Set **(K.B + U.B)**

A well define collection of distinct objects is called Set. A set is represented by capital English alphabets.

For example: A= Set of integers,
$B = \{1, 2, 3, ..., 10\}$ etc.

Presentation of Sets **(K.B + U.B)**

A set is presented by 3 ways

(i) Tabular form
(ii) Descriptive Form
(iii) Set builder notation

Some Important Sets **(K.B + U.B)**

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

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

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

E = The set of all even integers
$= \{0, \pm2, \pm4, \pm6, ...\}$

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

P = The set of prime numbers=$\{2,3,5,7,\ldots\}$

Q = The set of rational numbers
$$= \left\{ x/x = \frac{m}{n}, \text{where } m, n \in Z \wedge n \neq 0 \right\}$$

Q $'$= The set of irrational numbers
$$= \left\{ x/x \neq \frac{m}{n}, \text{where } m, n \in Z \wedge n \neq 0 \right\}$$

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

Empty Set or Null Set **(K.B + U.B)**

A set having no element in it is called an empty set. It is represented by ϕ (phi) or { }.

Singleton Set **(K.B + U.B)**

A set having only one element in it is called singleton set.

For example: {a}, {3} etc.

Subset **(K.B + U.B)**

(LHR 2016, D.G.K 2016)

"If A and B are two sets, such that every element of set A is present in set B, then set A is called subset of set B". It is represented as A$\subseteq$B.

For Example
If A = {1,2,3}, B = {1,2,3,4,5}
Then A $\subseteq$ B.

Note **(K.B + U.B)**

- Number of all possible subsets = 2^n
- Number of all possible proper subsets = $2^n - 1$.
- Number of improper subsets = 1

Proper Subset **(K.B + U.B)**

"If A and B are two sets, such that every element of set A is present in set B and there is at least one element in set B which is not in set A, then set A is called proper subset of set B". It is represented as A$\subset$B.

For example:
If A = {1,2,3} and B={1,2,3,4,5}
Then set A $\subset$ B.

Improper Subset **(K.B + U.B)**

If A and B are two sets, such that every element of set A is present in set B and there is no more element in set B which is not in set A, then set A is called improper subset of set B.

For example: $A = \{1, 2, 3\}, B = \{3, 2, 1\}$

Then A is improper subset of set B.

Equal Sets **(K.B + U.B)**

If A and B are two sets, such that A $\subseteq$ B and B $\subseteq$ A then A = B

For example
If A = {1,2,3}, B = {1,2,3}
Then A = B

Power Set **(K.B + U.B)**

A set consisting of all possible subsets of a set A is called power set of set A represented as P(A).
For example:
If A = {1,2} then P(A)={ϕ, {1}, {2}, {1,2}}

Note **(K.B + U.B)**

- Formula to find number of elements in the power set = 2^n

Disjoint Sets **(K.B + U.B)**

Two sets having no common elements are called disjoint sets.
i.e. If A∩B=ϕ then A and B are called disjoint sets.
For example
If $A=\{1,2\}$ $B=\{a,b\}$, then A and B are disjoint sets.

Overlapping Sets **(K.B + U.B)**

Two sets are called over lapping sets if they have:

- At least one element is common
- Neither set is subset of other.

For example
If A = {1,2,3}, B={2,4,6,8,10}
Then A and B are over lapping sets.

Operation on Sets

Union of Two Sets

(BWP 2014) **(K.B + U.B)**

The union of two sets A and B written as $A\cup B$ (read as A union B) is a set consisting of all the elements which are either in A or in B or in both.

$A\cup B=\{x \mid x\in A \text{ or } x\in B \text{ or } x\in A \text{ and } B \text{ both}\}$

For example
If $A=\{1,2,3\}, B=\{2,4,6,8,10\}$
Then $A\cup B=\{1,2,3,4,5,8,10\}$

Intersection of Two Sets

(LHR 2015) **(K.B + U.B)**

If A and B are two sets then a set consisting of common elements of set A and B is called A intersection B, represented by $A\cap B$.

$A\cap B=\{x \mid x\in A \text{ and } x\in B\}$

For example:
If $A=\{1,2,3\}, B=\{2,4,6,8,10\}$
Then $A\cap B=\{2\}$

Difference of Two Sets **(K.B + U.B)**

If A and B are two sets then their difference written as $A-B$ or $A\setminus B$ is a set consisting of all the elements of A which are not in B.

$A-B=\{x \mid x\in A \text{ and } x\notin B\}$

$B-A=\{x \mid x\in B \text{ and } x\notin A\}$

For example:
If $A=\{1,2,3\}, B=\{2,4,6,8,10\}$
Then $A-B=\{1,3\}$

Universal Set **(K.B + U.B)**

A set consists of all the elements of the sets under consideration is called universal set. It is represented by capital English alphabet U or X.
For example:
U= Set of integers, A = {1,2,3},
B={2,4,6,8,10},then U is universal set.

Complement of a Set **(K.B + U.B)**

(GRW 2014, SWL 2015, BWP 2016)

If U is a universal set and A is its subset then $U-A$ is called complement of A, represented as A' or A^c.
For example:
If U= {1,2,3,4,5}, A = {1,2,3}

$A' = U - A$
$= \{1,2,3,4,5\} - \{1,2,3\}$
$= \{4,5\}$

Exercise 5.1

Q.1 **(A.B)**

Given
$X=\{1,4,7,9\}$
$Y=\{2,4,5,9\}$

To Find
(i) X∪Y
(ii) X∩Y
(iii) Y∪X
(iv) Y∩X

Solution:

(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 **(A.B)**

Given:

X = set of prime numbers less than or equal to 17.

Y = set of first 12 natural number

To Find:

(i) $X \cup Y$
(ii) $Y \cup X$
(iii) $X \cap Y$
(iv) $Y \cap X$

Solution:

Here

X = Set of prime numbers less than or equal to 17.
$= \{2,3,5,7,11,13,17\}$

Y = Set of first 12 natural numbers
$= \{1,2,3,\ldots,12\}$

(i) $X \cup Y = \{2,3,5,7,11,13,17\} \cap \{1,2,3,...,12\}$
$= \{1, 2, 3, \ldots, 12, 13, 17\}$

(ii) $Y \cup X = \{1,2,3,\ldots,12\} \cup \{2,3,5,7,11,13,17\}$
$= \{1, 2, 3 \ldots 12, 13, 17\}$

(iii) $X \cap Y = \{2,3,5,7,11,13,17\} \cap \{1,2,3,...,12\}$
$= \{2, 3, 5, 7, 11\}$

(iv) $Y \cap X = \{1,2,3,...,12\} \cap \{2,3,5,7,11,13,17\}$
$= \{2, 3, 5, 7, 11\}$

Q.3 **(A.B)**

Given

$X = \phi, \quad Y = Z^+, \quad T = O^+$

To Find

(i) $X \cup Y$
(ii) $X \cup T$
(iii) $Y \cup T$
(iv) $X \cap Y$
(v) $X \cap T$
(vi) $Y \cap T$

Solution:

(i) $X \cup Y = \phi \cup Z^+$
$= Z^+$

(ii) $X \cup T = \phi \cup O^+$
$= O^+$

(iii) $Y \cup T = Z^+ \cup O^+$
$= Z^+$

(iv) $X \cap Y = \phi \cap Z^+$
$= \phi$

(v) $X \cap T = \phi \cap O^+$
$= \phi$

(vi) $Y \cap T = Z^+ \cap O^+$
$= O^+$

Q.4 Given **(A.B)**

$U = \{x | x \in N \wedge 3 < x \leq 25\}$

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

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

To Find

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

(ii) $(X \cap Y)'$ (iv) $X' \cup Y'$

Solution: Here

$U = \{x / x \in N \wedge 3 < x \leq 25\}$
$= \{4,5,6,\ldots,25\}$

$X = \{x \mid x \text{ is prime} \wedge 8 < x < 25\}$
$= \{11,13,17,19,23\}$

$Y = \{x \mid x \in W \wedge 4 \leq x \leq 17\}$
$= \{4,5,6,7,\ldots,17\}$

(i) $X \cup Y = \{11,13,17,19,23\} \cup \{4,5,6,...,17\}$

$= \{4,5,6,.....,17,19,23\}$

$(X \cup Y)' = U - (X \cup Y)$
$= \{4,5,6,..., 25\} - \{4,5,6,...,17,19,23\}$
$= \{18, 20, 21, 22, 24, 25\}$

(ii) $X' = U - X$
$= \{4,5,6,......, 25\} - \{11,13,17,19,23\}$
$= \{4,5,6,7,8,9,10,12,14,15,16,18,20,21,22,24,25\}$

$Y' = U - Y$
$= \{4,5,6,......, 25\} - \{4,5,6,......,17\}$
$= \{18,19,20,21,22,23,24,25\}$

$X' \cap Y' = \{4,5,6,.....,10,12,14,15,16,18,20,21,22,24,25\}$
$\cap \{18,19,20,......, 25\}$

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

(iii) $X \cap Y = \{11,13,17,19,23\} \cap \{4,5,6,...,17\}$

$= \{11,13,17\}$

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

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

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

(iv) $X' \cup Y'$

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

$\cup \{18,19,20,21,22,23,24,25\}$

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

Q.5 Given **(A.B)**

$X = \{2,4,6,.....,20\}$ **(LHR 2014)**

$Y = \{4,8,12,...,24\}$ **(FSD 2015)**

To Find

(i) $X - Y$

(ii) $Y - X$

Solution:

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

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

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

$= \{24\}$

Q.6 Given **(BWP 2014)** **(A.B)**

$A = N, B = W$ **(LHR 2015)**

To Find **(D.G.K 2014)**

(i) $A - B$

(ii) $B - A$

Solution:

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

$= \phi$

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

$= \{0\}$