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CH1: SET LANGUAGE

Exercise - 1.1

1. Which of the following are sets?

- i. The collection of prime numbers upto 100. - set
- ii. The collection of rich people in India. - Not a set
- iii. The collection of all rivers in India. - Set
- iv. The collection of good Hockey players. - Not a set

2. List the set of letters of the following words in Roster form.

- i. INDIA - $\{I, N, D, A\}$
- ii. PARALLELOGRAM - $\{P, A, R, L, E, O, G, R, A, M\}$
- iii. MISSISSIPPI - $\{M, I, S, P\}$
- iv. CZECHOSLOVAKIA - $\{C, Z, E, H, O, S, L, V, A, K, I, A\}$

3. Consider the following sets $A = \{0, 3, 5, 8\}$, $B = \{2, 4, 6, 10\}$ and $C = \{12, 14, 18, 20\}$.

(a) State Whether True or False.

i. $18 \in C$ - True

ii. $6 \in A$ - True

iii. $14 \in C$ - False

iv. $10 \in B$ - True

$$V, 5 \in B \quad \text{False}$$

$$VI, 0 \in B \quad \text{False}$$

(b) Fill ups

$$i, 3 \in \underline{A}$$

$$ii, 14 \in \underline{C}$$

$$iii, 18 \notin B$$

$$iv, 4 \in B$$

4. Represent the following sets in Roster form.

i, A = The set of all even natural numbers less than 20.

$$\text{Ans} = A = \{2, 4, 6, 8, 10, 12, 14, 16, 18\}$$

$$ii, B = \{y : y = \frac{1}{2n}, n \in \mathbb{N}, n \leq 5\}$$

$$\text{Ans} = B = \{\frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}, \frac{1}{10}\}$$

$$iii, C = \{x : x \text{ is perfect cube}, 27 < x < 216\}$$

$$\text{Ans} = C = \{64, 125\}$$

$$1^3 = 1$$

$$2^3 = 8$$

$$3^3 = 27$$

$$4^3 = 64$$

$$5^3 = 125$$

$$6^3 = 216$$

$$iv, D = \{x : x \in \mathbb{Z}, -5 < x \leq 2\}$$

$$\text{Ans} = D = \{-4, -3, -2, -1, 0, 1, 2\}$$

5. Represent the following sets in set builder form.

i, $B =$ The set of all cricket players in India who scored double centuries in one Day International.

Ans :- $B = \{x : x \text{ is an Indian player who scored double centuries in one Day International}\}$

ii, $C = \left\{ \frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \dots \right\}$

Ans :- $C = \left\{ x : x = \frac{n}{n+1}, n \in \mathbb{N} \right\}$

iii, $D =$ The set of all Tamil months in a year.

Ans :- $D = \{x : x \text{ is an Tamil month in a year}\}$

iv, $E =$ The set of odd whole numbers less than 9.

Ans :- $E = \{x : x \text{ is an odd whole number less than 9}\}$

6. Represent the following sets in descriptive form.

i. $P = \{ \text{January, June, July} \}$

Ans :- $P =$ The set of English months starting with letter J.

ii. $Q = \{ 7, 11, 13, 17, 19, 23, 29 \}$

Ans :- $Q =$ The set of prime numbers between 5 and 31.

iii. $R = \{ x : x \in \mathbb{N}, x < 5 \}$

Ans :- $R =$ The set of natural numbers less than 5.

iv. $S = \{ x : x \text{ is a consonant in English alphabets} \}$

Ans :- $S =$ The set of consonant in English alphabets.

17/7/2020

Exercise 1.2

1. Find the cardinal numbers of the following sets.

i. $M = \{p, q, r, s, t, u\}$

Ans :- $n(M) = 6.$

ii.

$$P = \{x : x = 3n + 2, n \in \mathbb{W} \text{ and } x < 15\}$$

Since, $\{n = \{0, 1, 2, 3, 4, \dots\}$
 $x < 15.$

$$x = 3(0) + 2 = 2$$

$$3(1) + 2 = 5$$

$$3(2) + 2 = 8$$

$$3(3) + 2 = 11$$

$$3(4) + 2 = 14$$

$$P = \{2, 5, 8, 11, 14\}$$

Ans :- $n(P) = 5$

iii.

$$Q = \{y : y = \frac{4}{3n}, n \in \mathbb{N} \text{ and } 2 < n \leq 5\}$$

$$n = \{3, 4, 5\}$$

$$y = \frac{4}{3(3)} = \frac{4}{9}$$

$$= \frac{4}{3(4)} = \frac{4}{12}$$

$$= \frac{4}{3(5)} = \frac{4}{15}$$

$$Q = \left\{ \frac{4}{9}, \frac{4}{12}, \frac{4}{15} \right\}$$

Ans :- $n(Q) = 3$

iv, $R = \{x : x \text{ is an integer, } x \in \mathbb{Z} \text{ and } -5 \leq x \leq 5\}$

$$x = \{-5, -4, -3, -2, -1, 0, 1, 2, 3, 4\}$$

$$R = \{-5, -4, -3, -2, -1, 0, 1, 2, 3, 4\}$$

Ans :- $n(R) = 10$

v, $S = \text{The set of all leap years between 1882 and 1906.}$

$\therefore 1884$ is leap year.

$$S = \{1884, 1888, 1892, 1896, 1900, 1904\}$$

Since :- $4 \overline{) 71} - Q$

$$\begin{array}{r} 4 \overline{) 1884} \\ \underline{16} \\ 28 \\ \underline{28} \\ 04 \end{array}$$

$\frac{4}{0} - R$

Ans :- $n(S) = 5$

2. Identify the following sets as finite or infinite

i, $x = \text{The set of all districts in Tamil Nadu}$

Ans :- Finite

ii, $y = \text{The set of all straight lines passing through a point.}$

Ans :- Infinite

iii. $\{x : x \in \mathbb{Z} \text{ and } x < 5\}$

Ans:- Infinite.

iv.

$$B = \{x : x^2 - 5x + 6 = 0, x \in \mathbb{N}\}$$

$$(x-3)(x-2) = 0$$

$$x-3=0$$

$$x=3$$

$$x-2=0$$

$$x=2$$

$$(x-3)(x-2)$$

B is a finite set.

$$x^2 - 3x - 2x + 6$$

$$x(x-3) - 2(x-3)$$

$$(x-3)(x-2) = 0$$

3. Which of the following sets are equivalent or unequal or equal sets?

i. A = The set of vowels in the English alphabets.

B = The set of all letters in the word "VOWEL".

Ans:- equivalent sets.

ii. $C = \{2, 3, 4, 5\}$

$$D = \{x : x \in \mathbb{W}, 1 < x < 5\}$$

Ans:- unequal sets.

iii. E = The set of A = $\{x : x \text{ is a letter in the word "LIFE"}\}$

$$F = \{F, I, L, E\}$$

Ans:- Equal sets.

iv. G = $\{x : x \text{ is a prime number and } 3 < x < 23\}$

H = $\{x : x \text{ is a divisor of } 18\}$.

Ans:- Equivalent sets.

4. Identify the following sets as null set or Singleton set.

i. $A = \{x : x \in \mathbb{N}, 1 < x < 2\}$

Ans :- null set.

ii. $B =$ The set of all even natural numbers which are not divisible by 2.

Ans :- null set.

iii. $C = \{0\}$.

Ans :- Singleton set.

iv. $D =$ The set of all triangles having four sides.

Ans :- null set.

5. ~~If~~ State which pairs of sets are disjoint or overlapping?

i. $A = \{f, i, a, s\}$ and $B = \{a, n, f, h, s\}$

Ans :- overlapping.

ii. $C = \{x : x \text{ is a prime number}, n < 2\}$ and $D = \{x : x \text{ is an even prime number}\}$

Ans :- disjoint

iii. $E = \{x : x \text{ is a factor of } 24\}$ and $F = \{x : x \text{ is a multiple of } 3, x < 30\}$

Ans :- overlapping.

6. If $S = \{\text{square, rectangle, circle, rhombus, triangle}\}$, list the elements of the following subset of S .

i. The set of shapes which have 4 equal sides.

Ans :- $\{\text{square, rhombus}\}$.

ii. The set of shapes which have radius

Ans :- $\{\text{circle}\}$.

iii. The set of shapes in which the sum of all interior angle is 180° .

Ans :- $\{\text{triangle}\}$.

iv. The set of shapes which have 5 sides.

Ans :- $\{\}$.

7. If $A = \{a, \{a, b\}\}$, write all the subsets of A .

Sol:-

Subsets of $A = \{\{\}, \{a\}, \{a, b\}, \{a, \{a, b\}\}\}$.

8. Write down the power set of the following sets.

i, $A = \{a, b\}$

Sol:-

Power set of $A = \{\{\}, \{a\}, \{b\}, \{a, b\}\}$.

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

Sol:-

Power set of $B = \{\{\}, \{1\}, \{2\}, \{3\}, \{1, 2\}, \{1, 3\}, \{2, 3\}, \{1, 2, 3\}\}$.

iii, $D = \{p, q, r, s\}$

Sol:-

Power set of $D = \{\{\}, \{p\}, \{q\}, \{r\}, \{s\}, \{p, q\}, \{p, r\}, \{p, s\}, \{q, r\}, \{q, s\}, \{r, s\}, \{p, q, r\}, \{p, q, s\}, \{p, r, s\}, \{q, r, s\}, \{p, q, r, s\}\}$

9. Find the number of subsets and the number of proper subsets of the following sets.

i, $W = \{\text{red, blue, yellow}\}$

Sol:-

Number of subsets $= 2^m$

$m = n(A)$

$m = 3$

$\therefore = 2^3$

Number of subsets $= 8$.

Number of proper subsets $= 2^m - 1$

$= 2^3 - 1$

$= 8 - 1$

Number of proper subsets $= 7$.

9.

ii,

$$X = \{x^2 : x \in \mathbb{N}, x^2 \leq 100\}.$$

$$x \leq \sqrt{100}$$

$$x \leq 10$$

$$X = \{1^2, 2^2, 3^2, 4^2, 5^2, 6^2, 7^2, 8^2, 9^2, 10^2\}$$

$$n(X) = 10$$

$$\text{Subset} = 2^n = 2^{10} = \underline{\underline{1024}}$$

$$\text{proper Subset} = 2^n - 1 = 1024 - 1 = 1023$$

Number of proper Subsets = 7.

10.

∴ If $n(A) = 4$, find $n[P(A)]$

Sol:

$$n(A) = m = 4$$

$$n[P(A)] = 2^m$$

$$= 2^4$$

$$= 2 \times 2 \times 2 \times 2$$

$$= 4 \times 4$$

$$n[P(A)] = 16$$

10. If $n(A) = 0$, find $n[P(A)]$.

$$n(A) = m = 0$$

$$n[P(A)] = 2^m$$

$$= 2^0$$

$$= 2^0 = 1$$

$$n[P(A)] = 1$$

iii,

If $n[P(A)] = 256$, find $n(A)$.

~~$n(A) = m$~~

$$n[P(A)] = 256$$

$$2^m = 256$$

$$2^m = 2^8$$

$$m = 8$$

$$n(A) = 8$$

$$\begin{array}{r} 2 \overline{) 256} \\ 2 \overline{) 28} \\ 2 \overline{) 64} \\ 2 \overline{) 32} \\ 2 \overline{) 16} \\ 2 \overline{) 8} \\ 2 \overline{) 4} \\ 2 \overline{) 2} \\ 1 \end{array}$$

Exercise 1.3

1. Using the given Venn diagram, write the elements of

i, A ii, B iii, $A \cup B$ iv, $A \cap B$

v, $A - B$ vi, $B - A$ vii, A' viii, B'

ix, U

$$A = \{2, 10, 8, 4, 7\}$$

$$B = \{9, 6, 3, 11, 4, 7\}$$

$$A \cap B = \{4, 7\}$$

$$A \cup B = \{2, 10, 8, 4, 7, 9, 6, 3, 11\}$$

$$A - B =$$

$$A = \{2, 10, 8, 4, 7\}$$

$$B = \{9, 6, 3, 11, 4, 7\}$$

$$A - B = \{2, 10, 8\}$$

$$B - A$$

$$A = \{2, 10, 8, 4, 7\}$$

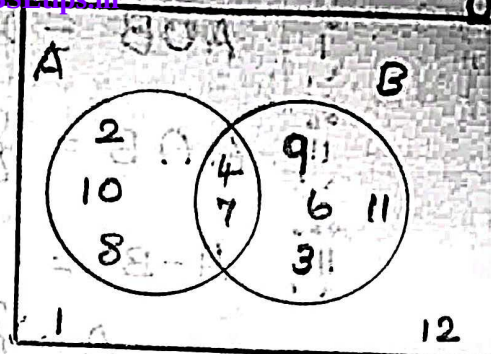
$$B = \{9, 6, 3, 11, 4, 7\}$$

$$B - A = \{9, 6, 3, 11\}$$

$$A' = \{9, 6, 11, 3, 1, 12\}$$

$$B' = \{2, 10, 8, 1, 12\}$$

$$U = \{2, 10, 8, 4, 7, 9, 6, 3, 11, 1, 12\}$$



2. Find $A \cup B$, $A \cap B$, $A - B$ and $B - A$ for the following sets.

$$A = \{2, 6, 10, 14\} \text{ and } B = \{2, 5, 14, 16\}$$

Find:- $A \cup B$, $A \cap B$, $A - B$, $B - A$

i. $A \cup B = \{6, 10, 2, 14, 5, 16\}$

ii. $A \cap B = \{2, 14\}$

iii. $A - B =$

$$A = \{6, 10, 2, 14\}$$

$$B = \{5, 16, 2, 14\}$$

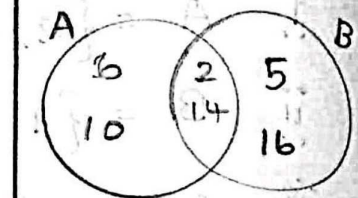
$$A - B = \{6, 10\}$$

iv. $B - A =$

$$A = \{6, 10, 2, 14\}$$

$$B = \{5, 16, 2, 14\}$$

$$B - A = \{5, 16\}$$



ii. $A = \{a, b, c, e, u\}$ and $B = \{a, e, i, o, u\}$

Find: $A \cup B, A \cap B, A - B, B - A$

i. $A \cup B = \{b, c, a, e, o, i, u\}$

ii. $A \cap B = \{a, e, u\}$

iii. $A - B =$

$$A = \{b, c, a, e, u\}$$

$$B = \{a, e, u, i, o\}$$

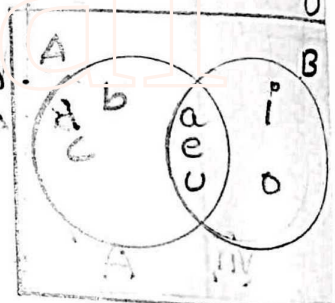
$$A - B = \{b, c\}$$

iv. $B - A =$

$$A = \{b, c, a, e, u\}$$

$$B = \{a, e, u, i, o\}$$

$$B - A = \{i, o\}$$

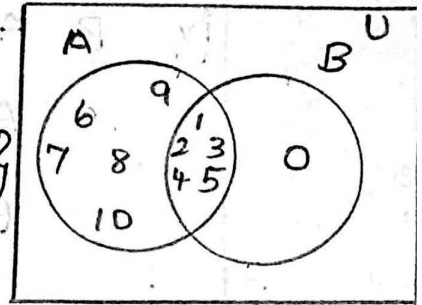


iii. $A = \{x: x \in \mathbb{N}, x \leq 10\}$ and $B = \{x: x \in \mathbb{W}, x \leq 6\}$
Find :-

$A \cup B, A \cap B, A - B, B - A$

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

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



i. $A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 0\}$

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

iii. $A - B =$

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

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

$$A - B = \{6, 7, 8, 9, 10\}$$

iv. $B - A =$

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

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

$$B - A = \{0\}$$

iv. $A =$ set of all letters in the word "mathematics" and
 $B =$ set of all letters in the word "geometry".
Find :-

$A \cup B, A \cap B, A - B, B - A$

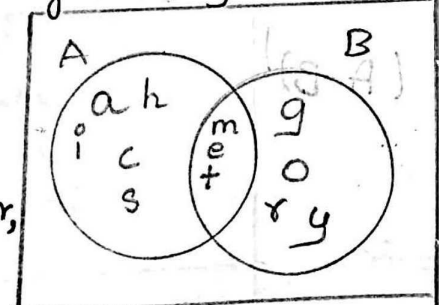
i. $A \cup B = \{a, h, i, c, s, m, e, t, g, o, r, y\}$

ii. $A \cap B = \{m, e, t\}$

iii. $A - B =$

$$A = \{a, c, h, i, c, s, m, e, t\}$$

$$B = \{g, o, r, y\}$$



$$A - B = \{a, c, h, i, e, s\}$$

iv,

$$B - A =$$

$$A = \{a, c, h, i, e, s, m, t\}$$

$$B = \{m, e, t, g, o, r, y\}$$

$$B - A = \{g, o, r, y\}$$

Exercise 1.3

3. If $U = \{a, b, c, d, e, f, g, h\}$

$A = \{b, d, f, h\}$ and

$B = \{a, d, e, h\}$ find the following.

Soln:-

$$A' = \{a, c, e, g\}$$

$$B' = \{b, c, f, g\}$$

$$A' \cup B' = \{a, b, c, e, f, g\}$$

$$A' \cap B' = \{c, g\}$$

$$(A \cup B)' = \{c, g\}$$

$$(A \cap B)' = \{a, b, c, e, f, h\}$$

$$(A')' = \{b, d, f, h\}$$

$$(B')' = \{a, d, e, h\}$$

4. Let $U = \{0, 1, 2, 3, 4, 5, 6, 7\}$, $A = \{1, 3, 5, 7\}$ and $B = \{0, 2, 3, 5, 7\}$. Find the following sets.

$$\therefore A' = \{2, 4, 6, 0\}$$

$$B' = \{1, 4, 6\}$$

$$A' \cup B' = \{0, 1, 2, 4, 6\}$$

$$A' \cap B' = \{4, 6\}$$

$$(A \cup B)' = \{4, 6\}$$

$$(A \cap B)' = \{0, 1, 2\} \quad \{0, 1, 2, 4, 6\}$$

$$(A')' = \{1, 3, 5, 7\}$$

$$(B')' = \{0, 2, 3, 5, 7\}$$

5. Find the Symmetric difference between the following sets.

i, $P = \{2, 3, 5, 7, 11\}$ and $Q = \{1, 3, 5, 11\}$

Soln

$$P \Delta Q = (P - Q) \cup (Q - P)$$

$$P - Q = \{2, 7\}$$

$$Q - P = \{1\}$$

$$P \Delta Q = \{P - Q\} \cup \{Q - P\}$$

$$= \{2, 7\} \cup \{1\}$$

$$P \Delta Q = \{1, 2, 7\}$$

ii, $R = \{l, m, n, o, p\}$ and $S = \{j, k, n, q\}$

Soln

$$R \Delta S = (R - S) \cup (S - R)$$

$$R - S = \{m, o, p\}$$

$$S - R = \{j, q\}$$

$$R \Delta S = \{R - S\} \cup \{S - R\}$$

$$= \{m, o, p\} \cup \{j, q\}$$

$$R \Delta S = \{m, o, p, j, q\}$$

iii, $X = \{5, 6, 7\}$ and $Y = \{5, 7, 9, 10\}$

$$P \Delta Q = (P - Q) \cup (Q - P)$$

$$X - Y = \{6\}$$

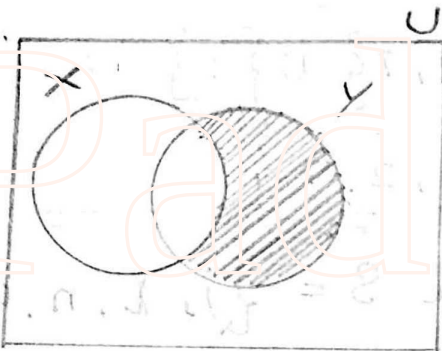
$$Y - X = \{9, 10\}$$

$$X \Delta Y = (X - Y) \cup (Y - X)$$

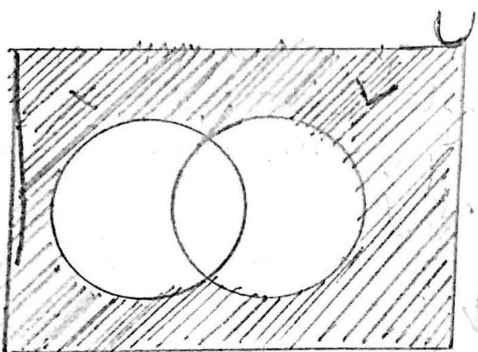
$$= \{6\} \cup \{9, 10\}$$

$$X \Delta Y = \{6, 9, 10\}$$

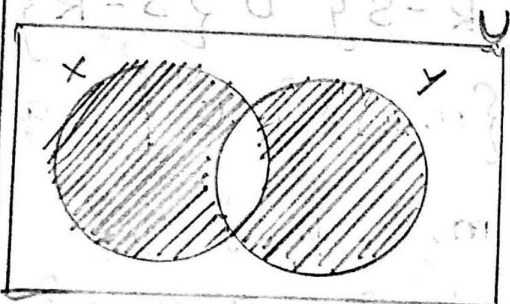
6. Using the set symbols, write down the expressions for the shaded region in the following.



$$\Rightarrow Y - X$$



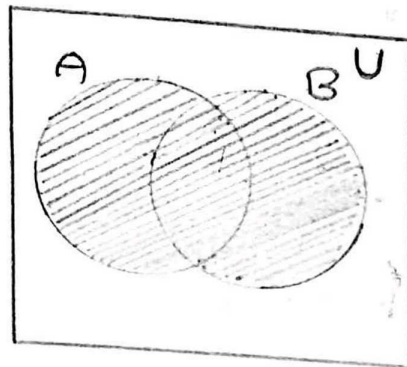
$$\Rightarrow X \cup Y$$



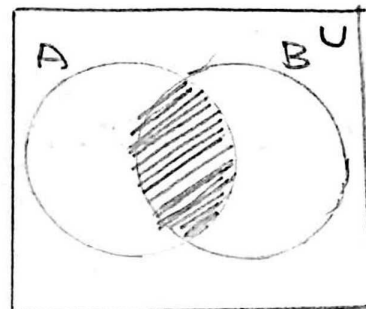
$$\Rightarrow (X - Y) \cup (Y - X)$$

7. Let A and B be two overlapping sets and the universal set be U . Draw appropriate Venn diagram for each of the following :-

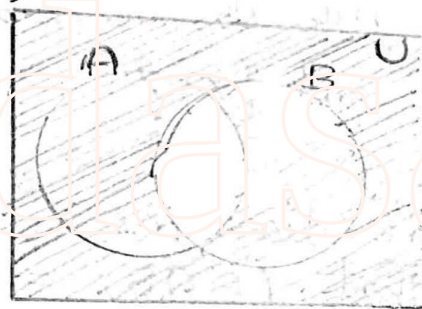
i, $A \cup B$



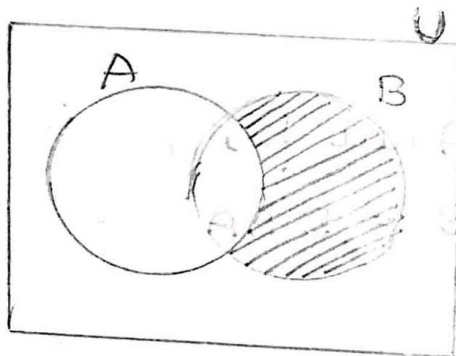
ii, $A \cap B$



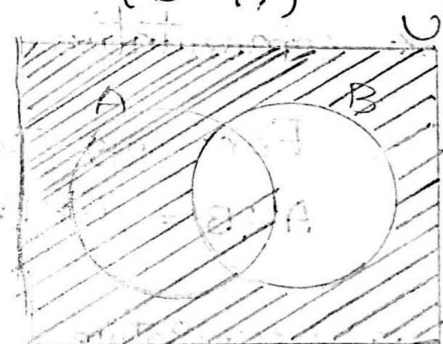
iii, $(A \cap B)'$



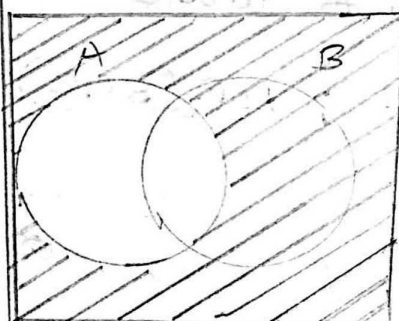
iv, $B - A$



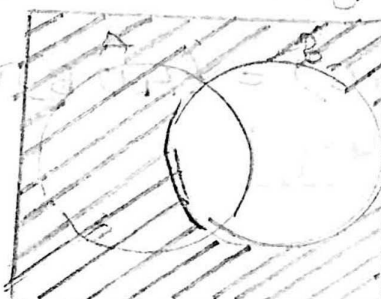
$(B - A)'$



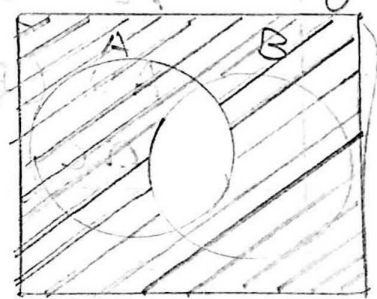
v, A'

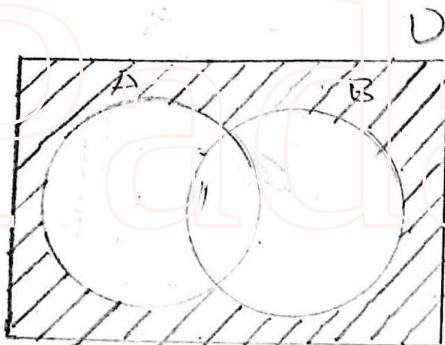
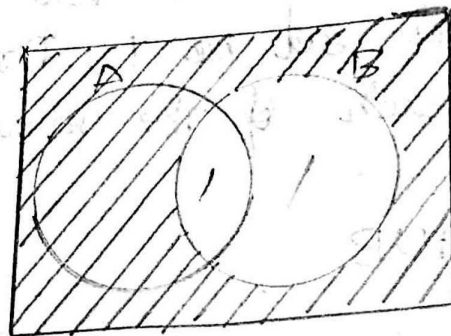
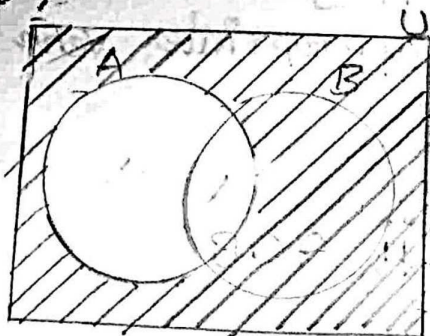


B'



$A' \cup B'$





vii. What do you observe from the venn diagram (iii) and (v)?

Ans :- From the diagrams (iii) and (v) we observe that $(A \cap B)^c = A' \cup B'$.

Exercise 1.4

1. If $P = \{1, 2, 5, 7, 9\}$, $Q = \{2, 3, 5, 9, 11\}$,
 $R = \{3, 4, 5, 7, 9\}$ and $S = \{2, 3, 4, 5, 8\}$, then

find

i. $(P \cup Q) \cup R$

Soln

$$P = \{1, 2, 5, 7, 9\} \cup \{2, 3, 5, 9, 11\}$$

$$(P \cup Q) = \{1, 2, 3, 5, 7, 9, 11\}$$

$$\therefore (P \cup Q) \cup R = \{1, 2, 3, 5, 7, 9, 11\} \cup \{3, 4, 5, 7, 9\}$$

$$= \{1, 2, 3, 4, 5, 7, 9, 11\}$$

$$\text{ii. } (P \cap Q) \cap S = (P \cap Q) \cap S$$

Soln

$$P = \{1, 2, 5, 7, 9\} \cap \{2, 3, 5, 9, 11\}$$

$$(P \cap Q) = \{2, 5, 9\} \cap \{2, 3, 4, 5, 8\}$$

$$\therefore (P \cap Q) \cap S = \{2, 5\}$$

$$\text{iii. } (Q \cap S) \cap R$$

Soln

$$Q = \{2, 3, 5, 9, 11\} \cap \{2, 3, 4, 5, 8\}$$

$$(Q \cap S) = \{2, 3, 5\} \cap \{3, 4, 5, 7, 9\}$$

$$\therefore (Q \cap S) \cap R = \{3, 5\}$$

2. Test for the commutative property of union and intersection of the sets

$P = \{x : x \text{ is a real number between 2 and 7}\}$ and

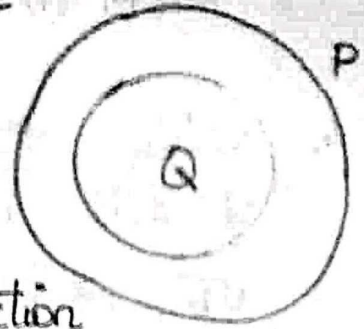
$Q = \{x : x \text{ is a rational number between 2 and 7}\}$

Soln

Commutative property of union:-

$$P \cup Q = P, Q \cup P = P$$

$$\therefore P \cup Q = Q \cup P$$



Commutative property of Intersection

$$P \cap Q = Q, Q \cap P = Q$$

$$P \cap Q = Q \cap P$$

3. If $A = \{p, q, r, s\}$, $B = \{m, n, q, s, t\}$ and $C = \{m, n, p, q, s\}$, then verify the associative property of union of sets.

Soln

Associative property of union of sets:-

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

$$\text{LHS} \Rightarrow (A \cup B) \cup C$$

$$A \cup B = \{p, q, r, s\} \cup \{m, n, q, s, t\}$$

$$= \{m, n, p, q, r, s, t\}$$

$$(A \cup B) \cup C = \{m, n, p, q, r, s, t\} \cup \{m, n, p, q, s\}$$

$$= \{m, n, p, q, r, s, t\} \rightarrow (1)$$

$$\text{RHS} \Rightarrow A \cup (B \cup C)$$

$$B \cup C = \{m, n, q, s, t\} \cup \{m, n, p, q, s\}$$

$$= \{m, n, p, q, s, t\}$$

$$A \cup (B \cup C) = \{p, q, r, s\} \cup \{m, n, p, q, s, t\}$$

$$= \{m, n, p, q, r, s, t\} \rightarrow (2)$$

From ① & ② $(A \cup B) \cap C = A \cup (B \cap C)$ verified.

4. Verify the associative property of intersection of sets for $A = \{-11, \sqrt{2}, \sqrt{3}, 7\}$, $B = \{\sqrt{3}, \sqrt{5}, \sqrt{6}, 13\}$ and $C = \{\sqrt{3}, \sqrt{2}, \sqrt{5}, 9\}$

Soln

Associative property of intersection

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

$$\text{LHS} \Rightarrow (A \cap B) \cap C$$

$$\begin{aligned} A \cap B &= \{-11, \sqrt{2}, \sqrt{5}, 7\} \cap \{\sqrt{3}, \sqrt{5}, \sqrt{6}, 13\} \\ &= \{\sqrt{5}\} \rightarrow \text{②} \end{aligned}$$

Form ① & ② $(A \cap B) \cap C = A \cap (B \cap C)$ verified.

5. If $A = \{x : x = 2^n, n \in \mathbb{N} \text{ and } n < 4\}$
 $B = \{x : x = 2^n, n \in \mathbb{N} \text{ and } 4 \leq n < 6\}$ and
 $C = \{0, 1, 2, 5, 6\}$ then verify the associative property of intersection of sets.

Soln.

Associative property of intersection of sets

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

$$\text{Let } A = \{x : x = 2^n, n \in \mathbb{N} \text{ and } n < 4\}$$

$$n = \{0, 1, 2, 3\}$$

$$\text{OC} \Rightarrow 2^n \Rightarrow 2^0 = 1 \text{ (anything power zero 1)}$$

$$\Rightarrow 2^1 = 2 \quad (2)$$

$$\Rightarrow 2^2 = 4 \quad (2 \times 2)$$

$$\Rightarrow 2^3 = 8 \quad (2 \times 2 \times 2)$$

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

$$\text{Let } B = \{x : x = 2n, n \in \mathbb{N} \text{ and } n \leq 4\}$$

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

$$x = 2n \Rightarrow 2(1) = 2$$

$$2(2) = 4$$

$$2(3) = 6$$

$$2(4) = 8$$

$$\therefore B = \{2, 4, 6, 8\}$$

$$A = \{1, 2, 4, 8\}, B = \{2, 4, 6, 8\} \text{ and } C = \{0, 1, 2, 5, 6\}$$

$$\text{LHS} \Rightarrow (A \cap B) \cap C$$

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

$$A \cap B = \{2, 4, 8\}$$

$$(A \cap B) \cap C = \{2, 4, 8\} \cap \{0, 1, 2, 5, 6\}$$

$$= \{2\} \rightarrow \textcircled{1}$$

$$\text{RHS} \Rightarrow A \cap (B \cap C)$$

$$B \cap C = \{2, 4, 6, 8\} \cap \{0, 1, 2, 5, 6\}$$

$$B \cap C = \{2, 6\}$$

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

$$= \{2\} \rightarrow \textcircled{2}$$

From

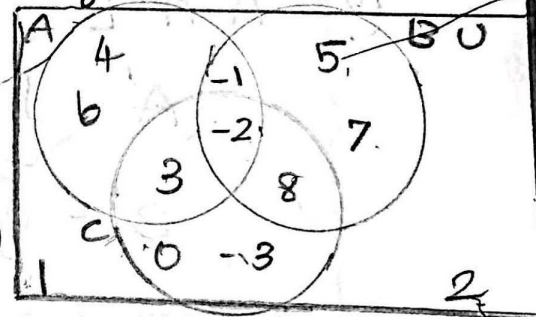
(1) & (2)

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

verified.

Exercise 1.5

1. Using the adjacent venn diagram find the following Sets:-



i, $A - B$ iii, $A' \cup B'$ v, $(B \cup C)'$

ii, $B - C$ iv, $A' \cap B'$ vi, $A - (B \cup C)$

vii, $A - (B \cap C)$

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

$$B = \{-2, -1, 5, 7, 8\}$$

$$C = \{-3, -2, 0, 3, 8\}$$

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

$$B = \{-2, -1, 5, 7, 8\}$$

$$C = \{-3, -2, 0, 3, 8\}$$

$$U = \{-3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8\}$$

$$A - B = \{3, 4, 6\}$$

ii, $B - C$

$$B = \{-2, -1, 5, 7, 8\}$$

$$C = \{-3, -2, 0, 3, 8\}$$

$$B - C = \{-1, 5, 7\}$$

(iii)

$$A' \cup B'$$

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

$$B = \{-2, -1, 5, 7, 8\}$$

$$A' \cup B' = \{-3, 0, 1, 2, 3, 4, 5, 6, 7, 8\}$$

Since :-

$$A' = \{-3, 0, 1, 2, 5, 7, 8\}$$

$$B' = \{-3, 0, 1, 2, 3, 4, 6\}$$

(iv)

$$A' \cap B'$$

~~$$A' = \{-3, 0, 1, 2, 5, 7, 8\}$$~~

~~$$B' = \{-3, 0, 1, 2, 3, 4, 6\}$$~~

$$A' = \{-3, 0, 1, 2, 5, 7, 8\}$$

$$B' = \{-3, 0, 1, 2, 3, 4, 6\}$$

$$A' \cap B' = \{-3, 0, 1, 2\}$$

(v)

$$(B \cup C)'$$

$$B = \{-2, -1, 5, 7, 8\}$$

$$C = \{-3, -2, 0, 3, 8\}$$

$$(B \cup C) = \{-3, -2, -1, 0, 3, 5, 7, 8\}$$

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

(vi)

$$A - (B \cup C)'$$

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

$$B = \{-2, -1, 5, 7, 8\}$$

$$C = \{-3, -2, 0, 3, 8\}$$

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

$$A - (B \cup C) = \{-2, -1, 3, 4, 6\} - \{-3, -2, -1, 0, 3, 5, 7, 8\}$$

$$A - (B \cup C) = \{4, 6\}$$

$$\text{vii, } A - (B \cap C) = \{$$

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

$$B = \{-2, -1, 5, 7, 8\}$$

$$C = \{-3, -2, 0, 3, 8\}$$

$$A - (B \cap C) = \{-2, -1, 3, 4, 6\} - \{-2, 8\}$$

$$A - (B \cap C) = \{-1, 3, 4, 6\}$$

2. If $K = \{a, b, d, e, f\}$, $L = \{b, c, d, g\}$ and $M = \{a, b, c, d, h\}$, then find the following.

i. $K \cup (L \cap M)$ ii. $K \cap (L \cup M)$

iii. $(K \cup L) \cap (K \cup M)$ iv. $(K \cap L) \cup (K \cap M)$

and verify distributive form.

Soln:-

i. $K \cup (L \cap M)$

$$L \cap M = \{b, c, d\}$$

$$K \cup (L \cap M) = \{a, b, d, e, f\} \cup \{b, c, d\}$$

$$= \{a, b, c, d, e, f\} \quad \rightarrow \textcircled{1}$$

$$ii. K \cap (L \cup M)$$

$$L \cup M = \{a, b, c, d, g, h\}$$

$$K \cap (L \cup M) = \{a, b, d, e, f\} \cap \{a, b, c, d, g, h\} \\ = \{a, b, d\} // \rightarrow \textcircled{2}$$

$$iii. (K \cup L) \cap (K \cup M)$$

$$K \cup L = \{a, b, c, d, e, f, g\}$$

$$K \cup M = \{a, b, c, d, e, f, h\}$$

$$(K \cup L) \cap (K \cup M) = \{a, b, c, d, e, f\} // \rightarrow \textcircled{3}$$

$$iv. (K \cap L) \cup (K \cap M)$$

$$K \cap L = \{b, d\}$$

$$K \cap M = \{a, b, d\}$$

$$(K \cap L) \cup (K \cap M) = \{a, b, d\} // \rightarrow \textcircled{4}$$



[Distributive laws]

For any three sets A, B, and C

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

$$ii. A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$$

From ① & ② and

② & ④ Distributive law verified.

$$\therefore K \cup (L \cap M) = (K \cup L) \cap (K \cup M)$$

$$K \cap (L \cup M) = (K \cap L) \cup (K \cap M) \quad \text{--- (2) (4)}$$

Ex: $A = \{x : x \in \mathbb{Z}, -2 < x \leq 4\}$

$$B = \{x : x \in \mathbb{W}, x \leq 5\}$$

$$C = \{-4, -1, 0, 2, 3, 4\} \text{ then}$$

verify $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$.

Soln

$$\text{Let } A = \{-1, 0, 1, 2, 3, 4\}, B = \{0, 1, 2, 3, 4, 5\}$$

$$\text{LHS} \Rightarrow A \cup (B \cap C)$$

$$B \cap C = \{0, 2, 3, 4\}$$

$$A \cup (B \cap C) = \{-1, 0, 1, 2, 3, 4\} \cup \{0, 2, 3, 4\}$$

$$= \{-1, 0, 1, 2, 3, 4\} \rightarrow \text{--- (1)}$$

$$\text{RHS} \Rightarrow (A \cup B) \cap (A \cup C)$$

$$A \cup B = \{-1, 0, 1, 2, 3, 4, 5\}$$

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

$$(A \cup B) \cap (A \cup C) = \{-1, 0, 1, 2, 3, 4\} \rightarrow \text{--- (1)}$$

$$\therefore \text{--- (1) \& (2)}$$

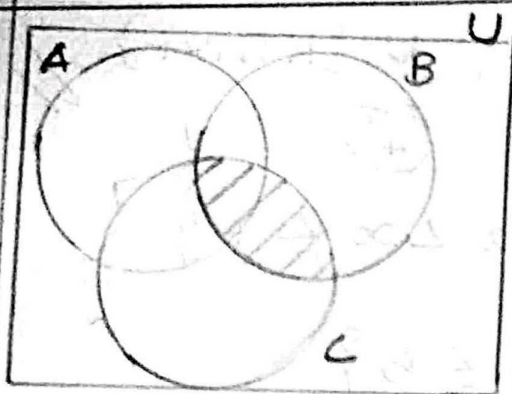
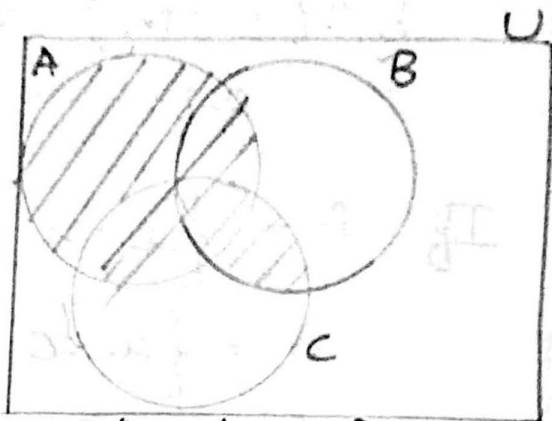
$$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$$

verified.

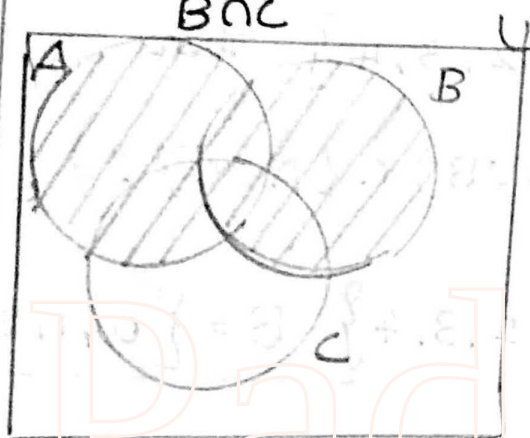
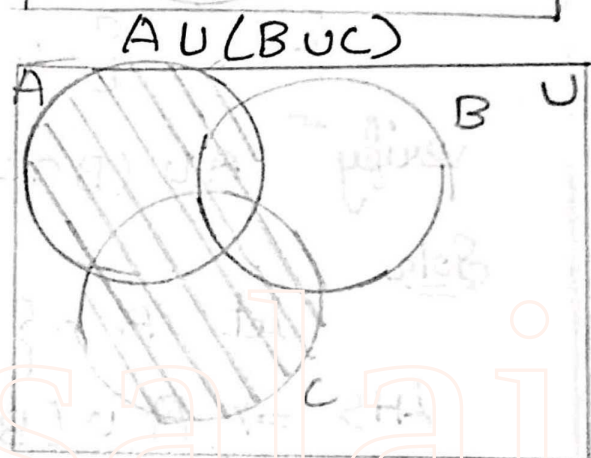
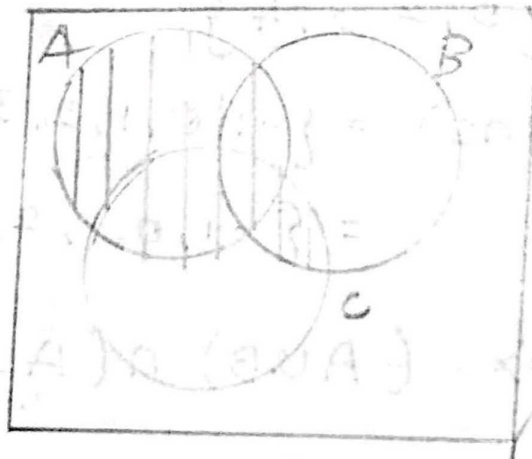
4. verify $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ using venn diagrams.

Soln:

$$\text{LHS} \Rightarrow A \cup (B \cap C)$$

 $B \cap C$ 

→ ①

 $A \cup B$  $A \cup C$ 

→ ②

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

From ① & ②

 $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ is verified.

5. If $A = \{b, c, e, g, h\}$, $B = \{a, c, d, g, i\}$ and $C = \{a, d, e, g, h\}$, then show that $A - (B \cap C) = (A - B) \cup (A - C)$.

Soln

$$\underset{\text{L.H.S}}{A - (B \cap C)} = \underset{\text{R.H.S}}{(A - B) \cup (A - C)}$$

Given :-

$$A = \{b, c, e, g, h\}$$

$$B = \{a, c, d, g, i\}$$

$$C = \{a, d, e, g, h\}$$

Find :-

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

LHS :-

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

$$(B \cap C) = \{a, c, d, g, i\} \cap \{a, d, e, g, h\}$$

$$(B \cap C) = \{a, d, g\}$$

$$A - (B \cap C) = \{b, c, e, g, h\} - \{a, d, g\}$$

$$A - (B \cap C) = \{b, c, e, h\} \rightarrow \textcircled{1}$$

RHS =

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

$$(A - B)$$

$$A = \{b, c, e, g, h\}$$

$$B = \{a, c, d, g, i\}$$

$$(A - B) = \{b, c, e, g, h\} - \{a, c, d, g, i\}$$

$$(A - B) = \{b, e, h\} \rightarrow \textcircled{3}$$

$$(A - C)$$

$$A = \{b, c, e, g, h\}$$

$$C = \{a, d, e, g, h\}$$

$$(A - C) = \{b, c, e, g, h\} - \{a, d, e, g, h\}$$

$$(A - C) = \{b, c\} \rightarrow \textcircled{4}$$

From $\textcircled{3}$ & $\textcircled{4}$

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

$$(A - B) \cup (A - C) = \{b, e, h\} \cup \{b, c\}$$

$$(A - B) \cup (A - C) = \{b, c, e, h\} \rightarrow \textcircled{2}$$

From $\textcircled{1}$ & $\textcircled{2}$ LHS = RHS

$$A - (B \cap C) = (A - B) \cup (A - C) \text{ is proved.}$$

6. $A = \{x : x = 6n, n \in \mathbb{W} \text{ and } n \leq 6\}$

$$B = \{x : x = 2n, n \in \mathbb{N} \text{ and } 2 \leq n \leq 9\}$$

$$C = \{x : x = 3n, n \in \mathbb{N} \text{ and } 4 \leq n \leq 10\}$$

$$A = \{x : x = 6n, n \in \mathbb{W} \text{ and } n \leq 6\}$$

$$\mathbb{W} = \{0, 1, 2, 3, 4, 5\}$$

$$A = 6 \times 0 = 0$$

$$6 \times 1 = 6$$

$$6 \times 2 = 12$$

$$6 \times 3 = 18$$

$$6 \times 4 = 24$$

$$6 \times 5 = 30$$

$$A = \{0, 6, 12, 18, 24, 30\}$$

$$B = \{x : x = 2n, n \in \mathbb{N} \text{ and } 2 \leq n \leq 9\}$$

$$\mathbb{N} = \{3, 4, 5, 6, 7, 8, 9\}$$

$$B = 2 \times 3 = 6$$

$$2 \times 4 = 8$$

$$2 \times 5 = 10$$

$$2 \times 6 = 12$$

$$2 \times 7 = 14$$

$$2 \times 8 = 16$$

$$2 \times 9 = 18$$

$$B = \{6, 8, 10, 12, 14, 16, 18\}$$

$$C = \{x : x = 3n, n \in \mathbb{N} \text{ and } 4 \leq n \leq 10\}$$

$$\mathbb{N} = \{4, 5, 6, 7, 8, 9\}$$

$$C = 3 \times 4 = 12$$

$$3 \times 5 = 15$$

$$3 \times 6 = 18$$

$$3 \times 7 = 21$$

$$3 \times 8 = 24$$

$$3 \times 9 = 27$$

$$C = \{12, 15, 18, 21, 24, 27\}$$

$$A = \{0, 6, 12, 18, 24, 30\}$$

$$B = \{6, 8, 10, 12, 14, 16, 18\}$$

$$C = \{12, 15, 18, 21, 24, 27\}$$

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

LHS:-

$$(B \cap C) = \{6, 8, 10, 12, 14, 16, 18\} \cap \{12, 15, 18, 21, 24, 27\}$$

$$= \{12, 18\}$$

$$A - (B \cap C) = \{0, 6, 12, 18, 24, 30\} - \{12, 18\}$$

$$A - (B \cap C) = \{0, 6, 24, 30\} \rightarrow \textcircled{1}$$

RHS:-

$$(A - B) = \{0, 6, 12, 18, 24, 30\} - \{6, 8, 10, 12, 14, 16, 18\}$$

$$= \{0, 24, 30\} \rightarrow \textcircled{3}$$

$$(A - C) = \{0, 6, 12, 18, 24, 30\} - \{12, 15, 18, 21, 24, 27\}$$

$$= \{0, 6, 30\} \rightarrow \textcircled{4}$$

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

$$(A - B) \cup (A - C) = \{0, 24, 30\} \cup \{0, 6, 30\}$$

$$(A - B) \cup (A - C) = \{0, 24, 30, 6\} \rightarrow \textcircled{2}$$

$$A - (B \cap C) = (A - B) \cup (A - C) \text{ is proved}$$

From $\textcircled{1}$ & $\textcircled{2}$

$$\text{LHS} = \text{RHS}$$

7.

$$A = \{-2, 0, 1, 3, 5\}$$

$$B = \{-1, 0, 2, 5, 6\}$$

$$C = \{-1, 2, 5, 6, 7\}$$

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

LHS:-

$$(B \cup C) = \{-1, 0, 2, 5, 6\} \cup \{-1, 2, 5, 6, 7\}$$

$$= \{-1, 0, 2, 5, 6, 7\}$$

$$A - (B \cup C) = \{-2, 0, 1, 3, 5\} - \{-1, 0, 2, 5, 6, 7\}$$

$$A - (B \cup C) = \{-2, 1, 3\} \rightarrow \textcircled{1}$$

RHS:- $(A - B)$

$$A - B = \{-2, 0, 1, 3, 5\} - \{-1, 0, 2, 5, 6\}$$

$$= \{-2, 1, 3\} \rightarrow \textcircled{3}$$

 $A - C$

$$A - C = \{-2, 0, 1, 3, 5\} - \{-1, 2, 5, 6, 7\}$$

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

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

$$(A - B) \cap (A - C) = \{-2, 1, 3\} \cap \{-2, 0, 1, 3\}$$

$$(A - B) \cap (A - C) = \{-2, 1, 3\} \rightarrow \textcircled{2}$$

From $\textcircled{1}$ & $\textcircled{2}$ $A - (B \cup C) = (A - B) \cap (A - C)$ is verified

LHS = RHS.

8. If $A = \{y: y = \frac{a+1}{2}, a \in \mathbb{W} \text{ and } a \leq 5\}$

$$B = \{y: y = \frac{2n-1}{2}, n \in \mathbb{W} \text{ and } n \leq 5\}$$

$$C = \{-1, -1/2, 1, 3/2, 2\} \text{ then show}$$

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

Soln $A = \{y: y = \frac{a+1}{2}, a \in \mathbb{W} \text{ and } a \leq 5\}$

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

$$y \Rightarrow \frac{a+1}{2} = \frac{0+1}{2} = \frac{1}{2}$$

$$\Rightarrow \frac{1+1}{2} = \frac{2}{2} = 1$$

$$\Rightarrow \frac{1+1}{2} = \frac{2}{2} = 1$$

$$\Rightarrow \frac{2+1}{2} = \frac{3}{2}$$

$$\Rightarrow \frac{3+1}{2} = \frac{4}{2} = 2$$

$$\Rightarrow \frac{4+1}{2} = \frac{5}{2}$$

$$\Rightarrow \frac{5+1}{2} = \frac{6}{2} = 3$$

$$A = \left\{ \frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, 3 \right\}$$

$$B = \left\{ y : y = \frac{2n-1}{2}, n \in \mathbb{N} \text{ and } n < 5 \right\}$$

$$n = \{0, 1, 2, 3, 4\}$$

$$y \Rightarrow \frac{2(0)-1}{2} = \frac{2(0)-1}{2} = -\frac{1}{2}$$

$$\Rightarrow \frac{2(1)-1}{2} = \frac{2-1}{2} = \frac{1}{2}$$

$$\Rightarrow \frac{2(2)-1}{2} = \frac{4-1}{2} = \frac{3}{2}$$

$$\Rightarrow \frac{2(3)-1}{2} = \frac{6-1}{2} = \frac{5}{2}$$

$$\Rightarrow \frac{2(4)-1}{2} = \frac{8-1}{2} = \frac{7}{2}$$

$$B = \left\{ -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2} \right\}$$

$$C = \left\{ -1, -\frac{1}{2}, 1, \frac{3}{2}, 2 \right\}$$

$$\text{To prove :- } A - (B \cup C) = (A - B) \cap (A - C)$$

$$\text{LHS} \Rightarrow A - (B \cup C)$$

$$B \cup C = \left\{ -\frac{1}{2}, \frac{1}{3}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2} \right\} \cup$$

$$\left\{ -1, -\frac{1}{3}, 1, \frac{3}{2}, 2 \right\}$$

$$= \left\{ -\frac{1}{2}, -1, 1, \frac{1}{2}, \frac{3}{2}, \frac{7}{3}, 2 \right\}$$

$$A - (B \cup C) = \left\{ \frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, 3 \right\} - \left\{ -\frac{1}{2}, -1, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}, 2 \right\}$$

$$= \{3\} \rightarrow \textcircled{1}$$

$$\text{RHS} \Rightarrow (A - B) \cap (A - C)$$

$$A - B = \left\{ \frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, 3 \right\} - \left\{ -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2} \right\}$$

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

$$A - C = \left\{ \frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, 3 \right\} - \left\{ -1, -\frac{1}{2}, 1, \frac{3}{2}, 2 \right\}$$

$$= \left\{ \frac{1}{2}, \frac{5}{2}, 3 \right\}$$

$$(A - B) \cap (A - C) = \{3\} \rightarrow \textcircled{2}$$

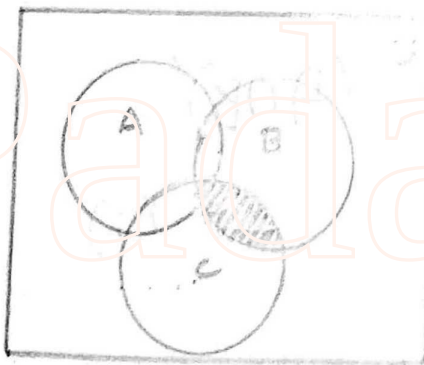
From $\textcircled{1}$ & $\textcircled{2}$

We set

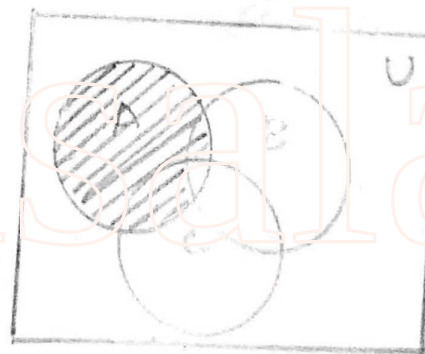
$$A - (B \cup C) = (A - B) \cap (A - C) //$$

9. verify $A - (B \cap C) = (A - B) \cup (A - C)$ using venn diagrams.
LHS:-

Soln



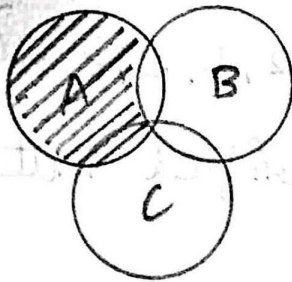
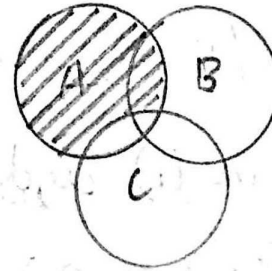
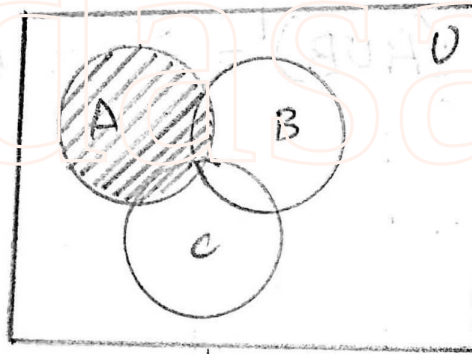
$B \cap C$



$A - (B \cap C)$

(1)

RHS:-

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

From ① & ②

It is verified that $A - (B \cap C) = (A-B) \cup (A-C)$

10. If $U = \{4, 7, 8, 10, 11, 12, 15, 16\}$, $A = \{7, 8, 11, 12\}$ and $B = \{4, 8, 12, 15\}$, then verify De Morgan's laws for complementation.

Soln

De Morgan's laws for complementation:-

$$\therefore (A \cup B)' = A' \cap B' \quad \text{and} \quad (A \cap B)' = A' \cup B'$$

$$\text{Let } \therefore (A \cup B)' = A' \cap B'$$

$$\text{Let } \therefore (A \cup B)' = A' \cap B'$$

$$\# \text{ LHS } \therefore (A \cup B)' = A' \cap B'$$

$$A \cup B = \{7, 8, 11, 12\} \cup \{4, 8, 12, 15\}$$

$$= \{4, 7, 8, 11, 12, 15\}$$

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

$$= \{4, 7, 8, 10, 11, 12, 15, 16\} - \{4, 7, 8, 11, 12, 15\}$$

$$= \{10, 16\} \rightarrow \textcircled{1}$$

$$* \text{ RHS } \Rightarrow A' \cap B'$$

$$A' = U - A$$

$$= \{4, 7, 8, 10, 11, 12, 15, 16\} - \{7, 8, 11, 12\}$$

$$= \{4, 10, 15, 16\}$$

$$B' = U - B$$

$$= \{4, 7, 8, 10, 11, 12, 15, 16\} - \{4, 8, 12, 15\}$$

$$= \{7, 10, 11, 16\}$$

$$A' \cap B' = \{7, 10, 11, 16\}$$

$$A' \cap B' = \{4, 10, 15, 16\} \cap \{7, 10, 11, 16\}$$

$$= \{10, 16\} \rightarrow \textcircled{2}$$

From $\textcircled{1}$ and $\textcircled{2}$ we get

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

$$\text{ii, } (A \cap B)' = A' \cap B'$$

$$* \text{ LHS } \Rightarrow (A \cap B)'$$

$$A \cap B = \{7, 8, 11, 12\} \cap \{4, 8, 12, 15\}$$

$$= \{8, 12\}$$

$$\begin{aligned}
 (A \cap B)' &= U - \{A \cap B\} \\
 &= \{4, 7, 8, 10, 11, 12, 15, 16\} - \{8, 12\} \\
 &= \{4, 7, 10, 11, 15, 16\} \rightarrow \textcircled{1}
 \end{aligned}$$

* RHS $\Rightarrow A' \cup B'$

$$\begin{aligned}
 A' \cup B' &= \{4, 10, 15, 16\} \cup \{7, 10, 11, 16\} \\
 &= \{4, 7, 10, 11, 15, 16\} \rightarrow \textcircled{1}
 \end{aligned}$$

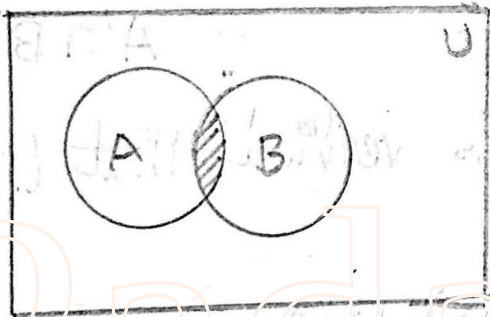
* RHS $\Rightarrow A' \cup B'$

$$\begin{aligned}
 A' \cup B' &= \{4, 10, 15, 16\} \cup \{7, 10, 11, 16\} \\
 &= \{4, 7, 10, 11, 15, 16\} \rightarrow \textcircled{2}
 \end{aligned}$$

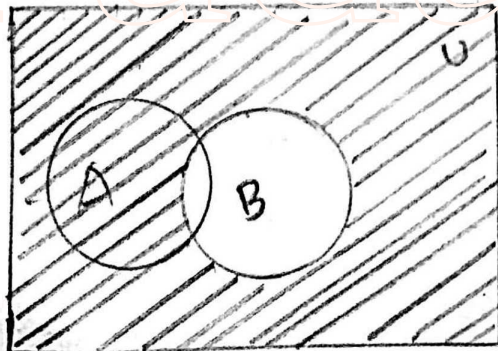
From $\textcircled{1}$ & $\textcircled{2}$ we get $\boxed{(A \cap B)' = A' \cup B'}$

11. Verify $(A \cap B)' = A' \cup B'$ venn diagrams.

Sol
LHS

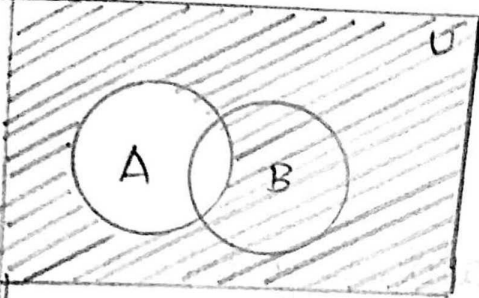


$\Rightarrow A \cap B$

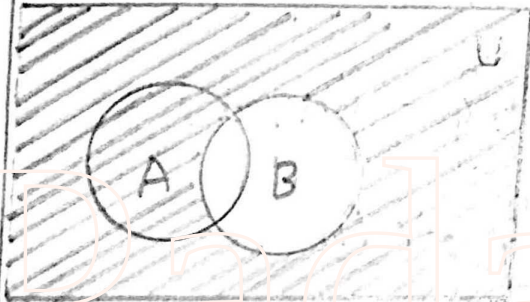


$\Rightarrow (A \cap B)'$

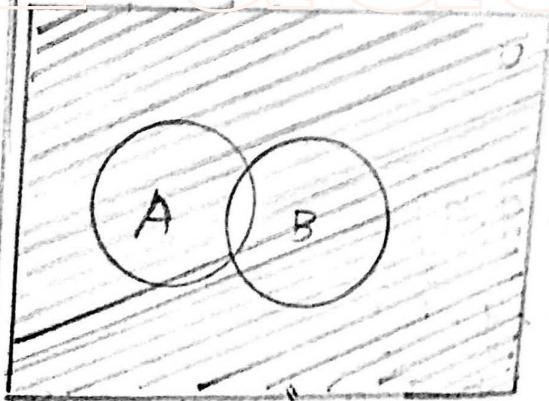
$\rightarrow (1)$

RHS ::

$$\Rightarrow A' \quad (U - A)$$



$$\Rightarrow B'$$



$$\Rightarrow A' \cup B'$$

 $\rightarrow (2)$

From (1) & (2)

$(A \cap B)' = (A' \cup B')$ is verified.

Exercise - 1.6

1. i. If $n(A) = 25$, $n(B) = 40$, $n(A \cup B) = 50$ and $n(B') = 25$, find $n(A \cap B)$ and $n(U)$.

Soln

$$n(U) = n(B) + n(B')$$

$$= 40 + 25$$

$$n(U) = 65$$

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

$$= 25 + 40 - 50$$

$$= 65 - 50$$

$$n(A \cap B) = 15$$

- ii. If $n(A) = 300$, $n(A \cup B) = 500$, $n(A \cap B) = 50$ and $n(A') = 350$, find $n(B)$ and $n(U)$.

Soln

we know that

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

$$500 = 300 + n(B) - 50$$

$$500 = 250 + n(B)$$

$$\boxed{n(B) = 250}$$

$$n(U) = n(B) + n(B')$$

$$= 250 + 350$$

$$n(U) = 600 //$$

2. If $U = \{x : x \in N, x < 10\}$, $A = \{2, 3, 4, 8, 10\}$ and $B = \{1, 2, 5, 8, 10\}$ then verify that
 $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

Sol Given:-

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

$$A = \{2, 3, 4, 8, 10\}$$

$$B = \{1, 2, 5, 8, 10\}$$

To verify:-

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

$$* \text{ LHS} \Rightarrow n(A \cup B)$$

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

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

$$n(A \cup B) = 7 \rightarrow \textcircled{1}$$

$$* \text{ RHS} \Rightarrow n(A \cap B) + n(A) + n(B) - n(A \cap B)$$

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

$$A \cap B = \{2, 8, 10\}$$

$$n(A \cap B) = 3 \rightarrow$$

$$n(A) = 5$$

$$n(B) = 5$$

$$\text{RHS} = n(A) + n(B) - n(A \cap B)$$

$$= 5 + 5 - 3$$

$$= 10 - 3$$

$$= 7 \rightarrow \textcircled{2}$$

From $\textcircled{1}$ & $\textcircled{2}$ it is verified that

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

3. verify $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(A \cap C) + n(A \cap B \cap C)$ for the following sets.

i. $A = \{a, c, e, f, h\}$, $B = \{c, d, e, f\}$ and $C = \{a, b, c, f\}$

$$n(A) = 5, n(B) = 4, n(C) = 4$$

$$(A \cap B) = \{c, e, f\}, (B \cap C) = \{c, f\}, (A \cap C) = \{a, c, f\}$$

$$(A \cap B \cap C) = \{c, f\}, (A \cup B \cup C) = \{a, b, c, d, e, f, h\}$$

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

$$7 = 5 + 4 + 4 - 3 - 2 - 3 + 2$$

$$7 = 13 - 6$$

$$7 = 7$$

Hence it's verified.

ii. $A = \{1, 3, 5\}$, $B = \{2, 3, 5, 6\}$, $C = \{1, 5, 6, 7\}$

$$n(A) = 3, n(B) = 4, n(C) = 4$$

$$(A \cup B \cup C) = \{1, 2, 3, 5, 6, 7\}$$

$$(A \cap B) = \{3, 5\}, (B \cap C) = \{5, 6\}, (A \cap C) = \{1, 5\}$$

$$(A \cap B \cap C) = \{5\}$$

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

$$6 = 3 + 4 + 4 - 2 - 2 - 2 + 1$$

$$6 = 12 - 6$$

$$6 = 6$$

Hence it's verified.

5. In a party of 45 people, each one likes tea or coffee or both. 35 people like tea and 20 people like coffee. Find the number of people who
- Like both tea and coffee.
 - do not like Tea.
 - do not like coffee.

Solution:

$$i. n(T \cap C) = n(T) + n(C) - n(T \cup C) = 35 + 20 - 45$$

$$= 55 - 45 = 10$$

The number of people who like both coffee and tea = 10

- ii. The number of people who do not like Tea.

$$n(T') = n(U) - n(T) = 45 - 35 = 10$$

- iii. The number of people who do not like coffee.

$$n(C') = n(U) - n(C) = 45 - 20 = 25$$

6. In an examination 50% of the students

Solution

Let the students who appeared in the examination be 100%.

Let the percentage of students who failed in mathematics be M.

Let the percentage of students who failed in science be S.

Failed in Maths = 100% - Pass % = 100% - 50% = 50%.

Failed in Science % = 100% - 70% = 30%.

Failed in both % = 10%.

$$n(M \cup S) = n(M) + n(S) - n(M \cap S)$$

$$= 50\% + 30\% - 10\% = 70\%.$$

% of students failed in at least one subject = 70%.

$\therefore$ The % of students who have passed in at least one subject = 100% - 70% = 30%.

$$30\% = 300$$

$$\therefore 100\% = \frac{100 \times 300}{30} = 1000$$

$\therefore$ The total number of students who appeared in the examination = 1000 students.

7.

Solution:

$$n(A-B) = 32 + x$$

$$n(B-A) = 5x$$

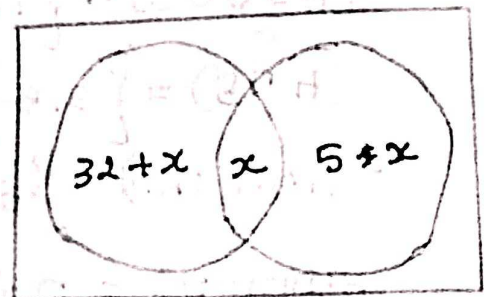
$$n(A \cap B) = x$$

$$n(A) = n(B)$$

$$32 + x + x = 5x + x$$

$$32 + 2x = 6x$$

$$4x = 32$$



8. Out of 500 car owners investigated, 400 owned car A and 200 owned car B 50 owned both A and B cars. Is this data correct?

Sch.

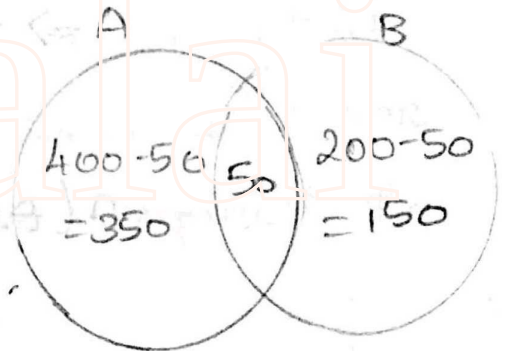
Given

$$n(U) = 350 + 150 + 50 \\ = 550$$

$$\text{Given } n(U) = 500$$

$550 \neq 500$ (This is contradiction)

Ans :- Given Data is not correct. //



9. In a colony, 275 families buy Tamil Newspaper, 150 families buy English newspaper, 45 families buy Hindi newspaper, 125 families buy Tamil and English newspapers, 17 families buy English and Hindi newspaper, 5 families buy Tamil and Hindi newspaper and 3 families =

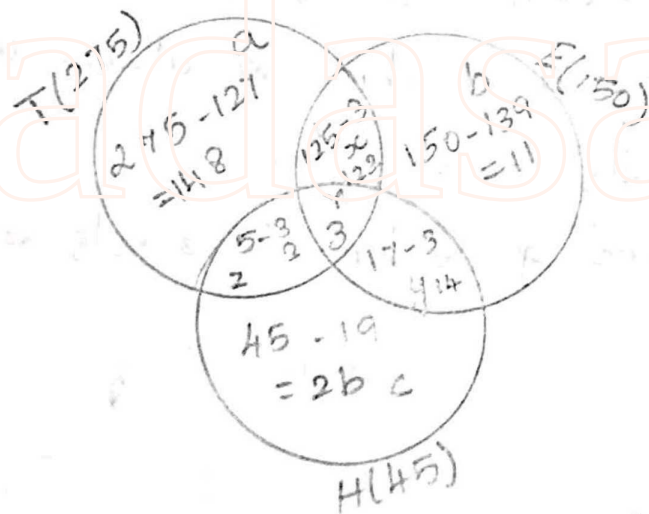
- i. In a colony 275 families buy Tamil News paper.
 $a+b+c =$
- ii. Number of families buy one only news paper.
 $x+y+z+v =$
- iii. Number of families buy atleast two news paper.
 $x+y+z+v =$
- iv. Total number of families in the colony.
 $a+b+c+x+y+z+v =$

Soln:-

Given:-

$$n(T) = 275, n(E) = 150, n(H) = 45$$

$$n(T \cap E) = 125, n(E \cap H) = 17, n(T \cap H) = 5, n(T \cap E \cap H) = 3$$



- i. Number of families buy only one news paper
 $= a+b+c$
 $= 148 + 11 + 26$
 $= 185$
- ii. Number of families buy atleast two news paper
 $= x+y+z+v$
 $= 122 + 14 + 2 + 3$
 $= 141$

iii

$$\begin{aligned}
 \text{Total Number of families in the colony} &= a+b+c+x+y+z+r \\
 &= 185 + 141 \\
 &= 326.
 \end{aligned}$$

10.

Soln

$$\begin{aligned}
 n(P) &= 600, n(R) = 350, n(L) = 280 \\
 n(P \cap R) &= 120, n(R \cap L) = 100, n(P \cap L) = 80
 \end{aligned}$$

$$\text{TOTAL No. of farmers} = 1000$$

To Find:- the No of farmers who grew all the three $n(P \cap R \cap L) = ?$

$$n(P \cup R \cup L) = n(P) + n(R) + n(L) - n(P \cap R) - n(R \cap L) - n(P \cap L) + n(P \cap R \cap L)$$

$$1000 = 600 + 350 + 280 - 120 - 100 - 80 + n(P \cap R \cap L)$$

$$1000 = 1230 - 300 + n(P \cap R \cap L)$$

$$1000 = 930 + n(P \cap R \cap L)$$

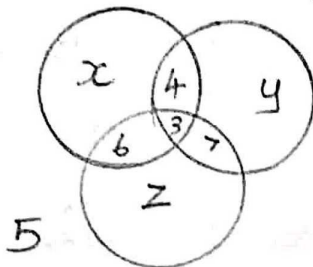
$$1000 - 930 = n(P \cap R \cap L)$$

$$n(P \cap R \cap L) = 70 //$$

11.

Soln.

$$n(U) = 125$$

Given:-

$$n(U) = 125$$

$$y = 2x \rightarrow (1)$$

$$z = x + 10 \rightarrow (2)$$

Find:- $x, y, \text{ and } z = ?$

$$x + y + z + 4 + 3 + 6 + 7 + 5 = 125$$

$$x + 2x + x + 10 + 35 = 125$$

$$4x = 125 - 45$$

$$4x = 80$$

$$\boxed{x = 20}$$

$$(1) \Rightarrow y = 2(20) = 40 \quad \left| \begin{array}{l} \therefore x = 20 \\ y = 40 \\ z = 30 \end{array} \right.$$

$$(2) \Rightarrow z = 20 + 10 = 30$$

12. Each Student in a class of 35 plays at least one game among chess, carrom and table tennis, 22 play chess, 21 play carrom, 15 play table tennis, 10 play chess and table tennis, 8 play carrom and table tennis and 6 play all the three games. Find the number of students who play
- i, chess and carrom but not table tennis
 - ii, only chess
 - iii, only carrom.

SolnGiven..

$$n(U) = 35$$

$$n(A) = 22$$

$$n(B) = 21$$

$$n(C) = 15, n(A \cap C) = 10, n(B \cap C) = 8$$

$$35 = a + b + c + x + y + z + r$$

$$35 = (12 - x) + (13 - a) + 3 + x + 2 + 4 + b$$

$$35 = 40 - x$$

$$x = 40 - 35$$

$$x = 5$$

i, chess and carrom but not table tennis
 $x = 5 //$

ii only chess

$$n = 12 - x$$

$$= 12 - 5$$

$$a = 7 //$$

iii

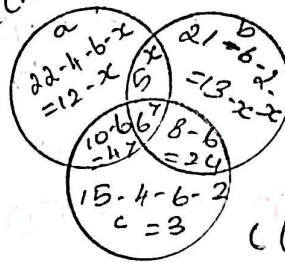
only carrom

$$b = 13 - x$$

$$= 13 - 5$$

$$b = 8 //$$

A (chess)



B (carrom)

C (Table Tennis)

Note

A = chess

B = carrom

C = Table Tennis

12. In a class of 50 students, each one come to school by bus or by bicycle or on foot, 25 by bus, 20 by bicycle, 30 on foot and 10 students by all the three. Now how many students come to school exactly by two modes of transport?

Soln

∴ Number of students come to school exactly by two modes of transport = $x + y + z$

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To find :-

$$x + y + z =$$

EMAIL: pearlkumar004@gmail.com
YouTube: Muthu Business Maths

Given:-

$$n(U) = 50$$

$$n(A) = 25$$

$$n(B) = 20$$

$$n(C) = 30$$

$$n(A \cap B \cap C) = 10$$

Note:-

A - Bus

B - Bicycle

C - foot



Total Number of Students in 3 sets

$$= a + b + c + x + y + z + r$$

$$50 = 15 - x - z + 10 - x - y + 20 - y - z + x + y + z + 10$$

$$50 = 55 - x - z - y$$

$$50 = 55 - (x + y + z)$$

$$x + y + z = 55 - 50$$

$$x + y + z = 5$$

$\therefore$ No Students come to School exactly by two modes of transport = 5.

Note:-

$$A = 25 - 10 - x - z$$

$$a = 15 - x - z$$

$$B = 20 - 10 - x - y$$

$$b = 10 - x - y$$

$$C = 30 - 10 - y - z$$

$$c = 20 - y - z$$