CBSE Board

Class X Mathematics

Sample Paper 8 – Solution

Section A

1. Correct option: C

Explanation:-

Since, $1 - \sin^2 x = \cos^2 x$, we have

$$\left(1-\sin^2 x\right)\sec^2 x = \cos^2 x \sec^2 x$$

$$=\left(\cos x \cdot \sec x\right)^2$$

$$=1 \;....\; \left(\because \cos x \cdot \sec x = 1\right)$$

2. Correct option: A

Explanation:-

$7\sin^2 \theta + 3\cos^2 \theta = 4$

$\Rightarrow 7\sin^2 \theta + 3(1 - \sin^2 \theta) = 4$

$\Rightarrow 7\sin^2 \theta + 3 - 3\sin^2 \theta = 4$

$\Rightarrow 4\sin^2 \theta = 1$

$\Rightarrow \sin \theta = \dfrac{1}{2} \Rightarrow \theta = 30^{\circ}$

3. Correct option: B

Explanation:-

Since, $\sin^2\theta = 1 - \cos^2\theta$

$$\sin^2\theta - \cos^2\theta$$

$$= 1 - 2\cos^2\theta$$

$$= 1 - 2\left(\frac{1}{\sqrt{3}}\right)^2$$

$$= 1 - \frac{2}{3}$$

$$= \frac{1}{3}$$

4. Correct option: D
Explanation:-
Co-ordinates of the mid-point of the line segment joining A (3, 4) and B (7, 6)
$$=\left(\frac{3+7}{2},\frac{4+6}{2}\right)=\left(\frac{10}{2},\frac{10}{2}\right)=(5,5)$$
Thus, the co-ordinates of midpoint of AB is (5, 5).

5. Correct option: A
Explanation:-
Given rational number is $\frac{17}{8}$

Now, $8 = 2^3$

The denominator is of the form 2^m.

Hence, the decimal expansion of $\frac{17}{8}$ is terminating and non-repeating.

6. Correct option: D
Explanation:-
We know that, product of two numbers = product of their HCF and LCM
$\therefore$ 18144 = 6 × LCM
$\therefore$ LCM = 3024

7. Correct option: B
Explanation:-
Distance of a point (– 6, – 7) from y-axis is 6 units.

8. Correct option: B
Explanation:-
Using the section formula which says the coordinates of a point, dividing the line segment joining $A(x_1,y_1)$ & $B(x_2,y_2)$ internally in the ratio m:n is

$\left(\frac{mx_2+nx_1}{m+n},\frac{my_2+ny_1}{m+n}\right)$, we get

$$x=\frac{2\times4+3\times(-1)}{2+3}=\frac{8-3}{5}=\frac{5}{5}=1$$

9. Correct option: C
Explanation:-
We know that,
3 median = mode + 2 mean

= 135.76 + 2 (137.058)

= 135.76 + 274.116

= 409.876

Median = 136.625

10. Correct option: D

Explanation:-

Given linear equations are

$9x + 3y + 12 = 0$ and $18x + 6y + k = 0$

Comparing these equations with $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$, we get:

$a_1 = 9, b_1 = 3, c_1 = 12, a_2 = 18, b_2 = 6, c_2 = k$

Since the given pair of equations need to be coincident

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

Hence, k = 24.

11. The probability of occurrence of an event A is denoted by P(A). Then, the range of P(A) will be $\underline{0 \le P(A) \le 1}$.

12. If (x − m) is a factor of the polynomial $x^3 - (m^2 - 1)x + 2$, then value of m is $\underline{-2}$.

Explanation:-

(x − m) is a factor of $x^3 - (m^2 - 1)x + 2$

Then for x = m

$m^3 - (m^2 - 1)m + 2 = 0$

$\Rightarrow m^3 - m^3 + m + 2 = 0$

Or $m = -2$

OR

If x = 1 is a zero of the polynomial $x^2 + kx + 3 = 0$, then k will be $\underline{-4}$.

Explanation:-

Let $p(x) = x^2 + kx + 3$

According to the question,

p(1) = 0

$\therefore 1 + k + 3 = 0$

$\therefore k = -4$

13. The common difference of an A.P. $7 + 10\frac{1}{2} + 14 + \ldots\ldots\ldots\ldots + 84$ is $\underline{\frac{7}{2}}$.

Explanation:-

For the given A.P. $7 + 10\frac{1}{2} + 14 + \text{...........} + 84$,

$a = 7$

$l = 84$

$$d = a_2 - a_1 = 10\frac{1}{2} - 7 = \frac{21}{2} - 7 = \frac{7}{2}$$

14. Sides of two similar triangles are in the ratio 4 : 9. Areas of these triangles are in the ratio <u>16 : 81</u>.

Explanation:-

If two triangles are similar, ratio between areas of these triangles will be equal to the square of the ratio of their corresponding sides.

Given that sides are in the ratio 4 : 9.

So, ratio between areas of these triangles = $\left(\frac{4}{9}\right)^2 = \frac{16}{81}$

15. A bucket is in the form of a frustum of a cone of slant height 31.62 cm with radii of its lower and upper ends as 10 cm and 20 cm respectively. The surface area of the bucket will be <u>3292.60 cm²</u>.

Explanation:-

Surface area of the bucket

= Curved surface area + surface area of the bottom

$$= 3.14 \times 31.62(20+10) + 3.14 \times (10)^2$$

$$= 3.14 \times 31.62 \times 30 + 3.14 \times 100$$

$$= 2978.60 + 314$$

$$= 3292.60 \text{ cm}^2$$

16. For the given AP, $a = 2$, $d = a_2 - a_1 = 7 - 2 = 5$, $n = 10$

We know that,

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

$$S_{10} = \frac{10}{2}\left[2(2) + (10-1)5\right]$$

$$= 5\left[4 + (9) \times (5)\right]$$

$$= 5 \times 49 = 245$$

17. Two tangents of a circle are parallel if they are drawn at the end points of a diameter.

Therefore, distance between them is the diameter of a circle = 2 × 5 cm = 10 cm

OR

Given, $2\pi r = \pi r^2$

$r = 2$

Thus, the radius of the circle is 2 units.

18. HCF(306, 657) = 9

We know that, LCM $\times$ HCF = Product of two numbers

$\therefore$ LCM $\times$ HCF = 306 $\times$ 657

$$\text{LCM} = \frac{306 \times 657}{\text{HCF}} = \frac{306 \times 657}{9}$$

LCM = 22338

19. The given quadratic equation is $4x^2 - 20x + 25 = 0$.

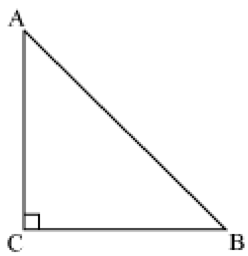
Comparing with the general form of quadratic equation $ax^2 + bx + c = 0$, we have

$a = 4$, $b = -20$ and $c = 25$

Therefore, $D = b^2 - 4ac = (-20)^2 - 4 \times 4 \times 25 = 400 - 400 = 0$

Hence, the roots are real and equal.

20.



Given that ΔABC is an isosceles triangle.

Therefore AC = CB

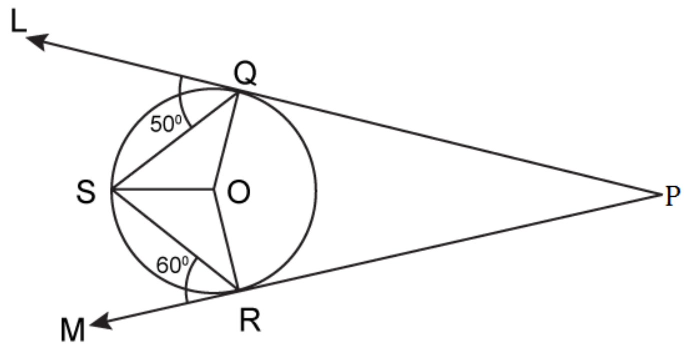
Applying Pythagoras theorem in ΔABC (i.e. right angled at point C)

$AC^2 + CB^2 = AB^2$

$2AC^2 = AB^2$ .... (as AC=CB)

Section B

21.



In the given figure, O is the centre of the circle.

Therefore, $\angle OQL = \angle ORM = 90°$ ... (Radius is $\perp$ to tangent at the point of contact)

Now, OS = OQ (radii of same circle)

$\angle OSQ = \angle OQS = 90° - 50° = 40°$

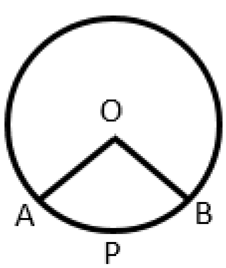
Also, OS = OR (radii of same circle)

$\angle RSO = \angle SRO = 90° - 60° = 30°$

Thus, $\angle QSR = \angle OSQ + \angle OSR = 40° + 30° = 70°$

OR

Area of sector OAPB = $\dfrac{\pi r^2\theta}{360} = \dfrac{22}{7} \times \dfrac{10 \times 10 \times 90}{360} = \dfrac{550}{7}$



Area of major sector = area of circle – area of sector OAPB

$$= \pi r^2 - \frac{550}{7}$$

$$= \frac{22}{7} \times 10 \times 10 - \frac{550}{7} = \left(\frac{2200}{7} - \frac{550}{7}\right) = \frac{1650}{7}\ \text{cm}^2$$

22. Radius (r_1) of 1st sphere = 3
Radius (r_2) of 2nd sphere = 4

Radius (r_3) of 3rd sphere = 5

Let the radius of resulting sphere be r

The object formed by recasting these spheres will be same in volume to the sum of volumes of these spheres.

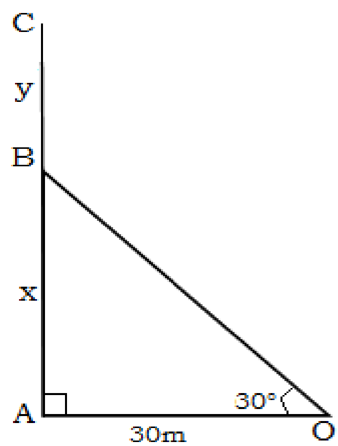
Volume of 3 spheres = volume of resulting sphere

$$\frac{4}{3}\pi\left[r_1^3 + r_2^3 + r_3^3\right] = \frac{4}{3}\pi r^3$$
$$\frac{4}{3}\pi\left[3^3 + 4^3 + 5^3\right] = \frac{4}{3}\pi r^3$$
$$r^3 = 27 + 64 + 125 = 216$$
$$r = 6 \text{ cm.}$$

So, the radius of sphere so formed will be 6cm.

23. Let AC be the tree broken at a point B such that the broken part CB takes the position BO and touches the ground at O.
OA = 30 m, m$\angle$AOB = 30°. Let AB = x and BC = BO = y.
In ΔAOB,

$$\tan 30^o = \frac{AB}{OA}$$



$$\frac{1}{\sqrt{3}} = \frac{x}{30}$$
$$x = 10\sqrt{3}$$

Again, in ΔAOB,

$$\cos 30^o = \frac{OA}{OB}$$
$$\frac{\sqrt{3}}{2} = \frac{30}{y}$$
$$y = 20\sqrt{3}$$

Height of the tree = (x + y) = $10\sqrt{3} + 20\sqrt{3}$ = $30\sqrt{3}$ metres

24. Given $\frac{AD}{BD} = \frac{3}{2}$

i. Let AD = 3x

Then DB = 2x

$$\therefore \frac{AD}{AB} = \frac{3x}{AD+DB}$$
$$= \frac{3x}{3x + 2x}$$
$$= \frac{3x}{5x} = \frac{3}{5}$$

ii. In ΔADE and ΔABC

$\angle ADE = \angle ABC$ [corr. Angles]

$\angle AED = \angle ACB$ [corr. Angles]

$\Rightarrow \Delta ADE \sim \Delta ABC$

$$\Rightarrow \frac{DE}{BC} = \frac{AD}{AB} = \frac{3}{5}$$

25. If any number ends with the digit 0, it should be divisible by 10 or in other words its prime factorisation must include primes 2 and 5 both.

Prime factorisation of $6^n = (2 \times 3)^n$

By Fundamental Theorem of Arithmetic, prime factorisation of a number is unique.

So 5 is not a prime factor of 6^n.

Hence, for any value of n, 6^n will not be divisible by 5.

Therefore, 6^n cannot end with the digit 0 for any natural number n.

26. In a non-leap year, there are 365 days, i.e., 52 weeks

52 weeks = 364 days

1 year = 52 weeks and 1 day

This extra one day can be Mon, Tue, Wed, Thu, Fri, Sat or Sun.

Total number of outcomes = 7

Number of favourable outcomes = 1

P(having 53 Thursdays) = $\frac{1}{7}$

OR

Let there be x blue balls in the bag.

Total number of balls in the bag = 5 + x

P_1 be the probability of drawing a blue ball.

P_2 be the probability of drawing a red ball.

According to the question,

$P_1 = 2P_2$

$$\frac{x}{5+x} = 2 \times \frac{5}{5+x}$$

x = 10

Hence, there are 10 blue balls in the bag.

Section C

27. If three points A, B and C are collinear, then area of ΔABC = 0.

$\Rightarrow \frac{1}{2}[7(1-k)+5(k+2)+3(-2-1)]=0$

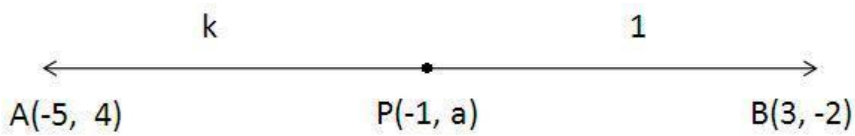
$\Rightarrow 7-7k+5k+10-9=0$

$\Rightarrow -2k+8=0$

$\Rightarrow k=4$

Thus, the given points are collinear for k = 4.

OR



$$\text{So}, -1=\frac{1\times(-5)+k\times 3}{k+1}$$

$$-k-1=-5+3k$$

$$-4k=-4$$

$$\Rightarrow k=1 \text{ and Ratio} = 1:1$$

$$\text{Now, } a=\frac{1\times 4+1\times(-2)}{2}$$

Therefore, a = 1.

28. $\text{L.H.S.}=\frac{\sec A+\tan A}{\sec A-\tan A}$

$$=\frac{\sec A+\tan A}{\sec A-\tan A}\times\frac{\sec A+\tan A}{\sec A+\tan A}$$

$$=\frac{(\sec A+\tan A)^2}{\sec^2 A-\tan^2 A}$$

$$=(\sec A+\tan A)^2 \quad \ldots (\because \sec^2\theta = 1+\tan^2\theta \text{ i.e. } \sec^2\theta-\tan^2\theta=1)$$

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

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

$$=\text{R.H.S.}$$

OR

$\tan 1^\circ \tan 2^\circ \tan 3^\circ \ldots\ldots\tan 89^\circ$

$= \tan(90^\circ - 89^\circ)\tan(90^\circ - 88^\circ)\tan(90^\circ - 87^\circ)\ldots\ldots\tan 87^\circ \tan 88^\circ \tan 89^\circ$

$= \cot 89^\circ \cot 88^\circ \cot 87^\circ\ldots\ldots\tan 87^\circ \tan 88^\circ \tan 89^\circ$

$= \cot 89^\circ \tan 89^\circ \cot 88^\circ \tan 88^\circ \cot 87^\circ \tan 87^\circ\ldots\cot 44^\circ \tan 44^\circ \tan 45^\circ$

$= 1 \times 1 \times 1 \ldots \times 1 = 1$

Hence, $\tan 1^\circ \tan 2^\circ \tan 3^\circ\ldots\ldots\tan 89^\circ = 1$

29. $\frac{x}{a} + \frac{y}{b} = 2$

$\Rightarrow bx + ay = 2ab$ ....(1)

$ax - by = a^2 - b^2$ ....(2)

Multiplying (1) with a and (2) with b and subtracting, we get

$y = b$

From (1), $bx + ab = 2ab$

$\Rightarrow bx = ab$

$\Rightarrow x = a$

Hence, $x = a$ and $y = b$.

30. Let $\frac{3}{2\sqrt{5}}$ be a rational number.

$\Rightarrow \frac{3}{2\sqrt{5}} = \frac{a}{b}$, where a and b are co-prime integers and $b \neq 0$.

$\Rightarrow \sqrt{5} = \frac{3b}{2a}$

Now, a, b, 2 and 3 are integers.

Therefore, $\frac{3b}{2a}$ is a rational number.

$\Rightarrow \sqrt{5}$ is a rational number.

This is a contradiction as we know that $\sqrt{5}$ is irrational.

Therefore, our assumption is wrong.

Hence, $\frac{3}{2\sqrt{5}}$ is an irrational number.

31. Converting the given distribution to continuous distribution, we have:

C.I.	f	c.f.
9.5 - 19.5	2	2
19.5 - 29.5	4	6
29.5 - 39.5	8	14
39.5 - 49.5	9	23
49.5 - 59.5	4	27
59.5 - 69.5	2	29
69.5 - 79.5	1	30

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

Median class is 39.5 - 49.5

Here, l = 39.5, c.f. = 14, f = 9, h = 10

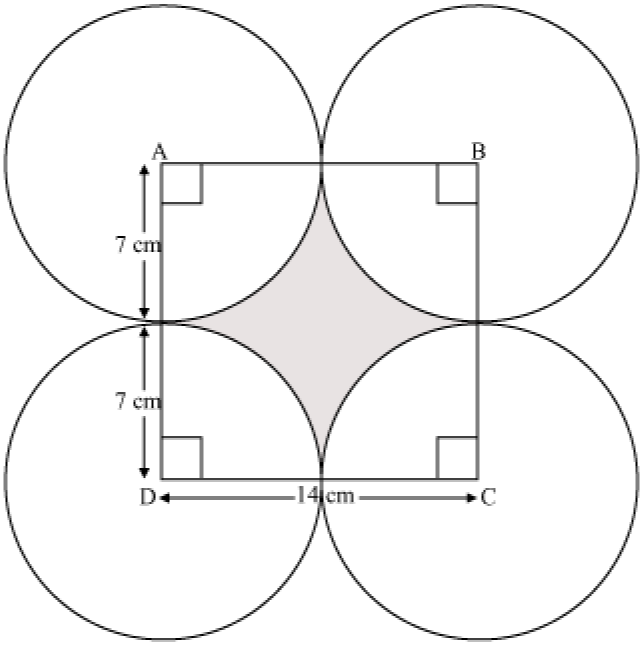
$$\text{Median} = l + \left(\frac{\frac{N}{2} - cf}{f}\right) \times h = 39.5 + \frac{10}{9}(15-14) = 39.5 + 1.1 = 40.6$$

32. Let a − d, a and a + d be three terms in an A.P.
According to the question,
$a - d + a + a + d = 3$
$3a = 3$ or $a = 1$
Also, $(a - d)(a)(a + d) = -8$
$a(a^2 - d^2) = -8$
Putting the value of a = 1, we get,
$1 - d^2 = -8$
$d^2 = 9$ or $d = \pm 3$
Thus, the required three terms are −2, 1, 4 or 4, 1, −2

OR

Given series is 3, 8, 13, 18, ..., 498
$a_1 = 3$, $d = 8 - 3 = 5$ and $t_n = 498$
$t_n = a_1 + (n - 1)d$
$498 = 3 + (n - 1) \times 5$
$498 - 3 = (n - 1) \times 5$
$495 = 5(n - 1)$
$n - 1 = 99$
$n = 100$
Hence, 100^{th} term of the given series is 498.

33.



Area of each 4 sectors is equal to each other and is a sector of 90° in a circle of 7 cm radius.

Area of each sector $= \frac{90^\circ}{360^\circ} \times \pi(7)^2$

$$= \frac{1}{4} \times \frac{22}{7} \times 7 \times 7$$

$$= \frac{77}{2} \text{ cm}^2$$

Area of square ABCD = $(\text{side})^2 = (14)^2$

$= 196 \text{ cm}^2$

Area of shaded portion = area of square ABCD – 4 × area of each sector

$$= 196 - 4 \times \frac{77}{2} = 196 - 154$$

$$= 42 \text{ cm}^2$$

Hence, area of the shaded portion is 42 cm^2.

34. Let $p(x) = 4x^4 - 20x^3 + 23x^2 + 5x - 6$
Given, 2 and 3 are the zeroes of the polynomial p(x).
So, $(x - 2)$, $(x - 3)$ are the factors of the polynomial p(x).
Thus, $(x^2 - 5x + 6)$ is a factor of the polynomial p(x).
We have,

$$
\begin{array}{r|l}
 & 4x^2 - 1 \\
\hline
x^2 - 5x + 6 & 4x^4 - 20x^3 + 23x^2 + 5x - 6 \\
 & 4x^4 - 20x^3 + 24x^2 \\
 & - \quad + \quad\quad - \\
\hline
 & \quad\quad\quad -\cancel{x^2} + \cancel{5x} - \cancel{6} \\
 & \quad\quad\quad -\cancel{x^2} + \cancel{5x} - 6 \\
 & \quad\quad\quad + \quad - \quad + \\
\hline
 & \quad\quad\quad\quad\quad 0 \\
\hline
\end{array}
$$

$\therefore\ 4x^4 - 20x^3 + 23x^2 + 5x - 6 = (x^2 - 5x + 6)(4x^2 - 1)$
$= (x - 2)(x - 3)(2x - 1)(2x + 1)$

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

Section D

35. Let ΔABC be an isosceles triangle having CA and CB of equal lengths, base AB is 8 cm and AD is the attitude of length 4 cm.
Now, the steps of construction are as follows:

i. Draw a line segment AB of 8 cm. Draw arcs of same radius on both sides of line segment while taking point A and B as its centre. Let these arcs intersect each other at O and O'. Join OO'. Let OO' intersect AB at D.

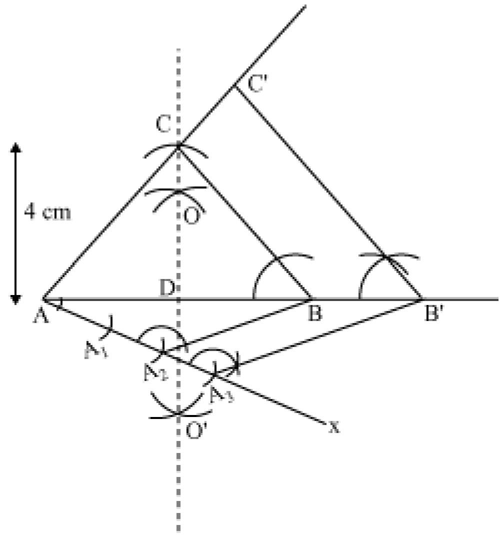
ii. Take D as centre and draw an arc of 4 cm radius which cuts the extended line segment OO' at point C. Now an isosceles ΔABC is formed, having CD (attitude) as 4 cm and AB (base) as 8 cm.

iii. Draw a ray AX making an acute angle with line segment AB on opposite side of vertex C.

iv. Locate 3 points (as 3 is greater between 3 and 2) on AX such that $AA_1 = A_1A_2 = A_2A_3$.

v. Join BA_2 and draw a line through A_3 parallel to BA_2 to intersect extended line segment AB at point B'.

vi. Draw a line through B' parallel to BC intersecting the extended line segment AC at C'. $\Delta AB'C'$ is the required triangle.



OR

Consider the below figure. QR and QS are the tangents to the given circle.

If they are inclined at 60°, then $\angle RQP = \angle SQP = 30°$

Hence, $\angle ROQ = \angle SOQ = 60°$

Consider ΔROP,

$\angle ROP = 60°$

OR = PO (radii)

So, $\angle RPO = \angle ORP = \angle ROP = 60°$

$\therefore \Delta ROP$ is an equilateral triangle

So, OR = PR = OP

$\angle PRQ = 90° - \angle PRO = 90° - 60° = 30°$

And $\angle RQP = 30°$

PQ = PR (isosceles triangle)

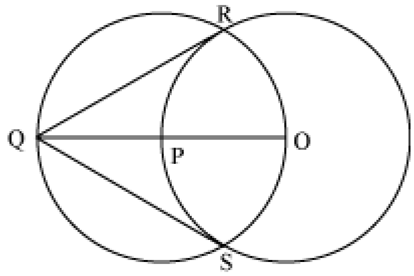
Hence, PQ = PR = PS (radius)

Now, the steps of construction are as follows:

i. Draw a circle of 5 cm radius and with centre O.

ii. Take a point P on circumference of this circle. Extend OP to Q such that OP = PQ.

iii. Midpoint of OQ is P. Draw a circle with radius OP with centre as P. Let it intersect the circle drawn previously at R and S. Join QR and QS. QR and QS are required tangents.



36. In right ΔPQR,

$PR^2 = PQ^2 + QR^2 = 5^2 + 12^2 = 25 + 144 = 169$

$\therefore$ PR = 13 cm

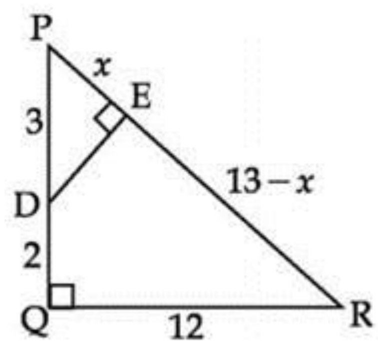
Let PE = x, then ER = 13 – x

In ΔPQR and ΔPED,

$\angle PQR = \angle PED$ … (90° each)

$\angle QPR = \angle EPD$ …. (Common angle)

$\therefore \Delta PQR \sim \Delta PED$ ….. [AA similarity]



$$\therefore \frac{PQ}{PE} = \frac{QR}{ED} = \frac{PR}{PD}$$

$$\Rightarrow \frac{5}{x} = \frac{12}{ED} = \frac{13}{3}$$

$$\therefore PE = x = \frac{5 \times 3}{13} = \frac{15}{13} = 1\frac{2}{13} \text{ cm}$$

$$ED = \frac{12 \times 3}{13} = \frac{36}{13} = 2\frac{10}{13} \text{ cm}$$

37. Let unit's place digit = x

Then, ten's place digit = $\frac{18}{x}$

Thus, number = $(1)(x) + (10)\left(\frac{18}{x}\right) = x + \frac{180}{x}$ ....(i)

Interchanged Number = $10x + 1\left(\frac{18}{x}\right)$

Given,

$$\left(x+\frac{180}{x}\right)-63=10x+\frac{18}{x}$$

$$\Rightarrow \frac{x^2+180-63x}{x}=\frac{10x^2+18}{x}$$

$$\Rightarrow \frac{x^2+180-63x}{x}-\frac{10x^2+18}{x}=0$$

$\Rightarrow x^2 + 180 - 63x - 10x^2 - 18 = 0$

$\Rightarrow -9x^2 - 63x + 162 = 0$

$\Rightarrow x^2 + 7x - 18 = 0$

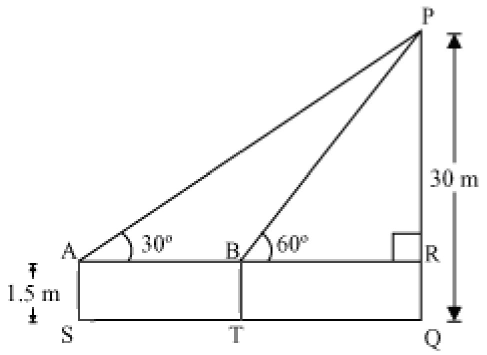
$(x + 9)(x - 2) = 0$

$\Rightarrow x = -9$ or 2

$\Rightarrow x = 2$ (Rejecting $x = -9$ since digit can never be negative)

From (i), Number = $x + \frac{180}{x} = 2+\frac{180}{2} = 2+90 = 92$

38.



Let the initial position of the boy be S.
He walks towards building and reached at point T.
In the figure, PQ is the building of height 30 m.

AS = BT = RQ = 1.5 m

PR = PQ – RQ = 30 m – 1.5 m = 28.5 m

In ΔPAR,

$$\frac{PR}{AR} = \tan 30^\circ$$

$$\frac{28.5}{AR} = \frac{1}{\sqrt{3}}$$

$$AR = 28.5\sqrt{3}$$

In ΔPRB,

$\frac{PR}{BR} = \tan 60°$

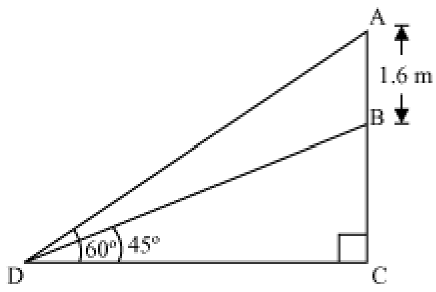
$\frac{28.5}{BR} = \sqrt{3}$

$BR = \frac{28.5}{\sqrt{3}} = 9.5\sqrt{3}$

ST = AB $= AR - BR = 28.5\sqrt{3} - 9.5\sqrt{3} = 19\sqrt{3}$

Thus, the distance the boy walked towards the building is $19\sqrt{3}$ m.

OR



Let AB be the statue, BC be the pedestal and D be the point on ground from where elevation angles are to be measured.

In ΔBCD,

$\frac{BC}{CD} = \tan 45°$

$\frac{BC}{CD} = 1$

$BC = CD \qquad \ldots (i)$

In ΔACD,

$\frac{AB + BC}{CD} = \tan 60°$

$\frac{AB + BC}{BC} = \sqrt{3}$ [From (i)]

$1.6 + BC = BC\sqrt{3}$

$BC\left(\sqrt{3} - 1\right) = 1.6$

$BC = \frac{(1.6)\left(\sqrt{3} + 1\right)}{\left(\sqrt{3} - 1\right)\left(\sqrt{3} + 1\right)}$

$= \frac{1.6\left(\sqrt{3} + 1\right)}{2} = 0.8\left(\sqrt{3} + 1\right)$

Thus, the height of pedestal is $0.8\left(\sqrt{3} + 1\right)$m.

39. Length of the cylinder = 24 cm

Diameter of copper wire = 4 mm = 0.4 cm

Therefore, the number of rounds of wire required to cover the length of cylinder

$$=\frac{\text{Length of cylinder}}{\text{Thickness of wire}}$$

$$=\frac{24\text{ cm}}{0.4\text{ cm}}=60$$

Now, diameter of cylinder = 20 cm

Therefore, length of wire required to complete one round

= circumference of base of the cylinder = πd

$$=\frac{22}{7}\times 20=\frac{440}{7}\text{ cm}$$

Length of wire required for covering the whole surface of cylinder

= length of wire required in completing 60 rounds

$$=60\times\frac{440}{7}=3771.428\text{ cm}$$

Radius of copper wire = $\frac{0.4}{2}\text{cm}=0.2\text{ cm}$

Therefore, volume of wire = $\pi r^2 h$ = $\frac{22}{7}\times(0.2)^2\times 3771.428$ = 474.122 cm^3

Weight of wire = volume × density

= 474.122 × 8.68 gm

= 4115.38 gm

= 4.11538 kg ≈ 4.12 kg

OR

For conical portion, r = 7cm, h_1 = 21 cm

For cylindrical portion, r =7cm, h_2 = 30 cm

For hemispherical portion, r = 7 cm.

Total volume = $V_{cone} + V_{cylinder} + V_{hemisphere}$

$$=\frac{1}{3}\pi r^2 h_1+\pi r^2 h_2+\frac{2}{3}\pi r^3=\pi r^2\left(\frac{h_1}{3}+h_2+\frac{2r}{3}\right)$$

$$=\frac{22}{7}\times 7\times 7\left(\frac{21}{3}+30+\frac{2\times 7}{3}\right)$$

$$=154\left(7+30+\frac{14}{3}\right)=154\left(\frac{21+90+14}{3}\right)$$

$$=\frac{154\times 125}{3}=6416.67\text{ cm}^3$$

40. From the data given as above we may observe that maximum class frequency is 61 belonging to class interval 60 – 80.

So, modal class = 60 – 80

Lower class limit (l) of modal class = 60

Frequency (f_1) of modal class = 61

Frequency (f_0) of class preceding the modal class = 52

Frequency (f_2) of class succeeding the modal class = 38

Class size (h) = 20

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

$$= 60 + \left(\frac{61 - 52}{2(61) - 52 - 38}\right)(20)$$

$$= 60 + \left(\frac{9}{122 - 90}\right)(20)$$

$$= 60 + \left(\frac{9 \times 20}{32}\right)$$

$$= 60 + \frac{90}{16} = 60 + 5.625$$

$$= 65.625$$

So, modal lifetime of electrical components is 65.625 hours.