

# 10th CLASS

## MATH

### CHAPTER 5

### SOLUTION

### NOTES

#### **Exercise 5.1**

**Question No.1** If  $X = \{1, 4, 7, 9\}$  and

$Y = \{2, 4, 5, 9\}$  then find:

**Solution:**

(i)  $X \cup Y$

$$\begin{aligned} X \cup Y &= \{1, 4, 7, 9\} \cup \{2, 4, 5, 9\} \\ &= \{1, 2, 4, 5, 7, 9\} \end{aligned}$$

(ii)  $X \cap Y$

$$\begin{aligned} X \cap Y &= \{1, 4, 7, 9\} \cap \{2, 4, 5, 9\} \\ &= \{4, 9\} \end{aligned}$$

(iii)  $Y \cup X$

$$\begin{aligned} Y \cup X &= \{2, 4, 5, 9\} \cup \{1, 4, 7, 9\} \\ &= \{1, 2, 4, 5, 7, 9\} \end{aligned}$$

(iv)  $Y \cap X$

$$\begin{aligned} Y \cap X &= \{2, 4, 5, 9\} \cap \{1, 4, 7, 9\} \\ &= \{4, 9\} \end{aligned}$$

**Question No.2**

If  $X$ = Set of Prime numbers less than or equal to 17.

$Y$ = Set of first 12 natural numbers, then find

**Solution:**

$$X = \{2, 3, 5, 7, 11, 13, 17\}$$

$$Y = \{1, 2, 3, 4, \dots, 12\}$$

(i).  $X \cup Y$

$$\begin{aligned} X \cup Y &= \{2, 3, 5, 7, 11, 13, 17\} \cup \{1, 2, 3, 4, \dots, 12\} \\ &= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 17\} \end{aligned}$$

(ii)  $Y \cup X$

$$\begin{aligned} Y \cup X &= \{1, 2, 3, 4, \dots, 12\} \cup \{2, 3, 5, 7, 11, 13, 17\} \\ &= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 17\} \end{aligned}$$

(iii)  $X \cap Y$

$$\begin{aligned} X \cap Y &= \{2, 3, 5, 7, 11, 13, 17\} \cap \{1, 2, 3, 4, \dots, 12\} \\ &= \{2, 3, 5, 7, 11\} \end{aligned}$$

(iv)  $Y \cap X$

$$\begin{aligned} Y \cap X &= \{1, 2, 3, 4, \dots, 12\} \cap \{2, 3, 5, 7, 11, 13, 17\} \\ &= \{2, 3, 5, 7, 11\} \end{aligned}$$

Q.3 If  $X = \phi$      $Y = Z^+$      $T = O^+$  then find

(i)  $X \cup Y$

$$X = \phi \quad Y = \{0, 1, 2, 3, \dots\}$$

$$X \cup Y = \{\} \cup \{0, 1, 2, 3, \dots\}$$

$$X \cup Y = \{0, 1, 2, 3, \dots\}$$

(ii)  $X \cup T$ 

$$X = \emptyset \quad T = \{1, 3, 5, \dots\}$$

$$X \cup T = \emptyset \cup \{1, 3, 5, \dots\}$$

$$X \cup T = \{1, 3, 5, \dots\}$$

(iii)  $Y \cup T$ 

$$Y = \{0, 1, 2, 3, \dots\} \quad T = \{1, 3, 5, 7, \dots\}$$

$$Y \cup T = \{0, 1, 2, 3, \dots\} \cup \{1, 3, 5, 7, \dots\}$$

$$Y \cup T = \{0, 1, 2, 3, 4, 5, \dots\}$$

(iv)  $X \cap Y$ 

$$X = \emptyset \quad Y = \{0, 1, 2, 3, \dots\}$$

$$X \cap Y = \{\} \cap \{0, 1, 2, 3, \dots\}$$

$$X \cap Y = \{\}$$

(v)  $X \cap T$ 

$$X = \emptyset \quad T = \{1, 3, 5, 7, \dots\}$$

$$X \cap T = \{\} \cap \{1, 3, 5, 7, \dots\}$$

$$X \cap T = \{\} \text{ or } \emptyset$$

(vi)  $Y \cap T$ 

$$Y \cap T = Z^+ \cap O^+$$

$$Y \cap T = \{1, 2, 3, 4, 5, \dots\} \cap \{1, 3, 5, 7, \dots\}$$

$$Y \cap T = \{1, 3, 5, 7, \dots\}$$

**Q.4** If  $U = \{x \mid x \in N \wedge 3 < x \leq 25\}$ 

$$X = \{x \mid x \text{ is Prime} \wedge 8 < x < 25\}$$

$$Y = \{x \mid x \in W \wedge 4 \leq x \leq 17\}$$

then find the value of:

**Solution:**  $U = \{4, 5, 6, 7, \dots, 25\}$ 

$$X = \{11, 13, 17, 19, 23\}$$

$$Y = \{4, 5, 6, 7, \dots, 17\}$$

(i)  $(X \cup Y)'$ 

$$X \cup Y = \{11, 13, 17, 19, 23\} \cup \{4, 5, 6, 7, \dots, 17\}$$

$$= \{4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 23\}$$

$$(X \cup Y)' = U - (X \cup Y)$$

$$= \{4, 5, 6, 7, \dots, 25\} - \{4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 23\}$$

$$= \{18, 20, 21, 22, 24, 25\}$$

(ii)  $X' \cap Y'$ 

$$X' = U - X$$

$$\begin{aligned} X' &= \{4, 5, 6, 7, \dots, 25\} - \{11, 13, 17, 19, 23\} \\ &= \{4, 5, \dots, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24, 25\} \end{aligned}$$

$$Y' = U - Y$$

$$\begin{aligned} Y' &= \{4, 5, 6, 7, \dots, 25\} - \{4, 5, 6, 7, \dots, 17\} \\ &= \{18, 19, 20, 21, 22, 23, 24, 25\} \end{aligned}$$

$$X' \cap Y' = \{4, 5, 6, 7, 8, 9, \dots, 17, 19, 23\} \cap \{18, 19, 20, 21, 22, 23, 24, 25\}$$

$$X' \cap Y' = \{18, 20, 21, 22, 24, 25\}$$

(iii)  $(X \cap Y)'$ 

$$\begin{aligned} (X \cap Y)' &= \{11, 13, 17, 19, 23\} \cap \{4, 5, 6, 7, \dots, 17\} \\ &= \{11, 13, 17\} \end{aligned}$$

$$(X \cap Y)' = U - (X \cap Y)$$

$$\begin{aligned} &= \{4, 5, 6, 7, \dots, 25\} - \{11, 13, 17\} \\ &= \{4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25\} \end{aligned}$$

(iv)  $X' \cup Y'$ 

$$\begin{aligned} X' &= U - X = \{4, 5, 6, 7, \dots, 25\} - \{11, 13, 17, 19, 23\} \\ &= \{4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24, 25\} \end{aligned}$$

$$\begin{aligned} Y' &= U - Y = \{4, 5, 6, 7, \dots, 25\} - \{4, 5, 6, 7, \dots, 17\} \\ &= \{18, 19, 20, 21, 22, 23, 24, 25\} \end{aligned}$$

$$\begin{aligned} X' \cup Y' &= \{4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24, 25\} \\ &\cup \{18, 19, 20, 21, 22, 23, 24, 25\} \\ &= \{4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25\} \end{aligned}$$

**Q.5** If  $X = \{2, 4, 6, \dots, 20\}$  and  $Y = \{4, 8, 12, \dots, 24\}$   
then find the following**Solution:** (i)  $X - Y$ 

$$\begin{aligned} X - Y &= \{2, 4, 6, 8, 10, 12, 14, 16, 18, 20\} - \{4, 8, 12, 16, 20, 24\} \\ &= \{2, 6, 10, 14, 18\} \end{aligned}$$

(ii)  $Y - X$ 

$$\begin{aligned} Y - X &= \{4, 8, 12, 16, 20, 24\} - \{2, 4, 6, 8, 10, 12, 14, 16, 18, 20\} \\ &= \{24\} \end{aligned}$$

**Question No.6** If  $A=N$  and  $B=W$  then find the value of**Solution:** (i)  $A - B$ 

$$\begin{aligned} A - B &= N - W = \{1, 2, 3, \dots\} - \{0, 1, 2, 3, \dots\} \\ &= \{ \} \end{aligned}$$

(ii)  $B - A$ 

$$\begin{aligned} B - A &= W - N = \{0, 1, 2, 3, \dots\} - \{1, 2, 3, \dots\} \\ &= \{0\} \end{aligned}$$

## Exercise 5.2

Question No.1

$$\text{if } X = \{1, 3, 5, 7, \dots, 19\} \quad Y = \{0, 2, 4, 6, 8, \dots, 20\}$$

$$Z = \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$$

then find the following

$$(i) \quad X \cup (Y \cup Z)$$

$$= (Y \cup Z)$$

$$Y \cup Z = \{0, 2, 4, 6, 8, \dots, 20\}$$

$$\cup \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$$

$$Y \cup Z$$

$$= \left\{ 0, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, \right. \\ \left. 14, 16, 17, 18, 19, 20, 23 \right\}$$

$$X \cup (Y \cup Z)$$

$$= \{1, 3, 5, 7, \dots, 19\} \cup$$

$$\left\{ 0, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, \right. \\ \left. 14, 16, 17, 18, 19, 20, 23 \right\}$$

$$X \cup (Y \cup Z)$$

$$= \left\{ 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, \right. \\ \left. 14, 15, 16, 17, 18, 19, 20, 23 \right\}$$

$$(ii) (X \cup Y) \cup Z$$

$$= (\{1, 3, 5, 7, \dots\} \cup \{0, 2, 4, 6, 8, \dots, 20\})$$

$$\cup \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$$

$$= \{0, 1, 2, 3, 4, 5, 6, 7, \dots, 20\} \cup$$

$$\{2, 3, 5, 7, 11, 13, 17, 19, 23\}$$

$$= \{0, 1, 2, 3, 4, 5, 6, 7, \dots, 20, 23\}$$

$$(iii) X \cap (Y \cap Z)$$

$$= \{1, 3, 5, 7, \dots, 19\} \cap \{(0, 2, 4, 6, 8, \dots, 20) \cap (2, 3, 5, 7, 11, 13, 17, 19, 23)\}$$

$$= \{1, 3, 5, 7, \dots, 19\} \cap \{2\}$$

$$= \{ \}$$

$$(iv) (X \cap Y) \cap Y$$

$$= \{(1, 3, 5, 7, \dots, 19) \cap (0, 2, 4, 6, 8, \dots, 20)\} \cap (2, 3, 5, 7, 11, 13, 17, 19, 23)$$

$$= \{ \} \cap \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$$

$$= \{ \}$$

$$(v) \quad X \cup (Y \cap Z)$$

$$= \{1, 3, 5, 7, \dots, 19\} \cup \left\{ \begin{array}{l} (0, 2, 4, 6, 8, \dots, 20) \\ \cap (2, 3, 5, 7, 11, 13, 17, 19, 23) \end{array} \right\}$$

$$= \{1, 3, 5, 7, \dots, 19\} \cup \{2\}$$

$$= \{1, 2, 3, 5, 7, \dots, 19\}$$

$$(vi) (X \cup Y) \cap (X \cup Z)$$

$$X \cup Y = \{1, 3, 5, 7, \dots, 19\} \cup \{0, 2, 4, 6, 8, \dots, 20\}$$

$$= \{0, 1, 2, 3, 4, 5, 6, 7, \dots, 20\}$$

$$X \cup Z = \{1, 3, 5, 7, \dots, 19\} \cup \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$$

$$= \{1, 2, 3, 5, 7, 9, 11, 13, 15, 17, 19, 23\}$$

$$= (X \cup Y) \cap (X \cup Z)$$

$$= \{0, 1, 2, 3, 4, 5, 6, 7, \dots, 20\} \cap \{1, 2, 3, 5, 7, 9, 11, 13, 15, 17, 19, 23\}$$

$$= \{1, 2, 3, 5, 7, 9, 11, 13, 15, 17, 19\}$$

$$(vii) X \cap (Y \cap Z)$$

$$= \{1, 3, 5, 7, \dots, 19\} \cap \{0, 2, 4, 6, 8, \dots, 20\} \cap (2, 3, 5, 7, 11, 13, 17, 19, 23)$$

$$= \{1, 3, 5, 7, \dots, 19\} \cap \{0, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 23\}$$

$$= \{3, 5, 7, 11, 13, 17, 19\}$$

$$(Viii) (X \cap Y) \cup (X \cap Z)$$

$$X \cap Y = \{1, 3, 5, 7, \dots, 19\} \cap \{0, 2, 4, 6, 8, \dots, 20\}$$

$$X \cap Y = \{ \}$$

$$X \cap Z = \{1, 3, 5, 7, \dots, 19\} \cap \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$$

$$X \cap Z = \{3, 5, 7, 11, 13, 17, 19\}$$

$$(X \cap Y) \cup (X \cap Z) = \{ \} \cup \{3, 5, 7, 11, 13, 17, 19\}$$

$$(X \cap Y) \cup (X \cap Z) = \{3, 5, 7, 11, 13, 17, 19\}$$

$$\text{Question No.3 If } U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

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

then verify the De Morgan's laws i.e,

$$(A \cup B)' = A' \cap B' \text{ and } (A \cap B)' = A' \cup B'$$

**Solution :**

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

$$\text{L.H.S} = A \cap B$$

$$= \{1, 2, 3, 4, 5, 6\} \cap \{2, 4, 6, 8\}$$

$$= \{2, 4, 6\}$$

$$\text{R.H.S} = B \cap A$$

$$= \{2, 4, 6, 8\} \cap \{1, 2, 3, 4, 5, 6\}$$

$$= \{2, 4, 6\}$$

$$\text{L.H.S} = \text{R.H.S}, \quad \text{so}$$

$$A \cap B = B \cap A$$

(II)  $A \cup B = B \cup A$

$$L.H.S = A \cup B$$

$$= \{1, 2, 3, 4, 5, 6\} \cup \{2, 4, 6, 8\}$$

$$= \{1, 2, 3, 4, 5, 6, 7, 8\}$$

$$R.H.S = B \cup A$$

$$= \{2, 4, 6, 8\} \cup \{1, 2, 3, 4, 5, 6\}$$

$$= \{1, 2, 3, 4, 5, 6, 7, 8\}$$

$$L.H.S = R.H.S$$

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

$$L.H.S = A \cap (B \cup C)$$

$$= A \cap (\{2, 4, 6, 8\} \cup \{1, 4, 8\})$$

$$= \{1, 2, 3, 4, 5, 6\} \cap \{1, 2, 4, 6, 8\}$$

$$= \{1, 2, 4, 6\}$$

$$R.H.S = (A \cap B) \cup (A \cap C)$$

$$A \cap B = \{1, 2, 3, 4, 5, 6\} \cap \{2, 4, 6, 8\}$$

$$= \{2, 4, 6\}$$

$$A \cap C = \{1, 2, 3, 4, 5, 6\} \cap \{1, 4, 8\}$$

$$= \{1, 4\}$$

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

$$= \{1, 2, 4, 6\}$$

$$L.H.S = R.H.S$$

So,  $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

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

$$L.H.S = A \cup (B \cap C)$$

$$= A \cup (\{2, 4, 6, 8\} \cap \{1, 4, 8\})$$

$$= \{1, 2, 3, 4, 5, 6\} \cap \{4, 8\}$$

$$= \{1, 2, 3, 4, 5, 6, 8\}$$

$$R.H.S = (A \cup B) \cap (A \cup C)$$

$$A \cup B = \{1, 2, 3, 4, 5, 6\} \cup \{2, 4, 6, 8\}$$

$$= \{1, 2, 3, 4, 5, 6, 8\}$$

$$A \cup C = \{1, 2, 3, 4, 5, 6\} \cup \{1, 4, 8\}$$

$$= \{1, 2, 3, 4, 5, 6, 8\}$$

$$(A \cup B) \cap (A \cup C) = \{1, 2, 3, 4, 5, 6, 8\} \cap \{1, 2, 3, 4, 5, 6, 8\}$$

$$= \{1, 2, 3, 4, 5, 6, 8\}$$

$$L.H.S = R.H.S$$

So,  $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

Question No.3 If  $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

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

then verify the De Morgan's laws i.e,

$$(A \cup B)' = A' \cap B' \text{ and } (A \cap B)' = A' \cup B'$$

Solution :

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

$$L.H.S = (A \cup B)'$$

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

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

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

$$= \{1, 2, 3, \dots, 10\} - \{1, 2, 3, 5, 7, 9\}$$

$$= \{4, 6, 8, 10\}$$

$$R.H.S = A' \cap B'$$

$$A' = U - A$$

$$= \{1, 2, 3, \dots, 10\} - \{1, 3, 5, 7, 9\}$$

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

$$B' = U - B$$

$$= \{1, 2, 3, \dots, 10\} - \{2, 3, 5, 7\}$$

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

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

$$= \{4, 6, 8, 10\}$$

$$L.H.S = R.H.S$$

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

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

$$L.H.S = (A \cap B)'$$

$$\begin{aligned} A \cap B &= \{1, 3, 5, 7, 9\} \cap \{2, 3, 5, 7\} \\ &= \{3, 5, 7\} \end{aligned}$$

$$\begin{aligned} (A \cap B)' &= U - (A \cap B) \\ &= \{1, 2, 3, \dots, 10\} - \{3, 5, 7\} \\ &= \{1, 2, 4, 6, 8, 9, 10\} \end{aligned}$$

$$R.H.S = A' \cup B'$$

$$\begin{aligned} A' &= U - A \\ &= \{1, 2, 3, \dots, 10\} - \{1, 3, 5, 7, 9\} \\ &= \{2, 4, 6, 8, 10\} \end{aligned}$$

$$\begin{aligned} B' &= U - B \\ &= \{1, 2, 3, \dots, 10\} - \{2, 3, 5, 7\} \\ &= \{1, 4, 6, 8, 9, 10\} \end{aligned}$$

$$\begin{aligned} A' \cup B' &= \{2, 4, 6, 8, 10\} \cup \{1, 4, 6, 8, 9, 10\} \\ &= \{1, 2, 4, 6, 8, 9, 10\} \end{aligned}$$

$$L.H.S = R.H.S$$

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

Qusection No. 4 If  $U = \{1, 2, 3, \dots, 20\}$ ,

$$X = \{1, 3, 7, 9, 15, 18, 20\}$$

$Y = \{1, 3, 5, \dots, 17\}$  then show that

$$(i) X - Y = X \cap Y'$$

Solution:

$$\begin{aligned} L.H.S &= X - Y \\ &= \{1, 3, 7, 9, 15, 18, 20\} - \{1, 3, 5, \dots, 17\} \\ &= \{18, 20\} \end{aligned}$$

$$R.H.S = X \cap Y'$$

$$\begin{aligned} Y' &= U - Y \\ &= \{1, 2, 3, \dots, 20\} - \{1, 3, 5, \dots, 17\} \\ &= \{2, 4, 6, 8, 10, \dots, 20\} \end{aligned}$$

$$\begin{aligned} X \cap Y' &= \{1, 3, 7, 9, 15, 18, 20\} \\ &\cap \{2, 4, 6, 8, 10, \dots, 20\} \\ &= \{18, 20\} \end{aligned}$$

$$L.H.S = R.H.S$$

$$X - Y = X \cap Y'$$

$$(ii) Y - X = Y \cap X'$$

Solution:

$$\begin{aligned} L.H.S &= Y - X \\ &= \{1, 3, 5, \dots, 17\} - \{1, 3, 7, 9, 15, 18, 20\} \\ &= \{5, 11, 13, 17\} \end{aligned}$$

$$R.H.S = Y \cap X'$$

$$\begin{aligned} X' &= U - X \\ &= \{1, 2, 3, \dots, 20\} - \{1, 3, 7, 9, 15, 18, 20\} \\ &= \left\{ \begin{array}{l} 2, 4, 5, 6, 8, 10, 11, 12, 13, \\ 14, 16, 17, 19 \end{array} \right\} \end{aligned}$$

$$\begin{aligned} Y \cap X' &= \{1, 3, 5, \dots, 17\} \cap \left\{ \begin{array}{l} 2, 4, 5, 6, 8, \\ 10, 11, 12, 13, 14, 16, 17, 19 \end{array} \right\} \\ &= \{5, 11, 13, 17\} \end{aligned}$$

$$L.H.S = R.H.S$$

$$Y - X = Y \cap X'$$

### Exercise 5.3

**Question No.1**

if  $U = \{1,2,3,4, \dots, 10\}$ ,  $A = \{1,3,5,7,9\}$  and  $B = \{1,4,7,10\}$

Then verify the following questions.

i.  $A - B = A \cap B'$

$L.H.S = A - B$

$$\begin{aligned} &= \{1,3,5,7,9\} - \{1,4,7,10\} \\ &= \{3,5,9\} \end{aligned}$$

$R.H.S = A \cap B'$

$B' = U - B$

$$= \{1,2,3,4, \dots, 10\} - \{1,4,7,10\}$$

$B' = \{2,3,5,6,8,9\}$

$$\begin{aligned} A \cap B' &= \{1,3,5,7,9\} \cap \{2,3,5,6,8,9\} \\ &= \{3,5,9\} \end{aligned}$$

So, L.H.S=R.H.S

ii.  $B - A = B \cap A'$

$L.H.S = B - A$

$$\begin{aligned} B - A &= \{1,4,7,10\} - \{1,3,5,7,9\} \\ &= \{4,10\} \end{aligned}$$

$R.H.S = B \cap A'$

$A' = U - A$

$$= \{1,2,3,4, \dots, 10\} - \{1,3,5,7,9\}$$

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

$$\begin{aligned} B \cap A' &= \{1,4,7,10\} \cap \{2,4,6,8,10\} \\ &= \{4,10\} \end{aligned}$$

So, L.H.S = R.H.S

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

$L.H.S = (A \cup B)' = U - (A \cup B)$

$$\begin{aligned} U - (A \cup B) &= \{1,2,3,4, \dots, 10\} \\ &\quad - (\{1,3,5,7,9\} \\ &\quad \cup \{1,4,7,10\}) \end{aligned}$$

$$\begin{aligned} U - (A \cup B) &= \{1,2,3,4, \dots, 10\} \\ &\quad - \{1,3,4,5,7,9,10\} \end{aligned}$$

$L.H.S = \{2,6,8\}$

$R.H.S = A' \cap B'$

$$\begin{aligned} A' &= U - A = \{1,2,3,4, \dots, 10\} \\ &\quad - \{1,3,5,7,9\} \\ &= \{2,4,6,8,10\} \end{aligned}$$

$$\begin{aligned} B' &= U - B = \{1,2,3,4, \dots, 10\} \\ &\quad - \{1,4,7,10\} \end{aligned}$$

$= \{2,3,5,6,8,9\}$

$A' \cap B' = \{2,4,6,8,10\} \cap \{2,3,5,6,8,9\}$

$R.H.S = \{2,6,8\}$

So, L.H.S = R.H.S

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

$L.H.S = (A \cap B)' = U - (A \cap B)$

$$\begin{aligned} U - (A \cap B) &= \{1,2,3,4, \dots, 10\} \\ &\quad - (\{1,3,5,7,9\} \cap \{1,4,7,10\}) \end{aligned}$$

$$U - (A \cup B) = \{1,2,3,4, \dots, 10\} - \{1,7\}$$

$$L.H.S = \{2,3,4,5,6,8,9,10\}$$

$R.H.S = A' \cup B'$

$$\begin{aligned} A' &= U - A = \{1,2,3,4, \dots, 10\} \\ &\quad - \{1,3,5,7,9\} \end{aligned}$$

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

$$\begin{aligned} B' &= U - B = \{1,2,3,4, \dots, 10\} \\ &\quad - \{1,4,7,10\} \end{aligned}$$

$= \{2,3,5,6,8,9\}$

$A' \cup B' = \{2,4,6,8,10\} \cup \{2,3,5,6,8,9\}$

$$R.H.S = \{2,3,4,5,6,8,9,10\}$$

So, L.H.S = R.H.S

v.  $(A - B)' = A' \cup B$

$L.H.S = (A - B)'$

$= U - (A - B)$

$$= \{1,2,3,4, \dots, 10\} - (\{1,3,5,7,9\} - \{1,4,7,10\})$$

$$U - (A \cup B) = \{1,2,3,4, \dots, 10\} - \{3,5,9\}$$

$L.H.S = \{1,2,4,6,7,8,10\}$

$R.H.S = A' \cup B$

$$\begin{aligned} A' &= U - A = \{1,2,3,4, \dots, 10\} \\ &\quad - \{1,3,5,7,9\} \end{aligned}$$

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

$A' \cup B = \{2,4,6,8,10\} \cup \{1,4,7,10\}$

$R.H.S = \{1,2,4,6,7,8,10\}$

So, L.H.S = R.H.S

vi.  $(B - A)' = B' \cup A$

$L.H.S = (B - A)'$

$= U - (B - A)$

$$\begin{aligned} &= \{1,2,3,4, \dots, 10\} - (\{1,4,7,10\} \\ &\quad - \{1,3,5,7,9\}) \end{aligned}$$

$= \{1,2,3,4, \dots, 10\} - \{4,10\}$

$L.H.S = \{1,2,3,5,6,7,8,9\}$

$R.H.S = B' \cup A = (U - B) \cup A$

$$= (\{1,2,3,4, \dots, 10\} - \{1,4,7,10\}) \cup \{1,3,5,7,9\}$$

$= \{2,3,6,8,9\} \cup \{1,3,5,7,9\}$

$R.H.S = \{1,2,3,5,6,7,8,9\}$

So, L.H.S = R.H.S

**Question No.2** if  $U = \{1,2,3,4, \dots, 10\}$ ,  $A = \{1,3,5,7,9\}$

$B = \{1,4,7,10\}$ ,  $C = \{1,5,8,10\}$

Then verify the following questions.

i.  $(A \cup B) \cup C = A \cup (B \cup C)$

$L.H.S = (A \cup B) \cup C$

$$= (\{1,3,5,7,9\} \cup \{1,4,7,10\}) \cup \{1,5,8,10\}$$

$= \{1,3,4,5,7,9,10\} \cup \{1,5,8,10\}$

$L.H.S = \{1,3,4,5,7,8,9,10\}$

$R.H.S = A \cup (B \cup C)$

$$= \{1,3,5,7,9\} \cup (\{1,4,7,10\} \cup \{1,5,8,10\})$$

$= \{1,3,5,7,9\} \cup \{1,4,7,8,10\}$

$R.H.S = \{1,3,4,5,7,8,9,10\}$

So, L.H.S = R.H.S

ii.  $(A \cap B) \cap C = A \cap (B \cap C)$

$L.H.S = (A \cap B) \cap C$

$= (\{1,3,5,7,9\} \cap \{1,4,7,10\}) \cap \{1,5,8,10\}$

$= \{1,3,4,5,7,9\} \cap \{1,10\}$

$L.H.S = \{1\}$

$R.H.S = A \cap (B \cap C)$

$= \{1,3,5,7,9\} \cap (\{1,4,7,10\} \cap \{1,5,8,10\})$

$= \{1,3,5,7,9\} \cap \{1,10\}$

$R.H.S = \{1\}$

So,  $L.H.S = R.H.S$

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

$L.H.S = A \cup (B \cap C)$

$= (\{1,3,5,7,9\} \cup \{1,4,7,10\}) \cap \{1,5,8,10\}$

$= \{1,3,5,7,9\} \cup \{1,10\}$

$L.H.S = \{1,3,5,7,9,10\}$

$R.H.S = (A \cup B) \cap (A \cup C)$

$= (\{1,3,5,7,9\} \cup \{1,4,7,10\}) \cap (\{1,3,5,7,9\} \cup \{1,5,8,10\})$

$= \{1,3,4,5,7,9,10\} \cap \{1,3,5,7,8,9,10\}$

$R.H.S = \{1,3,5,7,9,10\}$

So  $L.H.S = R.H.S$

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

$L.H.S = A \cap (B \cup C)$

$= (\{1,3,5,7,9\} \cap \{1,4,7,10\}) \cup \{1,5,8,10\}$

$= \{1,3,5,7,9\} \cap \{1,4,5,7,8,10\}$

$L.H.S = \{1,5,7\}$

$R.H.S = (A \cap B) \cup (A \cap C)$

$= (\{1,3,5,7,9\} \cap \{1,4,7,10\}) \cup (\{1,3,5,7,9\} \cap \{1,5,8,10\})$

$= \{1,5,7\} \cap \{1,5\}$

$R.H.S = \{1,5,7\}$

So  $L.H.S = R.H.S$

**Question No.3 if  $U = N$  then verify De Morgan's Laws by**

Using  $A = \emptyset$   $B = P$ .

Solution:

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

$A = \{\}$

$B = \{2,3,5,7, \dots\}$

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

$L.H.S = (A \cap B)'$

$= U - (A \cap B)$

$= \{1,2,3, \dots\} - (\{\} \cap \{2,3,5,7, \dots\})$

$= \{1,2,3, \dots\} - \emptyset$

$= L.H.S = \{1,2,3, \dots\}$

$L.H.S = A' \cup B'$

$A' = U - A = \{1,2,3, \dots\} - \emptyset = \{1,2,3, \dots\}$

$B' = U - B = \{1,2,3, \dots\} - \{2,3,5,7, \dots\} = \{1,4,6, \dots\}$

$A' \cup B' = \{1,2,3, \dots\} \cup \{1,4,6, \dots\}$

$R.H.S = \{1,2,3,4, \dots\}$

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

Now

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

$L.H.S = (A \cup B)'$

$= U - (A \cap B)$

$= \{1,2,3, \dots\} - (\{\} \cup \{2,3,5,7, \dots\})$

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

$= L.H.S = \{1,4,6, \dots\}$

$L.H.S = A' \cap B'$

$A' = U - A = \{1,2,3, \dots\} - \emptyset = \{1,2,3, \dots\}$

$B' = U - B = \{1,2,3, \dots\} - \{2,3,5,7, \dots\} = \{1,4,6, \dots\}$

$A' \cap B' = \{1,2,3, \dots\} \cap \{1,4,6, \dots\}$

$R.H.S = \{1,4,6, \dots\}$

So  $L.H.S = R.H.S$

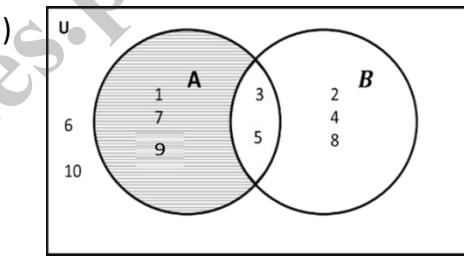
**Question No.4**

If  $U = \{1, 2, 3, 4, \dots, 10\}$ ,  $A = \{1, 3, 5, 7, 9\}$

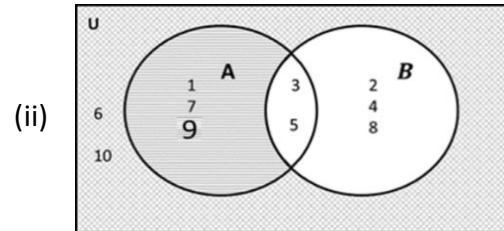
$B = \{2, 3, 4, 5, 8\}$  then prove the following questions by Venn diagram:

i.  $A - B = A \cap B'$

fig (i)



$L.H.S = A - B = \{1,7,9\}$



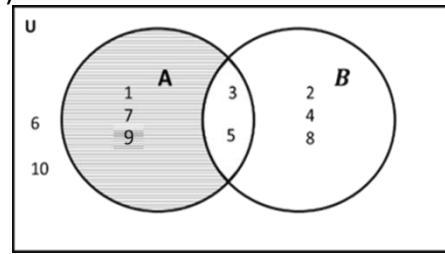
fig(ii)

$R.H.S = A \cap B'$

Now  $B' = U - B = \{1,6,7,9,10\}$

From fig. (i) and (i)

(iii)

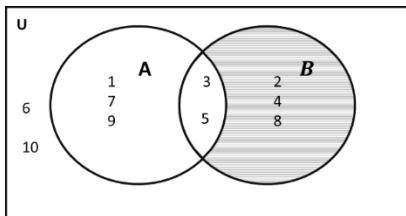


fig(iii)

$A \cap B' = \{1,7,9\}$

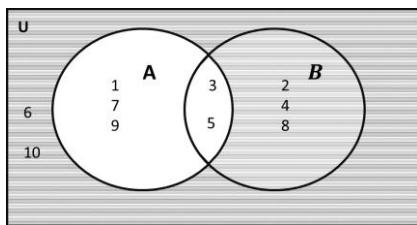
$L.H.S = R.H.S$

ii.  $B - A = B \cap A'$

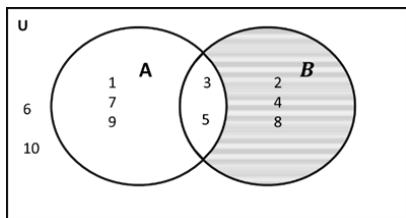


$$\text{L.H.S} = B - A = \{2, 3, 4, 4, 8\} - \{1, 3, 5, 7, 9\} \\ = \{2, 4, 8\}$$

Fig(i)



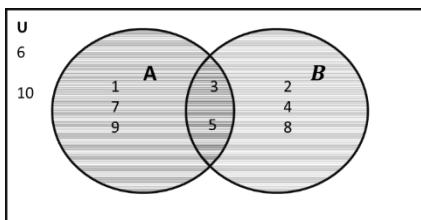
$$\text{R.H.S} = B \cap A' \\ A' = U - A = \{2, 4, 6, 8, 10\}$$



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

$$\text{So, } B - A = B \cap A'$$

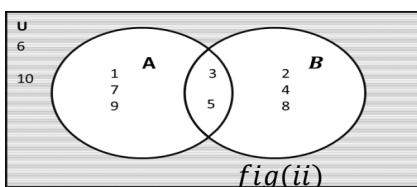
**iii.**  $(A \cup B)' = A' \cap B'$   
 $\text{L.H.S} = (A \cup B)'$



$$A \cup B = \{1, 2, 3, 4, 5, 7, 8, 9\}$$

Fig (i) show that  $A \cup B$

$$(A \cup B)' = U - (A \cup B) = \{6, 10\}$$

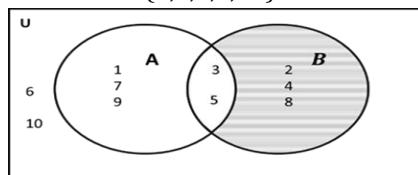


$$(A \cup B)' = U - (A \cup B) = \{6, 10\}$$

fig(ii) show that  $(A \cup B)'$

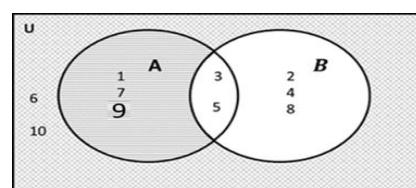
$$\text{R.H.S} = A' \cap B'$$

$$A' = U - A = \{2, 4, 6, 8, 10\}$$



fig(iii)

fig(iii) show that  $A'$

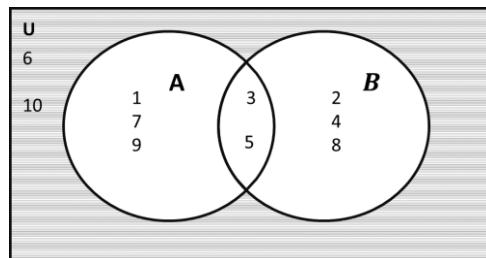


$$B' = U - B = \{1, 6, 7, 9, 10\}$$

fig(iv)

fig(iv) show that  $B'$

$$\text{R.H.S} = A' \cap B' = \{6, 10\}$$



fig(v)

fig(v) show that  $A' \cap B'$

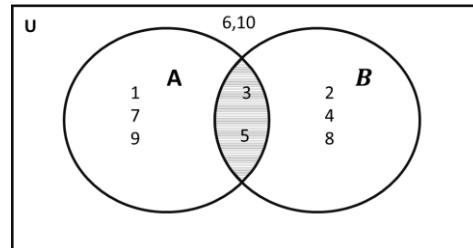
from fig(ii) and (v)

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

**iv.**  $(A \cap B)' = A' \cup B'$

$$\text{L.H.S} = (A \cap B)' = U - (A \cap B)$$

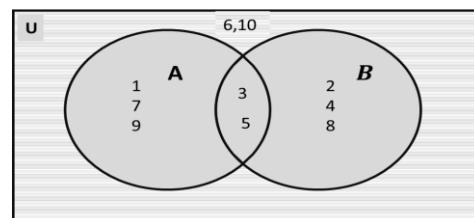
$$A \cap B = \{3, 5\}$$



fig(i)

fig(i) show that  $A \cap B$

$$(A \cap B)' = U - (A \cap B) = \{1, 2, 4, 6, 7, 8, 9, 10\}$$



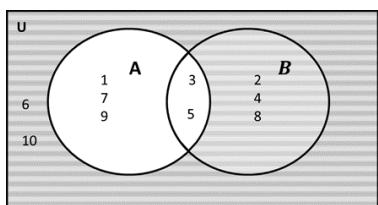
fig(ii)

fig(ii) show that  $(A \cap B)'$

$$\text{R.H.S} = A' \cup B'$$

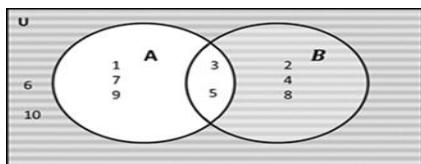
$$A' = U - A = \{2, 4, 6, 8, 10\}$$

$$B' = U - B = \{1, 6, 7, 9, 10\}$$



A' shadow part

fig(iii)

From (ii) and (iv)  $A' \cup B$  shadow part

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

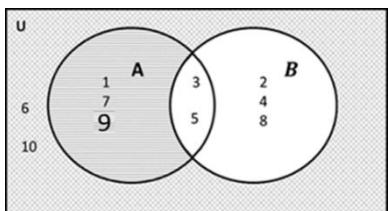
$$L.H.S = R.H.S$$

**vi.**  $(B - A) = B' \cup A$

$$L.H.S = (B - A) = U - (B - A)$$

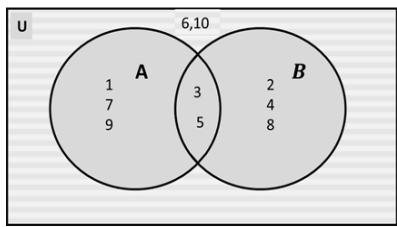
$$B - A = \{2, 4, 8\}$$

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



B' Shadow part

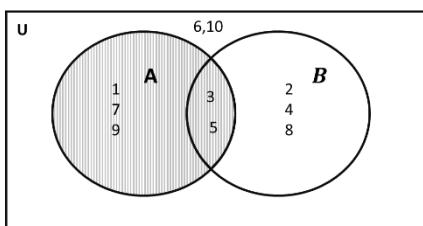
fig(iv)



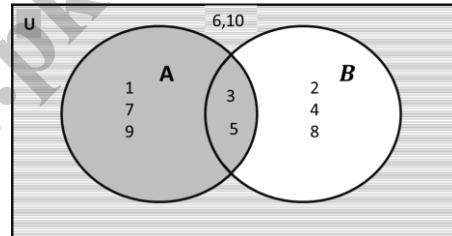
$A' \cup B'$  shadow part  
from (ii) and (iv)  $(A \cap B)' = A' \cup B'$

**v.**  $(A - B)' = A' \cup B$

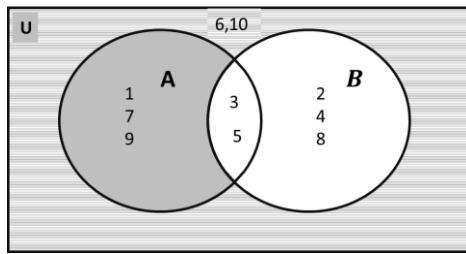
$$L.H.S = (A - B)' = U - (A - B) \\ = \{2, 3, 4, 5, 6, 8, 10\}$$

 $(A - B)$  shadow part.

fig(i)

 $(B - A)$  shadow part.

fig(i)

 $(B - A)'$  shadow part

fig(iii)

 $B'$  shadow part

$$R.H.S = B' \cup A$$

$$B' = U - B = \{1, 6, 7, 9, 10\}$$

$$B' \cup A = \{1, 3, 5, 6, 7, 9, 10\}$$

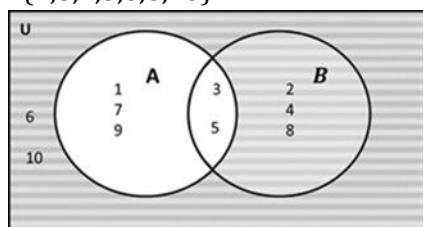
 $(A - B)'$  shadow part

$$R.H.S = A' \cup B$$

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

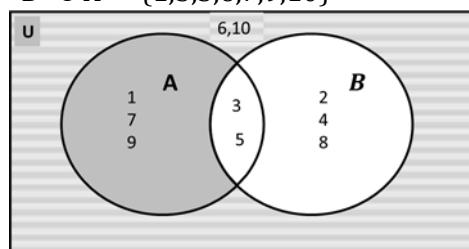
$$A' \cup B = \{2, 4, 6, 8, 10\} \cup \{2, 3, 4, 5, 8\}$$

$$= \{2, 3, 4, 5, 6, 8, 10\}$$



A' shadow part

fig(ii)



fig(iv)

 $(B' \cup A)$  shadow Part

from fig(ii) and (iv)

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

$$L.H.S = R.H.S$$

(ii)  $(2a+5, 3) = (7, b-4)$

$$\begin{aligned} 2a+5 &= 7 & , \quad 3 &= b-4 \\ 2a &= 7-5 & , \quad 3+4 &= b \\ 2a &= 2 & , \quad 7 &= b \\ a &= \frac{2}{2} & , \quad \boxed{b=7} \\ \boxed{a=1} \end{aligned}$$

(iii)  $(3-2a, b-1) = (a-7, 2b+5)$

$$\begin{aligned} 3-2a &= a-7 & , \quad b-1 &= 2b+5 \\ 3+7 &= a+2a & , \quad -1-5 &= 2b-b \\ 10 &= 3a & , \quad -6 &= b \\ \frac{10}{3} &= a & , \quad \boxed{b=-6} \\ \boxed{a=\frac{10}{3}} \end{aligned}$$

**Q.4** Find the sets X and Y if  
 $X \times Y = \{(a,a), (b,a), (c,a), (d,a)\}$

**Solution:**

$$\begin{aligned} X \times Y &= \{(a,a), (b,a), (c,a), (d,a)\} \\ X \times Y &= \{a, b, c, d\} \times \{a\} \\ X &= \{a, b, c, d\} \\ Y &= \{a\} \end{aligned}$$

**Q.5** If  $X = \{a, b, c\}$  and  $Y = \{d, e\}$ , then find the number of elements in

- Solution:**
- (i) No. of elements in  $X = n(X) = 3$
  - (ii) No. of elements in  $Y = n(Y) = 2$
  - (iii) No. of elements in  $X \times Y = n(X \times Y) = 3 \times 2 = 6$
  - (iv) No. of elements in  $Y \times X = n(Y \times X) = 2 \times 3 = 6$
  - (v) No. of elements in  $X \times X = n(X \times X) = 3 \times 3 = 9$

## Exercise 5.4

### Question No.1

If  $A = \{a, b\}$  and  $B = \{c, d\}$ , then find  $A \times B$  and  $B \times A$

### Solution:

$$\begin{aligned} A \times B &= \{a, b\} \times \{c, d\} \\ &= \{(a, c), (a, d), (b, c), (b, d)\} \\ B \times A &= \{c, d\} \times \{a, b\} \\ &= \{(c, a), (c, b), (d, a), (d, b)\} \end{aligned}$$

**Question No.2** If  $A = \{0, 2, 4\}$ ,  $B = \{-1, 3\}$  then find  $A \times B$ ,  $B \times A$ ,  $A \times A$ ,  $B \times B$ .

### Solution: (i) $A \times B$

$$\begin{aligned} A \times B &= \{0, 2, 4\} \times \{-1, 3\} \\ &= \{(0, -1), (0, 3), (2, -1), (2, 3), (4, -1), (4, 3)\} \end{aligned}$$

### (ii) $B \times A$

$$\begin{aligned} B \times A &= \{-1, 3\} \times \{0, 2, 4\} \\ &= \{(-1, 0), (-1, 2), (-1, 4), (3, 0), (3, 2), (3, 4)\} \end{aligned}$$

### (iii) $A \times A$

$$\begin{aligned} A \times A &= \{0, 2, 4\} \times \{0, 2, 4\} \\ &= \{(0, 0), (0, 2), (0, 4), (2, 0), (2, 2), (2, 4), (4, 0), (4, 2), (4, 4)\} \end{aligned}$$

### (iv) $B \times B$

$$\begin{aligned} B \times B &= \{-1, 3\} \times \{-1, 3\} \\ &= \{(-1, -1), (-1, 3), (3, -1), (3, 3)\} \end{aligned}$$

**Question No.3** Find a and b if

### Solution:

(i)  $(a-4, b-2) = (2, 1)$

$$\begin{aligned} a-4 &= 2 & , \quad b-2 &= 1 \\ a &= 2+4 & , \quad b &= 1+2 \\ \boxed{a=6} & , \quad \boxed{b=3} \end{aligned}$$

## Exercise 5.5

**Question No.1 if  $L = \{a, b, c\}$ ,  $M = \{3, 4\}$ , then find two binary relations of  $L \times M$  and  $M \times L$**

**Solution:**

$$\begin{aligned}L \times M &= \{a, b, c\} \times \{3, 4\} \\&= \{(a, 3), (a, 4), (b, 3), (b, 4), (c, 3), (c, 4)\}\\M \times L &= \{3, 4\} \times \{a, b, c\} \\&= \{(3, a), (3, b), (3, c), (4, a), (4, b), (4, c)\}\\R_1 &= \{(a, 3), (b, 4), (c, 3)\}\\R_2 &= \{(a, 4), (b, 3), (c, 3)\}\\R_3 &= \{(3, a), (4, a)\}\\R_4 &= \{(3, b), (4, b), (3, c), (4, c)\}\end{aligned}$$

**Question No.2 if  $Y = \{-2, 1, 2\}$ , then make two binary relations  $Y \times Y$ . Also Find their domain and range.**

**Solution:**

$$\begin{aligned}Y \times Y &= \{-2, 1, 2\} \times \{-2, 1, 2\} \\&= \{(-2, -2), (-2, 1), (-2, 2), (1, -2), (1, 1), (1, 2), (2, -2), (2, 1), (2, 2)\}\\R_1 &= \{(-2, -2), (-2, 1), (1, 2), (2, 2)\}\\Dom R_1 &= \{-2, 1, 2\} = L\\Range R_1 &= \{-2, 1, 2\}\\R_2 &= \{(-2, 1), (1, 1), (-2, 2)\}\\Dom R_2 &= \{-2, 1\}\\Range R_2 &= \{1, 2\}\end{aligned}$$

**Question No.3 if  $L = \{a, b, c\}$  and  $M = \{d, e, f, g\}$  then find two binary relations in each:**

i.  $L \times L$

$$\begin{aligned}L \times L &= \{a, b, c\} \times \{a, b, c\} \\&= \{(a, a), (a, b), (a, c), (b, a), (b, b), (b, c), (c, a), (c, b), (c, c)\}\end{aligned}$$

$$R_1 = \{(a, a), (a, b)\}$$

$$R_2 = \{(b, c), (c, c)\}$$

ii.  $L \times M$

$$\begin{aligned}L \times M &= \{a, b, c\} \times \{d, e, f, g\} \\&= \{(a, d), (a, e), (a, f), (a, g), (b, d), (b, e), (b, f), (b, g), (c, d), (c, e), (c, f), (c, g)\}\end{aligned}$$

$$\begin{aligned}
 R_1 &= \{(a, d), (b, g)\} \\
 R_2 &= \{(a, f), (b, f), (c, f)\} \\
 \text{i. } M \times M &= \{d, e, f, g\} \times \{d, e, f, g\} \\
 &= \{(d, d), (d, e), (d, f), (d, g), (e, d), (e, e), (e, f), (e, g) \\
 &\quad , (f, d), (f, e), (f, f), (f, g), (g, d), (g, e), (g, f), (g, g)\} \\
 R_1 &= \{(d, e), (d, f)\} \\
 R_2 &= \{(e, e), (f, f), (g, g)\}
 \end{aligned}$$

**Question No.4 if set M has 5 elements, then find the number of binary relations in M.**

**Solution:**

No. of elements in M=m=5

No. of Binary relations in M =  $2^{m \times m}$

**Question No.5 if L = {x|x ∈ N ∧ x ≤ 5}, M = {x|x ∈ P ∧ x ≤ 10}, then make the following relations from L to M. write the domain and range of each relations.**

**Solution:**

$$L = \{1, 2, 3, 4, 5\}$$

$$M = \{2, 3, 5, 7\}$$

$$\begin{aligned}
 L \times M &= \{1, 2, 3, 4, 5\} \times \{2, 3, 5, 7\} \\
 &= \left\{ \begin{array}{l} (1, 2), (1, 3), (1, 5), (1, 7), (2, 2), (2, 3), (2, 5), (2, 7), (3, 2) \\ (3, 3), (3, 5), (3, 7), (4, 2), (4, 3), (4, 5), (4, 7), (5, 2), (5, 3) \\ , (5, 5), (5, 7) \end{array} \right\}
 \end{aligned}$$

$$\begin{aligned}
 \text{i. } R_1 &= \{(x, y) | y < x\} \\
 &= \{(3, 2), (4, 2), (5, 2), (4, 3), (5, 3)\}
 \end{aligned}$$

$$\text{Dom } R_1 = \{3, 4, 5\}$$

$$\text{Range } R_1 = \{2, 3\}$$

$$\begin{aligned}
 \text{ii. } R_2 &= \{(x, y) | y = x\} \\
 &= \{(2, 2), (3, 3), (5, 5)\}
 \end{aligned}$$

$$\text{Dom } R_2 = \{2, 3, 5\}$$

$$\text{Range } R_2 = \{2, 3, 5\}$$

$$\begin{aligned}
 \text{iii. } R_3 &= \{(x, y) | x + y = 6\} \\
 &= \{(1, 5), (3, 3), (4, 2)\}
 \end{aligned}$$

$$\text{Dom } R_3 = \{1, 5, 4\}$$

$$\text{Range } R_3 = \{5, 3, 2\}$$

$$\begin{aligned}
 \text{iv. } R_4 &= \{(x, y) | y - x = 2\} \\
 &= \{(1, 3), (3, 5), (5, 7)\}
 \end{aligned}$$

$$\text{Dom } R_4 = \{1, 3, 5\}$$

$$\text{Range } R_4 = \{3, 5, 7\}$$

**Question No.6 indicate relations, into functions, one-one function, into function, and bijective function from the following. Also find their domain and range.**

$$\text{i. } R_1 = \{(1, 1), (2, 2), (3, 3), (4, 4)\}$$

$$\text{Dom } R_1 = \{1, 2, 3, 4\}$$

$$\text{Range } R_1 = \{1, 2, 3, 4\}$$

As, we know a relation becomes a function if

$$\text{Dom } f = A$$

And

Every  $x \in A$  appears in one and only one ordered pair in  $f$ .

So, the given relation is function. As, all distinct elements of A have distinct image of at least one element of set A i.e.

Range of  $f = B$ .

so given relation is also onto functions.

As. The given relation is one-one as well as onto functions so, it is bijective functions.

$$\text{ii. } R_2 = \{(1, 2), (2, 1), (3, 4), (3, 5)\}$$

**Solution:**

$$\text{Dom } R_2 = \{1, 2, 3\}$$

$$\text{Range } R_2 = \{1, 2, 4, 5\}$$

As, we know that A relation becomes a function if  $\text{Dom } f = A$  and

Every  $x \in A$  appears in one and only one ordered pair in  $f$ . As, we can clearly see the 3 is repeated in 3<sup>rd</sup> and 4<sup>th</sup> ordered pair so the given relation is not a function, its only a relation.

$$\text{iii. } R_3 = \{(b, a), (c, a), (d, a)\}$$

$$\text{Dom } R_3 = \{b, c, d\}$$

$$\text{Range } R_3 = \{a\}$$

As, we know A relation becomes a function if

$$\text{Dom } f = A$$

Every  $x \in A$  appears in one and only one ordered pair in  $f$ . So, the given relation is a function.

As, it doesn't fulfill any condition of one-one, Onto or into function so the relations is only a function.

$$\text{iv. } R_4 = \{(1, 1), (2, 3), (3, 4), (4, 3), (5, 4)\}$$

$$\text{Dom } R_4 = \{1, 2, 3, 4, 5\}$$

$$\text{Range } R_4 = \{1, 3, 4\}$$

As, we know relation becomes a function if

$$\text{Dom } f = A$$

And Every  $x \in A$  appears in one and only one ordered pair in  $f$ . So, the given relation is a function.

As, it doesn't fulfill condition of one-one. Every element of set B is an image of at least one element

Of set A. So, the given relation is an onto function.

$$\text{v. } R_5 = \{(a, b), (b, a), (c, d), (d, e)\}$$

$$\text{Dom } R_5 = \{a, b, c, d\}$$

$$\text{Range } R_5 = \{a, b, d, e\}$$

As, we know a relation becomes a functions if

$$\text{Dom } f = A$$

Every  $x \in A$  appears in one and only one ordered pair in  $f$ . So, the given relation is a functions.

As, all distinct elements of A have distinct images in B so, the given relation is One-One.

It doesn't fulfill condition of Onto functions.

So, the given relation is a One-One functions.

$$\text{vi. } R_6 = \{(1, 2), (2, 3), (1, 3), (3, 4)\}$$

$$\text{Dom } R_6 = \{1, 2, 3\}$$

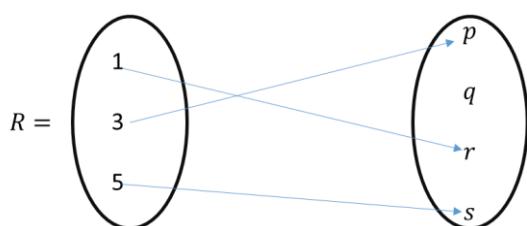
$$\text{Range } R_6 = \{2, 3, 4\}$$

As, we know A relation becomes functions if

$$\text{Dom } f = A \text{ and}$$

Every  $x \in A$  appears in one and only one ordered pair in  $f$ . As, we can clearly see the 1 is repeated in 1<sup>st</sup> and 3<sup>rd</sup> ordered pair so the given relation is not a function, it's only a relation.

vii.



$$R_7 = \{(1, r), (3, p), (5, s)\}$$

$$\text{Dom } R_7 = \{1, 3, 5\}$$

$$\text{Range } R_7 = \{p, r, s\}$$

As, we know a relation becomes a functions if

$$\text{Dom } f = A \text{ and}$$

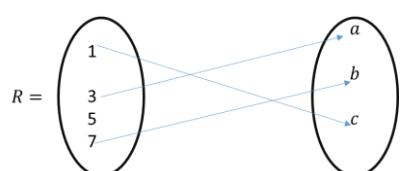
Every  $x \in A$  appears in one and only one ordered pair in  $f$ . So, the given relation is a functions.

As, all distinct elements of A have distinct images in B so , the given relation is One- One.

It doesn't fulfill condition of Onto functions.

So, the given relation is a One-One functions.

viii.



$$R_8 = \{(1, a), (3, a), (7, b)\}$$

$$\text{Dom } R_8 = \{1, 3, 7\}$$

$$\text{Range } R_8 = \{a, b, c\}$$

As, we know a relation becomes a functions if

$$\text{Dom } f = A \text{ and}$$

Every  $x \in A$  appears in one and only one ordered pair in  $f$ .

But  $\text{Dom } f \neq A$ , So, the given relation is not a Functions. It's only a relations.