Exercise 5.1

N = The set of natural numbers = $\{1, 2, 3, 4, \cdots\}$

W = The set of whole numbers = $\{0, 1, 2, 3, 4, \cdots\}$

Z = The set of all integers = $\{0, \pm1, \pm2, \pm3, \cdots\}$

E = The set of all even integers = $\{0, \pm2, \pm4, \cdots\}$

O = The set of all odd integers = $\{\pm1, \pm3, \pm5, \cdots\}$

P = The set of prime numbers = $\{2, 3, 5, 7, 11, 13, 17, \cdots\}$

Q = The set of all rational numbers = $\{x \mid x = \frac{m}{n}$, where $m, n \in Z$ and $n \neq 0\}$

Q' = The set of all irrational numbers = $\{x \mid x \neq \frac{m}{n}$, where $m, n \in Z$ and $n \neq 0\}$

R = The set of all real numbers = $Q \cup Q'$.

Q. 1: **If $X = \{1, 4, 7, 9\}$ and $Y = \{2, 4, 5, 9\}$**
Then find:

(i) $X \cup Y = \{1, 4, 7, 9\} \cup \{2, 4, 5, 9\}$
$= \{1, 2, 4, 5, 7, 9\}$

(ii) $X \cap Y = \{1, 4, 7, 9\} \cap \{2, 4, 5, 9\}$
$= \{4, 9\}$

(iii) $Y \cup X = \{2, 4, 5, 9\} \cup \{1, 4, 7, 9\}$
$= \{1, 2, 4, 5, 7, 9\}$

(iv) $Y \cap X = \{2, 4, 5, 9\} \cap \{1, 4, 7, 9\}$
$= \{4, 9\}$

Q. 2: **If $X =$ *Set of prime numbers less than or equal to* 17**
and $Y =$ *Set of first* 12 *natural numbers, then find the following*

$X = \{2, 3, 5, 7, 11, 13, 17\}$
$Y = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$

(i) $X \cup Y = \{2, 3, 5, 7, 11, 13, 17\} \cup \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 17\}$
$= Y \cup \{13, 17\}$

(ii) $X \cap Y = \{2, 3, 5, 7, 11, 13, 17\} \cap \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$
$= \{2, 3, 5, 7, 11\}$

(iii) $Y \cup X = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\} \cup \{2, 3, 5, 7, 11, 13, 17\}$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 17\}$
$= Y \cup \{13, 17\}$

(iv) $Y \cap X = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\} \cap \{2, 3, 5, 7, 11, 13, 17\}$
$= \{2, 3, 5, 7, 11\}$

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

$X = \{\ \}$

$Y = \{1, 2, 3, 4, 5, \ldots\}$

$T = \{1, 3, 5, \ldots\}$

(i) $X \cup Y = \{\ \} \cup \{1, 2, 3, 4, 5, \ldots\}$

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

$= Y$

(ii) $X \cup T = \{\ \} \cup \{1, 3, 5, \ldots\}$

$= \{1, 3, 5, \ldots\}$

$= T$

(iii) $Y \cup T = \{1, 2, 3, 4, 5, \ldots\} \cup \{1, 3, 5, \ldots\}$

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

$= Y$

(iv) $X \cap Y = \{\ \} \cap \{1, 2, 3, 4, 5, \ldots\}$

$= \{\ \}$

(v) $X \cap T = \{\ \} \cap \{1, 3, 5, \ldots\}$

$= \{\ \}$

(vi) $Y \cap T = \{1, 2, 3, 4, 5, \ldots\} \cap \{1, 3, 5, \ldots\}$

$= \{1, 3, 5, \ldots\}$

$= T$

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

$X = \{x | x \text{ is prime} \wedge 8 < x < 25\}$

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

Find the value of:

So,

$U = \{4, 5, 6, \ldots\ldots, 25\}$

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

$Y = \{4, 5, 6, \ldots\ldots, 17\}$

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

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

$= \{4, 5, 6, \ldots\ldots, 25\} - (\{11, 13, 17, 19, 23\} \cup \{4, 5, 6, \ldots\ldots, 17\})$

$= \{4, 5, 6, \ldots\ldots, 25\} - \{4, 5, 6, \ldots\ldots, 17, 19, 23\}$

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

(ii) $X' \cap Y'$

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

$= (\{4, 5, 6, \ldots\ldots, 25\} - \{11, 13, 17, 19, 23\}) \cap (\{4, 5, 6, \ldots\ldots, 25\} - \{4, 5, 6, \ldots\ldots, 17\})$

$= \{4, 5, 6, \ldots, 10, 11, 12, 14, 15, 16, 18, 20, 21, 22, 24, 25\} \cap \{18, 19, 20, 21, 22, 23, 24, 25\}$

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

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

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

$= \{4, 5, 6, \ldots\ldots, 25\} - (\{11, 13, 17, 19, 23\} \cap \{4, 5, 6, \ldots\ldots, 17\})$

$= \{4, 5, 6, \ldots \ldots, 25\} - \{11, 13, 17\}$

$= \{4, 5, 6, \ldots 10, 12, 14, 15, 16, 18, 19, 20, . . ,25\}$

(iv) $X' \cup Y'$

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

$= (\{4, 5, 6, \ldots \ldots, 25\} - \{11, 13, 17, 19, 23\}) \cup (\{4, 5, 6, \ldots \ldots, 25\} - \{4, 5, 6, \ldots \ldots, 17\})$

$= \{4, 5, 6, \ldots, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24, 25\} \cup \{18, 19, 20, 21, 22, 23, 24, 25\}$

$= \{4, 5, 6, \ldots 10, 12, 14, 15, 16, 18, 19, 20, . . ,25\}$

Q. 5: If $X = \{2, 4, 6, \ldots, 20\}$ and $Y = \{4, 8, 12, \ldots, 24\}$ then find the following:

(i) $X - Y = \{2, 4, 6, \ldots, 20\} - \{4, 8, 12, \ldots, 24\}$

$= \{2, 6, 10, 14, 18\}$

(ii) $Y - X = \{4, 8, 12, \ldots, 24\} - \{2, 4, 6, \ldots, 20\}$

$= \{24\}$

Q. 6: If $A = N$ and $B = W$ then find the following:

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

$B = \{0, 1, 2, \ldots \ldots\}$

(i) $A - B = \{1, 2, 3, \ldots \ldots\} - \{0, 1, 2, \ldots \ldots\}$

$= \{\ \}$

(ii) $B - A = \{0, 1, 2, \ldots \ldots\} - \{1, 2, 3, \ldots \ldots\}$

$= \{0\}$