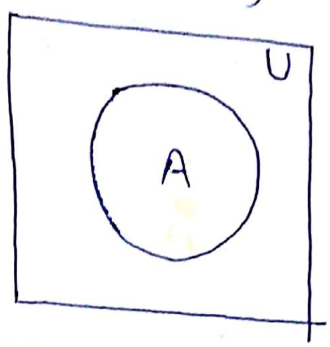
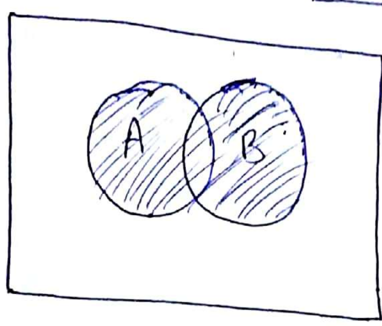
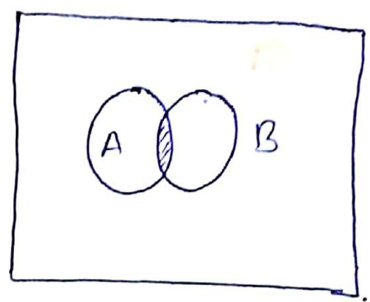
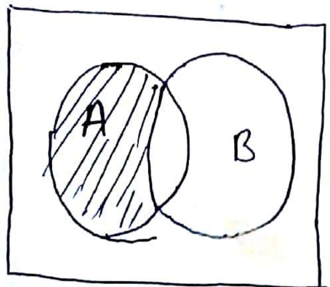
Vann diagrams:- A Venn diagram is a schematic representation of a set by set of points. Universal set containing all objects for which the discussion is meaningful. In the Venn diagram the Universal set U will be denoted by rectangle while the sets within the U is denoted by circle.



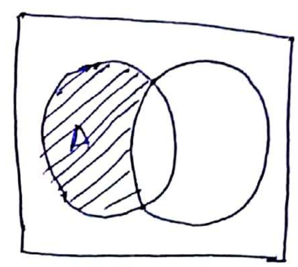

① 

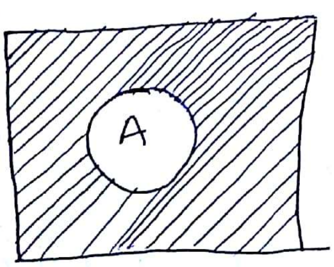

$A \cup B = \{x : x \in A \text{ or } x \in B\}$, $A \cap B = \{x : x \in A \text{ and } x \in B\}$

② 


A − B

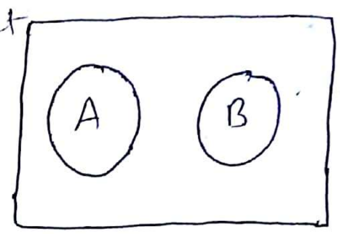
③ 


A − B

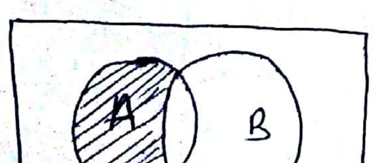
③ 


$A' \rightarrow \{x \mid x \notin A\}$

disjoint set

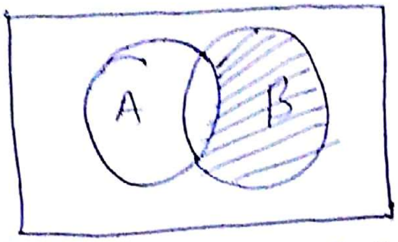



$A \cap B = \emptyset$

④ 

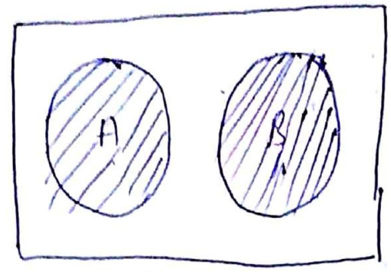

if A and B are two sets we define the complement of ~~[illegible]~~

$A - B = A \cap B'$

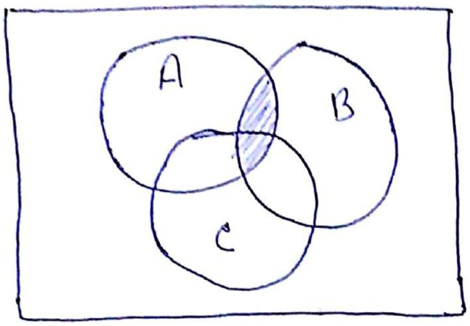



$B - A = B \cap A'$

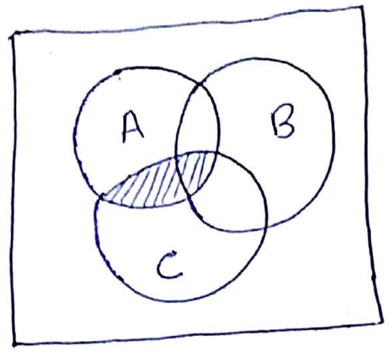
Compliment of A with respect to B



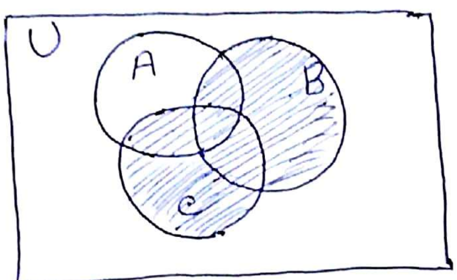

$A \cup B = \phi$
(disjoint set)



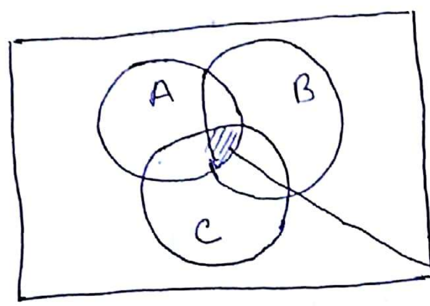

$A \cap B$




~~$A \cup B \cup C$~~ $A \cap C$




$B \cup C$

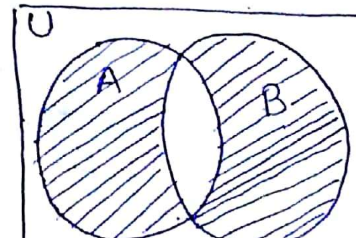



$A \cap B \cap C$

If A and B are two sets, we define their symmetric difference as the set of all elements that belong A or to B but not to both A and B. We denote it by $A \oplus B$. Thus

$$A \oplus B = \{ x \mid (x \in A \text{ and } x \notin B) \text{ or } (x \in B \text{ and } x \notin A) \}$$

$$A \oplus B = (A - B) \cup (B - A)$$



(7)

Power Set $P(S) = \{\{\phi\}, \{a\}, \{b\}, \{c\}, \{d\}, \{a,b\}, \{a,c\}, \{a,d\},$
$\{b,c\}, \{b,d\}, \{c,d\}, \{a,b,c\}, \{a,b,d\},$
$\{a,c,d\}, \{b,c,d\}, \{a,b,c,d\}\}$

Q)1 If $A = \{x : x \in N, x \text{ is a factor of } 6\}$.
$B = \{x : x \in N, x \text{ is a factor of } 8\}$.
Then find: ① $A \cup B$ ② $A \cap B$ ③ $A - B$ ④ $B - A$

Sol$^n$:- $A = \{1,2,3,6\}$ & $B = \{1,2,4,8\}$
$A \cup B = \{1,2,3,4,6,8\}$
$A \cap B = \{1,2\}$
$A - B = \{3,6\}$
$B - A = \{4,8\}$

Q)2 Find the power set of $\{4,6\}$ and $\{1,2,3\}$

Sol$^n$:- 1) Subset with zero element $= \{\phi\}$
Subset with one element $= \{4\}, \{6\}$
Subset with two element $= \{4,6\}$
Power set $P(S) = \{\{\phi\}, \{4\}, \{6\}, \{4,6\}\}$

2) Subset with zero element $= \{\phi\}$
Subset with one element $= \{1\}, \{2\}, \{3\}$
Subset with two element $= \{1,2\}, \{1,3\}, \{2,3\}$,
Subset with three element $= \{1,2,3\}$.
Power Set $P(S) = \{\{\phi\}, \{1\}, \{2\}, \{3\}, \{1,2\}, \{1,3\}, \{2,3\},$
$\{1,2,3\}\}$.

## ⊛ Commutative law

1) Prove that: $A \cup B = B \cup A$

Proof: LHS $\Rightarrow x \in A \cup B$

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

$= x \in B$ or $x \in A$

$= x \in B \cup A$

$A \cup B \subseteq B \cup A$ — ①

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

$= x \in B$ or $x \in A$

$= x \in A$ or $x \in B$

$= x \in A \cup B$

$B \cup A \subseteq A \cup B$ — ②

From eqn ① & ② $\boxed{A \cup B = B \cup A}$

2) Prove that: $A \cap B = B \cap A$

Proof: LHS $\Rightarrow x \in A \cap B$

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

or, $= x \in B$ and $x \in A$

$= x \in B \cap A$

$A \cap B \subseteq B \cap A$ — ①

RHS $\Rightarrow x \in B \cap A$

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

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

$= x \in A \cap B$

$B \cap A \subseteq A \cap B$ — ②

From eqn ① & ② $\boxed{A \cap B = B \cap A}$

## ⊛ Associative law

1) Prove that: $A \cup (B \cup C) = (A \cup B) \cup C$

Proof: LHS $= x \in A \cup (B \cup C)$

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

$= x \in A$ or $x \in B$ or $x \in C$

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

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

$\Rightarrow A \cup (B \cup C) \subseteq (A \cup B) \cup C$ — ①

RHS $\Rightarrow x \in (A \cup B) \cup C$

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

$x \in A$ or $x \in B$ or $x \in C$

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

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

$\Rightarrow (A \cup B) \cup C \subseteq A \cup (B \cup C)$ — ②

From ① & ②, $\boxed{A \cup (B \cup C) = (A \cup B) \cup C}$

7) Prove that: $A \cap (B \cap C) = (A \cap B) \cap C$

Proof: LHS ⇒ $x \in A \cap (B \cap C)$

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

$x \in A$ and $x \in B$ and $x \in C$

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

$x \in (A \cap B) \cap C$

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

RHS ⇒ $x \in (A \cap B) \cap C$

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

$x \in A$ and $x \in B$ and $x \in C$

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

$x \in A \cap (B \cap C)$

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

From ① & ②, $\boxed{A \cap (B \cap C) = (A \cap B) \cap C}$

## ⊛ Idempotent law

$$A \cup A = A$$
$$A \cap A = A$$

1) Prove that: $A \cup A = A$

Proof: LHS ⇒ $x \in A \cup A$

$x \in A$ or $x \in A$

$x \in A$

⇒ $A \cup A \subseteq A$ — ①

RHS ⇒ $x \in A$

$x \in A$ or $x \in A$

$x \in A \cup A$

$A \subseteq A \cup A$ — ②

From ① & ② $\boxed{A \cup A = A}$

2) Prove that: $A \cap A = A$

**Proof:** LHS $\Rightarrow$ $x \in A \cap A$

$x \in A$ and $x \in A$

$x \in A$

$A \cap A \subseteq A$ — (1)

RHS $\Rightarrow$ $x \in A$

$x \in A$ and $x \in A$

$x \in A \cap A$

$A \subseteq A \cap A$ — (2)

From (1) & (2), $\boxed{A \cap A = A}$

## ⊛ Identity law

$A \cup \phi = A$

$A \cap U = A$

1) Prove that: $A \cup \phi = A$

**Proof:** LHS $\Rightarrow$ $x \in A \cup \phi$

$x \in A$ or $x \in \phi$

$x \in A$

$A \cup \phi \subseteq A$ — (1)

RHS $\Rightarrow$ $x \in A$

$x \in A$ or $x \in \phi$

$x \in A \cup \phi$

$A \subseteq A \cup \phi$ — (2)

From (1) & (2), $\boxed{A \cup \phi = A}$

2) Prove that: $A \cap U = A$

**Proof:** LHS $\Rightarrow$ $x \in A \cap U$

$x \in A$ and $x \in U$

$x \in A$

$A \cap U \subseteq A$ — (1)

RHS $\Rightarrow$ $x \in A$

$x \in A$ and $x \in U$

$x \in A \cap U$

$A \subseteq A \cap U$ — (2)

From (1), & (2), $\boxed{A \cap U = A}$