Q. No. 2 Part (i) **Solution:-**

$(2x-1)^2 = (x+4)^2$

$(2x)^2 - 2(2x)(1) + (1)^2 = (x)^2 + 2(x)(4) + (4)^2$

$4x^2 - 4x + 1 = x^2 + 8x + 16$

$4x^2 - x^2 - 4x - 8x + 1 - 16 = 0$

$\boxed{3x^2 - 12x - 15 = 0}$

Here, $a = 3$, $b = -12$, $c = -15$

By applying quadratic formula,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-12) \pm \sqrt{(-12)^2 - 4(3)(-15)}}{2(3)}$$

$$x = \frac{12 \pm \sqrt{144 + 180}}{6}$$

$$x = \frac{12 \pm \sqrt{324}}{6}$$

$$x = \frac{12 \pm 18}{6}$$

$x = \frac{12+18}{6}$; $x = \frac{12-18}{6}$

$x = \frac{30}{6}$; $x = \frac{-6}{6}$

$\boxed{x = 5}$ **Ans** ; $\boxed{x = -1}$ **Ans**

$\therefore$ So, $x = -1, 5$ are the roots of the given equation and **S.S = {-1, 5}**

Q. No. 2 Part (ii) **Solution :**

Roll. No.	Marks (X)	X^2
1	60	3600
2	70	4900
3	40	1600
4	50	2500
5	30	900
	$\sum X = 250$	$\sum X^2 = 13,500$

A Table

Direct Formula of finding variance (S^2) is given by

$$Var(X) = S^2 = \frac{\sum X^2}{n} - \left(\frac{\sum X}{n}\right)^2$$

Here, $n = 5$, $\sum X = 250$, and $\sum X^2 = 13,500$.
Putting these values in direct formula,

$$S^2 = \frac{13500}{5} - \left(\frac{250}{5}\right)^2$$

$$= 2700 - (50)^2$$

$$= 2700 - 2500$$

$$\boxed{S^2 = 200}$$ Answer

∴ The value of variance (S^2) is 200.

Q. No. 2 Part (iii) **Solution:-** Prove $a:b = c:d$ if $\frac{5a+7b}{5a-7b} = \frac{5c+7d}{5c-7d}$.

$$\frac{5a+7b}{5a-7b} = \frac{5c+7d}{5c-7d}$$

By using componendo-dividendo Theorem,

$$\frac{5a+\cancel{7b}+5a-\cancel{7b}}{5a+7b-(5a-7b)} = \frac{5c+\cancel{7d}+5c-\cancel{7d}}{5c+7d-(5c-7d)}$$

$$\frac{10a}{\cancel{5a}+7b-\cancel{5a}+7b} = \frac{10c}{\cancel{5c}+7d-\cancel{5c}+7d}$$

$$\frac{10a}{14b} = \frac{10c}{14d}$$

Now multiplying $\frac{14}{10}$ on both sides, we get

$$\frac{\cancel{14}}{\cancel{10}} \times \frac{\cancel{10}a}{\cancel{14}b} = \frac{\cancel{14}}{\cancel{10}} \times \frac{\cancel{10}c}{\cancel{14}d}$$

$$\frac{a}{b} = \frac{c}{d}$$

i.e., $\boxed{a:b = c:d.}$ **Answer.**

$\therefore$ Hence proved that $a:b = c:d$ if

$$\frac{5a+7b}{5a-7b} = \frac{5c+7d}{5c-7d}.$$

Q. No. 2 Part (iv) **Solution:**

According to the given condition,

$v \propto \frac{1}{r^3}$

$\Rightarrow \boxed{v = \frac{k}{r^3}}$ — i)

Now put $v=5$ and $r=3$ in (i)

$5 = \frac{k}{(3)^3}$

$5 \times (3)^3 = k$

$k = 5 \times 27$

$\boxed{k = 135}$

Now, put $k=135$ in (i), and equation (i) becomes,

$\boxed{v = \frac{135}{r^3}}$ — ii)

Given: when, $r = 6$. To Find: $v = ?$

Now, put $r=6$ in (ii)

$v = \frac{135}{(6)^3}$

$v = \frac{135}{216}$

$\boxed{v = \frac{5}{8}}$ **Answer.**

$\therefore$ So, The value of v is $\frac{5}{8}$ when ~~if~~ $r = 6$.

Q. No. 2 Part (v) **Solution:**

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

L.H.S :-

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

(by taking LCM)

$$= \frac{1+\cancel{\cos\theta}+1-\cancel{\cos\theta}}{(1)^2-(\cos\theta)^2} \qquad \because a^2-b^2=(a+b)(a-b)$$

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

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

$$= 2\times\frac{1}{\sin^2\theta} = 2\times\left(\frac{1}{\sin\theta}\right)^2$$

$$= 2\times(\operatorname{cosec}\theta)^2$$

$$= 2\times\operatorname{cosec}^2\theta \qquad \because \frac{1}{\sin\theta} = \operatorname{cosec}\theta$$

$$= 2\operatorname{cosec}^2\theta = \text{R.H.S.}$$

$\therefore$ Hence verified that **L.H.S = R.H.S.**

Q. No. 2 Part (vi) **Solution:-**

$x^{2/3} + x^{1/3} - 6 = 0$ —(i)

Let $(x)^{1/3} = y$

Now, squaring both sides we get,

$(x^{1/3})^2 = y^2$

$x^{2/3} = y^2 \Rightarrow y^2 = x^{2/3}$

Now put value of $x^{1/3}$ and $x^{2/3}$ in (i)

$\boxed{y^2 + y - 6 = 0}$ —(ii)

Here, $a = 1$, $b = 1$, $c = -6$

By quadratic formula,

$y = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$y = \frac{-1 \pm \sqrt{(1)^2 - 4(1)(-6)}}{2(1)}$

$y = \frac{-1 \pm \sqrt{1 + 24}}{2}$

$y = \frac{-1 \pm \sqrt{25}}{2}$

$y = \frac{-1 \pm 5}{2}$

$y = \frac{-1+5}{2}$; $y = \frac{-1-5}{2}$

$y = \frac{4}{2}$; $y = \frac{-6}{2}$

$\boxed{y = 2}$; $\boxed{y = -3}$

Now, put $y = 2$ in $x^{1/3} = y$

So, $x^{1/3} = 2$

Taking cube on b-s.,

$(x^{1/3})^3 = (2)^3$

$\boxed{x = 8}$

Now, again, put $y = -3$ in $x^{1/3} = y$

So, $x^{1/3} = -3$

Taking cube on both sides,

$(x^{1/3})^3 = (-3)^3$

$\boxed{x = -27}$

$\therefore$ So,

S.S = $\{(-27, -3), (8, 2)\}$

Answer.

Q. No. 2 Part (vii) **Solution:-**

$$x^3 + x^2 - 7x + 2 = 0$$

If 2 is the root of the equation, then by synthetic division,

	1	1	−7	2
2	↓	2	6	−2
	1	3	−1	0

$*R = 0$

The depressed equation is

$$Q(x) = x^2 + 3x - 1 = 0$$

By applying quadratic formula,

$$a = 1, b = 3, c = -1$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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

$$x = \frac{-3 \pm \sqrt{9 + 4}}{2}$$

$$x = \frac{-3 \pm \sqrt{13}}{2}$$

$$\boxed{x = \frac{-3 + \sqrt{13}}{2}} ; \boxed{x = \frac{-3 - \sqrt{13}}{2}}$$ **Answer.**

So, the roots of equation $x^3 + x^2 - 7x + 2 = 0$ are 2, $\frac{-3 + \sqrt{13}}{2}$, and $\frac{-3 - \sqrt{13}}{2}$.

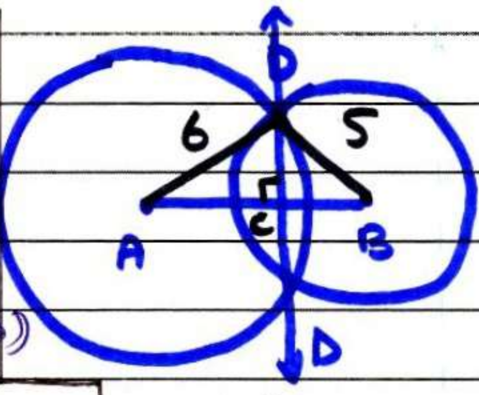
Q. No. 2 Part (viii)

Given:

$m\overline{AD} = 6\,cm$, $m\angle ACD = 90^\circ$

$m\overline{CD} = 4\,cm$, $m\angle BCD = 90^\circ$ (because tangent is ⊥ ~~chord~~ radius)

$m\overline{BD} = 5\,cm.$



Diagram

To Find: $m\overline{AB} = ?$

Formula: $m\overline{AB} = m\overline{AC} + m\overline{CB}$

Solution:-

* In $\angle$rt ΔACD,

$m\angle ACD = 90^\circ$ (~~Tangent ⊥ radia~~)

By using Pythagoras's Theorem,

$H^2 = P^2 + B^2$

$(6)^2 = (4)^2 + B^2$

$36 = 16 + B^2$

$B^2 = 36 - 16$

$B^2 = 20$

Taking square root on b.s.,

$\sqrt{B^2} = \sqrt{20}$

$B = 2\sqrt{5}\ cm.$

$\boxed{B = m\overline{AC} = 2\sqrt{5}\ cm.}$

* In $\angle$rt ΔBCD,

$m\angle BCD = 90^\circ$

By using Pythagoras' Theorem,

$H^2 = P^2 + B^2$

$(5)^2 = (4)^2 + B^2$

$25 = 16 + (BC)^2$

$(BC)^2 = 25 - 16$

$(BC)^2 = 9$

$\sqrt{(BC)^2} = \sqrt{9}$

$\boxed{m\overline{BC} = 3\ cm}$

~~No~~ Since,

$m\overline{AB} = m\overline{AC} + m\overline{CB}$

Now put $m\overline{AC} = 2\sqrt{5}\ cm$ and $m\overline{BC} = 3\ cm$ in it

So,

$m\overline{AB} = 2\sqrt{5} + 3$

$= 4.47213 + 3$

$\boxed{m\overline{AB} = 7.472\ cm}$

Answer.

∴ So, the distance between A and B i.e., $m\overline{AB}$ is $7.472\ cm.$

Q. No. 2 Part (ix) Solution:

$A = \{1, 2, 4, 8\}$

$B = \{3, 9\}$

$A \times B = \{1, 2, 4, 8\} \times \{3, 9\}$

$A \times B = \{(1, 3), (1, 9), (2, 3), (2, 9), (4, 3), (4, 9),$

$(8, 3), (8, 9)\}$

$R = \{(x, y) \mid x + y \in O\}$

Ans

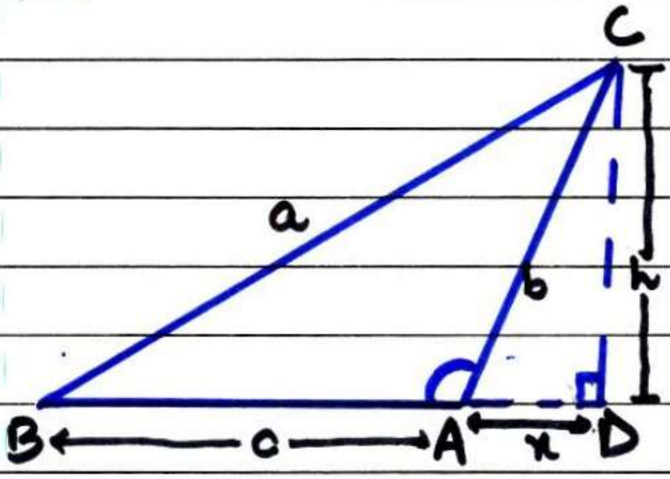
$\boxed{R = \{(2, 3), (2, 9), (4, 3), (4, 9), (8, 3), (8, 9)\}}$

Domain $R = \{2, 4, 8\}$ Ans

Range $R = \{3, 9\}$ Ans

Q. No. 3 (Page 1) **Theorem:-**

★ Diagram:-



★ Given: In ΔABC, $\angle BAC$ is obtuse at A. Draw $\overline{CD} \perp \overline{BA}$ produced so that $\overline{AD}$ is the projection of $\overline{AC}$ on $\overline{BA}$ produced. Take $m\overline{AB} = c$, $m\overline{BC} = a$, $m\overline{AC} = b$, $m\overline{AD} = x$ and $m\overline{CD} = h$.

★ To Prove:

$(BC)^2 = (AC)^2 + (AB)^2 + 2(m\overline{AB})(m\overline{AD})$

i.e, $a^2 = b^2 + c^2 + 2cx$

★ Proof:-

Statements	Reasons
In ΔCDA,	
$m\angle CDA = 90°$	Given
$\therefore (AC)^2 = (AD)^2 + (CD)^2$	Pythagoras' Theorem
or $b^2 = x^2 + h^2$ — (i)	

Q. No. 3 (Page 2)

Now, In Δ CDB,

$m\angle CDB = 90^\circ$ — given

$\therefore (BC)^2 = (BD)^2 + (CD)^2$ — Pythagoras' Theorem

or $a^2 = (c+x)^2 + h^2$ — $\because m\overline{BD} = m\overline{BA} + m\overline{AD}$

$\Rightarrow a^2 = c^2 + 2cx + x^2 + h^2$ — (ii)

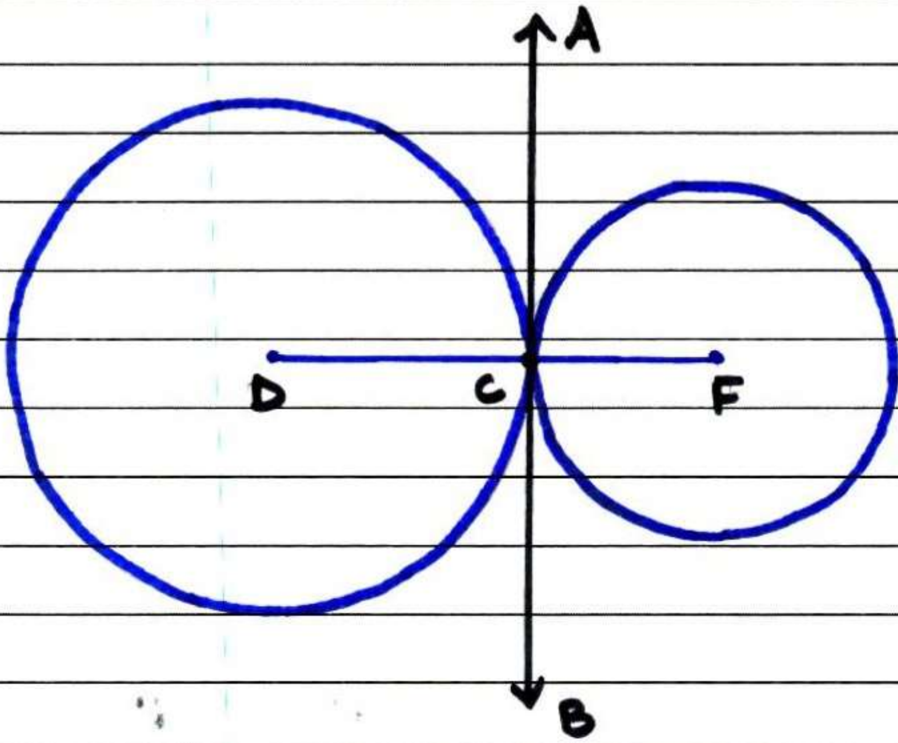
~~Now,~~

So, $a^2 = c^2 + 2cx + b^2$ — using (i) and (ii)

or $a^2 = b^2 + c^2 + 2cx$

i.e., $(BC)^2 = (AC)^2 + (AB)^2 + 2(m\overline{AB})(m\overline{AD})$

*Diagram:- (Theorem)



*** Given:-** Two circles with centres D and F respectively touch eachother externally at point C. Where, $\overline{CD}$ and $\overline{CF}$ are the radii of these two circles respectively.

*** To Prove:** Point C lies on the join of centres D and F and $m\overline{DF} = m\overline{DC} + m\overline{CF}$.

*** Construction:** Draw $\overleftrightarrow{ACB}$ as a common tangent to the pair of circles at point C.

*** Proof :-**

Statements	Reasons
Both circles touch eachother externally at C, where $\overline{CD}$ is the radial segment and $\overleftrightarrow{ACB}$ is the common tangent.	Given Construction.

Q. No. 4 (Page 2)

Statements	Reasons
$\therefore m\angle ACD = 90^\circ$ — (i)	radial segment $\overline{CD} \perp$ tangent line $\overline{AB}$.
Similarly, $\overline{CF}$ is the radial segment and $\overleftrightarrow{ACB}$ is the common tangent	Given construction.
$\therefore m\angle ACF = 90^\circ$ — (ii)	radial segment $\overline{CF} \perp$ tangent line $\overline{AB}$.
Now, $m\angle ACD + m\angle ACF = 90^\circ + 90^\circ$	using (i) and (ii)
$\Rightarrow m\angle ACD + m\angle ACF = m\angle DCF = 180^\circ$ — (iii)	Sum of Adjacent supplementary angles.
Hence, $\overline{DCF}$ is a line segment with point C lying between centres D and F.	from (iii)
And $m\overline{DF} = m\overline{DC} + m\overline{CF}$	

Q. No. 5 (Page 1) **Solution:-**

★**Given:**

★$U = \{x \mid x \in N \wedge 1 \leq x \leq 10\}$

$\Rightarrow U = \{1, 2, 3, \ldots, 10\}$

★ $A = \{x \mid x \in P \wedge 1 < x < 10\}$

$\Rightarrow A = \{2, 3, 5, 7\}$

★ $B = \{x \mid x \in O \wedge 1 \leq x < 10\}$

$\Rightarrow B = \{1, 3, 5, 7, 9\}$

★ **To Prove:** (De Morgan's Laws)

i) $(A \cup B)' = A' \cap B'$

ii) $(A \cap B)' = A' \cup B'$

★ **Verification:**

i) $(A \cup B)' = A' \cap B'$

★ L.H.S:-

$A \cup B = \{2, 3, 5, 7\} \cup \{1, 3, 5, 7, 9\}$

$A \cup B = \{1, 2, 3, 5, 7, 9\}$

$(A \cup B)' = U - (A \cup B) = \{1, 2, 3, \ldots, 10\} - \{1, 2, 3, 5, 7, 9\}$

$\boxed{(A \cup B)' = \{4, 6, 8, 10\}}$

★ R.H.S:-

★$A' = U - A = \{1, 2, 3, \ldots, 10\} - \{2, 3, 5, 7\}$

$A' = \{1, 4, 6, 8, 9, 10\}$

★ $B' = U - B = \{1, 2, 3, \ldots, 10\} - \{1, 3, 5, 7, 9\}$

$B' = \{2, 4, 6, 8, 10\}$

Q. No. 5 (Page 2) So, $A' \cap B' = \{1,4,6,8,9,10\} \cap \{2,4,6,8,10\}$

$\boxed{A' \cap B' = \{4,6,8,10\}}$ = **L.H.S.**

$\therefore$ Since, **L.H.S = R.H.S**, hence verified that $(A \cup B)' = A' \cap B'$.

ii) $(A \cap B)' = A' \cup B'$

★ L.H.S:-

$A \cap B = \{2,3,5,7\} \cap \{1,3,5,7,9\}$

$A \cap B = \{3,5,7\}$

$(A \cap B)' = U - (A \cap B) = \{1,2,3,---,10\} - \{3,5,7\}$

$\boxed{(A \cap B)' = \{1,2,4,6,8,9,10\}}$

★ R.H.S:-

* $A' = U - A = \{1,2,3,--,10\} - \{2,3,5,7\}$

$A' = \{1,4,6,8,9,10\}$

* $B' = U - B = \{1,2,3,---,10\} - \{1,3,5,7,9\}$

$B' = \{2,4,6,8,10\}$

$\Rightarrow A' \cup B' = \{1,4,6,8,9,10\} \cup \{2,4,6,8,10\}$

$\boxed{A' \cup B' = \{1,2,4,6,8,9,10\}}$ = **L.H.S**

Since, **L.H.S = R.H.S**, hence verified that $(A \cap B)' = A' \cup B'$.

$\therefore$ So, De Morgan's Laws are verified in (i) and (ii).

$x^2 - 4mx - 6$

$x^2 = 4m^2n^4 \times p^6$

$x = \pm 2mn^2p^3$

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

$\omega^{-18} = \frac{1}{\omega^{18}}$

$= \frac{1}{(\omega^3)^6}$

$= \frac{1}{(1)^6}$

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

$x - 1 = 0$

$x = 1$

$\omega^{-18} = \frac{1}{\omega^{18}}$

$n+1 \pm \sqrt{4m^2n^4p^6}$

$\pm 2mn^2p^3$

$\Delta = b^2 - 4ac$

$+ 2(n+1)$

$x - 1 = 0$

$x = 1$

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