Introduction to Set theory:-

Sets and Elements:-

A set is well defined collection of objects and denoted by upper case English letters. The objects in a set are known as elements and denoted by lower case English letters.

eg: $A = \{1, 2, 3, 4, 5, 6\}$

(or) $A = \{x \mid x$ is a natural number less than or equal to $6\}$

Equal sets:- Two sets A, B are said to be equal or identical if they have exactly the same elements and write as $A = B$.

Subset:- If every element of the set A belong to the set B i.e if $x \in A \Rightarrow x \in B$, then we say that A is Subset of B. and write $A \subseteq B$ (A is contained in B) or $B \supseteq A$ (B contains A).

Note:- If $A \subseteq B$ and $B \subseteq A$, then $A = B$.

Null set:- A null or an empty set is one which does not contain any element at all and denoted by ϕ

Note:- 1. Every set is a subset itself
2. An empty set is a subset of every set

UNION or SUM:-

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

$$A_1 \cup A_2 \cup A_3 \cup \cdots \cup A_n = \bigcup_{i=1}^{n} A_i = \{x \mid x \in A_i \text{ for at least one } i = 1, 2, 3 \cdots n\}$$

Intersection or Product:-

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

$$A_1 \cap A_2 \cap \cdots \cap A_n = \bigcap_{i=1}^{n} A_i = \{x \mid x \in A_i \ \forall i = 1, 2, 3 \cdots n\}$$

Relative Difference:

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

complement of a set:

$$\bar{A} = S - A$$

Algebra of sets:-

If A, B, C are subsets of a universal set S, then the following laws hold.

Commutative Laws:-

* $A \cup B = B \cup A$
* $A \cap B = B \cap A$

Associative Law:-

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

Distributive Laws:-

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

Complementary Laws:-

* $A \cup \bar{A} = S$
* $A \cap \bar{A} = \phi$
* $A \cup S = S$
* $A \cap S = A$

Difference Laws:-

$$A - B = A \cap \bar{B} = A - (A \cap B) = (A \cup B) - B$$

De-Morgan's Laws:-

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

Idempotent Laws:-

* $A \cup A = A$
* $A \cap A = A$

Involution Law:- $\overline{(\overline{A})} = A$

Fundamental principle of addition:-

1. Let A, B are two sets then
$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

2. Let A, B, C are three sets then
$$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$$

Fundamental principle of Multiplication:-

Let A, B be the distinct sets. Then the number of ways of selecting first object from A and second object from B in succession is given by
$$n(A \times B) = n(A) \times n(B)$$

Permutation :-

A permutation is an arrangement or ordered selection objects. The no. of permutations of n different objects taken $r(\leq n)$ at a time is

$$^nP_r = \frac{n!}{(n-r)!}$$

Combinations :-

A combination is an unordered selection or subset of the objects. The no. of combinations of n different objects taken $r(\leq n)$ at a time is

$$^nC_r = \frac{n!}{(n-r)!\, r!}$$

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