NAKUL PANDIT
PGT (MATHS)

TYPES OF SETS

1. EMPTY/NULL/VOID SET

A set which does not contain any element is called the empty set or the null set or the void set.

The empty set is denoted by the symbol ∅ (phi). It is also written as { }.

Examples:

(i) $\{x : x \in N, 2 < x < 3\} = \emptyset$

(ii) $\{x : x \in N,\ x^2 - 2 = 0\} = \emptyset$

(iii) $\{x : x \text{ is an even prime number greater than } 2\} = \emptyset$

2. SINGLETON SET

A set which contains exactly one element is called the Singleton Set.

Examples:

(i) $\{x : x \in N,\ 4 < x < 6\} = \{5\}$

(ii) $\{x : x \in N,\ x^2 - 9 = 0\} = \{3\}$

(iii) $\{x : x \text{ is an even prime number}\} = \{2\}$

3. FINITE AND INFINITE SETS

A set which is empty or contains of a definite number of elements, is called a finite set. On the other hand, a set which is not finite is called an infinite set.

Note: $).\textit{The number of elements in a set A is denoted by } n(A$

Examples:

(i) $A = \{x : x \text{ is a month of a year}\}$ $[\textit{Finite set}]$

(ii) $B = \{x : x \text{ is a natural number}\}$ $[\textit{Infinite set}]$

(iii) $C = \{x : x \text{ is a natural number less than } 50\}$ $[\textit{Finite set}]$

(iv) $D = \{x : x \text{ is a line parallel to the y\_axis}\}$ $[\textit{Infinite set}]$

(v) $E = \{x : x \text{ is the number of hair on your head}\}$ $[\textit{Finite set}]$

(vi) $F = \{x : x \text{ is the number of tangents on a circle}\}$ $[\textit{Infinite set}]$

(vii) $G = \{x : x \text{ is a multiple of } 5\}$ $[\textit{Infiinite set}]$

4. EQUAL SETS

Two sets A and B are said to be equal if every element of set A is in set B and every element of set B is in set A. If A and B are two equal sets, then we write $A = B$.

Examples:

(i) $A = \{a, b, c, d\}, \ \ B = \{c, b, a, d\}$ $[A = B]$

(ii) $A = \{2, 3, 5\}, \ \ B = \{x: x \text{ is a prime factor of } 30\}$ $[A = B]$

(iii) $A = \{A, S, M\}, \ \ B = \{x: x \text{ is a letter of the word "ASSAM"}\}$ $[A = B]$

(iv) $A = \{a, i, u, o, e\}, \ \ B = \{o, e. i, v, u\}$ $[A \neq B]$

iv) $A = \{2, 3\}, \ \ B = \{x: x \text{ is a solution of the equation } x^2 - 5x + 6 = 0\}$ $[A = B]$

5. EQUIVALENT SETS

Two finite sets A and B are said to be equivalent if they have the same number of elements.

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

Examples:

(i) $A = \{a, b, c, d\} \text{ and } B = \{2, 3, 5, 7\}$ *are equivalent sets.*

(ii) $P = \{Mango, Apple, Banana\}, \ Q = \{Pen, Pencil, Book\}$ *are equivalent sets.*

SUBSETS

1. SUBSETS

If A and B are two sets such that every element of set A is also an element of B, we say that A is a subset of B and we write $A \subset B$.

i.e. $\boxed{A \subset B \; if \; a \in A \Rightarrow a \in B}$

Remarks:

1. *If* $A \subset B$ *and* $A \neq B$ *, then A is called a proper subset of B and B is called superset of A.*
2. *If* $A \subset B$ *and* $= B$ *, then A is called an improper subset of B.*
3. *If* $A \subset B$ *and* $B \subset A$, *then* $A = B$.
4. *If A is not a subset of B, then we write,* $A \not\subset B$.
5. *Every set A is a subset of itself i.e.* $A \subset A$
6. *The empty set is* $\emptyset$ *a subset of every set.*

Examples:

(i) $A = \{1, 2, 3\}$, $B = \{1, 2, 3, 4, 5\}$

Here, A is a proper subset of B as $A \subset B$ *and* $A \neq B$. *Also B is the super set of A.*

(ii) $A = \{1, 2, 3\}$, $B = \{2, 3, 1\}$

Here, A is an improper subset of B as $A \subset B$ *and* $A = B$

(iii) $A = \{1, 2, 3\}$, $B = \{1, 2, 4, 5\}$

Here, A is not a subset of B i.e. $A \not\subset B$ *as* $3 \in A$ *but* $3 \notin A$.

NUMBER OF SUBSETS

Set	No. of Elements	Subsets	No. of subsets	
$\emptyset$	0	$\emptyset$	1	$1 = 2^0$
$\{a\}$	1	$\emptyset, \{a\}$	2	$2 = 2^1$
$\{a, b\}$	2	$\emptyset, \{a\}, \{b\}, \{a, b\}$	4	$4 = 2^2$
$\{a, b, c\}$	3	$\emptyset, \{a\}, \{b\}, \{c\}, \{a, b\}, \{b, c\}, \{c, a\}, \{a, b, c\}$	8	$8 = 2^3$
$\{a, b, c, d\}$	4	$\emptyset, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}$ $\{a, b, c, d\}$	16	$16 = 2^4$

Conclusion: *The number of subsets of the set containing* n *elements is* 2^n

The number of subsets of the set containing n elements is 2^n

Example-1

Write all possible subsets of the set $\{1, 2, 3\}$. *How many of these are proper sub sets ?*

Solution:

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

The possible subsets of the given set A are

$\emptyset, \{1\}, \{2\}, \{3\}, \{1, 2\}, \{2, 3\}, \{3, 1\}, \{1, 2, 3\}$

Since, $\{1, 2, 3\}$ *is an improper set of A.*

$\therefore$ *The total number of proper subsets of A is 7.*