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Operations On Sets:

(1) Union of two Sets.

"Union of two sets is a set consists of all the elements of both the sets without repetition."

If A and B are two sets, then Union of A and B is denoted as

$A \cup B = \{x \mid x \in A \vee x \in B\}$

(2) Intersection of two Sets.

"Intersection of two sets is a set consists of all the common elements from both the sets."

If A and B are two sets then Intersection of A and B is denoted as $A \cap B = \{x \mid x \in A \wedge x \in B\}$.

Venn Diagrams:

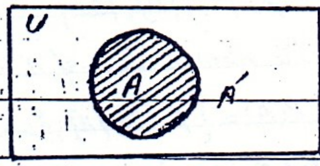
"The Figures (Diagrams) used to express (ظاہر کرنا) the relationship between two or more than sets are called Venn Diagram."

This idea was introduced by an English Mathematician "Jhon Venn."

In this diagram Universal Set is taken as a rectangle and other considerable Sets are taken as Circle in the rectangle.

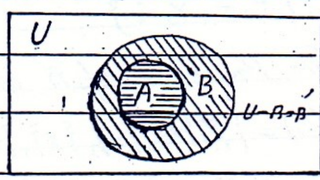
Some useful Diagrams are:-

(1) If A is a given set, while U is a universal set then $A' = U - A$ and is denoted as in Venn diagram.



$A' = U - A$ = unshaded region

(2) If A and B are two sets and $A \subset B$ then we write B as a greater circle and A as a smaller circle inside Greater Circle.

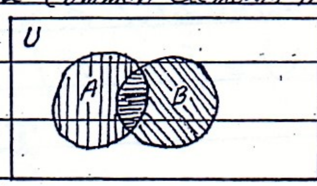


$A \subseteq B$

In this Case $A \cup B = B$

and $A \cap B = A$

(3) If A and B are two sets having some common elements then we write



In this Case $A \cup B =$ whole portion

In Case of $A \cap B =$ portion.

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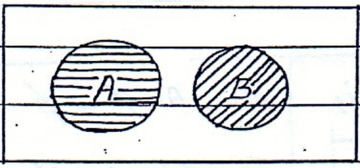
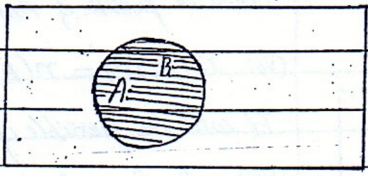
(4) In Case of disjoint sets A and B we write



$A \cup B =$ 

$A \cap B = \varphi$

(5) In Case of Equal sets A and B we write $A = B$



In This Case $A \subseteq B$ and $B \subseteq A$

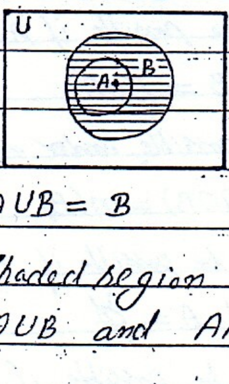
$A \cup B = A$ as well as B

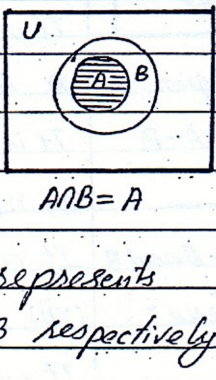
$A \cap B = A$ as well as B

Exercise 2.2

Q.1 Exhibit $A \cup B$ and $A \cap B$ by Venn diagrams in the following cases:

(i) $A \subseteq B$

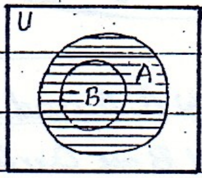


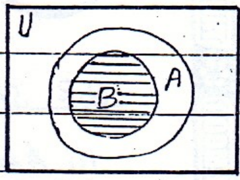


$A \cup B = B$ $\quad$ $A \cap B = A$

Shaded region represents $A \cup B$ and $A \cap B$ respectively.

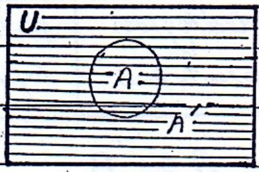
(ii) $B \subseteq A$





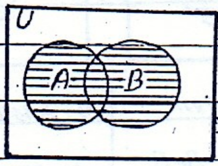
Shaded region represents $A \cup B = A$ | Shaded region represents $A \cap B = B$

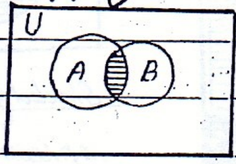
(iii) $A \cup A'$



Shaded region represents $A \cup A' = U$

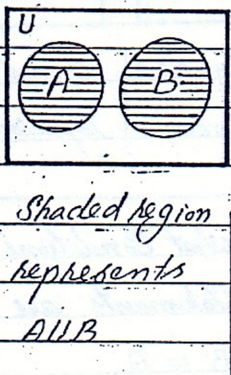
(iv) A and B are Overlapping Sets

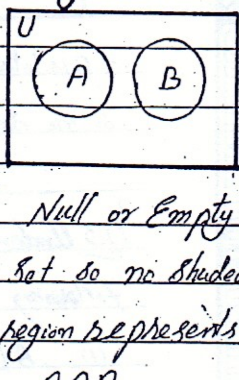




Shaded region represent $A \cup B$. | Shaded region represents $A \cap B$

(v) A and B are disjoint Sets.





Shaded region represents $A \cup B$ | Null or Empty Set so no Shaded region represents $A \cap B$

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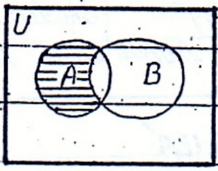
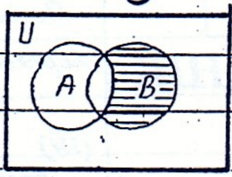
Q.2 Show A-B and B-A if

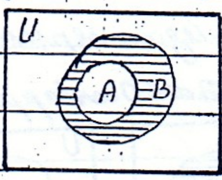
(i) A and B are Overlapping Sets.

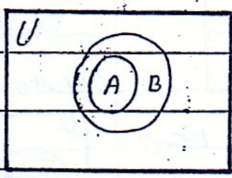




Shaded region represents A-B	Shaded region represents B-A

(ii) $A \subseteq B$





Shaded region represents B-A	$\because$ A is totally inside B so no difference.

(iii) $B \subseteq A$

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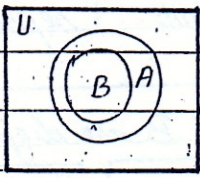

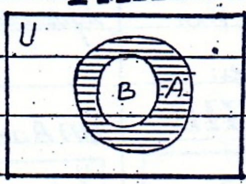

$\because$ B is totally inside A so no difference	Shaded region represents A-B

Q.3 Under what Conditions on A and B following Statements are true?

(i) $A \cup B = A$

It will be possible if $B \subseteq A$

(ii) $A \cup B = B$

It will be possible if $A \subseteq B$

(iii) $A - \phi = \phi$

It will be possible if $A = \phi$

(iv) $A \cap B = B$

It will be possible is $B \subseteq A$

(V) $n(A \cup B) = n(A) + n(B)$

It will be possible if A and B are disjoint.

(Vi) $n(A \cap B) = n(A)$

It will be possible if $A \subseteq B$

(Vii) $A - B = A$

It will be possible if $B = \phi$

or It will be possible if A and B are disjoint

(viii) $n(A \cap B) = 0$

It will be Possible if A and B are disjoint or one of the sets is null set (ϕ).

(IX) $A \cup B = U$.

It will be possible if $A = B^c$ or $B = A^c$

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

It is possible under every Condition.

(Xi) $n(A \cap B) = n(B)$

It will be possible if $B \subseteq A$

(Xii) $U - A = \phi$

It will be possible if $A = U$

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Q.4 If $U=\{1,2,3,\dots,10\}$ and

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

$C=\{1,3,5,7,9\}$ then find:

(i) A^c or A'

$A^c = U-A$

$A^c = \{1,2,3,\dots,10\}-\{2,4,6,8,10\}$

$A^c = \{1,3,5,7,9\} = C$

(ii) B^c or B'

$B^c = U-B$

$B^c = \{1,2,3,\dots,10\}-\{1,2,3,4,5\}$

$B^c = \{6,7,8,9,10\}$

(iii) $A \cup B$

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

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

(iv) $A-B$

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

$A-B = \{6,8,10\}$

(v) $A\cap C$

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

$A\cap C = \phi$

(vi) $A^c \cup C^c$

$A^c = U-A = \{1,2,3,\dots,10\}-\{2,4,6,8,10\}$

$A^c = \{1,3,5,7,9\}$

$C^c = U-C = \{1,2,3,\dots,10\}-\{1,3,5,7,9\}$

$C^c = \{2,4,6,8,10\}$

$A^c\cup C^c = \{1,3,5,7,9\}\cup\{2,4,6,8,10\}$

$A^c\cup C^c = \{1,2,3,\dots,10\} = U$

(vii) $A^c \cup C$

$\because A^c = \{1,3,5,7,9\} = C$

$\because A^c\cup C = \{1,3,5,7,9\}\cup\{1,3,5,7,9\}$

$A^c \cup C = \{1,3,5,7,9\} = C$

(viii) U^c

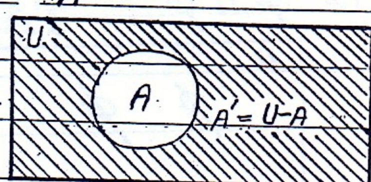
$U^c = U-U$

$U^c = \{1,2,3,\dots,10\}-\{1,2,3,\dots,10\}$

$U^c = \phi$

Q.5 Using the Venn diagrams, if necessary find a single set equal to the given sets:

(i) A^c

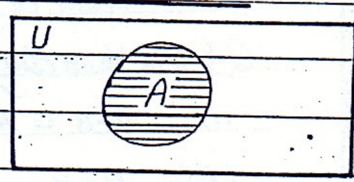


Shaded region represent A'.

From the figure it is obvious that

$A' = U-A$

(ii) $A\cap U$



Shaded region represents $A\cap U$ and it's obvious that $A\cap U = A$

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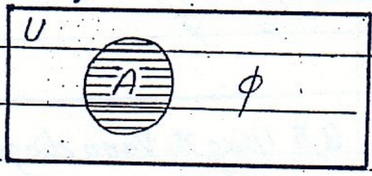
(iii) $A \cup U$

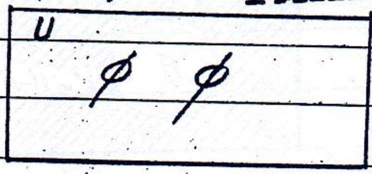
Shaded region represents $A \cup U$ and it is obvious that $A \cup U = U$

(iv) $A \cup \phi$



Shaded region represents $A \cup \phi$ and obviously $A \cup \phi = A$

(v) $\phi \cap \phi$ **TAHIR**

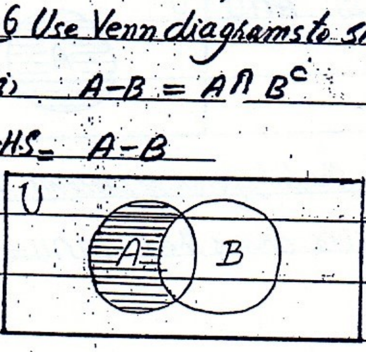


∴ Since there is no shaded region so $\phi \cap \phi$ is not shown and it is equal to ϕ.

Q.6 Use Venn diagrams to show

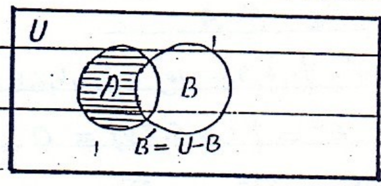
(i) $A - B = A \cap B^c$

L.H.S $= A - B$



Shaded region shows $A - B$.

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

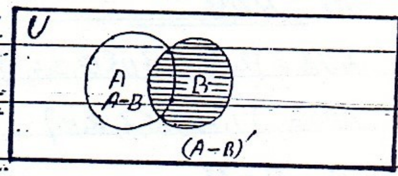


From the figure $A \cap B^c$ is Equal to $A - B$.

Hence $A - B = A \cap B^c$

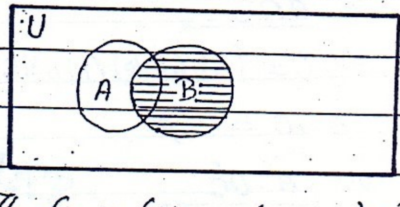
(ii) $(A-B)^c \cap B = B$

LHS $= (A-B)^c \cap B$



Shaded region shows the L.H.S i.e. $(A-B)^c \cap B$

RHS $= B$ **TAHIR**



The figure (Venn diagram) shows B.

From both figure

LHS = R.HS

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