1. Details of Module and its structure

Module Detail	
Subject Name	Mathematics
Course Name	Mathematics 01 (Class XI, Semester - 1)
Module Name/Title	Set Notations - Part 3
Module Id	kemh_10103
Pre-requisites	Concept of a set, Diagrammatic representation of relationship between two groups
Objectives	After going through this lesson, the learners will be able to understand the following: • Represent a Set(s) diagrammatically using a Venn Diagram • Perform the following operation on Sets and represent each relationship using a Venn Diagram: • Union • Intersection • Complement • Difference • Represent Operations on Sets using appropriate symbols
Keywords	Venn Diagram, Union of Sets, Intersection of Sets Complement of a Set, Difference of Sets

2. Development Team

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1. Venn diagrams

Diagrams make mathematics easier because they help us to see the whole situation at a glance. The English mathematician John Venn (1834–1923) began using diagrams called Venn diagrams to represent sets.

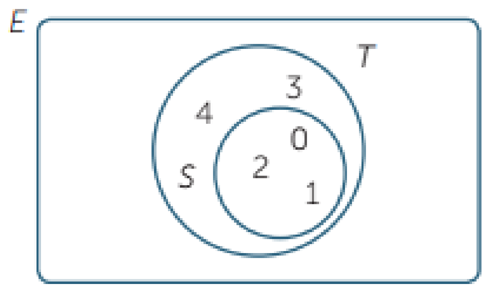
In most problems involving sets, it is convenient to choose a larger set that contains all of the elements in all of the sets being considered. This larger set is called the **universal set**, and is usually given the symbol E. In a Venn diagram, the universal set is generally drawn as a large rectangle, and then other sets are represented by circles within this rectangle.

For example, if V = { vowels }, we could choose the universal set as E = { letters of the alphabet } and all the letters of the alphabet would then need to be placed somewhere within the rectangle, as shown below.

Representing subsets on a Venn diagram

When we know that S is a subset of T, we place the circle representing S inside the circle representing T.

For example, let S = { 0, 1, 2 }, and T = { 0, 1, 2, 3, 4 }. Then S is a subset of T, as illustrated in the Venn diagram below.



2. Union of Sets

Union of two given sets is the smallest set which contains all the elements of both the sets.

The union of two given sets A and B is a set which consists of all the elements of A and all the elements of B such that no element is repeated.

The symbol for denoting union of sets is '∪'.

This new set contains all the elements of set A and all the elements of set B with no repetition of elements and is named as **union of set A and B**.

For example

Let set A = {2, 4, 5, 6}, set B = {4, 6, 7, 8}

Taking every element of both the sets A and B, without repeating any element,

we get a new set = {2, 4, 5, 6, 7, 8} where is **A ∪ B**

For example

Let **X** = {a, e, i, o, u} **and Y** = Ø.

X ∪ Y = {a, e, i, o, u}

Therefore, **union of any set with an empty set is the set itself**.

Union and the word 'or'

The word 'or' tells us that there is a union of two sets. For example:

{ singers } ∪ { instrumentalists } = { people who sing or play an instrument }

{ vowels } ∪ { letters in 'dingo' } = { letters that are vowels or are in 'dingo' }

Therefore, A ∪ B = {x : x ∈ A or x ∈ B}

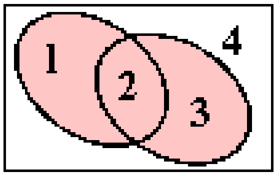
Representation of Union of sets using a Venn diagram

For A = {1, 2}; B = {2, 3}; U = {1, 2, 3, 4}

A ∪ B = { 1, 2 } ∪ { 2, 3 }

A ∪ B = { 1, 2, 3 }

Venn diagram:



3. The intersection of two sets

The intersection of two sets A and B consists of all elements belonging to A as well as to B also. This is written as **A ∩B**.

For example, some musicians are singers and some play an instrument.

If A = { singers } and B = { instrumentalists }, then

A ∩ B = { singers who play an instrument }.

Intersection and the word 'and'

The word 'and' tells us that there is an intersection of two sets.

For example:{ singers } ∩ { instrumentalists } = { people who sing and play an instrument }

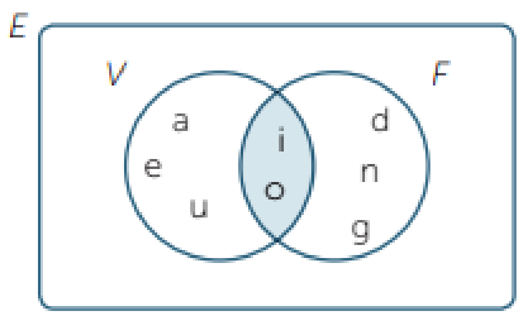
{ vowels } ∩ { letters of 'dingo' } = { letters that are vowels and are in 'dingo' }

Representation of Intersection of sets using a Venn diagram

If V = { vowels } and F = { letters in 'dingo' }, then

V ∩ F = { i, o }

This last example can be represented on a Venn diagram as follows:



4. The complement of a set

Suppose that a suitable universal set E has been chosen. The complement of a set S is the set of all elements of E that are not in S. The complement of S is written as S^c or **S'**.

For example, E = { whole numbers } and O = { odd whole numbers }, then

O' = {even whole numbers}.

Complement and the word 'not'

The word 'not' corresponds to the complement of a set.

For example, in the two examples above,

V' = { letters that are not vowels } = { consonants }

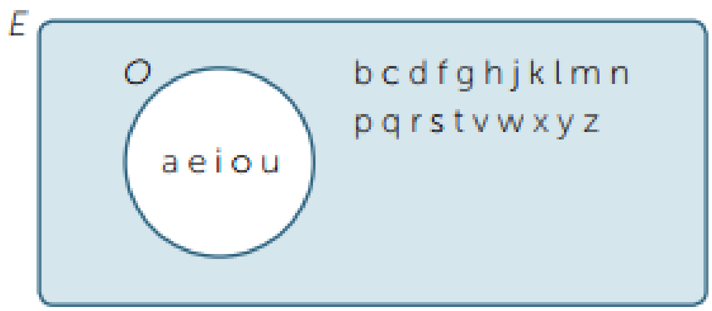
O' = { whole numbers that are not odd } = { even whole numbers }

Representation of Complement of a set using a Venn diagram

For example, E = { letters } and V = { vowels }, then

V ' = { consonants }

The set V' in the above example can be represented on a Venn diagram as follows:



Note:

(1) The complement of a universal set is an empty set.

(2) The complement of an empty set is a universal set.

5. Difference of two sets

If A and B are two sets, then their difference is written as **A - B** or **A / B**.

(A - B) means elements of A which are not the elements of B.

(B - A) means elements of B which are not the elements of A.

In general, A - B = {x : x ∈ A, and x ∉ B}

B - A = {x : x ∈ B, and x ∉ A}

For example, If A = {2, 3, 4} and B = {4, 5, 6}

A - B = {2, 3}

B - A = {5, 6}

Note: If A and B are disjoint sets, then A – B = A and B – A = B

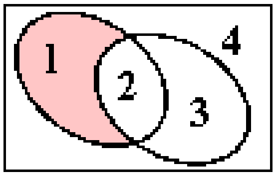
Representation of Difference of Sets using a Venn Diagram

Let A = { 1, 2 } ; B = { 2, 3 }

A – B = { 1, 2 } – { 2, 3 }

A – B = { 1 }

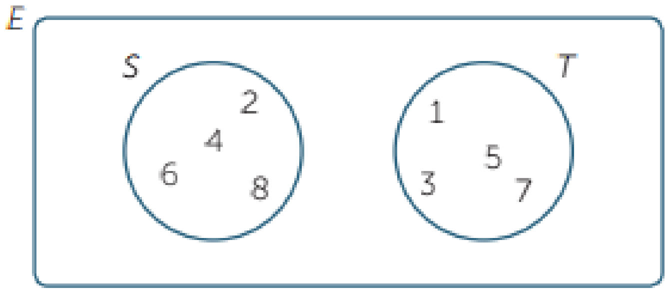
Venn diagram:



6. Representation of Disjoint sets using a Venn Diagram

Two sets are called disjoint if they have no elements in common.

For example: The sets S = { 2, 4, 6, 8 } and T = { 1, 3, 5, 7 } are disjoint.



Example1: If X and Y are subsets of the universal set U, the show that

(i) $Y \subset (X \cup Y)$ (ii) $(X \cap Y) \subset X$ (iii) $X \subset Y \Rightarrow (X \cap Y) = X$

Solution: (i) $X \cup Y = \{x : x \in X \ or \ x \in Y\}$

Thus, $x \in Y \Rightarrow x \in X \cup Y$,

Hence, $Y \subset X \cup Y$.

(ii) $X \cap Y = \{x : x \in X \ and \ x \in Y\}$

Thus, $x \in X \cap Y \Rightarrow x \in X$,

Hence, $X \cap Y \subset X$.

(iii) $x \in X \cap Y \Rightarrow x \in X$

Thus, $X \cap Y \subset X$

Also, since

$$X \subset Y,$$
$$x \in X \Rightarrow x \in Y \Rightarrow x \in X \cap Y$$

so that $X \subset X \cap Y$.

Hence the result $X = X \cap Y$ follows.

7. Summary

Let A and B be subsets of a suitable universal set E.

i. The union A ∪ B is the set of all elements belonging to A or to B.
ii. The intersection A ∩ B is the set of all elements belonging to A and to B.

The complement A^c is the set of all elements of E that are not in A.

Difference of Sets A - B is the set of elements of A which are not the elements of B.

Most of the relationships between sets can be represented by means of diagrams which are known as Venn diagrams.