l \times h) + b \times h$$
$$= 2 \times (10 \times 3) + 7 \times 3$$
$$= 60 + 21$$
$$= 81 \text{ m}^2$$

A semicircular part (area of a semicircle at back side wall) $= \frac{1}{2}\pi r^2$

$$= \frac{1}{2} \times \frac{22}{7} \times \left(\frac{7}{2}\right)^2$$

$$= \frac{77}{4} = 19.25 \text{ m}^2$$

Since, we have half a cylinder on the top, the curved surface area at the top $= \left(\frac{1}{2} \times 2\pi r\right) \times h'$

$$= \pi r h' = \frac{22}{7} \times \frac{7}{2} \times 10$$

$$= 110 \text{ m}^2$$

Total tin sheet area required

$$= 81 + 19.25 + 110$$

$$= 210.25 \text{ m}^2$$

Cost of tin sheets per square metre = ₹ 70

Cost of tin sheets required to make the shed

= ₹ 70 × 210.25 m^2

= ₹ 14,717.50

Delhi Set– 3 **30/4/3**

SECTION– A

4. Option (c) is correct.

Explanation: Given, Mode = 13, Median = 11

Formula for relation between Mean, Median and Mode is

2 × Mean + Mode = 3 × Median ...(i)

Put value of Mode and Median in the above Eq. (i)

2 × Mean + 13 = 3 × 11

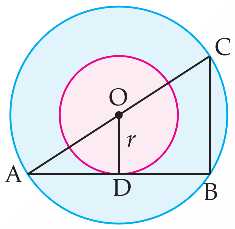
2 × Mean = 33 – 13

2 × Mean = 20

Mean = 10

5. Option (c) is correct.

Explanation:



In ΔOAD and ΔCAB, $\angle OAD = \angle CAB$ (common)

OD is perpendicular to AB, (AB is a tangent to the smaller circle at point D, the radius OD is perpendicular to AB.)

$$AD = BD,$$

as perpendicular from the centre to the chord bisects it.

$$AD : AB = 1 : 2$$

AC is the diameter of the larger circle and OA is its radius.

Therefore, $OA : AC = 1 : 2$

Thus, $AD : BD = OA : AC$

Hence, $\Delta AOD \sim \Delta ACB$

Ratio of corresponding sides of similar triangles are equal.

Therefore, $AD : BD = OA : AC$

$= 1 : 2 = OD : BC$

$1 : 2 = r : BC$

$BC = 2r$

9. Option (c) is correct.

Explanation: Two dice with A to F alphabets mentioned on it, if both the dice are thrown simultaneously then total number of possible outcomes is 36.

Total number of outcomes with vowel on both sides are (A, A) (A, E) (E, A) (E, E)

Probability of vowels on both sides if two dice are thrown simultaneously is $= \frac{4}{36} = \frac{1}{9}$

13. Option (a) is correct.

Explanation: The distance of a point from the x-axis is the absolute value of its y-coordinate.

The y-coordinate of point $P(1, -1)$ is -1.

So, distance = $|-1|$ = 1

17. Option (c) is correct.

Explanation:

$$\sec A = 2 \cos A \Rightarrow \frac{1}{2} = \frac{\cos A}{\sec A}$$

Also, $\cos A = \frac{1}{\sec A}$

$$\Rightarrow \cos^2 A = \frac{1}{2}$$

$$\cos A = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \cos 45° = \frac{1}{\sqrt{2}}$$

$$A = 45°$$

20. Option (a) is correct.

Explanation: The unit digit of 3^n follows a pattern: $3^1 = 3$, $3^2 = 9$, $3^3 = 27$, $3^4 = 81$, $3^5 = 243$, and so on. The unit digits are 3, 9, 7, 1, 3, 9, 7, 1, ...

None of these unit digits are even numbers.

3^n will only have 3 as a prime factor. Therefore, 2 cannot be a prime factor of 3^n.

Since, 2 is not a prime factor of 3^n, it cannot end in an even number.

Hence, both assertion and reason are true and reason is correct explanation of assertion.

SECTION– B

24. Renu and Simran born in same year 2000, which is leap year

(a) Probability of Renu and Simran both have same birthday, $P(E) = \frac{1}{366}$, because there is only day out of 366 on which they both can born on the same date.

(b) Probability of Renu and Simran not having same birthday, $P(E') = 1 - P(E) = 1 - \frac{1}{366} = \frac{365}{366}$

25. Let

$$73x - 37y = 109 \quad \ldots(i)$$
$$37x - 73y = 1 \quad \ldots(ii)$$

On adding eqs. (i) and (ii), we get

$$(73x - 37y) + (37x - 73y) = 109 + 1$$
$$73x + 37x - 37y - 73y = 110$$
$$110x - 110y = 110$$
$$x - y = 1 \quad \ldots(iii)$$

On subtracting eq. (ii) from eq. (i), we get

$$(73x - 37y) - (37x - 73y) = 109 - 1$$
$$73x - 37x - 37y + 73y = 108$$
$$36x + 36y = 108$$
$$x + y = 3 \quad \ldots(iv)$$

Now, add eqs (iii) and (iv) to eliminate y:

$$(x - y) + (x + y) = 1 + 3$$
$$2x = 4$$
$$x = 2$$

Substitute $x = 2$ into equation (iv), we get

$$2 + y = 3$$
$$y = 1$$

The required solution is (2, 1).

SECTION– C

28. Given, equation is $ax^2 - x + c$

Its roots are α and β

Then, $$\alpha + \beta = -\frac{(-1)}{a} = \frac{1}{a}$$

$$\alpha.\beta = \frac{c}{a}$$

When roots of the equation are $\alpha - 3$ and $\beta - 3$.

Then, sum of roots $= \alpha - 3 + \beta - 3 = \alpha + \beta - 6$

$$= \frac{1}{a} - 6$$

Product of roots $= (\alpha - 3).(\beta - 3) = \alpha\beta - 3(\alpha + \beta)$

$$+ 9 = \frac{c}{a} - \frac{3}{a} + 9$$

Then, required equation is :

x^2 – (sum of roots) x + product of roots = 0

$$x^2 - \left(\frac{1}{a} - 6\right)x + \left(\frac{c}{a} - \frac{3}{a} + 9\right) = 0$$

$$ax^2 - (1 - 6a)x + (c - 3 + 9a) = 0$$

31. Perimeter of rectangle = 70 cm

Let, L and B be the length and breadth of a rectangle.

$$2(L + B) = 70$$
$$L + B = 35 \quad \ldots(i)$$

Given $$L = 5 + 2B \quad \ldots(ii)$$

Replace the value of L from (ii) into (i)

$$5 + 2B + B = 35$$
$$3B = 30 \Rightarrow B = 10$$

On substituting $B = 10$ in eq. (i), we get $L = 25$

Hence, length of rectangle is 25 cm and breadth is 10 cm.

SECTION– D

33. Wooden bat is divided into 2 parts. First is cylindrical handle and other is cuboid.

Total height of bat is 2 m, height of handle is (h) 0.7 m, hence height of cuboidal part is , $H = 1.3$ m.

Width of cuboidal part $L = 0.5$ m and thickness,

$$B = 0.1 \text{ m}$$

Diameter of cylindrical part is 0.1 m, hence radius,

$$r = 0.05 \text{ m}$$

Volume of wood used = Volume of cylindrical part + Volume of cuboidal part

$$\text{Volume} = (L \times B \times H) + (\pi r^2 h)$$

$$V = (1.3 \times 0.5 \times 0.1) + (\frac{22}{7} \times 0.05 \times 0.05 \times 0.7)$$

$$V = 0.065 + 0.0055$$
$$V = 0.0705 \text{ m}^3$$

Total surface area = TSA of cuboid + TSA of cylinder (CSA of cylinder+Circular top of cylinder)

$$= 2(LB + BH + HL) + 2\pi rh + \pi r^2$$
$$= 2(1.3 \times 0.5 + 0.5 \times 0.1 + 1.3 \times 0.1) + 2 \times \pi \times 0.05 \times 0.7 + \pi \times (0.05)^2$$
$$= 2(0.65 + 0.05 + 0.13) + 0.07\pi + 0.0025\pi$$
$$= 1.66 + 0.0725 \times \frac{22}{7}$$
$$= 1.66 + 0.2279$$
$$= 1.8879 \text{ sq. m or } 1.89 \text{ sq. m}$$

34.

CI	f	x (mid-point of CI)	fx
2–6	11	4	44
6–10	10	8	80
10–14	7	12	84
14–18	4	16	64
18–22	4	20	80
22–26	3	24	72
26–30	1	28	28
Total	**40**		**452**

$$\text{Mean} = \frac{\Sigma fx}{\Sigma f} = \frac{452}{40} = \frac{113}{10} = 11.3$$

Here, modal class is 2 – 6.

Then, f_1(frequency of modal class) = 11

f_0 (frequency of class preceeding modal class) = 0

f_2(frequency of class succeeding modal class) = 10

$h = 4$

Lower limit of modal class , $l = 2$

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

$$= 2 + \frac{11-0}{22-0-10} \times 4$$

$$= 2 + \frac{44}{12}$$

$$= 2 + \frac{11}{3}$$

$$= \frac{17}{3} = 5.67 \text{ (approx.)}$$

Outside Delhi Set– 1 **30/6/1**

SECTION– A

1. **Option (d) is correct.**

Explanation: $\sqrt{0.4} = \sqrt{\frac{4}{10}} = \frac{2}{\sqrt{10}}$ is an irrational number

2. **Option (c) is correct.**

Explanation: 8^n ends in 2, 4, 6 or 8. But does not end in 0.

3. **Option (a) is correct.**

Explanation: $x^2 + 2x + 1 = 2x + 1$

$\Rightarrow \quad x^2 = 0$

$\Rightarrow \quad x = 0, 0$

4. **Option (a) is correct.**

Explanation: Since the zeroes are reciprocal to each other, product of zeroes is 1.

$$\frac{c}{a} = 1$$

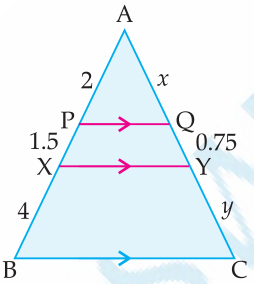
$$\frac{2a}{b \times a} = 1 \Rightarrow b = 2$$

5. **Option (b) is correct.**

Explanation: Distance from x-axis $= |-4| = 4$ units

6. **Option (c) is correct.**

Explanation:



Let AQ = x, YC = y

Using BPT, in $\Delta\, AXY$, $PQ || XY$

$$\frac{AP}{PX} = \frac{AQ}{QY}$$

$$\frac{2}{1.5} = \frac{x}{0.75}$$

$\Rightarrow \quad x = 1$ cm

Also,

Using BPT, in $\Delta\, ABC$, $XY || BC$

$$\frac{AX}{XB} = \frac{AY}{YC}$$

$$\frac{3.5}{4} = \frac{x + 0.75}{y}$$

$$3.5y = 4(1 + 0.75)$$

$$3.5y = 7$$

$$y = 2 \text{ cm}$$

AQ + CY = 1 + 2 = 3 cm

7. **Option (c) is correct.**

Explanation: $\Delta ABC \sim \Delta PQR$

$\angle A = \angle P = 30°$

$\angle B = \angle Q = 90°$

$\angle C = \angle R = 180° - (30° + 90°)$

$= 180° - 120°$

$= 60°$

$\angle R + \angle B = 60° + 90° = 150°$

8. **Option (c) is correct.**

Explanation: Total number of cases = 4

Number of favourable outcomes = 3

P(atleast one head) $= \frac{3}{4}$

9. **Option (d) is correct.**

Explanation: OBAP is a square since all sides and all angles are equal.

$$AB = \sqrt{2} OB$$

$$3\sqrt{2} = \sqrt{2}r \Rightarrow r = 3 \text{ cm}$$

Diameter of the circle = $2r$ = 6 cm

10. **Option (b) is correct.**

Explanation: Distance between parallel tangents = diameter of the circle = 10 cm

11. **Option (b) is correct.**

Explanation: $\angle S = 90°$ (Since TS is the tangent)

$x° + 3x° + 90° = 180°$

$4x° = 90°$

$x = \frac{90}{4} = 22.5°$

$2x = 2 \times 22.5°$

$= 45°$

12. **Option (c) is correct.**

Explanation:
$$x : y = \frac{2\tan 30°}{1 - \tan^2 30°} \times \frac{1 + \tan^2 30°}{2\tan 30°}$$

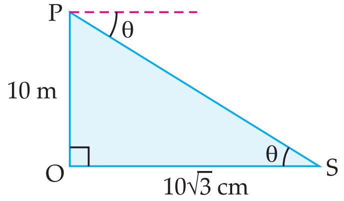
$$= \frac{1 + \frac{1}{3}}{1 - \frac{1}{3}}$$

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

$$= 2 : 1$$

13. Option (a) is correct.

Explanation:



$$\tan\theta = \frac{10}{10\sqrt{3}} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \qquad \theta = 30°$$

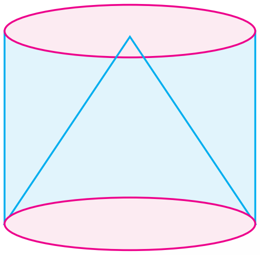
14. Option (c) is correct.

Explanation: Volume of cylinder $= \pi r^2 h$

$$\text{Volume of cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of remaining wood} = \pi r^2 h - \frac{1}{3}\pi r^2 h = \frac{2}{3}\pi r^2 h$$

$$\text{Required ratio} = \frac{2}{3}\pi r^2 h : \frac{1}{3}\pi r^2 h = 2:1$$



15. Option (b) is correct.

Explanation: Mode = 3 Median – 2 Mean

3 Median – 2 Mean = 10 ...(1)

Median + Mean = 25 ...(2)

Solving Eqs. (1) and (2), it gives

Mean = 13, Median = 12

16. Option (c) is correct.

Explanation: Mode is the observation with highest frequency

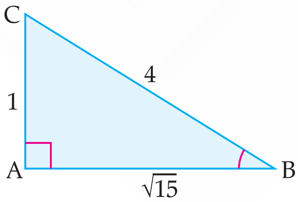
17. Option (a) is correct.

Explanation: $x = \frac{-1}{2}$, $y = \frac{5}{3}$

The system of equations has unique solution.

18. Option (d) is correct.

Explanation:



$$AB = \sqrt{4^2 - 1^2}$$
$$= \sqrt{15}$$

$$\sec B = \frac{CB}{AB} = \frac{4}{\sqrt{15}}$$

19. Option (d) is correct.

Explanation: Reason is true

LCM of two prime numbers p and q is pq. Hence assertion is false.

20. Option (d) is correct.

Explanation: Reason is true

E_1 and E_2 are not complementary events. Hence assertion is false.

SECTION– B

21. (a)

$$101x + 102y = 304 \qquad ...(i)$$
$$102x + 101y = 305 \qquad ...(ii)$$

Adding Eqs. (i) and (ii)

$$\Rightarrow \qquad 203x + 203y = 609$$
$$\Rightarrow \qquad x + y = 3 \qquad ...(iii)$$

Subtracting Eq. (ii) from Eq. (i)

$$\Rightarrow \qquad -x + y = -1 \qquad ...(iv)$$

Adding Eqs. (iii) and (iv)

$$\Rightarrow \qquad 2y = 2 \Rightarrow y = 1$$

Eqs. (iii) $\Rightarrow x + 1 = 3 \Rightarrow x = 2$

OR

(b) Let the greater angle be x and the smaller be y

$$x + y = 180° \qquad ...(i)$$
$$x = y + 50° \qquad ...(ii)$$

Substituting Eqs. (ii) in (i)

$$\Rightarrow \qquad y + 50° + y = 180°$$
$$2y = 180° - 50° = 130°$$
$$y = \frac{130°}{2} = 65°$$
$$x = 65° + 50° = 115°$$

22. (a)

$$a\sec\theta + b\tan\theta = m \qquad ...(i)$$
$$b\sec\theta + a\tan\theta = n \qquad ...(ii)$$

$(i)^2 - (ii)^2$

$\Rightarrow (a\sec\theta + b\tan\theta)^2 - (b\sec\theta + a\tan\theta)^2 = m^2 - n^2$

$(a^2\sec^2\theta + 2ab\sec\theta - \tan\theta + b^2\tan^2\theta) - (b^2\sec^2\theta + 2ab\sec\theta\tan\theta + a^2\tan^2\theta) = m^2 - n^2$

$a^2\sec^2\theta + b^2\tan^2\theta - b^2\sec^2\theta - a^2\tan^2\theta = m^2 - n^2$

$a^2(\sec^2\theta - \tan^2\theta) - b^2(\sec^2\theta - \tan^2\theta) = m^2 - n^2$

$$a^2 - b^2 = m^2 - n^2$$
$$\therefore \qquad a^2 + n^2 = b^2 + m^2$$

OR

(b) Given $\sin^2 A + \cos^2 A = 1$

Dividing by $\cos^2 A$

$$\Rightarrow \qquad \frac{\sin^2 A}{\cos^2 A} + \frac{\cos^2 A}{\cos^2 A} = \frac{1}{\cos^2 A}$$
$$\tan^2 A + 1 = \sec^2 A$$

when $\qquad \sec A = \frac{5}{3}$

$$\tan A = \sqrt{\sec^2 A - 1}$$
$$= \sqrt{\frac{25}{9} - 1}$$
$$= \sqrt{\frac{16}{9}} = \frac{4}{3}$$

23. Let P be the point (x, y)

Given $AP = BP$

$\Rightarrow \quad AP^2 = BP^2$

$$(x-7)^2 + (y-1)^2 = (x-3)^2 + (y-5)^2$$

$$x^2 - 14x + 49 + y^2 - 2y + 1 = x^2 - 6x + 9 + y^2 - 10y + 25$$

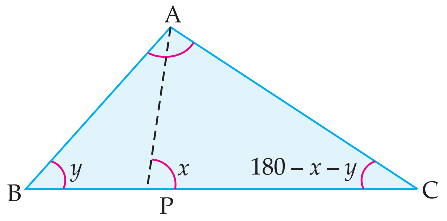
$$-14x + 6x = -10y + 2y + 34 - 50$$

$$-8x = -8y - 16$$

Dividing by – 8 gives $x = y + 2$

i.e., abscissa of P is 2 more than its ordinate.

24.



Let $\angle APC = \angle BAC = x$

$\angle ABC = y$

$\therefore \quad \angle ACP = 180 - x - y$

$\angle PAC = 180 - [x + 180 - x - y] = y$

$\therefore \quad \Delta BAC \sim \Delta APC$ (AA similarity)

$$\Rightarrow \quad \frac{BC}{AC} = \frac{AC}{PC}$$

(Corresponding sides of similar triangles are proportional)

$\Rightarrow \quad BC \times PC = AC \times AC$

$AC^2 = BC \times CP$

25. Let the number of black balls be x

Number of red balls $= x + 3$

Given $\dfrac{x+3}{x+x+3} = \dfrac{12}{23}$

$$23(x + 3) = 12(2x + 3)$$

$$23x + 69 = 24x + 36$$

$$x = 33$$

Total number of balls $= 2x + 3 = 66 + 3 = 69$

SECTION– C

26. **(a)** Let's assume that $\sqrt{5}$ is a rational number. If $\sqrt{5}$ is rational, that means it can be written in the form of $\frac{a}{b}$, where a and b integers that have no common factor other than 1 and $b \neq 0$., i.e., a and b are coprime numbers.

$$\frac{\sqrt{5}}{1} = \frac{a}{b}$$

$$\sqrt{5}b = a$$

Squaring both sides,

$$5b^2 = a^2 \quad \text{...(1)}$$

This means 5 divides a^2.

From this, 5 also divides a.

Then $a = 5c$, for some integer 'c'.

On squaring, we get

$$a^2 = 25c^2$$

Put the value of a^2 in Eq. (1).

$$5b^2 = 25c^2$$

$$b^2 = 5c^2$$

This means b^2 is divisible by 5 and so b is also divisible by 5. Therefore, a and b have 5 as common factor. But this contradicts the fact that a and b are coprime. This contradiction has arisen because of our incorrect assumption that $\sqrt{5}$ is a rational number. So, we conclude that $\sqrt{5}$ is irrational.

OR

(b) $pqr + q = q(pr + 1)$ has q and $pr + 1$ as factors besides 1 and $pqr + q$. Hence $pqr + q$ is a composite number

(i) Let $p = 3, q = 5, r = 7$

$pqr + 1 = 3 \times 5 \times 7 + 1 = 106$ is a composite number

(ii) Let $p = 3, q = 5, r = 2$

$pqr + 1 = 3 \times 5 \times 2 + 1 = 31$ is a prime number

27.

$$3x^2 - 4x - 4 = 0$$

$$b^2 - 4ac = (-4)^2 - 4 \times 3 \times -4$$

$$= 16 + 48$$

$$= 64$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{4 \pm 8}{6}$$

$$= \frac{4+8}{6} \text{ or } \frac{4-8}{6}$$

$$= 2 \text{ or } \frac{-2}{3}$$

Let $\alpha = 2 + 2 = 4$

$$\beta = \frac{-2}{3} + 2 = \frac{4}{3}$$

The polynomial whose roots are α and β is

$x^2 - (a + \beta)\, x + \alpha\beta$

$$= x^2 - \left(4 + \frac{4}{3}\right)x + \left(4 \times \frac{4}{3}\right)$$

$$= x^2 - \frac{16}{3}x + \frac{16}{3} \text{ or } 3x^2 - 16x + 16$$

28.

$$x + 3y = 6 \quad \text{...(i)}$$

$a_1 = 1, b_1 = 3, c_1 = 6$

$$-2x + 3y = -12 \quad \text{...(2)}$$

$a_2 = -2, b_2 = 3, c_2 = -12$

$$\frac{a_1}{a_2} = \frac{-1}{2}$$

$$\frac{b_1}{b_2} = \frac{3}{3} = 1$$

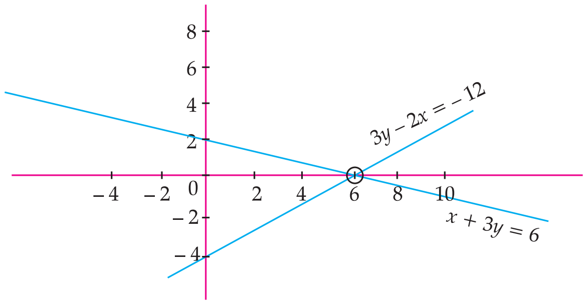
Since $\dfrac{a_1}{a_2} \neq \dfrac{b_1}{b_2}$, the pair of equations is consistent with unique solution

$x + 3y = 6$

x	0	6
y	2	0

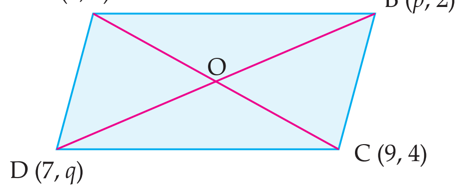
$-2x + 3y = -12$

x	0	6
y	–4	0



Solution: $x = 6, y = 0$

29.



The diagonals of a parallelogram bisect each other i.e., midpoint of AC = midpoint of BD

$$\left(\frac{6+9}{2}, \frac{1+4}{2}\right) = \left(\frac{p+7}{2}, \frac{q+2}{2}\right)$$

$$\frac{p+7}{2} = \frac{15}{2} \Rightarrow p + 7 = 15 \Rightarrow p = 8$$

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

By distance formula,

$$AC = \sqrt{(6-9)^2+(1-4)^2}$$
$$= \sqrt{9+9} = \sqrt{18}$$
$$BD = \sqrt{(p-7)^2+(2-q)^2}$$
$$= \sqrt{(8-7)^2+(2-3)^2}$$
$$= \sqrt{1+1} = \sqrt{2}$$

Since $AC \neq BD$, $ABCD$ is not a rectangle

30. (a)

$$\text{LHS} = \frac{\cos\theta - 2\cos^3\theta}{\sin\theta - 2\sin^3\theta} + \cot\theta$$
$$= \frac{\cos\theta\,(1-2\cos^2\theta)}{\sin\theta - 2\sin^3\theta} + \cot\theta$$
$$= \frac{\cos\theta[1-2(1-\sin^2\theta)]}{\sin\theta(1-2\sin^2\theta)} + \cot\theta$$
$$= \frac{\cos\theta(-1+2\sin^2\theta)}{\sin\theta(1-2\sin^2\theta)} + \cot\theta$$
$$= \frac{-\cos\theta(1-2\sin^2\theta)}{\sin\theta(1-2\sin^2\theta)} + \cot\theta$$
$$= -\cot\theta + \cot\theta$$
$$= 0$$
$$= \text{RHS}$$

OR

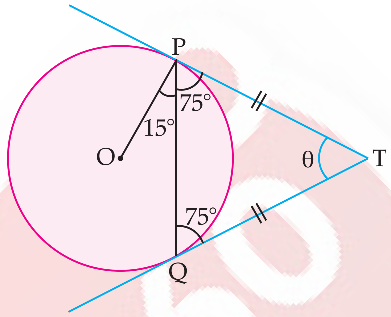
(b)

$$\sin\theta + \cos\theta = x \quad \text{...(i)}$$

Squaring both sides

$$(\sin\theta + \cos\theta)^2 = x^2$$
$$\sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta = x^2$$
$$1 + 2\sin\theta\cos\theta = x^2$$
$$\Rightarrow \quad \sin\theta\cos\theta = \frac{x^2-1}{2} \quad \text{...(ii)}$$
$$\sin^4\theta + \cos^4\theta = (\sin^2\theta + \cos^2\theta)^2 - 2\sin^2\theta\cos^2\theta$$
$$= 1 - 2\left(\frac{x^2-1}{2}\right)^2$$
$$= 1 - \frac{(x^2-1)^2}{2}$$
$$= \frac{2-(x^2-1)^2}{2}$$

31.



$\angle OPT = 90°$

(Angle between radius and tangent)

$\angle TPQ = \angle PQT = 90° – 15° = 75°$

$\theta = 180° – (75° + 75°)$

$= 180° – 150° = 30°$

$\sin 2\theta = \sin 60°$

$= \frac{\sqrt{3}}{2}$

32. (a) Given $AB = 65$ cm

Let $PB = x \Rightarrow PA = x + 35$

ΔAPB is right angled at P (angle in a semi-circle is 90°)

By Pythagoras theorem,

$$x^2 + (x + 35)^2 = 65^2$$
$$x^2 + x^2 + 70x + 1225 = 4225$$
$$2x^2 + 70x – 3000 = 0$$
$$x^2 + 35x – 1500 = 0$$
$$(x + 60)(x – 25) = 0$$
$$x = – 60 \text{ or } 25$$

Since $x > 0$, $x = 25$ m

$PA = x + 35 = 25 + 35 = 60$ m

$PB = x = 25$ m

OR

(b) $x^2 – (2p + 2)x + p^2 = 0$

For real roots, $b^2 – 4ac \geq 0$

$$(2p + 2)^2 – 4 \times 1 \times p^2 \geq 0$$
$$4p^2 + 8p + 4 – 4p^2 \geq 0$$
$$8p + 4 \geq 0$$
$$p \geq \frac{-1}{2}$$

Smallest value of $p = \frac{-1}{2}$

When $p = \frac{-1}{2}$, the given equation becomes

$$x^2 - 2\left(\frac{-1}{2}+1\right)x + \left(\frac{-1}{2}\right)^2 = 0$$

$$x^2 - x - \frac{1}{4} = 0$$

$$4x^2 - 4x + 1 = 0$$

$$(2x-1)^2 = 0$$

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

The roots are $\frac{1}{2}$ and $\frac{1}{2}$

33. **(a)** Converse: a line parallel to one side of a triangle divides the other two sides in the same ratio.

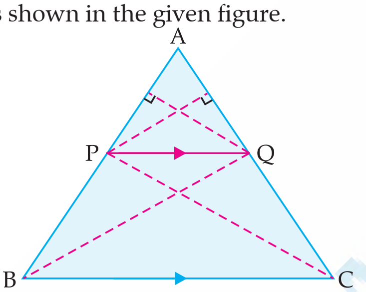
Consider a triangle ΔABC, as shown in the given figure. In this triangle, we draw a line PQ parallel to the side BC of ΔABC and intersecting the sides AB and AC in P and Q, respectively.

According to the basic proportionality theorem as stated above, we need to prove:

$$\frac{AP}{PB} = \frac{AQ}{QC}$$

Construction

Join the vertex B of ΔABC to Q and the vertex C to P to form the lines BQ and CP and then drop a perpendicular QN to the side AB and also draw PM ⊥ AC as shown in the given figure.



Proof

Now the area of ΔAPQ = $\frac{1}{2} \times AP \times QN$

(Since, area of a triangle = $\frac{1}{2}$ × Base × Height)

Similarly, area of ΔPBQ = $\frac{1}{2} \times PB \times QN$

Area of ΔAPQ = $\frac{1}{2} \times AQ \times PM$

Also, area of ΔQCP = $\frac{1}{2} \times QC \times PM$

Now, if we find the ratio of the area of triangles ΔAPQ and ΔPBQ, we have

$$\frac{\text{Area of } \Delta APQ}{\text{Area of } \Delta PBQ} = \frac{\frac{1}{2}\times AP\times QN}{\frac{1}{2}\times PB\times QN}$$

$$= \frac{AP}{PB} \quad \text{...(1)}$$

Similarly,

$$\frac{\text{Area of } \Delta APQ}{\text{Area of } \Delta QCP} = \frac{\frac{1}{2}\times AQ\times PM}{\frac{1}{2}\times QC\times PM} = \frac{AQ}{QC} \quad \text{...(2)}$$

According to the property of triangles, the triangles drawn between the same parallel lines and on the same base have equal areas.

Therefore, we can say that ΔPBQ and ΔQCP have the same area.

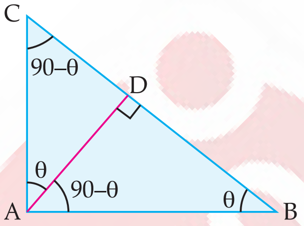
Area of ΔPBQ = Area of ΔQCP ...(3)

Therefore, from Eqs.(1), (2) and (3) we can say that,

$$\frac{AP}{PB} = \frac{AQ}{QC}$$

OR

(b)



Consider ΔADB and ΔCDA

∠ADB = ∠CDA = 90°

∠ABD = ∠CAD = θ

∴ ΔADB ~ ΔCDA (AA similarity) ...(i)

Given CD = 2 cm

BD = BC – CD

= 10 – 2

= 8 cm

Since ΔADB ~ ΔCDA

$$\frac{AD}{CD} = \frac{DB}{DA}$$

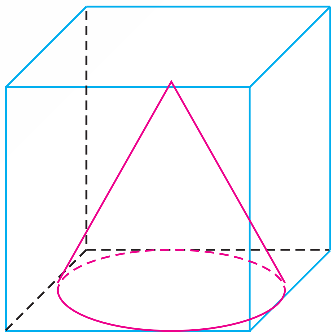
⇒ $AD^2 = DB \times CD$

= 8 × 2

= 16 cm

$AD = \sqrt{16} = 4\text{cm}$

34.



Volume of the cube = $14^3 = 2744 \text{ cm}^3$

Radius of largest cone = $\frac{14}{2} = 7\text{cm}$

Height of largest cone = 14 cm

Volume of largest cone = $\frac{1}{3}\pi \times r^2 h$

$$= \frac{1}{3} \times \frac{22}{7} \times 7 \times 7 \times 14$$

$$= \frac{2156}{3} \text{cm}^3$$

Volume of remaining solid $= 2744 - \frac{2156}{3}$

$= 2025.33 \text{ cm}^3$

TSA of reaming solid $= 5a^2 + (a^2 - \pi r^2) + \pi rl$

$$= 5 \times 14^2 + \left(14^2 - \frac{22}{7} \times 7 \times 7\right) + \frac{22}{7} \times 7 \times \sqrt{14^2 + 7^2}$$

$= 5 \times 196 + 196 - 154 + 344.35$

$= 1282.35 \text{ cm}^2$

35.

Marks	f_i	CF
10–20	12	12
20–30	30	42
30–40	x	$42 + x$
40–50	65	$107 + x$
50–60	y	$107 + x + y$
60–70	25	$132 + x + y$
70–80	18	$150 + x + y$
	$\Sigma f_i = 150 + x + y$	

Given $150 + x + y = 230$

$\Rightarrow$ $x + y = 80$ ...(i)

Median class $= 40 - 50$

Median $= 46$

$$l + \frac{\frac{N}{2} - C}{f} \times h = 46$$

$$40 + \frac{\frac{230}{2} - (42 + x)}{65} \times 10 = 46$$

$$\frac{115 - 42 - x}{65} \times 10 = 6$$

$$73 - x = \frac{65 \times 6}{10} = 39$$

$x = 73 - 39 = 34$

From (i), $y = 80 - 34 = 46$

SECTION– E

36. (i) $\angle PBA = 180° - (30° + 90°)$

$= 60°$

$\angle POA = 2 \times \angle PBA$

$= 2 \times 60° = 120°$

(ii) Length of wire = perimeter of semicircle

$= \pi r + d$

$$= \frac{22}{7} \times 35 + 70$$

$= 110 + 70$

$= 180$ m

(iii) (a) Area of part I

= Ar(sector POB) – Ar(ΔPOB)

$$= \frac{\theta}{360} \times \pi r^2 - \frac{\sqrt{3}}{4} a^2$$

$$= \frac{60}{360} \times \frac{22}{7} \times 35 \times 35 - \frac{\sqrt{3}}{4} \times 35 \times 35$$

$= 641.66 - 529.81$

$= 111.85 \text{ m}^2$

OR

(b) $\cos 30° = \frac{AP}{70}$

$AP = 70 \cos 30°$

$$= \frac{70\sqrt{3}}{2} = 35\sqrt{3}$$

$$\text{arc } \widehat{AP} = \frac{\theta}{360} \times 2\pi r$$

$$= \frac{120}{360} \times 2 \times \frac{22}{7} \times 35$$

$$= \frac{220}{3}$$

Length of wire needed to fence region III

$$= 35\sqrt{3} + \frac{220}{3}$$

$= 60.55 + 73.33$

$= 133.88$ m

37. (i) $a = 400$ m

$d = 7.6$ m

Length of 6th lane $= 400 + 5 \times 7.6$

$= 438$ m

(ii) Length of 8th lane – length of 4th lane

$= (a + 7d) - (a + 3d)$

$= 4d$

$= 4 \times 7.6$

$= 30.4$ m

(iii) (a)

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

$$S_6 = \frac{6}{2}[800 + 5 \times 7.6]$$

$= 3 \times 838$

$= 2514$ m

OR

(b) Length of line (4)

$a_4 = 400 + (4 - 1) \times 7.6$

$= 400 + 22.8 = 422.8$ m

Length of line (5)

$a_5 = a_4 + d = 422.8 + 7.6$

$= 430.4$ m

Length of line (6)

$$a_6 = a_5 + d = 430.4 + 7.6$$
$$= 438 \text{ m}$$

Length of line (7)

$$a_7 = a_6 + d = 438 + 7.6$$
$$= 445.6 \text{ m}$$

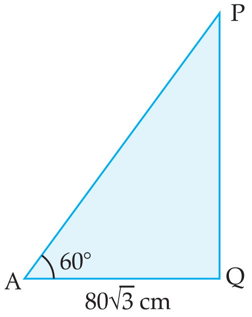
Length of line (8)

$$a_8 = a_7 + d = 445.6 + 7.6$$
$$= 453.2 \text{ m}$$

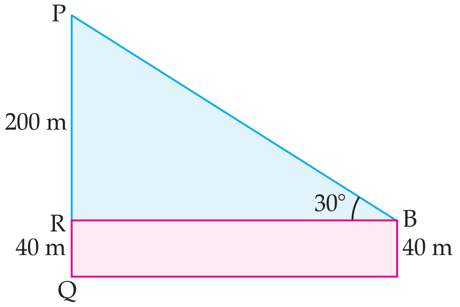
Total distance covered by students from line 4 to 8

$$= a_4 + a_5 + a_6 + a_7 + a_8$$
$$= 2190 \text{ m}$$

38. (i)



(ii)



(iii) (a) From situation I,

$$\tan 60° = \frac{PQ}{AQ}$$

$$\sqrt{3} = \frac{PQ}{80\sqrt{3}}$$

$$PQ = 80\sqrt{3} \times \sqrt{3} = 240 \text{ m}$$

Height including base = 240 m

Height excluding base = 240 – 58

= 182 m

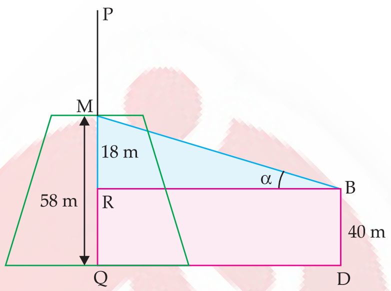
OR

(b) From situation II,

$$\tan 30° = \frac{200}{RB}$$

$$\frac{1}{\sqrt{3}} = \frac{200}{RB}$$

$$RB = 200\sqrt{3} \text{ m}$$



Now, from ΔMRB, $\angle B = \alpha$

$$\tan \alpha = \frac{MR}{RB}$$

$$= \frac{18 \text{ m}}{200\sqrt{3} \text{ m}}$$

$$= \frac{18\sqrt{3}}{200 \times 3}$$

$$\tan \alpha = \frac{3\sqrt{3}}{100} \text{m}$$

Outside Delhi Set– 2 **30/6/2**

SECTION – A

1. Option (a) is correct.

Explanation: For given system of equations,

$\Rightarrow$ $x + 5 = 0$ and $2x - 1 = 0$

$\Rightarrow$ $x = -5$ and $x = \frac{1}{2}$

Since the two equations give different values of x, there is no common solution.

Hence, given system of equations has no solution.

5. Option (a) is correct.

Explanation: For real and distinct roots, discriminant, $D = b^2 - 4ac > 0$

For equation 1 ($x^2 + 2x = 0$), $D_1 = (2)^2 - 4(1)(0)$

$= 4 > 0$

So, $x^2 + 2x = 0$ has real and distinct roots.

7. Option (c) is correct.

Explanation: The distance of a point (x, y) from the x-axis is given by the absolute value of its y-coordinate, i.e., $|y|$.

For the point $(a, -b)$, the y-coordinate is $-b$.

Thus, the distance from the x-axis is $|-b| = b$.

12. Option (c) is correct.

Explanation: We have,

$$x = \cos 30° - \sin 30° = \frac{\sqrt{3}}{2} - \frac{1}{2} = \frac{(\sqrt{3}-1)}{2} = 0.366$$

$$y = \tan 60° - \cot 60° = \sqrt{3} - \frac{1}{\sqrt{3}} = \frac{2}{\sqrt{3}} = 1.154$$

As $1.154 > 0.366$,

So, $y > x$ or $x < y$.

19. Option (d) is correct.

Explanation: Since x and y are prime numbers, their only common factor is 1, unless one is a multiple of the other.

Since both are distinct prime numbers, their HCF$(x, y) = 1$, not x.

The LCM of two distinct prime numbers x and y is their product,

i.e., LCM(x, y) = x times y, not y.

Since both parts of the assertion are incorrect, the Assertion is false.

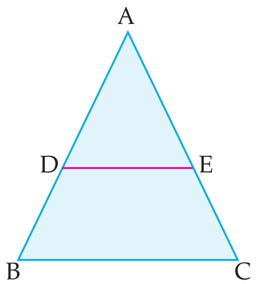
Also, HCF(x, y) $\leq$ LCM(x, y)

This is always true for all natural numbers.

Hence, Assertion (A) is false, but Reason (R) is true.

SECTION – B

21.



To prove: ΔABC is isosceles

$$\frac{AD}{BD} = \frac{AE}{EC} \quad \text{(given)}$$

By the converse of Basic Proportionality Theorem (BPT), this implies that DE is parallel to BC, i.e.,

$$DE \parallel BC.$$

$$\angle BDE = \angle CED \text{ (given)}$$

$$\Rightarrow \quad \angle ADE = \angle AED$$

Since $DE \parallel BC$, so $\angle ABC = \angle ACB$ or $\angle B = \angle C$

Also, $AB = AC$ (Sides opposite to equal angles are equal)

Therefore, ΔABC is isosceles.

22. Given that,

Bag contains cards numbered 5 to 100 (different)

Total number of cards = 96

(i) Perfect squares between 5 and 100: {9, 16, 25, 36, 49, 64, 81, 100}

Number of cards bearing perfect square numbers = 8

P(perfect square) = (Number of favourable outcomes)/(Total outcomes)

$$= \frac{8}{96}$$

$$= \frac{1}{12}$$

(ii) In our range [5, 100], valid two-digit numbers are 10 to 99.

Count of two-digit numbers: 99 – 10 + 1 = 90

P(2-digit number) = (Number of favourable outcomes)/(Total outcomes)

$$= \frac{90}{96} = \frac{15}{16}$$

SECTION – C

29. Given polynomial,

$$q(x) = 8x^2 - 2x - 3$$

$$= 8x^2 - 6x + 4x - 3$$

$$= 2x(4x - 3) + 1(4x - 3)$$

$$= (2x + 1)(4x - 3)$$

Zeroes are:

$$2x + 1 = 0$$

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

And $\quad 4x - 3 = 0$

$$\Rightarrow \quad x = \frac{3}{4}$$

So, zeroes of $q(x)$ are $-\frac{1}{2}$ and $\frac{3}{4}$.

Let the polynomial be $r(x)$ whose zeroes are two less than zeroes of $q(x)$

Zeroes of polynomial $r(x)$ will be:

$$\Rightarrow \quad -\frac{1}{2} - 2 = -\frac{5}{2} \text{ and } \frac{3}{4} - 2 = -\frac{5}{4}$$

Any polynomial is of the form,

$$P(x) = x^2 - (\text{Sum of zeroes})x + (\text{Product of zeroes})$$

So,

$$r(x) = x^2 - \left[\left(-\frac{5}{2}\right) + \left(-\frac{5}{4}\right)\right]x + \left[\left(-\frac{5}{2}\right) \times \left(-\frac{5}{4}\right)\right]$$

$$r(x) = x^2 - \left(-\frac{15}{4}\right)x + \frac{25}{8}$$

$$r(x) = x^2 + \left(\frac{15}{4}\right)x + \frac{25}{8}$$

or $\quad r(x) = 8x^2 + 30x + 25$

Hence, required polynomial is $8x^2 + 30x + 25$.

30. Given system of equations as:

$$x - 2y + 4 = 0$$

$$2x - y - 4 = 0$$

We have,

$$\frac{a_1}{a_2} = \frac{1}{2}$$

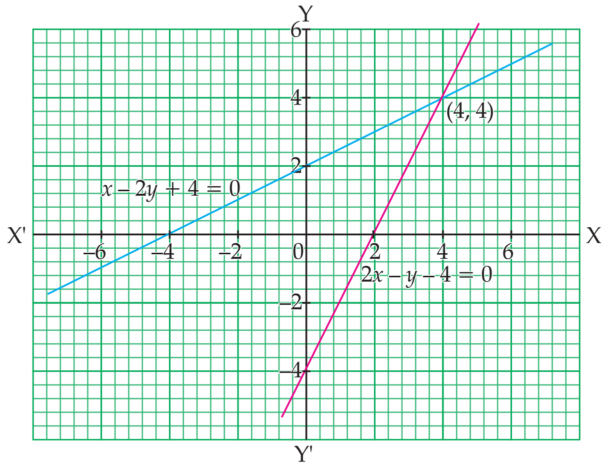
$$\frac{b_1}{b_2} = \frac{-2}{(-1)} = 2$$

$$\frac{c_1}{c_2} = \frac{4}{(-4)} = -1$$

$$\Rightarrow \quad \frac{a_1}{a_2} \neq \frac{b_1}{b_2} \quad \text{(unique solution)}$$

So, given system of equations is consistent with unique solution.

Using the graph:



Both lines intersect each other at point (4, 4).
Hence, the solution of given system of equations is $x = 4$ and $y = 4$.

SECTION – D

32. Given that,
Median number of members = 5
To find: Values of p and q
We have the distribution as:

Number of Members	Number of Bungalows	Cumulative Frequency
0 – 2	10	10
2 – 4	p	$10 + p$
4 – 6	60	$70 + p$
6 – 8	q	$70 + p + q$
8 – 10	5	$75 + p + q$
	Total = N = 120	

We have,

$$75 + p + q = 120$$

$$\Rightarrow \quad p + q = 45 \quad \text{...(i)}$$

$$\frac{N}{2} = \frac{120}{2} = 60$$

Since median is 5, lying in class interval 4 – 6, so,
Median class = 4 – 6
Class size, $h = 2$
Lower limit of median class, $l = 4$
Corresponding frequency, $f = 60$
Cumulative frequency, $CF = 10 + p$
Now,

$$\text{Median} = l + \left[\frac{\left(\frac{N}{2} - CF\right)}{f}\right] \times h$$

On putting the values,

$$5 = 4 + \left[\frac{(60 - (10 + p))}{60}\right] \times 2$$

$$1 = \left[\frac{(60 - 10 - p)}{60}\right] \times 2$$

$$1 = \frac{(50 - p)}{30}$$

$$30 = 50 - p$$

$$p = 20 \quad \text{...(ii)}$$

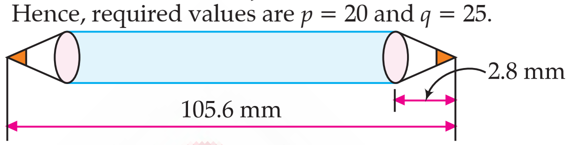
Putting value of p in Eq. (i),

$$\Rightarrow \quad 20 + q = 45$$

$$\Rightarrow \quad q = 45 - 20 = 25$$

Hence, required values are $p = 20$ and $q = 25$.

34.



Given that,
Diameter of cylindrical and conical part of pencil = 4.2 mm
Height of each conical part, h = 2.8 mm
Length of entire pencil = 105.6 mm
To find: Total surface area of pencil
We have,
Height of cylindrical part, H = 105.6 – (2.8 + 2.8) = 100 mm

Radius of cylindrical part, $R = \frac{4.2}{2} = 2.1$ mm

Radius of conical part, $r = \frac{4.2}{2} = 2.1$ mm

Slant height of conical part,

$$l = \sqrt{r^2 + h^2}$$

$$= \sqrt{(2.1)^2 + (2.8)^2} = 3.5 \text{ mm}$$

Now,
Total surface area of pencil = Curved surface area of cylindrical part + Curved surface area of 2 conical parts
Total surface area of pencil = $2\pi RH + 2 \times \pi rl$
On putting the values,

Total surface area of pencil = $(2 \times \frac{22}{7} \times 2.1 \times 100) + 2 \times (\frac{22}{7} \times 2.1 \times 3.5)$

$$= \left(2 \times \frac{22}{7} \times 2.1\right) [100 + 3.5]$$

$$= 2 \times 22 \times 0.3 \times 103.5$$

$$= 1366.2 \text{ mm}^2$$

Hence, total surface area of pencil is 1366.2 mm^2.

Outside Delhi Set– 3 **30/6/3**

SECTION – A

1. **Option (b) is correct.**
Explanation: Reflex $\angle POQ = 210°$ is given then

$$\angle POQ = 360° - 210°$$

$$\Rightarrow \quad \angle POQ = 150°$$

Since AP and AQ are tangents to the circle,

$$\angle OPA = \angle OQA = 90°$$

For quadrilateral APOQ, sum of all interior angles

$$\angle POQ + \angle OPA + \angle PAQ + \angle OQA = 360°$$

Substituting the values of angles in above equation,

$$150° + 90° + x + 90° = 360°$$

$$x = 360° – 330°$$
$$x = 30°$$
then, $2x = 2 \times 30° = 60°$

3. **Option (c) is correct.**

Explanation: Given $x = 2 \sin 60° \cos 60°$ and $y = \sin^2 30° – \cos^2 30°$ and $x^2 = ky^2$

Since, $\sin 60° = \frac{\sqrt{3}}{2}$, $\cos 60° = \frac{1}{2}$, $\sin 30° = \frac{1}{2}$, $\cos 30° = \frac{\sqrt{3}}{2}$, replacing all values in above equation to find the values of x and y

$$x = 2 \times \frac{\sqrt{3}}{2} \times \frac{1}{2} \Rightarrow x = \frac{\sqrt{3}}{2}$$

$$y = \frac{1}{4} - \frac{3}{4} \Rightarrow y = -\frac{1}{2}$$

Now, putting values of x and y to calculate k,

$$\Rightarrow \quad \frac{3}{4} = k \times \frac{1}{4} \Rightarrow k = 3$$

8. **Option (c) is correct.**

Explanation: Given system of equations,
$$y + a = 0 \text{ and } 2x = b$$
Solving these equations, we get
$$x = \frac{b}{2} \text{ and } y = – a$$

Hence, solution is $(b/2, – a)$.

12. **Option (c) is correct.**

Explanation: For real roots $D \geq 0$

For option (A),	$x^2 = 0$,	$D = b^2 – 4ac$,	D = 0	(real roots)
For option (B),	$2x – 1 = 3$,	$D = b^2 – 4ac$,	D = 4 + 0 = 4	(real roots)
For option (C),	$x^2 + 1 = 0$,	$D = b^2 – 4ac$,	D = –4	(imaginary roots)
For option (D),	$x^3 + x^2 = 0$,	$D = b^2 – 4ac$,	D = 1	(real roots)

Hence equation $x^2 + 1 = 0$, does not have real roots.

14. **Option (a) is correct.**

Explanation: The distance of a point from the y-axis is the absolute value of the x-coordinate of the point $P(3a, 4a)$ i.e. $3a$.
Hence, distance of point P from y-axis is $3a$.

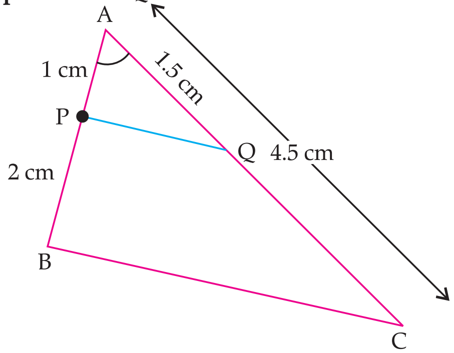
20. **Option (b) is correct.**

Explanation: For two odd prime numbers x and y, LCM $(2x, 4y) = 4xy$.
This is correct because the LCM of $2x$ and $4y$ is $4xy$, as shown by their prime factorization.
LCM of two numbers is a multiple of their HCF.
This is true, but not directly needed to prove the assertion.
Hence, both Assertion(A) and Reason(R) are true, but Reason(R) is not the correct explanation of Assertion(A).

SECTION – B

23. Given, AP = 1 cm , BP = 2 cm, AQ = 1.5 cm and AC= 4.5 cm

To prove : ΔAPQ ~Δ ABC



Proof: Here, AB = AP + BP = 3 cm

$$\frac{AP}{AB} = \frac{1}{3} \text{ and } \frac{AQ}{AC} = \frac{1.5}{4.5} = \frac{1}{3} \quad ...(i)$$

In ΔAPQ and ΔABC,

∠PAQ = ∠BAC (Common angle)

And $\frac{AP}{AB} = \frac{AQ}{AC} = \frac{1}{3}$ [From (i)]

Therefore, ΔAPQ ~Δ ABC
(By SAS similarity criterion)

Since, ratio of corresponding sides of similar triangles is equal.

Therefore, $\frac{AP}{AB} = \frac{PQ}{BC}$

$$\frac{1}{3} = \frac{PQ}{(3.6)}$$

$$PQ = \frac{3.6}{3} = 1.2 \text{ cm}$$

24. Given that,
Bag containing balls numbered differently from 2 to 91,
Total number of balls = 91 – 2 + 1 = 90

(i) We have,
Number of balls bearing two-digit numbers = 82

$$\text{P(2-digit number)} = \frac{82}{90} = \frac{41}{45}$$

(ii) Since, all numbers from 2 to 91 are multiples of 1,
So,
Number of balls bearing a multiple of 1 = 90

$$\text{P(multiple of 1)} = \frac{90}{90} = 1$$

SECTION – C

26. For checking the consistency of given system of equations, we have,

Given equations, $x – 2y = 0$ ...(i)

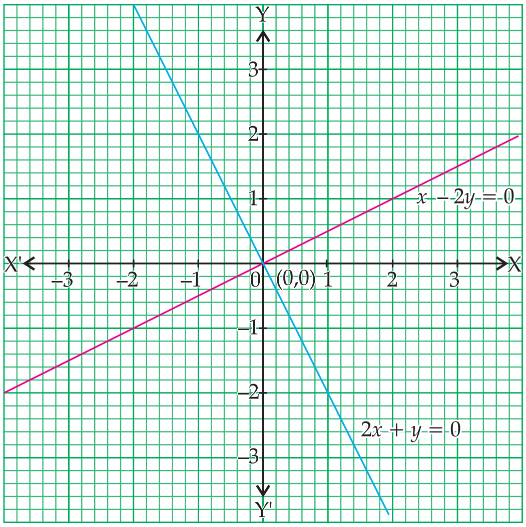
$2x + y = 0$ ...(ii)

Since, $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

i.e., $\frac{1}{2} \neq -\frac{2}{1}$,

Hence, the given system of equations is consistent and have unique solution .

For graphical solution, the graphs of both equations are plotted as shown:



As the graph of both equations intersect at point (0, 0)
So, the solution of given system of equations is (0, 0).

31. Given polynomial,

$$r(x) = 4x^2 + 3x - 1$$
$$= 4x^2 + 4x - x - 1$$
$$= 4x(x + 1) - 1(x + 1)$$
$$= (4x - 1)(x + 1)$$

$\Rightarrow \quad 4x - 1 = 0, x = \frac{1}{4}$

$\Rightarrow x + 1 = 0, x = -1$

Zeroes of given polynomial $r(x)$ are $\frac{1}{4}, -1$.

Now, reciprocal of zeroes of $r(x)$ are 4 and – 1
Zeroes of required polynomial, $p(x)$ are 4 and – 1
Polynomial, $p(x)$ having zeroes as reciprocal of $r(x)$ is of the form:
$p(x) = x^2$ – (sum of roots) x + (Product of roots)
$p(x) = x^2 - [(4) + (-1)]x + (4 \times -1)$
$p(x) = x^2 - 3x - 4$ is the required polynomial.

SECTION – D

33. Given that, A fermentation tank made up of a cylinder mounted on a cone
Total height of tank = 3.3 m,
Height of conical part, h = 1.2 m ,
Diameter of both cone and cylinder = 1 m
Radius of both shapes, r = 0.5 m
Height of cylindrical part, H = 3.3 – 1.2 = 2.1 m
Capacity of tank = Volume of cylinder + Volume of cone $= \pi r^2 H + \frac{\pi r^2 h}{3}$

$$V = \pi \times 0.5 \times 0.5 \times 2.1 + \pi \times 0.5 \times 0.5 \times \frac{1.2}{3}$$

$\Rightarrow \pi \times 0.25\,(2.1 + 0.4) = 0.625\pi$ cu. m
Tank is filled till 0.7 m from top, hence it is filled up to a height of (3.3 – 0.7) m = 2.6 m, out of which 1.2 m is conical and 1.4 m (h') is cylindrical.
Total surface area in contact with liquid

$$= \text{CSA of Cylinder} + \text{CSA of cone}$$
$$= 2\pi r h' + \pi r l$$
$$= \pi r\,(2h' + l)$$

Here, $l = \sqrt{1.44 + 0.25} = \sqrt{1.69} = 1.3$ m

Total surface area in contact with liquid

$$= \pi \times 0.5\,(2.8 + 1.3)$$
$$= 2.05\,\pi \text{ sq. m}$$

34. The given population of lions can be represented in following cumulative frequency distribution table:

CI	Frequency (f)	CI
0 – 100	2	2
100 – 200	5	7
200 – 300	9	16
300 – 400	12	28
400 – 500	x	$28 + x$
500 – 600	20	$48 + x$
600 – 700	15	$63 + x$
700 – 800	9	$72 + x$
800 – 900	y	$72 + x + y$
900 - 1000	2	$74 + x + y$
Total	100	

Here, $N = 100$

$$\frac{N}{2} = 50$$

Median class = 500 – 600
Class-size of given distribution, h = 100
Frequency of median class, f = 20
Cumulative frequency of class preceding median class, $cf = 28 + x$
Lower limit of median class, l = 500

$$\text{Median} = l\left(\frac{\frac{n}{2} - cf}{f}h\right)$$

$$525 = 500 + \left\{\frac{[50 - (28 + x)]}{20}\right\} \times 100$$

$$525 = 500 + 5 \times (22 - x)$$
$$25 = 5\,(22 - x)$$
$$5 = 22 - x$$
$$x = 22 - 5 = 17$$

Also, $74 + x + y = 100$
$\Rightarrow \quad 74 + 17 + y = 100$
$\Rightarrow \quad y = 100 - 91 = 9$
Hence, the values of x and y are 17 and 9, respectively.

❑❑