Set :- A set is defined as a collection of elements. Elements can be numbers, alphabets, names etc.

$A = \{a, b, c, d, e\}$

$B = \{1, 2, 3, 4, a, b, c, d\}$

The statement "a belongs to A" or "a is an element of A" is written as: $a \in A$

if "a is not belong to A" then we write $a \notin A$

Set can be formed by two ways :-

(i) Tabular Form of a set :- If a set is defined by actually listing its members.

If set A contain elements a, b, c, d then it is expressed as $A = \{a, b, c, d\}$

(ii) Bulider Form :- If a set is defined by the properties which its elements must satisfy.

$A = \{x : 1 \le x \le 9 \text{ and } x \text{ is an integer}\}$

Standard Notations :-

1. $x \in A$ — x belongs to A.
2. $x \notin A$ — x does not belong to A.
3. ϕ — Empty set
4. U — Universal set
5. N — The set of all natural numbers (Positive Integers)
6. Z — Set of Integers $-2, -1, 0, 1, 2$
7. Q — Set of Rational numbers
8. R — Set of Real numbers
9. C — Set of Complex numbers.

Singlen Set :- A set have single element then set is called ~~singlen~~ an singlen set.

eg. $A = \{1\}$

Null Set or Empty Set :- The set that contains no elements is called Null set and is denoted by ϕ.

eg. $A = \{\} = \phi$

(i) The set $A = \{0\}$ is not a null set because 0 is the element of the set.

(ii) The set $A = \{\phi\}$ is not a null set because set ϕ is the element of the set.

Subset of a Set :- If every element of a set A is also an element of a set B then A is called subset of B and is written as

$A \subseteq B$

If A is not a subset of B, we write it $A \not\subseteq B$.

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

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

In this eg. A is subset of B. $A \subseteq B$

Proper Subset :- If A is subset of B and $A \neq B$ then A is said to be proper subset of B. If A is a proper subset of B then B is not subset of A.

eg. $B = \{1, 2, 3, 4, 5, 6\}$

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

In this eg. A is proper subset of B. $A \subset B$.

Note :- The null set ϕ is a proper subset of every set.

Improper Subset → If A is subset of B and A = B, Then A is said to be an improper subset of B.

eg. $B = \{1, 2, 3, 4\}$

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

A is improper subset of B.

* Every set is improper subset of itself.

06/ Equality of sets / Principle of Extension →

Two set A and B are equal if and only if they have the same elements.

$A = B \Rightarrow (x \in A \text{ and } x \in B)$

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

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

Set A and B are equal sets.

/ Disjoint Sets → Two sets A and B are said to be disjoints if the sets have no common element.

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

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

means $A \cap B = \phi$

A and B are disjoint set because they have no common element.

06/ Finite Set → If a set consist of specific numbers of different elements then that set is called finite set.

eg. $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

06 Infinite Set :- If a set consists of infinite number of different elements or if the counting of different elements of the set does not come to an end, the set is called infinite set.

e.g. $A = \{1, 2, 3, 4, 5, \ldots\}$

Universal Set :- If all the sets under investigation are subsets of a fixed set U, then U is called universal set.

e.g. In human population studies the universal set consist of all the people in the world.

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Power Set → The power set of any given set A is the set of all subsets of A and is denoted by P(A). If A has n elements then P(A) has 2^n elements.

If $A = \{1, 2\}$ then its subsets are $\phi, \{1\}, \{2\}, \{1, 2\}$

$P(A) = \{\phi, \{1\}, \{2\}, \{1, 2\}\}$ which has $2^2 = 4$ elements.

Operations ON Sets :-

1. Union of Sets :- Union of sets A and B is defined to be the set of all those elements which belong to A or B or both and is denoted by $A \cup B$.

e.g. $A = \{1, 2, 3\}$, $B = \{3, 4, 5, 6\}$

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

2. Intersections of Sets :- Intersections of two sets A and B is a set of all those elements

which belong to both A and B and is denoted by $A \cap B$.

eg. $A = \{1, 2, 3, 4\}$; $B = \{3, 4, 5, 6\}$

$$A \cap B = \{3, 4\}$$

3. <u>Difference of sets</u> → The difference of two sets A and B is a set of all those elements which belong to A but do not belong to B and is denoted by $A - B$.

eg. $A = \{a, b, c, d\}$, $B = \{1, 2, c, d\}$

$$A - B = \{a, b\}$$

4. <u>Complement of a Set (With respect to Universal Set)</u> →

The Complement of a set A is a set of all those elements of the universal set which do not belong to A and is denoted by A^c.

$$A^c = U - A$$

eg. $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

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

then $A' = \{4, 6, 7, 8, 9\}$

5. <u>Symmetric Difference of Sets</u> → The symmetric Difference of two sets A and B is the set containing all the elements that are in A or in B but not in both and is denoted by $A \oplus B$. i.e.

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

eg. $A = \{a, b, c, d\}$, $B = \{a, b, l, m\}$

$$A \oplus B = \{c, d, l, m\}$$

Cardinality of a Set :- The total number of unique elements in the set is called the cardinality of set. The cardinality of the countably infinite set is countably infinite.

1. $A = \{1, 2, 3, 4, 5\}$

   Cardinality of set A is 5.

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

   Set A has infinite Cardinality.

Ordered Pairs :- An ordered pair consists of two elements such that one of them is designated as first member and other as second member. If 'a' is the first member and 'b' is the second member, then the ordered pair is written as (a, b).

eg:- $A = \{1, 2\}$ then possible ordered pairs of $A \times A$

$$A \times A = \{(1,1), (1,2), (2,1), (2,2)\}$$

Cartesian Product of two sets :-

The cartesian product of two sets A and B in that order is the set of all ordered pairs whose first element belongs to the set A and second element belongs to set B and is denoted by $A \times B$.

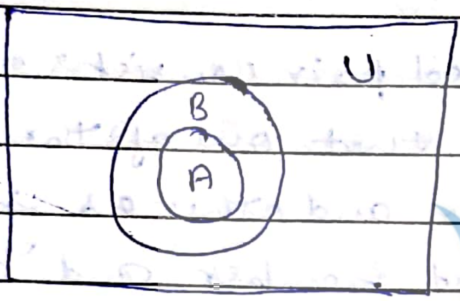
$$A \times B = \{(x, y) : x \in A, y \in B\}$$

eg. $A = \{1, 2\}$ and $B = \{3, 4\}$

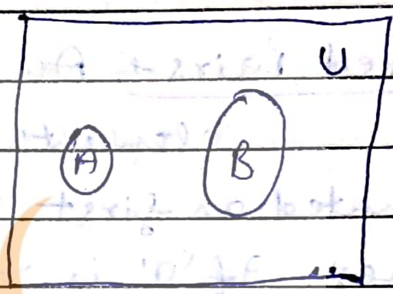
$$A \times B = [(1,3), (1,4), (2,3), (2,4)]$$

Note $A \times B \neq B \times A$

Venn Diagram → A Venn diagram is a pictorial representation of sets in which sets are represented by enclosed areas in the plane. The universal set U is represented by a rectangle and the other sets are represented by circles. The complement of the set is represented by that portion of the universal set which is not in the set.



$A \subseteq B$



A and B are disjoint

Algebra of Sets →

① **Idempotent Laws** → (a) $A \cup A = A$
(b) $A \cap A = A$

② **Associative Laws** → (a) $(A \cup B) \cup C = A \cup (B \cup C)$
(b) $(A \cap B) \cap C = A \cap (B \cap C)$

③ **Commutative Law** →
(a) $A \cup B = B \cup A$
(b) $A \cap B = B \cap A$

④ **Distributive Laws** →
(a) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
(b) $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

⑤ **Demorgan's Laws** →
(a) $(A \cup B)' = A' \cap B'$
(b) $(A \cap B)' = A' \cup B'$

(vi) Identity Laws → (a) $A \cup \phi = A$

(b) $A \cap U = A$

(c) $A \cup U = U$

(d) $A \cap \phi = \phi$

(vii) Complement Laws → (a) $A \cup A' = U$

(b) $A \cap A' = \phi$

(c) $U' = \phi$

(d) $\phi' = U$

(viii) Involution Law → $(A')' = A$