Date: 15/05/2026

Question Paper Code

30/8/2

SET-2

Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot-13, Sector-18, Udyog Vihar, Gurugram, Haryana-122015

Time: 3 Hrs.

Max. Marks: 80

MATHEMATICS (Standard)

CBSE Class-X (2026) Phase-2

Answers & Solutions

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them :

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

(ii) This question paper is divided into **FIVE** Sections - **A, B, C, D** and **E**.

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

(iv) In **Section-B**, Question numbers **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.

(v) In **Section-C**, Question numbers **26** to **31** are short answer (SA) type questions, carrying **3** marks each.

(vi) In **Section-D**, Question numbers **32** to **35** are long answer (LA) type questions carrying **5** marks each.

(vii) In **Section-E**, Question numbers **36** to **38** are case study based questions carrying **4** marks each. Internal choice is provided in **2** marks question in each case-study.

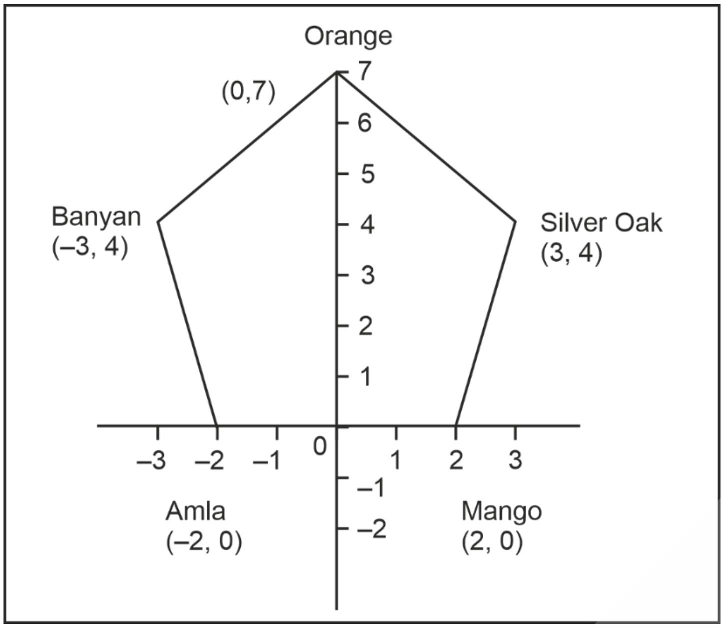
(viii) There is no overall choice. However, an internal choice has been provided in **2** questions in Section-**B**, **2** questions in Section-**C**, **2** questions in Section-**D** and **3** questions Section-**E**.

(ix) Draw neat diagrams wherever required. Take π = 22/7 wherever required, if not stated.

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

SECTION-A

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

1. 

5 trees Banyan, Silver Oak, Orange, Amla and Mango were planted in the garden as shown in the figure. If 1 unit = 1 m in the figure, which of the following trees are at a distance of 4 metres? **[1]**

(A) Amla and Mango (B) Mango and Silver Oak

(C) Silver Oak and Orange (D) Orange and Mango

Answer (A) **[1]**

Sol. Amla and Mango

Distance between Amla and Mango tree = $\sqrt{(2+2)^2+(0-0)^2}$

$= 4$ meters

2. The sum of ages of Sania and Yogesh is 50 years. If now Sania is twice as old as Yogesh was 5 years ago, then present age of Sania is : **[1]**

(A) 40 years (B) 35 years

(C) 20 years (D) 30 years

Answer (D) **[1]**

Sol. Let Sania's age be x years and Yogesh's age be y years, then

$x + y = 50$ …(i)

and $x = 2(y - 5)$

$\Rightarrow$ $x - 2y = -10$ …(ii)

Solving (i) and (ii), we get

$x = 30$ and $y = 20$

3. If mean of a frequency distribution is 7.5, $\Sigma f_i x_i = 120 + 3k$ and $\Sigma f_i = 30$, then value of k is **[1]**

(A) 45 (B) 50

(C) 35 (D) 40

Answer (C) **[1]**

Sol. Mean = $\dfrac{\sum x_i f_i}{\sum f_i}$

$\Rightarrow \quad 7.5 = \dfrac{120 + 3k}{30}$

$\Rightarrow \quad k = 35$

4. If the base radius of a cone and a cylinder are equal and their curved surface areas are also equal, then ratio of the slant height of cone to that of the height of cylinder is : **[1]**

(A) 2 : 1 (B) 1 : 3

(C) 1 : 2 (D) 3 : 1

Answer (A) **[1]**

Sol. CSA of cone = CSA of cylinder

$\Rightarrow \quad \pi rl = 2\pi rh$

$\Rightarrow \quad \dfrac{l}{h} = 2$

5. A jar contains some red, black and green marbles. If probability of getting a red marble is $\dfrac{1}{5}$ and probability of getting a black marble is $\dfrac{1}{4}$ and jar contains total 11 green marbles, then total number of marbles that were there in the jar is **[1]**

(A) 20 (B) 40

(C) 11 (D) 9

Answer (A) **[1]**

Sol. Let, total number of marbles be x

$P(R) = \dfrac{\text{Red marbles}}{x} = \dfrac{1}{5}$

$P(B) = \dfrac{\text{Black marbles}}{x} = \dfrac{1}{4}$

$\Rightarrow$ Red marbles = $\dfrac{x}{5}$ and

Black marbles = $\dfrac{x}{4}$

Now,

$\dfrac{x}{5} + \dfrac{x}{4} + 11 = x$

$\Rightarrow \quad \dfrac{4x + 5x + 220}{20} = x$

$\Rightarrow \quad 9x + 220 = 20x$

$\therefore \quad x = 20$

6. The area of a semi-circular disc whose diameter is 'd', is **[1]**

(A) πd^2

(B) $\frac{\pi d^2}{2}$

(C) $\frac{\pi d^2}{8}$

(D) $\frac{\pi d^2}{4}$

Answer (C) **[1]**

Sol. Diameter = d

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

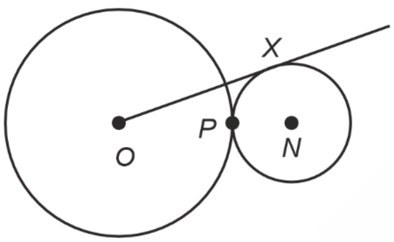
Area of circle = πr^2

Area of semicircle = $\frac{1}{2}\pi r^2$

$= \frac{1}{2}\pi\left(\frac{d}{2}\right)^2$

$= \frac{\pi d^2}{8}$

7.



Two circles with centres O and N touch each other at the point P as shown in the figure. O, P and N are collinear. Radius of the circle with centre O is twice that of the circle with centre N. OX is tangent to the circle with centre N and OX = 18 cm. The radius of the circle with centre N is : **[1]**

(A) $\frac{18}{\sqrt{2}}$ cm

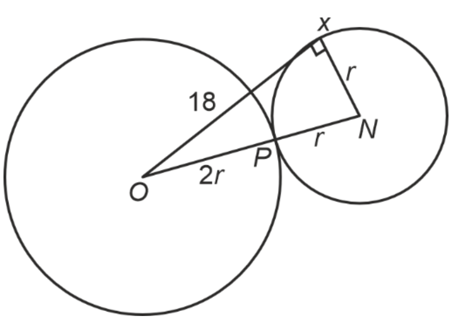
(B) 9 cm

(C) $\frac{9}{\sqrt{2}}$ cm

(D) $\frac{18}{\sqrt{10}}$ cm

Answer (C) **[1]**

Sol. Let, radius of circle with centre N be r. Then, radius of circle with centre 'O' will be $2r$.



OX = 18 cm

$\therefore \quad (2r + r)^2 = r^2 + 18^2$

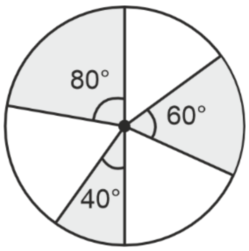
$9r^2 = r^2 + 18^2$

$8r^2 = 18^2$

$\therefore \quad r = \dfrac{18}{2\sqrt{2}}$

$r = \dfrac{9}{\sqrt{2}}$ cm

8.



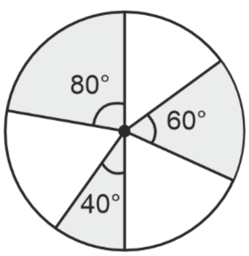
In the figure, three sectors of a circle of radius 7 cm making central angles 60°, 80° and 40° are shown. The area of the shaded region is : **[1]**

(A) 77 cm^2 (B) 22 cm^2

(C) 154 cm^2 (D) 0 cm^2

Answer (A) **[1]**

Sol. Radius = 7 cm.



$\because$ Area of sector = $\dfrac{\pi r^2 \theta}{360°}$

Required area of sector $= \dfrac{\pi 7^2 \cdot (80° + 60° + 40°)}{360°}$

$= \dfrac{\pi \cdot 7^2 \cdot 180°}{360°}$

$= \dfrac{22 \cdot 7^2}{7.2}$

$= 77$ cm^2

9. If the roots of a quadratic equation $ax^2 + bx + c = 0$ are equal but opposite in sign, then : **[1]**

(A) $a = 0$ (B) $b = 0$

(C) $b \neq 0$ (D) $a < b$

Answer (B) **[1]**

Sol. Roots are equal but opposite in signs

Let roots be α and $-\alpha$

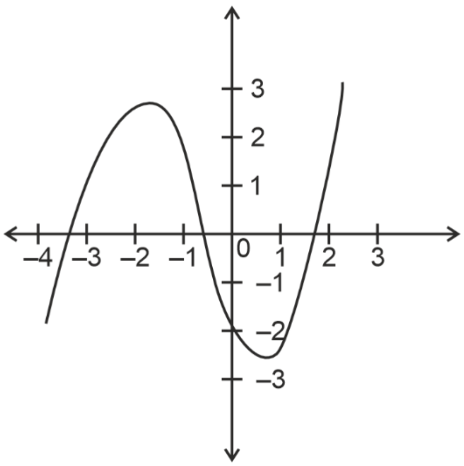
$\alpha + (-\alpha) = 0$

$\frac{-b}{a} = 0$

$\Rightarrow \quad b = 0$

Option (B) is correct.

10.



Here is the geometrical representation of a polynomial. How many zeroes does it have? **[1]**

(A) 3 (B) 1

(C) 2 (D) 4

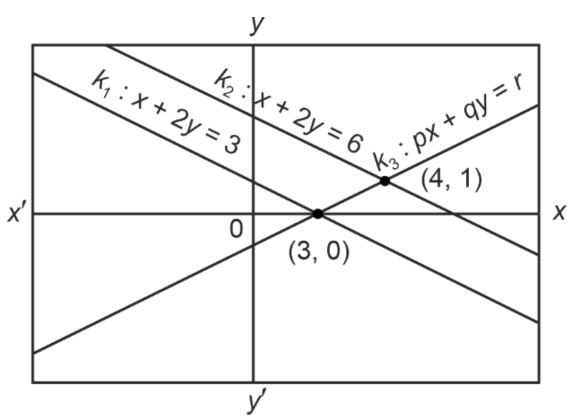
Answer (A) **[1]**

Sol. 3 zeroes

Option (A) is correct.

11. Three lines k_1, k_2, k_3 represent three different equations as shown in the figure below. Solution of the equations represented by lines k_1 and k_3 is $x = 3$, $y = 0$, while solution of equations represented by lines k_2 and k_3 is $x = 4$, $y = 1$.

Which of the following is the equation of line k_3? **[1]**



(A) $x - y = 3$ (B) $x - y = -3$

(C) $x + y = 3$ (D) $x + y = 1$

Answer (A) **[1]**

Sol. $px + qy = r$

$3p + q(0) = r$

$3p = r$ ...(i)

$4p + q = r$

$4p + q = 3p$

$p + q = 0$

12. Which term of A.P. 21, 18, 15, ... is zero? **[1]**

(A) 9^{th} (B) 5^{th}

(C) 8^{th} (D) 10^{th}

Answer (C) **[1]**

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

$0 = 21 + (n-1)(-3)$

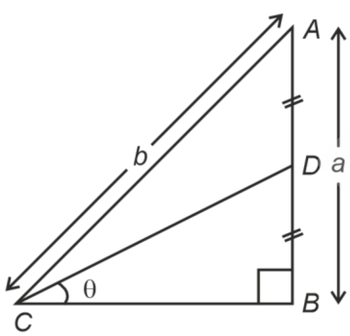
$0 = 21 - 3(n-1)$

$3(n-1) = 21$

$n - 1 = 7$

$\boxed{n = 8}$

13.



In the figure, $AD = DB$, $\angle B$ is a right angle and $\angle BCD = \theta$, $AC = b$ and $AB = a$. Then, $\tan\theta$ is equal to **[1]**

(A) $\frac{2a}{\sqrt{b^2 - a^2}}$ (B) $\frac{a}{2\sqrt{b^2 - a^2}}$

(C) $\frac{a}{2\sqrt{b^2 + a^2}}$ (D) $\frac{a}{2(b^2 - a^2)}$

Answer (B) **[1]**

Sol. $BC = \sqrt{b^2 - a^2}$

$$\tan\theta = \frac{\frac{a}{2}}{\sqrt{b^2 - a^2}}$$

$$\tan\theta = \frac{a}{2\sqrt{b^2 - a^2}}$$

14. For which value(s) of 'p' will the lines represented by the following pair of linear equations be parallel?

$3x - y - 5 = 0$ and $6x - 2y - p = 0$ **[1]**

(A) $\frac{1}{2}$ (B) 10

(C) $\frac{5}{2}$ (D) All real values except 10

Answer (D) **[1]**

Sol. For parallel lines,

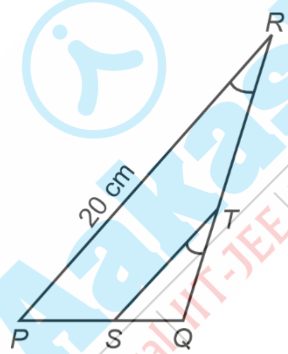
$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$$

$$\frac{3}{6} = \frac{-1}{-2} \neq \frac{-5}{-p}$$

$$\frac{1}{2} \neq \frac{5}{p}$$

$$p \neq 10$$

15. PQR is a triangle in which PR = 20 cm as shown in the figure. Line ST is drawn such that $\angle PRQ = \angle STQ$. If ST divides side QR in ratio 2 : 3, then the length of ST is : **[1]**

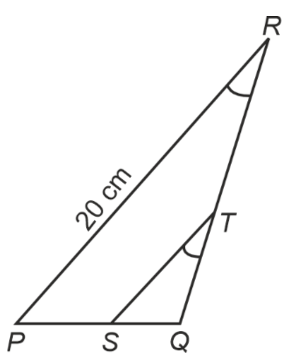


(A) $\frac{10}{3}$ cm (B) 8 cm

(C) 12 cm (D) $\frac{40}{3}$ cm

Answer (B) **[1]**

Sol.



$\angle PRQ = \angle STQ$ (Given)

$\angle PQR = \angle SQT$ (Common)

$\Delta PRQ \sim \Delta STQ$ (AA Similarly)

$$\frac{PR}{ST} = \frac{RQ}{TQ} = \frac{5}{2}$$

$$\frac{20}{ST} = \frac{5}{2} \text{ or } \boxed{ST = 8 \text{ cm}}$$

16. Suppose box *A* has 4 green and 5 black balls. Box *B* has 7 green and 8 red balls and box *C* has 8 green and 10 yellow balls. Which box has greatest probability of getting a green ball ? **[1]**

(A) Box *A* (B) Box *B*

(C) Box *C* (D) Can't say

Answer (B) **[1]**

Sol. Probability of getting a green ball in box $A = \frac{4}{9}$

Probability of getting a green ball in box $B = \frac{7}{15}$

Probability of getting a green ball in box $C = \frac{8}{18}$

17. What happens to the angle of elevation of the top of a tower, if distance between tower and observer is doubled? **[1]**

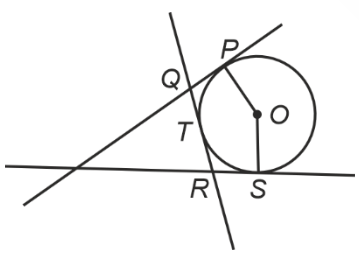
(A) Increases (B) Decreases

(C) Becomes 0° (D) Remains the same

Answer (B) **[1]**

Sol. If distance between tower and observer is doubled then angle of elevation decreases.

18. In the given figure, there is a circle with centre '*O*' having three tangents at points *P*, *T* and *S*. If *QR* = 12 cm and radius of a circle is 7 cm, then perimeter of polygon *PQRSO* is : **[1]**



(A) 26 cm (B) 31 cm

(C) 38 cm (D) 33 cm

Answer (C) **[1]**

Sol. ∵ *QR* = 12 cm

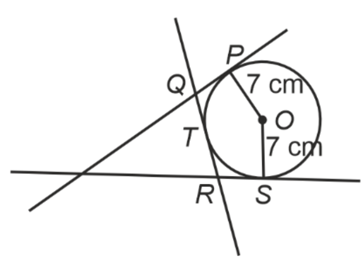
Radius = 7 cm

∵ *QP* = *QT* and

TR = *RS*

QR = *QT* + *TR*

∴ 12 = *QP* + *RS*



Perimeter of polygon PQRSO = 7 + 7 + 12 + 12

= 38 cm

(Assertion-Reason based questions)

Directions : Question Numbers **19** and **20** are Assertion (A) and Reason (R) based questions. Two statements are given, one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the options (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):** The number 12^n ends with digit 0 where '*n*' is a natural number.

Reason (R): Any number ends with digit 0 if its prime factor is of the form $2^m \times 5^n$, where 'm' and 'n' are natural numbers. **[1]**

Answer (D) **[1]**

Sol. 12^n can end with 2, 4, 8 or 6. So, assertion is false. But, reason is true.

20. **Assertion (A):** If values of Mode and Mean of a data are 60 and 66 respectively, then the value of Median is 64.

Reason (R): For any data, 2 Mean = Mode + 3 Median. **[1]**

Answer (A) **[1]**

Sol. $\because$ Mode = 3 Median – 2 mean

60 = 3 median – 2(66)

3 median = 60 + 132

= 192

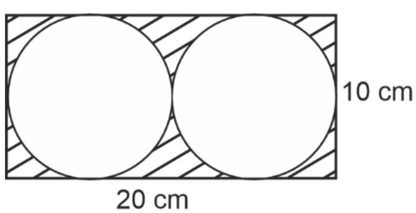
$\therefore$ Median = 64

So, assertion is correct. Also, reason is correct.

SECTION-B

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

21. (a) In the figure, find the area of the shaded region. **[2]**

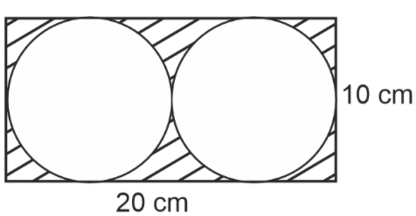


(Take π = 3.14)

OR

(b) Find the radius of the circle whose one sector has area of 66 sq. cm. and the length of its arc is 22 cm. **[2]**

Sol. (a) Radius of each circle = 5 cm



Area of circles = $2\pi r^2$ [½]

= $2 \times 3.14 \times 5^2$

= 157 cm^2 [½]

∴ Area of shaded region = (20 × 10) – 157 [½]

= 43 cm^2 [½]

OR

(b) Area of sector $= \frac{\pi r^2\theta}{360^\circ} = 66\ cm^2$ ...(i) [½]

And length of its arc $= \frac{2\pi r\theta}{360^\circ} = 22$ cm ...(ii) [½]

$\Rightarrow \quad \frac{\pi r\theta}{360^\circ} = 11$ [½]

Substituting it in (i), we get

$11r = 66$

$\Rightarrow \quad r = 6$ cm [½]

22. (a) Find the greatest number which divides 37, 66, 89, leaving remainder 2, 3, 5 respectively. [2]

OR

(b) Sum and difference of two numbers is 256 and 224 respectively. Find their HCF and LCM. [2]

Sol. (a) Here,

37 – 2 = 35,

66 – 3 = 63

And 89 – 5 = 84 [½]

Now, HCF (35, 63, 84) = 7 [∵ 35 = 5 × 7, 63 = 7 × 9 and 84 = 7 × 12] [1]

∴ The required number is 7. [½]

OR

(b) Let the two numbers be x and y

$x + y = 256$ ...(i)

and $x - y = 224$ ...(ii) [½]

Solving (i) and (ii), we get

$x = 240$ and $y = 16$ [½]

∴ HCF (240, 16) = 16 [∵ 240 = 16 × 15] [½]

And LCM (240, 16) = 240 [∵ 240 = 16 × 15] [½]

23. If 'α' and 'β' are the roots of quadratic equation $x^2 + (k^2 - 1)x - 20 = 0$ such that $\alpha^2 - \beta^2 - \alpha\beta = 29$ and $\alpha - \beta = 9$, then find the value of k. [2]

Sol. $x^2 + (k^2 - 1)x - 20 = 0$ [Given]

Roots are α and β

From given quadratic equation

$$\alpha + \beta = -\frac{(k^2 - 1)}{1}$$ [½]

$\alpha\beta = \frac{-20}{1}$ **[½]**

$\because$ $\alpha^2 - \beta^2 - \alpha\beta = 29$ [Given]

$(\alpha - \beta)(\alpha + \beta) - \alpha\beta = 29$

$9(\alpha + \beta) - (-20) = 29$ [$\because$ $\alpha - \beta = 9$ given]

$\Rightarrow$ $\alpha + \beta = 1$ **[½]**

Now,

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

$-1 = k^2 - 1$

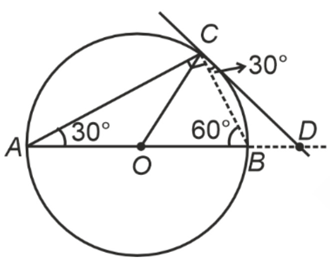
$k^2 = 0$

$\therefore$ $k = 0$ **[½]**

24. *AB* is diameter of a circle and *AC* is its chord such that $\angle BAC = 30°$. If the tangent at *C* intersects *AB* extended at *D*, then prove that *BC* = *BD*. **[2]**

Sol. To prove : *BC* = *BD*

Since, *AB* is the diameter of circle,



$\therefore$ $\angle ACB = 90°$ (Angle in semicircle) **[½]**

In ΔABC,

$\angle BAC = 30°$ and $\angle ACB = 90°$

$\therefore$ $\angle ABC = 180° - (30° + 90°)$

$\angle ABC = 60°$ **[½]**

$\angle BOC = \angle OBC = 60°$

$\Rightarrow$ $\angle BCD = 90° - 60° = 30°$ [$\because$ $OC \perp CD$] **[½]**

$\angle CBD = 180° - 60° = 120°$

In ΔBCD,

$\angle BDC + 30° + 120° = 180°$

$\angle BDC = 30°$

$\angle BDC = \angle BCD$

$\Rightarrow$ opposite sides are equal

$\therefore$ $BC = BD$ **[½]**

25. If points $A(1, 2)$, $B(4, y)$, $C(x, 6)$ and $D(3, 5)$ are the vertices of a parallelogram $ABCD$, then find values of x and y. **[2]**

Sol. Given vertices :

$A(1, 2)$, $B(4, y)$, $C(x, 6)$ and $D(3, 5)$

Diagonals bisect each other in a parallelogram.

Their midpoints must be equal

Mid-point of $AC = \left(\frac{1+x}{2}, \frac{2+6}{2}\right)$ [½]

$= \left(\frac{1+x}{2}, 4\right)$

Mid-point of $BD = \left(\frac{4+3}{2}, \frac{y+5}{2}\right)$

$= \left(\frac{7}{2}, \frac{y+5}{2}\right)$ **[½]**

For x :

$\frac{1+x}{2} = \frac{7}{2}$

$\Rightarrow \quad 1 + x = 7$

$\Rightarrow \quad x = 6$ **[½]**

For y :

$4 = \frac{y+5}{2}$

$\Rightarrow \quad 8 = y + 5$

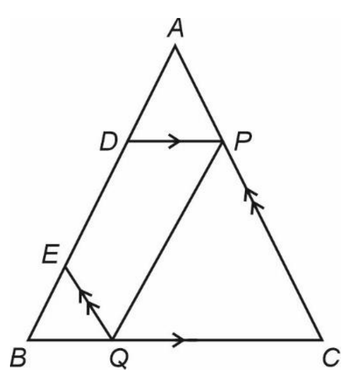
$\Rightarrow \quad y = 3$ **[½]**

$\therefore \quad x = 6, y = 3$

SECTION-C

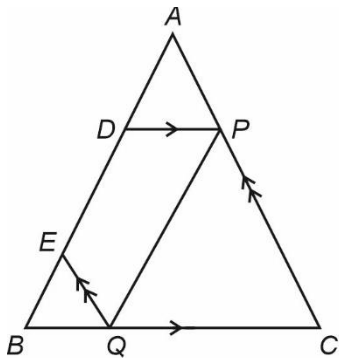
Question numbers 26 to 31 are short answer type questions of 3 marks each.

26. In the given figure, ABC is a triangle in which D, E are two points on the side AB such that $AD = BE$. If $DP \parallel BC$ and $EQ \parallel AC$, then prove that $PQ \parallel AB$. **[3]**



Sol. Given : $DP \parallel BC$, $EQ \parallel AC$ and $AD = BE$

To prove : $PQ \parallel AB$ **[½]**



Proof : We know that,

$\frac{AD}{BD} = \frac{AP}{CP}$ [By BPT] **[½]**

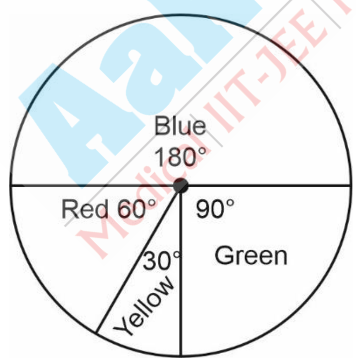
And $\frac{BE}{AE} = \frac{BQ}{CQ}$ [By BPT] **[½]**

$\Rightarrow \frac{AP}{CP} = \frac{BQ}{CQ}$ [$\because$ $AD = BE$ (Given) and $BD = BE + DE = AD + DE = AE$] **[1]**

$\therefore$ $PQ \parallel AB$ [By converse of BPT]

Hence, proved **[½]**

27. (a) In a Carton, there were blue, red, green and yellow balls. There were 240 balls. The number of balls of each colour is represented in the following pie chart. If Shreya picked a ball at random, then what is the probability that she picked a yellow ball? If 20 more yellow balls were added to the carton, what is the probability that now she picked a ball which is yellow or green? **[3]**



OR

(b) Offices in Delhi are open for 5 days a week Monday to Friday. Two employees of an office remain absent for one day in the same particular week. Find the probability that they remain absent on the same day. Also, find the probability that it was a Friday. **[3]**

Sol. (a) Total balls = 240

Number of yellow balls = $\frac{240}{12}$ = 20 **[½]**

The probability that she picked yellow = $\frac{20}{240} = \frac{1}{12}$ **[½]**

If 20 balls added of yellow colour then total number of yellow balls = 20 + 20 = 40 **[½]**

Number of green balls = $\frac{240}{4}$ = 60 **[½]**

Probability that now she picked yellow or green = $\frac{60+40}{260}$ = $\frac{100}{260}$ = $\frac{5}{13}$ **[1]**

OR

(b) Employee *A* can be absent on any of the 5 days.

For employee *B* to be absent on the same day as *A*, these is only 1 favorable day out of 5 possible days.

So *P*(same day) = $\frac{1}{5}$ **[1½]**

Probability that the common absent day was Friday = $\frac{1}{5}$. **[1½]**

28. Solve for $x : \frac{4}{x} - 3 = \frac{5}{2x+3}, x \neq 0, \frac{-3}{2}$. **[3]**

Sol. $\frac{4}{x} - 3 = \frac{5}{2x+3}$

$\frac{4}{x} - \frac{5}{2x+3} = 3$ **[½]**

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

$8x + 12 - 5x = 3x(2x + 3)$ **[½]**

$3x + 12 = 6x^2 + 9x$

$6x^2 + 9x - 3x - 12 = 0$ **[½]**

$6x^2 + 6x - 12 = 0$

$x^2 + x - 2 = 0$

$x^2 + 2x - x - 2 = 0$ **[½]**

$x(x + 2) - 1(x + 2) = 0$

$(x - 1)(x + 2) = 0$ **[½]**

$\boxed{x = 1, -2}$ **[½]**

29. (a) Show that $\frac{3+\sqrt{3}}{5}$ is an irrational number, given $\sqrt{3}$ is an irrational number. Also, find an irrational number whose sum with given number is an irrational number. **[3]**

OR

(b) Sandhya has two pieces of cloth – one 144 cm wide and the other 96 cm. She wants to cut both the cloth pieces into equal sized strips such that one is as wide as possible with none left over. What is the width she can cut? How many pieces will she get in all? **[3]**

Sol. (a) Let $\frac{3+\sqrt{3}}{5}$ be a rational number. **[½]**

$\Rightarrow \frac{3+\sqrt{3}}{5} = \frac{a}{b}$, where *a* and *b* are co-prime integers and $b \neq 0$. **[½]**

$\Rightarrow \quad \sqrt{3} = \frac{5a}{b} - 3$ **[½]**

Here, $\sqrt{3}$ is an irrational number. [Given]

But, $\frac{5a}{b} - 3$ is rational number [$\because$ $\frac{a}{b}$ is a rational number] **[½]**

So, LHS $\neq$ RHS

$\therefore$ Our assumption was incorrect.

$\therefore$ $\frac{3+\sqrt{3}}{5}$ is an irrational number. **[½]**

Hence, proved.

Also, $\frac{3+\sqrt{3}}{5} + \sqrt{5}$ is an irrational number.

$\therefore$ $\sqrt{5}$ can be the required number. **[½]**

OR

(b) If Sandhya wants to cut equal sized strips such that one is as wide as possible with none left over, then we need to calculate the HCF of 144 and 96. **[½]**

Here,

$144 = 2^4 \times 3^2$

And $96 = 2^5 \times 3$ **[½]**

$\therefore$ HCF (144, 96) = $2^4 \times 3 = 48$ **[½]**

$\therefore$ The width of one strip = 48 cm **[½]**

Also,

$\frac{144}{48} + \frac{96}{48} = 3 + 2 = 5$ **[½]**

$\therefore$ She can cut total 5 strips. **[½]**

30. If point $P(x, y)$ is equidistant from points $Q(a + b, b - a)$ and $R(a - b, a + b)$, then prove that $bx = ay$. **[3]**

Sol. $P(x, y)$

$Q(a + b, b - a)$

$R(a - b, a + b)$

$\because$ P is equidistant from point Q and R

$\therefore$ $PQ = PR$ **[½]**

$\Rightarrow$ $PQ^2 = PR^2$

$\Rightarrow$ $[x-(a+b)]^2 + [y-(b-a)]^2 = [x-(a-b)]^2 + [y-(a+b)]^2$ **[½]**

$\Rightarrow$ $x^2 + (a+b)^2 - 2x(a+b) + y^2 + (b-a)^2 - 2y(b-a)$

$= x^2 + (a-b)^2 - 2x(a-b) + y^2 + (a+b)^2 - 2y(a+b)$ **[½]**

$\Rightarrow$ $-2x(a+b) - 2y(b-a) = -2x(a-b) - 2y(a+b)$ [$\because$ $(b-a)^2 = (a-b)^2$] **[½]**

$\Rightarrow \quad x(a+b)+y(b-a)=x(a-b)+y(a+b)$

$\Rightarrow \quad x(a+b-a+b)=y(a+b-b+a)$ **[½]**

$\Rightarrow \quad 2bx = 2ay$

$\Rightarrow \quad bx = ay$ **[½]**

31. Prove that : (cosec A – sin A)(sec A – cos A) = $\dfrac{1}{\tan A+\cot A}$ **[3]**

Sol. From LHS

(cosec A – sin A)(sec A – cos A)

$\Rightarrow \left(\dfrac{1}{\sin A}-\sin A\right)\left(\dfrac{1}{\cos A}-\cos A\right)$ **[½]**

$\Rightarrow \left(\dfrac{1-\sin^2 A}{\sin A}\right)\left(\dfrac{1-\cos^2 A}{\cos A}\right)$ **[½]**

$\Rightarrow \dfrac{\cos^2 A}{\sin A}\cdot\dfrac{\sin^2 A}{\cos A}$

$\Rightarrow \dfrac{\sin A.\cos A}{1}$ **[½]**

$\Rightarrow \dfrac{\sin A.\cos A}{\sin^2 A+\cos^2 A}$ **[½]**

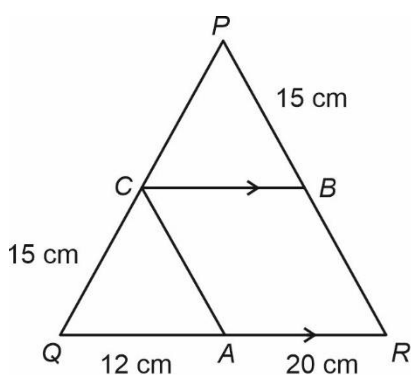
$\Rightarrow \dfrac{1}{\dfrac{\sin^2 A}{\sin A.\cos A}+\dfrac{\cos^2 A}{\sin A.\cos A}}$ **[½]**

$\Rightarrow \dfrac{1}{\tan A+\cot A}=\text{RHS}$ **[½]**

SECTION-D

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

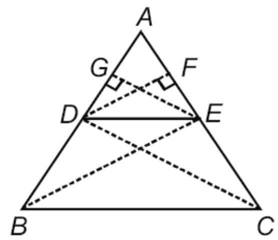
32. Prove that if a line is drawn parallel to one side of a triangle intersecting the other two sides at distinct points, then the other two sides are divided in the same ratio. **[5]**



If $CB \parallel QR$, $CA \parallel PR$, AQ = 12 cm, AR = 20 cm and PB = CQ = 15 cm, calculate the lengths PC and BR.

Sol. Given : ΔABC, in which DE is drawn parallel to BC.

To Prove : $\dfrac{AD}{DB}=\dfrac{AE}{EC}$



Construction : Join CD and BE. Draw $DF \perp AE$ and $EG \perp AD$.

Proof : $\text{ar}(\Delta ADE) = \frac{1}{2} \times AD \times EG$ ...(i) **[½]**

$\text{ar}(\Delta BDE) = \frac{1}{2} \times BD \times EG$ ...(ii) **[½]**

Dividing (i) by (ii), we get $\frac{\text{ar}(\Delta ADE)}{\text{ar}(\Delta BDE)} = \frac{\frac{1}{2} \times AD \times EG}{\frac{1}{2} \times BD \times EG} = \frac{AD}{BD}$ ...(iii) **[½]**

Similarly,

$\text{ar}(\Delta ADE) = \frac{1}{2} \times DF \times AE$

and $\text{ar}(\Delta CDE) = \frac{1}{2} \times CE \times DF$

$\Rightarrow \frac{\text{ar}(\Delta ADE)}{\text{ar}(\Delta CDE)} = \frac{\frac{1}{2} \times DF \times AE}{\frac{1}{2} \times DF \times CE} = \frac{AE}{CE}$ ...(iv) **[½]**

Now, $\text{ar}(\Delta BDE) = \text{ar}(\Delta CDE)$

[$\because$ Triangles on the same base and between the same parallel lines are equal in area]

$\Rightarrow \frac{\text{ar}(\Delta ADE)}{\text{ar}(\Delta BDE)} = \frac{\text{ar}(\Delta ADE)}{\text{ar}(\Delta CDE)}$ **[½]**

$\therefore$ From (iii) and (iv), we get

$\frac{AD}{DB} = \frac{AE}{EC}$ **[½]**

In ΔPQR, $CA \parallel PR$

$\frac{QC}{CP} = \frac{QA}{AR}$

$\frac{15}{PC} = \frac{12}{20}$ **[½]**

$PC = \frac{15 \times 20}{12} = 25$ cm **[½]**

$BC \parallel QR$

$\frac{PC}{CQ} = \frac{PB}{BR}$

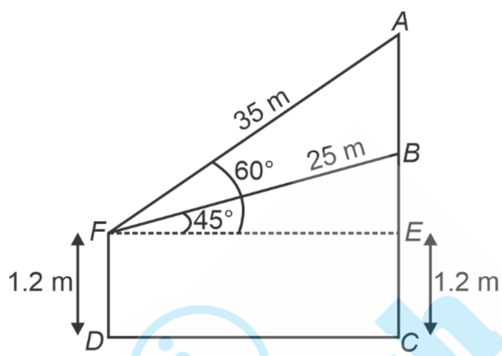
$$\frac{25}{15} = \frac{15}{BR}$$ [½]

$$BR = \frac{15 \times 15}{25} = \frac{225}{25} = 9\text{ cm}$$ [½]

33. Two boys of same height 1.2 m are flying kite at the same place. One of them takes 25 m long thread which makes an angle of elevation 45° with horizontal line whereas the other boy takes 35 m long thread which makes an angle of elevation 60° with the same horizontal line. If both kites are in the same vertical line, find how high the kite of the second boy is to the first boy.

$\left(\text{Take } \sqrt{3} = 1.73,\ \sqrt{2} = 1.41\right)$ **[5]**

Sol. According to given conditions,



Let *A* and *B* represent the two kites and *DF* represents the two boys standing at same place *D*. [½]

If *EF* is drawn parallel to *CD*, then *CE* = *DF* = 1.2 m.

Length of threads *BF* and *AF* are given as 25 m and 35 m respectively.

And angles of elevation $\angle BFE = 45°$ and $\angle AFE = 60°$ [½]

Now,

In ΔBFE,

$$\frac{BE}{BF} = \sin 45°$$

$$\Rightarrow \frac{BE}{25} = \frac{1}{\sqrt{2}}$$ [½]

$$\Rightarrow BE = \frac{25\sqrt{2}}{2}\text{ m} \quad \ldots\text{(i)}$$ [½]

And

In ΔAFE,

$$\frac{AE}{AF} = \sin 60°$$

$$\Rightarrow \frac{AE}{35} = \frac{\sqrt{3}}{2}$$

$$\Rightarrow AE = \frac{35\sqrt{3}}{2} \quad \ldots\text{(ii)}$$ [½]

$\Rightarrow AB = AE - BE$ **[½]**

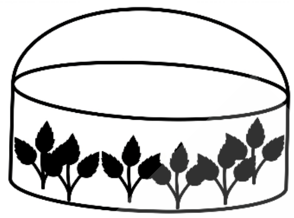
$= \frac{35\sqrt{3}}{2} - \frac{25\sqrt{2}}{2}$ **[½]**

$= \frac{(35 \times 1.73) - (25 \times 1.41)}{2}$

= 12.65 m **[1]**

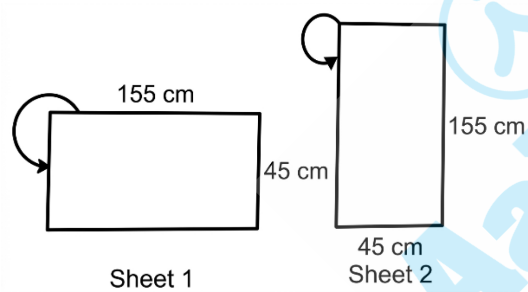
∴ Vertical distance between the two kites is 12.65 m **[½]**

34. (a) Saransh is building a green house in his farm as shown. The base of the green house is circular having a diameter of 12 m and it has a hemispherical dome on the top of a cylindrical base of height 2 m. How much will it cost him to cover the green house with transparent plastic both the cylindrical and hemispherical part if the plastic sheet costs ₹70 per sq. metre? Also, find the volume of air inside. **[5]**



OR

(b)



Two equal rectangular sheets of dimensions 155 cm × 45 cm as shown in the figure are folded to make hollow right circular cylinders in such a way that there is exactly 1 cm overlap when sticking the ends of the sheet. Sheet 1 is folded to form a cylinder of height 45 cm while sheet 2 is folded to get a cylinder of height 155 cm. Find the difference in the radii of the two cylinders and hence find the ratio of their volumes. **[5]**

Sol. (a) Base radius of cylinder (r) = $\frac{12}{2}$ m = 6 m **[½]**

Height of cylinder (h) = 2 m

C.S.A. of green house = $2\pi rh + 2\pi r^2$ **[½]**

$= 2\pi r(r+h)$

$= 2 \times \frac{22}{7} \times 6(6+2)$

$= 2 \times \frac{22}{7} \times 6 \times 8 \text{ m}^2$

$= 96\pi \text{ m}^2$ **[1]**

Total cost = C.S.A of green house × ₹70 **[½]**

= $96\pi \times 70$

= $96 \times \frac{22}{7} \times 70$

= ₹21120 **[1]**

Volume of air inside the green house = $\pi r^2 h + \frac{2}{3}\pi r^3$ **[½]**

$= \pi\left[6^2 \cdot 2 + \frac{2}{3} \cdot 6^3\right]$

$= \pi[72 + 144]$

$= 216\pi \text{ m}^3$ **[1]**

OR

(b) Height of cylinder formed by sheet 1 = 45 cm

It's base circumference = 155 – 1

= 154 cm = $2\pi r$ **[½]**

$\Rightarrow \quad r = \frac{154 \times 7}{2 \times 22}$

= 24.5 cm **[½]**

Height of cylinder formed by sheet 2 = 155 cm

It's base circumference = 45 – 1

= 44 cm = $2\pi r'$ **[½]**

$\Rightarrow \quad r' = \frac{44 \times 7}{2 \times 22}$ **[½]**

= 7 cm **[½]**

∴ Difference in the radii of the two cylinders = 24.5 – 7

= 17.5 cm **[½]**

Ratio of their volumes $= \frac{\pi r^2 h}{\pi (r')^2 h'}$ **[½]**

$= \frac{(24.5)^2 \times 45}{7^2 \times 155}$ **[½]**

$= \frac{245 \times 245 \times 45}{100 \times 49 \times 155}$ **[½]**

$= \frac{441}{124}$

∴ Ratio of their Rohmes = 441 : 124 **[½]**

35. (a) Find the sum of first 22 terms of an A.P. in which $d = 7$ and 22[nd] term is 149. **[5]**

OR

(b) Split 207 into three parts such that these three parts are in A.P. and the product of the two smaller parts is 4623. **[5]**

Sol. (a) Let first term = A

$T_n = A + (n-1)d$ **[½]**

$T_{22} = 149$ **[½]**

$149 = A + (22-1)(7)$ **[½]**

$A = 149 - 147$

$= 2$ **[½]**

Sum of first n terms = $S_n = \frac{n}{2}[2A + (n-1)d]$ **[½]**

$S_{22} = \frac{22}{2}[2(2) + (22-1)7]$ **[½]**

$= 11[4 + 147]$ **[½]**

$= 11[151]$ **[½]**

$= 1661$ **[1]**

OR

(b) Let three parts are $a - d$, a, $a + d$

$(a - d) + (a) + (a + d) = 207$ **[½]**

$3a = 207$ **[½]**

$a = \frac{207}{3}$ **[½]**

$= 69$ **[½]**

$(a - d) \times a = 4623$

$(69 - d) \times 69 = 4623$ **[½]**

$69 - d = \frac{4623}{69}$ **[½]**

$69 - d = 67$

$d = 69 - 67$ **[½]**

$= 2$ **[½]**

Three parts are 67, 69 and 71 **[1]**

SECTION-E

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

36. Sulphur dioxide (SO_2) is a major air pollutant and has significant impact upon human health. It influences the plants communities as well as animal life.

To find out concentration of SO_2 in the air (in parts per million *i.e.* ppm), the data was collected from 30 localities in Delhi and is presented below :

Concentration of SO_2 (in ppm)	Frequency
0.00 – 0.04	4
0.04 – 0.08	8
0.08 – 0.12	10
0.12 – 0.16	2
0.16 – 0.20	4
0.20 – 0.24	2

Based on the above, answer the following questions :

(i) What is the lower limit of median class? **[1]**

(ii) What is the modal class of the above data? **[1]**

(iii) (a) What is the mean concentration of SO_2 in air? **[2]**

OR

(b) Find the median of the above data. **[2]**

Sol. (i) Here,

Sum of frequencies = 4 + 8 + 10 + 2 + 4 + 2

= 30

$$\Rightarrow \frac{N}{2} = \frac{30}{2} = 15$$

And cumulative frequencies are 4, 12, 22, 24 28, 30 respectively. **[½]**

$\therefore$ Median class is class with cf = 22

It's lower limit = 0.08 **[½]**

(ii) Highest frequency = 10 **[½]**

And corresponding class is 0.08 – 0.12 which is the modal class. **[½]**

(iii) (a) Mean concentration of SO_2 can be found as,

Concentration of SO_2 (in ppm)	Frequency (f_i)	Class marks (x_i)	$x_i f_i$
0.00 – 0.04	4	0.02	0.08
0.04 – 0.08	8	0.06	0.48
0.08 – 0.12	10	0.10	1.00
0.12 – 0.16	2	0.14	0.28
0.16 – 0.20	4	0.18	0.72
0.20 – 0.24	2	0.22	0.44
	$\sum f_i = 30$		$\sum x_i f_i = 3.00$

[1]

$\therefore \quad \text{Mean} = \dfrac{\sum x_i f_i}{\sum f_i} = \dfrac{3}{30}$ **[½]**

$= 0.1$ **[½]**

OR

(b) We know that,

Median class is 0.08 – 0.12

So, $\dfrac{N}{2} = 15$, cf = 12, h = 0.04, f = 10 and l = 0.08

$\therefore \quad \text{Median} = l + \left(\dfrac{\frac{N}{2} - cf}{f}\right) \times h$ **[½]**

$= 0.08 + \left(\dfrac{15 - 12}{10}\right) \times 0.04$ **[½]**

= 0.08 + 0.012 **[½]**

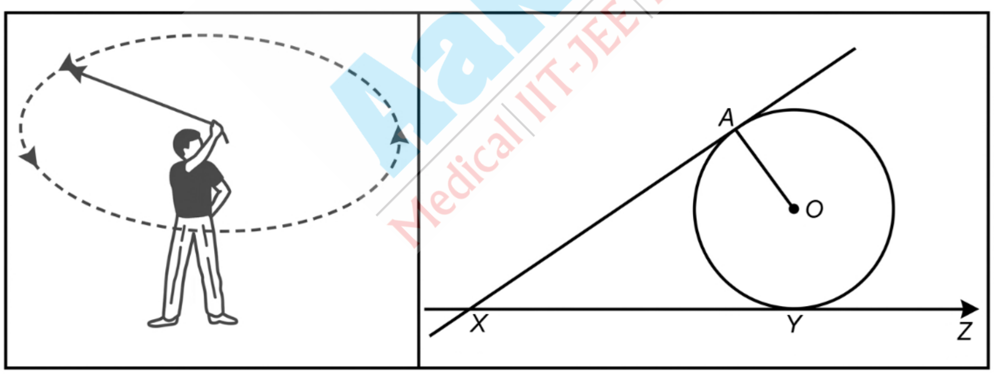
= 0.092 **[½]**

37. Ramesh was fond of spinning/revolving a ball tied with a rope of length 2 m. While playing, the ball slipped from the rope and hit his brother Suresh lightly. Suresh threw the ball back to Ramesh that made an angle of 60° with AX along the path XYZ which is a tangent to the imaginary circle as shown in fig. 1. *i.e.* $\angle AXZ = 60°$.

Based on the above, answer the following questions:

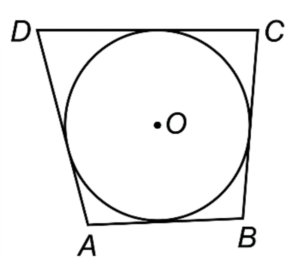
(i) If the length of rope used by Ramesh is 2 m, what is the diameter of the circle? **[1]**

(ii) Find the length XY shown in figure. **[1]**



(Fig. 1)

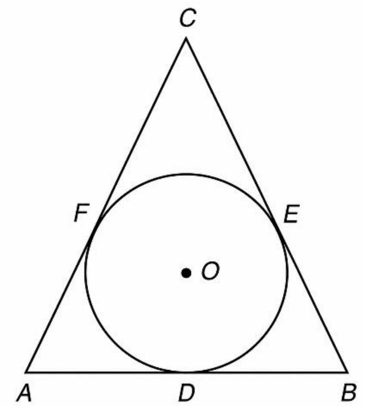
(iii) (a) Ramesh made the same circle on the ground using the rope he had and placed 4 sticks around it as shown in the figure with AB = 3, AD = BC = 5 m. Find length of CD. Justify your answer. **[2]**



(Fig. 2)

OR

(b) Suresh made another circle with radius 4 m and placed 3 sticks as shown in the figure. If AD = 6 m. BD = 8 m and area of triangle ABC is 84 sq. m., find the lengths of AC and BC. **[2]**



(Fig. 3)

Sol. (i) Length of rope (radius) = 2 m

Diameter = 2 × radius **[½]**

= (2 × 2) m

= 4 m **[½]**

(ii) Radius OY is perpendicular to tangent XZ

OY = 2 m

In right ΔXAO

$\angle AXZ = 60°$

$\tan 30° = \dfrac{OY}{XY}$ [∵ OX bisect $\angle AXZ$] **[½]**

$\Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{2}{XY}$

$\Rightarrow XY = 2\sqrt{3}$ **[½]**

∴ Length of XY = $2\sqrt{3}$ m

(iii) (a) AB = 3 m

$AD = BC$ = 5 m

$AB + CD = AD + BC$ [∵ AB, BC, CD, DA are tangents to the circle] **[1]**

$\Rightarrow$ 3 + CD = 5 + 5

$\Rightarrow$ CD = 10 – 3

$\Rightarrow$ CD = 7 cm **[1]**

OR

(b) $\text{ar}(\Delta ABC) = \text{ar}(\Delta AOB) + \text{ar}(\Delta BOC) + \text{ar}(\Delta AOC)$

$\Rightarrow \ 84 = \frac{1}{2} \times 4(14) + \frac{1}{2} \times 4 \times (8 + x) + \frac{1}{2} \times 4(6 + x)$ [Let $CE = CF = x$] **[½]**

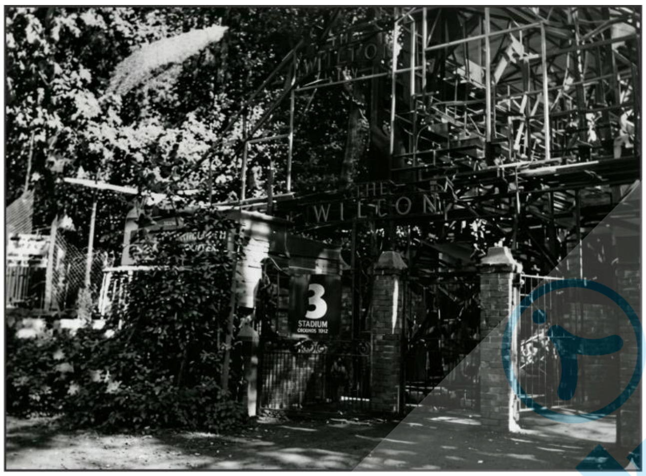
$\Rightarrow \ \frac{84}{2} = 28 + 2x$ **[½]**

$\Rightarrow \ \frac{42 - 28}{2} = x$

$\Rightarrow \ x = 7$

$\therefore \ AC = 6 + 7 = 13$ cm **[½]**

and $BC = 8 + 7 = 15$ cm **[½]**

38. 

Essel World is one of India's largest amusement park that offers a diverse range of thrilling rides and water attractions for visitors of all ages. The entry ticket charges for the park is ₹150 per child and ₹250 per adult.

On a day cashier of park found that 300 tickets were sold and an amount of ₹55,000 was collected.

Based on the above, answer the following questions :

(i) If number of children visited be x, the number of adults visited be y, write the given situation algebraically. **[1]**

(ii) How many children visited the park that day? **[1]**

(iii) (a) How many adults visited the park that day? If there were 50 more adults that day, how much money would have been collected from adults? **[2]**

OR

(b) How many adults visited the park that day? If a special show was arranged and hence the per ticket rate for adults was increased by ₹100, totally how much money will be collected? **[2]**

Sol. (i) If number of children visited be x, the number of adults visited be y

Total number of tickets sold = 300

$x + y = 300$ **[½]**

Total money collected = ₹55,000

Money from children = $150x$

Money from adults = $250y$

$150x + 250y = 55000$ **[½]**

(ii) $x + y = 300$ ...(i)

$150x + 250y = 55000$ ...(ii)

Substitute the value of x from equation (i) into equation (ii)

$150(300 - y) + 250y = 55000$ **[½]**

$\Rightarrow$ $45000 - 150y + 250y = 55000$

$\Rightarrow$ $45000 + 100y = 55000$

$\Rightarrow$ $100y = 10000$

$\Rightarrow$ $y = 100$

$\therefore$ $x + y = 300$

$\Rightarrow$ $x = 200$ **[½]**

$\therefore$ Number of children = 200

(iii) (a) $y = 100$

Number of adults = 100

If 50 more adults visited

100 + 50 = 150 **[1]**

Money collected from adults:

150 × 250 = 37500 **[1]**

$\therefore$ Money collected from adults = ₹37,500

OR

(b) Number of adults = 100 **[½]**

Increase in adult ticket price:

250 + 100 = 350 **[½]**

Extra increase per adult: ₹100

Total increase in collection: ₹10,000

Total collection = (100 × 350) + 30000

= ₹35000 + 30000

= ₹65000 **[1]**

❑ ❑ ❑