Saket Shishu Ranjan Higher Secondary School Vidisha
Class 11 maths

Chapter 1: Set

1. Introduction

What is Sets?
Simply put, it's a collection of objects
Examples
N : the set of all natural numbers
Z : the set of all integers
Q : the set of all rational numbers
R : the set of real numbers
Z+ : the set of positive integers
Q+ : the set of positive rational numbers, and
R+ : the set of positive real numbers
Set of even numbers: {..., -4, -2, 0, 2, 4, ...}
Set of odd numbers: {..., -3, -1, 1, 3, ...}
Set of prime numbers: {2, 3, 5, 7, 11, 13, 17, ...}
Positive multiples of 3 that are less than 10: {3, 6, 9}

2. Methods of representing a set

- For sets, we simply put each element, separated by a comma, and then put some curly brackets around the whole thing.
- Sets are usually denoted by capital letters A, B, C, X, Y, Z, etc
- The elements of a set are represented by small letters *a, b, c, x, y, z,* etc
- When we say an element a is in a set A, we use the symbol ∈ to show it.
  And if something is not in a set use ∉

Example:
In a set of even number E, $2 \in E$ but $3 \notin E$

Two Methods are used to represent Sets

(a) Roster forms

- In a Roster forms, all the elements in the set is listed.
  Example
  Set of Vowel ={ a,e,i,o,u}
- In roster form, the order in which the elements are listed is immaterial
- while writing the set in roster form an element is not generally repeated

(b) Set Builder Form

- In set-builder form, all the elements of a set possess a single common property which is not possessed by any element outside the set. For example, in the set $\{2,4,6,8\}$, all the elements possess a common property, namely, each of them is a even number less than 10. Denoting this set by N, we write
  $N=\{x:x \text{ is an even number less} 10\}$
- We describe the element of the set by using a symbol x (any other symbol like the letters *y, z,* etc. could be used) which is followed by a colon ":" . After the sign of colon, we write the characteristic property possessed by the elements of the set and then enclose the whole description within braces

3 Types of sets

(a) Empty set

- A set which does not contain any element is called the *empty set* or the *null set* or the *void set*
- It is denoted by ϕ or $\{\}$
- It is a set with *no elements*
- Examples of empty sets is
  $D=\{x:x \text{ is an even prime number and } x>5\}$
  Here D is the empty set, because the 2 is an even but 2 <5 . So it does not satisfied by any even value of x

(b) Finite or infinite set

- If M is a set then $n(M)$ defines the number of distinct elements in the set M.
- If $n(M)$ is zero or finite ,then M is a finite set
- If $n(M)$ is infinite then M is a infinite set

(C) Equal sets

- Two sets are said to be equal if they have same members in them.
- For A and B to be equal, every member of A should be present in set B and every member of B to be present in set A
- It is denoted by equality sign $A=B$

(d) singleton sets

- A sets are said to be singleton if has just one element in it
- A ={a } is a singleton set

Question 1
State which of the following sets are finite or infinite :
(i) {x : x ∈ N and (x - 4) (x - 5)(x- 6) = 0}
(ii) {x : x ∈ N and x^3 = 8}
(iii) {x : x ∈ N and 2x - 5 = 0}
(iv) {x : x ∈ N and x is prime}
(v) {x : x ∈ N and x is even}
Solution
(i) Given set = {4, 5,6}. Therefore, it is finite.
(ii) Given set = {2}. Therefore, it is finite.
(iii) Given set = f. Therefore, it is finite.
(iv) The given set is the set of all prime numbers and since set of prime numbers is infinite. Therefore the given set is infinite
(v) Since there are infinite number of even numbers, Therefore, the given set is infinite.

4. Subset

- A set A is said to be a subset of a set B if every element of A is also an element of BB .
- It is denoted by
  $A \subset B$ if whenever $a \in A$, then $a \in B$
- If $A \subset B$ and $B \subset A$, then $A=B$.
- Every set is subset of itself $A \subset A$
- Empty set is subset of every set $\phi \subset A$
- if $A \subset B$ and $B \subset C$,then $A \subset C$

Operation on Sets

Union of Sets

The union of two sets A and B is the set C which consists of all those elements which are either in A or in B (including those which are in both). In symbols, we write.

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

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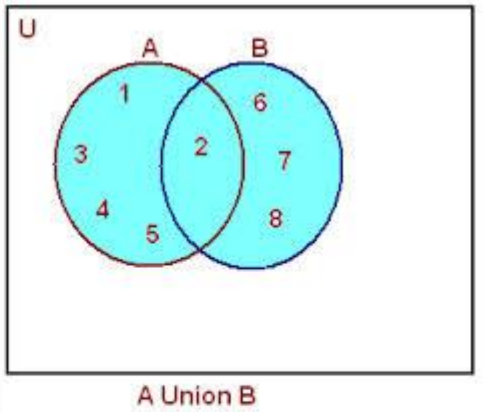
Venn Digram



Some Properties of the Operation of Union

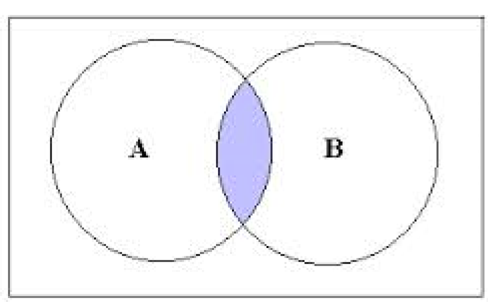
- Commutative law : $X\cup Y=Y\cup X$
- Associative law : $(X\cup Y)\cup Z=X\cup (Y\cup Z)$
- Law of identity element, ϕ is the identity of ∪∪ : $X\cup \phi=X$
- Idempotent law : $X\cup X=X$
- Law of U : $U\cup X=U$

Intersection of Sets

The Intersection of two sets A and B is the set C which consists of all those elements which are present in both A and B . In symbols, we write.

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

Venn Digram



Some Properties of Operation of Intersection

- Commutative law : $X\cap Y=Y\cap X$
- Associative law : $(X\cap Y)\cap Z=X\cap (Y\cap Z)$
- Idempotent law : $X\cap X=X$
- Distributive law : $X\cap (Y\cup Z)=(X\cap Y)\cup (X\cap Z)$

Difference of set

The difference of two sets A and B is the set C which consists of all those elements which are present in A but not in B . In symbols, we write,

$A-B=\{x:x\in A \text{ and } x\notin B\}$

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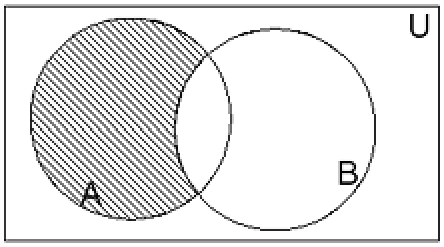
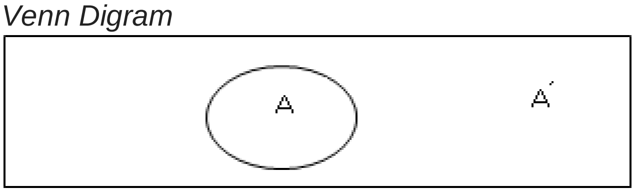


Compliment of set

Let U be the universal set and A a subset of U. Then the complement of A is the set of all elements of U which are not the elements of A. Symbolically, we write A' to denote the complement of A with respect to U. Thus,

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

Venn Digram



Some Properties of compliment of sets

Some Properties of compliment of sets

1. Complement laws:
   - $A\cup A'=U$
   - $A\cap A'=\phi$
2. De Morgan's law:
   - $(A\cup B)'=A'\cap B'$
   - $(A\cap B)'=A'\cup B'$
3. Law of double complementation: $(A')'=A$
4. Laws of empty set and universal set : $\phi'=U$ and $U'=\phi$

Cardinality of the set

- The cardinality of the set defines the number of element in the Set
- If A is the set, Cardinality of the set is defined as $n(A)$
- For $A=\{1,2,3\}$ then $n(A)=3$
- Cardinality of empty set is zero
- if $A=\phi$, then n(A)=0

Cardinality of Power set

- Cardinality of power set of A is given by 2^m where m is the Cardinality of set A
- if $n(A)=\phi$,then n[P(A)]=1

Set theory symbols

Set is a important mathematical tool .It has many symbols. Here I am giving list of all the Set theory symbols, meaning with examples

Symbol name |Symbol	Meaning	Example
Set | {}	A collection of objects	X= {1,2,3} Y = {a, b, c, d}
Not in | ∉	Elements in not in set	X = {1,2,3,4} 5 ∉ X
Belongs to |∈	Element is in the set	X = {1,2,3,4} 4 ∈ X
Empty set |ϕ	A set not having any elements	A= {} or $A=\phi$
Equal set |=	Two set are equal when they have same elements	X= {1,2,3} Y = {3,2,1} X=Y
Subset | ⊆	A is said to be a subset of a set B if every element of A is also an element of B.	A= {1,2,3} B= {3,2,1} A ⊆ B
Proper Subset |⊂	A is said to be a proper subset of a set B if every element of A is also an element of B and A is not equal to B	A= {1,2,3} B= {3,2,1,0} A ⊂ B
Not Subset| ⊄	A is not subset of B	A= {1,2,3,4} B= {3,2,1,0} A ⊄ B
Super set | ⊇	A is said to be a super set of a set B if every element of B is also an element of A	A= {1,2,3}

		B= {3,2,1} A ⊇ B
Proper Super set| ⊃	A is said to be a super set of a set B if every element of B is also an element of A and A has more elements than B	A= {1,2,3,0} B= {3,2,1} A ⊃ B
Universal Set |	A Universal is the set of all elements under consideration, denoted by capital U.	

Union | ∪	Union of sets.	A= {1,2,3,0} B= {3,2,1} A ∪ B = {0,1,2,3}
Intersection |∩	Intersection of sets	A= {1,2,3,0} B= {3,2,1} A ∩ B = {1,2,3}
Complement | A'	Complement of set	**U** = {1,2,3,4,5,6} A= {1,2,3} A' = {4,5,6}
Difference | -	Difference of set. A- B means elements present in A but not in B	A= {1,2,3,0} B= {3,2,1} A – B = {0}
N	the set of all-natural numbers	
Z	the set of all integers	
Q	the set of all rational numbers	
R	the set of real numbers	
Z+	the set of positive integers	
Q+	the set of positive rational numbers	
Power set | P(A)	The collection of all subsets of a set X is called the power set of X	A= {0,1} P(A) = { {}, {0}, {1}, {1,0} }

Number of elements | n(A)	Counts of number of elements in the set	A= {0,1} n(A) =2

Practice questions with solution based on

- **Union and intersection of sets**
- **Universal sets**
- **Venn diagram**
- **Difference of sets**
- **Complement of set**

1. Let U = {1, 2, 3, 4, 5, 6, 7, 8, 9}, A = {1, 2, 3, 4}, B = {2, 4, 6, 8} and C = {3, 4, 5, 6}. Find:
(i) A'
(ii) B'
(iii) (A ∪ C)'
(iv) (A ∪ B)'
(v) (A')'
(vi) (B – C)'
Ans. Given: U = {1, 2, 3, 4, 5, 6, 7, 8, 9},
A = {1, 2, 3, 4},

B = {2, 4, 6, 8} and C = {3, 4, 5, 6}.

(i) A' = U – A = {1, 2, 3, 4, 5, 6, 7, 8, 9} – {1, 2, 3, 4}
= {5, 6, 7, 8, 9}

(ii) B' = U – B = {1, 2, 3, 4, 5, 6, 7, 8, 9} – {2, 4, 6, 8}
= {1, 3, 5, 7, 9}

(iii) (A ∪ C)' = U – (A ∪ C)
= {1, 2, 3, 4, 5, 6, 7, 8, 9} – ({1, 2, 3, 4} ∪ {3, 4, 5, 6})

= {1, 2, 3, 4, 5, 6, 7, 8, 9} – {1, 2, 3, 4, 5, 6} = {7, 8, 9}

(iv) (A ∪ B)' = U – (A ∪ B)
= {1, 2, 3, 4, 5, 6, 7, 8, 9} – ({1, 2, 3, 4} ∪ {2, 4, 6, 8})

= {1, 2, 3, 4, 5, 6, 7, 8, 9} – {1, 2, 3, 4, 6, 8} = {5, 7, 9}

(v) (A')' = U – A' = U – (U – A)
= {1, 2, 3, 4, 5, 6, 7, 8, 9} – ({1, 2, 3, 4, 5, 6, 7, 8, 9} – {1, 2, 3, 4})

= {1, 2, 3, 4, 5, 6, 7, 8, 9} – {5, 6, 7, 8, 9}

= {1, 2, 3, 4} = A

(vi) (B – C)' = U – (B – C)
= {1, 2, 3, 4, 5, 6, 7, 8, 9} – ({2, 4, 6, 8} – {3, 4, 5, 6})

= {1, 2, 3, 4, 5, 6, 7, 8, 9} – {2, 8}

= {1, 3, 4, 5, 6, 7, 9}

2. If U = $\{a,b,c,d,e,f,g,h\}$, find the complement of the following sets:
(i) A = $\{a,b,c\}$
(ii) B = $\{d,e,f,g\}$
(iii) C = $\{a,c,e,g\}$
(iv) D = $\{f,g,h,a\}$

Ans. Given: U = $\{a,b,c,d,e,f,g,h\}$
(i) A' = U – A
= $\{a,b,c,d,e,f,g,h\}-\{a,b,c\}=\{d,e,f,g,h\}$

(ii) B' = U – B
= $\{a,b,c,d,e,f,g,h\}-\{d,e,f,g\}=\{a,b,c,h\}$

(iii) C' = U – C
= $\{a,b,c,d,e,f,g,h\}-\{a,c,e,g\}=\{b,d,f,h\}$

(iv) D' = U – D
= $\{a,b,c,d,e,f,g,h\}-\{f,g,h,a\}=\{b,c,d,e\}$

3. Taking the set of natural numbers as the universal set, write down the complement of the following set:
(i) {$x: x$ is an even natural number}
(ii) {$x: x$ is an odd natural number}

(iii) {$x : x$ is a positive multiple of 3}
(iv) {$x : x$ is a prime number}
(v) {$x : x$ is a natural number divisible by 3 and 5}
(vi) {$x : x$ is a perfect square}
(vii) {$x : x$ is a perfect cube}
(viii) {$x : x$ + 5 = 8}
(ix) {$x : 2x$ +5=9}
(x) $\{x : x \geq 7\}$
(xi) {$x : x$ $\in$ N and $2a+1>10$}

Ans. Given: U = $\{x : x \in \mathrm{N}\}$

(i) Let A = {$x : x$ is an even natural number}

$\therefore$ A' = U – A = $\{x : x \in \mathrm{N}\}$ – {$x : x$ is an even natural number}

= {$x : x$ is an odd natural number}

(ii) Let A = {$x : x$ is an odd natural number}

$\therefore$ A' = U – A = $\{x : x \in \mathrm{N}\}$ – {$x : x$ is an odd natural number}

= {$x : x$ is an even natural number}

(iii) Let A = {$x : x$ is a positive multiple of 3}

$\therefore$ A' = U – A = $\{x : x \in \mathrm{N}\}$ – {$x : x$ is a positive multiple of 3}

= {$x : x \in \mathrm{N},$ $x : x$ is not a positive multiple of 3}

(iv) Let A = {$x : x$ is a prime number}

$\therefore$ A' = U – A = $\{x : x \in \mathrm{N}\}$ – {$x : x$ is a prime number}

= {$x : x \in \mathrm{N},$ $x : x$ is not a prime number}

(v) Let A = {$x : x$ is a natural number divisible by 3 and 5}

$\therefore$ A' = U – A = $\{x : x \in \mathrm{N}\}$ – {$x : x$ is a natural number divisible by 15}

= {$x : x \in \mathrm{N},$ $x : x$ is not divisible by 15}

(vi) Let A = {$x : x$ is a perfect square}

$\therefore$ A' = U – A = $\{x : x \in \mathrm{N}\}$ – {$x : x$ is a perfect square}

= {$x: x \in N,\ x: x$ is not a perfect square}

(vii) Let A = {$x: x$ is a perfect cube}

∴ A' = U – A = $\{x: x \in N\}$ – {$x: x$ is a perfect cube}

= {$x: x \in N,\ x: x$ is not a perfect cube}

(viii) Let A = {$x: x$ + 5 = 8} = {3}

∴ A' = U – A = $\{x: x \in N\}$ – {3}

= {$x: x \in N,\ x \neq$ 3}

(ix) Let A = {$x: 2x$ +5=9} = {2}

∴ A' = U – A = $\{x: x \in N\}$ – {2}

= {$x: x \in N,\ x \neq$ 2}

(x) Let A = $\{x: x \geq 7\}$ = {7, 8, 9, 10, ………}

∴ A' = U – A = $\{x: x \in N\}$ – {7, 8, 9, 10, ………}

={1, 2, 3, 4, 5, 6} = {$x: x \in N,\ x <$ 7}

(xi) Let A = {$x: x$ ∈ N and $2a+1>10$} = {5, 6, 7, 8, ………..}

∴ A' = U – A = $\{x: x \in N\}$ – {5, 6, 7, 8, ………..}

= {1, 2, 3, 4}

4. If U = {1, 2, 3, 4, 5, 6, 7, 8, 9}, A = {2, 4, 6, 8} and B = {2, 3, 5, 7}, verify that:

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

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

Ans. Given: U = {1, 2, 3, 4, 5, 6, 7, 8, 9},
A = {2, 4, 6, 8} and B = {2, 3, 5, 7}

(i) L.H.S. = $(A \cup B)'$ = U – (A ∪ B)
= {1, 2, 3, 4, 5, 6, 7, 8, 9} – ({2, 4, 6, 8} ∪ {2, 3, 5, 7})

= {1, 2, 3, 4, 5, 6, 7, 8, 9} – {2, 3, 4, 5, 6, 7, 8} = {1, 9}

R.H.S. = $A' \cap B'$ = (U – A) $\cap$ (U – B)

= ({1, 2, 3, 4, 5, 6, 7, 8, 9} – {2, 4, 6, 8}) $\cap$ ({1, 2, 3, 4, 5, 6, 7, 8, 9} – {2, 3, 5, 7})

= {1, 3, 5, 7, 9} $\cap$ {1, 4, 6, 8, 9} = {1, 9}

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

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

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

= {1, 2, 3, 4, 5, 6, 7, 8, 9} – ({2, 4, 6, 8} $\cap$ {2, 3, 5, 7})

= {1, 2, 3, 4, 5, 6, 7, 8, 9} – {2}

= {1, 3, 4, 5, 6, 7, 8, 9}

R.H.S. = $A' \cup B'$ = (U – A) $\cup$ (U – B)

= ({1, 2, 3, 4, 5, 6, 7, 8, 9} – {2, 4, 6, 8}) $\cup$ ({1, 2, 3, 4, 5, 6, 7, 8, 9} – {2, 3, 5, 7})

= {1, 3, 5, 7, 9} $\cup$ {1, 4, 6, 8, 9}

= {1, 3, 4, 5, 6, 7, 8, 9}

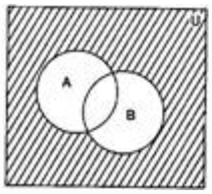
L.H.S. = R. H. S.

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

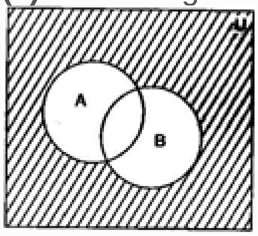
$\Rightarrow$

5. Draw appropriate Venn diagrams for each of the following:
(i) $(A \cup B)'$
(ii) $A' \cap B'$
(iii) $(A \cap B)'$
(iv) $A' \cup B'$

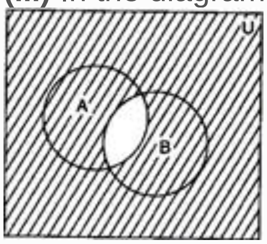
Ans. (i) In the diagrams, shaded portion represents $(A \cup B)'$



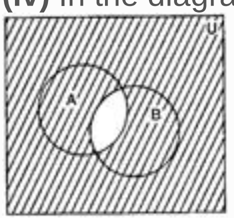
(ii) In the diagrams, shaded portion represents $A' \cap B'$



(iii) In the diagrams, shaded portion represents $(A \cap B)'$



(iv) In the diagrams, shaded portion represents $A' \cup B'$



6. Let U be the set of all triangles in a plane. If A is the set of all triangles with at least one angle different from 60°, what is A'?

Ans. Given: U = {$x : x$ is a triangle}

A = {$x : x$ is a triangle and has at least one angle different from 60°}

$\therefore$ A' = U – A = {$x : x$ is a triangle and has all angles equal to 60°}

= Set of all equilateral triangles

7. Fill in the blanks to make each of the following a true statement:

(i) $A' \cup A' =$ _______
(ii) $\phi' \cap A =$ _______
(iii) $A' \cap A' =$ _______
(iv) $U' \cap A' =$ _______

Practical problems based on set theory

General formula

For two disjoint sets A and B

n(A∪B)=n(A)+n(B)
n(A−B)=n(A)
n(A∩B)=0
n(B−A)=n(B)
n(A)=n(A∪B)−n(B)
n(B)=n(A∪B)−n(A)

For two overlapping sets A and B

n(A∪B)=n(A)+n(B)−n(A∩B)
n(A−B)=n(A∪B)−n(B)
n(A−B)=n(A)−n(A∩B)
n(B−A)=n(A∪B)−n(A)
n(U)=n(A)+n(B)−n(A∩B)+n((A∪B)')
n(A)=n(A∪B)+n(A∩B)−n(B)
n(B)=n(A∪B)+n(A∩B)−n(A)

1. If X and Y are two sets such that $n(X)=17, n(Y)=23$ and $n(X \cup Y)=38$, find $n(X \cap Y)$.

Ans. Given:
$n(X)=17, n(Y)=23$ and $n(X \cup Y)=38$

$\because n(X \cup Y) = n(X) + n(Y) - n(X \cap Y)$

$\therefore 38 = 17 + 23 - n(X \cap Y)$

$\Rightarrow n(X \cap Y) = 40 - 38 = 2$

2. If X and Y are two sets such that $X \cup Y$ has 18, X has 8 elements and Y has 15 elements; how many elements has $X \cap Y$?

Ans. Given:

$n(X) = 8, n(Y) = 15$ and $n(X \cup Y) = 18$

$\because n(X \cup Y) = n(X) + n(Y) - n(X \cap Y)$

$\therefore 18 = 8 + 15 - n(X \cap Y)$

$\Rightarrow n(X \cap Y) = 23 - 18 = 5$

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3. In a group of 400 people, 250 can speak Hindi and 200 can speak English. How many people can speak both Hindi and English?

Ans. Let H be the set of people speaking Hindi and E be the set of people speaking English.

$\therefore n(H) = 250, n(E) = 200$ and $n(H \cup E) = 400$

$\because n(H \cup E) = n(H) + n(E) - n(H \cap E)$

$\therefore 400 = 250 + 200 - n(H \cap E)$

$\Rightarrow n(H \cap E) = 450 - 400 = 50$

4. If S and T are two sets such that S has 21 elements T has 32 elements and $S \cap T$ has 11 elements, how many elements does $S \cup T$ have?

Ans. Given:

$n(S) = 21, n(T) = 32$ and $n(S \cap T) = 11$

$\because n(S \cup T) = n(S) + n(T) - n(S \cap T)$

$\therefore n(S \cup T) = 21 + 32 - 11 = 42$

5. If X and Y are two sets such that X has 40 elements, $X \cup Y$ has 60 elements and $X \cap Y$ has 10 elements, how many elements does Y have?

Ans. Given:

$n(X)=40, n(X \cap Y)=10$ and $n(X \cup Y)=60$

$\because n(X \cup Y)=n(X)+n(Y)-n(X \cap Y)$

$\therefore 60=40+n(Y)-10$

$\Rightarrow n(Y)=60-30=30$

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6. In a group of 70 people, 37 like coffee, 52 like tea and each person likes at least one of the two drinks. How many people like both coffee and tea?

Ans. Given:

$n(C)=37, n(T)=52$ and $n(C \cup T)=70$

$\because n(C \cup T)=n(C)+n(T)-n(C \cap T)$

$\therefore 70=37+52-n(C \cap T)$

$\Rightarrow n(C \cap T)=89-70=19$

7. In a group of 65 people, 40 people like cricket and 10 like both cricket and tennis. How many like tennis only and not cricket? How many like tennis?

Ans. Let C be the set of people who like cricket and T be the set of people who like tennis.

$n(C)=40, n(C \cap T)=10$

$\because n(C \cup T)=n(C)+n(T)-n(C \cap T)$

$\therefore 65=40+n(T)-10$

$\Rightarrow n(T)=65-30=35$

Therefore, number of people who like tennis are 35.

Now number of people who like tennis only and not cricket = $n(T-C)=n(T)-n(C \cap T)$

= 35 – 10 = 25

8. In a committee, 50 people speak French, 20 speak Spanish and 10 speak both Spanish and French. How many speak at least one of these two languages?

Ans. Let F be the set of people who speak French and S be the set of people who speak Spanish.

Then

$n(F) = 50, n(S) = 20$ and $n(F \cap S) = 10$

$\because$ n(FUS) = n(F) + n(S) – n(F ∩ S)

$\because$ $\therefore$ n(FUS) = 50+20-10 = 60

Therefore, Number of people who speak at least one of these two languages are 60.

Using properties of sets prove the statements given from Q1-Q5

Q1. For all sets A and B, A ∪ (B -A) = A ∪ B

Sol. L.H.S. $= A \cup (B - A) = A \cup (B \cap A')$ $\quad [\because A - B = A \cap B']$

$= (A \cup B) \cap (A \cup A') = (A \cup B) \cap U$ $\quad [\because A \cup A' = U]$

$= A \cup B =$ R.H.S. $\quad [\because A \cap U = A]$

Hence proved.

Q2. For all sets A and B, A – (A – B) = A ∩ B

Sol. L.H.S. $= A - (A - B)$

$= A - (A \cap B')$ $\quad [\because A - B = A \cap B']$

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

$= A \cap [A' \cup (B')']$ $\quad [\because (A \cap B)' = A' \cup B']$

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

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

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

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

Hence proved.

Q3. For all sets A and B, A – (A ∩ B) = A – B

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

$= A \cap (A \cap B)'$ $\quad [\because A - B = A \cap B']$

$= A \cap (A' \cup B')$ $\quad [\because (A \cap B)' = A' \cup B']$

$= (A \cap A') \cup (A \cap B') = \phi \cup (A \cap B') = A \cap B' = A - B = \text{R.H.S.}$

Hence proved.

Q4. For all sets A and B, (A ∪ B)- B = A-B

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

$= (A \cup B) \cap B'$ $\quad [\because A - B = A \cap B']$

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

$= (A \cap B') \cup \phi$ $\quad [\because B \cap B' = \phi]$

$= A \cap B' = A - B = \text{R.H.S.}$

Hence proved.

Q5. Let A, B and C be sets. Then show that A ∩ (B ∪ C) = (A ∩ B)∪ (A ∩ C).

Sol. Let $x \in A \cap (B \cup C)$

$\Rightarrow \quad x \in A$ and $x \in (B \cup C)$

$\Rightarrow \quad x \in A$ and $(x \in B$ or $x \in C)$

$\Rightarrow \quad (x \in A$ and $x \in B)$ or $(x \in A$ and $x \in C)$

$\Rightarrow \quad x \in A \cap B$ or $x \in A \cap C$

$\Rightarrow \quad x \in (A \cap B) \cup (A \cap C)$

$\Rightarrow \quad A \cap (B \cup C) \subset (A \cap B) \cup (A \cap C)$ (i)

Now, let $y \in (A \cap B) \cup (A \cap C)$

$\Rightarrow \quad y \in (A \cap B)$ or $y \in (A \cap C)$

$\Rightarrow \quad (y \in A$ and $y \in B)$ or $(y \in A$ and $y \in C)$

$\Rightarrow \quad y \in A$ and $(y \in B$ or $y \in C)$

$\Rightarrow \quad y \in A$ and $y \in B \cup C$

$\Rightarrow \quad y \in A \cap (B \cup C)$

$\Rightarrow \quad (A \cap B) \cup (A \cap C) \subset A \cap (B \cup C)$ (ii)

From (i) and (ii), we get .
A ∩ (B ∪ C) = (A ∩ B) ∪ (A ∩ C)