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Unit - I

Set Theory

Set → A set is any well-defined collection of objects.

$$MCA = \{\underbrace{1,2,3,4,5,6,7,8}_{\text{elements}}\}$$

→ The objects are called <u>elements</u> or members of the set

→ $A = \{a,b,c\}$

A ↓ capital letter (set)

a,b,c ↓ small letter (elements)

$a \in A$, $b \in A$, $c \in A$, $d \notin A$

$\in$: belongs to; $\notin$: not belongs to

* Representation of a set →

I Roster Method → A set can be represented by actually <u>listing</u> all the elements that belongs to it.

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

Equal $A = B$, order matter → No

$A \neq B$ order matter → Yes

distinct elements → in a set → $A = \{a,b,c,a\}$

→ $A = \{a,b,c\}$

II Set Builder Form → A set is sometimes define by the property or the <u>rules</u> which characterises all the elements of the set.

Set Builder → $A = \{x \mid x \in N, x \leq 7\}$

x: element; $\mid$: Such that; $\in$: belongs to

Roster → $A = \{1,2,3,4,5,6,7\}$

$A = \{x \mid x = n^2, n \in N\}$
$A = \{1, 4, 9, 16, 25, 36 \ldots \infty\}$

* Types of Sets →

① **Finite set** → A set is said to be finite if it consist of only finite number of elements. $A = \{x \mid x \in N, x \leq 7\}$

② **Infinite set** → A set is said to be infinite if it consist the infinite no. of elements.

$A = \{x \mid x \in N\}$

③ **The Empty set** → (NULL set)
A set having no elements is called the empty set. It is also called the NULL set or void set.
$A = \{\}, \phi$

④ $\{\phi\}$ → **Singleton set** → A set having one element is called singleton set.
$\{1\}, \{2\}, \{\phi\}, \{\alpha\}, \{\beta\}$

Subset →
Let A & B are 2 sets. The set A is said to be a subset of the ~~subset~~ set B if every element of set A is also an element of set B.

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

superset of set A → $B = \{1, 2, 3, 4, 5, 6\}$

$A \subseteq B$

↑ subset

* Every set is a subset of itself.

$A \subseteq A$

$\boxed{\text{Proper Subset}}$ → If A is the subset of B, $A \subseteq B$ & $A \neq B$ then we say that A is a proper subset of B.

$\boxed{\text{or}}$

A non-empty set A is said to be a proper subset of B, if there is atleast one element of B which is not in A.

$A = \{1, 2\}$ ← proper subset

$B = \{1, 2, 3, 4\}$

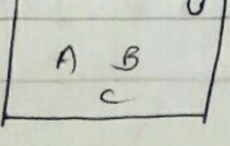
$A \subseteq B$, $A \neq B$

↑ subset → $\subset$, $=$

$$\boxed{A \subset B}$$

↑ proper subset

$\boxed{\text{Universal Set}}$ → If we are dealing with some sets, all of which are subset of a set then this set is called the universal set.



$A \subseteq U$

$\boxed{\text{Equal set}}$ → 2 set A & B are said to be equal if A is the subset of B & B is the subset of A

$A = \{1,2\}$, $B = \{1,2\}$ $A \subseteq B$ & $B \subseteq A$

$\boxed{A = B}$

$\boxed{\text{Cardinal Number of Finite Set}}$ →

The cardinal no. of a set is the no. of the distinct element in a finite set A & is denoted by $n(A)$.

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

$n(A) = 3$

$\boxed{\text{Equivalent Set}}$ → 2 Finite sets A & B are equivalent if their cardinal no.s are same.

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

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

elements d/t otherwise Equal set

$n(A) = 3$, $n(B) = 3$

$n(A) = n(B)$

$\boxed{\text{Power Set}}$ → Let a be a set then collectn of all the subset of A including the NULL set is set of A. & it's indicated by the power P(A) called

$\boxed{\begin{array}{l} A = n \\ P(A) = 2^n \end{array}}$

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

$P(A) = \{\}, \{1\}, \{2\}, \{3\}, \{1,2\}, \{2,3\}, \{3,1\}, \{1,2,3\}$

$n = 3$, $2^n = 2^3 = 8 = P(A)$

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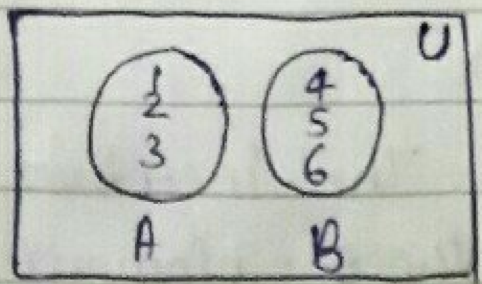
Venn Diagram

→ Many properties of the set can be easily verified with the help of diagrams. called the venn diagram.

→ In venn diagram the Universal set U is represented by points within a rectangle & its subsets are represented by points in closed reason usually circle drawn within the rectangle

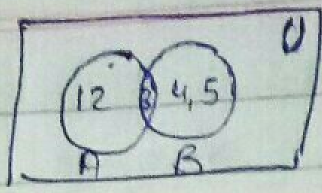


$A, B \subset U$

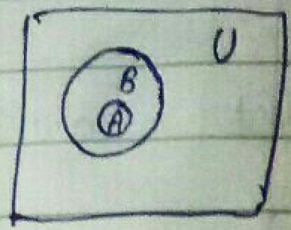
$A = \{1, 2, 3\}$

$B = \{4, 5, 6\}$

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



$A \subset B$



Operations on sets →

① Union OF 2 Set →

Let A & B be two Sets. The union of A & B is the set of all those elements which belong either to A or to B, or to both A and B.
The notation $\boxed{A \cup B}$ is used to denote the union of A and B.

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

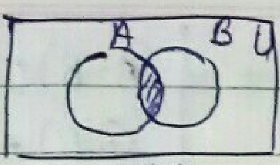
$A \cup B = \{1, 2, 3, 4, 5\}$

~~$A \cup B = \{x \mid x \in N : x \leq 5\}$~~

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

② Intersection OF two set →

Let A & B be 2 Sets. The insection of A and B is the set of all those element that belongs to both A and B.
→ The notation $A \cap B$ is used to denote the intersection of A and B



$A \cap B$

$A = \{1, 2, 3\}$ $\quad A \cap B = \{3\}$

$B = \{3, 4, 5\}$ $\quad A \cap B = \{x \mid x \in A \text{ and } x \in B\}$

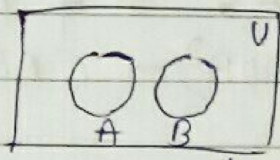
③ $\boxed{\text{Disjoint Set}}$ →

when 2 sets have no common elements then they are called the disjoint set.

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

$B = \{4, 5\}$

$A \cap B = \phi$

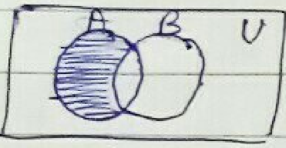


$A \cap B = \phi$

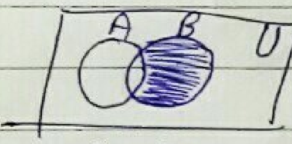
④ $\boxed{\text{Difference of 2 Sets}}$ → Let A & B be two sets, then $(A - B)$ is the set of all those elements of the set A which are not in the set B. $A = \{1, 2, 3, 4, 5, 6\}$ $B = \{2, 4, 6, 8, 10, 12\}$

$A - B = \{1, 3, 5\}$

$B - A = \{8, 10, 12\}$



A − B



B − A

$A - B = \{x \mid x \in A, x \notin B\}$ $\quad B - A = \{x \mid x \notin A, x \in B\}$

⑤ $\boxed{\text{Symmetric Difference of 2 Sets}}$ → Let A and B be two sets, the symmetric difference of set A & B is $\boxed{(A - B) \cup (B - A)}$ the set. & it is denoted by $A \Delta B$ or $A \oplus B$.

Δ ↓ Delta

⊕ Ringsum

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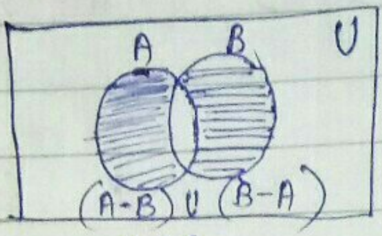
$A \Delta B = (A-B) \cup (B-A)$



$A \Delta B$

$A \Delta B = \{x : x \notin A \cap B\}$

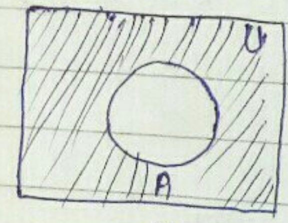
$A \Delta B = (A \cup B) - (A \cap B)$

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

$\boxed{LHS = RHS}$

⑥ **Complement of a Set** →

Let U be the universal set & A be any subset of U, then the complement of set A is the set of all those element of U which are not in the set A.



A'

$A' = \{x \mid x \in U, x \notin A\}$

⑦ **Principle of Mathematical Induction** →

→ It is one of the most imp. tools for making proofs of the theorems.

→ Acc. to this principle, A statement $P(n)$ is true for all Natural no.s n, if

Proove-(i) The statement is true for $n=1$

Consider-(ii) The statement is true for $n=k$

Proove-(iii) then it is also true for $n=k+1$ when k is any natural no.

(no. of steps $= n$) → $n=1$ single element $(n-1)+n+(n+1)$

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$\boxed{\text{eg}}$ → By the principle of mathematical induction, prove that

$$1.2 + 2.3 + \cdots + n(n+1) = \frac{n(n+1)(n+2)}{3}$$

$\boxed{\text{Sol}}$ →

Let $P(n) = 1.2 + 2.3 + \cdots + n(n+1) = \frac{n(n+1)(n+2)}{3}$

I $\boxed{n=1}$ ⇒ LHS = RHS

LHS $1.2 = 2$

RHS $\frac{1(1+1)(1+2)}{3} = \frac{1.2.3}{3} = 2$

∴ for $n=1$ given statement is true.

II suppose $\boxed{n=k}$

$$1.2 + 2.3 + \cdots + k(k+1) = \frac{k(k+1)(k+2)}{3}$$

III $\boxed{n = k+1}$

$\cdots + (n\quad)(n-1) + n(n+1)$

LHS → $1.2 + 2.3 + 3.4 + \cdots + (k+1)(k+2)$

$k(k+1)$

RHS → $\frac{(k+1)(k+1+1)(k+1+2)}{3} = \frac{(k+1)(k+2)(k+3)}{3}$

LHS

⇒ $\frac{k(k+1)(k+2)}{3} + (k+1)(k+2)$

$\frac{(k+1)(k+2)(k+3)}{3}$ = RHS

Q. $P(n) = 1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$

$n \geq 1$

$\boxed{n=1}$

LHS $\quad 1^2 = 1$

$RHS = \frac{1(2)(3)}{6} = 1$

$(n=k)$

$P(n): 1^2 + 2^2 + 3^2 + \dots + k^2 = \frac{k(k+1)(2k+1)}{6}$

$(n=k+1)$

$P(n): 1^2 + 2^2 + 3^2 + \dots (k)^2 + (k+1)^2 = \frac{(k+1)(k+2)(2k+3)}{6}$

LHS $\Rightarrow \frac{k(k+1)(2k+1)}{6} + (k+1)^2$

$\frac{(k+1)[k(2k+1) + 6(k+1)]}{6}$

$\frac{(k+1)(2k^2 + k + 6k + 6)}{6}$

$\Rightarrow \frac{(k+1)(2k^2 + 3k + 4k + 6)}{6}$

$\Rightarrow \frac{(k+1)(2k+3)(k+2)}{6} = RHS$

12
3–4
$2k^2 + 3k + 4k + 6$
$k(2k+3) + 2(2k+3)$

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Q. For any positive integer n proove that

$\boxed{7^n - 3^n}$ is divisible by 4.

4
8
12
16

$\boxed{\text{Sol}} \rightarrow$ Any number divisible by 4 = 4 X Natural numbers

For $\boxed{n=1}$ $P(n) = 7^n - 3^n = 4d$ where $d \in N$

LHS $7^1 - 3^1 \Rightarrow 4$

RHS $= 4 \times 1 = 4$ true

Assume $\boxed{n=K}$ $7^K - 3^K = 4m$, where $m \in N$ true

prove $\boxed{n = K+1} \Rightarrow 7^{K+1} - 3^{K+1} = \text{LHS}$ $\left[\begin{array}{l} 7^K - 3^K = 4m \\ 7^K = 4m + 3^K \end{array}\right]$

$\Rightarrow 7^K . 7^1 - 3^K 3^1$

$\Rightarrow 7.(4m + 3^K) - 3.3^K$

$\Rightarrow 7.4m + 7.3^K - 3.3^K$ true RHS.

$\Rightarrow 4.7m + 4.3^K \Rightarrow 4\underbrace{(7m + 3^K)}_{\text{Natural numbers}} = 4r$

Q $1^3 + 2^3 + 3^3 + \text{———} + n^3 = \left[\dfrac{n(n+1)}{2}\right]^2$

$n=1$ LHS = 1

RHS = 1

$n=k$ $1^3 + 2^3 + 3^3 + \text{———} + K^3 = \left[\dfrac{K(K+1)}{2}\right]^2$

$n=k+1$ $\underbrace{1^3 + 2^3 + 3^3 + \cdots\ k^3}_{} + (K+1)^3 = \left[\dfrac{(K+1)(K+2)}{2}\right]^2$

$\left[\dfrac{K(K+1)}{2}\right]^2 + (K+1)^3$

$\dfrac{K^2(K+1)^2 + 2^2(K+1)^3}{2^2}$

$\dfrac{(K+1)^2 \left((K+1)2^2 + K^2\right)}{2^2} \Rightarrow \dfrac{(K^2 + 4K + 4)(K+1)^2}{2^2} \Rightarrow \left[\dfrac{(K+2)(K+1)}{2}\right]^2$

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Q $\frac{1}{1.2} + \frac{1}{2.3} + \frac{1}{3.4} + \text{---} + \frac{1}{n(n+1)} = \frac{n}{n+1}$

P of M.I.

$P(n)$:

LHS $P(1) = \frac{1}{1.2} = \frac{1}{2}$

$P(2) = \frac{1}{1.2} + \frac{1}{2.3} = \frac{1}{2} + \frac{1}{6} = \frac{4}{6} = \frac{2}{3}$

RHS $\frac{n}{n+1} = \frac{1}{2}$

Assume $(n = k / m)$

$P(m) : \frac{1}{1.2} + \frac{1}{3.4} + \text{---} + \frac{1}{m(m+1)} = \frac{m}{m+1}$

$(n = m+1)$ — (1)

$P(m+1) = \frac{1}{1.2} + \frac{1}{3.4} + \text{---} + \frac{1}{m(m+1)} + \frac{1}{(m+1)(m+2)}$

LHS $\Rightarrow \frac{m}{m+1} + \frac{1}{(m+1)(m+2)} = \frac{m+1}{m+2}$

$\Rightarrow \frac{1}{(m+1)}\left[m + \frac{1}{m+2}\right]$

$\frac{1}{m+1} \cdot \frac{m(m+2)+1}{(m+2)} \Rightarrow \frac{m^2+2m+1}{m+1\ (m+2)}$

$\Rightarrow \frac{(m+1)^2}{(m+1)(m+2)} = \frac{m+1}{m+2}$ RHS

$$7^n - 3^n = 12 \qquad \frac{12}{4} = 3$$

$$7^n - 3^n = 4 \times 3$$

8

$$\boxed{7^n - 3^n = 4K} \quad 12 = 4 \times 3$$

$K \in N$

$P(n)$: $7^n - 3^n$ is divisible by 4

$n = 1$

$P(1)$ $\quad 7 - 3 = 4$

$n = m$

Suppose, $P(m)$: $7^m - 3^m$ is divisible by 4.

Variable, K belongs to Natural numbers.

$K \in N$

$$7^m - 3^m = 4k$$

$n = m+1$

$$P(m+1) = 7^{m+1} - 3^{m+1}$$

$$\Rightarrow 7^m . 7^1 - 3^m . 3^1$$

$$\Rightarrow 7^m (4+3) - 3^m . 3$$

$$\Rightarrow 7^m . 4 + 7^m . 3 - 3^m . 3$$

$$\Rightarrow 7^m . 4 + 3 (7^m - 3^m)$$

$$\Rightarrow 7^m 4 + 3 . 4K$$

$$\Rightarrow 4 . 7^m + 4 . 3K$$

$$\Rightarrow 4 (7^m + 3K)$$

$7^m + 3K = \mu$

$\mu \in N$

$\Rightarrow 4\mu$ Hence proved.

R.H.S.

* Principle of Inclusion - Exclusion →

⇒ Addition Rule →

2 finite set → A B dijoint set

$A \cap B = \phi$

$|A \cup B| = |A| + |B|$

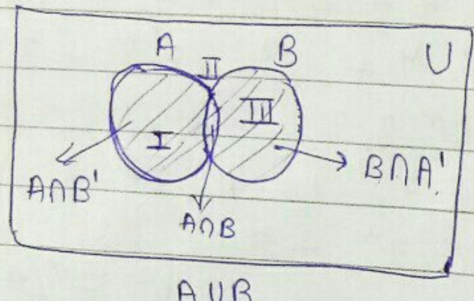
$n(A \cup B) = n(A) + n(B)$

I ⇒ A, B are 2 finite set but not dis joint

$$\boxed{|A \cup B| = |A| + |B| - |A \cap B|}$$

This is P of I-E.

$$|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |B \cap C| - |A \cap C| + |A \cap B \cap C|$$



$A \cup B$

$A =$ I + II

$B =$ II + III

$|A \cup B| = |A| + |B| - |A \cap B|$

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

acc. to addition rule → $|A \cup B| = |A| + |B|$

$|A \cup B| = |A \cap B'| + |A \cap B| + |A' \cap B|$ —— (1)

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

addition rule $|A| = |A \cap B'| + |A \cap B|$ —— (2)

$$|B| = |A \cap B| + |A' \cap B| \quad \text{——— (3)}$$

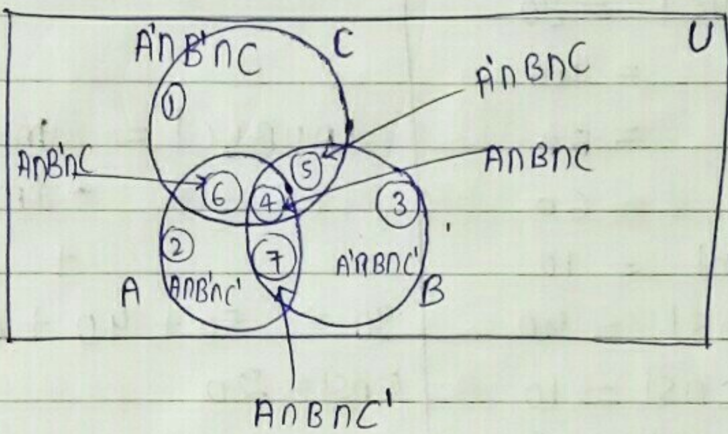
$$|A \cup B| = |A| \cancel{- |A \cap B|} \cancel{+ |A \cap B|} + |B| - |A \cap B|$$

$$\boxed{|A \cup B| = |A| + |B| - |A \cap B|}$$ proved

p. of I.E.

II 3 finite set → A, B, C, → not disjoint

$A = 2 + 4 + 6 + 7$
$B = 1 + 4 + 5 + 7$
$C = 3 + 4 + 5 + 6$



$|A \cup B \cup C| = A' \cap B' \cap C + A \cap B' \cap C' + A' \cap B \cap C' + A \cap B \cap C + A' \cap B \cap C + A \cap B \cap C' + A \cap B' \cap C$ ——— (4)

By addition Rule →

$$|A| = |A \cap B' \cap C'| + |A \cap B \cap C| + |A \cap B' \cap C| + |A \cap B \cap C'| \quad \text{— (1)}$$

$$|B| = |A' \cap B \cap C'| + |A \cap B \cap C| + |A \cap B \cap C'| + |A' \cap B \cap C| \quad \text{— (2)}$$

$$|C| = |A' \cap B' \cap C| + |A \cap B \cap C| + |A \cap B' \cap C| + |A' \cap B \cap C| \quad \text{— (3)}$$

[Add (1) + (2) + (3) eq. & (use eq (4))]

$$|A| + |B| + |C| = |A \cup B \cup C| + |A \cap B \cap C| + |A \cap B \cap C| + |A \cap B \cap C'| + |A \cap B' \cap C| + |A' \cap B \cap C| \quad \text{——— (5)}$$

[⇒ add & minus $|A \cap B \cap C|$]

$$|A| + |B| + |C| = |A \cup B \cup C| + |A \cap B \cap C| + |A \cap B \cap C| + |A \cap B \cap C'| + |A \cap B' \cap C| + |A' \cap B \cap C| + |A \cap B \cap C| - |A \cap B \cap C|$$

$$\left\{ \begin{aligned} |A \cap B| &= |A \cap B \cap C| + |A \cap B \cap C'| \\ |B \cap C| &= |A \cap B \cap C| + |A' \cap B \cap C| \\ |A \cap C| &= |A \cap B \cap C| + |A \cap B' \cap C| \end{aligned} \right\}$$

$$|A| + |B| + |C| = |A \cap B| + |B \cap C| + |A \cap C| + |A \cup B \cup C| - |A \cap B \cap C|$$

$$|A \cup B \cup C| = |A| + |B| + |C| + |A \cap B \cap C| - |A \cap B| - |B \cap C| - |A \cap C|$$ proved

Q In a group of 90 students each of whom has taken atleast matematic or computer science & social science.

It work! 40 student having math.

50 students having comp sci

60 student SS.

10 student have math & comp

40 Student have math as well as SS

10 Student have all the 3 subject

Find the no. of student computer sci & SS But not math.

Sol →

$|A \cup B \cup C| = 90$

$|m| = 40$

$|c| = 50$

$|S| = 60$

$|m \cap c| = 10$

$|m \cap S| = 40$

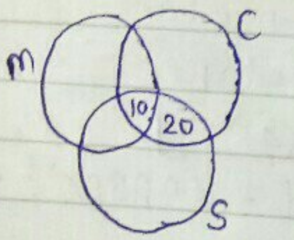
$|m \cap c \cap S| = 10$

$|c \cap S| = ?$

$|A \cup B \cup C| = |m| + |c| + |S| - |m \cap c| - |m \cap S| - |c \cap S| + |m \cap c \cap S|$

$90 \Rightarrow 50 + 40 + 60 - 10 - 40 - |c \cap S| + 10$

$|c \cap S| = 20$



$\Rightarrow |c \cap S| = I + II$

$20 = I + 10$

$\boxed{I = 10}$ Ans.

Que. In a committee, 50 people can speak french, 20 Spanish & 10 can speak Spanish & french both, then How many people can speak atleast one language or both.

$|F| = 50$

$|S| = 20$

$|F \cap S| = 10$

$|F \cup S| = |F| + |S| - |F \cap S|$

$= 50 + 20 - 10$

$\boxed{|F \cup S| = 60}$

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Q. In How many ways the letters AAAA EEE OO of english alphabet can be arranged so that all letters of the same kind don't appear in a single block ?

$$P(n,r) = {}^{n}P_{r} = \boxed{\frac{\lfloor n}{\lfloor r}}$$

(Total no. of object) distinct object (no. of ways)

no. of object selected

Sol → let P = the no. of permutations of 9 letter

$$P = \frac{9!}{4!\ 3!\ 2!} = \frac{9\times8\times7\times6\times5}{3\times2\times2} \Rightarrow 1260$$

Now the no. of permutation when all Four A's present of from of group

$$P(A) = \frac{6!}{3!\ 2!} = \frac{6\times5\times4}{2!} = \frac{120}{2} = 60$$

$$P(E) = \frac{7!}{4!\ 2!} = \frac{7\times6\times5}{2} = 105$$

$$P(O) = \frac{8!}{4!\ 3!} = \frac{8\times7\times6\times5}{3\times2} = 280$$

All Four A's and three E's as a group →

$$P(A\cap E) = \frac{4!}{2!} = 4\times3 = 12$$

$$P(A\cap O) = \frac{5!}{3!} = 20$$

$$P(E\cap O) = \frac{6!}{4!} = 6\times5 = 30$$

$$P(A\cap E\cap O) = 3! = 3\times2 = 6$$

P of I.E.

$$\boxed{P(A\cup E\cup O) = P(A) + P(E) + P(O) - P(A\cap E) - P(E\cap O) - P(A\cap O) + P(A\cap E\cap O)}$$

$$P(A \cup E \cup O) = \frac{6!}{3!\,2!} + \frac{7!}{4!\,2!} + \frac{8!}{4!\,3!} - \frac{4!}{2!} - \frac{5!}{3!} - \frac{6!}{4!} + 3!$$

$$= 60 + 105 + 280 - 12 - 20 - 30 + 6$$

$$= 445 - 12 - 20 - 30 + 6$$

$$= 445 - 62 + 6$$

$$= 451 - 62$$

$P(A \cup E \cup O) = 389$, all 4 A's, 3 E's, 2 O's are not in gap

$P(A' \cap E' \cap O') = P - P(A \cup E \cup O) = 1260 - 389 = 871$

Que. In how many ways the 26 letters of the english alphabet can be permuted so that none of the word SUN (B), TEA (C), BOY (D) or GIRL (E) occurs.

→ $S = \lfloor 26$

Let S be the set of permutation of all 26 letters of english alphabet

→ Further let B, C, D, E be the set of all permutations, when the word SUN, TEA, BOY and GIRL are present respectively in the permutation of S

$|B| = 24!$
$|C| = 24!$
$|D| = 24!$
$|E| = 23!$
$|B \cap C| = 22!$
$|B \cap D| = 22!$
$|C \cap D| = 22!$
$|B \cap E| = 21!$
$|C \cap E| = 21!$

$|B \cap C \cap D| = 20!$
$|B \cap C \cap E| = 19!$
$|B \cap D \cap E| = 19!$
$|C \cap D \cap E| = 19!$
$|B \cap C \cap E \cap D| = 17!$

Total no. of permutations possible with 26 alphabets

where B[SUN] occurs always, $|B| = (26-3+1)! = 24!$

$|C| = 24!$

$|D| = 24!$

$|E| = (26-4+1) = 23!$

where B[SUN] & C[TEA] occurs always, $|B \cap C| = (26-3-3+2) = 22!$

Sun	Boy	$|B \cap D| = 22!$
Sun	Girl	$|B \cap E| = (26-3-4+2) = 21!$
tea	Boy	$|C \cap D| = 22!$
tea	Girl	$|C \cap E| = 21!$
Boy	Girl	$|D \cap E| = 21!$

where SUN, TEA, BOY occurs always, $|B \cap C \cap D| = (26-3-3-3+3) = 20!$

Sun	tea	Girl	$|B \cap C \cap E| = (26-3-3-4+3) = 19!$
Sun	Boy	Girl	$|B \cap D \cap E| = 19!$
Tea	Boy	Girl	$|C \cap D \cap E| = 19!$

where Sun tea Boy Girl occurs always, $|B \cap C \cap D \cap E| = (26-3-3-3-4+4) = 17!$

$$|B \cup C \cup D \cup E| = |B| + |C| + |D| + |E| - |B \cap C| - |B \cap D| - |B \cap E| - |C \cap D| - |C \cap E| - |D \cap E| + |B \cap C \cap D| + |B \cap C \cap E| + |B \cap D \cap E| + |C \cap D \cap E| - |B \cap C \cap D \cap E|$$

$$\Rightarrow [24! + 24! + 24! + 23!] - 22! - 22! - 22! - 21! - 21! - 21! + [20! + 19! + 19! + 19!] - 17!$$

$$\Rightarrow [3(24!) + 23!] - 3(22!) - 3(21!) + [20! + 3(19!)] - 17!$$

$$|B' \cap C' \cap D' \cap E'| = |S| - |B \cup C \cup D \cup E|$$

$$= \underline{|26} - \left[[3(24!) + 23!] - [3(22!) + 3(21!)] + [20! + 3(19!)] - 17! \right]$$

$$\Rightarrow 26! - [3(24!) + 23!] + [3(22!) + 3(21!)] - [20! + 3(19!)] + 17!$$

(8) out of 20 members in a family 11 like to take tea & 14 like coffee. assume that each member likes atleast one of the two drinks. How many like →

i) both tea and coffee

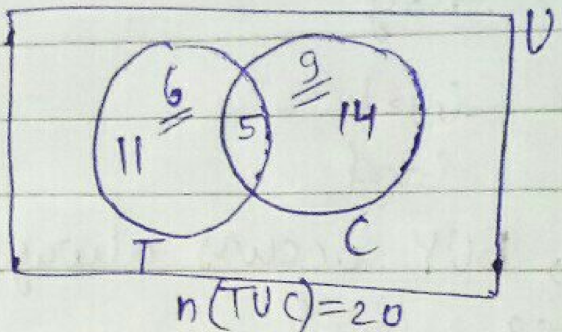
ii) only tea & not coffee

iii) only coffee & not tea

$|T| = 11$

$|C| = 14$

$|T \cup C| = 20$



$$|T \cup C| = |T| + |C| - |T \cap C|$$

$$20 = 11 + 14 - |T \cap C|$$

$$\boxed{|T \cap C| = 5}$$

i) $|T \cap C| = 5$

ii) $|T \cap C'| = |T| - |T \cap C|$

$= 11 - 5$

$|T| - |T \cap C| = 6$

iii) $|C| - |T \cap C| = 14 - 5$

$|C| - |T \cap C| = 9$

Q. 1 ——— 250 ← Find integer between

2, 3, 5 ← divisible by

$A = \frac{250}{2} = 125$

$B = \frac{250}{3} \neq 83.33 \neq$

$= 83$ ✓

$C = \frac{250}{5} = 50$

$|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |B \cap C| - |A \cap C| + |A \cap B \cap C|$

$|A \cap B| = \frac{250}{6} = 41$

$|B \cap C| = \frac{250}{15} = 16$

$|A \cap C| = \frac{250}{10} = 25$

$|A \cap B \cap C| = \frac{250}{30} = 8$

$\Rightarrow 125 + 83 + 50 - 41 - 16 - 25 + 8$

$\Rightarrow 266 - 82$

$\Rightarrow 184$

Ordered Pair →

Let A & B be two set, if we take an element $a \in A$ and $b \in B$ and write (a,b), the 1st element taken from the set A & the 2nd element taken from the set B, the (a,b) is called ordered pair

$(a,b) \rightarrow$ ordered pair can't write → ~~(b,a)~~
$a \in A$, $b \in B$

→ The ordered pair (a,b) is not the same as the ordered pair (b,a).

Cartisian Product of Sets →

→ Let A & B are 2 sets, the set of all ordered pair (a,b) such that $a \in A$ & $b \in B$, is called the cartisian product of set A and set B.

→ The cartisian product of 2 sets A and B is denoted by '$A \times B$'.

eg → 2 Finite set − A, B

$(x+y)\ (x^2+y^2)$

$A \times B$

$A = \{1,2\}$ $B = \{a,b,c\}$

$A \times B = \{1,2\} \times \{a,b,c\}$

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

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$\boxed{\text{Roster Form}}$:

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

$A \times B \neq B \times A$

$\boxed{\text{Set Builder Form}}$:

$A \times B = \{(a,b) \mid a \in A \ \& \ b \in B\}$