Sets

Definition

A set is defined as a collection of distinct objects of same type or class of objects.
The objects of a set are called elements or members of the set. objects can be number, alphabets, names etc.

e.g:- $A = \{1, 2, 3, 4, 5\}$

A is a set of numbers containing elements 1,2,3,4&5

⊛ A set is usually denoted by capital letters A, B, C, D, etc...

⊛ Elements of the set are defined by p, q, r, t or p_1, q_1, r_1, t_1 etc.

OR

A well defined collection of distinct object is called set

Note:- ① The objects in a set are called elements of the set

② We denote sets by the capital letters A, B, C, X, Y, Z etc.

③ Elements of the set is denoted by small letters a, b, c, x, y, z, p, q, r etc.

④ Elements of any set are enclosed with curly backet i.e; { }

$N = \{1, 2, 3, \ldots \infty\}$ Natural no.
$W = \{0, 1, 2, 3, \ldots, \infty\}$ whole no.
$I = \{0, \pm 1, \pm 2, \pm 3, \pm 4, \ldots \infty\}$ Integer No.

Date
Page

$Q = \{ \frac{p}{q} : q \neq 0 , p, q \in I \}$

$\{ \frac{1}{2}, \frac{2}{3}, \frac{4}{5}, -\frac{2}{3}, \dots \}$ $\frac{p}{q}$ → decimal Representation

Q' = Which can't represent in form of p/q

→ $\{ \sqrt{2}, \sqrt{3}, \sqrt{5}, \sqrt{6}, \dots \}$ Irrational No.

$Q \cup Q'$ ⟶ Real line / Real no.'s

<u>Set formation:-</u>

The set can be formed by two ways:-

① Tabular form of a set / Roaster Tabular form
② Set Builder form / Builder form of a set

<u>① Tabular form of a Set:-</u>

If a set is defined by

In this form, all the elements of a set are listed within curly brackets { } and are separated by commas.

<u>Example</u> :- Write the following sets in Roaster form
(i) A = Set of all factors of 12
(ii) B = Set of all even +ve integers less than 15

<u>Soln</u> (i) Factors of 12 are 1, 2, 3, 4, 5, 6, 12
∴ A = { 1, 2, 3, 4, 5, ... 12 }

(ii) +ve even integers less than 15 are
∴ B = { 2, 4, 6, 8, 10, 12, 14 }

2. (iii) Set Builder form :-

In this form, we list the property satisfied by all elements of the set. It represented as :-

$A = \{ x : x \text{ satisfy the property} \}$

e.g:- Write the following sets in Builder form

(i) $A = \{ 1, 2, 3, ------, 12 \}$

(ii) $B = \{ 2, 4, 6, ------, 14 \}$

Solⁿ (i) $A = \{ x : x \leq 12 \text{ and } x \text{ is a factor of } 12 \}$

(ii) $B = \{ x : x < 15 \text{ and } x \text{ is even +ve integer} \}$

(1) $A = \{ 1, 2, ---- 10 \}$ → Roaster form

$A = \{ x : x \in N, x \leq 10 \}$ → Set Builder form

(2) $A = \{ x : x^2 < 20 \text{ and } x \in I \}$

$A = \{ -4, -3, -2, -1, 0, 1, 2, 3, 4 \}$

(3) $B = \{ x : x^2 - 9 = 0 \}$ set Builder form

$B = \{ -3, 3 \}$ Roaster form

Types of sets :-

(1) Empty Sets :-

A set containing no element at all is called the empty set or Null set OR VOID SET and it is denoted by ϕ or $\{ \}$.

Ex. (i) $A = \{ x : x \in N \ \& \ 2 < x < 3 \} = \phi$

(ii) $B = \{ x : x \in R \ \& \ x^2 = -1 \} = \phi$

2. Singleton Set :-

A Set Containing exactly one element is called singleton set.

e.g: (i) $\{0\}$ is a singleton set whose element is 0.

(ii) $\{x : x \in N$ and $x^2 - 9 = 0\} = \{3\}$

3. Finite and Infinite Set :-

A Set is said to be finite if it contains only finite no. of elements Otherwise the set is called infinite set

e.g: (i) Let $A = \{1, 2, 3, 4\}$ then A is finite set

(ii) $N = \{1, 2, 3, 4, \ldots\}$ it is Infinite set

4. Equal Set :-

Let A and B be two sets, then A & B are said to be equal, if they have exactly the same elements and we write $A = B$.

If A and B are not equal then $A \neq B$

e.g: (i) Let $A = \{1, 2, 3\}$

$B = \{2, 3, 1\}$

then $A = B$

(ii) Let $A = \{1, 2, 3, 4, 5\}$ & $B = \{1, 2, 4\}$

then, $A \neq B$

5. Cardinal No. of Set :-

The no. of distinct elements containing in a finite set A is called cardinal no. of set A & it is denoted by $n(A)$

e.g:- (i) $A = \{1, 2, 3, 4, 5\} \rightarrow n(A) = 4$

(iii) $A = \{1, 1, 2, 2, 3\} \rightarrow n(A) = 3$

(iv) $A = \{1, 1, 1, 1\} \rightarrow n(A) = 1$

6. **Subset**:-

A set 'A' is said to be subset of a set B, if every element of A is also an element of B and it is denoted by $A \subseteq B$

$$A \subseteq B = \{x : x \in A \Rightarrow x \in B\}$$

(a) **Proper Subset** :-

If A is subset of B and $A \neq B$ then A is said to be proper subset of B. If A is a proper subset of B then B is not subset of A i.e; therefore is at least one element in B which is not in A e.g:-

(1) Let $A = \{2, 3, 4\}$ & $B = \{2, 3, 4, 5\}$

A is a proper subset of B

(2) The null set ϕ is a proper subset of every set.

(b) **Improper Subset** :-

If A is subset of B and $A = B$, then A is said to be an improper subset of B,

e.g:- (1) $A = \{2, 3, 4\}$, $B = \{2, 3, 4\}$

A is improper subset of B.

(2) Every set is improper subset of itself.

(b) $P = \{r, s, t\}$, $Q = \{r, r, s, t\}$

$R = \{s, r, t\}$ $S = \{r, s, t, t\}$

All the four ~~pairs~~ sets P, Q, R, S are equal

(c) $A = \{a, b, c\}$, $B = \{b, a, c\}$, $C = \{b, a\}$

The set A & B are equal but C is not equal to either A or B.

Power Set:-

The power set of any given set A is the set of all subsets of A and is denoted by P(A). If A has n elements then P(A) has 2^n elements.

If $A = \{r, s\}$ then its subset are $\phi, \{r\}, \{s\}, \{r, s\}$

$P(A) = \{\phi, \{r\}, \{s\}, \{r, s\}\}$ which has $2^2 = 4$ elements.

Universal set:-

If all sets under investigation are subsets of a fixed set U, then the set U is called universal set.

e.g. In plane geometry, the universal set consists of all the points in the plane.

Operation of SET:-

(1) Union of Sets:-

Let A & B be two sets then the union of two sets is denoted by $A \cup B$, is the set of all those elements which are either in A or in B or in both A & B.

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

$\therefore x \in A \cup B \Leftrightarrow x \in A \text{ or } x \in B$

and $x \notin A \cup B \Leftrightarrow x \notin A \text{ and } x \notin B$

2. Intersection of Set :-

The intersection of two sets A and B is denoted by $A \cap B$, is the set of all those elements which are common to both A & B

Thus,

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

$\therefore \quad x \in A \cap B \iff x \in A$ and $x \in B$

and $x \notin A \cap B \iff x \notin A$ ~~and~~ or $x \notin B$

3. Disjoint Set :-

Two sets A and B are said to be disjoint if $A \cap B = \phi$.

4. Difference of Sets :-

For two sets A and B, the difference of two sets is denoted by $A - B$ and it is defined as :-

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

$x \in A - B \implies x \in A$ and $x \notin B$

5. Symmetric Difference of sets :-

Let A & B be two sets, then $(A - B) \cup (B - A)$ is called symmetric difference of A and B and is denoted by

$A \Delta B$ and defined as :-

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

e.g. Let $A = \{1, 2, 3, 6\}$ & $B = \{1, 2, 4, 8\}$

then

$A - B = \{3, 6\}$;

$B - A = \{4, 8\}$

$\therefore \quad A \Delta B = (A - B) \cup (B - A) = \{3, 4, 6, 8\}$

Compliment of a Set :-

Let U be the universal set and $A \subseteq U$, then the complement of A is denoted by A' or $(U-A)$ and is defined as

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

Note:- Complement of a set of complement is itself a set

$$(A')' = A$$

e.g:- Let $U = \{1,2,3,4,5,6,7,8\}$

$A = \{2,4,6,8\}$ then

$A' = U - A = \{1,3,5,7\}$

Algebra of Set Theory :-

① **Commutative Law :-**

Let A and B be two sets then

ⓐ $A \cup B = B \cup A$ ⓑ $A \cap B = B \cap A$

② **Associative Law :-**

Let A, B and C be three sets, then

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

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

③ **Idempotent Law :-**

ⓐ $A \cup A = A$ ⓑ $A \cap A = A$

Note:- Do your self its proof.

④ **De-Morgan's Law :-**

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

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

Cartesian Product of Sets:-

Let A and B be two non-empty sets, then the cartesian product of A and B is the set of all ordered pairs (a, b) where $a \in A$ & $b \in B$. It is denoted by $A \times B$ and read as "A cross B".

e.g:- $A = \{0, 1, 2\}$ and $B = \{3, 5\}$

$A \times B = \{(0,3), (0,5), (1,3), (1,5), (2,3), (2,5)\}$

Note:-

If a set A contains m elements and B contains n elements then their cartesian product $A \times B$ contains $m \cdot n$ elements in the set.

Que:- Let ϕ be an empty set, then find the value of $P(\phi)$, $P(P(\phi))$, $P(P(P(\phi)))$

Sol^n

(i) $P(\phi) = \phi$

(ii) $P(P(\phi)) = \{\phi, \{\phi\}\}$

(iii) $P(P(P(\phi))) = \{\phi, \{\phi\}, \{\{\phi\}\}, \{\phi, \{\phi\}\}\}$

Some Important Results:-

$A \subset B$

- $\to A \cup B = B$
- $\to A \cap B = A$

e.g:- $A = \{a, b, c, d\}$, $B = \{a, c\}$

$A \cup B = \{a, b, c, d\} = A$

$A \cap B = \{a, c\} = B$

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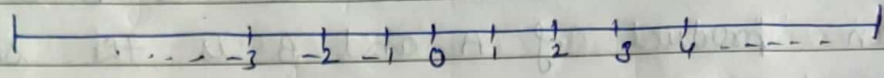
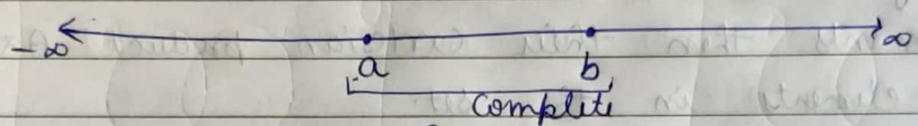
Intervals as subset of Real line :-



① Closed Interval :-

Let $a < b$. The set of all real numbers x such that $a \leq x \leq b$ is called a closed interval $[a, b]$

$$[a, b] = \{x \in R : a \leq x \leq b\}$$

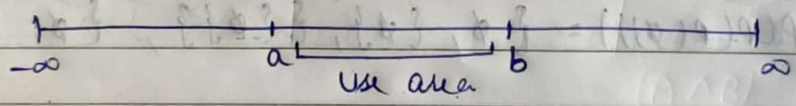


e.g. :- $[1, 2] = \{x : 1 \leq x \leq 2, x \in R\}$

② Open interval :-

Let $a < b$

$$(a, b) = \{x \in R : a < x < b\}$$

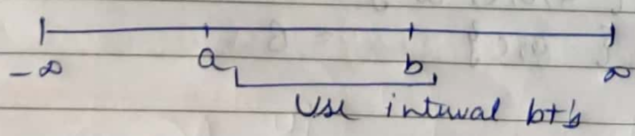


e.g. :- $(1, 2) = \{x : 1 < x < 2, x \in R\}$

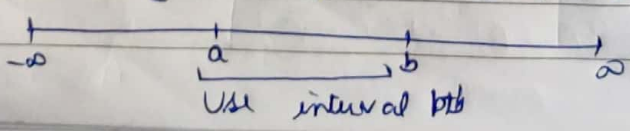
③ Semi - open or Semi closed Interval :-

Let $a < b$

ⓐ $(a, b] = \{x \in R : a < x \leq b\}$



ⓑ $[a, b) = \{x \in R : a \leq x < b\}$

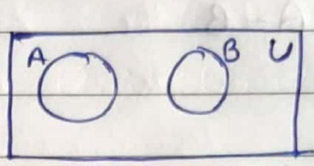


Venn Diagram :-

In order to express the relationship among sets, we represent them pictorically called Venn Diagram.

① Show a Universal set U

ⓐ

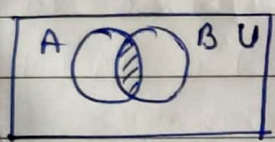


→ Disjoint set A & B.

$A \cap B = \phi$

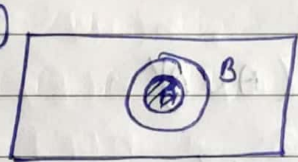
② Show that the set A & B are overlapping sets & shaded portion represent $A \cap B$

ⓐ

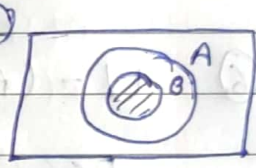


$A \cap B$

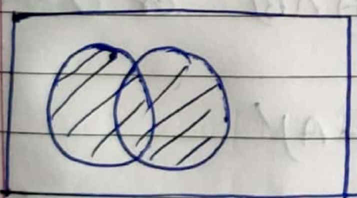
ⓑ

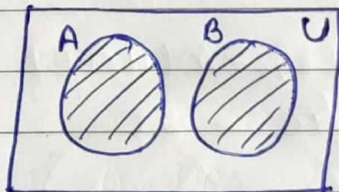


ⓒ

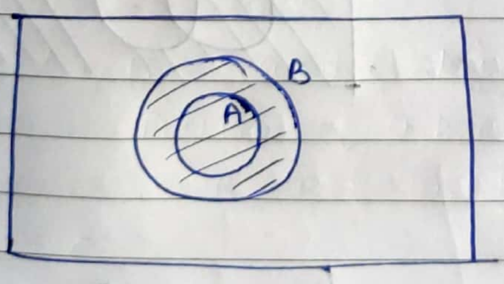


③ In the following figures the shaded portion represents $A \cup B$

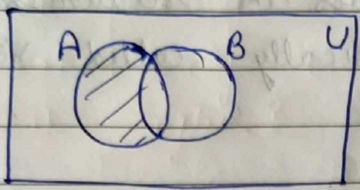




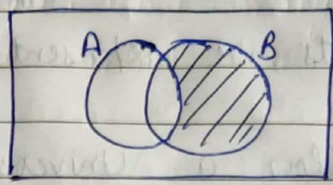
$A \cup B$



(4) Similarly, the shaded portion of the following Venn - Diagrams represents A – B & B – A

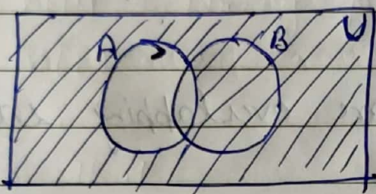


A – B

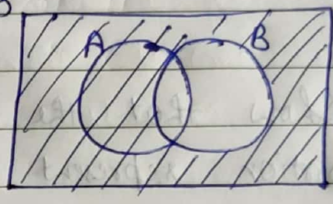


B – A

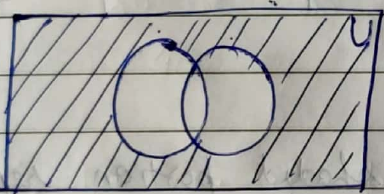
(5) A'

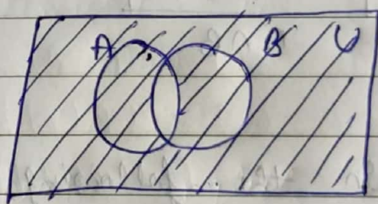


B'



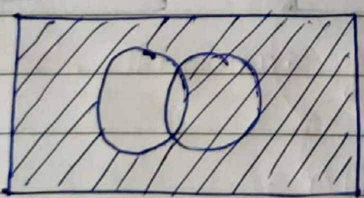
(6) U – (A ∪ B) or (A ∪ B)'





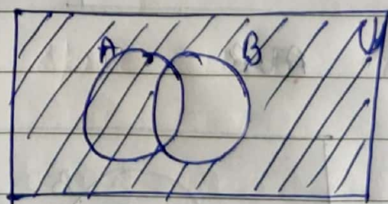
(A ∩ B)' or U – (A ∩ B)

(7) (A – B)'

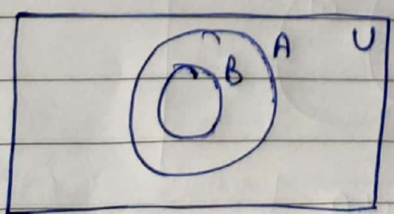


A ∪ B

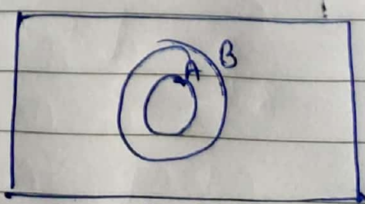
(B – A)'



(8)



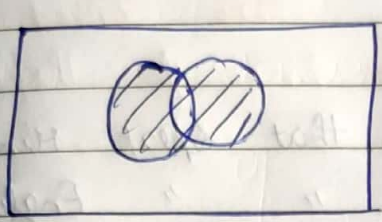
B ⊂ A

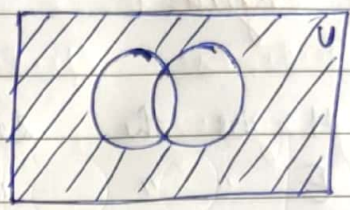


A ⊂ B

Ques:- Use Venn-Diagrams to prove that
$(A \cup B)' = A' \cap B'$

Sol^n $A \cup B$ = (The region which is in A or B or both)


$A \cup B$

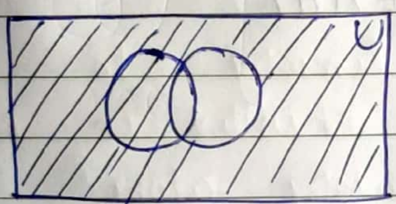


$(A \cup B)'$

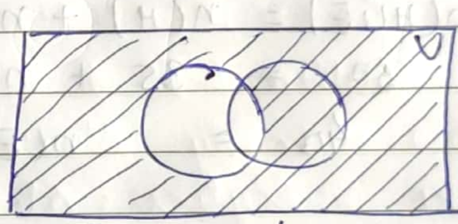
--- I

$(A \cup B)'$ = The region in the universal set and not in $A \cup B$

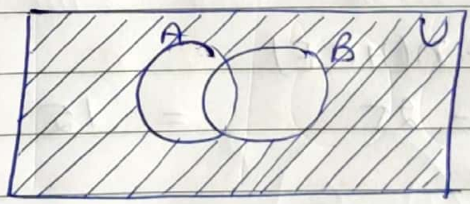
A' = The region of universal set, which is not in A
B' = " " " " " " " " B



B'



A'



$A' \cap B'$

——— II

Since the shaded portions I & II represent the same region

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

Ques:- In a group 50 People, 35 Speaks Hindi, 25 Speaks both English and Hindi and all people speak at least one of the two languages. How many people speak only English and not Hindi? How many speak English?

Soln:- Let H be the set of people that speak Hindi and
E " " " " " " " English

Let $n(H)$ = no. of people in the set H
$n(E)$ = " " " " " " E

Given that

$n(H \cup E) = 50$, $n(H) = 35$, $n(E \cap H) = 25$

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

$50 = 35 + n(E) - 25$

$40 = n(E)$

∴ The no. of people that speak English only

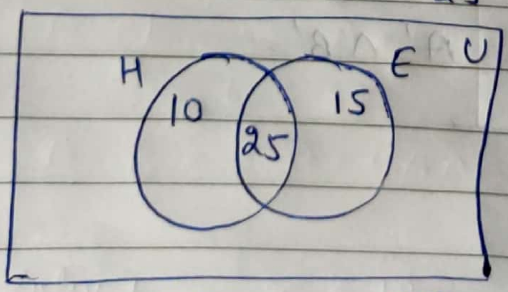
$= n(E) - n(H \cap E)$

$= 40 - 25 = 15$

∴ The no. of people that speak Hindi only

$= n(H) - n(H \cap E)$

$= 35 - 25 = 10$

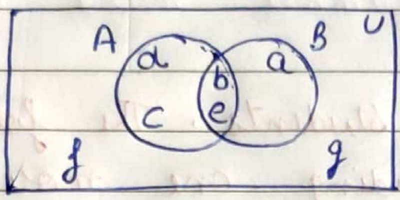


$A \cup B = 50$

$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$

Ques:- Given Universal set $U = \{a, b, c, d, e, f, g\}$,
$A = \{b, c, d, e\}$, $B = \{a, b, e\}$
Draw Venn - Diagram to represent the relationship b/w the given sets. Use the Diagram to find the following set :-
(i) A' (ii) $A - B$ (iii) $B - A$

Sol^n



$A' = \{$element of universal set, which are not in $A\}$
$= \{a, f, g\}$

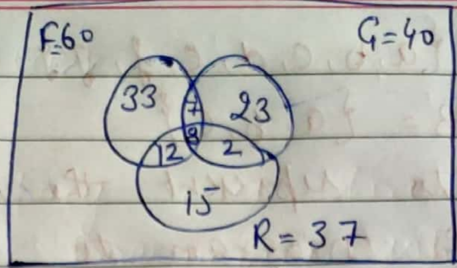
$A - B = \{$Elements of A, which are not in $B\}$
$= \{d, c\}$

$B - A = \{$Elements of B, which are not in $A\}$
$= \{a\}$

Ques:- Suppose that 100 of the mathematics students at a College take at least one of the languages french, German and Russian. Also suppose
60 study French, 15 study French & German
40 " German, 20 " " & Russian
37 " Russian, 10 " German & Russian

Draw a Venn - Diagram and fill in the correct no. of students in each region. Also determine the no. of students who study all three subjects.

Sol^n



51 Students study exactly one of the three languages.

Ques:- A class has 175 students. The following gives the no. of students studing one more of the subjects in this class

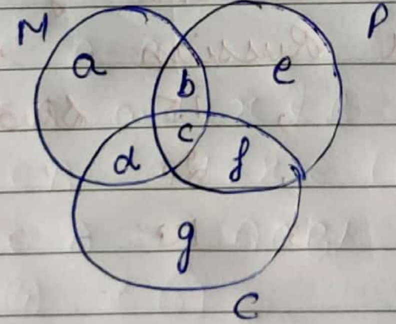
Mathematics - 100, Mathematics + Physics - 30
Physics - 30, Mathematics + Chemistry - 28
Chemistry - 46, Physics + Chemistry - 23,

Mathematics + Physics, Chemistry - 18

(i) How many students are enrolled in Maths alone, Physics alone & Chemistry alone?

(ii) The no. of students who have not offered any of these subject.

Sol^n



$a+b+c+d = 100$
$b+c+f+e = 70$
$c+d+g+f = 46$

$b+c = 30$
$c+d = 28$
$c+f = 23$
$c = 18$

Now, Solving $c = 18$, $b = 12$, $g = 13$,
$d = 10$, $f = 5$, $e = 35$

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classmate
Date
Page

(i) Mathematics alone - $a = 60$
Physics " - $e = 35$
Chemistry " - $g = 13$

(ii) No. of students not enrolled in any subject
$= 175 - (a+b+c+d+e+f)$
$= 22$

Ques:- $n(\underbrace{A \times A}) = 9$
$(-1, 0), (0, 1)$ Find $A \times A$ and also find set A

Sol^n

$A = \{-1, 0, 1\}$

$A \times A = \{(-1,1), (-1,0), (-1,1), (0,-1), (0,0), (0,1)$
$(1,-1), (1,0), (1,1)\}$

$n(A \times A) = 3 \times 3 = 9$

\# $(A \times B) \cup (B \times C)$
\# $A \times B \times C = \{x, y, z, x \in A, y \in B \& z \in C\}$
$= 27$

$n(A \times B \times C) = n(A \times B) \times (n(C))$
$= 9 \times 3 = 27$

\# $A \times B = \{(1,a), (1,b), (1,c), (2,a), (2,b), (2,c)\}$
$A = \{1, 2\}$, $B = \{a, b, c\}$
$n(A \times B) = 2 \times 3 = 6$

\# $A = \{1,2,3\}$, $B = \{2,3,4\}$, $C = \{1,4,5\}$
$(A \cup B) \times (B \cap C) = \{1,2,3,4\} \times \{4\}$
$= \{(1,4), (2,4), (3,4) (4,4)\}$

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Ques:- A company must hire 20 programmers to handle system programming job and 30 programmers for applications programming, of these hired 5 are expected to perform jobs of both types. How many programmer must be hired.

Solⁿ 45

Ques:- Show that for any two sets A and B

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

Solⁿ Let $x \in A - (A \cap B)$ — ①

$\Rightarrow (x \in A)$ and $(x \notin A \cap B)$

$\Rightarrow (x \in A)$ and $(x \notin A$ or $x \notin B)$

$\Rightarrow (x \in A$ and $x \notin A)$ or $(x \in A$ or $x \notin B)$

$\Rightarrow (x \in \emptyset)$ or $(x \in A - B)$

$\Rightarrow x \in \emptyset \cup (A - B)$

$\Rightarrow x \in (A - B)$ — ②

from ① & ②

$A - (A \cap B) \subseteq A - B$ — ③

Again

$x \in A - B$ — ④

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

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

$\Rightarrow x \in A - (A \cap B)$ — ⑤

from ④ & ⑤

$(A - B) \subseteq A - (A \cap B)$ — ⑥

from ③ & ⑥, we have

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

classmate
Date
Page

Ques:- Prove that $(A \times B) \cap (P \times Q) = (A \cap P) \times (B \cap Q)$

Proof
Let $(x, y) \in (A \times B) \cap (P \times Q)$

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

$\Rightarrow (x \in A$ and $y \in B)$ and $(x \in P$ and $y \in Q)$

$\Rightarrow (x \in A$ and $x \in P)$ and $(y \in B$ and $y \in Q)$

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

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

Therefore $(A \times B) \cap (P \times Q) \subset (A \cap P) \times (B \cap Q)$

Now, Conversely:-

$(x, y) \in (A \cap P) \times (B \cap Q)$

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

$\Rightarrow (x \in A$ and $x \in P)$ and $(y \in B$ and $y \in Q)$

$\Rightarrow (x \in A$ and $y \in B)$ and $(x \in P$ and $y \in Q)$

$\Rightarrow x \in (A \times B)$ and $y \in (P \times Q)$

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

Therefore $(A \cap P) \times (B \cap Q) = (A \times B) \cap (P \times Q)$

H.P

Ques:- Prove that $A \times (B \cap C) = (A \times B) \cap (A \times C)$

Ques:- Prove that $A \times (B \cup C) = (A \times B) \cup (A \times C)$

Do your self.

Tue – ③

⑧ Involution Laws :- $(A')' = A$

Multisets A Collection of an object that are non necessary distinct is called multiset.

OR

A Multisets is an unordered collection of elements, In which the multiplicity of an element may be one or more than one or zero. The multiplicity of an element is the number of times the element repeated in the multiset. In other words, we can say that an element can appear any number of times in a set e.g:-

$A = \{l, l, m, m, n, n, n\}$

$B = \{a, a, a, a, a, c\}$

$A = \{a,$

Note:- ① The no. of times an element appear in the multiset is called multiplicity of that element

② If A is a set and μ is the multiplicity function then it is defined as :-

$\mu : A = \{1, 2, 3, ----\}$.

so that $\mu(a) = R$ where R is the no. of times element a is the multiset.

e.g: ① If $A = \{a, b, c, c, a, c\}$ then

$\mu(a) = 2$, $\mu(b) = 1$, and $\mu(c) = 2$

② If $A = \{a, a, a, b, b, d, d, d, d, e\}$ then find $\mu(a)$, $\mu(b)$, $\mu(d)$, & $\mu(e)$

Operations of Multiset :-

1. Union of Multisets :- Let P & Q be two multisets, $P \cup Q$ is defined as the multisets such that for each element $x \in P \cup Q$, $\mu(x) = \max(\mu_P(x), \mu_Q(x))$

e.g. Let $P = \{1,1,1,2,2,3\}$ & $Q = \{1,2,2,2,3,3\}$

$P \cup Q = \{1,1,1,2,2,2,3,3\}$

2. Intersection of Multiset :- Let P & Q be two multisets then $P \cap Q$ is defined as the multiset s.t for each element $x \in P \cap Q$, we have

$$\mu(x) = \min\{\mu_P(x), \mu_Q(x)\}$$

Let $P = \{1,1,1,2,2,3\}$ & $Q = \{1,2,2,2,3,3\}$

$\mu_P(1) = 3$, $\mu_P(2) = 2$, $\mu_P(3) = 1$

$\mu_Q(1) = 1$ $\mu_Q(2) = 3$, $\mu_Q(3) = 2$

$\therefore P \cap Q = \{1, 2, 2, 3\}$

3. Difference of multisets Let P & Q be two multisets then difference of P and Q is denoted by P–Q & is a multiset s.t the multiplicity of an element in P–Q in that order is equal to the multiplicity of that element in P minus the multiplicity of the element in Q. If difference is +ve and is equal to 0, if the difference is zero or –ve then we will not consider.

$$x \in P - Q = \mu(x) = \mu_P(x) - \mu_Q(x)$$

e.g: $P = \{a, a, a, a, b, b, c, d\}$

$Q = \{a, a, b, d, e\}$

$\mu_P(a) = 4$, $\mu_P(b) = 2$, $\mu_P(c) = 1$, $\mu_P(d) = 1$

$\mu_Q(a) = 2$ $\mu_Q(b) = 1$ $\mu_Q(c) = 0$ $\mu_Q(d) = 1$

$\mu_Q(e) = 1$

$P - Q = \{a, a, b, c\}$

\# $A = (l, m, m, m, n, n, n, p, p, p)$

$B = (l, m, m, m, m, n, n, r, r, r)$

then $A - B = (\cancel{m}, n, p, p, p)$

④ <u>Sum of multisets</u>:- The sum of multisets of P & Q is defined as $x \in P + Q \Rightarrow \mu(x) = \mu_P(x) + \mu_Q(x)$

e.g: $P = \{a, a, b, b, b, c\}$ $Q = \{a, a, a, b, c, d, c, e\}$

$P + Q = \{a, a, a, a, a, b, b, b, b, c, c, c, d, e\}$

$A = \{l, m, n, p, r\}$

$B = \{l, l, m, m, n, n, n, p, r, r\}$

$A + B = \{l, l, l, m, m, m, n, n, n, n, p, p, r, r, r\}$

⑤ <u>Cardinality of a Multiset</u>:- The cardinality of a multiset is the number of distinct element in the multiset without considering of an element e.g:

$A = \{l, l, m, m, n, n, n, p, p, p, p, r, r, r\}$

$n(A) = 5$