

$$(iv) A' \cap B' = \{-3, 0, 1, 2, 5, 7, 8\} \cap \{-3, 0, 1, 2, 3, 4, 6\}$$

$$A' \cap B' = \{-3, 0, 1, 2\}$$

$$(v) (B \cup C) = \{5, 7, 8\}$$

$$(B \cup C)' = \{1, 2, 4, 6\}$$

$$\therefore (B \cup C)' = \{1, 2, 4, 6\}$$

$$(vi) A - (B \cup C) = \{4, 6\}$$

$$(vii) A - (B \cap C) = \{-1, 3, 4, 6\}$$

② If $K = \{a, b, d, e, f\}$, $L = \{b, e, d, g\}$ and $M = \{a, b, e, d, h\}$.
then find the following:

(i) $K \cup (L \cap M)$ (ii) $K \cap (L \cup M)$

(iii) $(K \cup L) \cap (K \cup M)$ (iv) $(K \cap L) \cup (K \cap M)$

and verify distributive laws.

\Rightarrow Given that $K = \{a, b, d, e, f\}$, $L = \{b, e, d, g\}$
and $M = \{a, b, e, d, h\}$.

(i) now, $L \cap M = \{b, e, d, g\} \cap \{a, b, e, d, h\}$
 $= \{b, e, d\}$

$$\therefore K \cup (L \cap M) = \{a, b, d, e, f\} \cup \{b, e, d\}$$
$$= \{a, b, e, d, e, f\}$$

(ii) $(L \cup M) = \{b, e, d, g\} \cup \{a, b, e, d, h\}$
 $= \{a, b, e, d, g, h\}$

now, $K \cap (L \cup M) = \{a, b, d, e, f\} \cap \{a, b, e, d, g, h\}$
 $= \{a, b, d\}$

$$(iii) \quad K \cup L = \{a, b, d, e, f\} \cup \{b, c, d, g\} \\ = \{a, b, c, d, e, f, g\}$$

$$\text{and } K \cup M = \{a, b, d, e, f\} \cup \{a, b, c, d, h\} \\ = \{a, b, c, d, e, f, h\}$$

$$\text{Now, } (K \cup L) \cap (K \cup M) \\ = \{a, b, c, d, e, f, g\} \cap \{a, b, c, d, e, f, h\} \\ = \{a, b, c, d, e, f\}$$

$$(iv) \quad K \cap L = \{a, b, d, e, f\} \cap \{b, c, d, g\} \\ = \{b, d\}$$

$$\text{and } K \cap M = \{a, b, d, e, f\} \cap \{a, b, c, d, h\} \\ = \{a, b, d\}$$

$$\text{Now, } (K \cap L) \cup (K \cap M) \\ = \{b, d\} \cup \{a, b, d\} \\ = \{a, b, d\}$$

Now, from (i) and (iii), we get,

$$\therefore K \cup (L \cap M) = (K \cup L) \cap (K \cup M)$$

and from (ii) and (iv), we get

$$\therefore K \cap (L \cup M) = (K \cap L) \cup (K \cap M)$$

It is verify that the Distributive laws of intersection and Union of Sets.

③ If $A = \{x: x \in \mathbb{Z}, -2 < x \leq 4\}$, $B = \{x: x \in \mathbb{W}; x \leq 5\}$,
 $C = \{-4, -1, 0, 2, 3, 4\}$, then verify $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$.

⇒ Given that $A = \{x: x \in \mathbb{Z}, -2 < x \leq 4\}$

$$A = \{-1, 0, 1, 2, 3, 4\}$$

$$B = \{x: x \in \mathbb{W}; x \leq 5\}$$

$$B = \{0, 1, 2, 3, 4, 5\} \quad \text{and} \quad C = \{-4, -1, 0, 2, 3, 4\}.$$

$$\begin{aligned} \text{Now, } B \cap C &= \{0, 1, 2, 3, 4, 5\} \cap \{-4, -1, 0, 2, 3, 4\} \\ &= \{0, 2, 3, 4\} \end{aligned}$$

$$\therefore A \cup (B \cap C) = \{-1, 0, 1, 2, 3, 4\} \cup \{0, 2, 3, 4\}$$

$$A \cup (B \cap C) = \{-1, 0, 1, 2, 3, 4\} \quad \text{--- (i)}$$

$$\begin{aligned} \text{Now, } A \cup B &= \{-1, 0, 1, 2, 3, 4\} \cup \{0, 1, 2, 3, 4, 5\} \\ &= \{-1, 0, 1, 2, 3, 4, 5\} \end{aligned}$$

$$\begin{aligned} \text{and } A \cup C &= \{-1, 0, 1, 2, 3, 4\} \cup \{-4, -1, 0, 2, 3, 4\} \\ &= \{-4, -1, 0, 1, 2, 3, 4\} \end{aligned}$$

$$\therefore \text{Now, } (A \cup B) \cap (A \cup C)$$

$$= \{-1, 0, 1, 2, 3, 4, 5\} \cap \{-4, -1, 0, 1, 2, 3, 4\}$$

$$= \{-1, 0, 1, 2, 3, 4\}$$

$$\therefore (A \cup B) \cap (A \cup C) = \{-1, 0, 1, 2, 3, 4\} \quad \text{--- (ii)}$$

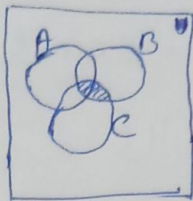
From (i) and (ii), we get.

$$\therefore A \cup (B \cap C) = (A \cup B) \cap (A \cup C).$$

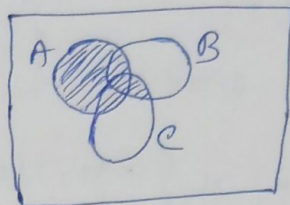
[verified]

④ verify $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ using Venn diagrams.

⇒ now, $B \cap C$

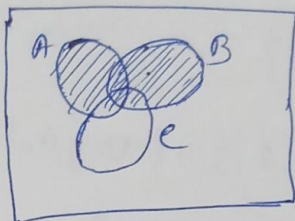


∴ $A \cup (B \cap C)$

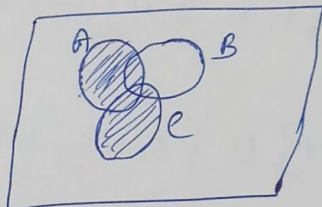


--- (i)

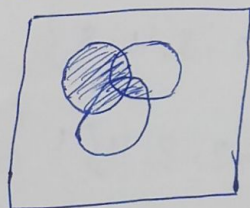
∴ $A \cup B$



and $A \cup C$



∴ $(A \cup B) \cap (A \cup C)$



--- (ii)

from (i) and (ii) Venn diagrams, we get.

$$\therefore A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$$

⑤ If $A = \{b, c, e, g, h\}$, $B = \{a, e, d, g, i\}$ and $C = \{a, d, e, g, h\}$, then show that

$$A - (B \cap C) = (A - B) \cup (A - C)$$

⇒ Given that $A = \{b, c, e, g, h\}$

$$B = \{a, e, d, g, i\} \text{ and } C = \{a, d, e, g, h\}$$

$$\text{now, } B \cap C = \{a, e, d, g, i\} \cap \{a, d, e, g, h\}$$

$$= \{a, d, g\}$$

$$\therefore A - (B \cap C) = \{b, c, e, g, h\} - \{a, d, g\}$$

$$A - (B \cap C) = \{b, c, e, h\} \dots (i)$$

$$\text{now, } (A - B) = \{b, c, e, g, h\} - \{a, c, d, g, i\}$$

$$= \{b, e, h\}$$

$$\text{and } (A - c) = \{b, c, e, g, h\} - \{a, d, e, g, h\}$$

$$= \{b, c\}$$

$$\text{now, } (A - B) \cup (A - c) = \{b, e, h\} \cup \{b, c\}$$

$$(A - B) \cup (A - c) = \{b, c, e, h\} \dots (ii)$$

From (i) and (ii), we get,

$$A - (B \cap C) = (A - B) \cup (A - c) \quad [\text{proved}]$$

⑥ If $A = \{x: x = 6n, n \in \mathbb{W} \text{ and } n < 6\}$, $B = \{x: x = 2n, n \in \mathbb{N}, \text{ and } 2 < n \leq 9\}$
 and $C = \{x: x = 3n, n \in \mathbb{N} \text{ and } 4 \leq n < 10\}$, then show that
 $A - (B \cap C) = (A - B) \cup (A - C)$.

⇒ Given that

$$A = \{x: x = 6n, n \in \mathbb{W} \text{ and } n < 6\}$$

$$A = \{0, 6, 12, 18, 24, 30\}$$

$$B = \{x: x = 2n, n \in \mathbb{N} \text{ and } 2 < n \leq 9\}$$

$$B = \{6, 8, 10, 12, 14, 16, 18\}$$

$$\text{and } C = \{x: x = 3n, n \in \mathbb{N} \text{ and } 4 \leq n < 10\}$$

$$C = \{12, 15, 18, 21, 24, 27\}$$

$$\text{now, } B \cap C = \{6, 8, 10, 12, 14, 16, 18\} \cap \{12, 15, 18, 21, 24, 27\}$$

$$B \cap C = \{12, 18\}$$

$$A - (B \cap C) = \{0, 6, 12, 18, 24, 30\} - \{12, 18\}$$

$$A - (B \cap C) = \{0, 6, 24, 30\} \dots (i)$$

$$\text{Now, } A + B = \{0, 6, 12, 18, 24, 30\} - \{6, 8, 10, 12, 14, 16, 18\}$$

$$= \{0, 24, 30\}$$

$$\text{and } A - C = \{0, 6, 12, 18, 24, 30\} - \{12, 15, 18, 21, 24, 27\}$$

$$= \{0, 6, 30\}$$

$$\text{Now, } (A - B) \cup (A - C) = \{0, 24, 30\} \cup \{0, 6, 30\}$$

$$(A - B) \cup (A - C) = \{0, 6, 24, 30\} \dots \text{(i)}$$

From (i) and (ii), we get.

$$A - (B \cap C) = (A - B) \cup (A - C) \quad [\text{proved}]$$

⑦ If $A = \{-2, 0, 1, 3, 5\}$, $B = \{-1, 0, 2, 5, 6\}$ and $C = \{-1, 2, 5, 6, 7\}$, then show that $A - (B \cap C) = (A - B) \cap (A - C)$.

\Rightarrow Given that $A = \{-2, 0, 1, 3, 5\}$

$B = \{-1, 0, 2, 5, 6\}$ and $C = \{-1, 2, 5, 6, 7\}$

$$\text{Now, } B \cap C = \{-1, 0, 2, 5, 6\} \cup \{-1, 2, 5, 6, 7\}$$

$$= \{-1, 0, 2, 5, 6, 7\}$$

$$\therefore A - (B \cap C) = \{-2, 0, 1, 3, 5\} - \{-1, 0, 2, 5, 6, 7\}$$

$$A - (B \cap C) = \{-2, 1, 3\} \dots \text{(i)}$$

$$\text{Now, } A - B = \{-2, 0, 1, 3, 5\} - \{-1, 0, 2, 5, 6\}$$

$$A - B = \{-2, 1, 3\}$$

$$A - C = \{-2, 0, 1, 3, 5\} - \{-1, 2, 5, 6, 7\}$$

$$= \{-2, 0, 1, 3\}$$

$$\text{Now, } (A - B) \cap (A - C) = \{-2, 1, 3\} \cap \{-2, 0, 1, 3\}$$

$$(A - B) \cap (A - C) = \{-2, 1, 3\} \dots \text{(ii)}$$

From (i) and (ii), we get

$$A - (B \cap C) = (A - B) \cap (A - C) \quad [\text{proved}]$$

⑧ If $A = \{x: x = \frac{a+1}{2}, a \in W \text{ and } a \leq 5\}$,
 $B = \{x: x = \frac{2n-1}{2}, n \in W \text{ and } n < 5\}$ and $C = \{-1, -\frac{1}{2}, 1, \frac{3}{2}, 2\}$,
 then show that $A - (B \cup C) = (A - B) \cap (A - C)$.

⇒ Given that

$$A = \{x: x = \frac{a+1}{2}, a \in W \text{ and } a \leq 5\}$$

$$A = \{\frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, 3\}$$

$$\therefore B = \{x: x = \frac{2n-1}{2}, n \in W \text{ and } n < 5\}$$

$$B = \{-\frac{1}{2}, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}\}$$

$$\text{and } C = \{-1, -\frac{1}{2}, 1, \frac{3}{2}, 2\}$$

$$\text{Now, } B \cup C = \{-\frac{1}{2}, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}\} \cup \{-1, -\frac{1}{2}, 1, \frac{3}{2}, 2\}$$

$$= \{-\frac{1}{2}, -1, \frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, \frac{7}{2}\}$$

$$\therefore A - (B \cup C) = \{\frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, 3\} - \{-\frac{1}{2}, -1, \frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, \frac{7}{2}\}$$

$$A - (B \cup C) = \{3\} \text{ --- (i)}$$

$$\text{Now, } A - B = \{\frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, 3\} - \{-\frac{1}{2}, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}\}$$

$$= \{1, 2, 3\}$$

$$A - C = \{\frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, 3\} - \{-1, -\frac{1}{2}, 1, \frac{3}{2}, 2\}$$

$$= \{\frac{1}{2}, \frac{5}{2}, 3\}$$

$$\text{Now, } (A - B) \cap (A - C) = \{1, 2, 3\} \cap \{\frac{1}{2}, \frac{5}{2}, 3\}$$

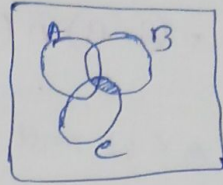
$$(A - B) \cap (A - C) = \{3\} \text{ --- (ii)}$$

From (i) and (ii), we get,

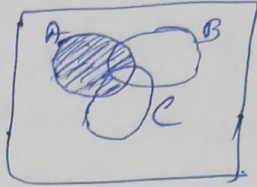
$$A - (B \cup C) = (A - B) \cap (A - C) \text{ [proved]}$$

9) verify $A - (B \cap C) = (A - B) \cup (A - C)$ using Venn diagrams.

⇒ now, $B \cap C$

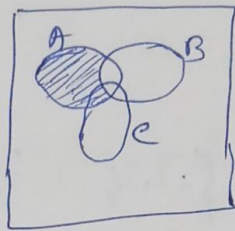


∴ $A - (B \cap C)$

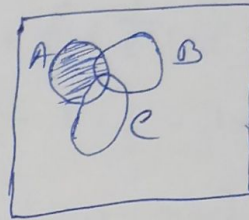


--- (i)

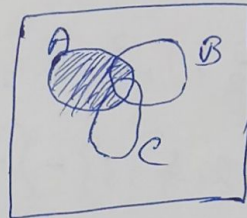
now, $A - B$



$A - C$



∴ $(A - B) \cup (A - C)$



--- (ii)

from (i) and (ii) Venn diagrams, we get,

$$A - (B \cap C) = (A - B) \cup (A - C).$$

10) If $U = \{4, 7, 8, 10, 11, 12, 15, 16\}$, $A = \{7, 8, 11, 12\}$ and $B = \{4, 8, 12, 15\}$ then verify De Morgan's laws for complementation.

⇒ Given that $U = \{4, 7, 8, 10, 11, 12, 15, 16\}$

$A = \{7, 8, 11, 12\}$ and $B = \{4, 8, 12, 15\}$

$$\begin{aligned} \text{Now, } A \cup B &= \{7, 8, 11, 12\} \cup \{4, 8, 12, 15\} \\ &= \{4, 7, 8, 11, 12, 15\} \end{aligned}$$

$$\therefore (A \cup B)' = U - (A \cup B)$$

$$(A \cup B)' = \{10, 16\} \text{ --- (i)}$$

$$\text{Now, } A' = U - A = \{4, 10, 15, 16\}$$

$$B' = U - B = \{7, 10, 11, 16\}$$

$$\text{now, } A' \cap B' = \{4, 10, 15, 16\} \cap \{7, 10, 11, 16\}$$

$$A' \cap B' = \{10, 16\} \text{ --- (i)}$$

from (i) and (ii), we get,

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

$$\text{now, } A' \cup B' = \{4, 10, 15, 16\} \cup \{7, 10, 11, 16\}$$

$$A' \cup B' = \{4, 7, 10, 11, 15, 16\} \text{ --- (ii)}$$

$$\begin{aligned} \text{now, } A \cap B &= \{7, 8, 11, 12\} \cap \{4, 8, 12, 15\} \\ &= \{8, 12\} \end{aligned}$$

$$\therefore (A \cap B)' = U - (A \cap B)$$

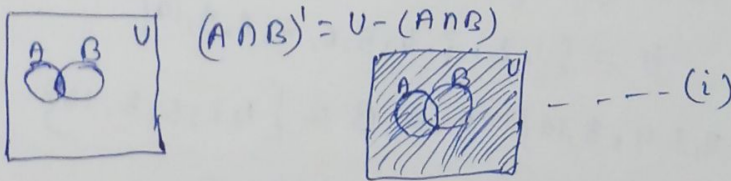
$$(A \cap B)' = \{4, 7, 10, 11, 15, 16\} \text{ --- (iv)}$$

from (ii) and (iv), we get,

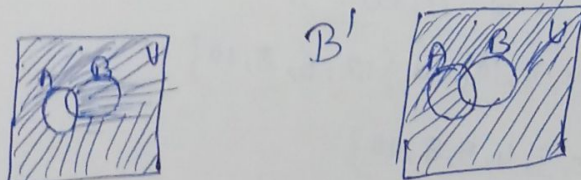
$$(A \cap B)' = A' \cup B'$$

\therefore It is verified that De Morgan's laws for complementation.

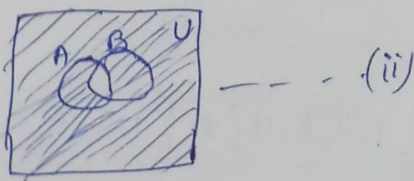
11 verify $(A \cap B)' = A' \cup B'$ using Venn diagrams.

$$\Rightarrow \text{now, } (A \cap B)' = U - (A \cap B) \quad (A \cap B)' = U - (A \cap B) \text{ --- (i)}$$


The diagram shows a universal set U represented by a square. Inside, two overlapping circles A and B are shown. The region where A and B overlap is shaded with diagonal lines, representing the intersection A ∩ B. The unshaded region outside both circles represents the complement (A ∩ B)'. The equation (A ∩ B)' = U - (A ∩ B) is written to the left, and the diagram is labeled (i) to the right.

$$\text{now, } A' \quad B'$$


Two Venn diagrams are shown side-by-side. The left one is labeled A' and shows a square universal set U with two overlapping circles A and B. The region inside the square but outside both circles is shaded with diagonal lines. The right one is labeled B' and shows the same setup, but the region outside both circles is shaded with diagonal lines.

$$\text{now, } A' \cup B' \text{ --- (ii)}$$


A Venn diagram showing a square universal set U with two overlapping circles A and B. The regions outside both circles are shaded with diagonal lines, representing the union of the complements A' ∪ B'. The diagram is labeled (ii) to the right.

from (i) and (ii) Venn diagrams, we get

$$\therefore (A \cap B)' = A' \cup B' \text{ [verified].}$$