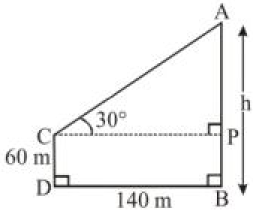
SAMPLE PAPER 2



1. **(a)** Let the height of the first tower be h (figure).

i.e., $AB = h$ and $AP = h - 60$

In ΔACP, $\tan 30° = \frac{AP}{CP}$

$\Rightarrow h = 60 + \frac{140}{\sqrt{3}} = 140.83$ m

2. **(d)** (k + 2), (4k – 6) and (3k – 2) are in A.P.

$\Rightarrow 4k - 6 - k - 2 = 3k - 2 - 4k + 6$

$\Rightarrow 3k - 8 = -k + 4 \Rightarrow 3k + k = 4 + 8 \Rightarrow 4k = 12 \Rightarrow k = \frac{12}{4} = 3$

3. **(d)** Since ST is a diameter of the circle with centre O, So $\angle SRT = 90°$. [Angle in a semicircle]

Now, $\angle PRS + \angle SRT + \angle TRQ = 180°$ [Linear pair]

$\angle PRS + 90° + 30° = 180°$

$\angle PRS = 180° - 120° = 60°$

4. **(b)** Let the required ratio be K : 1

$\therefore$ The co–ordinates of the required point on the y–axis is

$x = \frac{K(-4) + 3(1)}{K + 1}$; $y = \frac{K(2) + 5(1)}{K + 1}$

Since, it lies on y – axis

$\therefore$ Its x–cordinates = 0

$\therefore \frac{-4K + 3}{K + 1} = 0 \Rightarrow -4K + 3 = 0$

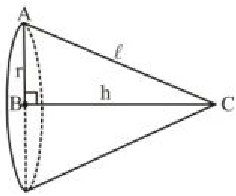
$\Rightarrow K = \frac{3}{4}$

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

$\therefore$ ratio = 3 : 4

5. **(c)** Area (ΔABC) = $\frac{1}{2} \times 5 \times 3 = 7.5$ sq. units

6. **(a)** Given, h = 16 cm and l = 20 cm.



$\therefore \quad r = \sqrt{l^2 - h^2} = \sqrt{20^2 - 16^2}$ cm = 12 cm

$\therefore \quad \text{Volume} = \frac{1}{3}\pi r^2 h = \frac{1}{3} \times \frac{22}{7} \times 12^2 \times 16 \text{ cm}^3$

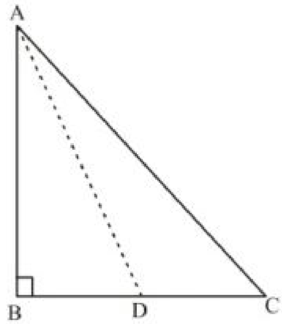
$= \frac{16896}{7} \text{ cm}^3 = 2413 \text{ cm}^3$

7. **(d)** We know that, to divide a line segment AB in the ratio $m : n$, first draw a ray AX which makes an acute $\angle BAX$ then, marked $m + n$ points at equal distance.

Here, $m = 2, n = 5$

$\therefore$ Minimum number of these points = 2 + 5 = 7

8. (a)



Given : A ΔABC in which $\angle B = 90°$ and D is the midpoint of BC.

Join AD.

In ΔABC, $\angle B = 90°$.

$\therefore \quad AC^2 = AB^2 + BC^2$ ... (i) [by Pythagoras' theorem]

In ΔABD, $\angle B = 90°$

$\therefore \quad AD^2 = AB^2 + BD^2$ ... (ii) [by Pythagoras' theorem]

$\Rightarrow \quad AB^2 = (AD^2 - BD^2)$.

$\therefore \quad AC^2 = (AD^2 - BD^2) + BC^2$ [using (i)]

$\Rightarrow \quad AC^2 = AD^2 - CD^2 + (2CD)^2$ [$\because$ BD = CD and BC = 2CD]

$\Rightarrow \quad AC^2 = AD^2 + 3CD^2$

Hence, $AC^2 = AD^2 + 3CD^2$

9. (b) Area of rectangle = 28 cm × 23 cm = 644 cm^2

Radius of semicircle = 28 cm ÷ 2 = 14 cm

Radius of quadrant = 23 cm − 16 cm = 7 cm

Area of unshaded region

$$= \left(\frac{1}{2} \times \frac{22}{7} \times 14cm \times 14cm\right) + \left(2 \times \frac{1}{4} \times \frac{22}{7} \times 7cm \times 7cm\right) = 385\ cm^2$$

Shaded area = 644 cm^2 − 385 cm^2 = 259 cm^2

10. (b) Coordinates of mid-point are given by $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Here, coordinates of mid-point are $\left(\frac{a}{3}, 4\right)$

So, $\frac{a}{3} = \frac{-6-2}{2}$

$\therefore \quad a = -12$

11. Since $x = 1$ is a common root of $ax^2 + ax + 3 = 0$ and $x^2 + x + b = 0$, we get

$a(1)^2 + a(1) + 3 = 0 \Rightarrow 2a + 3 = 0 \Rightarrow a = \frac{-3}{2}$

$(1)^2 + (1) + b = 0 \Rightarrow 2 + b = 0 \Rightarrow b = -2$

So the value of ab is $\left(-\frac{3}{2}\right)(-2) = 3$

Answer : 3

OR

Answer : $\frac{b^2}{4a}$

12. **Answer :** H.C.F.

13. Here, $(a \cos\theta - b \sin\theta) = c$ ... (i)

Now, $(a \cos\theta - b \sin\theta)^2 + (a \sin\theta + b \cos\theta)^2 = a^2 \cos^2\theta + b^2 \sin^2\theta - 2ab \cos\theta \sin\theta + a^2 \sin^2\theta + b^2\cos^2\theta + 2ab \sin\theta \cos\theta$

$= a^2 (\cos^2\theta + \sin^2\theta) + b^2 (\cos^2\theta + \sin^2\theta)$

$\therefore (a \sin\theta + b \cos\theta) = \pm \sqrt{a^2 + b^2 - c^2}$

Answer : $\pm \sqrt{a^2 + b^2 - c^2}$

14. **Answer :** angle of depression

15. $3\sin\theta + 5\cos\theta = 5$

$\Rightarrow (3 \sin\theta + 5\cos\theta)^2 = 25 \Rightarrow 9\sin^2\theta + 25\cos^2\theta + 30 \sin\theta \cos\theta = 25$

$9(1 - \cos^2\theta) + 25(1 - \sin^2\theta) + 30 \sin\theta \cos\theta = 25 \Rightarrow 9\cos^2\theta + 25 \sin^2\theta - 30 \sin\theta \cos\theta = 9$

$(5 \sin\theta - 3 \cos\theta)^2 = 9 \Rightarrow 5\sin\theta - 3\cos\theta = \pm 3$

Answer : ± 3

16. CQ = CP = 11 [$\because$ length of tangents from C to the circle are equal]

$\therefore$ CQ = 11cm

But BC = 7 cm $\therefore$ 7 + BQ = 11 [$\because$ CQ = BC + BQ]

$\therefore$ BQ = 11 – 7 = 4

Since BR = BQ = 4 [$\because$ length of tangents from B to the circle are equal]

Thus BR = 4 cm.

17. Suppose the required ratio is $m_1 : m_2$ [1 Mark]

Then, using the section formula, we get $-2 = \frac{m_1(4) + m_2(-3)}{m_1 + m_2}$

$\Rightarrow -2m_1 - 2m_2 = 4m_1 - 3m_2 \Rightarrow m_2 = 6m_1 \Rightarrow m_1 : m_2 = 1:6$ [1 Mark]

18. $r = \frac{10}{2}$ cm $= 5$ cm [1 Mark]

OR

22πm [1 Mark]

19. True. As $\angle BPA = 90°$, $\angle PAB = \angle OPA = 60°$. Also, $OP \perp PT$. Therefore, $\angle APT = 30°$ and $\angle PTA = 60° - 30° = 30°$. [1 Mark]

20. Volume of bucket $= \dfrac{\pi h}{3}(R^2 + Rr + r^2)$

(Frustum formula)

$= \dfrac{22}{7} \times \dfrac{40}{3}(1225 + 490 + 196) = 80080\,cm^3$ [1 Mark]

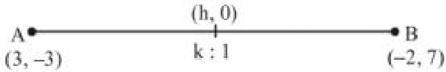
21. First number divisible by 8 between 200 and 500 is 208.
It forms an A.P. = 208, 216, 224, ..., 496.
Here, $a_n = 496$, $a = 208$, $d = 8$
$a_n = a + (n-1)d \Rightarrow 496 = 208 + (n-1)\,8$ [1 Mark]
$(n-1)8 = 496 - 208$

$(n-1) = \dfrac{288}{8} \Rightarrow n - 1 = 36 \quad \Rightarrow \quad n = 37$ [1 Mark]

OR

Factors of 1 to 10 numbers
$1 = 1$
$2 = 1 \times 2$
$3 = 1 \times 3$
$4 = 1 \times 2 \times 2$
$5 = 1 \times 5$
$6 = 1 \times 2 \times 3$
$7 = 1 \times 7$
$8 = 1 \times 2 \times 2 \times 2$
$9 = 1 \times 3 \times 3$
$10 = 1 \times 2 \times 5$ [1 Mark]
$\therefore$ LCM of number 1 to 10
$= 1 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 7 = 2520$ [1 Mark]

22.



Let (h, 0) be point on x-axis which divides AB in k : 1.

By section formula : $h = \dfrac{-2k+3}{k+1},\ 0 = \dfrac{7k-3}{k+1} \quad \Rightarrow \quad k = \dfrac{3}{7}$ [1 Mark]

Now, $h = \dfrac{-2\left(\frac{3}{7}\right) + 3}{\frac{3}{7} + 1} = \dfrac{-6+21}{10} = \dfrac{3}{2}$ [½ Mark]

point on x-axis $= \left(\dfrac{3}{2}, 0\right)$ and ratio is 3 : 7. [½ Mark]

23. Comparing the given equations with $a_1x, + b_1y = c_1$ and $a_2x + b_2y = c_2$ we have

$\therefore \quad \dfrac{a_1}{a_2} = \dfrac{1}{2};\ \dfrac{b_1}{b_2} = \dfrac{2}{1};\ \dfrac{c_1}{c_2} = \dfrac{4}{5}$ [1 Mark]

Here, $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ [½ Mark]

∴ The equations have consistent and unique solution. [½ Mark]

OR

Pair of lines are coincident if

$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ ... (i) [½ Mark]

Given lines,
$3x - y + 8 = 0$
and $6x - ky + 16 = 0$
Here, $a_1 = 3, b_1 = -1, c_1 = 8$
$a_2 = 6, b_2 = -k, c_2 = 16$ [½ Mark]
Using equation (i) we have

$\frac{3}{6} = \frac{-1}{-k} = \frac{8}{16}$ [½ Mark]

$\Rightarrow \frac{1}{k} = \frac{1}{2}$

∴ $k = 2$ [½ Mark]

24. Natural numbers between 101 and 999 divisible by 5 and 2 both, must be divisible by 10.
∴ {110, 120, ..., 990} are numbers divisible by both 2 and 5. [½ Mark]
It forms an A.P., in which a = 110, d = 10 and $a_n = 990$. [½ Mark]
∴ $a_n = a + (n-1)d \Rightarrow 990 = 110 + (n-1)\,10$
$\Rightarrow 99 = 11 + (n-1) \Rightarrow 88 + 1 = n \Rightarrow n = 89$ [1 Mark]

25. Since, number of white balls in the bag = 15
Let the number of black balls in the bag = x
As, P (drawing a black ball) = 3 × P (drawing a white ball) [1 Mark]

$\frac{x}{15+x} = 3 \times \frac{15}{15+x} \Rightarrow \quad x = 45 \; [\because x + 15 \neq 0]$ [1 Mark]

Hence, the number of black balls in the bag is 45.

26. S = {BBB, BBG, BGB, BGG, GBB, GBG, GGB, GGG}; n(S) = 8
E = {BBB, BBG, BGB, BGG, GBB, GBG, GGB}; n (E) = 7 [1 Mark]

∴ $P(E) = \frac{n(E)}{n(S)} = \frac{7}{8}$ [1 Mark]

27. Let us first find the H.C.F. of 210 and 55.
Applying Euclid's division lemma on 210 and 55, we get
$210 = 55 \times 3 + 45$ ... (i) [1 Mark]
Since, the remainder 45 ≠ 0. So, we now apply division lemma on the divisor 55 and the remainder 45 to get
$55 = 45 \times 1 + 10$ ... (ii) [½ Mark]
We consider the divisor 45 and the remainder 10 and apply division lemma to get
$45 = 4 \times 10 + 5$ ... (iii) [½ Mark]
We consider the divisor 10 and the remainder 5 and apply division lemma to get
$10 = 5 \times 2 + 0$ ... (iv)
We observe that the remainder at this stage is zero. So, the last divisor i.e., 5 is the H.C.F of 210 and 55.

∴ $5 = 210 \times 5 + 55y \Rightarrow y = \frac{-1045}{55} = (-19)$ [1 Mark]

28. As $3x^2 - 5$ divides $f(x)$ completely

$\therefore$ $(3x^2 - 5)$ is a factor of $f(x) \Rightarrow 3\left(x^2 - \frac{5}{3}\right)$ is a factor of $f(x)$

$\therefore$ $\left(x - \sqrt{\frac{5}{3}}\right)\left(x + \sqrt{\frac{5}{3}}\right)$ is a factor of $f(x)$. [½ Mark]

$\therefore$ $\sqrt{\frac{5}{3}}$ and $-\sqrt{\frac{5}{3}}$ are zeroes of $f(x)$. [½ Mark]

$$\begin{array}{r|l} & x^2 + x - 2 \\ 3x^2 - 5 & 3x^4 + 3x^3 - 11x^2 - 5x + 10 \\ & \underline{3x^4 \qquad\quad \mp 5x^2} \\ & \quad \underset{-}{} \qquad\qquad \underset{+}{} \\ & 3x^3 - 6x^2 + 5x \\ & \underline{3x^3 \qquad\quad \mp 5x} \\ & \quad \underset{-}{} \qquad\qquad \underset{+}{} \\ & -6x^2 + 10 \\ & -6x^2 + 10 \\ & \underline{+ \qquad -} \\ & \times \end{array}$$

[1 Mark]

$\therefore$ $(x^2 + x - 2)$ is a factor of $p(x) \Rightarrow (x^2 + 2x - x - 2)$ is a factor of $p(x)$
$\therefore$ $(x + 2)(x - 1)$ is a factor of $p(x)$
$\therefore$ -2 and 1 are zeroes of $p(x)$. [1 Mark]

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

29. Here, maximum frequency = 9, so modal class is $60 - 90$

Mode = $L + h\left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right)$ [1 Mark]

Here, $L = 60$, $f_1 = 9$, $f_0 = 6$, $f_2 = 6$ and $h = 30$.

Mode = $60 + 30\left(\frac{9-6}{2 \times 9 - 6 - 6}\right) = 60 + \frac{30 \times 3}{6} = 75$ [2 Marks]

30. The equations can be written as.

$(a + b)x + (a - b)y = a^2 - ab + b^2$
$(a - b)x + (a + b)y = a^2 + ab + b^2$

$\Rightarrow \frac{x}{(a-b)(a^2+ab+b^2)-(a+b)(a^2-ab+b^2)}$ [By Cross multiplication method]

$= \frac{y}{(a-b)(a^2-ab+b^2)-(a+b)(a^2+ab+b^2)} = \frac{-1}{(a+b)^2-(a-b)^2}$ [1 Mark]

$\Rightarrow \frac{x}{a^3 - b^3 - a^3 - b^3} = \frac{y}{-4a^2b - 2b^3} = \frac{-1}{4ab}$ [½ Mark]

$\Rightarrow \frac{x}{-2b^3} = \frac{y}{-4a^2b - 2b^3} = -\frac{1}{4ab}$ [½ Mark]

Either $\frac{x}{-2b^3} = \frac{-1}{4ab} \Rightarrow x = \frac{b^2}{2a}$ [½ Mark] or $\frac{y}{-4a^2b-2b^3} = \frac{-1}{4ab} \Rightarrow y = \frac{2a^2+b^2}{2a}$ [½ Mark]

$\therefore \quad x = \frac{b^2}{2a}, y = \frac{2a^2+b^2}{2a}$

31. **Given:** ΔABC is right-angled at A. $DEFG$ is a square [½ Mark]

To prove: $DE^2 = BD \times EC$.

Proof : In ΔAGF and ΔDBG

$\angle GAF = \angle BDG = 90°$

$\angle AGF = \angle DBG$ (corres. angles)

$\therefore \quad \Delta AGF \sim \Delta DBG$ ... (i) (AA similarity) [1 Mark]

In ΔAGF and ΔEFC,

$\angle GAF = \angle CEF = 90°$

$\angle AFG = \angle FCE$ (corres. angles)

$\therefore \quad \Delta AFG \sim \Delta EFC$ ... (ii) (AA similarity)

From (i) and (ii) [1 Mark]

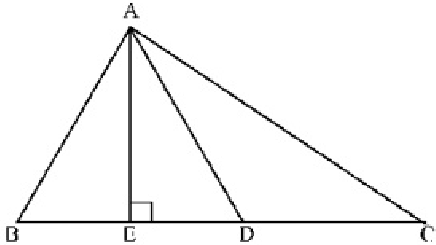
$\Delta DBG \sim \Delta EFC$

$\therefore \quad \frac{DB}{EF} = \frac{DG}{EC}$, But $EF = DG = DE$ (sides of a square)

$\therefore \quad \frac{DB}{DE} = \frac{DE}{EC} \quad \therefore \quad DE^2 = DB \times EC$ [½ Mark]

OR

In ΔAEB, $\angle AEB = 90°$



$\therefore AB^2 = AE^2 + BE^2$ ... (i) [½ Mark]

In ΔAED, $\angle AED = 90°$.

$\therefore AD^2 = (AE^2 + DE^2)$

$\Rightarrow AE^2 = (AD^2 - DE^2)$ [½ Mark]

$\therefore AB^2 = (AD^2 - DE^2) + BE^2$ [using (i)] [½ Mark]

$= (AD^2 - DE^2) + (BD - DE)^2$ [½ Mark]

$= (AD^2 - DE^2) + \left(\frac{1}{2}BC - DE\right)^2$ [½ Mark]

$= AD^2 + \frac{1}{4}BC^2 - BC \cdot DE$ [½ Mark]

32. Join OT. Let it intersect PQ at the point R. Then Δ TPQ is isosceles triangle and TO is the angle bisector of $\angle PTQ$.
So, $OT \perp PQ$ therefore, OT bisects PQ which gives PR = RQ = 4 cm.

Also, $OR = \sqrt{OP^2 - PR^2} = \sqrt{5^2 - 4^2}\,cm = 3\,cm.$ [1 Mark]

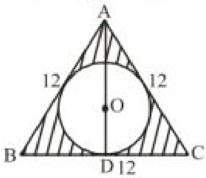
Now, $\angle TPR + \angle RPO = 90° = \angle TPR + \angle PTR$ [1 Mark]

So, $\angle RPO = \angle PTR$

Therefore, right triangle TRP is similar to the right triangle PRO (by AA similarity).

This gives $\frac{TP}{PO} = \frac{RP}{RO}$ i.e., $\frac{TP}{5} = \frac{4}{3}$ or $TP = \frac{20}{3}$ cm. [1 Mark]

33. Median and altitude of an equilateral triangle are same and passing through the centre of incircle and centre divides the median in ratio 2 : 1.



$\therefore$ In ΔABD, $\angle D = 90°$

By Pythagoras theorem

$AD^2 = AB^2 - BD^2 \Rightarrow AD^2 = 12^2 - 6^2$

$\Rightarrow AD^2 = 144 - 36 \Rightarrow AD = \sqrt{108} = 6\sqrt{3}cm$

AO : OD = 2 : 1 [1 Mark]

$\therefore \quad OD = \frac{1}{3}AD = \frac{1}{3} \times 6\sqrt{3} = 2\sqrt{3}$ [½ Mark]

Now, radius of circle $= 2\sqrt{3} = 2 \times 1.73 = 3.46\,cm$ [½ Mark]

Area of shaded region = Area of equilateral ΔABC – Area of circle [1 Mark]

$= \frac{\sqrt{3}}{4}(12)^2 - (2\sqrt{3})^2 \times \pi = 1.73 \times 36 - 12 \times 3.14 = 62.28 - 37.68 = 24.6\,cm^2.$

34. Suppose,
r_1 = Radius of the conical vessel = 5 cm
h_1 = Height of the conical vessel = 24 cm
r_2 = Radius of the cylindrical vessel = 10 cm
Suppose water rises up to a height h_2 cm in the cylindrical vessel.
A.T.Q,
Volume of the water in cylindrical vessel = Volume of water in conical vessel

$\Rightarrow \quad \pi r_2^2 h_2 = \frac{1}{3}\pi r_1^2 h_1$ [1 Mark]

$\Rightarrow \quad 3r_2^2 h_2 = r_1^2 h_1 \Rightarrow 3 \times 10 \times 10 \times h_2 = 5 \times 5 \times 24$ [1 Mark]

$\Rightarrow \quad h_2 = \frac{5 \times 5 \times 24}{3 \times 10 \times 10} \quad \Rightarrow \quad h_2 = 2\,cm$ [1 Mark]

Hence, the rise in the water level in the cylindrical vessel = 2 cm.

OR

Increase in the height of water level in the cylindrical vessel due to sphere (h) = $\frac{32}{9}$ cm

Radius of the sphere (R) = 6 cm [½ Mark]

Suppose radius of the cylindrical vessel be r.

Volume of water in cylinder = Volume of sphere [1 Mark]

$$\pi r^2 h = \frac{4}{3}\pi R^3 \Rightarrow r^2 = \frac{4\times 6^3 \times 9}{3\times 32} \Rightarrow r = \sqrt{27\times 3} = 9 \text{ cm}$$ [1 Mark]

Hence, diameter of the cylindrical vessel = 18 cm. [½ Mark]

35. Let A and D be the first term and common difference respectively of the given A.P. Then,

$a = p$th term $\Rightarrow a = A + (p-1)D$ ... (i)

$b = q$th term $\Rightarrow b = A + (q-1)D$ ... (ii) [1 Mark]

Subtracting (ii) from (i), we get $D = \frac{a-b}{p-q}$ [1 Mark]

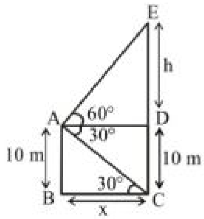
Adding (i) and (ii), we get $a+b = 2A + (p+q-1-1)D$

$$(a+b) + \frac{a-b}{p-q} = 2A + (p+q-1)D \text{ ... (iii)}$$ [1 Mark]

Now, S_{p+q} = Sum of $(p+q)$ terms

$$\Rightarrow S_{p+q} = \frac{p+q}{2}\{2A + (p+q-1)D\} = \frac{p+q}{2}\left\{a+b+\frac{a-b}{p-q}\right\}$$ [Using (iii)] [1 Mark]

36.



Suppose the man is standing on the deck of the ship at point A.

Suppose CE be the hill with base at C. [1 Mark]

Given that the angle of elevation of point E from A is 60° and the angle of depression of point C from A is 30°.

$\angle DAE = 60°, \angle CAD = 30°$ [½ Mark]

Now, $\angle CAD = \angle ACB = 30°$ [Alternate angles]

AB = 10 m [½ Mark]

Let ED = h m and BC = x m.

In ΔEAD, $\tan 60° = \frac{ED}{AD} \Rightarrow \sqrt{3} = \frac{h}{x} \Rightarrow h = x\sqrt{3}$ ... (i) [½ Mark]

In ΔABC, $\tan 30° = \frac{AB}{BC} \Rightarrow \frac{1}{\sqrt{3}} = \frac{10}{x} \Rightarrow x = 10\sqrt{3}$ ... (ii) [½ Mark]

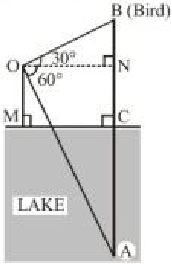
So, distance of the hill from the ship $= 10\sqrt{3}$m

From (i) and (ii), $h = 10\sqrt{3}\times\sqrt{3} = 30$m

Hence, height of the hill = h + 10 = 30 + 10 = 40 m. [1 Mark]

OR

Let A be the reflection of the bird B in the lake. then $CB = CA = h$ metres (say).



[1 Mark]

$\therefore$ $NB = (h-50)$ m and $AN = (h+50)$ m [1 Mark]

Let ON be d metres.

$$\tan 60° = \frac{h+50}{d} \Rightarrow \sqrt{3} = \frac{h+50}{d} \text{ and}$$

$$\tan 30° = \frac{h-50}{d} \Rightarrow d = (h-50)\sqrt{3}$$ [1 Mark]

$$\text{Thus, } 3 = \frac{h+50}{h-50} \Rightarrow h = 100$$ [1 Mark]

37. Let a = 50 and h = 20

Class	**Frequency (f_i)**	**Mid-point (x_i)**	$u_i = \frac{x_i - 50}{20}$	$f_i u_i$
0-20	f_1	10	–2	$-2f_1$
20-40	28	30	–1	–28
40-60	f_2	50	0	0
60-80	24	70	1	24
80-100	19	90	2	38
Total	$120 = 71 + f_1 + f_2$			$34 - 2f_1$

[2 Marks]

$71 + f_1 + f_2 = 120 \Rightarrow f_1 + f_2 = 49$ ... (i)

$$\overline{x} = a + h \times \frac{1}{n}\sum_{i=1}^{5} f_i u_i \Rightarrow 50 = 50 + 20 \times \frac{1}{120}(34 - 2f_1) \Rightarrow 34 - 2f_1 = 0 \Rightarrow f_1 = 17$$ [1 Mark]

Substituting the value of f_1 in (i),

$17 + f_2 = 49 \Rightarrow f_2 = 49 - 17 = 32$ [1 Mark]

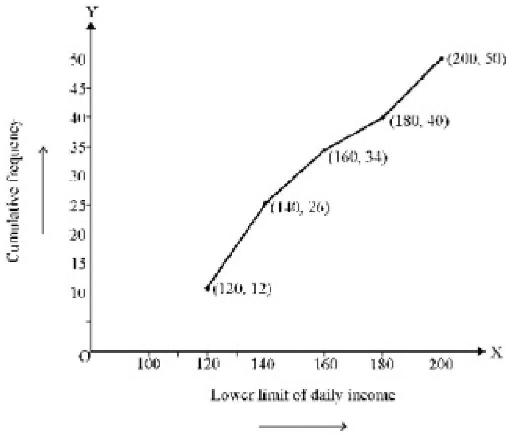
OR

Less than type frequency distribution.

Daily income (in ₹)	Cummulative Frequency
Less than 120	12
Less than 140	26
Less than 160	34
Less than 180	40
Less than 200	50

[2 Marks]

We first draw the coordinate x-axis with lower limits of the daily income (in ₹) along the horizontal axis and the cummulative frequency along the vertical axis. Then, we plot the points (120, 12), (140, 26), (160, 34), (180, 40), (200, 50) and join these points by a free hand smooth curve.



[2 Marks]

38. $\frac{1}{x+1}+\frac{3}{5x+1}=\frac{5}{x+4}, x \neq -1, -\frac{1}{5}, -4$

$\Rightarrow \frac{5x+1+3(x+1)}{(x+1)(5x+1)}=\frac{5}{x+4} \Rightarrow \frac{5x+1+3x+3}{5x^2+6x+1}=\frac{5}{x+4}$ [1 Mark]

$\Rightarrow (8x+4)(x+4)=25x^2+30x+5 \Rightarrow 8x^2+36x+16=25x^2+30x+5$ [1 Mark]

$\Rightarrow 17x^2-6x-11=0 \Rightarrow 17x^2-17x+11x-11=0$

$\Rightarrow 17x(x-1)+11(x-1)=0 \Rightarrow (x-1)(17x+11)=0$ [1 Mark]

$\Rightarrow x=1, \frac{-11}{17}$ [1 Mark]

Hence, the value of x is 1 or $\frac{-11}{17}$.

OR

Suppose, the smaller tap takes x hours to fill the given water tank.
Then the larger tap can fill the same water tank in $(x-10)$ hours.

$\therefore$ portion of tank filled by the larger tap $=\frac{1}{x-10}$ [½ Mark]

Portion of tank filled by the smaller tap $=\frac{1}{x}$ [½ Mark]

Also, we know that both taps together can fill the same tank in $9\frac{3}{8}$ hours

$\therefore$ portion of the tank filled by both taps in 1 hour $= \frac{1}{x} + \frac{1}{x-10}$.

$\Rightarrow \frac{1}{x} + \frac{1}{x-10} = \frac{1}{\left(\frac{75}{8}\right)} = \frac{8}{75} \quad \left(\because 9\frac{3}{8} = \frac{75}{8}\right)$ [1 Mark]

$\Rightarrow 8x^2 - 230x + 750 = 0 \Rightarrow 4x^2 - 115x + 375 = 0$

$\Rightarrow (x-25)(4x-15) = 0$ (By splitting the middle term) [1 Mark]

$\Rightarrow x = 25$ or $\frac{15}{4}$. Now, we reject $x = \frac{15}{4}$ $(\because x < 10)$

Hence, smaller tap takes 25 hours and larger tap takes 15 hours to fill the water tank. [1 Mark]

39. $\frac{\cos^2\theta - 3\cos\theta + 2}{\sin^2\theta} = 1 \Rightarrow \cos^2\theta - 3\cos\theta + 2 = \sin^2\theta$ [½ Mark]

$\Rightarrow \cos^2\theta - 3\cos\theta + 2 = 1 - \cos^2\theta \Rightarrow 2\cos^2\theta - 3\cos\theta + 1 = 0$ [1 Mark]

$\Rightarrow 2\cos^2\theta - 2\cos\theta - \cos\theta + 1 = 0 \Rightarrow 2\cos\theta(\cos\theta - 1) - 1(\cos\theta - 1) = 0$ [1 Mark]

$\Rightarrow (2\cos\theta - 1)(\cos\theta - 1) = 0$ [½ Mark]

Either $2\cos\theta - 1 = 0 \Rightarrow 2\cos\theta = 1 \Rightarrow \cos\theta = ½$

$\Rightarrow \cos\theta = \cos 60^\circ \Rightarrow \theta = 60^\circ$ or $\cos\theta - 1 = 0$

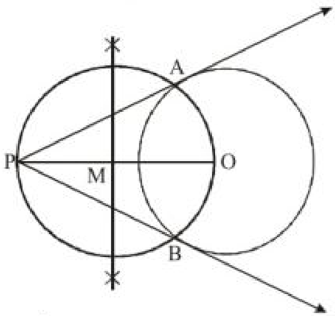
or $\cos\theta = 1 = \cos 0^\circ$

$\theta = 0^\circ$ (impossible)

$\therefore \theta = 60^\circ$ [1 Mark]

40. **Given :** A point P is at a distance of 6 cm. from the centre of a circle of radius 2.5 cm.

Required : To draw two tangents to the circle from the given point P. [1 Mark]



[2 Marks]

Steps of construction :

(i) Draw a line segment OP of length 6 cm.

(ii) With centre O and radius equal to 2.5 cm, draw a circle.

(iii) Draw the right bisector of OP, intersecting OP at M. Let M be mid-point of OP.

(iv) Taking M as centre and MO as radius draw a circle which intersect the given circle in two points, say A and B.

(v) Join PA and PB. These are the required tangents from P to the given circle. [1 Mark]