

## Ex 1.1

1. Write all subsets of the following sets.

$$(i) \{ \}$$

$$= \{ \}$$

$$(ii) \{ 1 \}$$

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

$$(iii) \{ a, b \}$$

$$= \{ \}, \{ a \}, \{ b \}, \{ a, b \}$$

2. Write all proper subsets of the following sets.

$$(i) \{ a \}$$

$$= \{ \}$$

$$(ii) \{ 0, 1 \}$$

$$= \{ \}, \{ 0 \}, \{ 1 \}$$

$$(iii) \quad \{1, 2, 3\}$$

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

3. Write all power set

of the following sets.

$$(i) \quad \{-1, 1\}$$

$$\text{Let } A = \{-1, 1\}$$

$$P(A) = \{\emptyset, \{-1\}, \{1\}, \{-1, 1\}\}$$

$$(ii) \quad \{a, b, c\}$$

$$\text{Let } B = \{a, b, c\}$$

$$P(B) = \{\emptyset, \{a\}, \{b\}, \{c\}, \\ \{a, b\}, \{b, c\}, \{a, c\}, \{a, b, c\}\}$$

## Exercise 1.2

1.

(a) Verify (a)  $A \cup B = B \cup A$

(b)  $A \cap B = B \cap A$

$$A = \{1, 2, 3, \dots, 10\}$$

$$B = \{7, 8, 9, 10, 11, 12\}$$

L.H.S :-

$$A \cup B = \{1, 2, 3, \dots, 10\} \cup \{7, 8, 9, 10, 11, 12\}$$

$$A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$$

R.H.S :-

$$B \cup A = \{7, 8, 9, 10, 11, 12\} \cup \{1, 2, 3, \dots, 10\}$$

$$B \cup A = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$$

L.H.S = R.H.S

(b)  $A \cap B = B \cap A$

L.H.S :-

$$A \cap B = \{1, 2, 3, \dots, 10\} \cap \{7, 8, 9, 10, 11, 12\}$$

$$A \cap B = \{7, 8, 9, 10\}$$

R.H.S :-

$$B \cap A = \{7, 8, 9, 10, 11, 12\} \cap \{1, 2, 3, \dots, 10\}$$

$$= \{7, 8, 9, 10\}$$

L.H.S = R.H.S

$$2. \quad A = \{1, 2, 3, \dots, 15\}$$

$$B = \{6, 8, 10, \dots, 20\}$$

Verify (a)  $A \cup B = B \cup A$

L.H.S.:

$$A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15\} \cup$$

$$\{6, 8, 10, 12, 14, 16, 18, 20\}$$

$$A \cup B = \{1, 2, 3, \dots, 15, 16, 18, 20\}$$

R.H.S.:

$$B \cup A = \{6, 8, 10, 12, 14, 16, 18, 20\} \cup \{1, 2, 3, \dots, 15\}$$

$$B \cup A = \{1, 2, 3, \dots, 15, 16, 18, 20\}$$

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

Q2 (i) Verify

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

$$X = \{a, b, c, d\}$$

$$Y = \{b, d, c, f\}$$

$$Z = \{c, f, g, h\}$$

L.H.S.:

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

$$\{a, b, c, d\} \cup (\{b, d, c, f\} \cap \{c, f, g, h\})$$

$$= \{a, b, c, d\} \cup \{b, c, d, f\}$$

$$= \{a, b, c, d, f, g, h\}$$

R.H.S.:

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

$$(\{a, b, c, d\} \cup \{b, d, c, f\}) \cap \{c, f, g, h\}$$

$$= \{a, b, c, d, f\} \cap \{c, f, g, h\}$$

$$= \{a, b, c, d, f, g, h\}$$

L.H.S = R.H.S

$$(b) \quad X \cap (Y \cap Z) = (X \cap Y) \cap Z$$

L.H.S.

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

$$\{a, b, c, d\} \cap (\{b, d, c, f\} \cap \{c, f, g, h\})$$

$$= \{a, b, c, d\} \cap \{c, f\}$$

$$= \{c\}$$

R.H.S.

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

$$(\{a, b, c, d\} \cap \{b, d, c, f\}) \cap \{c, f, g, h\}$$

$$= \{b, c\} \cap \{c, f, g, h\}$$

$$= \{c\}$$

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

$$Q2 (iii) \quad X = \{-1, 0, 2, 4, 5\}$$

$$Y = \{1, 2, 3, 4, 7\}$$

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

$$\text{Verify (b) } X \cap (Y \cap Z) = (X \cap Y) \cap Z$$

L.H.S

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

$$\{-1, 0, 2, 4, 5\} \cap (\{1, 2, 3, 4, 7\} \cap \{4, 6, 8, 10\})$$

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

$$= \{4\}$$

R.H.S

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

$$(\{-1, 0, 2, 4, 5\} \cap \{1, 2, 3, 4, 7\}) \cap \{4, 6, 8, 10\}$$

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

$$= \{4\}$$

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

Q3 of  $A = \{a, b, c\}$

$$B = \{b, d, f\}$$

$$C = \{a, f, c\}$$

Show that

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

L.H.S.

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

$$\{a, b, c\} \cup (\{b, d, f\} \cap \{a, f, c\})$$

$$= \{a, b, c\} \cup \{f\}$$

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

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

$$(\{a, b, c\} \cup \{b, d, f\}) \cap (\{a, b, c\} \cup \{a, f, c\})$$

$$= \{a, b, c, d, f\} \cap \{a, b, c, f\}$$

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

L.H.S = R.H.S

Q4 If  $A = \{0\}$ ,  $B = \{0, 1\}$ ,  $C = \{\}$

Show that  $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

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

$$= \{0\} \cup (\{0, 1\} \cap \{\})$$

$$= \{0\} \cup \{\}$$

$$= \{0\}$$



R.H.S.

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

$$(\{0\} \cup \{0, 1\}) \cap (\{0\} \cup \{\})$$

$$= \{0, 1\} \cap \{0\}$$

$$= \{0\}$$

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

Q5 Verify De Morgan's Laws if

$$U = N, \quad A = \emptyset \quad \text{and} \quad B = P$$

$$(i) (A \cup B)^c = A^c \cap B^c$$

$$U = N = \{1, 2, 3, 4, \dots\}$$

$$A = \emptyset = \{\}$$

$$B = P = \{2, 3, 5, 7, 11, \dots\}$$

L.H.S. :  $(A \cup B)^c = U - (A \cup B)$

$$\begin{aligned}
&= \{1, 2, 3, 4, \dots\} - (\{\} \cup \{2, 3, 5, 7, 11, \dots\}) \\
&= \{1, 2, 3, 4, \dots\} - \{2, 3, 5, 7, 11, \dots\} \\
&= \{1, 4, 6, 8, 9, 10, \dots\}
\end{aligned}$$

R.H.S.       $A^c \cap B^c$

$$\begin{aligned}
A^c &= U - A = \{1, 2, 3, \dots\} - \{\} \\
&= \{1, 2, 3, 4, \dots\}
\end{aligned}$$

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

$$\begin{aligned}
A^c \cap B^c &= \{1, 2, 3, 4, \dots\} \cap \{1, 4, 6, 8, 9, \dots\} \\
&= \{1, 4, 6, 8, 9, 10, \dots\}
\end{aligned}$$

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

(b)  $(A \cap B)^c = A^c \cup B^c$

$$\begin{aligned}
\text{L.H.S.} \therefore (A \cap B)^c &= U - (A \cap B) \\
&= \{1, 2, 3, 4, \dots\} - (\{\} \cap \{2, 3, 5, 7, 11, \dots\}) \\
&= \{1, 2, 3, 4, \dots\} - \{\} \\
&= \{1, 2, 3, 4, \dots\}
\end{aligned}$$

R.H.S. ∴

$$A^c \cup B^c$$

$$A^c = U - A = \{1, 2, 3, 4, \dots\} - \{\}$$

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

$$B^c = U - B = \{1, 2, 3, \dots\} - \{2, 3, 5, 7, \dots\}$$

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

$$A^c \cup B^c = \{1, 2, 3, 4, \dots\} \cup \{1, 4, 6, 8, 9, 10, \dots\}$$

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

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