# **Introduction of Sets**

A set is defined as a collection of distinct objects of the same type or class of objects. The purposes of a set are called elements or members of the set. An object can be numbers, alphabets, names, etc.

Examples of sets are:

1. A set of rivers of India.
2. A set of vowels.

We broadly denote a set by the capital letter A, B, C, etc. while the fundamentals of the set by small letter a, b, x, y, etc.

If A is a set, and a is one of the elements of A, then we denote it as a ∈ A. Here the symbol ∈ means -"Element of."

## **Sets Representation:**

Sets are represented in two forms:-

**a) Roster or tabular form:** In this form of representation we list all the elements of the set within braces { } and separate them by commas.

**Example:** If A= set of all odd numbers less then 10 then in the roster from it can be expressed as A={ 1,3,5,7,9}.

**b) Set Builder form:** In this form of representation we list the properties fulfilled by all the elements of the set. We note as {x: x satisfies properties P}. and read as 'the set of those entire x such that each x has properties P.'

**Example:** If B= {2, 4, 8, 16, 32}, then the set builder representation will be: B={x: x=2n, where n ∈ N and 1≤ n ≥5}

## **Standard Notations:**

|  |  |
| --- | --- |
| x ∈ A | x belongs to A or x is an element of set A. |
| x ∉ A | x does not belong to set A. |
| ∅ | Empty Set. |
| U | Universal Set. |
| N | The set of all natural numbers. |
| I | The set of all integers. |
| I0 | The set of all non- zero integers. |
| I+ | The set of all + ve integers. |
| C, C0 | The set of all complex, non-zero complex numbers respectively. |
| Q, Q0, Q+ | The sets of rational, non- zero rational, +ve rational numbers respectively. |
| R, R0, R+ | The set of real, non-zero real, +ve real number respectively. |

## **Cardinality of a Sets:**

The total number of unique elements in the set is called the cardinality of the set. The cardinality of the countably infinite set is countably infinite.

### **Examples:**

1. Let P = {k, l, m, n}  
The cardinality of the set P is 4.

2. Let A is the set of all non-negative even integers, i.e.  
A = {0, 2, 4, 6, 8, 10......}.

As A is countably infinite set hence the cardinality.

# **Types of Sets**

Sets can be classified into many categories. Some of which are finite, infinite, subset, universal, proper, power, singleton set, etc.

**1. Finite Sets:** A set is said to be finite if it contains exactly n distinct element where n is a non-negative integer. Here, n is said to be "cardinality of sets." The cardinality of sets is denoted by|A|, # A, card (A) or n (A).

**Example:**

1. Cardinality of empty set θ is 0 and is denoted by |θ| = 0
2. Sets of even positive integer is not a finite set.

A set is called a finite set if there is one to one correspondence between the elements in the set and the element in some set n, where n is a natural number and n is the cardinality of the set. Finite Sets are also called numerable sets. n is termed as the cardinality of sets or a cardinal number of sets.

**2. Infinite Sets:** A set which is not finite is called as Infinite Sets.

**Countable Infinite:** If there is one to one correspondence between the elements in set and element in N. A countably infinite set is also known as Denumerable. A set that is either finite or denumerable is known as countable. A set which is not countable is known as Uncountable. The set of a non-negative even integer is countable Infinite.

**Uncountable Infinite:** A set which is not countable is called Uncountable Infinite Set or non-denumerable set or simply Uncountable.

**Example:** Set R of all +ve real numbers less than 1 that can be represented by the decimal form 0. a1,a2,a3..... Where a1is an integer such that 0 ≤ ai ≤ 9.

**3. Subsets:** If every element in a set A is also an element of a set B, then A is called a subset of B. It can be denoted as A ⊆ B. Here B is called Superset of A.

**Example:** If A= {1, 2} and B= {4, 2, 1} the A is the subset of B or A ⊆ B.

**Properties of Subsets:**

1. Every set is a subset of itself.
2. The Null Set i.e.∅ is a subset of every set.
3. If A is a subset of B and B is a subset of C, then A will be the subset of C. If A⊂B and B⊂ C ⟹ A ⊂ C
4. A finite set having n elements has 2n subsets.

**4. Proper Subset:** If A is a subset of B and A ≠ B then A is said to be a proper subset of B. If A is a proper subset of B then B is not a subset of A, i.e., there is at least one element in B which is not in A.

**Example:**

(i) Let A = {2, 3, 4}  
B = {2, 3, 4, 5}

A is a proper subset of B.

(ii) The null ∅ is a proper subset of every set.

**5. Improper Subset:** If A is a subset of B and A = B, then A is said to be an improper subset of B.

**Example**

(i) A = {2, 3, 4}, B = {2, 3, 4}

A is an improper subset of B.

(ii) Every set is an improper subset of itself.

**6. Universal Set:** If all the sets under investigations are subsets of a fixed set U, then the set U is called Universal Set.

**Example:** In the human population studies the universal set consists of all the people in the world.

**7. Null Set or Empty Set:** A set having no elements is called a Null set or void set. It is denoted by∅.

**8. Singleton Set:** It contains only one element. It is denoted by {s}.

**Example:** S= {x|x∈N, 7<x<9} = {8}