SETS

A set is a well-defined collection of distinct objects.

Set of Natural Number less than 5

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

Roaster form

ROASTER FORM

In this form, we list all the member of the set within braces (curly brackets) and separate these by commas.

$A = \{x : x$ is a Natural Number less than 5$\}$

SET BUILDER FORM

In this form, we write a property which gives us all the elements belonging to the particular set.

$A = \{x : x \in N \ \& \ x < 5\}$

THE EMPTY SET

A set which has no element is called the null set or empty set and is denoted by ϕ .
The number of elements of a set A is denoted as n (A) and n (ϕ) = 0 as it contains no element.

ϕ (Phi)

Ex: $A = \{x : x$ is a Natural Number less than $1\}$

Singleton set :

A set consisting of a single element is called a singleton set.

$A = \{1\}$, $B = \{a\}$, $C = \{x : x - 2 = 0\}$

$\{0\}$

Empty = { }

FINITE & INFINTE SET

A set, which has finite numbers of elements, is called a finite set. Otherwise it is called an in finite set.
For example, the set of all days in a week is a finite set whereas; the set of all integers is an infinite set.

Order of a finite set : The number of elements in a finite set A is called the order of this set and denoted n(A).

It is also called cardinal number of the set.

e.g. A = {a, b, c, d} n(A) = 4 $D = (5)^2 - 4 \times 7 \times 1 < 0$

Ex: $A = \{x : x \text{ is a root of } x^2 + 5x + 7 = 0\}$

$n(A) = ?$, $n(A) = 0$

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

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

EQUAL SET

Given two sets A and B, if every element of A is also an element of B and if every element of B is also an element of A, then the sets A and B are said to be equal.

Clearly, the two sets have exactly the same elements.

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

Equivalent sets : Two finite sets A and B are equivalent if their number of elements are same

i.e. $n(A) = n(B)$

e.g. $A = \{1, 3, 5, 7\}$, $B = \{a, b, c, d\}$ Þ

$n(A) = 4$ and $n(B) = 4$

A and B are equivalent sets

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SUBSETS

A set A is said to be a subset of the set B if each element of the set A is also the element of the set B. The symbol used is '$\subseteq$' i.e. $A \subseteq B$

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

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

A is a subset of B.

$A \subseteq B$ → Superset

A is not a subset of B then we write $A \nsubseteq B$

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

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

$A \nsubseteq B$

$C \subseteq D$

Proper subset : If A is a subset of B and $A \neq B$ then A is a proper subset of B, and we write $A \subset B$

Ex→ $B = \{1, 2\}$ write all the subsets of B

$\{1\}, \{2\}, \{1, 2\}, \phi$ Subset $= 2^2 = 4$

Note-1 : Every set is a subset of itself i.e. $A \subseteq A$ for all A

Note-2 : Empty set ϕ is a subset of every set.

Note-3 : Clearly $N \subset W \subset Z \subset Q \subset R \subset C$

Note-4 : The total number of subsets of a finite set containing n elements is 2^n

POWER SET

The set of all subsets of a given set A is called the power set A and is denoted by P (A).

e.g. Let A = {1, 2} then P(A) = {{ }, {1}, {2}, {1, 2}}

$$P(A) = \{\{1\}, \{2\}, \{1, 2\}, \phi\}$$

Let $S = \{1, 2, 3, \ldots, 100\}$. The number of non-empty subsets A of S such that the product of elements in A is even, is **(2019 Main, 12 Jan I)**

(a) $2^{50}(2^{50} - 1)$ (b) $2^{50} - 1$

(c) $2^{50} + 1$ (d) $2^{100} - 1$

$(2^{100} - 1)$

even × even = even
even × odd =
odd × odd = odd

$\{1, 3, \ldots, 99\}$

$(2^{50} - 1)$

$(2^{100} - 1)$

$(2^{100} - 1) - (2^{50} - 1)$

$2^{100} - 2^{50}$

$2^{50}(2^{50} - 1)$

Universal set : A set consisting of all possible elements which occur in the discussion is called a Universal set and is denoted by U

Note : All sets are contained in the universal set

e.g. If A = {1, 2, 3}, B = {2, 4, 5, 6}, C = {1, 3, 5, 7} then

U = {1, 2, 3, 4, 5, 6, 7} can be taken as the Universal set.

Union of sets

Let A and B be any two sets. The union of A and B is the set which consists of all the elements of A and all the elements of B, the common elements being taken only once.

The symbol '∪' is used to denote the *union*.
Symbolically, we write $A \cup B$ *and usually read as 'A union B'*.

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e.g. If A = {1, 2, 3}, B = {2, 4, 5, 6}, C = {1, 3, 5, 7} then

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Intersection of sets

The intersection of sets A and B is the set of all elements which are common to both A and B. The symbol '∩' is used to denote the *intersection*.

The intersection of two sets A and B is the set of all those elements which belong to both A and B. Symbolically, we write $A \cap B = \{x : x \in A \text{ and } x \in B\}$.

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

$A \cap B = \{2, 3\}$

DIFFERENCE OF TWO SETS

The difference of two sets A and B is the set of all those elements of A which are not elements of B. It is denoted by

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

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

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

$A - B = \{1, 2\}$

$B - A = \{4, 5\}$

Complement of a Set

Let U be the universal set and A a subset of U. Then the complement of A is the set of all elements of U which are not the elements of A.

Symbolically, we write A′ to denote the complement of A with respect to U

$A' = \{x : x \in U \text{ and } x \notin A\}$. Obviously $A' = U - A$

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

$A = \{1, 2\}$

$A^c, A' = \{3, 4, 5\}$

CARDINAL NUMBER OF SETS

1. If A, B, C are finite sets and U be the finite universal set then

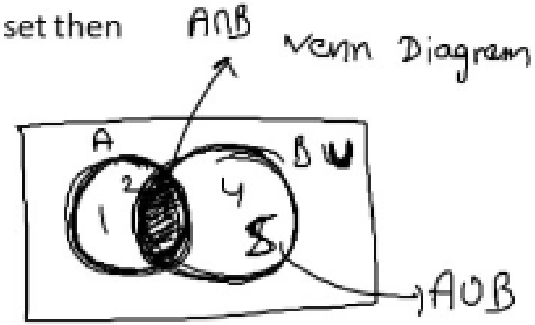
$n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$3 + 3 - A' = \{1, 2, 3\}$

5

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

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



Q. If X and Y are two sets such that X ∪ Y has 50 elements, X has 28 elements and Y has 32 elements, how many elements does X ∩ Y have ?

$n(X \cup Y) = 50, \; n(X) = 28, \; n(Y) = 32$

$n(X \cup Y) = n(X) + n(Y) - n(X \cap Y)$

$50 = 28 + 32 - n(X \cap Y)$

$50 = 60 - n(X \cap Y)$

10

3. If A, B, C are finite sets and U be the finite universal set then

$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(A \cap C) + n(A \cap B \cap C)$