

Operation on sets Venn Diagrams

EXERCISE - 6.1

1. $A = \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$ $B = \{3, 5, 7, 9, 11\}$, $C = \{0, 5, 10, 20\}$

i) $A \cup B = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 11\}$

ii) $A \cup C = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 10, 20\}$

iii) $B \cup C = \{0, 3, 5, 7, 9, 10, 11, 20\}$

iv) $A \cap B = \{3, 5, 7\}$

v) $A \cap C = \{0, 5\}$

vi) $B \cap C = \{5\}$

As $B \cup C$ has 8 elements, $n(B \cup C) = 8$

As $A \cap B$ has 3 elements, $n(A \cap B) = 3$

As $A \cap C$ has 2 elements, $n(A \cap C) = 2$

As $B \cap C$ has 1 element, $n(B \cap C) = 1$

2.

i) $A = \{0, 1, 4, 7\}$ and $\xi = \{x \mid x \in \mathbb{N}, x \leq 10\}$

Given $\xi = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

Complement of $A = A' = \{2, 3, 5, 6, 8, 9, 10\}$

ii) $A = \{\text{Consonants}\}$ and $\xi = \{\text{alphabets of English}\}$

Complement of $A = A' = \{\text{vowels}\}$

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

iii) $A = \{\text{boys in class VIII of all schools in Bengaluru}\}$ and

$\xi = \{\text{Students in class VIII of all schools in Bengaluru}\}$

Complement of $A = A' = \{\text{girls in class VIII of all schools in Bengaluru}\}$

iv. $A = \{\text{letters of KALKA}\}$ and $\xi = \{\text{letters of KOLKATA}\}$

Complement of $A = A' = \{0, 1\}$

v. $A = \{\text{odd natural numbers}\}$ and $\xi = \{\text{whole numbers}\}$

Complement of $A = A' = \{0, 2, 4, 6, 8, 10, 12, \dots\}$

3. $A = \{x : x \in \mathbb{N} \text{ and } 3 < x < 7\}$ and $B = \{x : x \in \mathbb{N} \text{ and } x \leq 4\}$

$A = \{4, 5, 6\}$ and $B = \{0, 1, 2, 3, 4\}$

i) $A \cup B = \{0, 1, 2, 3, 4, 5, 6\}$

ii) $A \cap B = \{4\}$

iii) $A - B = \{5, 6\}$

iv) $B - A = \{0, 1, 2, 3\}$

4. $P = \{0, 1, 2, 3, 4, 5\}$ and $Q = \{4, 5, 6, 7, 8\}$

i) $P \cup Q = \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$

ii) $P \cap Q = \{4, 5\}$

iii) $P - Q = \{0, 1, 2, 3\}$

iv) $Q - P = \{6, 7, 8\}$

Yes, $P \cup Q$ is a proper superset of $P \cap Q$ but vice versa is not possible

Since A contains elements not in B .

5. $A = \{\text{letters of word INTEGRITY}\}$ $B = \{\text{letters of word RECKONING}\}$

i) $A \cup B = \{I, N, T, E, G, R, Y, C, K, O\}$

ii) $A \cap B = \{I, N, E, G, R\}$

iii) $A - B = \{T, Y\}$

iv) $B - A = \{C, K, O\}$

a) $n(A) = 7$ $n(B) = 8$ $n(A \cap B) = 5$ $n(A \cup B) = 10$

$n(A - B) = 2$ $n(B - A) = 3$

$n(A) + n(B) - n(A \cap B) = 7 + 8 - 5 = 10 = n(A \cup B)$

b) $n(A \cup B) - n(B) = 10 - 8 = 2 = n(A - B)$

$n(A) - n(A \cap B) = 7 - 5 = 2 = n(A - B)$

c) $n(A \cup B) - n(A) = 10 - 7 = 3 = n(B - A)$

$n(B) - n(A \cap B) = 8 - 5 = 3 = n(B - A)$

d) $n(A - B) + n(B - A) + n(A \cap B) = 2 + 3 + 5 = 10 = n(A \cup B)$

6. $\xi = \{10, 11, 12, 13, 14, \dots, 40\}$

$A = \{5, 10, 15, 20, 25, 30, 35, 40\}$

$B = \{6, 12, 18, 24, 30, 36\}$

i) $A \cup B = \{5, 6, 10, 12, 15, 18, 20, 24, 25, 30, 36, 40\}$

$A \cap B = \{30\}$

ii) $n(A) = 8$, $n(B) = 6$, $n(A \cap B) = 1$ $n(A \cup B) = 13$

$n(A) + n(B) - n(A \cap B) = 8 + 6 - 1 = 13 = n(A \cup B)$

7

i) $A' = \{5, 9\}$

ii) $B' = \{1, 2, 3, 5, 7, 9\}$

iii) $A \cup B = \{1, 2, 3, 4, 6, 7, 8\}$

iv) $A \cap B = \{4, 6, 8\}$

v) $A - B = A \cap B' = \{1, 2, 3, 5, 7, 9\}$

vi) $B - A = B \cap A' = \{ \}$

vii) $(A \cap B)' = \{1, 2, 3, 5, 7, 9\}$

viii) $A' \cup B' = \{1, 2, 3, 5, 7, 9\}$

a) $(A \cap B)' = A' \cup B' = \{1, 2, 3, 5, 7, 9\}$ Verified

b) $n(A) = 7$ $n(A') = 2$ $n(\xi) = 9$

$n(A) + n(A') = 7 + 2 = 9 = n(\xi)$ Verified

c) $n(A \cap B) + n((A \cap B)')$

$n(A \cap B) = 3$; $n((A \cap B)') = 6$

$6 + 3 = 9 = n(\xi)$. Verified .

d) $n(A - B) = 4$ $n(B - A) = 0$ $n(A \cap B) = 3$

$n(A - B) + n(B - A) + n(A \cap B) = 4 + 0 + 3 = 7 = n(A \cup B)$

8. $\xi = \{x : x \in \mathbb{N}, x \leq 10\}$, $A = \{x : x \geq 5\}$ $B = \{x : 3 \leq x < 8\}$

$\xi = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ $A = \{5, 6, 7, 8, 9, 10\}$

$B = \{3, 4, 5, 6, 7\}$

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

$(A \cup B)' = \{0, 1, 2\}$

$B' = \{0, 1, 2, 8, 9, 10\}$

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

$$\text{Therefore } (A \cup B)' = A' \cap B' = \{0, 1, 2\}$$

$$\text{ii) } A \cap B = \{5, 6, 7\} \rightarrow (A \cap B)' = \{0, 1, 2, 3, 4, 8, 9, 10\}$$

$$A' \cup B' = \{0, 1, 2, 3, 4, 8, 9, 10\}$$

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

$$\text{iii) } A - B = \{8, 9, 10\}$$

$$A \cap B' = \{8, 9, 10\}$$

$$\therefore A - B = A \cap B'$$

$$\text{iv) } B - A = \{3, 4\}$$

$$B \cap A' = \{3, 4\}$$

$$\therefore B - A = B \cap A'$$

$$9. \quad n(A) = 20, \quad n(B) = 16, \quad n(A \cup B) = 30, \quad n(A \cap B) = 9$$

$$\text{We know } n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

$$30 = 20 + 16 - n(A \cap B)$$

$$n(A \cap B) = 26 - 30 = 6$$

$$\boxed{n(A \cap B) = 6}$$

$$10. \quad n(\xi) = 20, \quad n(A') = 7, \quad n(A) = 9$$

$$\text{We know } n(A) + n(A') = n(\xi)$$

$$n(A) = 20 - 7 = 13$$

$$\boxed{n(A) = 13}$$

$$11. \quad n(\xi) = 40, \quad n(A) = 20, \quad n(B') = 16, \quad n(A \cup B) = 32$$

$$n(B) + n(B') = n(\xi) \Rightarrow n(B) = 40 - 16 = 24$$

$$n(B) = 24$$

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

$$32 = 20 + 24 - n(A \cap B)$$

$$n(A \cap B) = 44 - 32 = 12$$

$$\boxed{n(B) = 24; n(A \cap B) = 12}$$

12. $n(\xi) = 32, n(A) = 20, n(B) = 16, n((A \cup B)') = 4$

i) $n(A \cup B) = n(\xi) - n((A \cup B)')$
 $= 32 - 4 = 28$

$$\boxed{n(A \cup B) = 28}$$

ii) $n(A \cap B) = n(A) + n(B) - n(A \cup B)$
 $= 20 + 16 - 28$
 $= 36 - 28 = 8$

$$\boxed{n(A \cap B) = 8}$$

iii) $n(A - B) = n(A) - n(A \cap B)$
 $= 20 - 8 = 12$

$$\boxed{n(A - B) = 12}$$

13. $n(\xi) = 40; n(A') = 15, n(B) = 12, n((A \cap B)') = 32$

i) $n(A) = n(\xi) - n(A') = 40 - 15 = 25$

ii) $n(B') = n(\xi) - n(B) = 40 - 12 = 28$

iii) $n(A \cap B) = n(A) + n(B) - n(A \cup B) = 25 + 12 - 32 = 5$

$$n(A \cap B) = n(\xi) - n((A \cap B)') = 40 - 32 = 8$$

iv) $n(A \cup B) = n(A) + n(B) - n(A \cap B) = 25 + 12 - 5 = 32$

v) $n(A - B) = n(A) - n(A \cap B) = 25 - 5 = 20$

vi) $n(B - A) = n(B) - n(A \cap B) = 12 - 5 = 7$

$$14. \quad n(A-B) = 12, \quad n(B-A) = 16, \quad n(A \cap B) = 5$$

$$i) \quad n(A) \quad ii) \quad n(B) \quad iii) \quad n(A \cup B)$$

$$i) \quad n(A-B) = n(A) - n(A \cap B)$$

$$n(A) = 12 + 5 = 17$$

$$ii) \quad n(B-A) = n(B) - n(A \cap B)$$

$$n(B) = 16 + 5 = 21$$

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

$$= 17 + 21 - 5 = 38 - 5 = 33$$

$$n(A \cup B) = 33.$$

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EXERCISE : 6.2

1. From Venn diagram, we find that

i) $A = \{0, 5, 7, 8, 9, 11\}$

ii) $B = \{2, 5, 6, 8\}$

iii) $\xi = \{0, 1, 2, 4, 5, 6, 7, 8, 9, 11, 12\}$

iv) $A' = \{1, 2, 4, 12\}$

v) $B' = \{0, 1, 4, 7, 9, 11, 12\}$

vi) $A \cup B = \{0, 2, 5, 6, 7, 8, 9, 11\}$

vii) $A \cap B = \{5, 8\}$

viii) $(A \cup B)' = \{1, 4, 12\}$

ix) $(A \cap B)' = \{0, 1, 2, 4, 6, 7, 9, 11, 12\}$

2.

i) $P = \{a, b, d, e, f, g, h, i\}$

ii) $Q = \{b, d, e\}$

iii) $\xi = \{a, b, c, d, e, f, g, h, i\}$

iv) $P' = \{c, j\}$

v) $Q' = \{a, c, f, g, h, i, j\}$

vi) $P \cup Q = \{a, b, d, e, f, g, h, i\}$

vii) $P \cap Q = \{b, d, e\}$

viii) $(P \cup Q)' = \{c, j\}$

ix) $(P \cap Q)' = \{a, c, f, g, h, i, j\}$

3.

$$i) \xi = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$$

$$ii) A \cap B = \{0, 5, 8\}$$

$$iii) A \cap B \cap C = \{0, 5\}$$

$$iv) C' = \{2, 7, 8, 9, 10, 11, 12\}$$

$$v) A - C = A \cap C' = \{8, 10\}$$

$$vi) B - C = B \cap C' = \{7, 8, 11\}$$

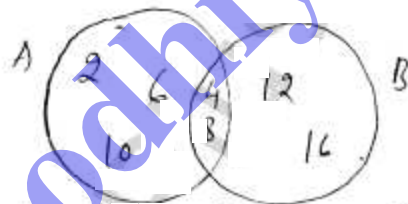
$$vii) C - B = C \cap B' = \{3, 4, 6\}$$

$$viii) (A \cup B)' = \{2, 4, 6, 9, 12\}$$

$$ix) (A \cup B \cup C)' = \{2, 9, 12\}$$

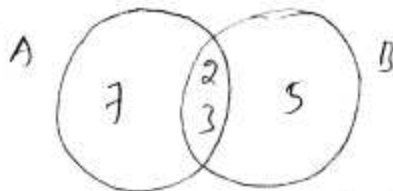
$$4. i) A = \{x \mid x \in \mathbb{N}, x = 2n, n < 5\} \quad B = \{x \mid x \in \mathbb{W}, x = 4n, n < 5\}$$

$$A = \{2, 4, 6, 8, 10\} \quad B = \{4, 8, 12, 16\}$$



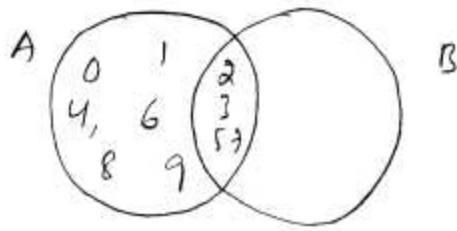
$$ii) A = \{\text{prime factors of } 42\} \quad B = \{\text{prime factors of } 60\}$$

$$A = \{2, 3, 7\} \quad B = \{2, 3, 5\}$$

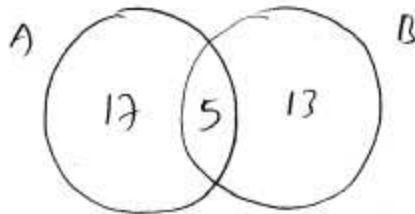


$$iii) P = \{x \mid x \in \mathbb{W}, x < 10\} \quad Q = \{\text{prime factors of } 210\}$$

$$P = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\} \quad Q = \{2, 3, 7, 5\}$$



5. $n(A) = 22$ $n(B) = 18$ $n(A \cap B) = 5$

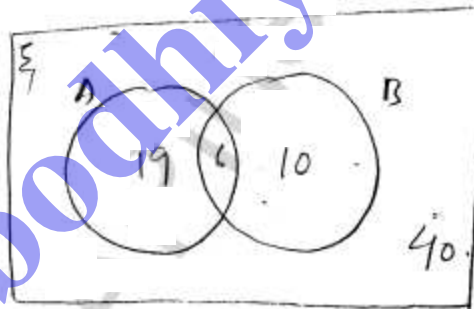


i) $n(A \cup B) = 17 + 5 + 13 = 35$

ii) $n(A - B) = n(A) - n(A \cap B) = 17 - 5 = 12$

iii) $n(B - A) = n(B) - n(A \cap B) = 13 - 5 = 8$

6. $n(A) = 25$ $n(B) = 16$ $n(A \cap B) = 6$, $n((A \cup B)') = 5$



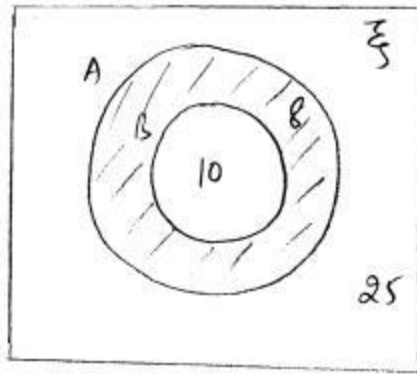
i) $n(A \cup B) = 19 + 6 + 10 = 35$

ii) $n(U) = n(A \cup B) + n((A \cup B)') = 35 + 5 = 40$

iii) $n(A - B) = n(A) - n(A \cap B) = 25 - 6 = 19$

iv) $n(B - A) = n(B) - n(A \cap B) = 16 - 6 = 10$

7. $n(\xi) = 25$ $n(A') = 7$ $n(B) = 10$ BCA



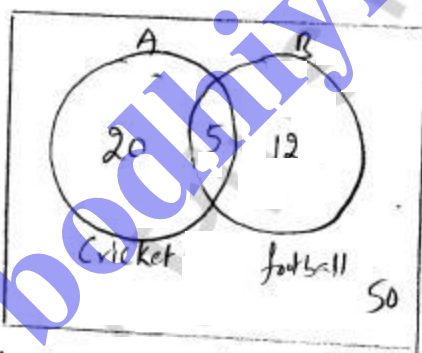
A-B shaded

$$n(A) = n(\xi) - n(A') = 25 - 7 = 18$$

$$n(A-B) = n(A) - n(A \cap B) = 18 - 10 = 8$$

\therefore Cardinal number of set A-B is 8.

8.



i) No. of boys who play atleast one of the two games

$$= n(\text{Only Cricket}) + n(\text{Only Football}) + n(\text{Both Cricket \& Football})$$

$$= 20 + 12 + 5$$

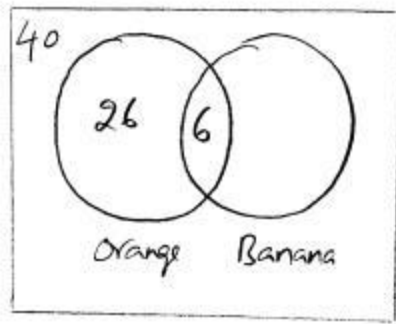
$$= 37$$

ii) Neither Cricket nor Football

$$n((A \cup B)') = \text{Total Student} - n(A \cup B)$$

$$= 50 - 37 = 13$$

9.



from Venna Diagram

i) Both orange and Bananas.
 A B

$$\begin{aligned} n(A \cap B) &= \text{no. of Students who like both orange and Bananas} \\ &= \text{no. of student who like orange} - \text{no. of student who like orange but not bananas} \\ &= 32 - 26 \\ &= 6. \end{aligned}$$

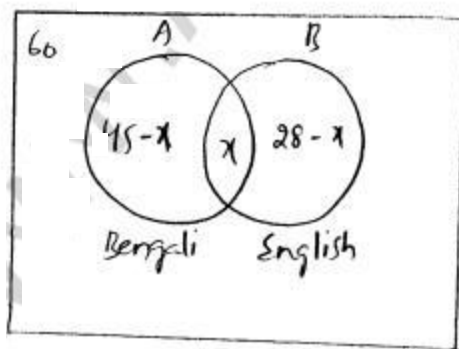
ii) $n(B) = 9$

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

$$\begin{aligned} n(B) &= 40 - 32 + 6 = 46 - 32 \\ &= 14 \end{aligned}$$

$$\begin{aligned} \text{Number of student who like only banana} &= 14 - 6 \\ &= 8. \end{aligned}$$

10.



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

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

$$60 = 45 + 28 - x$$

$$x = 73 - 60$$

$$\boxed{x = 13}$$

∴ No of people who speak both Bengali and English are
13

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