CBSE EXAMINATION PAPER-2025

Mathematics (Basic)

Class-10th

(Solved)

(Delhi & Outside Delhi Sets)

Time : 3 Hours | **Max. Marks : 80**

General Instructions:

Read the following instructions carefully and follow them:

(i) *This question paper contains **38** questions. **All** questions are **compulsory**.*

(ii) *Question paper is divided into **FIVE** sections – Section **A, B, C, D** and **E.***

(iii) *In **section A,** question number **1** to **18** are multiple choice questions (MCQs) and question number **19** and **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In **section B,** question number **21** to **25** are very short answer (VSA) type questions of **2** marks each.*

(v) *In **section C,** question number **26** to **31** are short answer (SA) type questions carrying 3 marks each.*

(vi) *In **section D,** question number **32** to **35** are long answer (LA) type questions carrying 5 marks each.*

(vii) *In **section E,** question number **36** to **38** are **case-based integrated units** of assessment 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 of figures wherever required. Take π = 22/7 wherever required if not stated.*

(x) *Use of calculators is **NOT allowed.***

Delhi Set-1 | **430/4/1**

SECTION – A

Question Nos. 1 to 20 are multiple choice questions of 1 mark each.

1. If HCF $(x, 20) = 2$ and LCM $(x, 20) = 60$, then value of x is:

(A) 3 **(B)** 6

(C) 20 **(D)** 10

2. The distance between the points (–6, 9) and (2, 7) is:

(A) $2\sqrt{17}$ **(B)** $4\sqrt{17}$

(C) $2\sqrt{5}$ **(D)** $2\sqrt{15}$

3. If n^{th} term of an A.P. is $5n - 6$, then its common difference is:

(A) –6 **(B)** $5n$

(C) 5 **(D)** 6

4. One of the zeroes of the polynomial $p(x) = kx^2 - 9x + 3$ is $\left(-\frac{3}{2}\right)$. The value of k is:

(A) $\frac{22}{3}$ **(B)** $-\frac{14}{3}$

(C) $\frac{14}{3}$ **(D)** $-\frac{22}{3}$

5. Three coins are tossed together. The probability that only coin shows tail, is:

(A) $\frac{1}{2}$ **(B)** $\frac{3}{8}$

(C) $\frac{7}{8}$ **(D)** 1

6. Two right circular cylinders of equal volumes have their heights in the ratio 1 : 2. The ratio of their radii is:

(A) $\sqrt{2}:1$ **(B)** $1:2$

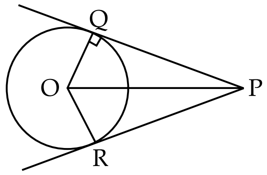
(C) $1:4$ **(D)** $1:\sqrt{2}$

7. If $\sqrt{2}\sin\theta = 1$, then $\cot\theta \times \text{cosec}\,\theta$ is equal to:

(A) $\frac{1}{\sqrt{2}}$ **(B)** $\frac{1}{2\sqrt{2}}$

(C) $\sqrt{2}$ **(D)** $\frac{1}{2}$

8. PQ and PR are tangents to the circle of radius 3 cm and centre O. If length of each tangent is 4 cm, then perimeter of ΔOQP is:



(A) 5 cm **(B)** 12 cm

(C) 9 cm **(D)** 8 cm

9. α, β are zeroes of the polynomial $2x^2 + 5x + 1$. The value of $\left(\frac{1}{\alpha}+\frac{1}{\beta}\right)$ is:

(A) $-\frac{5}{4}$ **(B)** 5

(C) $\frac{5}{4}$ **(D)** – 5

10. The 20th term of the A.P. : $10\sqrt{2}, 6\sqrt{2}, 2\sqrt{2},...$ is:

(A) $-76+10\sqrt{2}$ **(B)** $-62\sqrt{2}$

(C) $-66\sqrt{2}$ **(D)** $86\sqrt{2}$

11. If $\sec\theta - \tan\theta = 2$, then $\sec\theta + \tan\theta$ is equal to:

(A) $\frac{1}{2}$ **(B)** $\sqrt{2}$

(C) $\frac{1}{\sqrt{2}}$ **(D)** 2

12. A card is drawn at random from a well shuffled deck of 52 playing cards. The probability that drawn card shows number '9' is:

(A) $\frac{1}{26}$ **(B)** $\frac{4}{13}$

(C) $\frac{1}{52}$ **(D)** $\frac{1}{13}$

13. The length of arc subtending an angle of 210° at the centre of the circle, is $\frac{44}{3}$ cm. The radius of the circle is:

(A) $2\sqrt{2}$ cm **(B)** 4 cm

(C) 8 cm **(D)** $\frac{1}{4}$ cm

14. The value of m which lines $14x + my = 20$ and $-3x + 2y = 16$ are parallel, is :

(A) $-\frac{3}{14}$ **(B)** $-\frac{7}{3}$

(C) $-\frac{28}{3}$ **(D)** $-\frac{3}{28}$

15. The curved surface area of a cone with base radius 7 cm, is 550 cm^2. The slant height of the cone is:

(A) 25 cm **(B)** 14 cm

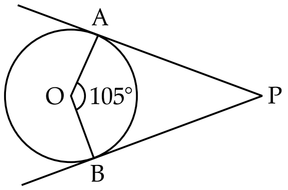
(C) 20 cm **(D)** 24 cm

16. If $\sin A = \frac{2}{3}$, then $\cos A$ is equal to:

(A) $\frac{3}{2}$ **(B)** $\frac{\sqrt{5}}{3}$

(C) $\frac{1}{3}$ **(D)** $\frac{1}{\sqrt{3}}$

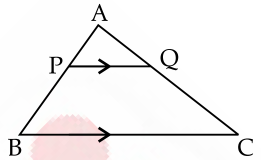
17. PA and PB are tangents to a circle with centre O. If $\angle AOB = 105°$ then $\angle OAP + \angle APB$ is equal to:



(A) 75° **(B)** 175°

(C) 180° **(D)** 165°

18. In ΔABC, $PQ \mid\mid BC$. It is given that $AP = 2.4$ cm, $PB = 3.6$ cm and $BC = 5.4$ cm. PQ is equal to:



(A) 2.7 cm **(B)** 1.8 cm

(C) 3.6 cm **(D)** 2.16 cm

Directions: Question numbers 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below:

(A) Both, Assertion (A) and Reason (R) are true and Reason (R) is the 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) : Median marks of students in a class test is 16. It means half of the class got marks less than 16.

Reason (R): Median divides the distribution in two equal parts.

20. Assertion (A) : If E is an event such that $P(E) = \frac{1}{999}$, then $P(\bar{E}) = 0.001$.

Reason (R): $P(E) + P(\bar{E}) = 1$

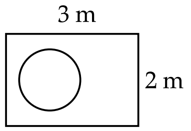
SECTION – B

Question Nos. 21 to 25 are very short answer questions of 2 marks each.

21. Show that 45^n cannot end with the digit 0, n being a natural number. Write the prime number 'a' which on multiplying with 45^n makes the product end with the digit 0.

22. Point $P(x, 0)$ divides the line segment joining the points (2, 8) and (–3, –5) in a certain ratio. Find the ratio and hence find the value of x.

23. (a) A coin is dropped at random on the rectangular region shown in the figure. What is the probability that it will land inside the circle with radius 0.7 m?



OR

(b) A die is thrown twice. What is the probability that (i) difference between two numbers obtained is 3? (ii) sum of the numbers obtained is 8?

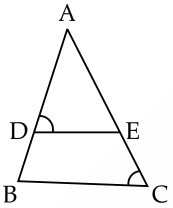
24. (a) Prove that the angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line segment joining the points of contact at the centre.

OR

(b) Prove that the tangents drawn at the ends of a diameters of a circle are parallel.

25. In the given figure $\angle ADE = \angle ACB$ and $\frac{AD}{DB} = \frac{AE}{EC}$.

Prove that ΔABC is an isosceles triangle.



SECTION – C

Question Nos. 26 to 31 are short answer questions of 3 marks each.

26. Find the zeroes of the polynomial $p(x) = 6x^2 + 13x - 5$ and verify the relationship between its zeroes and the coefficients.

27. (a) Find the sum of the A.P. 7, $10\frac{1}{2}$, 14, ... 84.

OR

(b) If the sum of first n terms of an A.P. is given by $S_n = \frac{n}{2}(2n+8)$. Then, find its first and common difference. Hence, find its 15th term.

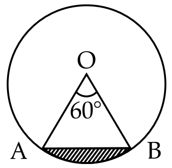
28. Prove that $\sqrt{3}$ is an irrational number.

29. (a) If points $A(-5, y)$, $B(2, -2)$, $C(8, 4)$ and $D(x, 5)$ taken in order, form a parallelogram $ABCD$, then find the values of x and y. Hence, find lengths of sides of the parallelogram.

OR

(b) $A(6, -3)$, $B(0, 5)$ and $C(-2, 1)$ are vertices of ΔABC. Points $P(3, 1)$ and $Q(2, -1)$ lie on sides AB and AC respectively. Check whether $\frac{AP}{PB} = \frac{AQ}{QC}$.

30. A chord of a circle of radius 10 cm subtends an angles of 60° at the centre O. Find the area of the shaded region. (Use $\sqrt{3} = 1.73, \sqrt{2} = 1.41$ and $\pi = 3.14$)



31. Prove that the opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle.

SECTION – D

Question Nos. 32 to 35 are long answer questions of 5 marks each.

32. (a) It is given that $p^2x^2 + (p^2 - q^2)x - q^2 = 0$; $(p \neq 0)$

(i) Show that the discriminant (D) of above equation is a perfect square.

(ii) Find the roots of the equation.

OR

(b) Three consecutive positive integers are such that the sum of the square of smallest and product of other two is 67. Find the numbers, using quadratic equation.

33. Find 'mean' and 'mode' of the following data:

Class	Frequency
15 – 20	6
20 – 25	16
25 – 30	17
30 – 35	4
35 – 40	5
40 – 45	2

34. (a) If a line is drawn parallel to one side of a triangle to intersect the other two sides in district points, then prove that the other two sides are divided in the same ratio.

OR

(b) In a ΔABC, P and Q are points on AB and AC respectively such that $PQ || BC$. Prove that the median AD, drawn from A to BC, bisects PQ.

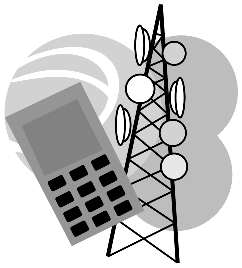
35. From a point on the ground, the angle of elevation of the top of a pedestal is 30° and that of the top of the flagstaff fixed on the pedestal is 60°. If the length of the flagstaff is 5 m, then find the height of the pedestal and its distance from the point of observation on ground. (Use $\sqrt{3}$ = 1.73)

SECTION – E

Question Nos. 36 to 38 are case based questions of 4 marks each.

36. A telecommunication company came up with two plans – plan A and plan B for its customers.

The plans are represented by linear equations where 't' represents the time (in minutes) bought and 'C' represents the cost. The equations are:



Plan A : $3C = 20t$

Plan B : $3C = 10t + 300$

Based on above information, answer the following questions:

(i) If you purchase plan B, how much initial amount you have to pay? **1**

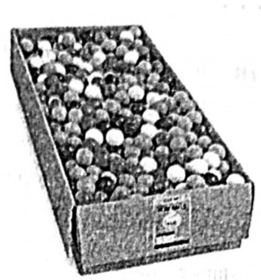
(ii) Charu purchased plan A. How many minutes she bought for ₹ 250 ? **1**

(iii) (a) At how many minutes, do both the plans charge the same amount ? What is that amount? **2**

OR

(iii) (b) Which plan is better if you want to buy 60 minutes? Give reason for your answer. **2**

37. Playing in a ball pool is good entertainment for kids. Suhana bought 600 news balls of diameter 7 cm to fill in the pool for her kids. The cuboidal box containing 600 balls has dimensions 42 cm × 91 cm × 50 cm ($l \times b \times h$).



Based on above information, answer the following questions:

(i) Find the volume of one ball. 1

(ii) 10 balls are painted with neon colours. Determine the area of painted surface. **1**

(iii)(a) Find the volume of empty space in the box. **2**

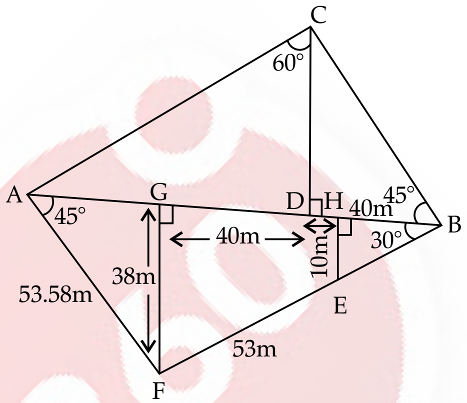
OR

(b) The lowermost layer of the balls covers the base of the box edge to edge when balls are placed evenly adjacent to each other. **2**

(A) How much area is covered by one ball?

(B) How many balls are there in lowermost layer?

38. Rahim and Nadeem are two friends whose plots are adjacent to each other. Rahim's son made a drawing of the plots with necessary details.



$BH = 40$ m

$HD = 10$ m

$DG = 40$ m

$GF = 38$ m

$FE = 53$ m

$AF = 53.58$ m

It is decided that Rahim will fence the triangular plot ABC and Nadeem will fence along the sides AF, FE and BE.

Observe the diagram carefully and answer the following questions:

(Use $\sqrt{2} = 1.41$ and $\sqrt{3} = 1.73$)

(i) Find length BC. **1**

(ii) Find length AG. **1**

(iii) (a) Calculate perimeter of ΔABC. **2**

OR

(iii) (b) Calculate length of $(AF + FE + EB)$. **2**

Delhi Set-2 **430/4/2**

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

SECTION – A

11. Two dice are rolled together. The probability that at least one of them shows six, is:

(A) $\frac{12}{36}$ **(B)** $\frac{5}{36}$

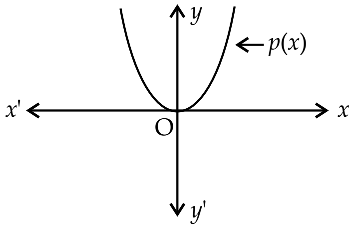
(C) $\frac{11}{36}$ **(D)** $\frac{6}{36}$

13. If $\tan A = \frac{1}{2}$, then $\sin A$ is equal to:

(A) $\frac{2}{\sqrt{5}}$ **(B)** $\frac{1}{\sqrt{3}}$

(C) $\frac{1}{\sqrt{5}}$ **(D)** 1

16. In the given figure, graph of $p(x)$ is shown. Number of distinct zeroes of $p(x)$ is:

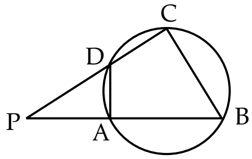


(A) 0 **(B)** 1

(C) 2 **(D)** many

SECTION – B

21. Two chords BA and CD intersect at point P outside the circle. Prove that $\Delta PDA \sim \Delta PBC$



23. Find the ratio in which point $P(-1, m)$ divides the line segment joining the points $A(2, 5)$ and $B(-5, -2)$. Hence, find the value of m.

SECTION – C

28. Prove that the parallelogram circumscribing a circle is a rhombus.

31. Prove that $\sqrt{5}$ is an irrational number.

SECTION – D

33. As observed from the top of a 70 m high lighthouse from the sea level, the angles of depression of two ships are 30° and 45°. If one ship is exactly behind the other on the same sides of the lighthouse, find the distance between the two ships. (Use $\sqrt{3}$ = 1.73)

35. Find 'median' and 'mode' of the following data:

Class	Frequency
100 – 105	6
105 – 110	8
110 – 115	10
115 – 120	4
120 – 125	9
125 – 130	3

Delhi Set-3 **430/4/3**

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

SECTION – A

4. If α, β are zeroes of the polynomial $3x^2 + 14x - 5$, then the value of $3\left(\frac{\alpha+\beta}{\alpha\beta}\right)$ is:

(A) $\frac{14}{5}$ **(B)** $\frac{42}{5}$

(C) $-\frac{14}{5}$ **(D)** $-\frac{42}{5}$

6. The LCM of two numbers is 3600. Which of the following cannot be their HCF ?

(A) 600 **(B)** 400

(C) 500 **(D)** 150

15. In an A.P., $a_n - a_{n-4} = 32$. Its common difference is:

(A) –8 **(B)** 8

(C) $4n$ **(D)** 4

16. The perimeter of a quadrant of a circle of radius 7 cm, is:

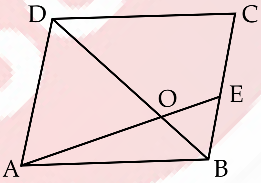
(A) 18 cm **(B)** 11 cm

(C) 22 cm **(D)** 25 cm

SECTION – B

22. Find the ratio in which the segment joining the points (2, –5) and (5, 3) is divided by x-axis. Also, find coordinates of the point on x-axis.

24. The diagonal BD of parallelogram $ABCD$ is divided by segment AE in the ratio 1 : 2. If BE = 1.8 cm, find the length of AD.

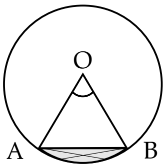


SECTION – C

28. Find the zeroes of the polynomial $p(x) = 9x^2 - 6x - 35$ and verify the relationship between zeroes and its coefficients.

29. Prove that $\sqrt{2}$ is an irrational number.

31. A chord of a circle of radius 14 cm subtends an angle of 90° at the centre. Find perimeter of shaded region. (Use $\sqrt{2}$ = 1.41)



SECTION – D

32. The angle of elevation of the top of a tower, 300 m high, from a point on the ground is observed as 30°. At an instant a hot air balloon passes vertically above the tower and at that instant its angle of elevation from same point on the ground is 60°. Find height of the balloon from the ground and distance of tower from point of observation. (Use $\sqrt{3}$ = 1.73)

35. Find 'mean' and ' mode' of the following data:

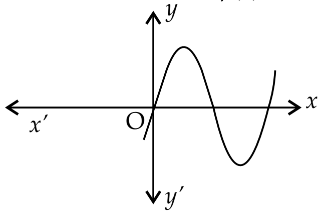
Class	Frequency
20 – 25	9
25 – 30	8
30 – 35	11
35 – 40	13
40 – 45	4
45 – 50	5

Outside Delhi Set-1 **430/6/1**

SECTION – A

Question Nos. 1 to 20 are multiple choice questions of 1 mark each.

1. In the given figure, graph of polynomial $p(x)$ is shown. Number of zeroes of $p(x)$ is:



(A) 3 **(B)** 2
(C) 1 **(D)** 4

2. 22^{nd} term of the A.P.: $\frac{3}{2}, \frac{1}{2}, \frac{-1}{2}, \frac{-3}{2}, \ldots\ldots\ldots\ldots$ is:

(A) $\frac{45}{2}$ **(B)** –9
(C) $\frac{-39}{2}$ **(D)** –21

3. The line $2x - 3y = 6$ intersects x-axis at:

(A) (0, – 2) **(B)** (0, 3)
(C) (–2, 0) **(D)** (3, 0)

4. Two identical cones are joined as shown in the figure. If radius of base is 4 cm and slant height of the cone is 6 cm, then height of the solid is:

(A) 8 cm **(B)** $4\sqrt{5}$ cm
(C) $2\sqrt{5}$ cm **(D)** 12 cm

5. The value of k for which the system of equations $3x - 7y = 1$ and $kx + 14y = 6$ is inconsistent, is:

(A) –6 **(B)** $\frac{2}{3}$
(C) 6 **(D)** $\frac{-3}{2}$

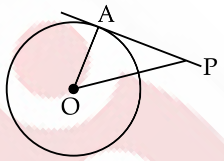
6. Two dice are rolled together. The probability of getting a sum more than 9 is:

(A) $\frac{5}{6}$ **(B)** $\frac{5}{18}$
(C) $\frac{1}{6}$ **(D)** $\frac{1}{2}$

7. $ABCD$ is a rectangle with its vertices at (2, –2), (8, 4), (4, 8) and (–2, 2) taken in order. Length of its diagonal is:

(A) $4\sqrt{2}$ **(B)** $6\sqrt{2}$
(C) $4\sqrt{26}$ **(D)** $2\sqrt{26}$

8. In the given figure, PA is tangent to a circle with centre O. If $\angle APO = 30°$ and $OA = 2.5$ cm, then OP is equal to:



(A) 2.5 cm **(B)** 5 cm
(C) $\frac{5}{\sqrt{3}}$ cm **(D)** 2 cm

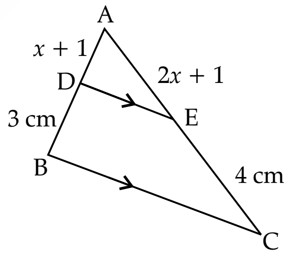
9. If probability of happening of an event is 57%, then probability of non-happening of the event is:

(A) 0.43 **(B)** 0.57
(C) 53% **(D)** $\frac{1}{57}$

10. OAB is sector of a circle with centre O and radius 7 cm. If length of arc $\overset{\frown}{AB} = \frac{22}{3}$ cm, then $\angle AOB$ is equal to:

(A) $\left(\frac{120}{7}\right)^{\circ}$ **(B)** 45°
(C) 60° **(D)** 30°

11. In ΔABC, $DE \parallel BC$. If $AE = (2x + 1)$ cm, $EC = 4$ cm, $AD = (x + 1)$ cm and $DB = 3$ cm, then value of x is:



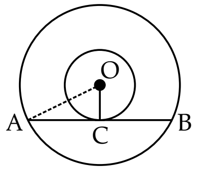
(A) 1 **(B)** $\frac{1}{2}$
(C) –1 **(D)** $\frac{1}{3}$

12. Three coins are tossed together. The probability that exactly one coin shows head, is:

(A) $\frac{1}{8}$ (B) $\frac{1}{4}$

(C) 1 (D) $\frac{3}{8}$

13. In two concentric circles centred at O, a chord AB of the larger circle touches the smaller circle at C. If $OA = 3.5$ cm, $OC = 2.1$ cm, then AB is equal to:



(A) 5.6 cm **(B)** 2.8 cm

(C) 3.5 cm **(D)** 4.2 cm

14. If $\sqrt{3}\sin\theta = \cos\theta$, then value of θ is:

(A) $\sqrt{3}$ **(B)** 60°

(C) $\frac{1}{\sqrt{3}}$ **(D)** 30°

15. To calculate mean of a grouped data, Rahul used assumed mean method. He used $d = (x - A)$, where A is assumed mean. Then $\bar{x}$ is equal to:

(A) $A + \bar{d}$ **(B)** $A + h\bar{d}$

(C) $h(A + \bar{d})$ **(D)** $A - h\bar{d}$

16. If the sum of first n terms of an A.P. is given by $S_n = \frac{n}{2}(3n+1)$, then the first term of the A.P. is:

(A) 2 **(B)** $\frac{3}{2}$

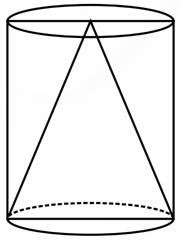
(C) 4 **(D)** $\frac{5}{2}$

17. In ΔABC, $\angle B = 90°$, If $\frac{AB}{AC} = \frac{1}{2}$, then $\cos C$ is equal to

(A) $\frac{3}{2}$ **(B)** $\frac{1}{2}$

(C) $\frac{\sqrt{3}}{2}$ **(D)** $\frac{1}{\sqrt{3}}$

18. The volume of air in a hollow cylinder is 450 cm^3. A cone of same height and radius as that of cylinder is kept inside it. The volume of empty space of the cylinder is:



(A) 225 cm^3 **(B)** 150 cm^3

(C) 250 cm^3 **(D)** 300 cm^3

Assertion-Reason based questions

Directions: In question numbers 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 correct explanation for 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): $(a+\sqrt{b})\cdot(a-\sqrt{b})$ is a rational number, where a and b are positive integers.

Reason (R): Product of two irrationals is always rational.

20. Assertion (A): $\Delta ABC \sim \Delta PQR$ such that $\angle A = 65°$, $\angle C = 60°$. Hence $\angle Q = 55°$.

Reason (R): Sum of all angles of a triangle is 180°.

SECTION – B

Question Nos. 21 to 25 are Very Short Answer type questions of 2 marks each.

21. (a) Solve the equation $4x^2 - 9x + 3 = 0$, using quadratic formula.

OR

(b) Find the nature of roots of the equation $3x^2 - 4\sqrt{3}x + 4 = 0$.

22. In a trapezium $ABCD$, $AB \parallel DC$ and its diagonals intersect at O. Prove that $\frac{OA}{OC} = \frac{OB}{OD}$.

23. A box contains 120 discs, which are numbered from 1 to 120. If one disc is drawn at random from the box, find the probability that

(i) it bears a 2-digit number

(ii) the number is a perfect square.

24. (a) Evaluate: $\frac{\cos 45°}{\tan 30° + \sin 60°}$

OR

(b) Verify that $\sin 2A = \frac{2\tan A}{1+\tan^2 A}$, for $A = 30°$.

25. Using prime factorisation, find the HCF of 180, 140 and 210.

SECTION – C

Question Nos. 26 to 31 are Short Answer type question of 3 marks each.

26. (a) If α, β are zeroes of the polynomial $8x^2 - 5x - 1$, then form a quadratic polynomial in x whose zeroes are $\frac{2}{\alpha}$ and $\frac{2}{\beta}$.

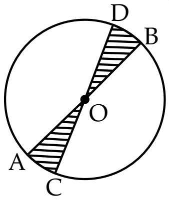
OR

(b) Find the zeroes of the polynomial $p(x) = 3x^2 + x - 10$ and verify the relationship between zeroes and its coefficients.

27. Find length and breadth of a rectangular park whose perimeter is 100 m and area is 600 m^2.

28. Three measuring rods are of lengths 120 cm, 100 cm and 150 cm. Find the least length of a fence that can be measured an exact number of times, using any of the rods. How many times each rod will be used to measure the length of the fence?

29. *AB* and *CD* are diameters of a circle with centre *O* and radius 7 cm. If $\angle BOD = 30°$, then find the area and perimeter of the shaded region.



30. Prove that $\dfrac{\tan\theta}{1-\cot\theta} + \dfrac{\cot\theta}{1-\tan\theta} = \sec\theta \,\text{cosec}\,\theta + 1$.

31. (a) Find the A.P. whose third term is 16 and seventh term exceeds the fifth term by 12. Also, find the sum of first 29 terms of the A.P.

OR

(b) Find the sum of first 20 terms of an A.P. whose n^{th} term is given by $a_n = 5 + 2n$. Can 52 be a term of this A.P.?

SECTION – D

Question. Nos. 32 to 35 are Long Answer type questions of 5 marks each.

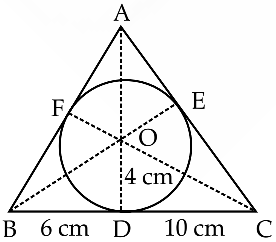
32. (a) Solve the following pair of linear equations by graphical method:

$2x + y = 9$ and $x - 2y = 2$

OR

(b) Nidhi received simple interest of ₹ 1,200 when invested ₹ x at 6% p.a. and ₹ y at 5% p.a. for 1 year. Had she invested ₹ x at 3% p.a. and ₹ y at 8% p.a. for that year, she would have received simple interest of ₹ 1,260. Find the values of x and y.

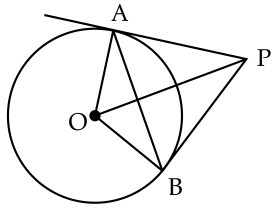
33. (a) The given figure shows a circle with centre *O* and radius 4 cm circumscribed by ΔABC. *BC* touches the circle at *D* such that *BD* = 6 cm, *DC* = 10 cm. Find the length of *AE*.



OR

(b) *PA* and *PB* are tangents drawn to a circle with centre *O*.

If $\angle AOB = 120°$ and *OA* = 10 cm, then



(i) Find $\angle OPA$. **1**

(ii) Find the perimeter of ΔOAP. **3**

(iii) Find the length of chord *AB*. **1**

34. The angles of depression of the top and the foot of a 9 m tall building from the top of a multi-storeyed building are 30° and 60° respectively. Find the height of the multi-storeyed building and the distance between the two buildings. (Use $\sqrt{3}$ = 1.73)

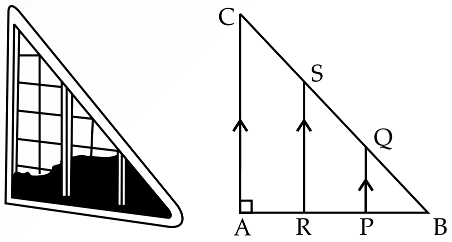
35. Find 'mean' and 'mode' of the following data:

Class	Frequency
15 – 20	12
20 – 25	10
25 – 30	15
30 – 35	11
35 – 40	7
40 – 45	5

SECTION – E

Question. Nos. 36 to 38 are Case study based Questions of 4 marks each.

36.



A triangular window of a building is shown above. Its diagram represents in a ΔABC with $\angle A = 90°$ and *AB* = *AC*. Points *P* and *R* trisect *AB* and *PQ* || *RS* || *AC*.

Based on the above, answer the following questions:

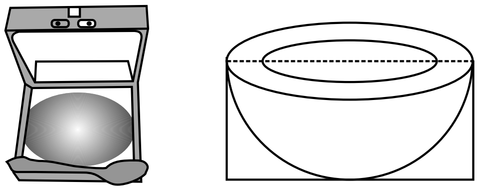
(i) Show that $\Delta BPQ \sim \Delta BAC$. **1**

(ii) Prove that $PQ = \dfrac{1}{3}AC$. **1**

(iii)(a) If *AB* = 3 m, find length *BQ* and *BS*. Verify that $BQ = \dfrac{1}{2}BS$. **2**

OR

(b) Prove that $BR^2 + RS^2 = \frac{4}{9}BC^2$

37. 

A hemispherical bowl is packed in a cuboidal box. The bowl just fits in the box. Inner radius of the bowl is 10 cm. Outer radius of the bowl is 10.5 cm.

Based on the above, answer the following questions:

(i) Find the dimensions of the cuboidal box. **1**

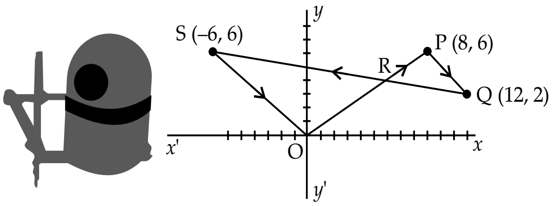
(ii) Find the total outer surface area of the box. **1**

(iii)(a) Find the difference between the capacity of the bowl and the volume of the box. (use $\pi = 3.14$) **2**

OR

(iii)(b) The inner surface of the bowl and the thickness is to be painted. Find the area to be painted. **2**

38. Gurveer and Arushi built a robot that can paint a path as it moves on a graph paper. Some co-ordinate of points are marked on it. It starts from (0, 0), moves to the points listed in order (in straight lines) and ends at (0, 0).



Arushi entered the points $P(8, 6)$, $Q(12, 2)$ and $S(–6, 6)$ in order. The path drawn by robot is shown in the figure.

Based on the above, answer the following questions:

(i) Determine the distance OP. **1**

(ii) QS is represented by equation $2x + 9y = 42$. Find the co-ordinates of the point where it intersects y-axis. **1**

(iii)(a) Point $R(4.8, y)$ divides the line segment OP in a certain ratio, find the ratio. Hence, find the value of y. **2**

OR

(iii)(b) Using distance formula, show that $\frac{PQ}{OS} = \frac{2}{3}$. **2**

Outside Delhi Set-2 430/6/2

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

SECTION – A

5. 15th term of the A.P. $\frac{13}{3}, \frac{9}{3}, \frac{5}{3}$, ... is:

(A) 23 **(B)** $\frac{-53}{3}$

(C) –11 **(D)** $\frac{-43}{3}$

7. A quadratic polynomial having zeroes 0 and –2, is:

(A) $x(x – 2)$ **(B)** $4x(x + 2)$

(C) $x^2 + 2$ **(D)** $2x^2 + 2x$

13. Two dice are rolled together. The probability of getting an outcome (a, b) such that $b = 2a$, is:

(A) $\frac{1}{6}$ **(B)** $\frac{1}{12}$

(C) $\frac{1}{36}$ **(D)** $\frac{1}{9}$

15. If $\sin\theta = \frac{1}{9}$, then $\tan\theta$ is equal to:

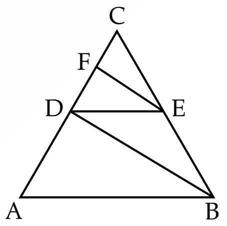
(A) $\frac{1}{4\sqrt{5}}$ **(B)** $\frac{4\sqrt{5}}{9}$

(C) $\frac{1}{8}$ **(D)** $4\sqrt{5}$

SECTION – B

23. Using prime factorisation, find the HCF of 144, 180 and 192.

25. In the given figure, $AB \parallel DE$ and $BD \parallel EF$. Prove that $DC^2 = CF \times AC$.



SECTION – C

26. Three friends plan to go for a morning walk. They step off together and their steps measures 48 cm, 52 cm and 56 cm respectively. What is the minimum distance each should walk so the each can cover the same distance in complete steps ten times?

27. Prove that $\left(1+\frac{1}{\tan^2\theta}\right)\left(1+\frac{1}{\cot^2\theta}\right) = \frac{1}{\sin^2\theta - \sin^4\theta}$

31. The sum of a number and its reciprocal is $\frac{13}{6}$. Find the number.

SECTION – D

32. Two poles of equal heights are standing opposite each other on either side of the road which is 85 m wide. From a point between them on the road, the angles of elevation of the top of the poles are 60° and 30° respectively. Find the height of the poles and the distances of the point from the poles.

(Use $\sqrt{3}$ = 1.73)

34. Find 'mean' and 'mode' of the following data:

Class	Frequency
0 – 15	11
15 – 30	8
30 – 45	15
45 – 60	7
60 – 75	10
75 – 90	9

Outside Delhi Set-3 **430/6/3**

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

SECTION – A

2. Three coins are tossed together. The probability that at least one head comes up, is:

(A) $\frac{3}{8}$ **(B)** $\frac{7}{8}$

(C) $\frac{1}{8}$ **(D)** $\frac{3}{4}$

4. If the length of the shadow of a tower is $\sqrt{3}$ times its height, then the angle of elevation of the sun is:

(A) 45° **(B)** 30°

(C) 60° **(D)** 0°

11. The point (3, – 5) lies on the line $mx - y = 11$. The value of m is:

(A) 3 **(B)** –2

(C) 8 **(D)** 2

SECTION – B

23. (a) Solve the quadratic equation $\sqrt{3}x^2 + 10x + 7\sqrt{3} = 0$ using quadratic formula.

OR

(b) Find the nature of roots of the equation $4x^2 - 4a^2x + a^4 - b^4 = 0, b \neq 0$

25. The perimeters of two similar triangles are 22 cm and 33 cm respectively. If one side of first triangle is 9 cm, then find the length of corresponding side of the second triangle.

SECTION – C

Question Nos. 26 to 31 are short answer questions of 3 marks each.

26. Given that $\sqrt{5}$ is an irrational number, prove that $2 + 3\sqrt{5}$ is an irrational number.

28. Prove that $\frac{\sin\theta}{1+\cos\theta} + \frac{1+\cos\theta}{\sin\theta} = 2\operatorname{cosec}\theta$.

31. (a) α, β are zeroes of the polynomial $3x^2 - 8x + k$. Find the value of k, if $\alpha^2 + \beta^2 = \frac{40}{9}$

OR

(b) Find the zeroes of the polynomial $2x^2 + 7x + 5$ and verify the relationship between its zeroes and co-efficients.

SECTION – D

32. Find 'mean' and 'mode' marks of the following data:

Class	Number of Students
0 – 5	2
5 – 10	3
10 – 15	8
15 – 20	15
20 – 25	14
25 – 30	8

35. A drone is flying at a height of h metres. At an instant it observes the angle of elevation of top of an industrial turbine as 60° and angle of depression of foot of the turbine as 30°. If height of turbine is 200 metres, find the value of h and distance of drone from the turbine.

(Use $\sqrt{3}$ = 1.73)

ANSWERS

Delhi Set-1 **430/4/1**

SECTION – A

1. Option (B) is correct.

Explanation: We know that product of two numbers = HCF × LCM

$$x \times 20 = \text{HCF}(x, 20) \times \text{LCM}(x, 20)$$

$$\Rightarrow \quad x \times 20 = 2 \times 60$$

$$\Rightarrow \quad x = \frac{2 \times 60}{20}$$

$$\therefore \quad x = 6$$

2. Option (A) is correct.

Explanation: The given points are $A(-6, 9)$ and $B(2, 7)$ where $x_1 = -6$; y_1 and $x_2 = 2$; $y_2 = 7$

As, distance between two points

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

On substituting values we get,

$$AB = \sqrt{[(2-(-6)]^2 + (7-9)^2}$$

$$= \sqrt{(2+6)^2 + (-2)^2}$$

$$= \sqrt{8^2 + (-2)^2}$$

$$= \sqrt{64+4} = \sqrt{68} = 2\sqrt{17}$$

Thus, distance between two points = $2\sqrt{17}$ units

3. Option (C) is correct.

Explanation: Given: $T_n = (5n - 6)$

$$\Rightarrow \quad T_1 = (5 \times 1 - 6) = 5 - 6 = -1$$

$$\Rightarrow \quad T_2 = (5 \times 2 - 6) = 10 - 6 = 4$$

As, common difference $(d) = T_2 - T_1$

$$= 4 - (-1) = 4 + 1 = 5.$$

4. Option (D) is correct.

Explanation: Given: $p(x) = kx^2 - 9x + 3$

As, $\frac{-3}{2}$ is a zero of $p(x)$, then

$$p\left(\frac{-3}{2}\right) = 0$$

$$\Rightarrow k \times \left(\frac{-3}{2}\right)^2 - 9 \times \frac{-3}{2} + 3 = 0$$

$$\Rightarrow \quad \frac{9}{4}k + \frac{27}{2} + 3 = 0$$

$$\Rightarrow \quad \frac{9k + 54 + 12}{4} = 0$$

$$\Rightarrow \quad 9k + 66 = 0$$

$$\Rightarrow \quad k = \frac{-66}{9} = \frac{-22}{3}$$

Thus, value of $k = \frac{-22}{3}$

5. Option (B) is correct.

Explanation: As, three coins are tossed together.

∴ Total number of possible outcomes = 8

As, all possible outcomes are HHH, TTT, HTH, HHT. THH, HTT, THT, TTH

Now, let E be the event of getting one coin shows tail so, the favourable outcomes are HTH, THH, HHT.

Thus, number of favourable outcomes = 3

$$\therefore \quad P(E) = \frac{\text{Favourable outcomes}}{\text{Total outcomes}} = \frac{3}{8}$$

6. Option (A) is correct.

Explanation: Given: $h_1 : h_2 = 1 : 2$

Volume of cylinder 1 = Volume of cylinder 2

$$\Rightarrow \quad \frac{\pi r_1^2 h_1}{\pi r_2^2 h_2} = 1$$

$$\Rightarrow \quad \frac{r_1^2 \times 1}{r_2^2 \times 2} = 1$$

$$\Rightarrow \quad \frac{r_1^2}{r_2^2} = \frac{2}{1}$$

$$\Rightarrow \quad \frac{r_1}{r_2} = \sqrt{\frac{2}{1}}$$

Thus, $\frac{r_1}{r_2} = \frac{\sqrt{2}}{1}$

∴ Ratio of their radii = $\sqrt{2} : 1$

7. Option (C) is correct.

Explanation: Given: $\sqrt{2}\sin\theta = 1$

$$\Rightarrow \quad \sin\theta = \frac{1}{\sqrt{2}} = \frac{P}{H}$$

As, per pythagoras theorem,

$$H^2 = P^2 + B^2$$

$$(\sqrt{2})^2 = 1^2 + B^2$$

$$2 - 1 = B^2$$

$$\Rightarrow \quad B = \sqrt{1} = 1$$

Now, $\cot\theta = \frac{\cos\theta}{\sin\theta}$

and $\cos\theta = \frac{B}{H} = \frac{1}{\sqrt{2}}$

$$\Rightarrow \quad \cot\theta = \frac{1}{\sqrt{2}} \div \frac{1}{\sqrt{2}}$$

$$= \frac{1}{\sqrt{2}} \times \frac{\sqrt{2}}{1} = 1 \quad \text{...(i)}$$

and, $\operatorname{cosec}\theta = \frac{1}{\sin\theta} = \sqrt{2}$ ...(ii)

By using (i) and (ii) we get,

$$\cot\theta \times \operatorname{cosec}\theta = 1 \times \sqrt{2} = \sqrt{2}$$

8. Option (B) is correct.

Explanation: Given: $PQ = PR = 4$ cm

$$OQ = OR = 3 \text{ cm}$$

$$\angle OQP = \angle ORP = 90°$$

(∵ Radius is ⊥ to the tangent)

Now, in right angled ΔOQP,
By using Pythagoras theorem

$\Rightarrow \quad OP^2 = OQ^2 + QP^2$

$\Rightarrow \quad OP^2 = 3^2 + 4^2$

$\Rightarrow \quad OP^2 = 25$

Thus, $\quad OP = 5$ cm

Now, perimeter of

$\Delta OQP = OP + PQ + OQ$
$= 5 + 4 + 3$
$= 12$ cm

9. Option (D) is correct.

Explanation: Given, α and β are zeroes of $2x^2 + 5x + 1 = 0$, on comparing it with $ax^2 + bx + c = 0$, we get

$a = 2, b = 5, c = 1$

Now, $\quad \alpha + \beta = \frac{-b}{a} = \frac{-5}{2}$

and $\quad \alpha\beta = \frac{c}{a} = \frac{1}{2}$

$\therefore \quad \left(\frac{1}{\alpha} + \frac{1}{\beta}\right) = \frac{(\alpha + \beta)}{\alpha\beta} = \frac{-5}{2} \times \frac{2}{1} = -5$

Thus, value of $\left(\frac{1}{\alpha} + \frac{1}{\beta}\right) = -5$.

10. Option (C) is correct.

Explanation: Given, A.P. = $10\sqrt{2}, 6\sqrt{2}, 2\sqrt{2}$

Here, $\quad a = 10\sqrt{2}$

$d = 6\sqrt{2} - 10\sqrt{2} = -4\sqrt{2}$

As, $\quad a_n = a + (n - 1)d$

$\Rightarrow \quad a_{20} = 10\sqrt{2} + (20 - 1)d$
$= 10\sqrt{2} + 19d$
$= 10\sqrt{2} + 19 \times (-4\sqrt{2})$
$= 10\sqrt{2} - 76\sqrt{2}$
$= -66\sqrt{2}$

Thus, 20th term of A.P. is $-66\sqrt{2}$.

11. Option (A) is correct.

Explanation: Given, $\sec\theta - \tan\theta = 2$ ...(i)

As, per trigonometry identity

$1 + \tan^2\theta = \sec^2\theta$

$\Rightarrow \quad \sec^2\theta - \tan^2\theta = 1$ ...(ii)

Now, by using algebraic identity

$(a^2 - b^2) = (a + b)(a - b)$

we get, $(\sec^2\theta - \tan^2\theta) = (\sec\theta + \tan\theta)(\sec\theta - \tan\theta)$

By substituting value from (i) and (ii)

$1 = (\sec\theta + \tan\theta) \times 2$

$\Rightarrow \quad \sec\theta + \tan\theta = \frac{1}{2}$

12. Option (D) is correct.

Explanation: Total possible outcomes = 52
Number of drawn cards having 9 number = 4
i.e., 1 of each colour.
Thus, favourable outcomes = 4.

$\therefore \quad P(E) = \frac{\text{Favourable outcomes}}{\text{Possible outcomes}}$
$= \frac{4}{52} = \frac{1}{13}$

13. Option (B) is correct.

Explanation: Given, central angle (θ) = 210°

Length of arc = $\frac{44}{3}$ cm

As, we know

Length of arc = $\frac{2\pi r\theta}{360°}$

$\Rightarrow \quad \frac{44}{3} = 2 \times \frac{22}{7} \times r \times \frac{210°}{360°}$

$\Rightarrow \quad \frac{44}{3} \times \frac{3}{11} = r$

$\Rightarrow \quad 4 = r$

Thus, radius of circle = 4 cm.

14. Option (C) is correct.

Explanation: When lines are parallel, there is no solution.

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

Given, $\quad 14x + my = 20$ and $-3x + 2y = 16$

On comparing with $ax + by + c = 0$, we get,

$a_1 = 14 \quad a_2 = 3$
$b_1 = m \quad b_2 = 2$
$c_1 = -20 \quad c_2 = -16$

On substituting in above formula.

$\frac{14}{-3} = \frac{m}{2} \neq \frac{-20}{-16}$

$\Rightarrow \quad \frac{14}{-3} = \frac{m}{2}$

$\Rightarrow \quad \frac{14 \times 2}{-3} = m$

$\Rightarrow \quad \frac{28}{-3} = m$

Thus, value of m is $\frac{-28}{3}$.

15. Option (A) is correct.

Explanation: Given, radius of cone = 7 cm
Curved surface area = 550 cm²
As, per formula

CSA of cone = πrl

where $\quad l$ = slant height

$\Rightarrow \quad 550 = \frac{22}{7} \times 7 \times l$

$\Rightarrow \quad \frac{550}{22} = l$

$\Rightarrow \quad l = 25$ cm

Thus, slant height of cone is 25 cm.

16. Option (B) is correct.

Explanation: Given, $\sin A = \frac{2}{3} = \frac{P}{H}$

By using Pythagoras theorem,

$H^2 = P^2 + B^2$
$3^2 = 2^2 + B^2$

$\Rightarrow \quad 9 - 4 = B^2$

$\Rightarrow \quad 5 = B^2$

$\Rightarrow \quad B = \sqrt{5}$

Substituting value of B is $\cos A$ we get,

As, $\quad \cos A = \frac{B}{H} = \frac{\sqrt{5}}{3}$

17. Option (D) is correct.

Explanation: Given, PA and PB are tangents.

$$\angle AOB = 105°$$

Now, $\angle AOB + \angle APB = 180°$

$\Rightarrow \quad 105° + \angle APB = 180°$

($\because$ The angle between the two tangents drawn from an external point to a circle is supplementary to the angle subtended by the line segment joining the points of contact at the centre.)

$\Rightarrow \quad \angle APB = 180° - 105°$

$= 75°$

And, $\quad \angle OAP = 90°$

($\because$ The tangent at any point of a circle is $\perp$ to the radius through the point of contact.)

Thus, $\angle OAP + \angle APB = 90° + 75°$

$= 165°$

18. Option (D) is correct.

Explanation: In ΔABC, $PQ || BC$

$\therefore \quad \dfrac{AP}{AB} = \dfrac{PQ}{BC}$ (By BPT)

$\Rightarrow \quad \dfrac{AP}{AP+PB} = \dfrac{PQ}{BC}$

$\Rightarrow \quad \dfrac{2.4}{2.4+3.6} = \dfrac{PQ}{5.4}$

$\Rightarrow \quad \dfrac{2.4 \times 5.4}{6} = PQ$

[$\because AP = 2.4$, $PB = 3.6$ and $BC = 5.4$]

$\Rightarrow \quad PQ = 2.16$ cm

19. Option (D) is correct.

Explanation: In case of assertion,

As, median represents the middle value of the given data. So, it means that half of the class got marks less than or equal to 16 not only less than 16.

So, Assertion is false.

In case of reason, according to median concept, median divides the distribution in two equal parts.

So, Reason is true.

Hence, Assertion is false but Reason is true.

20. Option (D) is correct.

Explanation: In case of Assertion,

Given: $\quad P(E) = \dfrac{1}{999}$

$\Rightarrow \quad P(\overline{E}) = 1 - P(E)$

$= 1 - \dfrac{1}{999} = \dfrac{999-1}{999}$

$= \dfrac{998}{999} = 0.99$ (approx)

which is not equal to 0.001

Thus, Assertion is false.

In the case of Reason: The sum of probability and its complement is always equal to 1.

$\therefore \quad P(E) + P(\overline{E}) = 1$ is true.

Thus, Assertion is false but Reason is true.

SECTION – B

21. If 45^n ends with digit 0, then it must have 2 and 5 as factor i.e., it must be divisible by 10.

But $45^n = (3^2 \times 5)^n = 3^{2n} \times 5^n$ which shows that 3 and 5 are the only prime factors of 45^n.

As we know that according to the fundamental theorem of arithmetic the prime factorisation of each number is unique.

So, 2 is not a factor of 45^n

Hence, 45^n can never end with the digit 0.

Thus, from above, we can say that prime number $a = 2$ which on multiplying with 45^n makes the product end with the digit 0.

22. Here, $P(x, 0)$

$$x_1 = 2, y_1 = 8, x_2 = -3 \text{ and } y_2 = -5$$

Section formula: $\quad x = \dfrac{mx_2 + nx_1}{m+n} \quad y = \dfrac{my_2 + ny_1}{m+n}$

Let the required ratio be $k : 1$

Then, by section formula, the coordinates of P are

$$P\left(\frac{-3k+2}{k+1}, \frac{-5k+8}{k+1}\right)$$

Now, substituting coordinates of P as $(x, 0)$

we get, $\quad x = \dfrac{-3k+2}{k+1}, \; 0 = \dfrac{-5k+8}{k+1}$

By using $\quad 0 = \dfrac{-5k+8}{k+1}$ we get,

$0 = -5k + 8$

$\Rightarrow \quad 5k = 8$

$\Rightarrow \quad k = \dfrac{8}{5}$

$\therefore \quad$ Value of $x = \dfrac{-14}{13}$

23. (a) Probability that coin will land inside the circle

$$P(E) = \frac{\text{Area of circle}}{\text{Area of rectangle}}$$

Here, area of circle $= \pi r^2$

$= \dfrac{22}{7} \times 0.7 \times 0.7$

$\Rightarrow \quad = 1.54 \text{ m}^2$

Area of rectangle $= L \times B = 3 \times 2$

$= 6 \text{ m}^2$

Now, $\quad P(E) = \dfrac{1.54}{6}$

(Substitute value in above formula)

$= 0.2567$

Thus, probability of coin landing inside the circle

$= 0.2567$ (approx)

OR

(b) When a die is thrown twice, then the total number of outcomes $= 6^2 = 36$

(i) Difference between 2 numbers obtained is 3

Pairs for this are (1, 4) (4, 1) (2, 5) (5, 2) (3, 6) (6, 3)

$\therefore$ Number of favourable outcomes = 6

Thus, $P(E) = \dfrac{\text{Favourable outcomes}}{\text{Total outcomes}} = \dfrac{6}{36} = \dfrac{1}{6}$

(ii) Sum of the numbers obtained is 8.

Here, pairs are (2, 6) (3, 5) (4, 4) (5, 3) (6, 2)

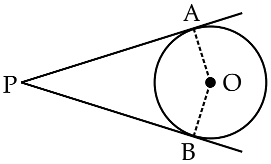
$\therefore$ Number of favourable outcomes = 5

Thus, $P(E) = \dfrac{\text{Favourable outcomes}}{\text{Total outcomes}} = \dfrac{5}{36}$

Hence, probability of difference between two numbers is 3 = $\frac{1}{6}$

And, probability of sum of numbers obtained is 8 = $\frac{5}{36}$

24. (a) Given: PA and PB are two length tangents drawn from an external point P to a circle with centre O.



To prove: $\angle APB + \angle AOB = 180°$

Proof: $OA \perp PA$ [$\because$ Tangent to a circle is $\perp$ to the radius through the point of contact]

$\Rightarrow \quad \angle OAP = 90°$

and, $\quad \angle OBP = 90°$

Now, as the sum of the all the angles of a quadrilateral is 360°

$\therefore \angle OAP + \angle OBP + \angle APB + \angle AOB = 360°$

On substituting value of $\angle OAP$ and $\angle OBP$ we get,

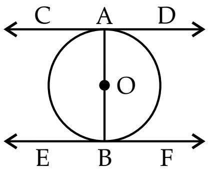
$90° + 90° + \angle APB + \angle AOB = 360°$

$\Rightarrow \angle APB + \angle AOB = 360° - 180°$

$\therefore \angle APB + \angle AOB = 180°$ **Hence Proved**

OR

(b) Given: CD and EF are tangents at the end points A and B of diameter AB of a circle with centre O.



To prove: $CD \parallel EF$

Proof: $OA \perp CD$ and $OB \perp EF$

[As, tangent to circle is to the radius through the point of contact]

$\Rightarrow \angle OAC = 90°$ and $\angle OBF = 90°$,

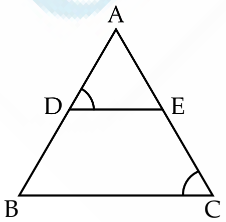
$\Rightarrow \angle OAC = \angle OBF = 90°$

As, these are alternate interior angles and are equal

$\therefore CD \parallel EF$ **Hence Proved**

25. Given: $\quad \angle ADE = \angle ACB$

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



To prove: ΔABC is isosceles

i.e., $\quad AB = BC$

Proof: In ΔABC

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

$\Rightarrow \quad DE \parallel BC$ (By converse of BPT)

$\therefore \quad \angle ADE = \angle ABC$

(corresponding $\angle$s are equal)

But, $\quad \angle ADE = \angle ACB$ (given)

Thus, $\quad \angle ABC = \angle ACB$ (from above)

So, $\quad AB = AC$

(sides opposite to equal side angles are equal)

Hence, ΔABC is an isosceles triangle.

Hence Proved.

SECTION – C

26. As, given polynomial $p(x) = 6x^2 + 13x - 5$

$\Rightarrow \quad 6x^2 + 15x - 2x - 5 = 0$

$\Rightarrow \quad 3x(2x + 5) - 1(2x + 5) = 0$

$\Rightarrow \quad (2x + 5)(3x - 1) = 0$

$\Rightarrow \quad 2x + 5 = 0$ and $3x - 1 = 0$

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

$\Rightarrow \quad x = \frac{1}{3}$

So, the zeroes of $p(x)$ are $\frac{-5}{2}$ and $\frac{1}{3}$.

Now, sum of the zeroes = $\left(\frac{-5}{2} + \frac{1}{3}\right) = \left(\frac{-15+2}{6}\right)$

$= \frac{-13}{6} = \frac{-(\text{coefficient of } x)}{(\text{coefficient of } x^2)}$

Product of zeroes = $\left(\frac{-5}{2} \times \frac{1}{3}\right) = \frac{-5}{6}$

$= \frac{\text{constant term}}{\text{coefficient of } x^2}$

Hence Verified

27. (a) Given, A.P. = 7, $10\frac{1}{2}$, 14 ... 84

Here, $\quad a = 7, d = \left(10\frac{1}{2} - 7\right) = \left(\frac{21}{2} - 7\right)$

$= \frac{21-14}{2} = \frac{7}{2}$

and $\quad T_n(l) = 84$

As, $\quad T_n = a + (n-1)d$

$\Rightarrow \quad 84 - 7 = (n-1)\frac{7}{2}$

$\Rightarrow \quad 77 \times \frac{2}{7} = (n-1)$

$\Rightarrow \quad 22 + 1 = n$

$\Rightarrow \quad n = 23$

Now, $\quad S_{23} = \frac{n}{2}(a+l) = \frac{23}{2}(7+84)$

$$= \frac{23}{2} \times 91 = \frac{2093}{2} = 1046\frac{1}{2}$$

Thus, sum of A.P. is $1046\frac{1}{2}$.

OR

(b) Given, $S_n = \frac{n}{2}(2n+8)$

Let $n = 1$

$T_1 = S_1$

$= \frac{1}{2}(2 \times 1 + 8)$

$= \frac{1}{2} \times 10 = 5$

If $n = 2$ $\quad S_2 = \frac{2}{2}(2 \times 2 + 8) = 12$

Now, $T_2 = S_2 - S_1 = 12 - 5 = 7$

and, common difference $(d) = 7 - 5 = 2$

$(\because d = T_2 - T_1)$

$a = 5$ and $d = 12$

15th term $= T_{15} = a + (n-1)d$

$= 5 + (15 - 1) \times 2$

$= 5 + 14 \times 2 = 5 + 28 = 33$

Hence, 15th term of A.P. is 33.

28. Let $\sqrt{3}$ be rational number

Thus, $\sqrt{3} = \frac{a}{b}$ where a and b are integers having no common factor other than 1 and $b \neq 0$.

Now, $\sqrt{3} = \frac{a}{b}$

On squaring both the sides, we get

$$3 = \frac{a^2}{b^2}$$

$\Rightarrow \quad 3b^2 = a^2 \quad$ ...(i)

$\Rightarrow$ 3 divides a^2

$\Rightarrow$ 3 divides a

Let $a = 3c$ for some integer c.

Putting $a = 3c$ in (i) we get,

$3b^2 = 9c^2$

$\Rightarrow \quad b^2 = 3c^2$

$\Rightarrow$ 3 divides b^2

$\Rightarrow$ 3 divides b

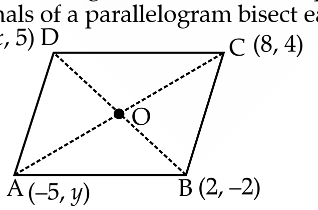
Thus, 3 is a common factor of a and b.

But this contradicts the fact that a and b have no common factor other than 1.

Thus, our assumption is wrong.

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

29. **(a)** Given, $A(-5, y)$, $B(2, -2)$, $C(8, 4)$ and $D(x, 5)$ are vertices of parallelogram $ABCD$. Join AC and BD intersecting each other at the point O. As, diagonals of a parallelogram bisect each other.



$\therefore$ O is the mid-point of AC as well as BD.

$\therefore$ mid-point of $AC = \left(\frac{-5+8}{2}, \frac{y+4}{2}\right) = \left(\frac{3}{2}, \frac{y+4}{2}\right)$

and midpoint of $BD = \left(\frac{2+x}{2}, \frac{-2+5}{2}\right) = \left(\frac{2+x}{2}, \frac{3}{2}\right)$

As, these points coincide at point O.

$\therefore \quad \frac{x+2}{2} = \frac{3}{2}$ and $\frac{y+4}{2} = \frac{3}{2}$

$\Rightarrow \quad x = 3 - 2$ and $y = 3 - 4$

$\Rightarrow \quad x = 1$ and $y = -1$

Hence, $x = 1$ and $y = -1$

Now, length of sides of a parallelogram can be calculated by distance formula

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

$\Rightarrow \quad AB = \sqrt{(2+5)^2 + (-2-y)^2}$

$= \sqrt{7^2 + (-2+1)^2}$

$= \sqrt{49+1} = \sqrt{50}$

$BC = \sqrt{(8-2)^2 + (4+2)^2}$

$= \sqrt{6^2 + 6^2} = \sqrt{36+36}$

$= \sqrt{72} = 6\sqrt{2}$

$CD = \sqrt{(1-8)^2 + (5-4)^2}$

$= \sqrt{(-7)^2 + (1)^2} = \sqrt{49+1}$

$= \sqrt{50}$

$DA = \sqrt{(-5-1)^2 + (-1-5)^2}$

$= \sqrt{(-6)^2 + (-6)^2}$

$= \sqrt{36+36} = \sqrt{72} = 6\sqrt{2}$

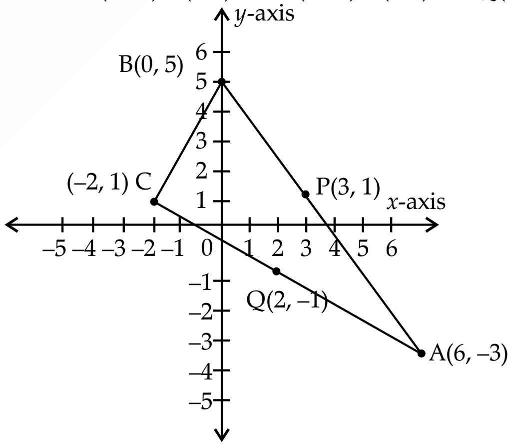
Thus, length of the sides of the parallelogram $ABCD$ are

$AB = CD = \sqrt{50}$ units

and, $BC = DA = 6\sqrt{2}$ units.

OR

(b) Given: $A(6, -3)$, $B(0, 5)$ and $C(-2, 1)$, P(3, 1) and $Q(2, -1)$



As per section formula $\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$

Let ratio of $\frac{AP}{PB} = \frac{m}{n}$ then,

$$P(3, 1) = \left[\left(\frac{m\times 0+n\times 6}{m+n}\right),\left(\frac{m\times 5+n\times -3}{m+n}\right)\right]$$

$\Rightarrow 3 = \frac{0+6n}{m+n}$ and $1 = \frac{5m-3n}{m+n}$

$\Rightarrow 3m + 3n = 0 + 6n$ $\Rightarrow m + n = 5m - 3n$

$\Rightarrow 3m = 3n$ $\Rightarrow n + 3n = 5m - m$

$\Rightarrow \frac{m}{n} = \frac{3}{3} = \frac{1}{1}$ $\Rightarrow \frac{m}{n} = \frac{4}{4} = 1$

Thus, $\frac{AP}{PB} = \frac{m}{n} = 1$ ... (i)

Similarly ratio of $\frac{AQ}{QB} = \frac{m}{n}$ then,

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

$\Rightarrow 2 = \frac{-2m+6n}{m+n}$ and $-1 = \left[\frac{m+(-3n)}{m+n}\right]$

$\Rightarrow 2m + 2n = -2m + 6n$ and $-m - n = m - 3n$

$\Rightarrow 2m + 2m = 6n - 2n$ and $-m - m = -3n + n$

$\Rightarrow 4m = 4n$ and $-2m = -2n$

$\Rightarrow \frac{m}{n} = \frac{4}{4} = 1$ and $\frac{m}{n} = \frac{-2}{-2} = 1$

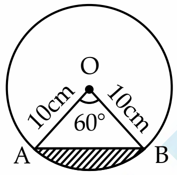
Thus, $\frac{AQ}{QB} = \frac{m}{n} = 1$ ... (ii)

From (i) and (ii) we get

$$\frac{AP}{PB} = \frac{AQ}{QB}$$

30. Given; $\angle AOB = \theta = 60°$

$OA = OB$ = radii = 10 cm



Area of shaded region = (Area of sector – Area of triangle AOB)

In ΔOAB, let $\angle OBA = \angle OBA = x$ (angles opposite to equal sides angle sum property)

Now, $\angle AOB + \angle OAB + \angle OBA = 180°$

$\Rightarrow 60° + x + x = 180°$

$\Rightarrow 2x = 120°$

$x = 60°$

As, all angles are of 60°

$\therefore \Delta AOB$ is an equilateral triangle

Now, area of $\Delta AOB = \frac{\sqrt{3}}{4}a^2$

Area of shaded region $= \frac{\theta\pi r^2}{360°} - \frac{\sqrt{3}}{4}a^2$

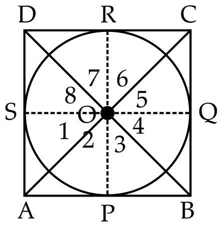
$$= \frac{60°}{360°}\times 3.14\times 10\times 10 - \frac{\sqrt{3}}{4}\times 10\times 10$$

$= 52.33 - 43.25$

$= 9.08$

Thus, area of shaded region = 9.08 cm^2

31. Given: A quadrilateral $ABCD$ circumscribing a circle with centre O.



To prove: $\angle AOB + \angle COD = 180°$

and $\angle AOD + \angle BOC = 180°$

Construction: Join OP, OQ, OR and OS

Proof: As we know that tangents drawn from an external point of a circle, subtend equal angles at the centre.

$\therefore \angle 1 = \angle 2, \angle 3 = \angle 4, \angle 5 = \angle 6$ and $\angle 7 = \angle 8$

Also, $\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 + \angle 6 + \angle 7 + \angle 8 = 360°$(complete angle)

$\Rightarrow 2(\angle 2 + \angle 3) + 2(\angle 6 + \angle 7) = 360°$

$\Rightarrow 2\angle AOB + 2\angle BOC = 360°$

$\Rightarrow \angle AOD + \angle COD = 180°$ ...(i)

Similarly, $2(\angle 1 + \angle 8) + 2(\angle 4 + \angle 5) = 360°$

$\Rightarrow 2(\angle AOD + 2\angle BOC) = 360°$

$\Rightarrow \angle AOD + \angle BOC = 180°$ ...(ii)

From (i) and (ii) we get,

$\angle AOB + \angle COD = 180°$

and $\angle AOD + \angle BOC = 180°$

Hence proved

SECTION – D

32. (a) Quadratic equation $= p^2x^2 + (p^2 - q^2)x - q^2 = 0$.

On comparing is with $ax^2 + bx + c = 0$ we get,

$a = p^2$, $b = p^2 - q^2$ and $c = -q^2$

(i) As, $D = b^2 - 4ac$

$= (p^2 - q^2)^2 - 4 \times p^2 \times -q^2$

$= p^4 + q^4 - 2p^2q^2 + 4p^2q^2$

$= p^4 + q^4 + 2p^2q^2 = (p^2 + q^2)^2$

Thus, D is a perfect square.

(ii) As $D > 0$, so roots will be real.

$$\therefore \quad \alpha = \frac{-b+\sqrt{D}}{2a}$$

$$= \frac{-(p^2-q^2)+\sqrt{(p^2+q^2)^2}}{2\times p^2}$$

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

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

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

$$= \frac{-(p^2-q^2)-\sqrt{(p^2+q^2)^2}}{2\times p^2}$$

$$= \frac{-2p^2}{2p^2} = -1$$

Hence, roots of the equation are $\frac{q^2}{p^2}$ and –1.

OR

(b) Let three consecutive positive integers be,
x, $(x + 1)$ and $(x + 2)$
As per given information
$x^2 + (x+1)(x+2) = 67$
$x^2 + x^2 + 2x + x + 2 = 67$
$2x^2 + 3x + 2 - 67 = 0$
$2x^2 + 3x - 65 = 0$
$2x^2 + 13x - 10x - 65 = 0$
$x(2x + 13) - 5(2x + 13) = 0$
$(2x + 13)(x - 5) = 0$
$\Rightarrow 2x + 13 = 0$ and $x - 5 = 0$

$\Rightarrow \quad x = \frac{-13}{2}$ and $x = 5$

Since, integers are positive, so value of x cannot be negative.
Thus, three integers are
$x = 5,$
$x + 1 = 5 + 1 = 6$
and $x + 2 = 5 + 2 = 7.$

33. (i)

Class interval	Frequency (f_i)	Class mark (x_i)	($f_i x_i$)
15 – 20	6	17.5	105
20 – 25	16	22.5	360
25 – 30	17	27.5	467.5
30 – 35	4	32.5	130
35 – 40	5	37.5	187.5
40 – 45	2	42.5	85
	$\Sigma f_i = 50$		$\Sigma f_i x_i = 1335$

$$\therefore \quad \text{Mean } (\overline{X}) = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$= \frac{1355}{50} = 26.7$$

(ii) Clearly the modal class is 25–30 as it has maximum frequency.
Thus, $l = 25, h = 5, f = 17, f_0 = 16$ and $f_1 = 4$

$$\text{Mode, M} = l_0 + \left[\frac{h \times (f - f_0)}{2f - f_0 - f_1}\right]$$

$$= 25 + \left[\frac{5 \times (17 - 16)}{2 \times 17 - 16 - 4}\right]$$

$$= 25 + \left[5 \times \frac{1}{34 - 20}\right]$$

$$= 25 + \frac{5}{14}$$

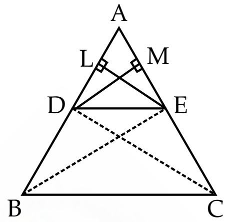
$$= \frac{350 + 5}{14}$$

$$= \frac{355}{14}$$

$$= 25.36$$

34. (a) Given: $DE \parallel BC$

To prove: $\frac{AD}{DB} = \frac{AE}{EC}$



Construction: Join BE and CD
Draw $EL \perp AB$ and $DM \perp AC$.

Proof: Area of $\Delta ADE = \frac{1}{2} \times AE \times DM$

$\left(\because \text{area of } \Delta = \frac{1}{2} \times b \times h\right)$

Area of $\Delta DEC = \frac{1}{2} \times EC \times DM$

$$\therefore \quad \frac{\text{Area of } \Delta ADE}{\text{Area of } \Delta DEC} = \frac{\frac{1}{2} \times AE \times DM}{\frac{1}{2} \times EC \times DM} = \frac{AE}{EC} \quad \text{...(i)}$$

Similarly, Area of $\Delta ADE = \frac{1}{2} \times AD \times EL$

and, Area of $\Delta BDE = \frac{1}{2} \times BD \times EL$

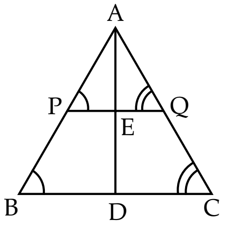
$$\therefore \quad \frac{\text{Area of } \Delta ADE}{\text{Area of } \Delta BDE} = \frac{\frac{1}{2} \times AD \times EL}{\frac{1}{2} \times BD \times EL} = \frac{AD}{DB} \quad \text{... (ii)}$$

As, ΔBDE and ΔDEC are on same base DE and between same parallel lines DE and BC.
Thus, area of ΔBDE = area of ΔDEC ... (iii)
So, from (i), (ii) and (iii)

$$\frac{AD}{DB} = \frac{AE}{EC}$$ **Hence proved.**

OR

(b) Given: $PQ \parallel BC$
AD is median cutting PQ at E



To prove: $PE = EQ$

Proof: In ΔAPE and ΔABD,

$\angle APE = \angle ABD$ (corresponding $\angle$s are equal)

$\angle PAE = \angle BAD$ (common)

$\therefore$ $\Delta APE \sim \Delta ABD$ (AA similarity)

As in similar triangles, the corresponding sides are proportional.

$\therefore$ $\frac{AE}{ED} = \frac{PE}{BD}$ ...(i)

Similarly, in ΔAEQ is ΔADC

$\angle EAQ = \angle DAC$ (common)

$\angle AQE = \angle ACD$ (corresponding $\angle$s)

$\therefore$ $\Delta AEQ \sim \Delta ADC$ (A-A similarily)

Thus, $\frac{AE}{ED} = \frac{EQ}{DC}$ ... (ii)

From (i) and (ii) we get,

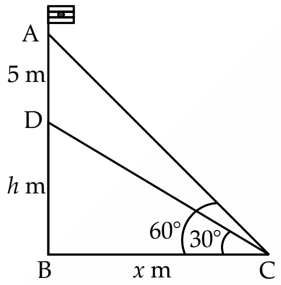
$\frac{PE}{BD} = \frac{EQ}{DC}$

As, $BD = DC$ ($\because$ AD is median to BC)

$\Rightarrow$ $PE = EQ$ **Hence proved.**

35. Given height of flag staff (AD) = 5 cm

$\angle DCB = 30°$ and $\angle ACB = 60°$



Let $DB = h$ metres and $BC = x$ m

Now, in right angled ΔDBC,

$\angle B = 90°$

$\Rightarrow$ $\tan 30° = \frac{BD}{BC} = \frac{h}{x}$

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

$\Rightarrow$ $x = h\sqrt{3}$ ... (i)

In right angled ΔABC, $\angle B = 90°$

$\tan 60° = \frac{AB}{BC} = \frac{5+h}{x}$

$\Rightarrow$ $\sqrt{3} = \frac{5+h}{h\sqrt{3}}$ (from (i))

$\Rightarrow$ $3h - h = 5 \Rightarrow 2h = 5 \Rightarrow h = 2.5$ m

Now, substituting value of 'h' in Eq. (i) we get

$x = 2.5\sqrt{3} = 2.5 \times 1.73$

$= 4.325$ m

Thus, height of the pedestal = 2.5 m and, its distance from the point of observation = 4.325 m.

SECTION – E

36. (i) Plan B, $3C = 10t + 300$

At initial amount time = 0

So, substituting $t = 0$ we get,

$3C = 10 \times 0 + 300$

$\Rightarrow$ $3C = 300$

$\Rightarrow$ $C = 100$

Thus, initial amount we have to pay = ₹ 100.

(ii) Charu spent ₹ 250 to purchase Plan A, equation for Plan A is $3C = 20t$

Substitute value of C = ₹ 250 we get,

$3(250) = 20\,t$

$\Rightarrow$ $750 = 20t$

$\Rightarrow$ $\frac{750}{20} = t$

Thus, time she bought = 37.5 minutes.

(iii) (a) As, both the plans charge the same amount,

So, equate both the equations,

$20t = 10t + 300,$

$\Rightarrow$ $20t - 10t = 300$

$\Rightarrow$ $10t = 300$

$\therefore$ $t = 30$

Thus, both the plans charge the same amount at 30 minutes.

Now, substitute $t = 30$ in either of the equation.

Plan A; $3C = 20t$

$3C = 20 \times 30$

$C = \frac{600}{3}$

$\Rightarrow$ $C = 200$

Thus, amount = ₹ 200

OR

(b) For 60 minutes

Value of Plan A:

$3C = 20 \times 60$

$\Rightarrow$ $C = \frac{1200}{3}$ = ₹ 400

For Plan B:

$3C = 10t + 300$

$\Rightarrow$ $3C = 10 \times 60 + 300$

$\Rightarrow$ $3C = 600 + 300$

$\Rightarrow$ $C = \frac{900}{3}$ = ₹ 300

Thus, Plan A costs ₹ 400 and Plan B costs ₹ 300 for 60 minutes.

Hence, Plan B is better.

37. Given: Radius of ball = $\frac{7}{2}$ = 3.5 cm

Number of balls = 600

Dimensions of cuboid = 42 cm × 91 cm × 50 cm.

(i) Volume of ball $(V) = \frac{4}{3}\pi r^3$

On substituting volume of $r = 3.5$ we get

$V = \frac{4}{3} \times \frac{22}{7} \times (3.5)^3$

$= \frac{4}{3} \times \frac{22}{7} \times \frac{35}{10} \times \frac{35}{10} \times \frac{35}{10}$

$= 179.67 \text{ cm}^3$

(ii) Area of one ball $= 4\pi r^2$

$$= 4 \times \frac{22}{7} \times \frac{35}{10} \times \frac{35}{10}$$

$= 154 \text{ cm}^2$

Area of 10 balls = area of painted surface

$= 154 \times 10$

$= 1540 \text{ cm}^2$

(iii) (a) Volume of empty space in a box = Volume of box – Volume of 600 balls.

Here,

Volume of box $= l \times b \times h$

$= 91 \times 42 \times 50$

$= 191100 \text{ cm}^3$ ...(i)

Volume of 600 balls = 600 × Volume of ball

$= 600 \times 179.67$ [from (i)]

$= 107802 \text{ cm}^3$ ... (ii)

Hence, from (i) and (ii)

Volume of empty space = 191100 – 107802

$= 83{,}298 \text{ cm}^3$

OR

(b) (A) Area covered by one ball in the lowermost layer = circle formed by ball when it touches the surface

So, area covered by one ball $= \pi r^2$

$$= \frac{22}{7} \times \frac{35}{10} \times \frac{35}{10}$$

$= 38.5 \text{ cm}^2$

(B) Dimensions of box base = 42 cm × 91 cm.

Diameter of ball = 7 cm

$\Rightarrow$ Number of balls along with its length 42 cm $= \frac{42}{7}$

Number of balls along with its breath 91 cm $= \frac{91}{7} = 13$

$\Rightarrow$ Total numbers of balls = 6 × 13 = 78

38. As per given information

BH = 40 m, HD = 10 m, DG = 40 m, GF = 38 m

FE = 53 m, and AF = 53.58 m

(i) In right angled ΔBDC, $\angle D = 90°$ and $\angle B = 45°$

$$\Rightarrow \cos 45° = \frac{BD}{BC} = \frac{BH + HD}{BC} = \frac{40 + 10}{BC}$$

$$\Rightarrow \frac{1}{\sqrt{2}} = \frac{50}{BC} \quad \left(\because \cos 45° = \frac{1}{\sqrt{2}}\right)$$

$$\Rightarrow BC = 50\sqrt{2}$$

$= 50 \times 1.41 = 70.50$ m

(ii) In right angled Δ*AGF*, $\angle G = 90°$ and $\angle A = 45°$

$$\therefore \tan 45° = \frac{GF}{AG} \quad (\therefore \tan 45° = 1)$$

$$\Rightarrow 1 = \frac{38°}{AG}$$

$$\Rightarrow AG = 38 \text{ m}$$

(iii) (a) Perimeter of Δ*ABC* = *AG* + *GD* + *DH* + *HB* + *BC* + *AC*.

Now, in right angled Δ*ADC*

$\angle D = 90°$ and $\angle ACD = 60°$

$$\sin 60° = \frac{P}{H} \quad \left(\because \sin 60° = \frac{\sqrt{3}}{2}\right)$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{AD}{AC}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{AG + GD}{AC}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{38 + 40}{AC}$$

[From part (ii), *AG* = 38 m]

$$\Rightarrow AC = 78 \times \frac{2}{\sqrt{3}}$$

$$\Rightarrow AC = \frac{156}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$\Rightarrow AC = \frac{156\sqrt{3}}{3} = 52\sqrt{3}$$

$$\Rightarrow AC = 52 \times 1.73$$

Thus, $AC = 89.96$ m

$\therefore$ Perimeter of Δ*ABC* = 38 + 40 + 10 + 40 + 70 .50 + 89.96 (on substituting values)

$\Rightarrow$ Perimeter of Δ*ABC* = 288.46 m.

OR

(b) In right angled Δ*BHE*, $\angle H = 90°$ and $\angle B = 30°$

$$\cos 30° = \frac{BH}{BE}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{40}{BE}$$

$$\Rightarrow BE = \frac{80}{\sqrt{3}} = \frac{80}{1.73} = 46.24$$

$\therefore$ Length of (*AF* + *FE* + *EB*) = 53.58 + 53 + 46.24

= 152.82 m.

Delhi Set-2 **430/4/2**

SECTION – A

11. Option (C) is correct.

Explanation: The table shown the different cases:

Cases	Outcomes (Pairs)	Count
Both dice show 6	(6, 6)	1
One die shows 6 (first die)	(6, 1), (6, 2), (6, 3), (6, 4), (6, 5)	5
One die shows 6 (second die)	(1, 6), (2, 6), (3, 6), (4, 6), (5, 6)	5

Favourable outcomes = 1 + 5 + 5 = 11

Total outcomes = 36

Probability that at least one die shows six $= \frac{11}{36}$

13. Option (C) is correct.

Explanation: $\tan A = \frac{P}{B} = \frac{1}{2}$

Let $P = x$ units and $B = 2x$ units

Use the Pythagorean theorem,

$$H = \sqrt{P^2 + B^2} = \sqrt{x^2 + (2x)^2}$$

$$= \sqrt{x^2 + 4x^2} = \sqrt{5x^2}$$

$$= x\sqrt{5} \text{ units}$$

$$\sin A = \frac{P}{H} = \frac{x}{x\sqrt{5}} = \frac{1}{\sqrt{5}}$$

16. Option (B) is correct.

Explanation: The zeroes of a polynomial function are the values of x for which $p(x) = 0$. Graphically, these are the points where the graph of $p(x)$ intersects the x-axis.

In this case, the graph of the quadratic equation just touches the x-axis at one point (origin). Hence, the quadratic equation has one distinct real root which means the two roots are equal.

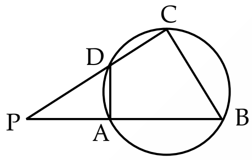
Since there is one distinct zero at $x = 0$.

SECTION – B

21. Given: Two chords BA and CD intersect at point P outside the circle.

To Prove: $\Delta PDA \sim \Delta PBC$

Proof: In ΔPDA and ΔPBC,



$\angle DPA = \angle CPB$ (Common angle)

$\angle PDA = \angle PBC$

(Exterior angle of a cyclic quadrilateral is equal to the opposite interior angle)

$\Rightarrow$ $\Delta PDA \sim \Delta PBC$ (By AA criteria)

23. Let points $A(2, 5)$, $B(-5, -2)$ and $P(-1, m)$ divides AB in the ratio $k : 1$.

Here,

$A(2, 5) \Rightarrow x_1 = 2, y_1 = 5$

$B(-5, -2) \Rightarrow x_2 = -5, y_2 = -2$

$P(-1, m) \Rightarrow x = -1, y = m$ ...(1)

Using section formula:

$$x = \frac{kx_2 + x_1}{k+1} \quad ...(2)$$

$$y = \frac{ky_2 + y_1}{k+1} \quad ...(3)$$

From (1) and (2), we get:

$$-1 = \frac{kx_2 + x_1}{k+1}$$

$\Rightarrow$ $-1(k + 1) = kx_2 + x_1$

$\Rightarrow$ $-k - 1 = k(-5) + (2)$

$\Rightarrow$ $-k - 1 = -5k + 2$

$\Rightarrow$ $4k = 3$

$\Rightarrow$ $k = \frac{3}{4}$

Required ratio $= k : 1 = \frac{3}{4} : 1 = 3 : 4$

From (1) and (3), we get:

$$m = \frac{ky_2 + y_1}{k+1}$$

$$\Rightarrow \quad m = \frac{\left(\frac{3}{4}\right)(-2) + 5}{\frac{3}{4} + 1}$$

$$\Rightarrow \quad m = \frac{\left(\frac{-6}{4}\right) + 5}{\frac{3}{4} + 1}$$

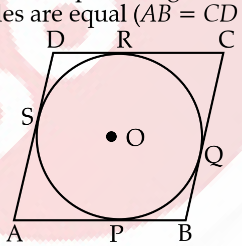
$$\Rightarrow \quad m = \frac{\frac{-6 + 20}{4}}{\frac{3 + 4}{4}}$$

$$\Rightarrow \quad m = \frac{14}{7}$$

$$\Rightarrow \quad m = 2$$

SECTION – C

28. Given: $ABCD$ is a parallelogram which means that opposite sides are equal ($AB = CD$ and $BC = AD$).



To Prove: A parallelogram circumscribing a circle is a rhombus.

Proof: Now, according to the tangent theorem, the lengths of tangents drawn from an external point to a circle are always equal.

Applying this to our parallelogram:

- From point $B : BP = BQ$ … (i)
- From point $C : CR = CQ$ … (ii)
- From point $D : DR = DS$ … (iii)
- From point $A : AP = AS$ … (iv)

Adding all these Eqs. (i), (ii), (iii) and (iv):

$\Rightarrow BP + CR + DR + AP = BQ + CQ + DS + AS$

Rearrange the terms:

$\Rightarrow (BP + AP) + (CR + DR)$

$= (BQ + CQ) + (DS + AS)$

From the figure, we get:

$BP + AP = AB$,

$CR + DR = CD$, $BQ + CQ = BC$

and $DS + AS = AD$

So, substituting these values, we get:

$\Rightarrow$ $AB + CD = BC + AD$

Now, since $ABCD$ is a parallelogram, we already know that $AB = CD$ and $BC = AD$. So, substituting these values:

$\Rightarrow$ $AB + AB = BC + BC$

$\Rightarrow \quad 2AB = 2BC$

$\Rightarrow \quad AB = BC$ ...(v)

$AB = CD$

and $\quad BC = AD$ [Given] ...(vi)

From (v) and (vi), we can conclude that all four sides of the parallelogram are equal:

$$AB = BC = CD = DA$$

Thus, the parallelogram is a rhombus.

31. Step 1: Assume $\sqrt{5}$ is rational number.

Let $\quad \sqrt{5} = \frac{p}{q}$

where p and q are integers with no common factors (other than 1) and $q \neq 0$

$\Rightarrow \quad 5 = \left(\frac{p}{q}\right)^2$ [Square both sides]

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

This equation shows that p^2 is a multiple of 5. So, we can write $p = 5k$ for an integer k.

From number properties, if p^2 is divisible by 5, then p must also be divisible by 5.

Step 2: Substitute $p = 5k$ in the eq. (i)

$5q^2 = (5k)^2$

$\Rightarrow \quad 5q^2 = 25k^2$

$q^2 = 5k^2$

This shows that q^2 is also a multiple of 5 which means q must also be divisible by 5.

Step 3:

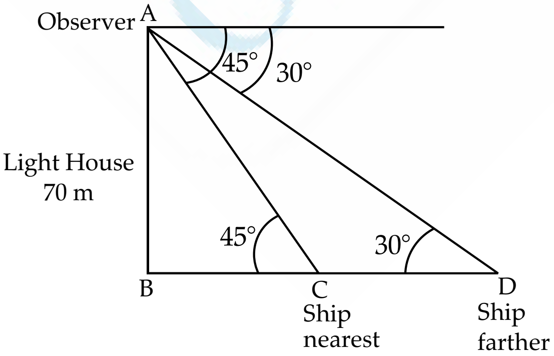
We initially assumed that p and q have no common factors other than 1. But now, we found that both p and q are divisible by 5, which means they have a common factor of 5. This contradicts our assumption that $\frac{p}{q}$ is in simplest form.

Step 4:

Since our assumption led to a contradiction, our assumption must be wrong. Thus, $\sqrt{5}$ cannot be written as a fraction of two integers which means $\sqrt{5}$ is an irrational number.

SECTION – D

33. Distance between the two ships (CD) is shown in the diagram:



In ΔABC (for ship C):

Using trigonometry, $\tan C = \frac{AB}{BC}$

$\Rightarrow \quad \tan 45° = \frac{70}{BC}$

$\Rightarrow \quad 1 = \frac{70}{BC}$

$\therefore \quad BC = 70$ m

In ΔABD (for ship D):

Using trigonometry, $\tan D = \frac{AB}{BD}$

$\Rightarrow \quad \tan 30° = \frac{70}{BD}$

$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{70}{BD}$

$\therefore \quad BD = 70\sqrt{3}$ m

Distance between the two ships $CD = BD - BC$

$= 70\sqrt{3} - 70$

$= 70(\sqrt{3} - 1)$

$= 70(1.73 - 1)$

$= 70 \times 0.73$

$= 51.1$ m

$\therefore$ The distance between the two ships is 51.1 metres.

35. Frequency distribution table is:

Class Interval	Frequency (f)	Cumulative Frequency (cf)
100 – 105	6	6
105 – 110	8 (f_0)	6 + 8 = 14
110 – 115 **(Median class)** (Modal class)	10 (f_1) (Frequency 20 lies) (Highest frequency)	14 + 10 = 24
115 – 120	4 (f_2)	24 + 4 = 28
120 – 125	9	28 + 9 = 37
125 – 130	3	37 + 3 = 40
	$N = 40$	

From the table:

$\Rightarrow$ Median class: Class where $\frac{N}{2} = \frac{40}{2} = 20$

From the cumulative frequency column, 20 lies in the class 110 – 115.

h = Class width = 115 – 110 = 5 (class width)

$\Rightarrow L$ = Lower boundary of modal class = 110

$\Rightarrow cf$ = Cumulative frequency before median class = 14

$\Rightarrow f$ = Frequency of median class = 10

$$\text{Median} = L + \left(\frac{\frac{N}{2} - cf}{f}\right) \times h$$

$$= 110 + \left(\frac{\frac{40}{2} - 14}{10}\right) \times 5$$

$$= 113$$

Modal class: Class with maximum frequency

$= 110 – 115$

$\Rightarrow L$ = Lower boundary of modal class = 110

$\Rightarrow f_1$ = Frequency of modal class = 10

$\Rightarrow f_0$ = Frequency of the class before modal class

= 8 (preceding class frequency)

$\Rightarrow f_2$ = Frequency of the class after modal class

= 4 (succeeding class frequency)

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

$$= 110 + \left(\frac{10 - 8}{2 \times 10 - 8 - 4}\right) \times 5$$

$$= 110 + \left(\frac{2}{8}\right) \times 5$$

$$= 110 + 1.25$$

$$= 111.25$$

Delhi Set-3 **430/4/3**

SECTION – A

4. Option (B) is correct.

Explanation: Given that,

α and β are zeroes of polynomial $3x^2 + 14x - 5$,

$$\text{Sum of zeroes} = \alpha + \beta = -\frac{14}{3}$$

$$\text{Product of zeroes} = \alpha\beta = -\frac{5}{3}$$

$$\text{Value of } 3\left(\frac{\alpha+\beta}{\alpha\beta}\right) = 3\left(\frac{\frac{-14}{3}}{\frac{-5}{3}}\right)$$

$$= 3\left(\frac{14}{5}\right) = \frac{42}{5}$$

6. Option (C) is correct.

Explanation: Given that,

LCM of two numbers = 3600

Since HCF is a factor of LCM of any two numbers.

So, {600, 400, 150} are factors of 3600 but 500 is not a factor of 3600.

Hence, 500 cannot be their HCF.

15. Option (B) is correct.

Explanation: For given A.P.,

$$a_n - a_{n-4} = 32$$

$\Rightarrow [a + (n-1)d] - [a + (n-4-1)d] = 32$

$\Rightarrow a + nd - d - a - nd + 5d = 32$

$\Rightarrow \quad 4d = 32$

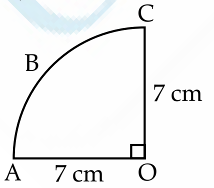
$\Rightarrow \quad d = 8$

Common difference of given A.P. is 8.

16. Option (D) is correct.

Explanation: Given that,

Radius of circle, $r = 7$ cm



$$\text{Perimeter of quadrant of circle} = 2r + \pi\frac{r}{2}$$

$$= 2 \times 7 + \frac{22}{7} \times 7 \times \frac{1}{2} = 25 \text{ cm}$$

SECTION – B

22. We know that,

Any point on the x-axis is of the form $(x, 0)$

Let the segment joining the points (2, –5) and (5, 3) is divided by x-axis in the ratio $k : 1$

Using the section formula for y-coordinate,

$$0 = \frac{k(3) + 1(-5)}{k+1}$$

$$3k - 5 = 0$$

$$k = \frac{5}{3}$$

So, the required ratio is 5 : 3.

Using the section formula for finding x-coordinate,

$$x = \frac{k(5) + 1(2)}{k+1}$$

$$x = \frac{\frac{5}{3} \times 5 + 2}{\frac{5}{3} + 1} \quad \left(\text{Putting } k = \frac{5}{3}\right)$$

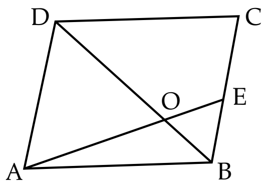
$$x = \frac{\frac{31}{3}}{\frac{8}{3}} = \frac{31}{8}$$

Coordinates of point on x-axis are $\left(\frac{31}{8}, 0\right)$.

24. Given that,

Diagonal BD of parallelogram $ABCD$ is divided by segment AE in ratio 1 : 2

So, $\quad \dfrac{BO}{OD} = \dfrac{1}{2}$



To find: Length of AD

$BE = 1.8$ cm (given)

In ΔAOD & ΔBOE,

$\angle OBE = \angle ODA$ (alternate angles)

$\angle AOD = \angle BOE$ (vertically opposite angles)

By AA similarity criterion,

$$\Delta AOD \sim \Delta BOE$$

As ratio of corresponding sides of similar triangles are equal, so

$$\frac{BE}{AD} = \frac{BO}{DO}$$

$$\frac{1.8}{AD} = \frac{1}{2}$$

$$AD = 3.6 \text{ cm}$$

SECTION – C

28. Given polynomial,

$$p(x) = 9x^2 - 6x - 35$$
$$= 9x^2 - 21x + 15x - 35$$
$$= 3x(3x - 7) + 5(3x - 7)$$
$$= (3x + 5)(3x - 7)$$

$\Rightarrow \quad 3x + 5 = 0$ and $3x - 7 = 0$

$\Rightarrow \quad x = -\frac{5}{3}$ and $x = \frac{7}{3}$

Zeroes of polynomial, $p(x)$ are $-\frac{5}{3}$ and $\frac{7}{3}$.

On comparing $p(x)$ with $ax^2 + bx + c$

We get the coefficients as:

$$a = 9, b = -6 \text{ and } c = -35$$

Using the zeroes of polynomial,

$$\text{Sum of zeroes} = -\frac{5}{3} + \frac{7}{3} = \frac{2}{3}$$

$$\text{Product of zeroes} = \left(-\frac{5}{3}\right) \times \left(\frac{7}{3}\right) = -\frac{35}{9}$$

Also, using coefficients

$$\text{Sum of zeroes} = -\frac{b}{a} = -\left(-\frac{6}{9}\right) = \frac{2}{3}$$

$$\text{Product of zeroes} = \frac{c}{a} = -\frac{35}{9}$$

Since, the sum and product of zeroes are same using zeroes and coefficients.

Hence, the relationship between zeroes and its coefficients is verified.

29. **To prove:** $\sqrt{2}$ is an irrational number.

Proof:

Let us assume that $\sqrt{2}$ is rational number.

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

where p and q are co-prime integers and $q \neq 0$

On squaring both sides, we get

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

$\Rightarrow \quad p^2 = 2q^2 \quad$ ...(i)

Since 2 divides p^2, so, 2 divides p

Also, let $\quad p = 2m$ for some integer m

Putting $\quad p = 2m$ in (i),

$\Rightarrow \quad (2m)^2 = 2q^2$

$\Rightarrow \quad 4m^2 = 2q^2$

$\Rightarrow \quad q^2 = 2m^2$

Since 2 divides q^2, so, 2 divides q

Thus, 2 is a common factor of p and q. But this contradicts the fact that p and q have no common factor other than 1.

This contradiction arises by wrong assumption of $\sqrt{2}$ being rational.

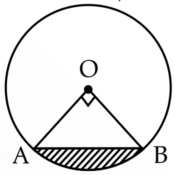
Therefore, $\sqrt{2}$ is an irrational number.

Hence proved.

31. Given that,

Radius of circle, $\quad r = 14$ cm

Angle subtended at centre, $\angle AOB = \theta = 90°$



To find: Perimeter of shaded region

ΔAOB is right-angled triangle

Applying Pythagoras theorem,

$$AB^2 = OA^2 + OB^2$$
$$AB^2 = (14)^2 + (14)^2$$
$$AB^2 = 196 + 196$$
$$AB^2 = 392$$
$$AB = \sqrt{392} = 14\sqrt{2}$$
$$= 14 \times 1.41 = 19.74 \text{ cm}$$

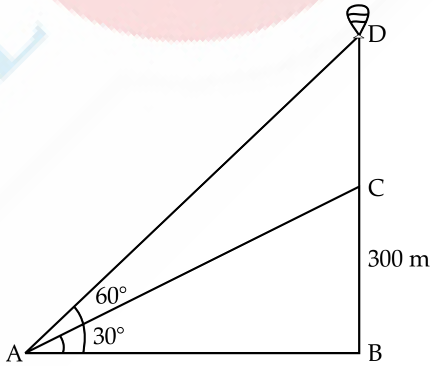
$$\text{Length of arc } AB = \frac{2\pi r\theta}{360°} = 2 \times \frac{22}{7} \times 14 \times \frac{90°}{360°}$$
$$= 22$$

Perimeter of shaded region = AB + Length of arc AB

$$= 22 + 19.74$$
$$= 41.74 \text{ cm}$$

SECTION – D

32.



Let the tower be represented by BC of height 300 m

BD be the height of hot air balloon from ground AB be the distance of base of tower from observation point.

To Find: Height of balloon from ground and distance of tower from point of observation

In ΔABC,

$$\tan 30° = \frac{BC}{AB}$$

$$\frac{1}{\sqrt{3}} = \frac{300}{AB}$$

$$AB = 300 \times 1.73 = 519 \text{ m}$$

Distance of tower from point of observation = 519 m

Now,

In ΔABD,

$$\tan 60° = \frac{BD}{AB}$$

$$\sqrt{3} = \frac{BD}{519}$$

$$519\sqrt{3} = BD$$

$$BD = 519 \times 1.73 = 897.87 \text{ m}$$

Height of balloon from ground = 897.87 m

35. From the given data:

Class	Class Mark (x_i)	Frequency (f_i)	f_ix_i
20–25	22.5	9	202.5
25–30	27.5	8	220
30–35	32.5	11	357.5
35–40	37.5	13	487.5
40–45	42.5	4	170
45–50	47.5	5	237.5
		$\Sigma f_i = 50$	$\Sigma f_ix_i = 1675$

To find: Mean and Mode

We know that,

$$\text{Mean} = \frac{\Sigma f_ix_i}{\Sigma f_i} = \frac{1675}{50} = 33.5$$

Also,

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

Class having highest frequency (Modal Class) is 35 – 40

Lower limit of modal class, $l = 35$

$\Rightarrow$ $f_1 = 13, f_0 = 11, f_2 = 4$

Class size, $h = 5$

Putting the values in the formula, we get:

$$\text{Mode} = 35 + \frac{13 - 11}{2(13) - 11 - 4} \times 5$$

$$= 35 + \frac{2}{11} \times 5 = 35 + \frac{10}{11}$$

$$= 35 + 0.91 = 35.91$$

Hence, for given data mean is 33.5 and mode is 35.91.

Outside Delhi Set-1 430/6/1

SECTION – A

1. Option (A) is correct.

Explanation: We know that number of zeroes of plynomial = Number of times graph touches x-axis

$\Rightarrow$ Zeroes of polynomial = 3

2. Option (C) is correct.

Explanation: Given A.P. is: $\frac{3}{2}, \frac{1}{2}, \frac{-1}{2}, \frac{-3}{2}, \ldots$

Here, $a = \frac{3}{2}$

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

We know that, $a_n = a + (n-1)d$

$\Rightarrow$ $a_{22} = \frac{3}{2} + 21 \times -1$

$\Rightarrow$ $a_{22} = \frac{3}{2} - 21$

$\Rightarrow$ $a_{22} = \frac{-39}{2}$

3. Option (D) is correct.

Explanation: A line representing linear equation in two variables intersects x-axis at $y = 0$

For, $2x - 3y = 6$

At $y = 0$

$2x - 3(0) = 6$

$\Rightarrow$ $2x - 0 = 6$

$\Rightarrow$ $2x = 6$

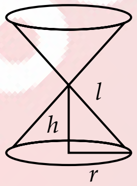
$\Rightarrow$ $x = 3$

Therefore, the coordinates are (3, 0).

4. Option (B) is correct.

Explanation: Given, Radius (r) = 4 cm

Slant height (l) = 6 cm



We know that, $l^2 = h^2 + r^2$

$\Rightarrow$ $(6)^2 = h^2 + (4)^2$

$\Rightarrow$ $36 = h^2 + 16$

$\Rightarrow$ $20 = h^2$

$\Rightarrow$ $h = 2\sqrt{5}$

Now, height of solid = height of two cones

$= 2 \times 2\sqrt{5} = 4\sqrt{5}$ cm

5. Option (A) is correct.

Explanation: Given equations are:

$3x - 7y = 1$ or, $3x - 7y - 1 = 0$

And $kx + 14y = 6$ or, $kx + 14y - 6 = 0$

For a pair of linear equations in two variables to be inconsistent,

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

$\Rightarrow$ $\frac{3}{k} = \frac{-7}{14} \neq \frac{-1}{-6}$

$\Rightarrow$ $-7k = 42$

$\Rightarrow$ $k = -6$

6. Option (C) is correct.

Explanation: When two dice are rolled together, the outcomes are:

(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6)
(2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6)
(3, 1), (3, 2), (3, 3), (3, 4), (3, 5), (3, 6)
(4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6)
(5, 1), (5, 2), (5, 3), (5, 4), (5, 5), (5, 6)

(6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6) = 36 outcomes
The favourable outcomes that give sum more than 9 are: (5, 5), (5, 6), (6, 5), (6, 4), (4, 6) and (6, 6) = 6 outcomes

$\Rightarrow P(\text{getting sum more than 9}) = \frac{6}{36} = \frac{1}{6}$

7. Option (D) is correct.

Explanation: Points taken in order are A (2, –2), B (8, 4), C (4, 8) and D (–2, 2)
Since, $ABCD$ is a rectangle, AC and BD are diagonals and are equal in length.
Using distance formula,

$$AC = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$\Rightarrow AC = \sqrt{(4-2)^2 + (8-(-2))^2}$$
$$\Rightarrow AC = \sqrt{(2)^2 + (10)^2}$$
$$\Rightarrow AC = \sqrt{104}$$
$$\Rightarrow AC = 2\sqrt{26}$$

8. Option (B) is correct.

Explanation: Here, $\angle OAP = 90°$ (radius is perpendicular to the tangent at the point of contact)

$$\Rightarrow \sin 30° = \frac{OA}{OP}$$
$$\Rightarrow \frac{1}{2} = \frac{2.5}{OP}$$
$$\Rightarrow OP = 5 \text{ cm}$$

9. Option (A) is correct.

Explanation: $P(E) + P(\bar{E}) = 1$

$$P(E) = 57\% = 0.57$$
$$\Rightarrow 0.57 + P(\bar{E}) = 1$$
$$\Rightarrow P(\bar{E}) = 1 - 0.57$$
$$\Rightarrow P(\bar{E}) = 0.43$$

10. Option (C) is correct.

Explanation: Length of arc $= \frac{\theta}{360°} \times 2\pi r$

$$\Rightarrow \frac{\theta}{360°} \times 2 \times \frac{22}{7} \times 7 = \frac{22}{3}$$
$$\Rightarrow \theta = \frac{180°}{3} = 60°$$

11. Option (B) is correct.

Explanation: Since $DE \parallel BC$

$$\Rightarrow \frac{AD}{DB} = \frac{AE}{EC}$$
$$\Rightarrow \frac{x+1}{3} = \frac{2x+1}{4}$$
$$\Rightarrow 4(x+1) = 3(2x+1)$$
$$\Rightarrow 4x + 4 = 6x + 3$$
$$\Rightarrow 2x = 1$$
$$\Rightarrow x = \frac{1}{2}$$

12. Option (D) is correct.

Explanation: The outcomes when three coins are tossed, are: HHH, HHT, HTH, THH, TTT, TTH, THT, HTT
$\Rightarrow$ Number of favourable outcomes = Outcomes with exactly one head = 3

$\Rightarrow P(\text{exactly one head}) = \frac{3}{8}$

13. Option (A) is correct.

Explanation: Here, OC is perpendicular to AB
$\Rightarrow AC = BC$ (perpendicular from centre bisects the chord)
In ΔOCA,

$$OC^2 + AC^2 = OA^2$$
$$\Rightarrow (2.1)^2 + AC^2 = (3.5)^2$$
$$\Rightarrow 4.41 + AC^2 = 12.25$$
$$\Rightarrow AC^2 = 7.84$$
$$\Rightarrow AC = 2.8$$

Now, $AB = 2 \times AC = 2 \times 2.8 = 5.6$ cm

14. Option (D) is correct.

Explanation: Given, $\sqrt{3} \sin\theta = \cos\theta$

$$\Rightarrow \tan\theta = \frac{1}{\sqrt{3}}$$
$$\Rightarrow \tan\theta = \tan 30°$$
$$\Rightarrow \theta = 30°$$

15. Option (A) is correct.

Explanation: The formula for mean, using the assumed mean method is $\bar{x} = A + \frac{\sum fd}{\sum f}$

$$\Rightarrow \bar{x} = A + \bar{d}$$

16. Option (A) is correct.

Explanation: $S_n = \frac{n}{2}(3n+1)$

Taking $n = 1$

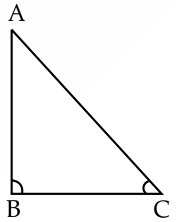
$$\Rightarrow S_1 = \frac{1}{2}(3 \times 1 + 1)$$
$$\Rightarrow S_1 = 2 = a_1$$

Therefore, the first term of A.P. is 2.

17. Option (C) is correct.

Explanation: Here, $\frac{AB}{AC} = \frac{1}{2}$

$$\Rightarrow \sin C = \frac{1}{2}$$



$$\Rightarrow \sin C = \sin 30°$$
$$\Rightarrow \angle C = 30°$$
$$\Rightarrow \cos C = \cos 30°$$
$$\Rightarrow \cos C = \frac{\sqrt{3}}{2}$$

18. Option (D) is correct.

Explanation: Volume of empty space = volume of cylinder – volume of cone

$$\Rightarrow \text{Volume of empty space} = \pi r^2 h - \frac{1}{3}\pi r^2 h$$
$$\Rightarrow \text{Volume of empty space} = \frac{2}{3}\pi r^2 h$$
$$\Rightarrow \text{Volume of empty space} = \frac{2}{3} \times 450$$
$$= 2 \times 150 = 300 \text{ cm}^3$$

19. Option (C) is correct.

***Explanation*:** Assertion: $(a+\sqrt{b})(a-\sqrt{b}) = a^2 - b$ is rational number. Thus, assertion is true.

Reason: The product of two irrational numbers can be either rational or irrational, depending on the specific numbers. Thus the reason statement is false.

20. Option (A) is correct.

***Explanation*:** Since $\Delta ABC \sim \Delta PQR$

$\Rightarrow \quad \angle A = \angle P$

$\Rightarrow \quad \angle B = \angle Q$

$\Rightarrow \quad \angle C = \angle R$

So, $\angle A + \angle B + \angle C = 180°$

(Angle sum property of triangle)

$\Rightarrow \quad 65° + \angle B + 60° = 180°$

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

$\Rightarrow \quad \angle B = 180° - 125°$

$\Rightarrow \quad \angle B = 55° = \angle Q$

Thus, assertion is true.

Reason: Sum of all angles of a triangle is always 180°. Thus, reason is also true and is the correct explanation of assertion. By using this angle sum property only, we have proved that $\angle B = \angle Q = 55°$

SECTION – B

21. (a) Given equation is: $4x^2 - 9x + 3 = 0$

Here, $a = 4$, $b = -9$ and $c = 3$

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

$$\Rightarrow \quad x = \frac{-(-9) \pm \sqrt{(-9)^2 - 4\times4\times3}}{2\times4}$$

$$\Rightarrow \quad x = \frac{9 \pm \sqrt{81-48}}{2\times4}$$

$$\Rightarrow \quad x = \frac{9+\sqrt{33}}{8} \text{ or } x = \frac{9-\sqrt{33}}{8}$$

OR

(b) Given, $3x^2 - 4\sqrt{3}x + 4 = 0$

Here, $a = 3$, $b = -4\sqrt{3}$ and $c = 4$

Since, $\quad D = b^2 - 4ac$

$\Rightarrow \quad D = (4\sqrt{3})^2 - 4\times3\times4$

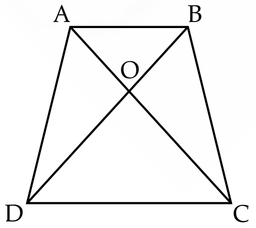
$\Rightarrow \quad D = 16 \times 3 - 48$

$\Rightarrow \quad D = 48 - 48$

Here, $D = 0$, thus the equation has real and equal roots.

22. Given: $AB \parallel DC$

To prove: $\dfrac{OA}{OC} = \dfrac{OB}{OD}$



Proof: In $\Delta OAB \sim \Delta OCD$,

Since, $AB \parallel DC$ (given)

$\Rightarrow \quad \angle OAB = \angle OCD$ (alternate interior angle)

And, $\angle OBA = \angle ODC$ (alternate interior angle)

By AA similarity criterion, $\Delta OAB \sim \Delta OCD$.

By CPCT, $\dfrac{OA}{OC} = \dfrac{OB}{OD}$ **Hence proved**

23. Total number of discs = 120

$$P(E) = \frac{\text{Number of favourable outcomes}}{\text{Number of total outcomes}}$$

(i) Number of discs bearing a two-digit number = 90 (from 10 to 99)

$\Rightarrow P(\text{bears a 2-digit number}) = \dfrac{90}{120} = \dfrac{3}{4}$

(ii) Number of discs bearing a perfect square = 10 (1, 4, 9, 16, 25, 36, 49, 64, 81, 100)

$\Rightarrow P(\text{bears perfect square}) = \dfrac{10}{120} = \dfrac{1}{12}$

24. (a) $\dfrac{\cos 45°}{\tan 30° + \sin 60°}$

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

$$= \frac{2\sqrt{3}}{5\sqrt{2}} = \frac{\sqrt{6}}{5}$$

OR

(b) To verify, $\sin 2A = \dfrac{2\tan A}{1+\tan^2 A}$, for $A = 30°$

Solving LHS $= \sin 2A = \sin 2 \times 30°$

$= \sin 60°$

$= \dfrac{\sqrt{3}}{2}$

Solving RHS

$$\frac{2\tan A}{1+\tan^2 A} = \frac{2\tan 30°}{1+\tan^2 30°} = \frac{2\times\frac{1}{\sqrt{3}}}{1+\left(\frac{1}{\sqrt{3}}\right)^2}$$

$$= \frac{\frac{2}{\sqrt{3}}}{1+\frac{1}{3}} = \frac{2\times3}{\sqrt{3}\times4}$$

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

Therefore, LHS = RHS **Hence verified**

25. By prime factorisaton:

$180 = 2^2 \times 3^2 \times 5^1$

$140 = 2^2 \times 5^1 \times 7^1$

$210 = 2^1 \times 3^1 \times 5^1 \times 7^1$

$\Rightarrow$ HCF (180, 140, 210) $= 2^1 \times 5^1 = 10$

SECTION – C

26. (a) $p(x) = 8x^2 - 5x - 1$

$\Rightarrow$ Sum of zeroes $= \alpha + \beta = \dfrac{-b}{a} = \dfrac{-(-5)}{8} = \dfrac{5}{8}$

And product of zeroes $= \alpha\beta = \dfrac{c}{a} = \dfrac{(-1)}{8} = \dfrac{-1}{8}$

Now, $p(x) = k\{x^2 - (\text{sum of zeroes})x + (\text{product of zeroes})\}$, where k is any real number

$$\Rightarrow \quad p(x) = k\left\{x^2 - \left(\frac{2}{\alpha} + \frac{2}{\beta}\right)x + \left(\frac{2}{\alpha} \times \frac{2}{\beta}\right)\right\}$$

$$\Rightarrow \quad p(x) = k\left\{x^2 - \left(\frac{2\beta + 2\alpha}{\alpha\beta}\right)x + \frac{4}{\alpha\beta}\right\}$$

$$\Rightarrow \quad p(x) = k\left\{x^2 - \left(\frac{2(\beta + \alpha)}{\alpha\beta}\right)x + \frac{4}{\alpha\beta}\right\}$$

$$\Rightarrow \quad p(x) = k\left\{x^2 - \left(\frac{2 \times \frac{5}{8}}{\frac{-1}{8}}\right)x + \frac{4}{\left(\frac{-1}{8}\right)}\right\}$$

$$\Rightarrow \quad p(x) = k\left\{x^2 - \left(\frac{-10}{(1)}\right)x + \frac{-32}{(1)}\right\}$$

$$\Rightarrow \quad p(x) = k\{x^2 + 10x - 32\}$$

Let $k = 1$

Thus, $p(x) = x^2 + 10x - 32$ is the required polynomial.

OR

(b) $p(x) = 3x^2 + x - 10$

$\Rightarrow \quad p(x) = 3x^2 + 6x - 5x - 10$

$\Rightarrow \quad p(x) = 3x(x + 2) - 5(x + 2)$

$\Rightarrow \quad p(x) = (3x - 5)(x + 2)$

$\Rightarrow \quad 3x - 5 = 0$ or $x + 2 = 0$

$\Rightarrow \quad x = \dfrac{5}{3}$ or $x = -2$

$\Rightarrow \quad \alpha = \dfrac{5}{3}$ and $\beta = -2$

Now, sum of zeroes $= \alpha + \beta = \dfrac{5}{3} + (-2)$

$= \dfrac{5}{3} - 2 = \dfrac{-1}{3}$

Also, $\dfrac{-(\text{coeffficient of } x)}{\text{coefficient of } x^2} = \dfrac{-b}{a} = \dfrac{-1}{3}$

So, $\dfrac{-b}{a} = \alpha + \beta$

Now, product of zeroes $= \alpha\beta = \dfrac{5}{3} \times -2 = \dfrac{-10}{3}$

Also, $\dfrac{\text{constant term}}{\text{coefficient of } x^2} = \dfrac{c}{a} = \dfrac{-10}{3}$

So, $\dfrac{c}{a} = \alpha\beta$ **Hence verified.**

27. Perimeter of park = 100 m

$\Rightarrow$ 2(length + breadth) = 100

Let length of rectangular park be x m

$\Rightarrow$ Breadth of park $= (50 - x)$ m

According to question,

$$x \times (50 - x) = 600$$

$$\Rightarrow \quad 50x - x^2 = 600$$

$$\Rightarrow \quad x^2 - 50x + 600 = 0$$

$$\Rightarrow \quad x^2 - 30x - 20x + 600 = 0$$

$$\Rightarrow \quad x(x - 30) - 20(x - 30) = 0$$

$$\Rightarrow \quad (x - 30)(x - 20) = 0$$

$$\Rightarrow \quad x = 30, 20$$

Therefore, when length of rectangle = 30 m, then breadth = 20 m and when , length of rectangle = 20 m, then breadth = 30 m.

28. Least length that can be measured using any of the rods an exact number of times = LCM (120, 100, 150)

$\Rightarrow \quad 120 = 2^3 \times 3^1 \times 5^1$

$100 = 2^2 \times 5^2$

$150 = 2^1 \times 3^1 \times 5^2$

$\Rightarrow$LCM (120, 100, 150) $= 2^3 \times 5^2 \times 3^1 = 600$

Thus, the least length that can be measured using any of the rods an exact number of times is 600 cm.

Now, number of times each rod will be used:

For 120 cm, $n = \dfrac{600}{120} = 5$

For 100 cm, $n = \dfrac{600}{100} = 6$

For 150 cm, $n = \dfrac{600}{150} = 4$

29. Area of shaded region = area of 2 sectors

$= 2 \times \dfrac{\theta}{360°}\pi r^2$

$\Rightarrow \quad \text{Area} = 2 \times \dfrac{30°}{360°} \times \dfrac{22}{7} \times 7 \times 7$

$\Rightarrow \quad \text{Area} = \dfrac{1}{3} \times 11 \times 7$

$\Rightarrow \quad \text{Area} = \dfrac{77}{3}\ \text{cm}^2 = 25.67\ \text{cm}^2$

Now, perimeter of shaded region = Length of two arcs + Length of 2 diameters

$\Rightarrow \quad \text{Perimeter} = \left(2 \times \dfrac{\theta}{360°} 2\pi r\right) + (2 \times 2r)$

$\Rightarrow \quad \text{Perimeter} = \left(2 \times \dfrac{30°}{360°} \times 2 \times \dfrac{22}{7} \times 7\right) + (4 \times 7)$

$\Rightarrow \quad \text{Perimeter} = \left(\dfrac{1}{3} \times 22\right) + (28)$

$\Rightarrow \quad \text{Perimeter} = \dfrac{22}{3} + 28$

$\Rightarrow \quad \text{Perimeter} = \dfrac{22 + 84}{3}$

$\Rightarrow \quad \text{Perimeter} = \dfrac{106}{3}\ \text{cm} = 35.33\ \text{cm}$

30. To pove: $\dfrac{\tan\theta}{1-\cot\theta}+\dfrac{\cot\theta}{1-\tan\theta}$ = sec θ cosec θ + 1

Solving LHS,

$$=\frac{\frac{\sin\theta}{\cos\theta}}{1-\left(\frac{\cos\theta}{\sin\theta}\right)}+\frac{\left(\frac{\cos\theta}{\sin\theta}\right)}{1-\left(\frac{\sin\theta}{\cos\theta}\right)}$$

$$=\frac{\frac{\sin\theta}{\cos\theta}}{\left(\frac{\sin\theta-\cos\theta}{\sin\theta}\right)}+\frac{\left(\frac{\cos\theta}{\sin\theta}\right)}{\left(\frac{\cos\theta-\sin\theta}{\cos\theta}\right)}$$

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

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

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

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

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

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

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

Putting a = sin θ, b = cos θ

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

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

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

As $\cos^2 A + \sin^2 A = 1$

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

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

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

= sec θ × cosec θ + 1

= 1+ sec θ cosec θ

= RHS **Hence proved**

31. **(a)** Given that $a_3 = 16$ and $a_7 = a_5 + 12$

We know that, $a_n = a + (n-1)d$

$\Rightarrow$ $a + 2d = 16$ … (i)

and $a + 6d = a + 4d + 12$

$\Rightarrow$ $2d = 12$

$\Rightarrow$ $d = 6$

Putting this value of 'd' in (i)

$\Rightarrow$ $a + 12 = 16$

$\Rightarrow$ $a = 4$

Therefore, the A.P. is 4, 10, 16, ……

Now,

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

$$\Rightarrow S_n = \frac{29}{2}(2\times4+(29-1)6)$$

$$\Rightarrow S_n = \frac{29}{2}(8+28\times6)$$

$$\Rightarrow S_n = \frac{29}{2}(176)$$

$\Rightarrow$ $S_n = 29 \times 88$

$\Rightarrow$ $S_n = 2552$

OR

(b) Here, $a_n = 5 + 2n$

So, $a_1 = 5 + 2(1) = 5 + 2 = 7$

and $a_{20} = 5 + 2(20) = 5 + 40 = 45$

$$S_n = \frac{n}{2}(a+l)$$

$$\Rightarrow S_n = \frac{20}{2}(7+45)$$

$\Rightarrow$ $S_n = 10 \times 52$

$\Rightarrow$ $S_n = 520$

Now, let us check whether 52 is a term of this A.P. or not.

So, $a_1 = 7$

$a_2 = 5 + 2(2) = 5 + 4 = 9$

$\Rightarrow$ $d = 9 - 7 = 2$

So, $a_n = a + (n-1)d$

$\Rightarrow$ $52 = 7 + (n-1)2$

$\Rightarrow$ $45 = (n-1)2$

$$\Rightarrow \frac{45}{2} = n-1$$

$$\Rightarrow \frac{45}{2}+1 = n$$

$$\Rightarrow n = \frac{47}{2}$$

Since, n is not an integer, it proves that 52 is not a term of this A.P.

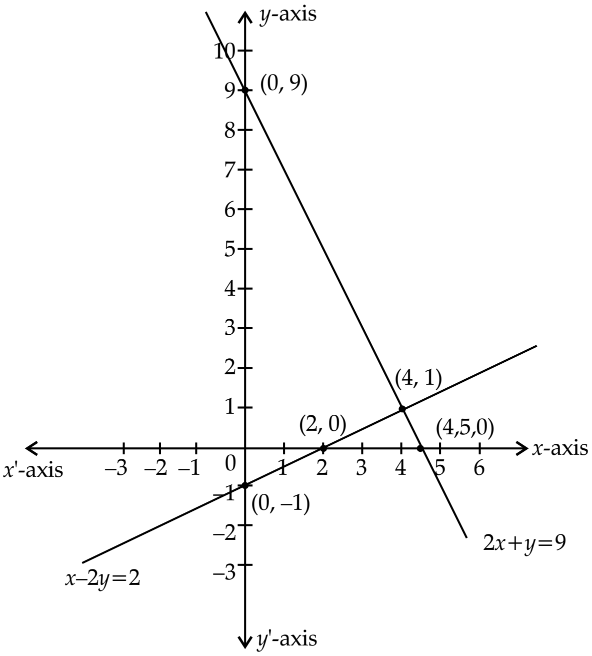
SECTION – D

32. **(a)** $2x + y = 9$

x	4.5	0	1
y	0	9	7

$x - 2y = 2$

x	2	0	4
y	0	–1	1



Therefore, the solution is (4, 1)

OR

(b) Case 1:

Interest earned on ₹ $x = \frac{6x}{100}$

Interest earned on ₹ $y = \frac{5y}{100}$

According to question: $\frac{6x}{100} + \frac{5y}{100} = 1200$

$\Rightarrow \quad 6x + 5y = 120000$ ...(i)

Case 2:

Interest earned on ₹ $x = \frac{3x}{100}$

Interest earned on ₹ $y = \frac{8y}{100}$

According to question: $\frac{3x}{100} + \frac{8y}{100} = 1260$

$\Rightarrow \quad 3x + 8y = 126000$ ...(ii)

Multtiplying (ii) by 2

$\Rightarrow \quad 6x + 16y = 252000$ ...(iii)

Subtracting (i) from (iii)

$16y - 5y = 132000$

$\Rightarrow \quad 11y = 132000$

$\Rightarrow \quad y = 12000$

Putting this value of y in (i)

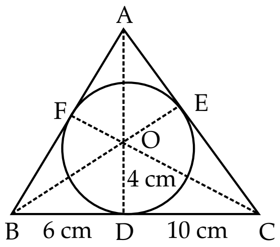
$6x + 60000 = 120000$

$\Rightarrow \quad 6x = 60000$

$\Rightarrow \quad x = 10000$

So, x = ₹ 10000 and y = ₹ 12,000

33. (a) Here, $BD = BF = 6$ cm (tangents from a common point are equal)



and $CD = CE = 10$ cm (tangents from a common point are equal)

Let $AF = AE = x$ cm (tangents from a common point are equal)

Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$

Here, $a(BC) = 16$ cm,

$b(AC) = (10 + x)$ cm,

$c(AB) = (6 + x)$ cm

$\Rightarrow \quad s = \frac{16+(10+x)+(6+x)}{2}$

$\Rightarrow \quad s = \frac{32+2x}{2}$

$\Rightarrow \quad s = 16 + x$

Now, area $= \sqrt{(16+x)(16+x-16)(16+x-10-x)(16+x-6-x)}$

$\Rightarrow \quad \text{Area} = \sqrt{(16+x)(x)(6)(10)}$

$\Rightarrow \quad \text{Area} = \sqrt{(16+x)60x}$

$\Rightarrow \quad \text{Area} = \sqrt{60x^2+960x}$ ...(i)

Now, area of $\Delta OBC = \frac{1}{2} \times BC \times OD$

$= \frac{1}{2} \times 16 \times 4 = 32 \text{ cm}^2$

Area of $\Delta OAC = \frac{1}{2} \times AC \times OE$

$= \frac{1}{2} \times (10 + x) \times 4$

$= 2(10 + x) \text{ cm}^2$

Area of $\Delta OAB = \frac{1}{2} \times AB \times OF$

$= \frac{1}{2} \times (6 + x) \times 4$

$= 2(6 + x) \text{ cm}^2$

Area of $\Delta ABC = 32 + 20 + 2x + 12 + 2x$

$= 64 + 4x$ ... (ii)

From (i) and (ii)

$\sqrt{60x^2+960x} = 64 + 4x$

$\Rightarrow \quad 60x^2 + 960x = (64 + 4x)^2$

$\Rightarrow \quad 60x^2 + 960x = 4096 + 16x^2 + 512x$

$\Rightarrow \quad 44x^2 + 448x - 4096 = 0$

$\Rightarrow \quad 11x^2 + 112x - 1024 = 0$

$\Rightarrow \quad 11x^2 + 176x - 64x - 1024 = 0$

$\Rightarrow \quad 11x(x + 16) - 64(x + 16) = 0$

$\Rightarrow \quad (x + 16)(11x - 64) = 0$

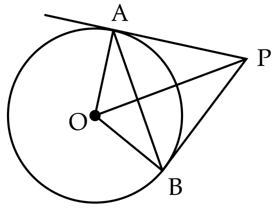
$\Rightarrow \quad x = -16, \frac{64}{11}$

$x = -16$ can't be used as length cannot be negative so, $x = \frac{64}{11}$

Thus, $AE = \frac{64}{11}$ cm

OR

(b)



(i) Here, $\angle AOB = 120°$

Now, $\angle OAP = 90° = \angle OBP$

(radius is perpendicular at the point of contact)

So, $\angle OAP + \angle APB + \angle OBP + \angle AOB = 360°$

(Angle sum property of quadrilateral)

$\Rightarrow 90° + \angle APB + 90° + 120° = 360°$

$\Rightarrow \angle APB = 360° - 300°$

$\Rightarrow \angle APB = 60°$

Now, in ΔOAP and ΔOBP

$OA = OB$ (radius)

$AP = BP$

(tangents from a common point are equal)

$OP = OP$ (common)

By SSS, $\Delta OAP \simeq \Delta OBP$

By CPCT, $\angle OPA = \angle OPB = \frac{60°}{2} = 30°$

(ii) Now, in ΔOAP

$\sin 30° = \frac{OA}{OP}$

$\Rightarrow \frac{1}{2} = \frac{10}{OP}$

$\Rightarrow OP = 20$ cm

Also, $\tan 30° = \frac{OA}{AP}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{10}{AP}$

$\Rightarrow AP = 10\sqrt{3}$ cm

So, perimeter of $\Delta OAP = OA + OP + AP$

Perimeter $= 10 + 20 + 10\sqrt{3}$

Perimeter $= 30 + 10\sqrt{3}$

Perimeter $= 10(3+\sqrt{3})$ cm

(iii) Here, $PA = PB$

(tangents from a common point are equal)

$\Rightarrow \angle PAB = \angle PBA$

(angles opposite to equal sides of a triangle are equal)

$\Rightarrow \angle PAB + \angle PBA + \angle APB = 180°$

$\Rightarrow 2\angle PAB + 60° = 180°$

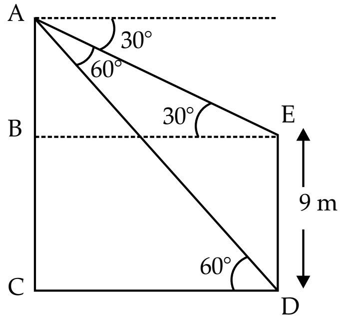
$\Rightarrow 2\angle PAB = 120°$

$\Rightarrow \angle PAB = 60° = \angle PBA$

Thus, ΔAPB is an equilateral triangle

$\Rightarrow AB = AP = 10\sqrt{3}$

34. Here, let $AB = h$



So, in ΔABE

$\tan 30° = \frac{AB}{BE} \Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{BE}$

$\Rightarrow BE = h\sqrt{3}$

Here, $BE = CD = h\sqrt{3}$

Now, in ΔACD

$\tan 60° = \frac{AC}{CD}$

$\Rightarrow \sqrt{3} = \frac{h+9}{h\sqrt{3}}$

$\Rightarrow 3h = h + 9$

$\Rightarrow 2h = 9$

$\Rightarrow h = \frac{9}{2} = 4.5$ m

So, height of multi-storeyed building = 9 + 4.5 = 13.5 m

Also, $CD = h\sqrt{3}$

$\Rightarrow CD = 4.5\sqrt{3}$

$\Rightarrow CD = 4.5 \times 1.73$

$\Rightarrow CD = 7.785$ m

So, distance between the two buildings = 7.785 m

35. Calculating mean

Class	**Class Mark (x_i)**	**Frequency (f_i)**	$f_i x_i$
15–20	17.5	12	210
20–25	22.5	10	225
25–30	27.5	15	412.5
30–35	32.5	11	357.5
35–40	37.5	7	262.5
40–45	42.5	5	212.5
		$\Sigma f_i = 60$	$\Sigma f_i x_i = 1680$

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

$\Rightarrow \bar{x} = \frac{1680}{60}$

$\Rightarrow \bar{x} = 28$

Now, calculating mode

Class	**Frequency (f_i)**
15–20	12
20–25	$10 = f_0$
25–30	$15 = f_1$
30–35	$11 = f_2$

35–40	7
40–45	5

Now, $L = 25, f_1 = 15, f_0 = 10, f_2 = 11, h = 5$

$$\text{mode} = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

$$\Rightarrow \quad \text{mode} = 25 + \frac{15-10}{30-10-11} \times 5$$

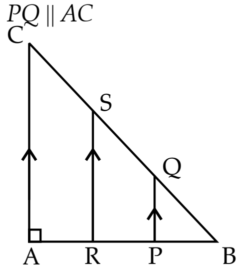
$$\Rightarrow \quad \text{mode} = 25 + \frac{5}{9} \times 5$$

$$\Rightarrow \quad \text{mode} = 25 + \frac{25}{9}$$

$$\Rightarrow \quad \text{mode} = \frac{250}{9} = 27.78$$

SECTION – E

36. (i) Given: $PQ \parallel AC$



$\Rightarrow$ In ΔBPQ and ΔBAC

$\Rightarrow \quad \angle B = \angle B$ (common)

and $\angle BPQ = \angle BAC = 90°$ (corresponding angles)

by AA similarity criterion

$$\Delta BPQ \sim \Delta BAC$$

Thus, $\dfrac{PQ}{AC} = \dfrac{BP}{BA} = \dfrac{BQ}{BC}$ ...(i)

(ii) Here, $BP = \dfrac{1}{3}AB$

(P and R trisect AB; given)

$$\Rightarrow \quad \frac{BP}{BA} = \frac{1}{3}$$

$\Rightarrow \quad \dfrac{PQ}{AC} = \dfrac{1}{3}$ (From (i))

$$\Rightarrow \quad PQ = \frac{1}{3}AC$$

(iii) (a) Since $AB = 3$ cm

$$\Rightarrow \quad BP = \frac{1}{3}AB = \frac{1}{3} \times 3 = 1$$

Now, $AB = AC$ (given)

$\Rightarrow \quad \angle C = \angle B = 45°$

Now, in ΔBPQ

$$\cos 45° = \frac{BP}{BQ}$$

$$\Rightarrow \quad \frac{1}{\sqrt{2}} = \frac{1}{BQ}$$

$\Rightarrow \quad BQ = \sqrt{2}$ cm ...(ii)

Also, since P and R trisect AB

$\Rightarrow \quad BP = RP = AR$

$\Rightarrow \quad BR = 2BP$

$\Rightarrow \quad BR = 2$ cm

In in ΔBRS

$$\cos 45° = \frac{BR}{BS}$$

$$\Rightarrow \quad \frac{1}{\sqrt{2}} = \frac{2}{BS}$$

$\Rightarrow \quad BS = 2\sqrt{2}$ cm ...(iii)

From (ii) and (iii)

$$\frac{BQ}{BS} = \frac{\sqrt{2}}{2\sqrt{2}} = \frac{1}{2}$$

$$\Rightarrow \quad BQ = \frac{1}{2}BS$$

OR

(b) Since, $BR = 2$ cm and $AB = 3$ cm

$$\Rightarrow \quad \frac{BR}{AB} = \frac{2}{3} = \frac{BS}{BC}$$

$$\Rightarrow \quad BS = \frac{2}{3}BC$$

Here, in ΔBRS, $BR^2 + RS^2 = BS^2$

$$\Rightarrow \quad BR^2 + RS^2 = \left(\frac{2}{3}BC\right)^2$$

$\Rightarrow \quad BR^2 + RS^2 = \dfrac{4}{9}BC^2$ **Hence proved**

37. (i) Outer radius of bowl, $R = 10.5$ cm

$\Rightarrow$ Diameter $= 2 \times R = 21$ cm $=$ Length and breadth of cuboidal box

Height of bowl $=$ outer radius

$= r = 10.5$ cm $=$ Height of cuboidal box

So, the dimensions of cuboidal box are:

$l = 21$ cm, $b = 21$ cm, $h = 10.5$ cm

(ii) TSA of cuboidal box $= 2(lb + bh + hl)$

$= 2(21 \times 21 + 21 \times 10.5 + 10.5 \times 21)$

$= 2(441 + 220.5 + 220.5)$

$= 2(882)$

$= 1764$ cm^2

(iii) (a) Capacity of bowl $= \dfrac{2}{3}\pi r^3$

$= \dfrac{2}{3} \times 3.14 \times 10 \times 10 \times 10$

$= \dfrac{2}{3} \times 314 \times 10$

$= 2093.33$ cm^3

Capacity of cuboidal box $= lbh$

$= 21 \times 21 \times 10.5$

$= 4630.5$ cm^3

Difference in capacity $= 4630.5 - 2093.33 = 2537.17$ cm^3

OR

(b) Area to be painted $=$ CSA of bowl $+$ area of ring

$= 2\pi r^2 + (\pi R^2 - \pi r^2)$

$= 2\pi r^2 + \pi R^2 - \pi r^2$

$= \pi r^2 + \pi R^2$

$= \pi(r^2 + R^2)$

$= 3.14\{(10)^2 + (10.5)^2\}$

$= 3.14(100 + 110.25)$

$= 3.14 \times 210.25$

$= 660.185$ cm^2

38. (i) Distance $OP = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$O = (0, 0)$

$\Rightarrow \quad OP = \sqrt{(8-0)^2 + (6-0)^2}$

$\Rightarrow \quad OP = \sqrt{(8)^2 + (6)^2}$

$\Rightarrow \quad OP = \sqrt{64 + 36}$

$\Rightarrow \quad OP = \sqrt{100}$

$\Rightarrow \quad OP = 10$ units

(ii) Equation of line QS is $2x + 9y = 42$

On y-axis, x-coordinate (abscissa) is zero.

$\therefore \quad 2(0) + 9y = 42$

$\Rightarrow \quad 9y = 42$

$$y = \frac{42}{9} = \frac{14}{3}$$

Therefore, the coordinates of the point where the line QS intersects y-axis are $\left(0, \frac{14}{3}\right)$.

(iii) (a) Let the ratio be $k : 1$.

Now,

$$R = \left(\frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2}\right)$$

$$\Rightarrow \quad (4.8, y) = \left(\frac{k(8) + 1(0)}{k+1}, \frac{k(6) + 1(0)}{k+1}\right)$$

$$\Rightarrow \quad (4.8, y) = \left(\frac{8k}{k+1}, \frac{6k}{k+1}\right)$$

On comparing,

$$4.8 = \frac{8k}{k+1}$$

$\Rightarrow \quad 4.8k + 4.8 = 8k$

$\Rightarrow \quad 4.8 = 3.2k$

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

And $$y = \frac{6k}{k+1}$$

Putting value of k in this equation

$$\Rightarrow \quad y = \frac{6\left(\frac{3}{2}\right)}{\left(\frac{3}{2}\right) + 1}$$

$$\Rightarrow \quad y = \frac{9}{\left(\frac{5}{2}\right)} = 3.6$$

OR

(b) By distance formula,

Distance between two points (x_1, x_2) and (y_1, y_2) is given by

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

$P = (8, 6)$

$Q = (12, 2)$

$\therefore \quad PQ = \sqrt{(12-8)^2 + (2-6)^2}$

$\Rightarrow \quad PQ = \sqrt{(4)^2 + (-4)^2}$

$\Rightarrow \quad PQ = \sqrt{16 + 16}$

$\Rightarrow \quad PQ = \sqrt{32}$

$\Rightarrow \quad PQ = 4\sqrt{2}$ units

Now, $O = (0, 0)$

$S = (-6, 6)$

$\Rightarrow \quad OS = \sqrt{(-6-0)^2 + (6-0)^2}$

$\Rightarrow \quad OS = \sqrt{(-6)^2 + (6)^2}$

$\Rightarrow \quad OS = \sqrt{36 + 36}$

$\Rightarrow \quad OS = \sqrt{72}$

$\Rightarrow \quad OS = 6\sqrt{2}$

Now, $$\frac{PQ}{OS} = \frac{4\sqrt{2}}{6\sqrt{2}} = \frac{2}{3}$$

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SECTION – A

5. Option (D) is correct.

Explanation: $$a = \frac{13}{3}$$

$$d = \frac{9}{3} - \frac{13}{3} = \frac{-4}{3}$$

$$a_{15} = a + 14d = \frac{13}{3} + 14 \times \frac{-4}{3} = \frac{-43}{3}$$

7. Option (B) is correct.

Explanation: Let $P(x) = a(x - 0)(x + 2)$

$= ax(x + 2)$

Putting $a = 4$ gives $P(x) = 4x(x + 2)$

13. Option (B) is correct.

Explanation: Total number of cases $= 6 \times 6 = 36$

Favourable cases $= (1, 2), (2, 4), (3, 6)$

Number of favourable cases $= 3$

$$\text{Required probability} = \frac{3}{36} = \frac{1}{12}$$

15. Option (B) is correct.

Explanation: $$\sin\theta = \frac{1}{9}$$

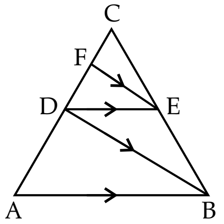
$$\cos\theta = \sqrt{1 - \sin^2\theta} = \sqrt{1 - \frac{1}{81}} = \sqrt{\frac{80}{81}} = \frac{4\sqrt{5}}{9}$$

$$\tan\theta = \frac{\sin\theta}{\cos\theta} = \frac{\frac{1}{9}}{\frac{4\sqrt{5}}{9}} = \frac{1}{4\sqrt{5}}$$

SECTION – B

23.
$$144 = 2^4 \times 3^2$$
$$180 = 2^2 \times 3^2 \times 5^1$$
$$192 = 2^6 \times 3^1$$
$$\text{HCF} = 2^2 \times 3^1 = 4 \times 3 = 12$$

25.



In ΔCAB, using basic proportionality theorem,
$$\frac{CD}{DA} = \frac{CE}{EB} \quad ...(i)$$
In ΔCDB, using basic proportionality theorem,
$$\frac{CF}{FD} = \frac{CE}{EB} \quad ...(ii)$$
From (i) and (ii),
$$\frac{CD}{DA} = \frac{CF}{FD}$$
$$\frac{DA}{CD} = \frac{FD}{CF}$$
Adding 1 to both sides,
$$\Rightarrow \frac{DA+CD}{CD} = \frac{FD+CF}{CF}$$
$$\Rightarrow \frac{CA}{CD} = \frac{CD}{CF}$$
$$\Rightarrow CA \times CF = CD^2$$
$$\Rightarrow DC^2 = CF \times AC$$

SECTION – C

26.
$$48 = 2^4 \times 3^1$$
$$52 = 2^2 \times 13^1$$
$$56 = 2^3 \times 7^1$$
LCM of 48, 52 and 56 $= 2^4 \times 3 \times 13 \times 7 = 4368$

They meet each other when each have covered 4368 cm

Minimum distance covered in meeting 10 times
$= 4368 \times 10$
$= 43680$ cm
$= 436.8$ m

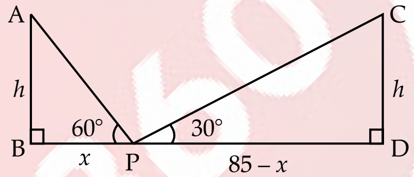
27.
$$\text{LHS} = \left(1+\frac{1}{\tan^2\theta}\right)\left(1+\frac{1}{\cot^2\theta}\right)$$
$$= \left(\frac{\tan^2\theta+1}{\tan^2\theta}\right)\left(\frac{\cot^2\theta+1}{\cot^2\theta}\right)$$
$$= \sec^2\theta \times \text{cosec}^2\theta \times \frac{1}{\tan^2\theta} \times \tan^2\theta$$
$$= (1 + \cot^2\theta)(1 + \tan^2\theta)$$
$$= \text{cosec}^2\theta \times \sec^2\theta$$
$$= \frac{1}{\sin^2\theta\cos^2\theta}$$
$$= \frac{1}{\sin^2\theta(1-\sin^2\theta)}$$
$$= \frac{1}{\sin^2\theta - \sin^4\theta}$$
$= \text{RHS}$ **Hence proved**

31. Let the number be x

Given
$$x + \frac{1}{x} = \frac{13}{6}$$
$$\frac{x^2+1}{x} = \frac{13}{6}$$
$$6x^2 + 6 = 13x$$
$$6x^2 - 13x + 6 = 0$$
$$6x^2 - 9x - 4x + 6 = 0$$
$$3x(2x-3) - 2(2x-3) = 0$$
$$(2x-3)(3x-2) = 0$$
$$x = \frac{3}{2} \text{ or } \frac{2}{3}$$

SECTION – D

32.



Let the height of the pole be 'h'.
Let P be a point at a distance 'x' m from pole AB.

From ΔABP, $\tan 60° = \frac{h}{x}$
$$\sqrt{3} = \frac{h}{x}$$
$$h = \sqrt{3}h \quad ...(i)$$
From ΔCDP, $\tan 30° = \frac{h}{85-x}$
$$\frac{1}{\sqrt{3}} = \frac{h}{85-x}$$
$$85 - x = \sqrt{3}h \quad ...(ii)$$
Substituting (i) in (ii)
$$\Rightarrow 85 - x = \sqrt{3} \times \sqrt{3}x$$
$$\Rightarrow 85 - x = 3x$$
$$\Rightarrow 4x = 85$$
$$\Rightarrow x = \frac{85}{4} = 21.25 \text{ m}$$
(Distance of first pole from point P)

Height of the pole $= h = \sqrt{3}x$
$= 1.73 \times 21.25$
$= 36.76$ m

Distance of point P from pole AB
$= x = 21.25$ m

Distance of P from pole CD
$= 85 - x$
$= 85 - 21.25$
$= 63.75$ m

34.

Class	f_i	x_i	f_ix_i
0–15	11	7.5	82.5
15–30	8	22.5	180
30–45	15	37.5	562.5
45–60	7	52.5	367.5
60–75	10	67.5	675
75–90	9	82.5	742.5
	$\Sigma f_i = 60$		$\Sigma f_ix_i = 2610$

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

$$= \frac{2610}{60}$$

$$= 43.5$$

Modal class = 30-45

(as maximum frequency is 15)

$L = 30, h = 15$

$f_0 = 8, f_1 = 15, f_2 = 7$

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

$$= 30 + \left(\frac{15-8}{30-8-7}\right) \times 15$$

$$= 30 + \frac{7}{15} \times 15$$

$$= 30 + 7$$

$$= 37$$

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SECTION – A

2. Option (B) is correct.

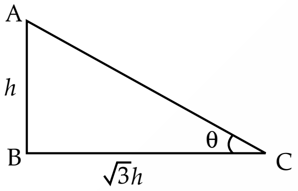
Explanation: Total number of cases = 8

Number of favourable cases = 7

$$P(\text{at least one head}) = \frac{7}{8}$$

4. Option (B) is correct.

Explanation:



$$\tan \theta = \frac{h}{\sqrt{3}h} = \frac{1}{\sqrt{3}}$$

Angle of elevation, $\theta = 30°$

11. Option (D) is correct.

Explanation: Substituting the point (3, –5) in the equation $mx - y = 11$ gives

$3m + 5 = 11$

$3m = 6$

$m = 2$

SECTION – B

23. (a) $a = \sqrt{3}, b = 10, c = 7\sqrt{3}$

Given quadratic equation is: $\sqrt{3}x^2 + 10x + 7\sqrt{3} = 0$

On comparing the above equation with $ax^2 + bx + c = 0$, we get

By quadratic formula,

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-10 \pm \sqrt{10^2 - 4 \times \sqrt{3} \times 7\sqrt{3}}}{2\sqrt{3}}$$

$$= \frac{-10 \pm \sqrt{16}}{2\sqrt{3}}$$

$$= \frac{-10 \pm 4}{2\sqrt{3}} = \frac{-10+4}{2\sqrt{3}} \text{ or } \frac{-10-4}{2\sqrt{3}}$$

$$= \frac{-6}{2\sqrt{3}} \text{ or } \frac{-14}{2\sqrt{3}}$$

$$= -\sqrt{3} \text{ or } -\frac{7\sqrt{3}}{3}$$

OR

(b) $a = 4, b = -4a^2, c = a^4 - b^4$

Given quadratic equation is: $4x^2 - 4a^2x + a^4 - b^4 = 0$

On comparing the above equation with $ax^2 + bx + c = 0$, we get

Discriminant $= b^2 - 4ac$

$= (-4a^2)^2 - 4 \times 4 \times (a^4 - b^4)$

$= 16a^4 - 16a^4 + 16b^4$

$= 16b^4 > 0$

Discriminant > 0 and a perfect square.

Hence the roots are real, distinct and rational.

25. Let the corresponding side of the second triangle be x.

For similar triangles, ratio of corresponding sides will be equal to the ratio of the perimeters of the corresponding triangles.

$$\frac{9}{x} = \frac{22}{33}$$

$$\frac{9}{x} = \frac{2}{3}$$

$$2x = 27$$

$$x = \frac{27}{2} = 13.5 \text{ cm}$$

SECTION – C

26. Given that $\sqrt{5}$ is irrational

Assume that $2 + 3\sqrt{5}$ is rational.

That means there exists some rational number a such that $2 + 3\sqrt{5} = a$.

$\Rightarrow$ $3\sqrt{5} = a - 2$

$$\Rightarrow \qquad \sqrt{5} = \frac{a-2}{3}$$

Since a is rational, $\frac{a-2}{3}$ is also rational which contradicts our assumption since $\sqrt{5}$ is irrational.

Hence we conclude that $2+3\sqrt{5}$ is irrational.

28. $\text{LHS} = \frac{\sin\theta}{1+\cos\theta} + \frac{1+\cos\theta}{\sin\theta}$

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

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

$$= \frac{2+2\cos\theta}{\sin\theta(1+\cos\theta)} \quad (\because \sin^2\theta + \cos^2\theta = 1)$$

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

$$= \frac{2}{\sin\theta} = 2\,\text{cosec}\,\theta$$

$= \text{RHS}$ **Hence proved**

31. (a) Here, $\alpha + \beta = \frac{-b}{a} = \frac{8}{3}$

$$\alpha\beta = \frac{c}{a} = \frac{k}{3}$$

$$\alpha^2 + \beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$$

$$\frac{40}{9} = \left(\frac{8}{3}\right)^2 - \frac{2k}{3}$$

$$\frac{2k}{3} = \frac{64}{9} - \frac{40}{9} = \frac{24}{9} = \frac{8}{3}$$

$$2k = 8 \Rightarrow k = 4$$

OR

(b) $2x^2 + 7x + 5 = 0$

$$2x^2 + 2x + 5x + 5 = 0$$

$$2x(x+1) + 5(x+1) = 0$$

$$(x+1)(2x+5) = 0$$

$$x = -1 \text{ or } \frac{-5}{2}$$

The zeroes are -1 and $\frac{-5}{2}$.

$$\text{Sum of zeroes} = (-1) + \left(\frac{-5}{2}\right) = \frac{-7}{2} = \frac{-b}{a}$$

$$\text{Product of zeroes} = (-1)\left(\frac{-5}{2}\right) = \frac{5}{2} = \frac{c}{a}$$

SECTION – D

32.

Class	Frequency (f_i)	x_i	f_ix_i
0–5	2	2.5	5
5–10	3	7.5	22.5
10–15	8	12.5	100
15–20	15	17.5	262.5
20–25	14	22.5	315
25–30	8	27.5	220
	$\Sigma f_i = 50$		$\Sigma f_ix_i = 925$

$$\text{Mean} = \frac{\Sigma f_ix_i}{\Sigma f_i} = \frac{925}{50} = 18.5$$

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

Modal class $= 15 - 20$

(as maximum frequency belongs to this class)

$L = 15$

$f_1 = 15, f_0 = 8, f_2 = 14$

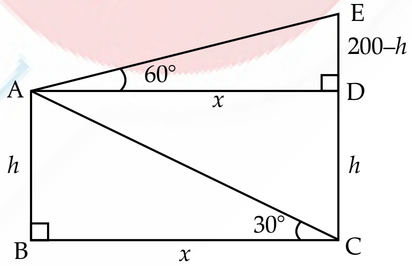
$h = 5$

$$\therefore \quad \text{Mode} = 15 + \left(\frac{15-8}{30-8-14}\right) \times 5$$

$$= 15 + \frac{7}{8} \times 5$$

$$= 19.375$$

35.



$$\text{From } \Delta ABC, \quad \tan 30° = \frac{h}{x}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{x}$$

$$\Rightarrow \qquad x = \sqrt{3}h \qquad \text{...(i)}$$

$$\text{From } \Delta ADE, \quad \tan 60° = \frac{200-h}{x}$$

$$\sqrt{3} = \frac{200-h}{\sqrt{3}h}$$

$$3h = 200 - h$$

$$4h = 200$$

$$h = \frac{200}{4} = 50 \text{ m}$$

$$x = \sqrt{3}h = 1.73 \times 50$$

$$= 86.5 \text{ m}$$

❑❑