1 SETS

1 OMQ + 1 VSAQ + 1 SAQ [1 M + 2M +4M = 7 M]

CONCEPTS & FORMULAS

1.1 **Set:** A set is a 'well defined collection' of **elements** / objects / ideas.

In a set, (i) **order** of elements (ii) **repetition** of elements are ignored.

Ex 1: A= {1,2,3}

Ex 2: The rivers of India

Non-Ex : The collection of ten most talented writers of India.

- If x is an element of a set A, then we write, $x \in A$; if x is not a member of A, then we write $x \notin A$.

1.2.0 Here we have a **Big list of few sets.** Using this we can understand the concepts of sets easily.

1.2.1 **Sets in Roster form:**

A = {1,2,3}, B = {2,3,5,7}, C = {4,6,8,9,10},

D = {Sun, Mon, Tue, Wed, Thu, Fri,Sat}, E ={ }, F = {1,5}, M = {5,10,15,....},

N = {1,2,3,4,5,.....∞}, W = {0,1,2,3,.....∞}, O = {0}, P = {3,2,1}, S = {1}, V = {a,e,i,o,u}.

Non-Ex: {a, 1, Friend}, {best cricket player, Jan 1, Top Hero, India}

1.2.2 **Sets in Set builder form:** The set builder forms of the sets given in (1.2.0) are as follows:

A = {x/ x is a natural number less than 4}, B = {x: x is a prime number below 8},

C = {x: x is a composite number less than 12}, D = {x/ x is a day of week}, E = {x/ x ≠ x},

F = {x/ x is a factor of 5}, M = {x/ x is a multiple of 5} **[Upto Exercise 1(a)]**

1.3 **Empty Set(∅):** A set which does not contain any element is called the empty set or null set.

Ex: A = {x : x is an even prime number greater than 2}

1.4.1 **Finite Sets:** Sets with **definite(countable)** number of elements are finite sets.

In (1.2.0), the finite sets are A, B, C, D, E, F, O, P, S, V;

- The empty set ∅ is finite.
- **Singleton set:** It is a finite set with a single element.

Ex: In (1.2.0), the singleton sets are O, S.

1.4.2 **Infinite Sets:** Sets with **infinite (uncountable)** number of elements are infinte sets.

In (1.2.0), the infinite sets are M, N, W.

1.5 **Equal Sets:** Sets with **exactly the same elements** are equal sets.

In (1.2.0), A = P; A ≠ B ≠ C [☞Order of elements may differ in equal sets.]

☞ **Cardinality of a set n(A):** The **number of elements** in a set is called its cardinality.

In (1.2.0) we have, n(A) = 3, n(B) = 4, n(C) = 5, n(D) = 7, n(∅) = 0, n(F) = 2, n(O)= 1, n(S) = 1

[Upto Exercise 1(b)]

1.6. Subset($A \subset B$): If all the elements of a set A are also present in set B, then A is a subset of B.

In (1.2.0), $A \subset N, N \subset W, S \subset A, A \subset P;$; $A \not\subset B, B \not\subset C$

- $\varnothing$ is subset to every set. • Every set is subset to itself.

Power set P(A): The set of **all subsets of A** is called the power set of A .

- If n(A) = m then the number of elements in its power sets is $n(P(A)) = 2^m$.
- In (1.2.0), $F = \{1, 5\} \Rightarrow P(F) = \{\{1\},\{5\}, \{1,5\},\varnothing\}$. Here, n(F) = 2 $\therefore n(P(F)) = 2^2 = 4$

1.6.1 Subsets of real numbers: $N \subset W \subset Z \subset Q \subset R$; $Q' \subset R$

1.6.2 Intervals as subsets of R:

i)Closed interval $[a, b] = \{x : a \le x \le b\}$. Here, both the end numbers a,b are included.

ii) Open interval $(a, b) = \{x : a < x < b\}$. Here, both the end numbers a,b are not included.

iii) Left- closed, right-open interval $[a, b) = \{x : a \le x < b\}$. Here, a is included and b is excluded.

iv) Left- open, right- closed interval $(a, b] = \{x : a < x \le b\}$. Here, a is excluded and b is included.

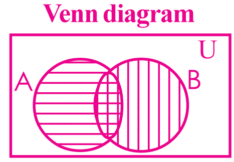
1.7 Universal set (U): It is the **super set** containing all the related sets.

Ex : Set of reals R is a universal set to N, W, Z, Q, Q'. **[Upto Exercise 1(c)]**

1.8 Venn Diagrams depict various relationships between sets diagrammatically.
Here the Universal set is denoted by a rectangle and sets are denoted by circles.

1.9 Operations on Sets:

Venn diagram

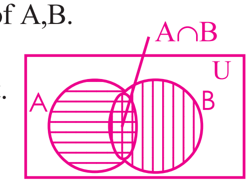


1.9.1 Union of Sets($A \cup B$): It is a set with **all the elements** from A,B.

In (1.2.0), $A \cup B = \{1, 2, 3, 5, 7\}$; $A \cup B \cup C = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

- Repetition of elements should be dropped in $A \cup B$
- $A \cup B = \{x / x \in A \text{ or } x \in B\}$

1.9.2 Intersection of Sets($A \cap B$): It is a set with the **common elements** of A,B.

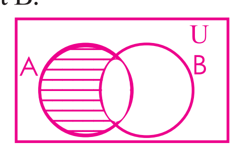


In (1.2.0), $A \cap B = \{2, 3\}$, $B \cap M = \{5\}$, $B \cap C = \varnothing$

- $A \cap B = \{x / x \in A \text{ and } x \in B\}$ • If $A \cap B = \varnothing$ then A, B are disjoint.

Disjoint Sets: Sets with **no common elements** are disjoint sets.
In (1.2.0), the disjoint sets: A&D; A&E; A&M; D&N; C&F.....

1.9.3 Difference of Sets(A–B): Elements in the first set A but not in the second set B.



In (1.2.0), $A - B = \{1\}$; $B - A = \{5, 7\}$; $N - W = \varnothing$; $W - N = \{0\}$

- $A - B = \{x / x \in A \text{ and } x \notin B\}$; • $A - B = A - (A \cap B)$ (**only A** but not B)

Laws on Sets:

i) Idempotent Laws: $A \cup A = A$, $A \cap A = A$

ii)Associative Laws: $(A \cup B) \cup C = A \cup (B \cup C)$; $(A \cap B) \cap C = A \cap (B \cap C)$

iii)Commutative Laws: $A \cup B = B \cup A$; $A \cap B = B \cap A$

iv)Distributive Laws: $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$; $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

v) Identity laws: $A \cup \varnothing = A$, $A \cup U = U$; $A \cap U = A$, $A \cap \varnothing = \varnothing$

vi)Laws of absorption: $A \cup (A \cap B) = A$; $A \cap (A \cup B) = A$ **[Upto Exercise 1(d)]**

1.9 Complement of a set (A') : It is the set with all elements in the universal set but **not A**.

Ex: In Real numbers (R), the complementary set of all rationals (Q) is the set of all Irrationals (Q')

i)Complement Laws: $A \cup A' = U$, $A \cap A' = \varnothing$; $(A')' = A$, $U' = \varnothing$, $\varnothing' = U$

ii)De-Morgan's Laws: $(A \cup B)' = A' \cap B'$; $(A \cap B)' = A' \cup B'$ **[Upto Exercise 1(e&f)]**