EXERCISE 5.2

Q.1 If $X = \{1, 3, 5, 7, ..., 19\}$
$Y = \{0, 2, 4, 6, 8, ..., 20\}$
$Z = \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$, then find the following:

(i) $X\cup(Y\cup Z)$ (ii) $(X\cup Y)\cup Z$
(iii) $X\cap(Y\cap Z)$ (iv) $(X\cap Y)\cap Z$
(v) $X\cup\cap Y\cap Z)$ (vi) $(X\cup Y)\cap(X\cup Z)$
(vii) $X\cap(Y\cup Z)$ (viii) $(X\cap Y)\cup(X\cap Z)$

Solution:

(i) $X\cup(Y\cup Z)$

$= X \cup (\{0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20\} \cup \{2, 3, 5, 7, 11, 13, 17, 19, 23\})$

$= \{1, 3, 5, 7, 9, 11, 13, 15, 17, 19\} \cup \{0,2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 23\}$

$= \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,13, 14,15,16,17,18,19,20,23\}$

(ii) $(X\cup Y)\cup Z$

$= (\{1,3,5,7,...,19\}\cup\{0,2,4,6,8,....,20\})\cup Z$

$= \{0, 1, 2, 3, 4, 5, 6, 7, ..., 20\} \cup \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$

$= \{0, 1, 2, 3, 4, 5, 6, 7, ..., 20, 23\}$

(iii) $X\cap (Y\cap Z)$

$= X \cap (\{0,2,4,6, 8, ..., 20\} \cap \{2, 3, 5, 7, 11, 13, 17, 19, 23\})$

$= \{1, 3, 5, 7, ..., 19\} \cap \{2\}$

$= \phi$

(iv) $(X\cap Y)\cap Z$

$= (\{1,3,5,7, ..,19\}\cap\{0,2,4,6, 8,..,20\}) \cap Z$

$= \{\ \} \cap \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$

$= \phi$

(v) $X\cup(Y\cap Z)$

$= X \cup (\{0,2,4,6,8, ..., 20\} \cap \{2, 3, 5, 7, 11, 13, 17, 19, 23\})$

$= \{ 1, 3, 5, 7, ..., 19\} \cup \{2\}$

$= \{1, 2, 3 , 5, 7, ..., 19\}$

(vi) $(X\cup Y)\cap(X\cup Z)$

$X\cup Y =\{1,3,5, 7,..., 19\}\cup\{0,2,4,6,8, ..., 20\}$

$=\{ 0, 1, 2, 3, 4, 5, ..., 20\}$

$X\cup Z =\{1,3,5,7, ..., 19\}\cup\{2,3,5,7,11,13,17, 19, 23\}$

$= \{1, 2, 3, 5, 7, 9, 11, 13, 15, 17, 19, 23\}$

$(X\cup Y)\cap(X\cup Z)$

$= \{0,1,2,3,4, ..., 20\}\cap\{1,2,3,5,7,9,11,13,15,17,19,23\}$

$= \{1,2, 3, 5, 7, 9, 11, 13, 15, 17, 19\}$

(vii) $X\cap(Y\cup Z)$

$X\cap(Y\cup Z)$

$= X\cap(\{0,2,4,6,8, ...,20\}\cup\{2,3,5,7,11,13, 17,19,23\})$

$= \{1,3,5,7, ..., 19\}\cap\{0,2,3,4,5,6,7,8, 10,11, 12,13,14,16,17,18,19,20,23\}$

$= \{3, 5, 7, 11, 13, 17, 19\}$

(viii) $(X\cap Y)\cup(X\cap Z)$

$X\cap Y = \{1,3,5,7, ..., 19\}\cap\{0,2,4,6,8, ..., 20\}$

$= \{\ \}$

$X\cap Z=\{1,3,5,7, ..., 19\}\cap\{2,3,5,7,11,13,17, 19,23\}$

$= \{3, 5, 7, 11, 13, 17, 19\}$

$(X\cap Y) \cup(X\cap Z)=\{\ \ \}\cup \{3,5,7,11,13, 17,19\}$

$= \{3, 5, 7, 11, 13, 17, 19\}$

Q. 2. If $A = \{1, 2, 3, 4, 5, 6\}$
$B = \{2, 4, 6, 8\}$ $C = \{1, 4, 8\}$ Prove the following identities:

(i) $A\cap B = B\cap A$
(ii) $A\cup B = B\cup A$
(iii) $A\cap (B\cap C) = (A\cap B) \cup (A\cap C)$
(iv) $A\cup (B\cap C) = (A\cup B) \cap (A\cup C)$

Solution:

(i) $A\cap B = B\cap A$

L.H.S $= A\cap B$

$= \{1, 2, 3, 4, 5, 6\} \cap \{2, 4, 6, 8\}$

$= \{2, 4, 6\}$

R.H.S $= B\cap A$

$=\{2, 4, 6, 8\} \cap \{1, 2, 3, 4, 5, 6\}$

$= \{2, 4, 6\}$

L.H.S = R.H.S, so

$A\cap B = B\cap A$

(ii) $A\cup B = B\cup A$

L.H.S $= A\cup B$

$= \{1, 2, 3, 4, 5, 6\} \cup \{2, 4, 6, 8\}$

$= \{1, 2, 3, 4, 5, 6, 8\}$

R.H.S $= B\cup A$

$= \{2, 4, 6, 8\} \cup \{1, 2, 3, 4, 5, 6\}$

$= \{1, 2, 3, 4, 5, 6, 8\}$

L.H.S = R.H.S,

So, $A\cup B = B\cup A$

(iii) $A\cap (B\cup C) = (A\cap B) \cup (A\cap C)$

L.H.S $= A\cap (B\cup C)$

$= A \cap (\{2, 4, 6, 8\} \cup \{1, 4, 8\})$

$= \{1, 2, 3, 4, 5, 6\} \cap \{1, 2, 4, 6, 8\}$

$= \{1, 2, 4, 6\}$

R.H.S $= (A\cap B) \cup (A\cap C)$

$A\cap B = \{1,2,3,4,5,6\} \cap \{2,4,6,8\}$

$= \{2, 4, 6\}$

$A\cap C = \{1, 2, 3, 4, 5, 6\} \cap \{1, 4, 8\}$

$= \{1, 4\}$

$(A\cap B) \cup (A\cap C) = \{2, 4, 6\} \cup \{1, 4\}$

$= \{1, 2, 4, 6\}$

L.H.S = R.H.S

So, $A\cap (B\cup C) = (A\cap B) \cup (A\cap C)$

(iv) $A\cup (B\cap C) = (A\cup B) \cap (A\cup C)$

L.H.S $= A\cap (B\cap C)$

$= A \cup (\{2, 4, 6, 8\} \cap \{1, 4, 8\})$

$= \{1, 2, 3, 4, 5, 6\} \cup \{4, 8\}$

$= \{1, 2, 3, 4, 5, 6, 8\}$

R.H.S $= (A\cup B) \cap (A\cup C)$

$A\cup B =\{1, 2, 3, 4, 5, 6\}\cup\{2, 4, 6, 8\}$

$=\{1, 2, 3, 4, 5, 6, 8\}$

$A\cup C = \{1, 2, 3, 4, 5, 6\} \cup \{1, 4, 8\}$

$= \{1, 2, 3, 4, 5, 6, 8\}$

$(A\cup B) \cap (A\cup C)$

$= \{1,2,3,4,5,6,8\}\cap\{1,2,3,4,5,6,8\}$

$= \{1, 2, 3, 4, 5, 6, 8\}$

L.H.S = R.H.S,

So, $A\cup (B\cap C) = (A\cup B) \cap (A\cup C)$

Q.3 If $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ $A = \{1, 3, 5, 7, 9\}$, $B = \{2, 3, 5, 7\}$ then verify the De Morgan's laws i.e., $(A\cup B)'=A'\cap B'$ and $(A\cap B)' = A'\cup B'$

Solution:

(i) $(A\cup B)'=A'\cap B'$

L.H.S $= (A\cup B)'$

$A\cup B = \{1, 3, 5, 7, 9\} \cup \{2, 3, 5, 7\}$

$= \{1, 2, 3, 5, 7, 9\}$

$(A\cup B)'= U - (A\cup B)$

$=\{1,2,3,4, \ldots,10\} - \{1,2,3,5,7,9\}$

$= \{4, 6, 8, 10\}$............(i)

R.H.S $= A'\cap B'$

$A'= U - A$

$= \{1, 2, 3, 4, \ldots, 10\} - \{1,3, 5, 7, 9\}$

$= \{2, 4, 6, 8, 10\}$

$B'= U - B$

$= \{1, 2, 3, 4, 5, \ldots, 10\} - \{2, 3, 5, 7\}$

$= \{1, 4, 6, 8, 9, 10\}$

$A' \cap B' = \{2, 4, 6, 8, 10\} \cap \{1, 4, 6, 8, 9, 10\}$

$= \{4, 6, 8, 10\}$..........(ii)

From (i) and (ii)

L.H.S = R.H.S

$(A \cup B)' = A' \cap B'$

(ii) $(A \cap B)' = A' \cup B'$

L.H.S $= (A \cap B)'$

$A \cap B = \{1, 3, 5, 7, 9\} \cap \{2, 3, 5, 7\}$

$= \{3, 5, 7\}$

$(A \cap B)' = U - (A \cap B)$

$= \{1, 2, 3, 4, \ldots, 10\} - \{3, 5, 7\}$

$= \{1, 2, 4, 6, 8, 9, 10\}$.........(i)

R.H.S $= A' \cup B'$

$A' = U - A$

$= \{1,2,3,4,5,\ldots,10\} - \{1,3,5,7,9\}$

$= \{2, 4, 6, 8, 10\}$

$B' = U - B$

$= \{1, 2, 3, 4, 5, \ldots, 10\} - \{2, 3,5, 7\}$

$= \{1, 4, 6, 8, 9, 10\}$

$A' \cup B' = \{2, 4, 6, 8, 10\} \cup \{1, 4,6,8,9,10\}$

$= \{1, 2, 4, 6, 8, 9, 10\}$.........(ii)

From (i) and (ii)

L.H.S = R.H.S

So $(A \cap B)' = A' \cup B'$

Q.4 If $U = \{1, 2, 3, \ldots, 20\}$

$X = \{1, 3, 7, 9, 15, 18, 20\}$

$Y = \{1, 3, 5, \ldots, 17\}$ then show that,

(i) $X - Y = X \cap Y'$ (ii) $Y - X = Y \cap X'$

Solution:

(i) $X - Y = X \cap Y'$

L.H.S $= X - Y$

$= \{1, 3, 7, 9, 15, 18, 20\} -$
$\{1, 3, 5, 7, 9, 11, 13, 15, 17\}$

$= \{18, 20\}$..........(i)

R.H.S $= X \cap Y'$

$Y' = U - Y$

$= \{1,2,3,\ldots, 20\} - \{1,3,5,\ldots,17\}$

$= \{2,4,6,8,10,12,14,16,18,19,20\}$

$X \cap Y' = \{1, 3, 7, 9, 15, 18, 20\} \cap$
$\{2, 4, 6, 8, 10, 12, 14, 16, 18, 19, 20\}$

$= \{18, 20\}$..........(ii)

From (i) and (ii)

L.H.S = R.H.S,

So, $X - Y = X \cap Y'$

(ii) $Y - X = Y \cap X'$

L.H.S $= Y - X$

$= \{1,3,5,\ldots,17\} - \{1,3,7,9,15,18,20\}$

$= \{5, 11, 13, 17\}$..........(i)

R.H.S $= Y \cap X'$

$X' = U - X$

$= \{1,2,3, \ldots,20\} - \{1,3,7,9,15,18,20\}$

$= \{2, 4, 5, 6, 8, 10, 11, 12, 13, 14, 16, 17, 19\}$

$Y \cap X' = \{1, 3, 5, 7, 9, 11, 13, 15, 17\} \cap$
$\{2, 4, 5, 6, 8, 10, 11, 12, 13, 14, 16, 17, 19\}$

$= \{5, 11, 13, 17\}$..........(ii)

From (i) and (ii)

L.H.S = R.H.S

So, $Y - X = Y \cap X'$

Verification of Fundamental Properties of Sets

(a) Commutative Property of Union i.e., $A \cup B = B \cup A$

For example $A = \{1, 3, 5, 7\}$ and

$B = \{2, 3, 5, 7\}$

Then $A \cup B = \{1, 3, 5, 7\} \cup \{2, 3, 5, 7\}$

$= \{1, 2, 3, 5, 7\}$

and $B \cup A = \{2, 3, 5, 7\} \cup \{1, 3, 5, 7\}$

$= \{1, 2, 3, 5, 7\}$

Hence, verified that $A \cup B = B \cup B$

(b) Commutative property of intersection i.e., $A \cap B = B \cap A$

For example $A = \{1, 3, 5, 7\}$ and

$B = \{2, 3, 5, 7\}$

Then $A \cap B = \{1, 3, 5, 7\} \cap \{2, 3, 5, 7\}$

$= \{3, 5, 7\}$

and $B \cap A = \{2, 3, 5, 7\} \cap \{1, 3, 5, 7\}$

$= \{3, 5, 7)$

Hence, verified that $A \cap B = B \cap A$

(c) Associative Property of Union i.e., $(A \cup B) \cup C = A \cup (B \cup C)$.

Suppose $A = \{1, 2, 4, 8\}$, $B = \{2, 4, 6\}$

and $C = \{3, 4, 5, 6\}$ then

L.H.S $= (A \cup B) \cup C$

$= (\{1, 2, 4, 8\} \cup \{2, 4, 6\}) \cup \{3, 4, 5, 6\}$

$= \{1, 2, 4, 6, 8\} \cup \{3, 4, 5, 6\}$

$= \{1, 2, 3, 4, 5, 6, 8\}$

and R.H.S $= A \cup (B \cup C)$

$= \{1, 2, 4, 8\} \cup (\{2, 4, 6\} \cup \{3, 4, 5, 6\})$

$= \{1, 2, 4, 8\} \cup \{2, 3, 4, 5, 6\}$

$= \{1, 2, 3, 4, 5, 6, 8\}$

L.H.S = R.H.S

Hence, union of sets is associative

(d) Associative Property of intersection i.e., $(A \cap B) \cap C = A \cap (B \cap C)$

Suppose $A = \{1, 2, 4, 8\}$

$B = \{2, 4, 6\}$

and $C = \{3, 4, 5, 6\}$

Then L.H.S $= (A \cap B) \cap C$

$= (\{1, 2, 4, 8\} \cap \{2, 4, 6\}) \cap \{3, 4, 5, 6\}$

$= \{2, 4\} \cap \{3, 4, 5, 6\}$

$= \{4\}$

and R.H.S $= A \cap (B \cap C)$

$= \{1, 2, 4, 8\} \cap (\{2, 4, 6\} \cap \{3, 4, 5, 6\})$

$= \{1, 2, 4, 8\} \cap \{4, 6\}$

$= \{4\}$

L.H.S = R.H.S

Hence, intersection of sets is associative law.

(e) Distributive Property of Union over Intersection i.e., $A \cup (B \cap C) = (A \cup B) \cap (A \cup B)$:

Suppose $A = \{1, 2, 4, 8\}$

$B = \{2, 4, 6\}$ and

$C = \{3, 4, 5, 6\}$

Let L.H.S $= A \cup (B \cap C)$

$= \{1, 2, 4, 8\} \cup (\{2, 4, 6\} \cap \{3, 4, 5, 6\})$

$= \{1, 2, 4, 8\} \cup \{4, 6\}$

$= \{1, 2, 4, 6, 8\}$

R.H.S $= (A \cup B) \cap (A \cup C)$

$(A \cup B) = (\{1, 2, 4, 8\} \cup \{2, 4, 6\})$

$= \{1, 2, 4, 6, 8\}$

$(A \cup C) = (\{1, 2, 4, 8\} \cup \{3, 4, 5, 6\})$

$= \{1, 2, 3, 4, 5, 6, 8\}$

$(A \cup B) \cap (A \cup C)$

$= \{1, 2, 4, 6, 8\} \cap \{1, 2, 3, 4, 5, 6, 8\}$

$= \{1, 2, 4, 6, 8\}$

L.H.S = R.H.S

(f) Distributive Property of Intersection over Union

i.e., $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

Suppose

$A = \{1, 2, 3, 4, 5, \ldots, 20\}$

$B = \{5, 10, 15, 20, 25, 30\}$

$C = \{3, 9, 15, 21, 27, 33\}$

L.H.S $= A \cap (B \cup C)$

$= A \cap (\{5,10,15,20,25,30\} \cup \{3,9,15,21,27,33\})$

$= \{1,2,3,4, 5, \ldots. 20\} \cap$

$\{3, 5, 9, 10, 15, 20, 21, 25, 27, 30, 33\}$

L. H.S $= \{3, 5, 9, 10, 15, 20\}$

R.H.S $= (A \cap B) \cup (A \cap C)$

$(A \cap B) = \{1,2,3,4, .., 20\} \cap \{5,10,15,20,25,30\}$

$= \{5, 10, 15, 20\}$

$(A \cap C) = \{1,2,3,4,5,\ldots,20) \cap \{3,9,15,21,27,33\}$

$= \{3, 9, 15\}$

$(A \cap B) \cup (A \cap C)$

$= \{5, 10, 15, 20\} \cup \{3, 9, 15\}$

$= \{3, 5, 9, 10, 15, 20\}$

L.H.S = R.H.S

(g) De Morgan's laws

If set A and B are the subsets of universal set U then De Morgan's laws are expressed as.

(i) $(A \cup B)' = A' \cap B'$

(ii) $(A \cap B)' = A' \cup B'$

Proof:

(i) $(A \cup B)' = A' \cap B'$

Suppose

$U = \{1, 2, 3, 4, \ldots, 10\}$

$A = \{2, 4, 6, 8, 10\} \Rightarrow A' = \{1, 3, 5, 7, 9\}$

$B = \{1,2, 3, 4, 5, 6\} \Rightarrow B' = \{7, 8, 9, 10\}$

L.H.S $= (A \cup B)'$

$(A \cup B) = \{2, 4, 6, 8, 10\} \cup \{1, 2, 3, 4, 5, 6\}$

$= \{1, 2,3, 4, 5, 6, 8, 10\}$

L.H.S $= (A \cup B)'$

$= U - (A \cup B)$

$= \{1,2,3,4, \ldots, 10\} - \{1,2,3,4,5,6,8,10\}$

L.H.S $= \{7, 9\}$ .... (i)

R.H.S $= A' \cap B'$

$= \{1, 3, 5, 7, 9\} \cap \{7, 8, 9, 10\}$

$= \{7, 9\}$ .... (ii)

From (i) and (ii)

L.H.S = R.H.S

(ii) $(A \cap B)' = A' \cup B'$

Suppose

$U = \{1, 2, 3, 4, \ldots, 10\}$

$A = \{2, 4, 6, 8, 10\} \Rightarrow A' = \{1, 3, 5, 7, 9\}$

$B = \{1, 2, 3, 4, 5, 6\} \Rightarrow B' = \{7, 8, 9, 10\}$

Let L.H.S $= (A \cap B)'$

$A \cap B = \{2, 4, 6, 8, 10\} \cap \{1, 2, 3, 4, 5, 6\}$

$= \{2, 4, 6\}$

L.H.S $= (A \cap B)'$

$= U - (A \cap B)$

$= \{1, 2, 3, 4, .., 10\} - \{2, 4, 6\}$

$= \{1, 3, 5, 7, 8, 9, 10\}$...............(i)

R.H.S $= A' \cup B'$

$= \{1, 3, 5, 7, 9\} \cup \{7, 8, 9, 10\}$

$= \{1, 3, 5, 7, 8, 9, 10\}$...............(ii)

From (i) and (ii)

L.H.S = R.H.S

Venn Diagram

British mathematician John Venn (1834–1923) introduced rectangle for a universal set U and its subsets A and B as closed figures inside this rectangle.

Use Venn diagrams to represent:

(a) Union and intersection of sets

Disjoint sets | Overlapping sets | Subsets ($A \subseteq B$)

$A \cup B$

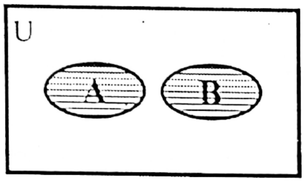


*Fig.*1

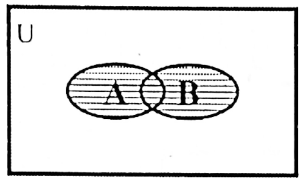


*Fig.*2

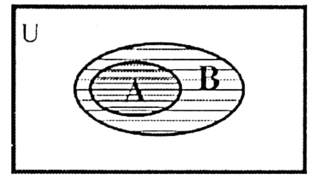


*Fig.*3

$A \cap B$

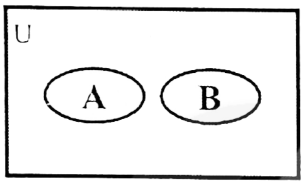


*Fig.*4

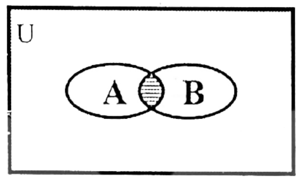


*Fig.*5

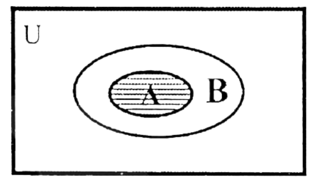
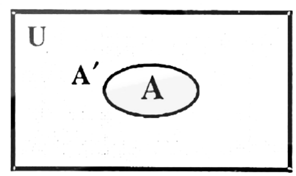


*Fig.*6

Regions shown by horizontal line segments in figures 1 to 6 shows A∪B and A∩B

(b) Complement of a set

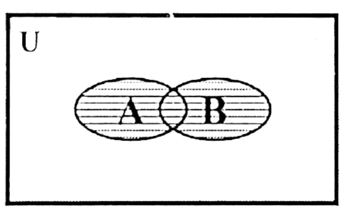
U – A = A′ is shown by Shaded area.



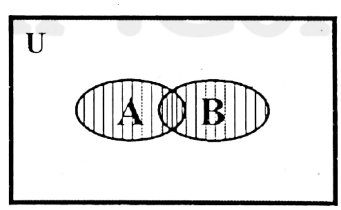
Use Venn diagram to verify:

Commutative law for union and intersection of sets.

- **Commutative Law for Union:**



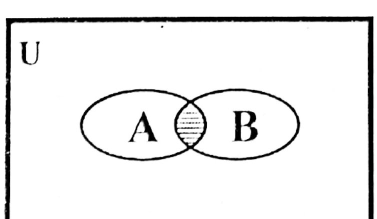
A∪B is shown by horizontal line segments



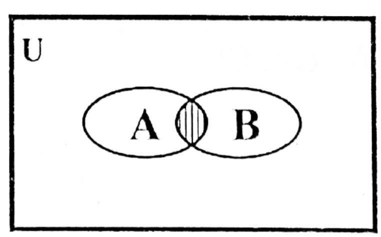
B∪A is shown by vertical line segments

The region shown in both cases are equal. Thus A∪B = B∪A.

- **Commutative Law for Intersection:**



A∩B is shown by horizontal line segments



B∩A is shown by vertical line segments

The regions shown in both cases are equal. Thus A∩B = B∩A

(c) **De Morgan's laws**

(i) $(A \cup B)' = A' \cap B'$ (ii) $(A \cap B)' = A' \cup B'$

(i) $(A \cup B)' = A' \cap B'$

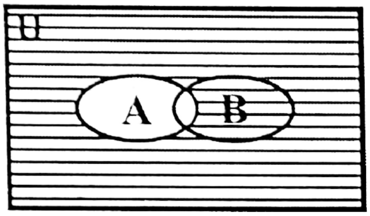


Fig. 1 : A′ is shown by horizontal line segments

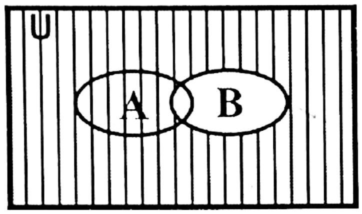


Fig. 2 : B′ is shown by vertical line segments

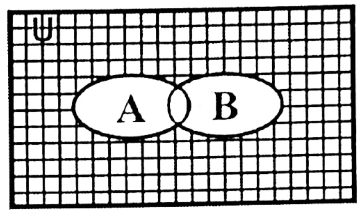


Fig. 3 : A′∩B′ is shown by squares

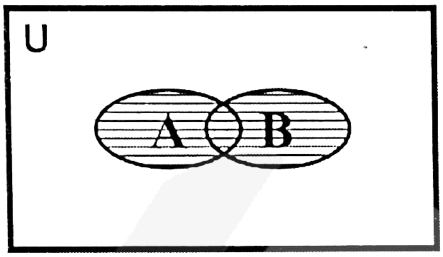


Fig. 4 : A∪B is shown by horizontal line segments

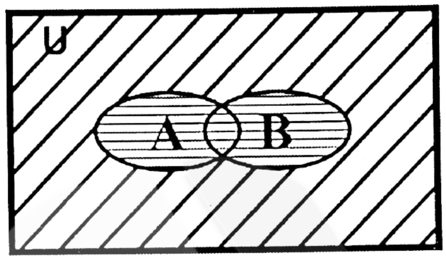
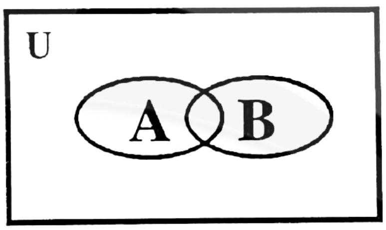


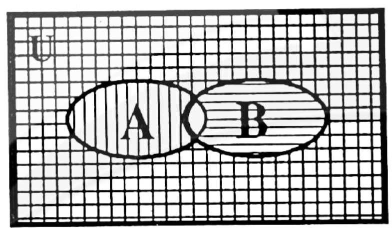
Fig. 5 : (A∪B)′ is shown by slanting line segments

Regions shown in figure 3 and 5 are equal thus $(A \cup B)' = A' \cap B'$.

(ii) $(A \cap B)' = A' \cup B'$



U–)A∩B(=)A∩B(is shown by shading



A′∪B′ is shown by squares, horizontal and vertical line segments.

Regions shown in fig. 6 and fig. 7 are equal.

Thus $(A \cap B)' = A' \cup B'$

(d) **Associative law of Union and Intersection:**

(i) **Associative law of Union: $(A \cup B) \cup C = A \cup (B \cup C)$**

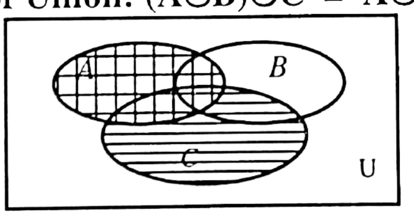


Fig-1

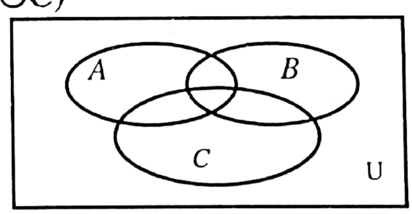


Fig-2

$(A \cup B) \cup C$ is shown in the above Fig-1. $A \cup (B \cup C)$ is shown in the above Fig-2. Regions shown in Fig. 1 and Fig. 2 by different ways are equal.

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

(ii) **Associative law of Intersection: (A∩B)∩C = A∩(B∩C)**

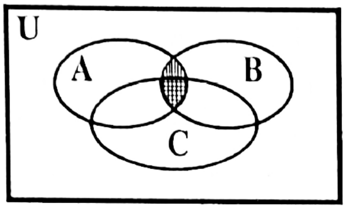


Fig. 3

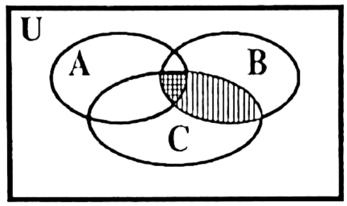


Fig. 4

(A∩B)∩C is shown in figure 3 by double crossing line segments.

A∩(B∩C) is shown in figure 4 by double crossing line segments.

Regions shown in Fig 3 and Fig. 4 are equal.

Thus (A∩B)∩C = A∩(B∩C)

(e) **Distributive law:**

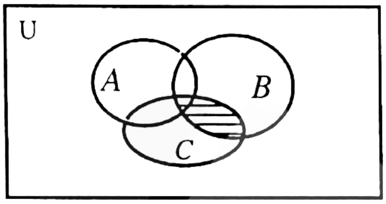


Fig. 1

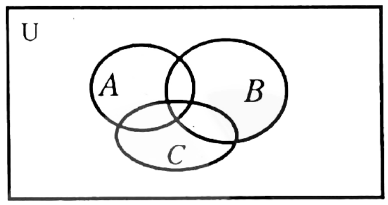


Fig. 2

Fig. 1: A∪(B∩C) is shown by horizontal line segments in the above figure 1.

Fig. 2: A∪B is shown by horizontal line segments in the fig. 2.

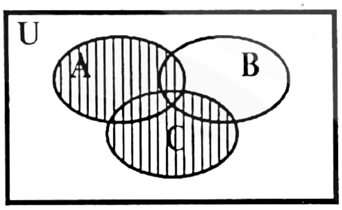


Fig. 3

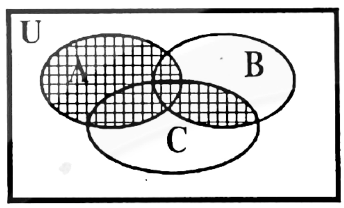


Fig. 4

Fig. 3: A∪C is shown by vertical line segments in fig.3

Fig. 4: (A∪B)∩(A∪C) is shown by double crossing line segments in fig. 4.

Regions shown in fig 1 and Fig.4 are equal. Thus A∪(B∩C) = (A∪B)∩(A∪C)

Distributive Law of Intersection over Union:

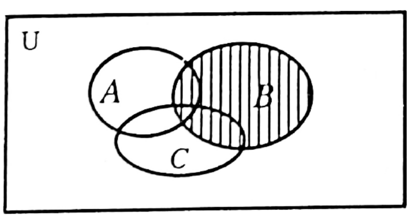


Fig.5

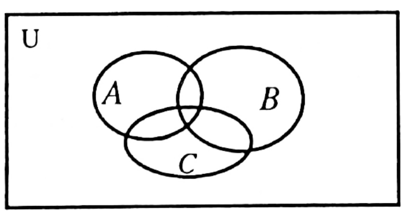


Fig.6

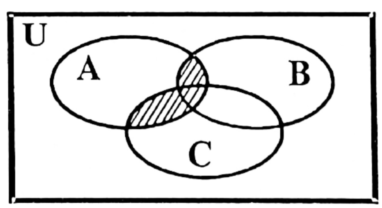


Fig. 7

Fig. 5: B∪C is shown by vertical line segments in Fig 5.

Fig. 6: A∩(B∪C) is shown in Fig.6 by vertical line segments.

Fig. 7: (A∩B)∪(A∩C) is shown in fig. 7 by slanting line segments.

Regions displayed in Fig. 6 and Fig. 7 are equal.

Thus A∩(B∪C) = (A∩B)∪(A∩C)