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Module - 3

Sets

#

$A = \{2, 4, 6, 8, 10, 12 \ldots\}$

$B = \{1, 3, 5, 7, 9, 11 \ldots\}$

1. Union Set

$A = \{1, 2, 3\}$
$B = \{4, 5, 6\}$
$A \cup B = \{1, 2, 3, 4, 5, 6\}$

The union of two sets A B is the set of all those element x such that x belongs to atleast one of the two sets A & B. Denoted $A \cup B$

2. Intersection

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

The interaction of two sets A & B is the set of all those elements x such that x belongs to both A & B. Denoted by $A \cap B$

Q. Prove $A \cup B = B \cup A$

$A \cup B$

x be an any element of $A \cup B$.

$x \in A \cup B$

$\Rightarrow x \in A$ or $x \in B$

$\Rightarrow x \in B$ and $x \in A$

$\Rightarrow x \in B \cup A$.

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Finite and Infinite Set:-

A Set with finite number of elements in it, is called a finite Set.
ex - (a) The Set vowels in english alphabets.
(b) The Set of students in a class.

An infinite Set is a Set which contain's infinite number of elements is called infinite Set
ex - (a) A = a set of Integers
= [0, 1, 2 ....}

Null Set

A Set who is contains no elements at all is called Null Set. [also known as empty Set or Void Set]. It is denoted by the Symbol ϕ.

Singleton Set

A Set which has only one element is called Singleton Set.
ex = $S = \{a\}$ is a Singleton Set.

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ex # operations of sets

1. $A \cup B = B \cup A$
2. $A \cap B = B \cap A$ } $\Longrightarrow$ commutative law

exam

1. Prove $A \cup B = B \cup A$

$= x \in A \cup B$ $\Rightarrow x \in B \cup A \Rightarrow x \in B$ or $x \in A$
$= x \in A$ or $x \in B$ $\Rightarrow x \in A$ or $x \in B$
$= x \in B \cup A$ $\Rightarrow x \in A \cup B$
$\therefore B \cup A \subseteq A \cup B$ — (2)
$A \cup B \subseteq B \cup A$ — (1) $\therefore A \cup B = B \cup A$

Hence proved

2. Prove $A \cap B = B \cap A$

$\in$

$\in$

$= x \in A \cap B$
$= x \in A$ and $x \in B$
$= x \in B \cap A$

$= A \cap B \subseteq B \cap A$ —— (1)

Again $x \in B \cap A \Rightarrow x \in B$ and $x \in A$
$\Rightarrow x \in A$ and $x \in B$
$\Rightarrow x \in A \cap B$
$\therefore B \cap A \subseteq A \cap B$ —— (2)

from (1) and (2), we get,
$A \cap B = B \cap A$

Hence
Proved

ex
2) $A \cup (B \cup C) = (A \cup B) \cup (A \cup C)$ } → Distributive law
3) $A \cap (B \cap C) = (A \cap B) \cap (A \cap C)$

1) $A \cup (B \cup C) = (A \cup B) \cup (A \cup C)$

$= x \in A \cup (B \cup C)$
$= x \in A \cup B$ or $x \in A \cup C$
$= x x A$ or $(B \cup C)$
$= x \in A$ or $(x \in B$ or $x \in C)$
$= (x \in A$ or $B)$ or $(x \in A$ or $C)$

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Subset:-

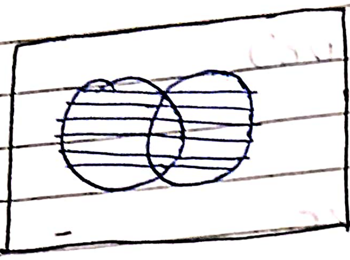
If A and B are sets such that such that every element of A is also an element of B, the A is said to be subset of B [or A is contained in B) and is denoted by $A \subseteq B$

ex :- The set $A = \{1, 2, 3, 4\}$
$B = \{1, 2, 3, 4, 5\}$

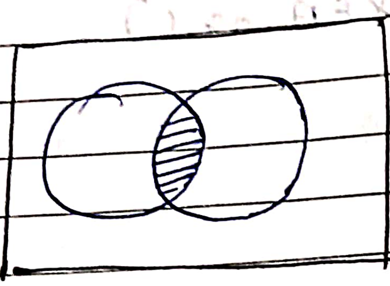
- Every set A is a subset itself.

Venn Diagram

1. $A \cup B$



2. $A \cap B$

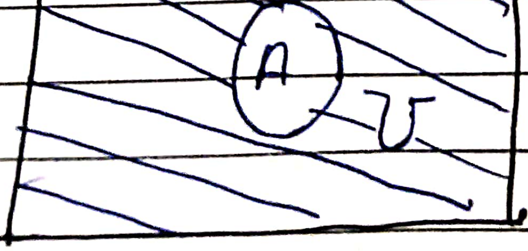


Complements:

Let U be the universal set and A be any subset of U. The absolute complement of A or simply, complement of A, denoted by A^c or A' is the set of elements which belong to U but which do no belong to A.

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

$A' =$



Cartesian Product:-

Let A and B be sets. Cartesian Product of A and B, denoted by $A \times B$ is defined as

$$A \times B = \{(a,b) : a \in A \text{ and } b \in B\}$$

If $A = (a,b)$ and $B = \{1\}$, Then

$A \times B = \{(a,1),(b,1)\}$

$B = 1$

$A = \{a, b\}$

$B \times A = \{(1,a),(1,b)\}$

exam

Q1. Prove that $A \times (B \cap C) = (A \times B) \cap (A \times C)$

Sol^n Let (x,y) be any element of $A \times (B \cap C)$.

Then $(x,y) \in A \times (B \cap C)$ $\Rightarrow x \in A$ and $y \in (B \cap C)$

$\Rightarrow x \in A$ and $y \in (B \cap C)$ $\Rightarrow x \in A$ and $(y \in B$ and $y \in C)$

$\Rightarrow x \in A$ and $(y \in B$ and $y \in C)$ $\Rightarrow x$

$\Rightarrow (x \in A$ and $y \in B)$ and $(x \in A$ and $y \in C)$

$\Rightarrow (x,y) \in A \times B$ and $(x,y) \in A \times C$

$\Rightarrow (x,y) \in (A \times B) \cap (A \times C)$

$A \times (B \cap C) \subseteq (A \times B) \cap (A \times C)$ —— (1)

again. $(x,y) \in (A \times B) \cap (A \times C)$

$\Rightarrow (x,y) \in A \times B$ and $(x,y) \in A \times C$

$\Rightarrow (x \in A, y \in B)$ and $(x \in A, y \in C)$

$\Rightarrow x \in A$ and $(y \in B$ and $y \in C)$

$\Rightarrow x \in A$ and $y \in B \cap C$

$\Rightarrow (x,y) \in A \times (B \cap C)$

$\therefore (A \times B) \cap (A \times C) \subseteq A \times (B \cap C)$ — ②

from ① & ②, we get that

$A \times (B \cap C) = (A \times B) \cap (A \times C)$

Hence proved

Q^ques. $A \cup B$

$A = \{1, 2, 3, 4, 5, 6\}$

$B = \{3, 6, 8, 12, 17, 18\}$

$\Rightarrow A \cup B =$

$\Rightarrow \{1, 2, 3, 4, 5, 6, 8, 12, 17, 18\}$

$\Rightarrow A \cap B = \{3, 6\}$