SAMPLE PAPER TEST 3 FOR BOARD EXAM 2025

SUBJECT: MATHEMATICS **MAX. MARKS : 80**
CLASS : X **DURATION : 3 HRS**

General Instruction:

1. This Question Paper has 5 Sections A-E.
2. **Section A** has 20 MCQs carrying 1 mark each.
3. **Section B** has 5 questions carrying 02 marks each.
4. **Section C** has 6 questions carrying 03 marks each.
5. **Section D** has 4 questions carrying 05 marks each.
6. **Section E** has 3 case based integrated units of assessment (04 marks each) with sub-parts of the values of 1, 1 and 2 marks each respectively.
7. All Questions are compulsory. However, an internal choice in 2 Qs of 5 marks, 2 Qs of 3 marks and 2 Questions of 2 marks has been provided. An internal choice has been provided in the 2marks questions of Section E
8. Draw neat figures wherever required. Take π =22/7 wherever required if not stated.

SECTION – A

Questions 1 to 20 carry 1 mark each.

1. If $1080 = 2^x \times 3^y \times 5$, then (x – y) is equal to :
(a) 6 (b) – 1 (c) 1 (d) 0

2. The sum of exponents of prime factors in the prime-factorisation of 196 is:
(a) 3 (b) 4 (c) 5 (d) 6

3. The roots of the quadratic equation $x^2 - 4 = 0$ is/are :
(a) 2 only (b) – 2, 2 (c) 4 only (d) – 4, 4

4. Which of the following relationship is correct ?
(a) $P(E) = 1 + P(\overline{E})$ (b) $P(\overline{E}) - P(E) = 1$ (c) $P(E) + P(\overline{E}) = 1$ (d) $P(E) = 2P(\overline{E})$

5. $\left(\frac{1}{\tan^2\theta} - \frac{1}{\sin^2\theta}\right)$ is equal to :
(a) 1 (b) – 1 (c) $\sec^2\theta$ (d) $\sin^2\theta$

6. If one zero of a quadratic polynomial $kx^2 + 4x + k$ is 1, then the value of k is :
(a) 2 (b) – 2 (c) 4 (d) – 4

7. The pair of equations $x + 2y + 5 = 0$ and $-3x - 6y + 1 = 0$ have
(a) a unique solution (b) exactly two solutions
(c) infinitely many solutions (d) no solution

8. If C(1, –1) is the mid-point of the line segment AB joining points A(4, x) and B(– 2, 4), then value of x is :
(a) 5 (b) – 5 (c) 6 (d) – 6

9. A card is selected at random from a well shuffled deck of 52 playing cards. The probability of its being a face card is
(a) 3/13 (b) 4/13 (c) 6/13 (d) 9/13

10. The distance between the points (2, – 1) and (– 1, – 5) is :
(a) 15 units (b) 5 units (c) 25 units (d) 41 units

11. If a cylinder is covered by two hemispheres shaped lid of equal shape, then the total curved surface area of the new object will be
(a) $4\pi rh + 2\pi r^2$ (b) $4\pi rh - 2\pi r^2$ (c) $2\pi rh + 4\pi r^2$ (d) $2\pi rh + 4\pi r$

12. In a circle of radius 21 cm, if an arc subtends an angle of 60° at the centre of the circle, then the length of the arc is :
(a) 11 cm (b) 44 cm (c) 22/7 cm (d) 22 cm

13. If the lines $3x + 2ky - 2 = 0$ and $2x + 5y + 1 = 0$ are parallel, then what is the value of k?
(a) 4/15 (b) 15/4 (c) 4/5 (d) 5/4

14. The median group in the following frequency distribution is :

Class	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Frequency	5	8	20	15	7	5

(a) 10 – 20 (b) 20 – 30 (c) 30 – 40 (d) 40 – 50

15. The distance of the point P (2, 3) from the x-axis is
(a) 2 (b) 3 (c) 1 (d) 5

16. A circus artist is climbing a 30 m long rope, which is tightly stretched and tied from the top of a vertical pole to the ground. Find the distance of the pole to the peg in the ground, if the angle made by the rope with the ground level is 30º.
(a) $20\sqrt{3}$ m (b)$15\sqrt{3}$ m (c)$10\sqrt{3}$ m (d) 20 m

17. The ratio in which the line segment joining the points P(-3, 10) and Q(6, –8) is divided by O(-1, 6) is:
(a) 1:3 (b) 3:4 (c) 2:7 (d) 2:5

18. A box contains cards numbered 6 to 50. A card is drawn at random from the box. The probability that the drawn card has a number which is a perfect square is :
(a) 1/45 (b) 2/15 (c) 4/45 (d) 1/9

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

19. Assertion (A): In ΔABC, DE || BC such that AD = (7x - 4) cm, AE = (5x - 2) cm, DB = (3x + 4) cm and EC = 3x cm than x equal to 5.
Reason (R): If a line is drawn parallel to one side of a triangle to intersect the other two sides in distant point, than the other two sides are divided in the same ratio.
(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.

20. Assertion (A): The largest number that divide 70 and125 which leaves remainder 5 and 8 is 13
Reason (R): HCF (65,117) =13
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A

(c) A is true and R is false
(d) A is false and R is true

SECTION-B

Questions 21 to 25 carry 2 marks each

21. If the system of equations 2x + 3y = 7 and (a + b)x + (2a – b)y = 21 has infinitely many solutions, then find a and b.

22. Two dice are thrown at the same time. Find the probability of getting (i) same number on both dice (ii) different numbers on both dice.

OR

Cards marked with number 3, 4, 5, …, 50 are placed in a box and mixed thoroughly. A card is drawn at random from the box. Find the probability that the selected card bears (i) a perfect square number (ii) a single digit number

23. XY and PQ are two tangents drawn at the end points of the diameter AB of a circle. Prove that XY || PQ.

24. Find the points on the ***x***–axis which are at a distance of 2**√**5 from the point (7, –4). How many such points are there?

OR

If A and B are (-2, -2) and (2, -4) respectively, find the coordinates of P such that AP = $\frac{3}{7}$ AB and P lies on the line segment AB.

25. Find the zeroes of the quadratic polynomials p(t) = $5t^2 + 12t + 7$ and verify the relationship between the zeroes and the coefficients.

SECTION-C

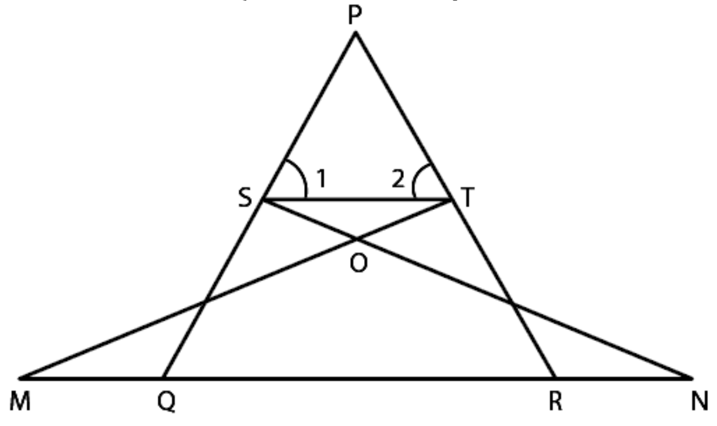
Questions 26 to 31 carry 3 marks each

26. On a morning walk, three persons step off together and their steps measure 40 cm, 42 cm and 45 cm, respectively. Find the minimum distance each should walk so that each can cover the same distance in complete steps.

OR

Prove that 2 + 5√3 is an irrational number, if it is given that 3 is an irrational number.

27. In the below figure, if ∠1 =∠2 and ΔNSQ = ΔMTR, then prove that ΔPTS ~ ΔPRQ.



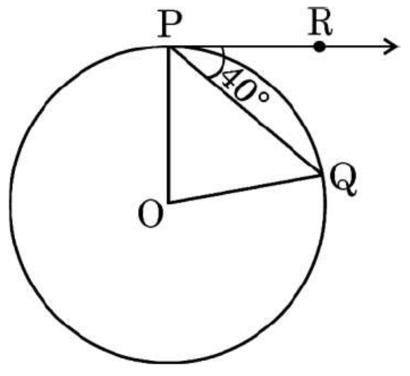
28. Prove that: $(\tan A+\sec A)^2+(\tan A-\sec A)^2=2\left(\frac{1+\sin^2 A}{1-\sin^2 A}\right)$

29. If $2x + y = 23$ and $4x - y = 19$, find the values of $5y - 2x$ and $y/x - 2$.

30. (a) Prove that opposite sides of a quadrilateral circumscribing a circle subtends supplementary angles at the centre of the circle.

OR

(b) If O is the centre of a circle, PQ is a chord and the tangent PR at P makes an angle of 40° with PQ, then find the measure of ∠POQ.



31. From a point on a ground, the angle of elevation of bottom and top of a transmission tower fixed on the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower.

SECTION-D

Questions 32 to 35 carry 5 marks each

32. A motorboat whose speed in still water is 9 km/h, goes 15km downstream and comes back to the same spot, in a total time of 3 hours 45 minutes. Find the speed of the stream.

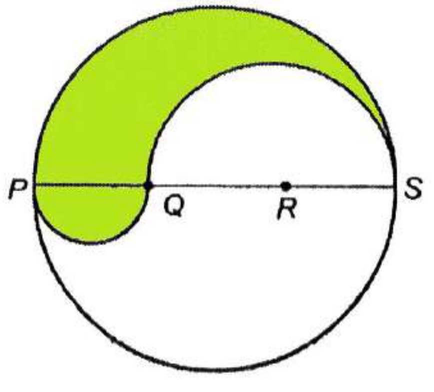
OR

A takes 6 days less than the time taken by B to finish a piece of work. If both A And B together can finish it in 4 days, find the time taken by B to finish the work.

33. A chord of a circle of radius 15 cm subtends an angle of 60° at the centre. Find the areas of the corresponding minor and major segments of the circle. (Use $\pi = 3.14$ and $\sqrt{3} = 1.73$)

OR

PQRS is a diameter of a circle of radius 6 cm. The lengths PQ, QR and RS are equal. Semi-circles are drawn on PQ and QS as diameters as shown in below figure. Find the perimeter and area of the shaded region



34. Prove that if a line is drawn parallel to one side of a triangle intersecting the other two sides in distinct points, then the other two sides are divided in the same ratio.
Using the above theorem prove that a line through the point of intersection of the diagonals and parallel to the base of the trapezium divides the non parallel sides in the same ratio.

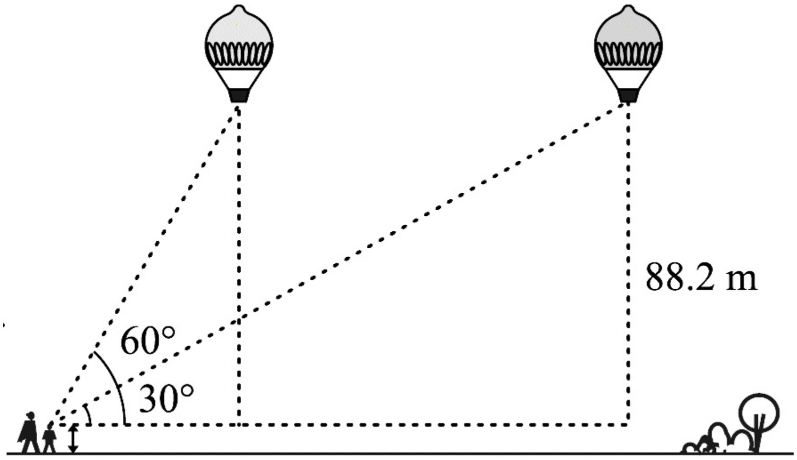
35. A survey regarding the heights (in cm) of 50 girls of class Xth of a school was conducted and the following data was obtained. Find the mean, median and mode of the given data.

Heights (in cm)	120 – 130	130 – 140	140 – 150	150 – 160	160 – 170
No. of Girls	2	8	12	20	8

SECTION-E (Case Study Based Questions)

Questions 36 to 38 carry 4 marks each

36. A 1.2 m tall girl spots a balloon moving with the wind in a horizontal line at a height of 88.2 m from the ground. The angle of elevation of the balloon from the eyes of the girl at any instant is 60°. After 30 seconds, the angle of elevation reduces to 30° (see the below figure).



Based on the above information, answer the following questions. (Take $\sqrt{3}$ =1.732)

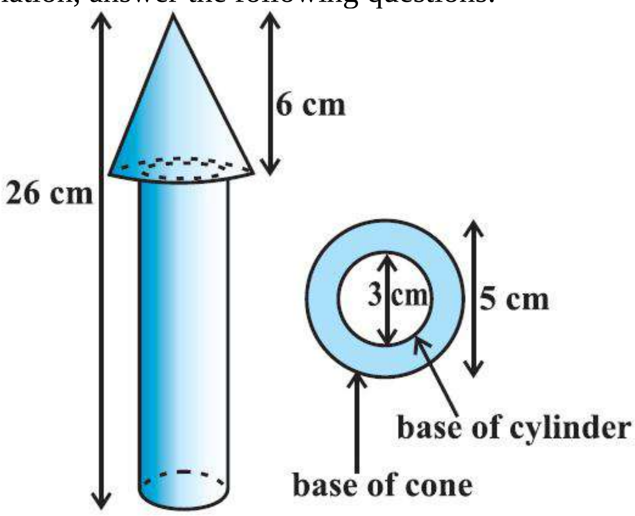
(i) Find the distance travelled by the balloon during the interval. (2)

(ii) Find the speed of the balloon. (2)

OR

(ii) If the elevation of the sun at a given time is 30°, then find the length of the shadow cast by a tower of 150 feet height at that time. (2)

37. In a toys manufacturing company, wooden parts are assembled and painted to prepare a toy. One specific toy is in the shape of a cone mounted on a cylinder. For the wood processing activity center, the wood is taken out of storage to be sawed, after which it undergoes rough polishing, then is cut, drilled and has holes punched in it. It is then fine polished using sandpaper. For the retail packaging and delivery activity center, the polished wood sub-parts are assembled together, then decorated using paint. The total height of the toy is 26 cm and the height of its conical part is 6 cm. The diameters of the base of the conical part is 5 cm and that of the cylindrical part is 3 cm. On the basis of the above information, answer the following questions:



(a) If its cylindrical part is to be painted yellow, find the surface area need to be painted. [1]
(b) If its conical part is to be painted green, find the surface area need to be painted. [2]

OR

(b) Find the volume of the wood used in making this toy. [2]
(c) If the cost of painting the toy is 3 paise per sq cm, then find the cost of painting the toy. (Use π = 3.14) [1]

38. Aditya is a fitness freak and great athlete. He always wants to make his nation proud by winning medals and prizes in the athletic activities.

An upcoming activity for athletes was going to be organised by Railways. Aditya wants to participate in 200 m race. He can currently run that distance in 51 seconds. But he wants to increase his speed, so to do it in 31 seconds. With each day of practice, it takes him 2 seconds less.
(i) He wants to makes his best time as 31 sec. In how many days will be able to achieve his target?
(ii) What will be the difference between the time taken on 5th day and 7th day.

OR

(ii) Which term of the arithmetic progression 3, 15, 27, 39 .... will be 120 more than its 21st term?

SAMPLE PAPER TEST 3 FOR BOARD EXAM 2025
(ANSWERS)

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8. Draw neat figures wherever required. Take π =22/7 wherever required if not stated.

SECTION – A
Questions 1 to 20 carry 1 mark each.

1. If $1080 = 2^x \times 3^y \times 5$, then (x – y) is equal to :
(a) 6 (b) – 1 (c) 1 (d) 0
Ans. (d) 0

2. The sum of exponents of prime factors in the prime-factorisation of 196 is:
(a) 3 (b) 4 (c) 5 (d) 6
Ans. (b) 4

3. The roots of the quadratic equation $x^2 - 4 = 0$ is/are :
(a) 2 only (b) – 2, 2 (c) 4 only (d) – 4, 4
Ans. (b) – 2, 2

4. Which of the following relationship is correct ?
(a) $P(E) = 1 + P(\overline{E})$ (b) $P(\overline{E}) - P(E) = 1$ (c) $P(E) + P(\overline{E}) = 1$ (d) $P(E) = 2P(\overline{E})$
Ans. (c) $P(E) + P(\overline{E}) = 1$

5. $\left(\frac{1}{\tan^2\theta} - \frac{1}{\sin^2\theta}\right)$ is equal to :
(a) 1 (b) – 1 (c) $\sec^2\theta$ (d) $\sin^2\theta$
Ans. (b) – 1

6. If one zero of a quadratic polynomial $kx^2 + 4x + k$ is 1, then the value of k is :
(a) 2 (b) – 2 (c) 4 (d) – 4
Ans. (b) – 2

7. The pair of equations x + 2y + 5 = 0 and –3x – 6y + 1 = 0 have
(a) a unique solution (b) exactly two solutions
(c) infinitely many solutions (d) no solution
Ans: (d) no solution
$a_1 = 1;\ b_1 = 2;\ c_1 = 5$

$a_2 = -3$; $b_2 = -6$; $c_2 = 1$
$a_1/a_2 = -1/3$
$b_1/b_2 = -2/6 = -1/3$
$c_1/c_2 = 5/1 = 5$
Here, $a_1/a_2 = b_1/b_2 \neq c_1/c_2$
Therefore, the pair of equation has no solution.

8. If C(1, –1) is the mid-point of the line segment AB joining points A(4, x) and B(– 2, 4), then value of x is :
(a) 5 (b) – 5 (c) 6 (d) – 6
Ans. (d) – 6

9. A card is selected at random from a well shuffled deck of 52 playing cards. The probability of its being a face card is
(a) 3/13 (b) 4/13 (c) 6/13 (d) 9/13
Ans: (a) 3/13
Total number of outcomes = 52
Number of face cards = 12
The probability of its being a face card = 12/52 = 3/13

10. The distance between the points (2, – 1) and (– 1, – 5) is :
(a) 15 units (b) 5 units (c) 25 units (d) 41 units
Ans. (b) 5 units

11. If a cylinder is covered by two hemispheres shaped lid of equal shape, then the total curved surface area of the new object will be
(a) $4\pi rh + 2\pi r^2$ (b) $4\pi rh - 2\pi r^2$ (c) $2\pi rh + 4\pi r^2$ (d) $2\pi rh + 4\pi r$
Ans: (c) 2πrh + 4πr2
Curved surface area of cylinder = $2\pi rh$
The curved surface area of hemisphere = $2\pi r^2$
Here, we have two hemispheres.
So, total curved surface area = $2\pi rh + 2(2\pi r^2) = 2\pi rh + 4\pi r^2$

12. In a circle of radius 21 cm, if an arc subtends an angle of 60° at the centre of the circle, then the length of the arc is :
(a) 11 cm (b) 44 cm (c) 22/7 cm (d) 22 cm
Ans. (d) 22 cm

13. If the lines $3x + 2ky - 2 = 0$ and $2x + 5y + 1 = 0$ are parallel, then what is the value of k?
(a) 4/15 (b) 15/4 (c) 4/5 (d) 5/4
Ans: (b) 15/4
The condition for parallel lines is a1/a2 = b1/b2 ≠ c1/c2
Hence, 3/2 = 2k/5
⇒ k = 15/4

14. The median group in the following frequency distribution is :

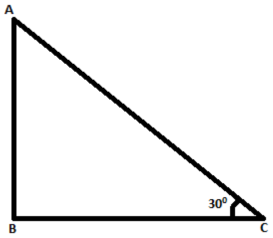
Class	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Frequency	5	8	20	15	7	5

(a) 10 – 20 (b) 20 – 30 (c) 30 – 40 (d) 40 – 50
Ans. (b) 20 – 30

15. The distance of the point P (2, 3) from the x-axis is
(a) 2 (b) 3 (c) 1 (d) 5
Ans: (b) 3

We know that, (x, y) is a point on the Cartesian plane in first quadrant.
Then, x = Perpendicular distance from Y – axis and
y = Perpendicular distance from X – axis
Therefore, the perpendicular distance from X-axis = y coordinate = 3

16. A circus artist is climbing a 30 m long rope, which is tightly stretched and tied from the top of a vertical pole to the ground. Find the distance of the pole to the peg in the ground, if the angle made by the rope with the ground level is 30º.
(a) $20\sqrt{3}$ m (b)$15\sqrt{3}$ m (c)$10\sqrt{3}$ m (d) 20 m
Ans: (b)$15\sqrt{3}$ m



$$\cos 30^\circ = \frac{BC}{AC} \Rightarrow BC = \cos 30^\circ \times AC = \frac{\sqrt{3}AC}{2} = \frac{30\sqrt{3}}{2} = 15\sqrt{3}\,\text{m}$$

17. The ratio in which the line segment joining the points P(-3, 10) and Q(6, –8) is divided by O(-1, 6) is:
(a) 1:3 (b) 3:4 (c) 2:7 (d) 2:5
Ans: (c) 2:7
Let k :1 be the ratio in which the line segment joining P(-3, 10) and Q(6, -8) is divided by point O(-1, 6).
By the section formula, we have -1 = (6k – 3)/(k + 1)
⇒ –k – 1 = 6k – 3
⇒ 7k = 2 ⇒ k = 2/7
Hence, the required ratio is 2:7.

18. A box contains cards numbered 6 to 50. A card is drawn at random from the box. The probability that the drawn card has a number which is a perfect square is :
(a) 1/45 (b) 2/15 (c) 4/45 (d) 1/9
Ans. (d) 1/9
P(perfect Square)= 5/45 = 1/9

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

19. Assertion (A): In ΔABC, DE || BC such that AD = (7x - 4) cm, AE = (5x - 2) cm, DB = (3x + 4) cm and EC = 3x cm than x equal to 5.
Reason (R): If a line is drawn parallel to one side of a triangle to intersect the other two sides in distant point, than the other two sides are divided in the same ratio.
(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.
Ans: (d) Assertion (A) is false but Reason (R) is true.

$$\frac{AD}{DB} = \frac{AE}{EC} \Rightarrow \frac{7x-4}{3x+4} = \frac{5x-2}{3x}$$

$\Rightarrow 21x^2 - 12x = 15x^2 + 20x - 6x - 8$
$\Rightarrow 6x^2 - 26 + 8x = 0 \Rightarrow 3x^2 - 13x + 4 = 0$
$\Rightarrow 3x^2 - 12x - x + 4 = 0 \Rightarrow 3x(x - 4) - 1(x - 4) = 0$
$\Rightarrow (x - 4)(3x - 1) = 0 \Rightarrow x = 4, 1/3$
Neglecting x = 1/3 as AD will become negative, we have x = 4
So, A is false but R is true.

20. Assertion (A): The largest number that divide 70 and125 which leaves remainder 5 and 8 is 13
Reason (R): HCF (65,117) =13
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A
(c) A is true and R is false
(d) A is false and R is true
Ans: (a) Both A and R are true and R is the correct explanation of A

SECTION-B

Questions 21 to 25 carry 2 marks each

21. If the system of equations 2x + 3y = 7 and (a + b)x + (2a – b)y = 21 has infinitely many solutions, then find a and b.
Ans: Given system of equations
2x + 3y = 7 ...(i)
(a + b)x + (2 a – b) y = 21 ...(ii)
Equations have infinitely many solutions, if $\frac{2}{a+b} = \frac{3}{2a-b} = \frac{7}{21} = \frac{1}{3} \Rightarrow \frac{2}{a+b} = \frac{1}{3}$
$\Rightarrow 6 = a + b \Rightarrow a + b = 6$ ...(i)
and $\frac{3}{2a-b} = \frac{1}{3} \Rightarrow 2a - b = 9$ ...(ii)
On solving equation (i) and (ii), we get a = 5, b = 1

22. Two dice are thrown at the same time. Find the probability of getting (i) same number on both dice (ii) different numbers on both dice.
Ans: Total number of possible outcomes = 36
(i) Same number on both dice.
Number of possible outcomes = 6
Therefore, the probability of getting same number on both dice = 6/36 = 1/6
(ii) Different number on both dice.
Number of possible outcomes = 36 – 6 = 30
Therefore, the probability of getting different number on both dice = 30/36 = 5/6

OR

Cards marked with number 3, 4, 5, …, 50 are placed in a box and mixed thoroughly. A card is drawn at random from the box. Find the probability that the selected card bears (i) a perfect square number (ii) a single digit number
Ans: Total number of cards = 48
(i) Total number of perfect squares = 6
∴ Required Probability = 6/48 = 1/8
(ii) Total single digit numbers = 7
∴ Required Probability = 7/48

23. XY and PQ are two tangents drawn at the end points of the diameter AB of a circle. Prove that XY || PQ.
Ans. Given: XY & PQ are tangents, AB is the diameter
To prove: XY || PQ

Proof: XY ⊥ OA (Tangent is perpendicular to radius)
∴ ∠OAY = 900
PQ ⊥ OB (Tangent is perpendicular to radius)
∴ ∠OBP = 90°
But ∠OAY and ∠OBP are alternate interior angles
∴ XY || PQ

24. Find the points on the ***x***–axis which are at a distance of 2**√**5 from the point (7, –4). How many such points are there?
Ans: Let coordinates of the point=(x, 0)(given that the point lies on x axis)
$x_1 = 7$, y_1=-4and $x_2 = x$, y_2=0
Distance $=\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
According to the question, $2\sqrt{5}=\sqrt{(x - 7)^2 + (0 - 4(-4))^2}$
Squaring L.H.S and R.H.S, we get $20 = x^2 + 49 - 14x + 16$
$\Rightarrow 20=x^2 + 65 - 14x \Rightarrow x^2 - 14x + 45 = 0 \Rightarrow x^2 - 9x - 5x + 45 = 0$
$\Rightarrow x(x - 9) - 5(x - 9) = 0 \Rightarrow (x - 9)(x - 5) = 0 \Rightarrow x - 9 = 0, x - 5 = 0$
$\Rightarrow x = 9$ or $x = 5$
Therefore, coordinates of points (9, 0) or (5, 0)

OR

If A and B are (-2, -2) and (2, -4) respectively, find the coordinates of P such that AP = $\frac{3}{7}$ AB and P lies on the line segment AB.
Ans: Given that AP = $\frac{3}{7}$ AB ⇒ PB = $\frac{4}{7}$ AB
Therefore, Point P divides AB internally in the ratio 3 : 4
Using section formula, we get
Coordinates of $P = \left(\frac{3\times(2)+4\times(-2)}{3+4}, \frac{3\times(-4)+4\times(-2)}{3+4}\right) = \left(\frac{-2}{7}, \frac{-20}{7}\right)$

25. Find the zeroes of the quadratic polynomials $p(t) = 5t^2 + 12t + 7$ and verify the relationship between the zeroes and the coefficients.
Ans: $5t^2 + 12t + 7 = 0 \Rightarrow 5t^2 + 5t + 7t + 7 = 0$
$\Rightarrow 5t(t + 1) + 7(t + 1) = 0 \Rightarrow (t + 1)(5t + 7) = 0$
$\Rightarrow t + 1 = 0 \Rightarrow t = -1$
$5t + 7 = 0 \Rightarrow 5t = -7 \Rightarrow t = -7/5$
Therefore, zeroes are (-7/5) and -1
Now, Sum of the zeroes = – (coefficient of x) ÷ coefficient of x2
$\alpha + \beta = - b/a$
$\Rightarrow (-1) + (-7/5) = -(12)/5$
$\Rightarrow -12/5 = -12/5$
Product of the zeroes = constant term ÷ coefficient of x2
$\alpha\beta = c/a$
$\Rightarrow (-1)(-7/5) = 7/5$
$\Rightarrow 7/5 = 7/5$

SECTION-C

Questions 26 to 31 carry 3 marks each

26. On a morning walk, three persons step off together and their steps measure 40 cm, 42 cm and 45 cm, respectively. Find the minimum distance each should walk so that each can cover the same distance in complete steps.
Ans: Step measures of three persons are 40 cm, 42 cm and 45 cm.

The minimum distance each should walk so that each can cover the same distance in complete steps is the LCM of 40 cm, 42 cm and 45 cm.
Prime factorisation of 40, 42 and 45 gives
40 = 23 × 5, 42 = 2 × 3 × 7, 45 = 32 × 5
LCM (40, 42, 45) = Product of the greatest power of each prime factor involved in the numbers
= 23 × 32 × 5 × 7 = 8 × 9 × 35 = 72 × 35 = 2520 cm.

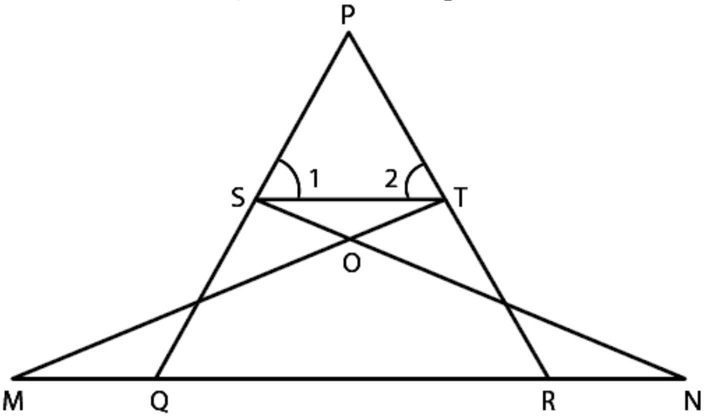
OR

Prove that 2 + 5√3 is an irrational number, if it is given that 3 is an irrational number.
Ans. Let us assume that x= 2 + 5√3 is a rational number

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

Now RHS is rational number but LHS is an irrational number
Therefore, our assumption is wrong
Hence 2 + 5√3 is an irrational number

27. In the below figure, if ∠1 =∠2 and ΔNSQ = ΔMTR, then prove that ΔPTS ~ ΔPRQ.



Ans: According to the question, Δ NSQ ≅ ΔMTR and ∠1 = ∠2
Since, ΔNSQ = ΔMTR
So, SQ = TR ….(i)
Also, ∠1 = ∠2 ⇒ PT = PS….(ii) [sides opposite to equal angles]
From Equation (i) and (ii),
PS/SQ = PT/TR
⇒ ST || QR (By converse of basic proportionality theorem)
∴ ∠1 = ∠PQR and ∠2 = ∠PRQ (corresponding angles)
In ΔPTS and ΔPRQ.
∠P = ∠P [Common angles]
∠1 = ∠PQR (proved)
∠2 = ∠PRQ (proved)
∴ ΔPTS – ΔPRQ [By AAA similarity criteria]
Hence proved

28. Prove that: $(\tan A+\sec A)^2+(\tan A-\sec A)^2=2\left(\frac{1+\sin^2 A}{1-\sin^2 A}\right)$

Ans. LHS = $\tan^2$ A + $\sec^2$ A + 2secA tanA + $\tan^2$ A + $\sec^2$ A - 2secA tanA

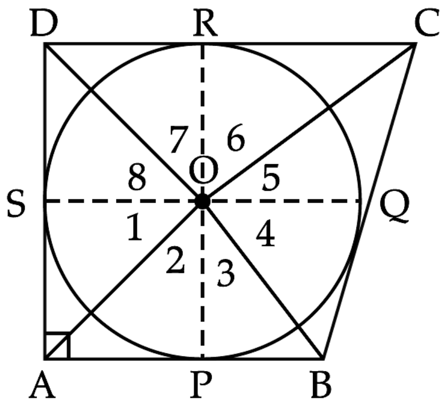
$= 2\tan^2 A + 2\sec^2 A = 2\left(\frac{\sin^2 A}{\cos^2 A}\right)+2\left(\frac{1}{\cos^2 A}\right) = 2\left(\frac{1+\sin^2 A}{\cos^2 A}\right)$

$= 2\left(\frac{1+\sin^2 A}{1-\sin^2 A}\right)$ = RHS

29. If 2x + y = 23 and 4x – y = 19, find the values of 5y – 2x and y/x – 2.

Ans: Given equations are $2x + y = 23$ …(i)
$4x - y = 19$ …(ii)
On adding both equations, we get $6x = 42$
$\Rightarrow x = 7$
Put the value of x in Eq. (i), we get
$2(7) + y = 23$
$\Rightarrow y = 23 - 14$
$\Rightarrow y = 9$
Hence $5y - 2x = 5(9) - 2(7) = 45 - 14 = 31$
$y/x - 2 = 9/7 - 2 = -5/7$

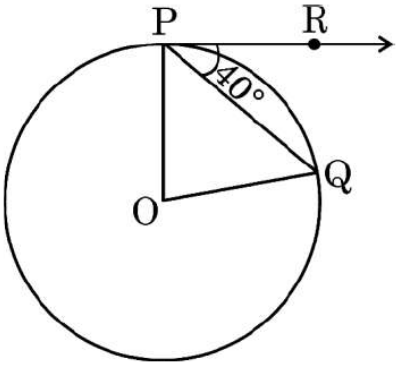
30. (a) Prove that opposite sides of a quadrilateral circumscribing a circle subtends supplementary angles at the centre of the circle.
Ans. Given A quad. ABCD circumscribes a circle with centre O.
To Prove: $\angle AOB + \angle COD = 180°$
and $\angle AOD + \angle BOC = 180°$
Join OP, OQ, OR and OS.
We know that the tangent drawn from an external point of a circle subtends equal angles at the centre.



$\Rightarrow \angle 1 = \angle 2, \angle 3 = \angle 4, \angle 5 = \angle 6, \angle 7 = \angle 8,$
And $\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 + \angle 6 + \angle 7 + \angle 8 = 360°$ [∠S at a Point]
$\Rightarrow 2(\angle 2 + \angle 3) + 2(\angle 6 + \angle 7) = 360°$
$2(\angle 1 + \angle 8) + 2(\angle 4 + \angle 5) = 360°$
$\Rightarrow \angle 2 + \angle 3 + \angle 6 + \angle 7 = 180°$
$\angle 1 + \angle 8 + \angle 4 + \angle 5 = 180°$
$\Rightarrow \angle AOB + \angle COD = 180°$
$\angle AOD + \angle BOC = 180°$

OR

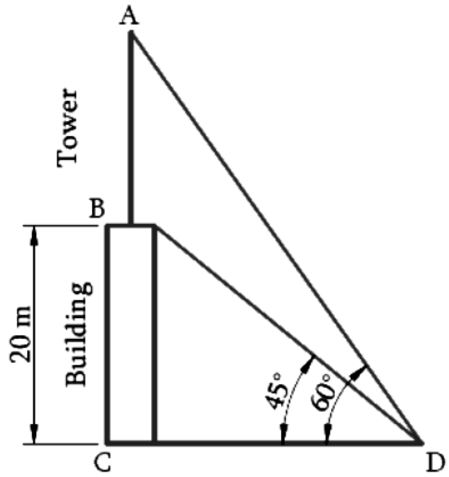
(b) If O is the centre of a circle, PQ is a chord and the tangent PR at P makes an angle of 40° with PQ, then find the measure of ∠POQ.



Ans. $\angle RPQ = 40°$ (given)
$\angle OPR = 90°$ (radius ⊥ tangent)

⇒ ∠OPQ = 90° – 40° = 50°
In ΔPOQ, OP = OQ (radii of same circle)
⇒ ∠OPQ = ∠OQP = 50° (angles opposite to equal sides)
Now, ∠OPQ + ∠OQP + ∠POQ = 180°
⇒ 50° + 50° + ∠POQ = 180°
⇒ ∠POQ = 80°

31. From a point on a ground, the angle of elevation of bottom and top of a transmission tower fixed on the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower.
Ans: Let the height of the building is BC, the height of the transmission tower which is fixed at the top of the building be AB.



D is the point on the ground from where the angles of elevation of the bottom B and the top A of the transmission tower AB are 45° and 60° respectively.
The distance of the point of observation D from the base of the building C is CD.
Combined height of the building and tower = AC = AB + BC
In ΔBCD, tan 45° = BC/CD
⇒ 1 = 20/CD
⇒ CD = 20
In ΔACD, tan 60° = AC/CD
⇒ √3 = AC/20
⇒ AC = 20√3
Height of the tower, AB = AC - BC
⇒ AB = 20√3 - 20 m = 20 (√3 - 1) m

SECTION-D

Questions 32 to 35 carry 5 marks each

32. A motorboat whose speed in still water is 9 km/h, goes 15km downstream and comes back to the same spot, in a total time of 3 hours 45 minutes. Find the speed of the stream.
Ans: Let speed of stream be x km/h.
Given, Speed of boat = 9 km/h
Distance covered upstream = 15 km
Distance covered downstream = 15 km
Total time taken = 3 hours 45 minutes = 15/4 hours
Now, Speed of boat upstream = 9 − x km/h
Speed of boat downstream = 9 + x km/h
According to the question, $\frac{15}{9+x}+\frac{15}{9-x}=\frac{15}{4}$

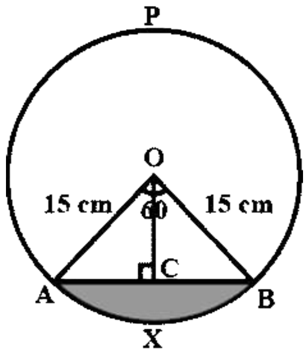
$\Rightarrow \frac{1}{9+x}+\frac{1}{9-x}=\frac{1}{4} \Rightarrow \frac{9-x+9+x}{(9+x)(9-x)}=\frac{1}{4} \Rightarrow \frac{18}{(9+x)(9-x)}=\frac{1}{4}$

$\Rightarrow \frac{18}{81-x^2} = \frac{1}{4}$
$\Rightarrow 81 - x^2 = 72$
$\Rightarrow x^2 = 9$
$\Rightarrow$ x = 3 (x is the speed of the stream and thus cannot have negative value)
Thus, the speed of the stream is 3 km/hr.

OR

A takes 6 days less than the time taken by B to finish a piece of work. If both A And B together can finish it in 4 days, find the time taken by B to finish the work.
Ans: Let B takes a total of x days to complete the work alone.
So as know that A takes 6 days less than B we can write that A takes
x - 6 days to complete the work alone.
Work done by B in a day = $\frac{1}{x}$
Work done by A in a day = $\frac{1}{x-6}$
According to the question, $\frac{1}{x} + \frac{1}{x-6} = \frac{1}{4} \Rightarrow \frac{x-6+x}{x(x-6)} = \frac{1}{4} \Rightarrow \frac{2x-6}{x(x-6)} = \frac{1}{4}$
$\Rightarrow 8x - 24 = x^2 - 6x$
$\Rightarrow x^2 - 14x + 24 = 0$
$\Rightarrow x^2 - 12x - 2x + 24 = 0$
$\Rightarrow x(x - 12) - 2(x - 12) = 0$
$\Rightarrow$ x = 2, 12
We will reject x = 2 as x − 6 will become negative.
Hence, B takes 12 days to complete the work alone.

33. A chord of a circle of radius 15 cm subtends an angle of 60° at the centre. Find the areas of the corresponding minor and major segments of the circle. (Use π = 3.14 and √3 = 1.73)
Ans: Here, O is the centre of circle, AB is a chord
AXB is a major arc, OA = OB = radius = 15 cm
Arc AXB subtends an angle 60º at O.
Area of sector $AOB = \frac{60}{360} \times \pi \times r^2 = \frac{60}{360} \times 3.14 \times (15)^2 = 117.75\, cm^2$

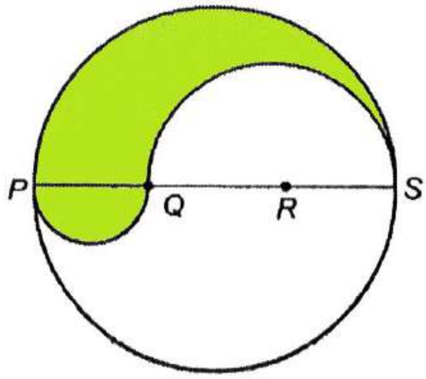


Area of minor segment (Area of Shaded region) = Area of sector AOB − Area of △ AOB
By trigonometry, AC = 15sin30º and OC = 15cos30º
Also, AB = 2AC
∴ AB = 2 × 15sin30º = 15 cm
$\therefore OC = 15\cos 30^0 = 15\frac{\sqrt{3}}{2} = 15 \times \frac{1.73}{2} = 12.975$
∴ Area of △AOB = 0.5×15×12.975 = 97.3125cm^2
∴ Area of minor segment (Area of Shaded region) =117.75 − 97.3125 = 20.4375 cm^2
Area of major segment = Area of circle − Area of minor segment

$= (3.14\times15\times15) - 20.4375 = 686.0625\ cm^2$

OR

PQRS is a diameter of a circle of radius 6 cm. The lengths PQ, QR and RS are equal. Semi-circles are drawn on PQ and QS as diameters as shown in below figure. Find the perimeter and area of the shaded region



Ans: Here, PS = 12 cm

as $PQ = QR = RS = \frac{1}{3} \times PS = \frac{1}{3} \times 12 = 4$ cm

and $QS = 2PQ \Rightarrow QS = 2 \times 4 = 8$ cm

Area of shaded region: A = area of a semicircle with PS as diameter + area of a semicircle with PQ as diameter – the area of a semicircle with QS as diameter;

$= \frac{1}{2}\ [\ 3.14 \times 6^2 + 3.14 \times 2^2 - 3.14 \times 4^2\ ]$

$= \frac{1}{2}\ [\ 3.14 \times 36 + 3.14 \times 4 - 3.14 \times 16\ ]$

$= \frac{1}{2}\ [\ 3.14\ (\ 36 + 4 - 16)]$

$= \frac{1}{2}\ (\ 3.14 \times 24\ ) = \frac{1}{2} \times 75.36 = 37.68\ cm^2$

The area of shaded region = $37.68\ cm^2$.

The perimeter of the shaded region = Arc of the semicircle of radius 6 +Arc of the semicircle of radius 4 + Arc of the semicircle of radius 2

$= (6\pi + 4\pi + 2\pi) = 12\pi$

$= 12 \times \frac{22}{7} = \frac{264}{7} = 37.71$ cm

34. Prove that if a line is drawn parallel to one side of a triangle intersecting the other two sides in distinct points, then the other two sides are divided in the same ratio.

Using the above theorem prove that a line through the point of intersection of the diagonals and parallel to the base of the trapezium divides the non parallel sides in the same ratio.

Ans: For the Theorem :

Given, To prove, Construction and figure of 1½ marks

Proof of 1½ marks

Let ABCD be a trapezium DC ∥ AB and EF is a line parallel to AB and hence to DC.

Join AC, meeting EF in G.

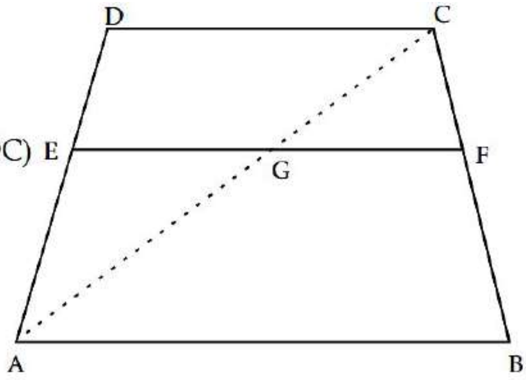
In ΔABC, we have $GF \parallel AB$

$\frac{CG}{GA} = \frac{CF}{FB}$ [By BPT] ...(1)

In ΔADC, we have $EG \parallel DC$ ($EF \parallel AB$ & $AB \parallel DC$)

$\frac{DE}{EA} = \frac{CG}{GA}$ [By BPT] ...(2)

From (1) & (2), we get, $\frac{DE}{EA} = \frac{CF}{FB}$



35. A survey regarding the heights (in cm) of 50 girls of class Xth of a school was conducted and the following data was obtained. Find the mean, median and mode of the given data.

Heights (in cm)	120 – 130	130 – 140	140 – 150	150 – 160	160 – 170
No. of Girls	2	8	12	20	8

Ans:

Height (in cm)	Number of girls	Cumulative frequency
120 – 130	2	2
130 – 140	8	10
140 – 150	$12 = f_0$	$22 = c.f.$
150 – 160	$20 = f_1$	42
160 – 170	$8 = f_2$	50
Total	50	

$n = 50 \Rightarrow \frac{n}{2} = 25$

$\therefore$ Median class = 150 – 160

$l = 150$, $c.f. = 22$, $f = 20$, $h = 10$

$\therefore$ Median $= l + \frac{\frac{n}{2} - c.f.}{f} \times h$

$= 150 + \frac{25-22}{20} \times 10 = 150 + 1.5 = 151.5$

Modal class = 150 – 160

$l = 150$, $h = 10$, $f_1 = 20$, $f_0 = 12$, $f_2 = 8$

Mode $= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 150 + \frac{20-12}{2 \times 20 - 12 - 8} \times 10 = 150 + 4 = 154$

Now, Mode = 3 Median – 2 Mean

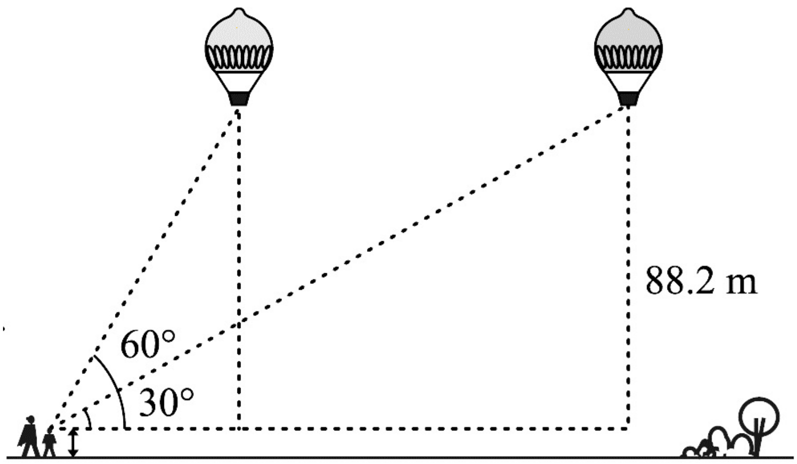
$\Rightarrow 154 = 3 \times 151.5 - 2$ Mean $\Rightarrow 154 - 454.5 = -2$ Mean

$\Rightarrow 300.5 = 2$ Mean $\Rightarrow$ Mean $= \frac{300.5}{2} = 150.25$

SECTION-E (Case Study Based Questions)

Questions 36 to 38 carry 4 marks each

36. A 1.2 m tall girl spots a balloon moving with the wind in a horizontal line at a height of 88.2 m from the ground. The angle of elevation of the balloon from the eyes of the girl at any instant is 60°. After 30 seconds, the angle of elevation reduces to 30° (see the below figure).



Based on the above information, answer the following questions. (Take √3 =1.732)
(i) Find the distance travelled by the balloon during the interval. (2)
(ii) Find the speed of the balloon. (2)

OR

(ii) If the elevation of the sun at a given time is 30°, then find the length of the shadow cast by a tower of 150 feet height at that time. (2)

Ans: (i) In the figure, let C be the position of the observer (the girl).
A and P are two positions of the balloon.
CD is the horizontal line from the eyes of the (observer) girl.
Here PD = AB = 88.2 m − 1.2 m = 87 m

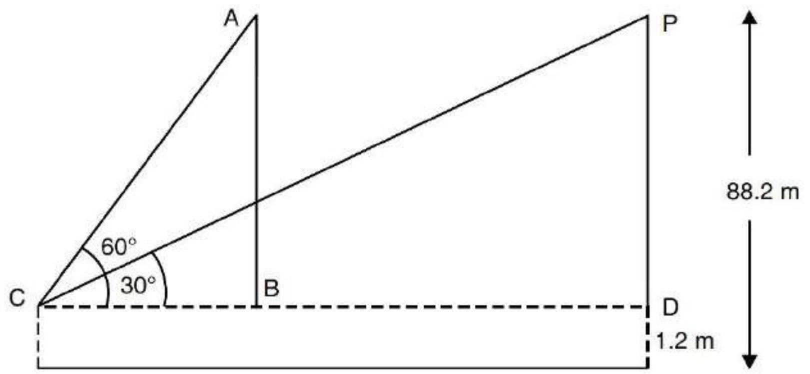
In right $\Delta\, ABC$, we have $\frac{AB}{BC} = \tan 60°$

$$\Rightarrow \frac{87}{BC} = \sqrt{3} \Rightarrow BC = \frac{87}{\sqrt{3}}\text{ m}$$

In right $\Delta\, PDC$, we have $\frac{PD}{CD} = \tan 30°$

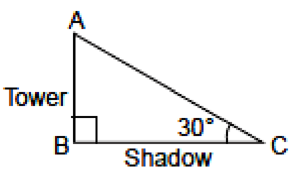
$$\Rightarrow \frac{87}{CD} = \frac{1}{\sqrt{3}} \Rightarrow CD = 87\sqrt{3}$$

Now, $BD = CD - BC = 87\sqrt{3} - \frac{87}{\sqrt{3}} = 58\sqrt{3}$ m



Thus, the required distance between the two positions of the balloon = 58 √3 m
= 58 x 1.732 = 100.46 m (approx.)
(ii) Speed of the balloon = Distance/time = 100.46/30 = 3.35 m/s (approx.)

OR

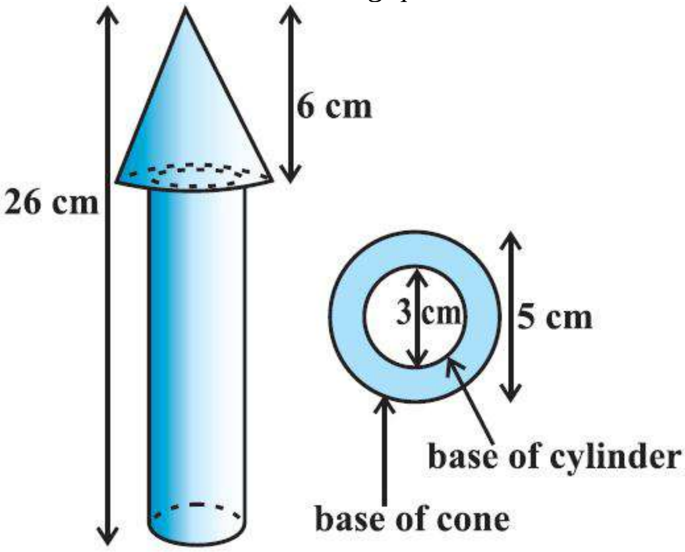


In right ΔABC

$$\frac{AB}{BC} = \tan 30° \Rightarrow \frac{150}{BC} = \frac{1}{\sqrt{3}} \Rightarrow BC = 150\sqrt{3}\text{ feet}$$

37. In a toys manufacturing company, wooden parts are assembled and painted to prepare a toy. One specific toy is in the shape of a cone mounted on a cylinder. For the wood processing activity center, the wood is taken out of storage to be sawed, after which it undergoes rough polishing, then is cut, drilled and has holes punched in it. It is then fine polished using sandpaper. For the retail packaging and delivery activity center, the polished wood sub-parts are assembled together, then decorated using paint. The total height of the toy is 26 cm and the height of its conical part is 6 cm.

The diameters of the base of the conical part is 5 cm and that of the cylindrical part is 3 cm. On the basis of the above information, answer the following questions:



(a) If its cylindrical part is to be painted yellow, find the surface area need to be painted. [1]
(b) If its conical part is to be painted green, find the surface area need to be painted. [2]

OR

(b) Find the volume of the wood used in making this toy. [2]
(c) If the cost of painting the toy is 3 paise per sq cm, then find the cost of painting the toy. (Use $\pi = 3.14$) [1]

Ans: Let the radius of cone be r, slant height of cone be l, height of cone be h, radius of cylinder be r′ and height of cylinder be h′.

Then r = 2.5 cm, h = 6 cm, r′ = 1.5 cm, h′ = 26 – 6 = 20 cm and

Slant height, $l = \sqrt{r^2 + h^2} = \sqrt{2.5^2 + 6^2} = \sqrt{6.25 + 36} = \sqrt{42.25} = 6.5cm$

(a) Area to be painted yellow = CSA of the cylinder + area of one base of the cylinder

$= 2\pi r'h' + \pi(r')^2 = \pi r'(2h' + r') = (3.14 \times 1.5)(2 \times 20 + 1.5)\ cm^2$

$= 4.71 \times 41.5\ cm^2$

$= 195.465\ cm^2$

(b) Area to be painted green = CSA of the cone + base area of the cone – base area of the cylinder

$= \pi rl + \pi r^2 - \pi(r')^2 = \pi[(2.5 \times 6.5) + (2.5)^2 - (1.5)^2]\ cm^2$

$= \pi[20.25]\ cm^2 = 3.14 \times 20.25\ cm^2$

$= 63.585\ cm^2$

OR

Volume of wood used in making the toy = Volume of cone + Volume of cylinder

$$= \frac{1}{3}\pi r^2 h + \pi r'^2 h' \quad = \pi\left[\frac{1}{3}r^2 h + r'^2 h'\right] \quad = 3.14\left[\frac{1}{3} \times 2.5 \times 2.5 \times 6 + 1.5 \times 1.5 \times 20\right]$$

$$= 3.14(12.5 + 45) = 180.55cm^3$$

(c) Total area of painting = 195.465 + 63.585 = 259.05 cm^2

Cost of painting 1 cm^2 = Re. 0.03

Total cost of painting = Rs. 0.03 x 256.05

= Rs. 7.77

38. Aditya is a fitness freak and great athlete. He always wants to make his nation proud by winning medals and prizes in the athletic activities.

An upcoming activity for athletes was going to be organised by Railways. Aditya wants to participate in 200 m race. He can currently run that distance in 51 seconds. But he wants to increase his speed, so to do it in 31 seconds. With each day of practice, it takes him 2 seconds less.
(i) He wants to makes his best time as 31 sec. In how many days will be able to achieve his target?
(ii) What will be the difference between the time taken on 5th day and 7th day.

OR

(ii) Which term of the arithmetic progression 3, 15, 27, 39 .... will be 120 more than its 21st term?
Ans: Ans:
(i) Let, the number of days taken to achieve the target be n.
In the given A.P., $a = 51$, $d = -2$
Since $an = a + (n - 1)d \Rightarrow 31 = 51 + (n - 1)(-2)$
$\Rightarrow 31 - 51 = (n - 1)(-2) \Rightarrow -20 = (n - 1)(-2)$
$\Rightarrow (n - 1) = 10 \Rightarrow n = 11$
Hence, 11 days are needed to achieve the target.
(ii) $a_5 = a + 4d = 51 + 4(-2) = 51 - 8 = 43$ sec
$a_7 = a + 6d = 51 + 6(-2) = 51 - 12 = 39$ sec
Now, time difference = 43 – 39 = 4 sec.

OR

(ii) We have, $a = 3$ and $d = 12$
$\therefore a_{21} = a + 20d = 3 + 20 \times 12 = 243$
Let nth term of the given AP be 120 more than its 21st term. Then, $a_n = 120 + a_{21}$
$\Rightarrow 3 + (n - 1)d = 120 + 243$
$\Rightarrow 3 + 12(n - 1) = 363 \Rightarrow 12(n - 1) = 360$
$\Rightarrow n - 1 = 30 \Rightarrow n = 31$
Hence, 31st term of the given AP is 120 more than its 21st term.