

Class X Session 2023-24
Subject - Mathematics (Standard)
Sample Question Paper - 3

Time Allowed: 3 hours

Maximum Marks: 80

General Instructions:

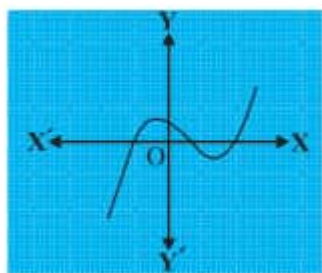
1. This Question Paper has 5 Sections A, B, C, D and E.
2. Section A has 20 MCQs carrying 1 mark each
3. Section B has 5 questions carrying 02 marks each.
4. Section C has 6 questions carrying 03 marks each.
5. Section D has 4 questions carrying 05 marks each.
6. Section E has 3 case based integrated 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 $\pi = \frac{22}{7}$ wherever required if not stated.

Section A

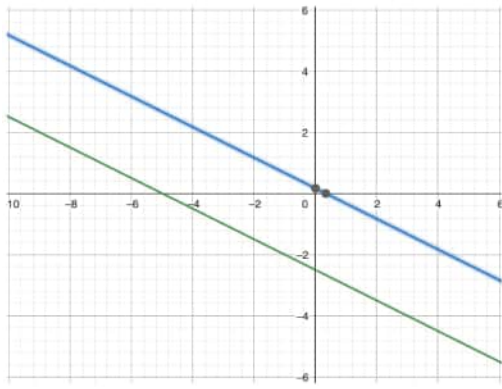
1. If two positive integers m and n can be expressed as $m = x^2y^5$ and $n = x^3y^2$, where x and y are prime numbers, then HCF(m, n) = [1]

- | | |
|-------------|-------------|
| a) x^2y^2 | b) x^2y^3 |
| c) x^3y^2 | d) x^3y^3 |

2. Find the number of zeroes of p(x) in the figure given below. [1]



- | | |
|------|------|
| a) 3 | b) 0 |
| c) 2 | d) 1 |
3. The pair of equations $x + 2y + 5 = 0$ and $-3x - 6y + 1 = 0$ have [1]



a) a unique solution

b) infinitely many solutions

c) no solution

d) exactly two solutions

4. $4x^2 - 2x - 3 = 0$ have

[1]

a) Real roots

b) Real and Distinct roots

c) No Real roots

d) Real and Equal roots

5. If 18, a, b, -3 are in A.P., then $a + b =$

[1]

a) 7

b) 15

c) 19

d) 11

6. The point of intersection of the x-axis and y-axis is called

[1]

a) ordinate

b) abscissa

c) quadrant

d) origin

7. In what ratio does x-axis divide the line segment joining the points A(2, -3) and B(5, 6)?

[1]

a) 1 : 2

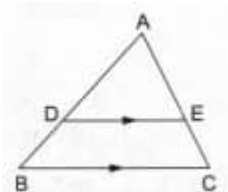
b) 3 : 5

c) 2 : 1

d) 2 : 3

8. In a $\triangle ABC$, if DE is drawn parallel to BC, cutting AB and AC at D and E respectively such that $AB = 7.2$ cm, $AC = 6.4$ cm and $AD = 4.5$ cm. Then, $AE = ?$

[1]



a) 4 cm

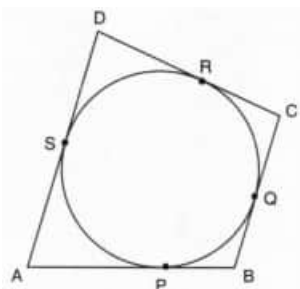
b) 5.4 cm

c) 3.2 cm

d) 3.6 cm

9. In Figure, a quadrilateral ABCD is drawn to circumscribe a circle such that its sides AB, BC, CD and AD touch the circle at P, Q, R and S respectively. If $AB = x$ cm, $BC = 7$ cm, $CR = 3$ cm and $AS = 5$ cm, then $x =$

[1]



- a) 7
b) 10
c) 9
d) 8

10. The length of the tangent drawn from a point 8 cm away from the centre of a circle of radius 6 cm is [1]
a) 5 cm
b) $\sqrt{7}$ cm
c) 10 cm
d) $2\sqrt{7}$ cm

11. $(1 + \tan \theta + \sec \theta)(1 + \cot \theta - \operatorname{cosec} \theta) =$ [1]
a) 0
b) 2
c) 1
d) -1

12. If $\sec \theta + \tan \theta = p$, then the value of $\sin \theta$ is [1]
a) $\frac{1-p^2}{p^2+1}$
b) $\frac{p^2-1}{p^2+1}$
c) None of these
d) $\frac{p^2+1}{p^2-1}$

13. Two men are on the same side of a tower. They observe the angles of elevation of the top of the tower as 30° and 45° respectively. If the height of the tower is 100m, then the distance between them is [1]
a) None of these
b) $100(\sqrt{3} + 1)m$
c) $100(\sqrt{3} - 1)m$
d) $100(1 - \sqrt{3})m$

14. If θ is the angle (in degrees) of a sector of a circle of radius r, then area of the sector is [1]
a) $\frac{\pi r^2 \theta}{360}$
b) $\frac{2\pi r \theta}{360}$
c) $\frac{\pi r^2 \theta}{180}$
d) $\frac{2\pi r \theta}{180}$

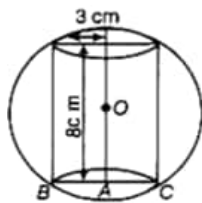
15. If a chord of a circle of radius 28 cm makes an angle of 90° at the centre, then the area of the major segment is [1]
a) 1456 cm^2
b) 1848 cm^2
c) 392 cm^2
d) 2240 cm^2

16. If a number x is chosen from the numbers 1, 2, 3 and a number y is selected from the numbers 1, 4, 9, then $P(xy < 9)$ [1]
a) $\frac{7}{9}$
b) $\frac{5}{9}$
c) $\frac{2}{3}$
d) $\frac{1}{9}$

17. A girl calculates that the probability of her winning the first prize in a lottery is 0.08. If 6000 tickets are sold, how many tickets has she bought? [1]
a) 240
b) 750
c) 480
d) 40

18. The marks obtained by 9 students in Mathematics are 59, 46, 31, 23, 27, 40, 52, 35 and 29. The mean of the data is [1]
a) 30
b) 41
c) 23
d) 38

19. **Assertion (A):** In the given figure, a sphere circumscribes a right cylinder whose height is 8 cm and radius of the base is 3 cm. The ratio of the volumes of the sphere and the cylinder is 125 : 54 [1]



Reason (R): Ratio of their volume = $\frac{\text{Volume of sphere}}{\text{Volume of cylinder}}$

- 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 but R is false. d) A is false but R is true.

20. **Assertion (A):** Three consecutive terms $2k + 1$, $3k + 3$ and $5k - 1$ form an AP than k is equal to 6. [1]

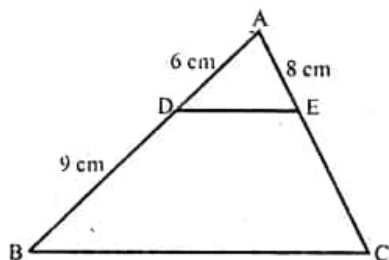
Reason (R): In an AP a , $a + d$, $a + 2d$, ... the sum to n terms of the AP be $S_n = \frac{n}{2}(2a + (n - 1)d)$

- 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 but R is false. d) A is false but R is true.

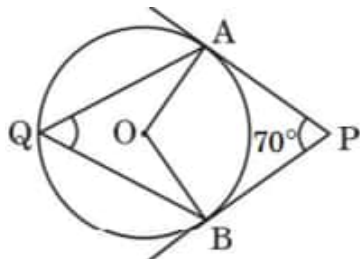
Section B

21. Find H.C.F. and L.C.M. of 56 and 112 by prime factorisation method. [2]

22. In the adjoining figure, find AC. [2]



23. In Figure, PA and PB are tangents to the circle with centre at O. If $\angle APB = 70^\circ$, then find $m \angle AQB$. [2]



24. Prove the trigonometric identity: [2]

$$\sqrt{\frac{1 - \sin \theta}{1 + \sin \theta}} = \sec \theta - \tan \theta$$

OR

Prove that: $(\sin \alpha + \cos \alpha)(\tan \alpha + \cot \alpha) = \sec \alpha + \operatorname{cosec} \alpha$

25. The perimeter of a sector of a circle of radius 5.2 cm is 16.4 cm. Find the area of the sector. [2]

OR

Find the area of the sector of a circle of radius 5 cm, if the corresponding arc length is 3.5 cm.

Section C

26. Renu has collected 8 U.S. stamps and 12 international stamps. She wants to display them in identical groups of U.S. and international stamps, with no stamps left over. What is the greatest number of groups Renu can display them in? [3]

27. If one zero of the polynomial $2x^2 + 3x + \lambda$ is $\frac{1}{2}$, find the value of λ and other zero. [3]

28. A shopkeeper gives books on rent for reading. She takes a fixed charge for the first two days, and an additional charge for each day thereafter. Latika paid Rs.22 for a book kept for 6 days, while Anand paid Rs.16 for the book kept for four days. Find the fixed charges and charge for each extraday. [3]

OR

Find the four angles of a cyclic quadrilateral ABCD in which $\angle A = (2x - 1)^\circ$, $\angle B = (y + 5)^\circ$, $\angle C = (2y + 15)^\circ$ and $\angle D = (4x - 7)^\circ$

29. From an external point P, two tangents, PA and PB are drawn to a circle with centre O. At one point E on the circle tangent is drawn which intersects PA and PB at C and D respectively. If PA = 10 cm, find the perimeter of the triangle PCD. [3]

OR

ABCD is a quadrilateral such that $\angle D = 90^\circ$. A circle C (O, r) touches the sides AB, BC, CD and DA at P, Q, R and S respectively. If BC = 38 cm, CD = 25 cm and BP = 27 cm, Find r.

30. If $\sec \alpha = \frac{5}{4}$ evaluate $\frac{1 - \tan \alpha}{1 + \tan \alpha}$, [3]
31. If the mean of the following frequency distribution is 18, find the missing frequency. [3]

Class interval	11-13	13-15	15-17	17-19	19-21	21-23	23-25
Frequency	3	6	9	13	f	5	4

Section D

32. The product of Tanay's age (in years) five years ago and his age ten years later is 16. Determine Tanay's present age. [5]

OR

Solve for x:

$$\frac{1}{(x-1)(x-2)} + \frac{1}{(x-2)(x-3)} = \frac{2}{3}; x \neq 1, 2, 3$$

33. D and E are points on the sides AB and AC respectively of $\triangle ABC$ such that $DE \parallel BC$ and divides $\triangle ABC$ into two parts, equal in area, Find $\frac{BD}{AB}$. [5]
34. A solid wooden toy is in the shape of a right circular cone mounted on a hemisphere. If the radius of the hemisphere is 4.2 cm and the total height of the toy is 10.2 cm, find the volume of the wooden toy. [5]

OR

A solid is composed of a cylinder with hemispherical ends. If the whole length of the solid is 104 cm and the radius of each of the hemispherical ends is 7 cm, find the cost of polishing its surface at the rate of ₹10 per dm^2 .

35. Calculate the median from the following frequency distribution: [5]

Class	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40	40 - 45
Frequency	5	6	15	10	5	4	2	2

Section E

36. Read the text carefully and answer the questions: [4]
- Students of a school thought of planting trees in and around the school to reduce air pollution. It was decided that the number of trees, that each section of each class will plant, will be the same as the class, in which they are studying, e.g., a section of class I will plant 1 tree, a section of class II will plant 2 trees and so on till class XII.

There are three sections of each class.



- (i) Find total number of trees planted by primary 1 to 5 class students?
- (ii) Find the total number of trees planted by the students of the school.

OR

Find the total no of trees planted by class 12th students.

- (iii) Find the total number of trees planted by class 10th student.

37. **Read the text carefully and answer the questions:**

[4]

In an examination hall, students are seated at a distance of 2 m from each other, to maintain the social distance due to CORONA virus pandemic. Let three students sit at points A, B and C whose coordinates are (4, -3), (7, 3) and (8, 5) respectively.



- (i) What is the distance between A and C?
- (ii) If an invigilator at point 7, lying on the straight line joining B and C such that it divides the distance between them in the ratio of 1 : 2. Then what are the coordinates of I(invigilator)?

OR

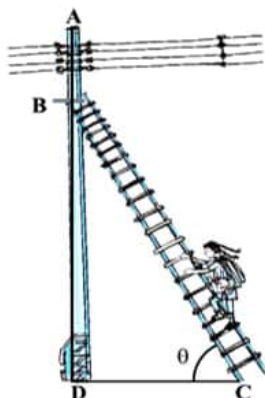
What is the ratio in which B divides the line segment joining A and C?

- (iii) What is the mid-point of the line segment joining A and C?

38. **Read the text carefully and answer the questions:**

[4]

In a village, group of people complained about an electric fault in their area. On their complaint, an electrician reached village to repair an electric fault on a pole of height 10 m. She needs to reach a point 1.5 m below the top of the pole to undertake the repair work (see the adjoining figure). She used ladder, inclined at an angle of θ to the horizontal such that $\cos \theta = \frac{\sqrt{3}}{2}$, to reach the required position.



- (i) Find the length BD?
- (ii) Find the length of ladder.

OR

If the height of pole and distance BD is doubled, then what will be the length of the ladder?

(iii) How far from the foot of the pole should she place the foot of the ladder?

Solution

Section A

1. (a) x^2y^2

Explanation: $x^2y^5 = y^3(x^2y^2)$

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

Therefore HCF (m, n) is x^2y^2

2. (a) 3

Explanation: The number of zeroes is 3 as the graph intersects the x-axis at three points.

3.

(c) no solution

Explanation: Given, equations are

$$x + 2y + 5 = 0, \text{ and}$$

$$-3x - 6y + 1 = 0.$$

Comparing the equations with general form:

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

$$\text{Here, } a_1 = 1, b_1 = 2, c_1 = 5$$

$$\text{And } a_2 = -3, b_2 = -6, c_2 = 1$$

Taking the ratio of coefficients to compare

$$\frac{a_1}{a_2} = \frac{-1}{3}, \frac{b_1}{b_2} = \frac{-1}{3}, \frac{c_1}{c_2} = \frac{5}{1}$$

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

This represents a pair of parallel lines.

Hence, the pair of equations has no solution.

4.

(b) Real and Distinct roots

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

$$D = (-2)^2 - 4 \times 4 \times (-3)$$

$$D = 4 + 48$$

$$D = 52$$

$D > 0$. Hence Real and Distinct roots.

5.

(b) 15

Explanation: 18, a, b - 3 are in A.P., then $a - 18 = -3 - b$

$$\Rightarrow a + b = -3 + 18$$

$$\Rightarrow a + b = 15$$

6.

(d) origin

Explanation: The point of intersection of the x-axis and y-axis is called an origin.

The coordinates of the origin are (0, 0).

7. (a) 1 : 2

Explanation: Let the x axis cut AB at P(x, 0) in the ratio K : 1

$$\text{Then } \frac{6k-3}{k+1} = 0 \Rightarrow 6k - 3 - 0 \Rightarrow 6k = 3 \Rightarrow k = \frac{1}{2}$$

$$\text{required ratio} = \left(\frac{1}{2} : 1\right) = 1 : 2$$

8. (a) 4 cm

Explanation: In $\triangle ABC$, $DE \parallel BC$

$AB = 7.2$ cm, $AC = 6.4$ cm, $AD = 4.5$ cm

Let $AE = x$ cm

$DE \parallel BC$

$\triangle ADE \sim \triangle ABC$

$$\frac{AD}{AB} = \frac{AE}{AC} \Rightarrow \frac{4.5}{7.2} = \frac{AE}{6.4}$$

$$\Rightarrow AE = \frac{4.5 \times 6.4}{7.2} = 4.0 = 4 \text{ cm}$$

9.

(c) 9

Explanation: In the given figure,

ABCD is a quadrilateral circumscribe a circle and its sides AB, BC, CD and DA touch the circle at P, Q, R and S respectively

$AB = x$ cm, $BC = 7$ cm, $CR = 3$ cm, $AS = 5$ cm

CR and CQ are tangents to the circle from C

$CR = CQ = 3$ cm

$BQ = BC - CQ = 7 - 3 = 4$ cm

BQ and BP are tangents from B

$BP = BQ = 4$ cm

AS and AP are tangents from A

$AP = AS = 5$ cm

$AB = AP + BP = 5 + 4 = 9$ cm

$x = 9$ cm

10.

(d) $2\sqrt{7}$ cm

Explanation: Radius of the circle = 6 cm

and distance of the external point from the centre = 8 cm

Length of tangent = $\sqrt{\{(8)^2 - (6)^2\}}$

$$= \sqrt{(64 - 36)} = \sqrt{28}$$

$$= \sqrt{(4 \times 7)} = 2\sqrt{7} \text{ cm}$$

11.

(b) 2

Explanation: By applying formulae

$$\tan \theta = \frac{\sin \theta}{\cos \theta}, \quad \cot \theta = \frac{\cos \theta}{\sin \theta}, \quad \sec \theta = \frac{1}{\cos \theta}, \quad \csc \theta = \frac{1}{\sin \theta}$$

$$= \left(1 + \frac{\sin \theta}{\cos \theta} + \frac{1}{\cos \theta}\right) \left(1 + \frac{\cos \theta}{\sin \theta} - \frac{1}{\sin \theta}\right)$$

$$= \left(\frac{1 + \cos \theta + \sin \theta}{\cos \theta}\right) \left(\frac{\sin \theta + \cos \theta - 1}{\sin \theta}\right)$$

Multiplying both terms, we get

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

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

$$= \frac{1 + 2 \sin \theta \cos \theta - 1}{\cos \theta \sin \theta}$$

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

$$= 2$$

Therefore, $(1 + \tan \theta + \sec \theta)(1 + \cot \theta - \csc \theta) = 2$

12.

(b) $\frac{p^2 - 1}{p^2 + 1}$

Explanation: Given: $\sec \theta + \tan \theta = p$

$$\Rightarrow \frac{1}{\cos \theta} + \frac{\sin \theta}{\cos \theta} = p$$

$$\Rightarrow \frac{1 + \sin \theta}{\cos \theta} = p$$

Squaring both sides, we get

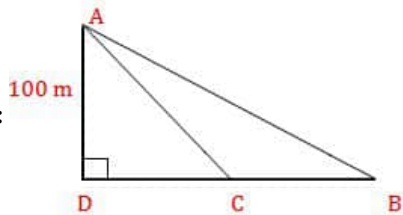
$$\Rightarrow \frac{(1 + \sin \theta)^2}{\cos^2 \theta} = p^2$$

$$\begin{aligned}
&\Rightarrow \frac{(1+\sin\theta)^2}{1-\sin^2\theta} = p^2 \\
&\Rightarrow \frac{(1+\sin\theta)^2}{(1+\sin\theta)(1-\sin\theta)} = p^2 \\
&\Rightarrow \frac{1+\sin\theta}{1-\sin\theta} = p^2 \\
&\Rightarrow 1+\sin\theta = p^2(1-\sin\theta) \\
&\Rightarrow 1+\sin\theta = p^2 - p^2\sin\theta \\
&\Rightarrow \sin\theta + p^2\sin\theta = p^2 - 1 \\
&\Rightarrow \sin\theta(1+p^2) = p^2 - 1 \\
&\Rightarrow \sin\theta = \frac{p^2-1}{p^2+1}
\end{aligned}$$

13.

(c) $100(\sqrt{3} - 1)m$

Explanation:



Let AD be the height of the tower of 100 m.

In triangle ABD,

$$\tan 30^\circ = \frac{AD}{BD}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{100}{BD}$$

$$\Rightarrow BD = 100\sqrt{3} \text{ m}$$

Now, in triangle ACD,

$$\tan 45^\circ = \frac{AD}{CD}$$

$$\Rightarrow 1 = \frac{100}{CD}$$

$$\Rightarrow CD = 100 \text{ m}$$

$$\text{Therefore, required distance} = BC = BD - CD = 100\sqrt{3} - 100 = 100(\sqrt{3} - 1) \text{ m}$$

14. (a) $\frac{\pi r^2 \theta}{360}$

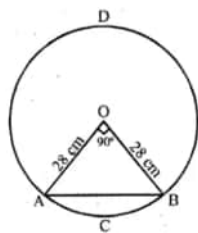
Explanation: $\frac{\pi r^2 \theta}{360}$

15.

(d) 2240 cm^2

Explanation: A chord AB makes an angle of 90° at the centre

Radius of the circle = 28 cm



Area of minor segment ACB

$$= \pi r^2 \times \frac{\theta}{360^\circ} - \text{area of } \triangle AOB$$

$$= \pi r^2 \times \frac{90^\circ}{360^\circ} - \frac{1}{2} OA \times OB$$

$$= \frac{1}{4} \pi r^2 - \frac{1}{2} \times r^2$$

$$= \frac{1}{4} \times \frac{22}{7} \times 28 \times 28 - \frac{1}{2} \times 28 \times 28$$

$$= 616 - 392$$

$$= 224 \text{ cm}^2$$

\therefore Area of the major segment ADB

= Area of circle - area of minor segment

$$= \pi r^2 - 224 = \frac{22}{7} \times 28 \times 28 - 224$$

$$= 2464 - 224$$

$$= 2240 \text{ sq. cm}$$

16.

(b) $\frac{5}{9}$

Explanation: Numbers $x = 1, 2, 3$ and $y = 1, 4, 9$

Now $xy = \{1, 4, 9, 2, 8, 18, 3, 12, 27\} = 9$

$$\therefore n = 9$$

and $xy < 9$ are 1, 2, 3, 4, 8

$$\therefore m = 5$$

$$\therefore P(xy < 9) = \frac{5}{9}$$

17.

(c) 480

Explanation: Given, the total number of sold tickets = 6000

Let she bought x tickets.

Then, the probability of her winning the first prize is given as,

$$\Rightarrow \frac{x}{6000} = 0.08 \text{ [given]}$$

$$\Rightarrow x = 0.08 \times 6000$$

$$\therefore x = 480$$

Hence, she bought 480 tickets.

18.

(d) 38

Explanation: Given: 59, 46, 31, 23, 27, 40, 52, 35 and 29

$$\begin{aligned} \text{Mean} &= \frac{\text{Sum of all observations}}{\text{Number of observations}} \\ &= \frac{59+46+31+23+27+40+52+35+29}{9} \\ &= \frac{342}{9} \\ &= 38 \end{aligned}$$

19. (a) Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

20.

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

Explanation: For $2k + 1$, $3k + 3$ and $5k - 1$ to form an AP

$$(3k + 3) - (2k + 1) = (5k - 1) - (3k + 3)$$

$$k + 2 = 2k - 4$$

$$2 + 4 = 2k - k = k$$

$$k = 6$$

So, both assertion and reason are correct but reason does not explain assertion.

Section B

21. Using the factor tree we have,

$$56 = 2^3 \times 7 \text{ and } 112 = 2^4 \times 7$$

$$\text{Hence HCF is } 2^3 \times 7 = 56 \text{ and}$$

$$\text{LCM is } 2^4 \times 7 = 112$$

22. In the given figure in $\triangle ABC$, we have

$DE \parallel BC$. Let $EC = x$

$$\therefore \frac{AD}{DB} = \frac{AE}{EC} \Rightarrow \frac{6}{9} = \frac{8}{x}$$

$$\Rightarrow x = \frac{9 \times 8}{6} = 12$$

$$\therefore AC = AE + EC = 8 + 12 = 20 \text{ cm}$$

23. \therefore AOPB is a quadrilateral

$\therefore \angle APB + \angle AOB = 180^\circ$ (opposite angles of quadrilateral are supplementary)

$$70 + \angle AOB = 180^\circ$$

$$\angle AOB = 180 - 70 = 110^\circ$$

Now, $\angle AQB = \frac{1}{2} \angle AOB$ (angle on the circumference of the circle by same arc)

$$\angle AQB = \frac{1}{2} \times 110 = 55$$

$$\angle AQB = 55$$

24. We have,

$$\text{L. H. S} = \sqrt{\frac{1-\sin\theta}{1+\sin\theta}}$$

$$\Rightarrow \text{L. H. S} = \sqrt{\frac{1-\sin\theta}{1+\sin\theta} \times \frac{1-\sin\theta}{1-\sin\theta}} \quad [\text{Multiplying and dividing by } (1 - \sin\theta)]$$

$$\Rightarrow \text{L. H. S} = \sqrt{\frac{(1-\sin\theta)^2}{1-\sin^2\theta}} = \sqrt{\frac{(1-\sin\theta)^2}{\cos^2\theta}} \quad [\because 1 - \sin^2\theta = \cos^2\theta]$$

$$\Rightarrow \text{L. H. S} = \sqrt{\left(\frac{1-\sin\theta}{\cos\theta}\right)^2} = \frac{1-\sin\theta}{\cos\theta} = \left(\frac{1}{\cos\theta} - \frac{\sin\theta}{\cos\theta}\right)$$

$$= (\sec\theta - \tan\theta) = \text{R.H.S} \quad \left[\because \frac{1}{\cos\theta} = \sec\theta, \frac{\sin\theta}{\cos\theta} = \tan\theta\right]$$

$$\text{therefore, } \sqrt{\frac{1-\sin\theta}{1+\sin\theta}} = \sec\theta - \tan\theta$$

Hence proved.

OR

$$\text{LHS} = (\sin\alpha + \cos\alpha)(\tan\alpha + \cot\alpha)$$

$$= (\sin\alpha + \cos\alpha) \left(\frac{\sin\alpha}{\cos\alpha} + \frac{\cos\alpha}{\sin\alpha} \right)$$

$$= (\sin\alpha + \cos\alpha) \left(\frac{\sin^2\alpha + \cos^2\alpha}{\sin\alpha \cos\alpha} \right)$$

$$= (\sin\alpha + \cos\alpha) \frac{1}{\sin\alpha \cos\alpha} \quad [\because \sin^2\alpha + \cos^2\alpha = 1]$$

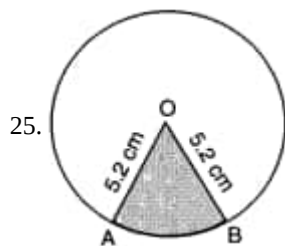
$$= \frac{\sin\alpha}{\sin\alpha \cos\alpha} + \frac{\cos\alpha}{\sin\alpha \cos\alpha}$$

$$= \frac{1}{\cos\alpha} + \frac{1}{\sin\alpha}$$

$$= \sec\alpha + \operatorname{cosec}\alpha$$

$$= \text{RHS}$$

Hence, proved.



Let OAB be the given sector.

It is given that Perimeter of sector OAB = 16.4 cm

$$\Rightarrow OA + OB + \text{arc AB} = 16.4 \text{ cm}$$

$$\Rightarrow 5.2 + 5.2 + \text{arc AB} = 16.4$$

$$\Rightarrow \text{arc AB} = 6 \text{ cm}$$

$$\Rightarrow l = 6 \text{ cm}$$

$$\therefore \text{Area of sector OAB} = \frac{1}{2}lr = \frac{1}{2} \times 6 \times 5.2 \text{ cm}^2 = 15.6 \text{ cm}^2$$

OR

According to the question,

$$\text{Radius of a circle} = r = 5 \text{ cm}$$

$$\text{Arc length} = l = 3.5 \text{ cm}$$

$$\therefore \text{Area of sector} = \frac{1}{2} \times l \times r$$

$$= \frac{1}{2} \times 3.5 \times 5$$

$$= 8.7 \text{ cm}^2$$

Section C

26. To make all the groups identical and find the greatest number of groups, we have to find the greatest number which can divide by 8 and 12 exactly.

That is nothing but H.C.F. of 8 and 12.

$$\text{H.C.F of } (8, 12) = 4$$

That is, 8 U.S stamps can be displayed in 4 groups at 2 stamps/group.

And 12 international stamps can be displayed in 4 groups at 3 stamps/group.

In this way, each of the 4 groups would have 2 U.S. stamps and 3 international stamps. And all the 4 groups would be identical.

Hence, the greatest number of groups can be made is 4.

27. Let $P(x) = 2x^2 + 3x + \lambda$

Its one zero is $\frac{1}{2}$ so $P(\frac{1}{2}) = 0$

$$P(\frac{1}{2}) = 2 \times (\frac{1}{2})^2 + 3(\frac{1}{2}) + \lambda = 0$$

$$\Rightarrow 2 \times \frac{1}{4} + \frac{3}{2} + \lambda = 0$$

$$\Rightarrow \frac{1}{2} + \frac{3}{2} + \lambda = 0$$

$$\Rightarrow \frac{4}{2} + \lambda = 0$$

$$\Rightarrow 2 + \lambda = 0$$

$$\Rightarrow \lambda = -2$$

Let the other zero be α

$$\text{Then } \alpha + \frac{1}{2} = -\frac{3}{2}$$

$$\Rightarrow \alpha = -\frac{3}{2} - \frac{1}{2} = -\frac{4}{2} = -2$$

28. Let the fixed charge for first three days be *Rs. x*

The additional charge for each day thereafter be *Rs. y*.

Then according to question, we have

$$x + 4y = 22 \text{ ... (i)}$$

$$x + 2y = 16 \text{ ... (ii)}$$

Subtracting equation (ii) from (i),

$$2y = 6$$

$$\Rightarrow y = 3$$

Substituting $y = 3$ in (ii),

$$x + 2(3) = 16$$

$$\Rightarrow x + 6 = 16$$

$$\Rightarrow x = 10$$

Thus, the fixed charge for first three days is *Rs. 10*.

and the additional charge for each day thereafter is *Rs. 3*.

OR

Since, we know that the sum of the opposite angles of a cyclic quadrilateral is 180° . In the cyclic quadrilateral ABCD, angles A and C and angles B and D form pairs of opposite angle.

$$\therefore \angle A + \angle C = 180^\circ \text{ and } \angle B + \angle D = 180^\circ$$

$$\Rightarrow 2x - 1 + 2y + 15 = 180 \text{ and } y + 5 + 4x - 7 = 180$$

$$\Rightarrow 2x + 2y + 14 = 180 \text{ and } 4x + y - 2 = 180$$

$$\Rightarrow 2x + 2y = 166 \text{ and } 4x + y = 182$$

$$\Rightarrow x + y = 83 \text{ (i)}$$

$$\text{and, } 4x + y = 182 \text{ (ii)}$$

Subtracting equation (i) from equation (ii), we get

$$4x + y - (x + y) = 182 - 83$$

$$4x + y - x - y = 99$$

$$3x = 99 \Rightarrow x = 33$$

Substitute the value of $x = 33$ in equation (i), we get

$$33 + y = 83$$

$$y = 83 - 33$$

$$y = 50$$

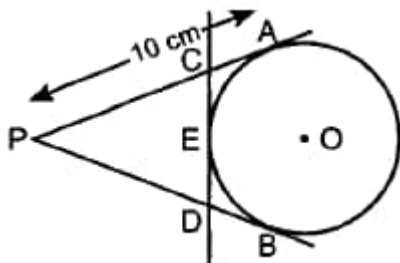
Therefore

$$\angle A = (2 \times 33 - 1)^\circ = 65^\circ, \angle B = (y + 5)^\circ = (50 + 5)^\circ = 55^\circ$$

$$\angle C = (2y + 15)^\circ = (2 \times 50 + 15)^\circ = 115^\circ \text{ and } \angle D = (4 \times 33 - 7)^\circ = 125^\circ$$

$$\text{Thus } \angle A = 65^\circ, \angle B = 55^\circ, \angle C = 115^\circ \text{ and } \angle D = 125^\circ$$

29. Given,



$$PA = 10 \text{ cm.}$$

$PA = PB$ [If P is external point] ... (i) [From an external point tangents drawn to a circle are equal in length]

If C is external point, then $CA = CE$

If D is external point, then

$$DB = DE \text{ ... (ii)}$$

Perimeter of triangle $\triangle PCD$

$$= PC + CD + PD$$

$$= PC + CE + ED + PD$$

$$= PC + CA + DB + PD$$

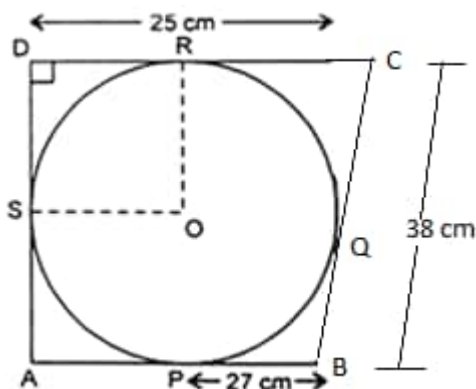
$$= PA + PB$$

$$= PA + PA$$

$$= 2 PA$$

$$= 2 \times 10 = 20 \text{ cm [From (i)]}$$

OR



Given that ABCD is a quadrilateral such that $\angle D = 90^\circ$.

$BC = 38 \text{ cm}$, $CD = 25 \text{ cm}$ and $BP = 27 \text{ cm}$

\therefore From the figure,

$BP = BQ = 27 \text{ cm}$ [Tangents from an external point are equal]

Now, $BC = 38$

$$\Rightarrow BQ + QC = 38$$

$$\Rightarrow 27 + QC = 38$$

$$\Rightarrow QC = 38 - 27$$

$$\Rightarrow QC = 11 \text{ cm}$$

$\therefore QC = 11 \text{ cm} = CR$ [Tangents from an external point are equal]

$$CD = 25 \text{ cm}$$

$$CR + RD = 25$$

$$\Rightarrow 11 + RD = 25$$

$$\Rightarrow RD = 25 - 11$$

$$\Rightarrow RD = 14 \text{ cm}$$

Also,

$RD = DS = 14 \text{ cm}$ [Tangents from an external point are equal]

OR and OS are radii of the circle.

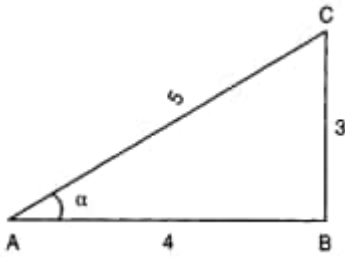
From tangents R and S, $\angle ORD = \angle OSD = 90^\circ$

Thus, ORDS is a square.

$$OR = DS = 14 \text{ cm}$$

Hence, the radius of the circle, $r = OR = 14 \text{ cm}$

30.



We have,

$$\sec \alpha = \frac{\text{Hypotenuse}}{\text{Base}} = \frac{5}{4}$$

So, Let us draw a right triangle ABC, $\angle B = 90^\circ$ such that

hypotenuse = AC = 5 units, Base = AB = 4 units, and $\angle BAC = \alpha$.

Applying Pythagoras theorem in $\triangle ABC$, we get

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

$$\Rightarrow 5^2 = 4^2 + BC^2$$

$$\Rightarrow BC^2 = 5^2 - 4^2 = 9$$

$$\Rightarrow BC = \sqrt{9} = 3$$

$$\therefore \tan \alpha = \frac{BC}{AB} = \frac{3}{4}$$

$$\text{Now, we have, } \frac{1 - \tan \alpha}{1 + \tan \alpha} = \frac{1 - \frac{3}{4}}{1 + \frac{3}{4}} = \frac{\frac{1}{4}}{\frac{7}{4}} = \frac{1}{7}$$

$$\text{therefore, } \frac{1 - \tan \alpha}{1 + \tan \alpha} = \frac{1}{7}$$

31.

Class interval	Frequency f_i	Mid-value x_i	$f_i x_i$
11-13	3	12	36
13-15	6	14	84
15-17	9	16	144
17-19	13	18	234
19-21	f	20	20f
21-23	5	22	110
23-25	4	24	96
	$\sum f_i = 40 + f$		$\sum f_i x_i = 704 + 20f$

let the missing frequency is 'f'.

$$\text{we know that, Mean} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\Rightarrow 18 = \frac{704 + 20f}{40 + f}$$

$$\Rightarrow 18(40 + f) = 704 + 20f$$

$$\Rightarrow 720 + 18f = 704 + 20f$$

$$\Rightarrow 2f = 16$$

$$\Rightarrow f = 8$$

Section D

32. Let the present age of Tanay be x years

By the question,

$$(x - 5)(x + 10) = 16$$

$$\text{or, } x^2 + 5x - 50 = 16$$

$$\text{or, } x^2 + 5x - 66 = 0$$

$$\text{or, } x^2 + 11x - 6x - 66 = -66$$

$$x(x + 1) - 6(x - 11) = 0$$

$$(x + 11)(x - 6) = 0$$

$$= -11, 6$$

Rejecting $x = -11$, as age cannot be negative.

\therefore Present age of Tanay is 6 years.

OR

$$\text{Given, } \frac{1}{(x-1)(x-2)} + \frac{1}{(x-2)(x-3)} = \frac{2}{3}$$

$$\frac{(x-3) + (x-1)}{(x-1)(x-2)(x-3)} = \frac{2}{3}$$

$$\frac{x-3 + x-1}{(x-1)(x-2)(x-3)} = \frac{2}{3}$$

$$\frac{2x-4}{(x-1)(x-2)(x-3)} = \frac{2}{3}$$

$$\frac{2(x-2)}{(x-1)(x-2)(x-3)} = \frac{2}{3}$$

$$\frac{2}{(x-1)(x-3)} = \frac{2}{3}$$

$$(x-1)(x-3) = 3$$

$$x^2 - 4x + 3 = 3$$

$$x^2 - 4x = 0$$

$$x(x-4) = 0$$

$$x = 0, x-4 = 0$$

$$x = 0, x = 4$$

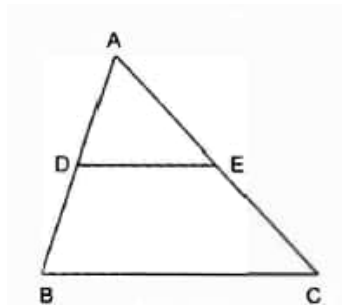
33. We have,

$$\text{Area } (\triangle ADE) = \text{Area (trapezium BCED)}$$

$$\Rightarrow \text{Area } (\triangle ADE) + \text{Area } (\triangle ADE) = \text{Area (trapezium BCED)} + \text{Area } (\triangle ADE)$$

$$\Rightarrow 2 \text{ Area } (\triangle ADE) = \text{Area } (\triangle ABC) \dots (i)$$

In $\triangle ADE$ and $\triangle ABC$, we have



$DE \parallel BC$, therefore, $\angle ADE = \angle B$ [Corresponding angles]

and, $\angle A = \angle A$ [Common]

$\therefore \triangle ADE \sim \triangle ABC$

Since for similar triangles, the ratio of the areas is the square of the ratio of their corresponding sides. Therefore,

$$\frac{\text{Area } (\triangle ADE)}{\text{Area } (\triangle ABC)} = \frac{AD^2}{AB^2}$$

$$\Rightarrow \frac{\text{Area } (\triangle ADE)}{2 \text{ Area } (\triangle ADE)} = \frac{AD^2}{AB^2}$$

$$\Rightarrow \frac{1}{2} = \left(\frac{AD}{AB} \right)^2$$

$$\Rightarrow \frac{AD}{AB} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow AB = \sqrt{2} AD$$

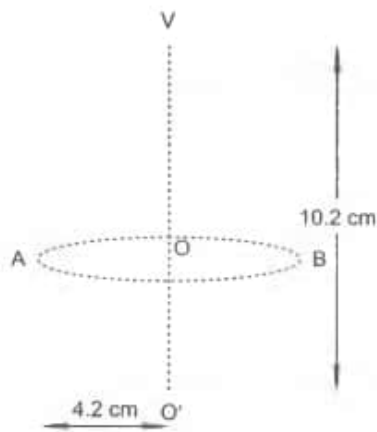
$$\Rightarrow AB = \sqrt{2} (AB - BD)$$

$$\Rightarrow (\sqrt{2} - 1) AB = \sqrt{2} BD \Rightarrow \frac{BD}{AB} = \frac{\sqrt{2}-1}{\sqrt{2}} = \frac{2-\sqrt{2}}{2}$$

34. We have, $VO' = 10.2\text{cm}$, $OA = OO' = 4.2\text{cm}$

Let r be the radius of the hemisphere and h be the height of the conical part of the toy.

Then, $r = OA = 4.2\text{ cm}$, $h = VO = VO' - OO' = (10.2 - 4.2)\text{ cm} = 6\text{ cm}$



Also, radius of the base of the cone = OA = r = 4.2 cm

∴ Volume of the wooden toy = Volume of the conical part + Volume of the hemispherical part

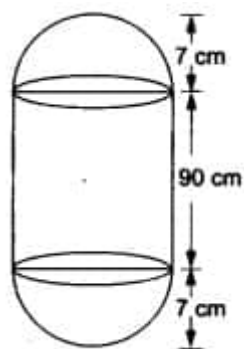
$$= \left(\frac{1}{3} \pi r^2 h + \frac{2\pi}{3} r^3 \right) \text{ cm}^3$$

$$= \frac{\pi r^2}{3} (h + 2r) \text{ cm}^3$$

$$= \frac{1}{3} \times \frac{22}{7} \times 4.2 \times 4.2 \times (6 + 2 \times 4.2) \text{ cm}^3$$

$$= \frac{1}{3} \times \frac{22}{7} \times 4.2 \times 4.2 \times 14.4 \text{ cm}^3 = 266.11 \text{ cm}^3$$

OR



Radius of each hemispherical end = 7 cm.

Height of each hemispherical part = its radius = 7 cm.

Height of the cylindrical part = (104 - 2 × 7) cm = 90 cm.

Area of surface to be polished = 2(curved surface area of the hemisphere) + (curved surface area of the cylinder)

$$= [2 (2\pi r^2) + 2\pi r h] \text{ sq units}$$

$$= \left[\left(4 \times \frac{22}{7} \times 7 \times 7 \right) + \left(2 \times \frac{22}{7} \times 7 \times 90 \right) \right] \text{ cm}^2$$

$$= (616 + 3960) \text{ cm}^2 = 4576 \text{ cm}^2$$

$$= \left(\frac{4576}{10 \times 10} \right) \text{ dm}^2 = 45.76 \text{ dm}^2 [\because 10 \text{ cm} = 1 \text{ dm}].$$

∴ cost of polishing the surface of the solid

$$= ₹(45.76 \times 10) = ₹ 457.60.$$

35. Calculation of median:

Class interval	Frequency(f_i)	Cumulative frequency
5 - 10	5	5
10- 15	6	11
15 - 20	15	26
20 - 25	10	36
25 - 30	5	41
30 - 35	4	45
35 - 40	2	47

Now, $N = 49 \Rightarrow \frac{N}{2} = 24.5$.

Thus, the median class is 15 - 20.

$\therefore l = 15, h = 5, f = 15, \text{c.f.} = 11$

$$\text{Median, } M = l + \left\{ h \times \frac{\left(\frac{N}{2} - \text{c.f.}\right)}{f} \right\}$$

$$= 15 + \left(5 \times \frac{(24.5 - 11)}{15} \right)$$

$$= 15 + \left(5 \times \frac{13.5}{15} \right)$$

$$= 15 + 4.5 = 19.5$$

Hence, the median of frequency distribution is 19.5

Section E

36. Read the text carefully and answer the questions:

Students of a school thought of planting trees in and around the school to reduce air pollution. It was decided that the number of trees, that each section of each class will plant, will be the same as the class, in which they are studying, e.g., a section of class I will plant 1 tree, a section of class II will plant 2 trees and so on till class XII. There are three sections of each class.



(i) Each class has 3 section

class 1 plants = 3 trees

class 2 plants = 6 trees

class 3 plants = 9 trees

$\therefore 3, 6, 9, \dots$

The no of trees planted by each class is in AP.

$$S_n = \frac{n}{2} \{2a + (n - 1)d\}$$

$$S_5 = \frac{5}{2} \{2 \times 3 + (5 - 1)3\}$$

$$S_5 = \frac{5}{2} \{6 + 12\}$$

$$S_5 = \frac{5}{2} \times 18$$

$$S_5 = 45$$

\therefore class 1 to 5 students plant 45 trees.

(ii) $S_n = \frac{n}{2} \{2a + (n - 1)d\}$

$$S_{12} = \frac{12}{2} \{2 \times 3 + (12 - 1)3\}$$

$$S_{12} = 6 \{6 + 33\}$$

$$S_{12} = 6 \times 39$$

$$S_{12} = 234$$

\therefore total no of trees planted by school = 234

OR

\therefore Class 12th has 3 sections and each section plants 12 trees.

\therefore total no of trees = 12×3

= 36 trees.

(iii) 30

37. Read the text carefully and answer the questions:

In an examination hall, students are seated at a distance of 2 m from each other, to maintain the social distance due to CORONA virus pandemic. Let three students sit at points A, B and C whose coordinates are (4, -3), (7, 3) and (8, 5) respectively.



- (i) The distance between A and C
 $= \sqrt{(8-4)^2 + (5+3)^2} = \sqrt{4^2 + 8^2}$
 $= \sqrt{16 + 64} = \sqrt{80} = 4\sqrt{5}$ units

- (ii) Let the coordinates of I be (x, y)

$$\begin{array}{ccc} & 1:2 & \\ \overline{\hspace{1.5cm}} & & \\ B(7, 3) & I(x, y) & C(8, 5) \end{array}$$

Then, by section formula,

$$x = \frac{1 \times 8 + 2 \times 7}{1+2} = \frac{8+14}{3} = \frac{22}{3}$$

$$\text{and } y = \frac{1 \times 5 + 2 \times 3}{1+2} = \frac{5+6}{3} = \frac{11}{3}$$

Thus, the coordinates of I is $\left(\frac{22}{3}, \frac{11}{3}\right)$

OR

Let B divides the line segment joining A and C in the ratio $k : 1$. Then, the coordinates of B will be $\left(\frac{8k+4}{k+1}, \frac{5k-3}{k+1}\right)$.

Thus, we have $\left(\frac{8k+4}{k+1}, \frac{5k-3}{k+1}\right) = (7, 3)$

$$\Rightarrow \frac{8k+4}{k+1} = 7 \text{ and } \frac{5k-3}{k+1} = 3$$

$$\text{Consider, } \frac{8k+4}{k+1} = 7 \Rightarrow 8k+4 = 7k+7 \Rightarrow k = 3$$

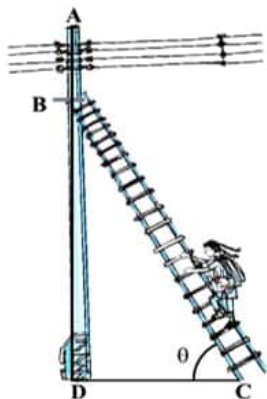
Hence, the required ratio is 3 : 1.

- (iii) The mid-point of A and C

$$= \left(\frac{8+4}{2}, \frac{5-3}{2}\right) = (6, 1)$$

38. Read the text carefully and answer the questions:

In a village, group of people complained about an electric fault in their area. On their complaint, an electrician reached village to repair an electric fault on a pole of height 10 m. She needs to reach a point 1.5 m below the top of the pole to undertake the repair work (see the adjoining figure). She used ladder, inclined at an angle of θ to the horizontal such that $\cos \theta = \frac{\sqrt{3}}{2}$, to reach the required position.



- (i) Length $BD = AD - AB = 10 - 2.5 = 8.5$

- (ii) The length of ladder BC

In $\triangle BDC$

$$\cos \theta = \frac{\sqrt{3}}{2}$$

$$\Rightarrow \theta = 30^\circ$$

$$\sin 30^\circ = \frac{BD}{BC}$$

$$\Rightarrow \frac{1}{2} = \frac{8.5}{BC}$$

$$\Rightarrow BC = 2 \times 8.5 = 17 \text{ m}$$

OR

If the height of pole and distance BD is doubled, then the length of the ladder is

$$\sin 30^\circ = \frac{BD}{BC}$$

$$\Rightarrow \frac{1}{2} = \frac{17}{BC}$$

$$\Rightarrow BC = 2 \times 17 = 34 \text{ m}$$

(iii) Distance between foot of ladder and foot of wall CD

In $\triangle BDC$

$$\cos 30^\circ = \frac{CD}{BC}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{CD}{17}$$

$$\Rightarrow CD = 8.5\sqrt{3} \text{ m}$$