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It gives me great pride and pleasure in bringing to you **Sura's Mathematics Guide** for **9th Standard**. It is prepared as per the Latest New Textbook.

This guide encompasses all the requirements of the students to comprehend the text and the evaluation of the textbook.

- Additional questions have been provided exhaustively for clear understanding of the units under study.
- Chapter-wise Unit Test are given.

In order to learn effectively, I advise students to learn the subject section-wise and practice the exercises given. It will be a teaching companion to teachers and a learning companion to students.

Though these salient features are available in this Guide, I cannot negate the indispensable role of the teachers in assisting the student to understand the subject thoroughly.

I sincerely believe this guide satisfies the needs of the students and bolsters the teaching methodologies of the teachers.

I pray the almighty to bless the students for consummate success in their examinations.

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SYLLABUS

Month	Unit	Chapter
June	1	Set Language
July	2	Real Numbers
	4	Geometry (4.1)
I MID TERM TEST (June, July)		
August	3	Algebra (3.1 - 3.4)
	4	Geometry (4.2)
September	3	Algebra (3.5 - 3.8)
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	5	Coordinate Geometry (5.5 - 5.7)
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January	7	Mensuration
February	8	Statistics
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March	9	Probability
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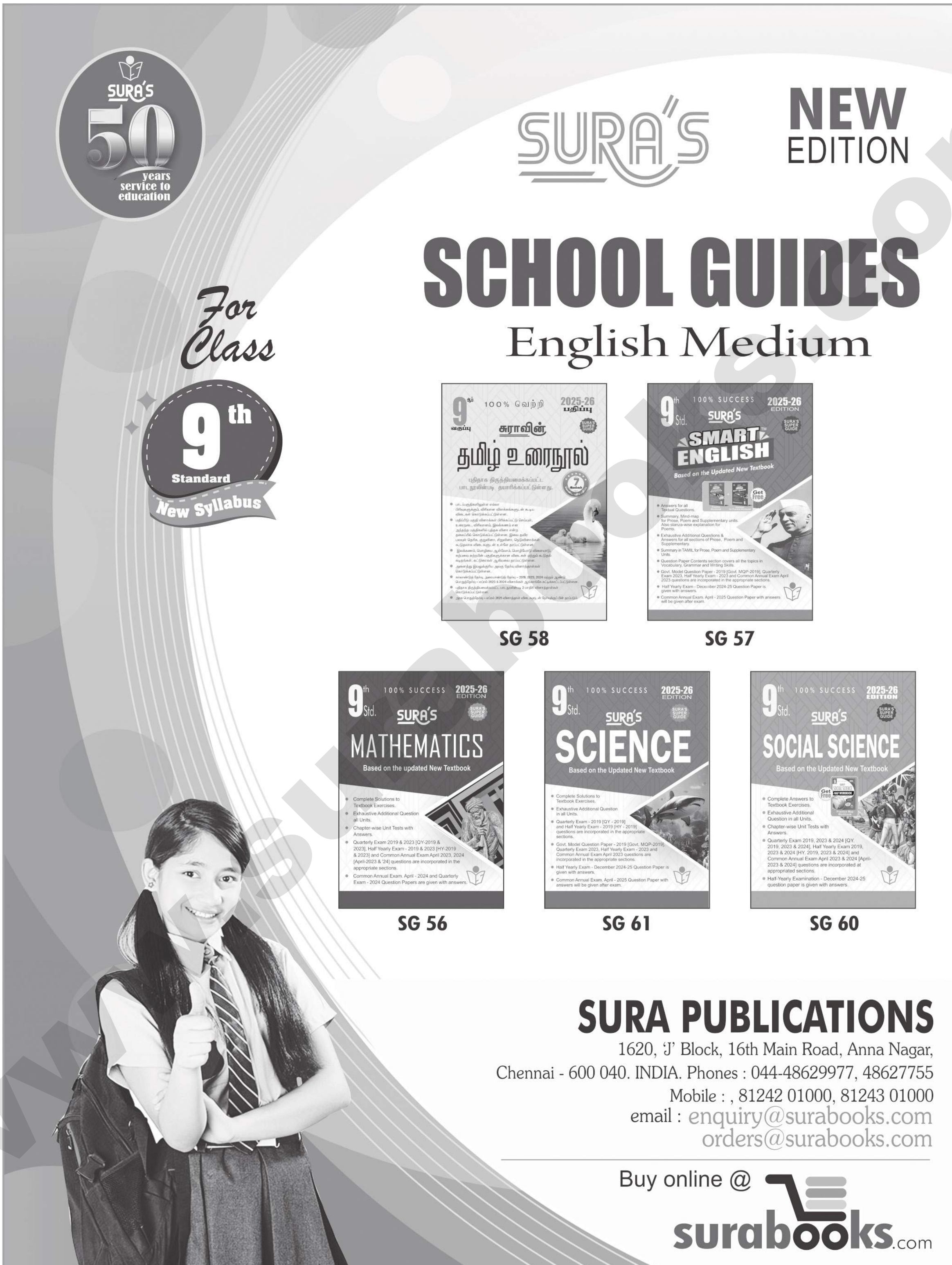
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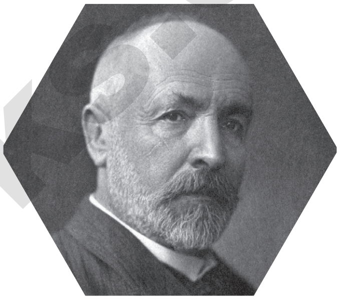
1 Set Language

1.1 Introduction



In our daily life, we often deal with collection of objects like books, stamps, coins, etc. Set language is a mathematical way of representing a collection of objects.

1.2 Set :

(i) A set is a well - defined collection of objects.

(ii) The objects of a set are called its members or elements.

For example,

1. The collection of all books in a District Central Library.
2. The collection of all colours in a rainbow.

1.3 Representation of a Set :

The collection of odd numbers can be described in many ways:

(1) "The set of odd numbers" is a fine description.

(2) It can be written as {1, 3, 5, …}.

(3) Also, it can be said as the collection of all numbers x where x is an odd number.

1.3.1 Descriptive Form :

In descriptive form, a set is described in words.

For Example,

(i) The set of all vowels in English alphabets.

(ii) The set of all whole numbers.

1.3.2 Set Builder Form or Rule Form :

In set builder form, all the elements are described by a rule.

For example,

(i) A = {x : x is a vowel in English alphabets}

(ii) B = {x | x is a whole number}

1.3.3 Roster Form or Tabular Form

A set can be described by listing all the elements of the set.

For example,

(i) A = {a, e, i, o, u}

(ii) B = {0,1,2,3,…}

Exercise 1.1

1. **Which of the following are sets?**
   (i) The collection of prime numbers upto 100.
   (ii) The collection of rich people in India.
   (iii) The collection of all rivers in India.
   (iv) The collection of good Hockey players.

Sol. (i) A = {2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89 and 97}

As the collection of prime numbers upto 100 is known and can be counted (well defined). Hence this is a set.

(ii) The collection of rich people in India. Rich people has no definition.
Hence, it is not a set.

(iii) A = {Cauvery, Sindhu, Ganga, ...}
Hence, it is a set.

(iv) The collection of good hockey players is not a well - defied collection because the criteria for determining a hockey player's talent may vary from person to person.

Hence, this collection is not a set.

2. **List the set of letters of the following words in Roster form.**
   (i) INDIA *[HY-'23]* **(ii) PARALLELOGRAM** *[HY-'23]*
   (iii) MISSISSIPPI **(iv) CZECHOSLOVAKIA**

Sol. (i) A = {I, N, D, A}
(ii) B = {P, A, R, L, E, O, G, M}
(iii) C = {M, I, S, P}
(iv) D = {C, Z, E, H, O, S, L, V, A, K, I}.

3. **Consider the following sets A = {0, 3, 5, 8} B = {2, 4, 6, 10} C = {12, 14, 18, 20}**
   (a) State whether True or False:
   (i) $18 \in C$ (ii) $6 \notin A$ (iii) $14 \notin C$ (iv) $10 \in B$ (v) $5 \in B$ (vi) $0 \in B$
   (b) Fill in the blanks:
   (i) $3 \in$ ____ (ii) $14 \in$ _____ (iii) 18 ____ B (iv) 4 _____ B

Sol. (a) (i) True (ii) True (iii) False (iv) True (v) False (vi) False.
(b) (i) A (ii) C (iii) $\notin$ (iv) $\in$

4. **Represent the following sets in Roster form.**
   (i) A = The set of all even natural numbers less than 20. *[QY-'19; April-'23]*
   (ii) $B = \{y : y = \frac{1}{2n}, n \in \mathbb{N}, n \le 5\}$
   (iii) $C = \{x : x$ is perfect cube, $27 < x < 216\}$
   (iv) $D = \{x : x \in \mathbb{Z}, -5 < x \le 2\}$

Sol. (i) A = {2, 4, 6, 8, 10, 12, 14, 16, 18}

(ii) N = { 1, 2, 3, 4, 5}

if, $n = 1, y = \frac{1}{2n} = \frac{1}{2\times1} = \frac{1}{2}$

$n = 2, y = \frac{1}{2\times2} = \frac{1}{4}$

$n = 3, y = \frac{1}{2\times3} = \frac{1}{6}$

$n = 4, y = \frac{1}{2\times4} = \frac{1}{8}$

$n = 5, y = \frac{1}{2\times5} = \frac{1}{10}$

$\therefore$ B = $\left\{\frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}, \frac{1}{10}\right\}$

(iii) C = {64, 125}

(iv) 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 Internationals.

(ii) C = $\left\{\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \ldots\right\}$.

(iii) D = The set of all Tamil months in a year.

(iv) E = The set of odd Whole numbers less than 9.

Sol. (i) B = {x : x is an Indian player who scored double centuries in One Day Internationals}

(ii) C = $\{x : x = \frac{n}{n+1}, n \in \mathbb{N}\}$

(iii) D = {x : x is a Tamil month in a year}

(iv) E = {x : x is an odd number, $x \in \mathbb{W}$, $x < 9$, where W is the set of whole numbers}.

6. Represent the following sets in descriptive form.

(i) P = {January, June, July}

(ii) Q = {7,11,13,17,19,23,29}

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

(iv) S = {x : x is an consonant in English alphabet}

Sol. (i) P is the set of English Months beginning with J.

(ii) Q is the set of all prime numbers between 5 and 31.

(iii) R is the set of all natural numbers less than 5.

(iv) S is the set of all English consonants.

1.4. Types of sets

1.4.1 Empty Set or Null Set :

A set consisting of no element is called the empty set or null set or void set.

For example,

A={x : x is an odd integer and divisible by 2}

$\therefore$ A={ } or $\varnothing$

1.4.2 Singleton Set :

A set which has only one element is called a singleton set.

For example,

A = $\{x : 3 < x < 5, x \in \mathbb{N}\}$ where A = {4}

1.4.3 Finite Set :

A set with finite number of elements is called a finite set.

For example,

1. The set of family members.
2. The set of indoor/outdoor games you play.

1.4.4 Infinite Set :

A set which is not finite is called an infinite set.

For example,

(i) {5,10,15,...} (ii) The set of all points on a line.

1.4.5 Equivalent Sets :

Two finite sets A and B are said to be equivalent if they contain the same number of elements. It is written as A $\approx$ B.

If A and B are equivalent sets, then n(A) = n(B).

1.4.6 Equal Sets :

Two sets are said to be equal if they contain exactly the same elements, otherwise they are said to be unequal.

In other words, two sets A and B are said to be equal, if

(i) every element of A is also an element of B

(ii) every element of B is also an element of A.

1.4.7 Subset :

Let A and B be two sets. If every element of A is also an element of B, then A is called a subset of B. We write A $\subseteq$ B.

1.4.8 Proper Subset :

Let A and B be two sets. If A is a subset of B and A$\neq$B, then A is called a proper subset of B and we write A $\subset$ B.

For example,

If A={1,2,5} and B={1,2,3,4,5} then A is a proper subset of B i.e. A $\subset$ B.

1.4.9 Power set :

The set of all subsets of A is said to be the power set of the set A and is denoted as P(A)

For example,

Let A = {–3, 4}

The subsets of A are , $\varnothing$, {–3}, {4}, {–3, 4}

Then the power set of A is P(A) = {$\varnothing$, {–3}, {4}, {–3, 4}}

Exercise 1.2

1. Find the cardinal number of the following sets.

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

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

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

(iv) R = $\{x : x$ is an integers, $x \in \mathbb{Z}$ and $-5 \leq x < 5\}$

(v) S = The set of all leap years between 1882 and 1906.

Sol. (i) $n(M) = 6$

(ii) W = {0, 1, 2, 3, ...}

if $n = 0$, $x = 3(0) + 2 = 2$

if $n = 1$, $x = 3(1) + 2 = 5$

if $n = 2$, $x = 3(2) + 2 = 8$

if $n = 3$, $x = 3(3) + 2 = 11$

if $n = 4$, $x = 3(4) + 2 = 14$

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

$n(P) = 5$

(iii) N = {1, 2, 3, 4, ...}

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

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

if $n = 4$, $y = \frac{4}{3(4)} = \frac{4}{12}$

if $n = 5$, $y = \frac{4}{3(5)} = \frac{4}{15}$

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

$n(Q) = 3$

(iv) $x \in z$

R = {–5, –4, –3, –2, –1, 0, 1, 2, 3, 4}

n (R) = 10.

(v) S = {1884, 1888, 1892, 1896, 1904}

n (S) = 5.

2. Identify the following sets as finite or infinite.

(i) X = The set of all districts in Tamilnadu.

(ii) Y = The set of all straight lines passing through a point.

(iii) A = $\{x : x \in \mathbb{Z}$ and $x < 5\}$

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

Sol. (i) Finite set

(ii) Infinite set

(iii) A = { ...., –2, –1, 0, 1, 2, 3,4} ∴ Infinite set

(iv) $x^2 - 5x + 6 = 0$

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

B = {3, 2} ∴ Finite set.

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"

(ii) C = {2, 3, 4, 5}

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

(iii) X = { x : x is a letter in the word "LIFE"}

Y = {F, I, L, E}

(iv) G = {x : x is a prime number and $3 < x < 23$}

H = {x : x is a divisor of 18}

Sol. (i) A = {a, e, i, o, u}

B = {V, O,W, E, L}

The sets A and B contain the same number of elements. ∴ Equivalent sets

(ii) C = {2, 3, 4, 5}

D = {2, 3, 4} ∴ Unequal sets

(iii) X = {L, I, F, E}

Y = {F, I, L, E}

The sets X and Y contain exactly the same elements. ∴ Equal sets.

(iv) G = {5, 7, 11, 13, 17, 19}

H = {1, 2, 3, 6, 9, 18} ∴ Equivalent sets.

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

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

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

(iii) C = {0}.

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

Sol. (i) A = { } ∵ There is no element in between 1 and 2 in Natural numbers.∴ Null set

(ii) B = { }∵ All even natural numbers are divisible by 2. ∴ B is Null set

(iii) C = {0} ∴ Singleton set

(iv) D = { } ∵ No triangle has four sides. ∴ D is a Null set.

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

(i) A = {f, i, a, s} and B = {a, n, f, h, s}

(ii) C = {x : x is a prime number, $x > 2$} and D ={x : x is an even prime number}

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

Sol. (i) A = {f, i, a, s}

B = {a, n, f, h, s}

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

Since $A \cap B \neq \phi$, A and B are overlapping sets.

(ii) C = {3, 5, 7,11, ...}

D = {2}

C ∩ D = {3, 5, 7, 11, ...} ∩ {2}= { }

Since C ∩ D=∅, C and D are disjoint sets.

(iii) E = {1, 2, 3, 4, 6, 8, 12, 24}

F = {3, 6, 9, 12, 15, 18, 21, 24, 27}

E ∩ F = {1, 2, 3, 4, 6, 8, 12, 24} ∩ {3, 6, 9, 12, 15, 18, 21, 24, 27}

= {3, 6, 12, 24}

Since E ∩ F ≠ ϕ, E and F are overlapping sets.

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

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

(ii) The set of shapes which have radius.

(iii) The set of shapes in which the sum of all interior angles is 180°

(iv) The set of shapes which have 5 sides.

Sol. (i) {Square, Rhombus} (ii) {Circle}

(iii) {Triangle} (iv) Null set.

7. If A={*a*,{*a*,*b*}}, write all the subsets of A. ***[April-'25]***

Sol. A = {*a*, {*a*, *b*}} subsets of A are { } {*a*}, {*a*, *b*}, {*a*, {*a*, *b*}}.

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

(i) A={*a*,*b*} (ii) B={1,2,3} (iii) D={*p*,*q*,*r*,*s*} (iv) E = ∅

Sol. (i) The subsets of A are ∅, {*a*}, {*b*}, {*a*, *b*}

The power set of A

P(A) = {∅, {*a*}, {*b*}, {*a*, *b*}}

(ii) The subsets of B are φ, {1}, {2}, {3}, {1, 2}, {2, 3}, {1, 3}, {1, 2, 3}

The power set of B

P(B) = {∅, {1}, {2}, {3}, {1, 2}, {2, 3}, {1, 3}, {1, 2, 3}}

(iii) The subset of D are ∅, {*p*}, {*q*}, {*r*}, {*s*}, {*p*, *q*}, {*p*, *r*}, {*p*, *s*}, {*q*, *r*}, {*q*, *s*}, {*r*, *s*},{*p*, *q*, *r*}, {*q*, *r*, *s*}, {*p*, *r*, *s*}, {*p*, *q*, *s*}, {*p*, *q*, *r*, *s*}}

The power set of D

P(D) = {∅, {*p*}, {*q*}, {*r*}, {*s*}, {*p*, *q*}, {*p*, *r*}, {*p*, *s*}, {*q*, *r*}, {*q*, *s*}, {*r*, *s*}, {*p*, *q*, *r*}, {*q*, *r*, *s*}, {*p*, *r*, *s*}, {*p*, *q*, *s*}, {*p*, *q*, *r*, *s*}}

(iv) The power set of E

P(E) = {{ }}.

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

(i) W={red, blue, yellow} **(ii) X ={ x^2 : $x \in \mathbb{N}$, $x^2 \leq 100$}.** ***[QY-'23]***

Sol. (i) Given W = {red, blue, yellow}

Then n(W) = 3

The number of subsets = $n[P(W)] = 2^3 = 8$

The number of proper subsets = $n[P(W)] - 1 = 2^3 - 1 = 8 - 1 = 7$

(ii) Given X $= \{1, 2, 3, ...\}$

$X^2 = \{1, 4, 9, 16, 25, 36, 49, 64, 81, 100\}$

$n(X) = 10$

The Number of subsets $= n[P(X)] = 2^{10} = 1024$

The Number of proper subsets $= n[P(X)]-1 = 2^{10} - 1 = 1024 - 1 = 1023.$

10. (i) If $n(A) = 4$, find $n[P(A)]$. ***[QY-'19 & '23]*** **(ii) If $n(A) = 0$, find $n[P(A)]$.**

(iii) If $n[P(A)] = 256$, find $n(A)$. ***[April-'23]***

Sol. (i) $n(A) = 4$

$n[P(A)] = 2^n = 2^4 = 16$

(ii) $n(A) = 0$

$n[P(A)] = 2^0 = 1$

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

2 | 256
2 | 128
2 | 64
2 | 32
2 | 16
2 | 8
2 | 4
2 | 2
  1

$n[P(A)] = 2^8$

$\therefore n(A) = 8.$

1.5 Set operations :

1.5.1 Complement of a Set

The Complement of a set A is the set of all elements of U (the universal set) that are not in A.

It is denoted by A′ or A^C. In symbols $A' = \{x : x \in U, x \notin A\}$

1.5.2 Union of Two Sets

The union of two sets A and B is the set of all elements which are either in A or in B or in both. It is denoted by A∪B and read as A union B.

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

1.5.3 Intersection of Two Sets

The intersection of two sets A and B is the set of all elements common to both A and B. It is denoted by A∩B and read as A intersection B.

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

1.5.4 Difference of Two Sets

Let A and B be two sets, the difference of sets A and B is the set of all elements which are in A, but not in B. It is denoted by A–B or A\B and read as A difference B.

In symbol, $A - B = \{x : x \in A \text{ and } x \notin B\}$; $B - A = \{y : y \in B \text{ and } y \notin A\}$.

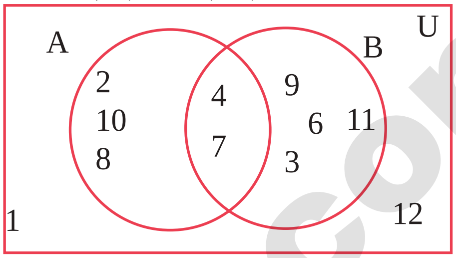
1.5.5 Symmetric Difference of Sets

The symmetric difference of two sets A and B is the set $(A - B) \cup (B - A)$. It is denoted by $A \Delta B$.

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

Exercise 1.3

1. Using the given Venn diagram, write the elements of *[QY-'23]*
(i) A (ii) B (iii) A∪B (iv) A∩B (v) A – B (vi) B – A (vii) A′ (viii) B′ (ix) U



Sol.
(i) A = {2, 4, 7, 8, 10}
(ii) B = {3, 4, 6, 7, 9, 11}
(iii) A∪B = {2, 3, 4, 6, 7, 8, 9, 10, 11}
(iv) A∩B = {4, 7}
(v) A – B = {2, 8, 10}
(vi) B – A = {3, 6, 9, 11}
(vii) A′ = {1, 3, 6, 9, 11, 12}
(viii) B′ = {1, 2, 8, 10, 12}
(ix) U = {1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12}.

2. Find A∪B, A∩B, A – B and B – A for the following sets.
(i) A = {2, 6, 10, 14} and B = {2, 5, 14, 16}
(ii) A = {*a, b, c, e, u*} and B = {*a, e, i, o, u*}
(iii) A={*x* : *x* ∈ N, *x* ≤ 10} and B={*x* : *x* ∈ W, *x* < 6}
(iv) A = Set of all letters in the word "mathematics" and B = Set of all letters in the word "geometry"

Sol. (i) A = {2, 6, 10, 14} and B = {2, 5, 14, 16}
A ∪ B = {2, 6, 10, 14} ∪ {2, 5, 14, 16} = {2, 5, 6, 10, 14, 16}
A ∩ B = {2, 6, 10, 14} ∩ {2, 5, 14, 16} = {2, 14}
A – B = {~~2~~, 6, 10, ~~14~~ } – {2, 5, 14, 16} = {6, 10}
B – A = {~~2~~, 5, ~~14~~, 16} – {2, 6, 10, 14} = {5, 16}

(ii) A = {*a, b, c, e, u*} and B = {*a, e, i, o, u*}
A ∪ B = {*a, b, c, e, u*} ∪ {*a, e, i, o, u*} = {*a, b, c, e, i, o, u*}
A ∩ B = {*a, b, c, e, u*} ∩ {*a, e, i, o, u*}={*a, e, u*}
A – B = {~~*a*~~, *b, c*, ~~*e*~~, ~~*u*~~} – {*a, e, i, o, u*}= {*b, c*}
B – A = {~~*a*~~, ~~*e*~~, *i, o*, ~~*u*~~} – {*a, b, c, e, u*} = {*i, o*}

(iii) *x* ∈ {1, 2, 3, ...} ; *x* ∈ {0, 1, 2, 3, 4, 5, ...}
A = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
B = {0, 1, 2, 3, 4, 5}
A ∪ B= {1, 2, 3, 4, 5, 6, 7, 8, 9, 10} ∪ {0, 1, 2, 3, 4, 5}
= {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
A ∩ B= {1, 2, 3, 4, 5, 6, 7, 8, 9, 10} ∩ {0, 1, 2, 3, 4, 5} = {1, 2, 3, 4, 5}
A – B = {~~1~~, ~~2~~, ~~3~~, ~~4~~, ~~5~~, 6, 7, 8, 9, 10} – {0, 1, 2, 3, 4, 5}= {6, 7, 8, 9, 10}
B – A = {0, ~~1~~, ~~2~~, ~~3~~, ~~4~~, ~~5~~} – {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}= {0}

(iv)A = {*m, a, t, h, e, i, c, s*}, B = {*g, e, o, m, t, r, y*}
A ∪ B = {*m,a t,h,e,i,c,s*} ∪ {*g,e,o,m,t,r,y*} = {*m, a, t, h, e, i, c, s, g, o, r, y*}
A ∩ B = {*m, a, t, h,* ***e****, i, c, s*} ∩ {*g, e, o, m, t, r, y*} = {*m, t, e*}
A – B = {~~*m*~~, *a*, ~~*t*~~, *h*, ~~*e*~~, *i, c, s*} – {*g, e, o, m, t, r, y*} = {*a, h, i, c, s*}
B – A = {*g*, ~~*e*~~, *o*, ~~*m*~~, ~~*t*~~, *r, y*} – {*m, a, t, h, e, i, c, s*} = {*g, o, r, y*}

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 sets.
(i) A′ (ii) B′ (iii) A′∪B′ *[QY-'19]* (iv) A′∩B′
(v) (A∪B)′ (vi) (A∩B)′ (vii) (A′)′ (viii) (B′)′

Sol. (i) $A' = U - A = \{a, \cancel{b}, c, \cancel{d}, e, \cancel{f}, g, \cancel{h}\} - \{b, d, f, h\} = \{a, c, e, g\}$

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

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

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

(v) $(A \cup B)' = U - (A \cup B) = \{\cancel{a}, \cancel{b}, c, \cancel{d}, \cancel{e}, \cancel{f}, g, \cancel{h}\} - \{a,b,d,e,f,h\} = \{c, g\}$

(vi) $(A \cap B)' = U - (A \cap B)$

$= \{a, b, c, \cancel{d}, e, f, g, \cancel{h}\} - \{d, h\} = \{a, b, c, e, f, g\}$

(vii) $(A')' = U - A' = \{\cancel{a}, b, \cancel{c}, d, \cancel{e}, f, \cancel{g}, h\} - \{a, c, e, g\} = \{b, d, f, h\}$

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

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.
(i) A′ (ii) B′ (iii) A′∪B′ (iv) A′∩B′ (v) (A∪B)′ (vi) (A∩B)′ (vii) (A′)′ (viii) (B′)′

Sol. (i) $A' = U - A = \{0, \cancel{1}, 2, \cancel{3}, 4, \cancel{5}, 6, \cancel{7}\} - \{1, 3, 5, 7\} = \{0, 2, 4, 6\}$

(ii) $B' = U - B = \{\cancel{0}, 1, \cancel{2}, \cancel{3}, 4, \cancel{5}, 6, \cancel{7}\} - \{0, 2, 3, 5, 7\} = \{1, 4, 6\}$

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

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

(v) $(A \cup B)' = U - (A \cup B) = \{\cancel{0}, \cancel{1}, \cancel{2}, \cancel{3}, 4, \cancel{5}, 6, \cancel{7}\} - \{0, 1, 2, 3, 5, 7\}$

$= \{4, 6\}$

(vi) $(A \cap B)' = U - (A \cap B) = \{0, 1, 2, \cancel{3}, 4, \cancel{5}, 6, \cancel{7}\} - \{3, 5, 7\} = \{0, 1, 2, 4, 6\}$

(vii) $(A')' = U - A' = \{\cancel{0}, 1, \cancel{2}, 3, \cancel{4}, 5, \cancel{6}, 7\} - \{0, 2, 4, 6\} = \{1, 3, 5, 7\}$

(viii) $(B')' = U - B' = \{0, \cancel{1}, 2, 3, \cancel{4}, 5, \cancel{6}, 7\} - \{1, 4, 6\} = \{0, 2, 3, 5, 7\}$.

5. Find the symmetric difference between the following sets.
(i) P = {2, 3, 5, 7, 11} and Q = {1, 3, 5, 11} *[QY-'19]*
(ii) R = {*l, m, n, o, p*} and S = {*j, l, n, q*}
(iii) X = {5, 6, 7} and Y = {5, 7, 9, 10}

Sol. (i) $P = \{2, 3, 5, 7, 11\}$

$Q = \{1, 3, 5, 11\}$

$P - Q = \{2, \cancel{3}, \cancel{5}, 7, \cancel{11}\} - \{1, 3, 5, 11\} = \{2, 7\}$

$Q - P = \{1, \cancel{3}, \cancel{5}, \cancel{11}\} - \{2, 3, 5, 7, 11\} = \{1\}$

$P \Delta Q = (P - Q) \cup (Q - P) = \{2, 7\} \cup \{1\} = \{1, 2, 7\}$

(ii) $R = \{l, m, n, o, p\}$

$S = \{j, l, n, q\}$

$R - S = \{l, m, n, o, p\} - \{j, l, n, q\} = \{m, o, p\}$

$S - R = \{j, \cancel{l}, \cancel{n}, q\} - \{l, m, n, o, p\} = \{j, q\}$

$R \Delta S = (R - S) \cup (S - R) = \{m, o, p\} \cup \{j, q\} = \{j, m, o, p, q\}$

(iii) X = {5, 6, 7}

Y = {5, 7, 9, 10}

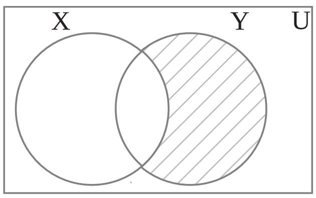
X – Y = {~~5~~, 6, ~~7~~} – {5, 7, 9, 10}= {6}

Y – X = {~~5~~, ~~7~~, 9, 10} – {5, 6, 7} = {9, 10}

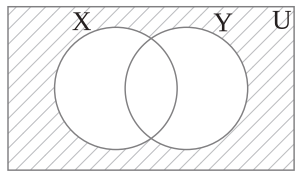
X Δ Y = (X – Y) ∪ (Y – X) = {6} ∪ {9, 10} = {6, 9, 10}.

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

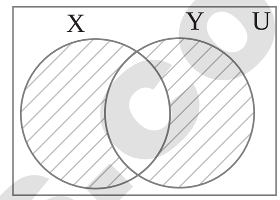
(i)



(ii)



(iii)



Sol. (i) Y – X (ii) (X ∪ Y)′ (iii) (X – Y) ∪ (Y – X).

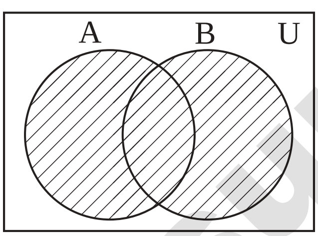
7. Let A and B be two overlapping sets and the universal set be U. Draw appropriate Venn diagram for each of the following,

(i) A∪B **(ii) A∩B** **(iii) (A∩B)′**
(iv) (B – A)′ **(v) A′∪B′** **(vi) A′∩B′**

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

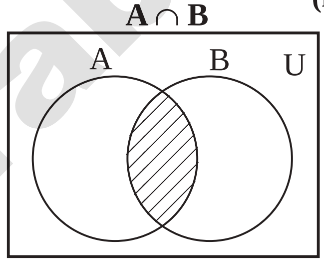
Sol. **(i)**

A ∪ B



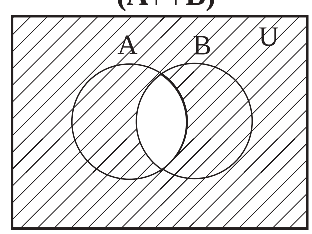
(ii)

A ∩ B



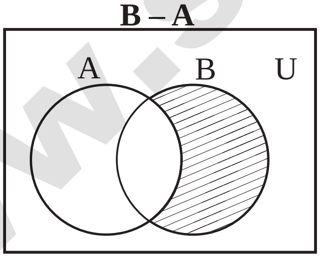
(iii)

(A ∩ B)′

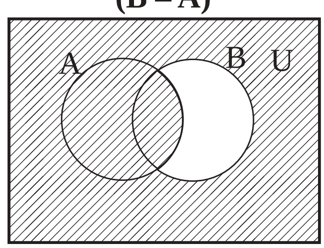


(iv)

B – A

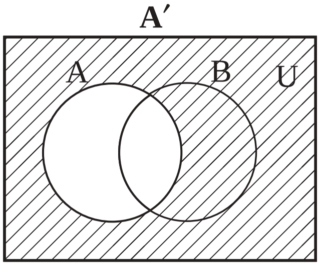


(B – A)′

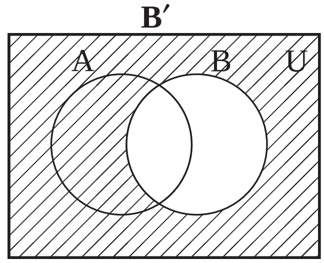


(v)

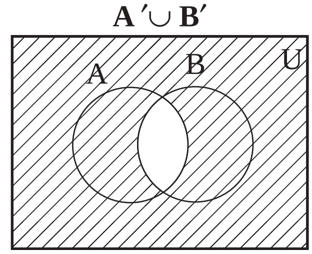
A′



B′

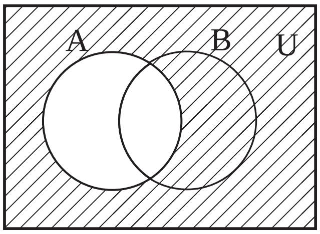


A′∪ B′

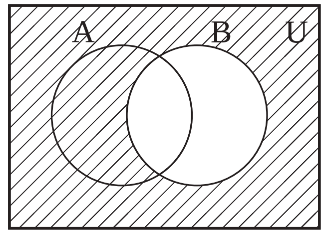


(vi)

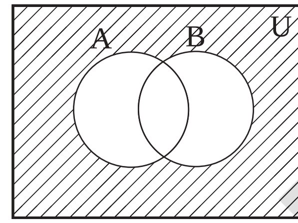
A′



B′



A′ ∩ B′



(vii) From the Venn diagrams (iii) and (v) we observe that $(A\cap B)' = A'\cup B'$.

1.6 Properties of Set Operations :

It is an interesting investigation to find out if operations among sets (like union, intersection, etc.) follow mathematics properties such as commutativity, Associativity, etc.

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) $(P\cup Q)\cup R$ (ii) $(P\cap Q)\cap S$ (iii) $(Q\cap S)\cap R$

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

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

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

(ii) $(P\cap Q)\cap S$

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

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

(iii) $(Q\cap S)\cap R$

$$(Q\cap S) = \{\underline{2}, \underline{3}, \underline{5}, 9, 11\} \cap \{\underline{2}, \underline{3}, 4, \underline{5}, 8\} = \{2, 3, 5\}$$

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

2. Test for the commutative property of union and intersection of the sets ***[QY-'23]***
P = { *x* : *x* is a real number between 2 and 7} and
Q = { *x* : *x* is a rational number between 2 and 7}

Sol. **Commulative Property of union of sets**

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

$$\text{Here } P = \{3, 4, 5, 6\},\ Q = \{\sqrt{3}, \sqrt{5}, \sqrt{6}\}$$

$$P\cup Q = \{3, 4, 5, 6\}\cup\{\sqrt{3}, \sqrt{5}, \sqrt{6}\} = \{3, 4, 5, 6, \sqrt{3}, \sqrt{5}, \sqrt{6}\} \quad \text{... (1)}$$

$$Q\cup P = \{\sqrt{3}, \sqrt{5}, \sqrt{6}\} \cup \{3, 4, 5, 6\} = \{\sqrt{3}, \sqrt{5}, \sqrt{6}, 3, 4, 5, 6\} \quad \text{... (2)}$$

$$(1) = (2)$$

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

∴ It is verified that union of sets is commutative.

Commutative Property of intersection of sets

$(P\cap Q) = (Q\cap P)$

$P \cap Q = \{3, 4, 5, 6\} \cap \{\sqrt{3}, \sqrt{5}, \sqrt{6}\} = \{\ \ \}$ ... (1)

$Q \cap P = \{\sqrt{3}, \sqrt{5}, \sqrt{6}\} \cap \{3, 4, 5, 6\} = \{\ \ \}$ ... (2)

From (1) and (2)

$P \cap Q = Q \cap P$

$\therefore$ It is verified that intersection of sets is commutative.

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.

Sol. **Associative Property of union of sets**

A∪(B ∪ C) = (A∪B)∪C)

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

$A \cup (B \cup C) = \{p, q, r, s\} \cup \{m, n, p, q, s, t\} = \{m, n, p, q, r, s, t\}$ ... (1)

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

$(A \cup B) \cup C = \{p, q, r, s, m, n, t\} \cup \{m, n, p, q, s\} = \{p, q, r, s, m, n, t\}$ ... (2)

From (1) & (2)

It is verified that A∪(B ∪ C) = (A∪B)∪C

4. Verify the associative property of intersection of sets for A={−11, $\sqrt{2}$, $\sqrt{5}$,7}, B = { $\sqrt{3}$, $\sqrt{5}$, 6, 13} and C ={ $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, 9}. *[HY-'19]*

Sol. **Associative Property of intersection of sets**

A∩(B∩C) = (A∩B)∩C)

$B \cap C = \{\sqrt{3}, \sqrt{5}, 6, 13\} \cap \{\sqrt{2}, \sqrt{3}, \sqrt{5}, 9\} = \{\sqrt{3}, \sqrt{5}\}$

$A \cap (B \cap C) = \{-11, \sqrt{2}, \sqrt{5}, 7\} \cap \{\sqrt{3}, \sqrt{5}\} = \{\sqrt{5}\}$ ... (1)

$A \cap B = \{-11, \sqrt{2}, \sqrt{5}, 7\} \cap \{\sqrt{3}, \sqrt{5}, 6, 13\} = \{\sqrt{5}\}$

$(A \cap B) \cap C = \{\sqrt{5}\} \cap \{\sqrt{2}, \sqrt{3}, \sqrt{5}, 9\} = \{\sqrt{5}\}$ ... (2)

From (1) and (2), it is verified that A∩(B∩C) = (A∩B)∩C

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

Sol. $A = \{x : x = 2^n, n \in \mathbb{W}, n < 4\}$

$\Rightarrow x = 2^0 = 1$

$x = 2^1 = 2$

$x = 2^2 = 4$

$x = 2^3 = 8$

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

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

$\Rightarrow x = 2 \times 1 = 2$

$x = 2 \times 2 = 4$

$x = 2 \times 3 = 6$

$x = 2 \times 4 = 8$

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

$C = \{0, 1, 2, 5, 6\}$

Associative property of intersection of sets

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

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

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

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

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

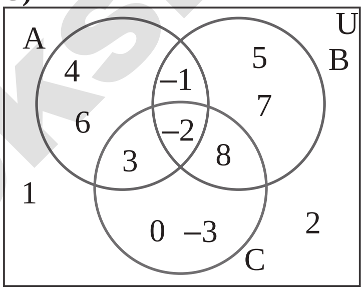
From (1) and (2), It is verified that $A \cap(B \cap C) = (A \cap B) \cap C$

Exercise 1.5

1. Using the adjacent Venn diagram, find the following sets :

(i) $A - B$ (ii) $B - C$ (iii) $A'\cup B'$ (vi) $A'\cap B'$

(v) $(B\cup C)'$ (vi) $A - (B\cup C)$ (vii) $A - (B\cap C)$



Sol. (i) $A - B = \{3, 4, 6\}$

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

(iii) $A'\cup B'$

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

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

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

(iv) $A'\cap B'$

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

(v) $(B \cup C)'$

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

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

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

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

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

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

$B\cap C = \{-2, 8\}$

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

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 laws.

Sol. $K = \{a, b, d, e, f\}$, $L = \{b, c, d, g\}$ and $M \{a, b, c, d, h\}$

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

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

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

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

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

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

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

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

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

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

(iv) (K∩L)∪(K∩M)

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

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

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

Distributive laws

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

$$\{a, b, c, d, e, f\} = \{a, b, c, d, e, f, g\} \cap \{a, b, c, d, e, f, h\} = \{a, b, c, d, e, f\}$$

Thus Verified.

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

$$\{a, b, d\} = \{b, d\} \cup \{a, b, d\}$$

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

Thus Verified.

3. If 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}, then verify A∪(B∩C) = (A∪B)∩(A∪C).

Sol.

$$A = \{x : x \in \mathbb{Z}, -2 < x \leq 4\} = \{-1, 0, 1, 2, 3, 4\}$$

$$B = \{x : x \in \mathbb{W}, x \leq 5\} = \{0, 1, 2, 3, 4, 5\}$$

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

A∪(B∩C)

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

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

(A∪B) ∩(A∪C)

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

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

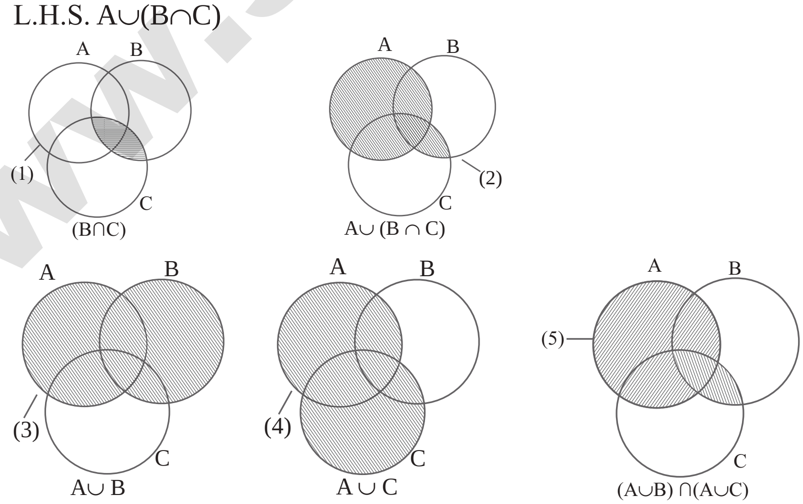
$$(A \cup B) \cap (A \cup C) = \{-1, 0, 1, 2, 3, 4\} \quad \text{... (2)}$$

From (1) and (2), it is verified that

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

4. Verify A∪(B∩C) = (A∪B)∩(A∪C) using Venn diagrams.

Sol. L.H.S. A∪(B∩C)



From (2) and (5), it is verified that A∪(B∩C) = (A∪B) ∩ (A∪C)

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 ∩ C) = (A − B) ∪ (A − C).

Sol.

$$A = \{b, c, e, g, h\}$$
$$B = \{a, c, d, g, i\}$$
$$C = \{a, d, e, g, h\}$$
$$B \cap C = \{a, d, g\}$$
$$A - (B \cap C) = \{b, c, e, g, h\} - \{a, d, g\} = \{b, c, e, h\} \quad \text{... (1)}$$
$$A - B = \{b, c, e, g, h\} - \{a, c, d, g, i\} = \{b, e, h\}$$
$$A - C = \{b, c, e, g, h\} - \{a, d, e, g, h\} = \{b, c\}$$
$$(A - B) \cup (A - C) = \{b, c, e, h\} \quad \text{... (2)}$$

From (1) and (2) it is verified that

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

6. If A = {$x : x = 6n, n \in \mathbb{W}$ and $n < 6$}, B = {$x : x = 2n, n \in \mathbb{N}$ and $2 < n \leq 9$} and C = {$x : x = 3n, n \in \mathbb{N}$ and $4 \leq n < 10$}, then show that A−(B∩C)= (A−B)∪(A−C)

Sol.

$$A = \{x : x = 6n, n \in \mathbb{W}, n < 6\}$$
$$x = 6n$$
$$n = \{0, 1, 2, 3, 4, 5\}$$
$$\Rightarrow x = 6 \times 0 = 0$$
$$x = 6 \times 1 = 6$$
$$x = 6 \times 2 = 12$$
$$x = 6 \times 3 = 18$$
$$x = 6 \times 4 = 24$$
$$x = 6 \times 5 = 30$$
$$\therefore A = \{0, 6, 12, 18, 24, 30\}$$
$$B = \{x : x = 2n, n \in \mathbb{N}, 2 < n \leq 9\}$$
$$n = \{3, 4, 5, 6, 7, 8, 9\}$$
$$x = 2n$$
$$\Rightarrow x = 2 \times 3 = 6$$
$$2 \times 4 = 8$$
$$2 \times 5 = 10$$
$$2 \times 6 = 12$$
$$2 \times 7 = 14$$
$$2 \times 8 = 16$$
$$2 \times 9 = 18$$
$$\therefore B = \{6, 8, 10, 12, 14, 16, 18\}$$
$$C = \{x : x = 3n, n \in \mathbb{N}, 4 \leq n < 10\}$$
$$\mathbb{N} = \{4, 5, 6, 7, 8, 9\}$$
$$\Rightarrow x = 3 \times 4 = 12$$
$$x = 3 \times 5 = 15$$
$$x = 3 \times 6 = 18$$
$$x = 3 \times 7 = 21$$
$$x = 3 \times 8 = 24$$
$$x = 3 \times 9 = 27$$

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

A−(B∩C) = (A−B)∪(A−C)

L.H.S R.H.S

B∩C = {12, 18}

A−(B∩C) = {0, 6, 12, 18, 24, 30} – {12, 18}= {0, 6, 24, 30} ... (1)

(A− B) = {0, 24, 30}

(A− C) = {0, 6, 30}

(A−B)∪(A−C) = {0, 6, 24, 30} ... (2)

From (1) and (2), it is verified that

A−(B∩C) = (A−B)∪(A−C).

7. If A = {–2, 0, 1, 3, 5}, B = {–1, 0, 2, 5, 6} and C = {–1, 2, 5, 6, 7}, then show that A−(B∪C) = (A−B)∩(A−C).

Sol. A = {–2, 0, 1, 3, 5}, B = {–1, 0, 2, 5, 6}

C = {–1, 2, 5, 6, 7}

B ∪ C = {–1, 0, 2, 5, 6, 7}

A – (B ∪ C) = {–2, 1, 3} ... (1)

(A – B) = {–2, 1, 3}

(A – C) = {–2, 0, 1, 3}

(A – B) ∩ (A – C) = {–2, 1, 3} ... (2)

From (1) and (2), it is verified that

A−(B∪C) = (A−B)∩(A−C)

8. If A = $\left\{y : y = \frac{a+1}{2}, a \in \mathbb{W} \text{ and } a \le 5\right\}$, B = $\left\{y : y = \frac{2n-1}{2}, n \in \mathbb{W} \text{ and } n < 5\right\}$ and C = $\left\{-1, -\frac{1}{2}, 1, \frac{3}{2}, 2\right\}$, then show that A−(B ∪ C) = (A−B) ∩ (A−C).

Sol. A = $\left\{y : y = \frac{a+1}{2}, a \in \mathbb{W}, a \le 5\right\}$

a = {0, 1, 2, 3, 4, 5} ⇒ $y = \frac{0+1}{2} = \frac{1}{2}$

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

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

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

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

$y = \frac{5+1}{2} = \frac{6}{2} = 3$ $\therefore$ A= $\left\{\frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}, 3\right\}$

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

$$n = \{0, 1, 2, 3, 4\} \Rightarrow \quad y = \frac{(2\times 0)-1}{2} = \frac{-1}{2}$$

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

$$y = \frac{(2\times 2)-1}{2} = \frac{3}{2}$$

$$y = \frac{(2\times 3)-1}{2} = \frac{5}{2}$$

$$y = \frac{(2\times 4)-1}{2} = \frac{7}{2} \quad \therefore \text{B} = \left\{-\frac{1}{2}, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}\right\}$$

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

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

$$\text{A}-(\text{B} \cup \text{C}) = \{3\} \quad \ldots (1)$$

$$\text{A} - \text{B} = \{1, 2, 3\}$$

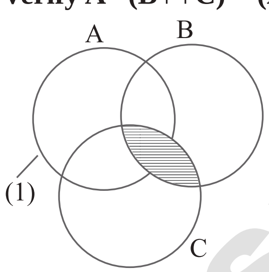
$$\text{A} - \text{C} = \left\{\frac{1}{2}, \frac{5}{2}, 3\right\}$$

$$(\text{A} - \text{B}) \cap (\text{A} - \text{C}) = \{3\} \quad \ldots (2)$$

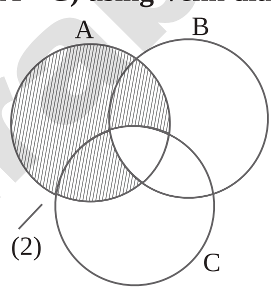
From (1) and (2), it is verified that A−(B ∪ C) = (A−B) ∩ (A−C)

9. Verify A– (B ∩ C) = (A – B) ∪ (A – C) using Venn diagrams. *[April-'25]*

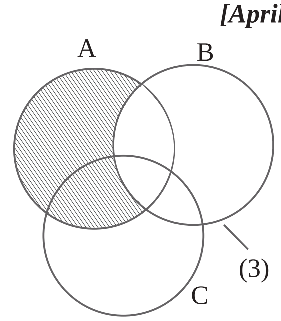
Sol.



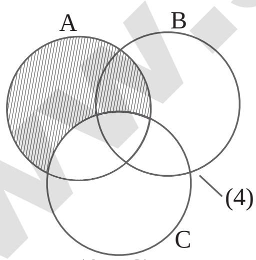
B∩C



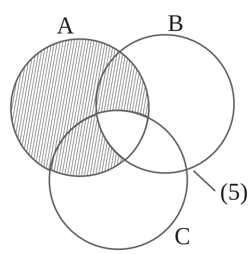
A – (B ∩ C)



(A – B)



(A – C)



(A – B) ∪ (A – C)

∴ A– (B ∩ C) = (A – B) ∪ (A – C) Hence it is proved.

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. *[HY-'23]*

Sol.

U = {4, 7, 8, 10, 11, 12, 15, 16}

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

De Morgan's Laws for complementation.

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

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

$$(A \cup B)' = \{4, 7, 8, 10, 11, 12, 15, 16\} - \{4, 7, 8, 11, 12, 15\}$$

$$= \{10, 16\} \quad \ldots (1)$$

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

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

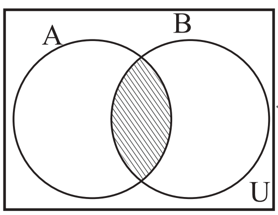
$$A' \cap B' = \{10, 16\} \quad \ldots (2)$$

From (1) and (2) it is verified that

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

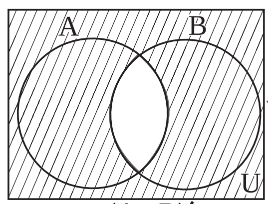
11. Verify $(A \cap B)' = A' \cup B'$ using Venn diagrams. *[HY-'19]*

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



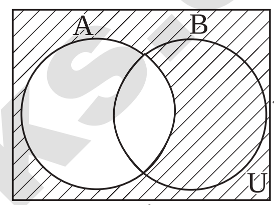
(1)

$(A \cap B)$



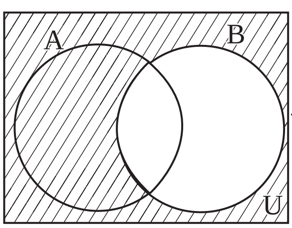
(2)

$(A \cap B)'$



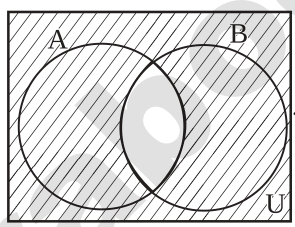
(3)

A'



(4)

B'



(5)

$A' \cup B'$

$$(2) = (5)$$

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

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 $n(U)$. *[HY-'23]*

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

Sol. (i)

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

$$n(A \cap B) = 25 + 40 - 50 = 65 - 50 = 15$$

$$n(U) = n(B) + n(B') = 40 + 25 = 65$$

(ii)

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

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

$$n(B) = n(A \cup B) + n(A \cap B) - n(A) = 500 + 50 - 300 = 250$$

$$n(U) = 250 + 350 = 600.$$

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

Sol.

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

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

$$n(A \cup B) = 7, n(A \cap B) = 3$$

L.H.S = $n(A \cup B) = 7$

R.H.S = $n(A) + n(B) - n(A \cap B) = 5 + 5 - 3 = 7$

$\therefore$ L.H.S = R.H.S proved.

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}

(ii) A = {1, 3, 5} B = {2, 3, 5, 6} and C = {1, 5, 6, 7}.

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

(i) A = {a, c, e, f, h}, B = {c, d, e, f}, C = {a, b, c, f}

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

$n(A \cap B) = 3$

$n(B \cap C) = 2$

$n(A \cap C) = 3$

$n(A \cap B \cap C) = 2$

$A \cap B = \{c, e, f\}$

$B \cap C = \{c, f\}$

$A \cap C = \{a, c, f\}$

$A \cap B \cap C = \{c, f\}$

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

$\therefore n(A \cup B \cup C) = 7$ ... (1)

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

$= 5 + 4 + 4 - 3 - 2 - 3 + 2 = 15 - 8 = 7$ ... (2)

(1) = (2)

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

Hence it is verified.

(ii) A = {1, 3, 5}, B = {2, 3, 5, 6 }, C = {1, 5, 6, 7}

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

$n(A \cap B) = 2$

$n(B \cap C) = 2$

$n(C \cap A) = 2$

$n(A \cap B \cap C) = 1$

$n(A \cup B \cup C) = 6$

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

$6 = 3 + 4 + 4 - 2 - 2 - 2 + 1 = 12 - 6 = 6$

Hence it is verified.

4. In a class, all students take part in either music or drama or both. 25 students take part in music, 30 students take part in drama and 8 students take part in both music and drama. Find ***[QY-'19]***

(i) The number of students who take part in only music.

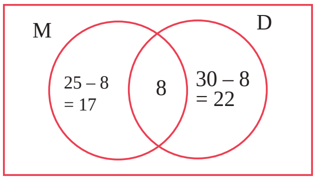
(ii) The number of students who take part in only drama.

(iii) The total number of students in the class.

Sol. Let the number of students take part in music is M.

Let the number of students take part in drama is D.

By using Venn diagram



(i) The number of students take part in only music is 17.

(ii) The number of students take part in only drama is 22.

(iii) The total number of students in the class is 17 + 8 + 22 = 47.

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 *[April-'23]*

(i) like both tea and coffee. (ii) do not like tea.

(iii) do not like coffee.

Sol. Let the people who like tea be T.

Let the people who like coffee be C

By using formula : $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

(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 passed in Mathematics and 70% of students passed in Science while 10% students failed in both subjects. 300 students passed in both the subjects. Find the total number of students who appeared in the examination, if they took examination in only two subjects.

Sol. 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 atleast one subject = 70%

∴ The % of students who have passed in atleast one subject = 100% – 70% = 30%

30% = 300

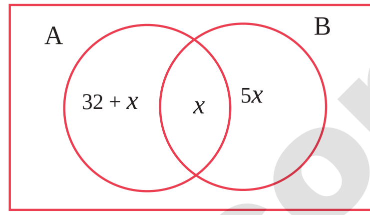
$$\therefore 100\% = \frac{100 \times \cancel{300}^{10}}{\cancel{30}} = 1000$$

∴ The total number of students who appeared in the examination = 1000 students.

7. A and B are two sets such that $n(A - B) = 32 + x$, $n(B - A) = 5x$ and $n(A \cap B) = x$. Illustrate the information by means of a Venn diagram. Given that $n(A) = n(B)$, calculate the value of x.

Sol.

$$\begin{aligned} n(A - B) &= 32 + x \\ n(B - A) &= 5x \\ n(A \cap B) &= x \\ n(A) &= n(B) \\ 32 + x + x &= 5x + x \\ 32 + 2x &= 6x \\ 4x &= 32 \\ x &= 8 \end{aligned}$$



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? *[HY-'19]*

Sol.

$$\begin{aligned} n(A \cup B) &= n(A) + n(B) - n(A \cap B) \\ n(A \cup B) &= 500 \text{ (given)} \quad \ldots (1) \\ n(A) &= 400 \\ n(B) &= 200 \\ n(A \cap B) &= 50 \\ \therefore n(A) + n(B) - n(A \cap B) &= 400 + 200 - 50 = 550 \quad \ldots (2) \\ 1 &\neq 2 \therefore \text{ This data is incorrect.} \end{aligned}$$

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 newspapers, 5 families buy Tamil and Hindi newspapers and 3 families buy all the three newspapers. If each family buy atleast one of these newspapers then find

(i) Number of families buy only one newspaper
(ii) Number of families buy atleast two newspapers
(iii) Total number of families in the colony.

Sol. (i)

Tamil Newspaper buyers $n(A) = 275$

English Newspaper buyers $n(B) = 150$

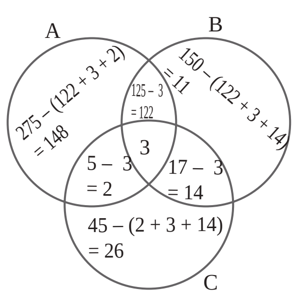
Hindi Newspaper buyers $n(C) = 45$

Tamil and English Newspaper buyers $n(A \cap B) = 125$

English and Hindi Newspaper buyers $n(B \cap C) = 17$

Hindi and Tamil Newspaper buyers $n(C \cap A) = 5$

All the three Newspaper buyers $n(A \cap B \cap C) = 3$



(i) Number of families buy only one newspaper
$= 148 + 11 + 26 = 185$

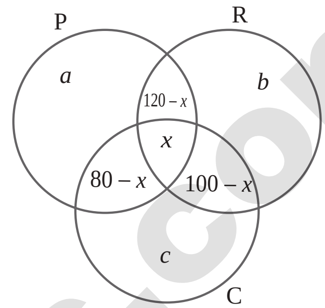
(ii) Number of families buy atleast two news papers
$= 122 + 14 + 2 + 3 = 141$

(iii) Total number of families in the colony
$= 148 + 11 + 26 + 122 + 14 + 2 + 3 = 326$

10. A survey of 1000 farmers found that 600 grew paddy, 350 grew ragi, 280 grew corn, 120 grew paddy and ragi, 100 grew ragi and corn, 80 grew paddy and corn. If each farmer grew atleast any one of the above three, then find the number of farmers who grew all the three. *[QY-'23; April-'24]*

Sol.

$a = 600 - (120 - x + x + 80 - x)$
$= 600 - (200 - x)$
$= 600 - 200 + x = 400 + x$
$b = 350 - (120 - x + x + 100 - x)$
$= 350 - (220 - x)$
$= 350 - 220 + x = 130 + x$
$c = 280 - (80 - x + x + 100 - x)$
$= 2800 - (180 - x) = 280 - 180 + x = 100 + x$



Each farmer grew atleast one of the above three, the number of farmers who grew all the three is x.

$\Rightarrow a + b + c + 120 - x + 100 - x + 80 - x + x = 1000$

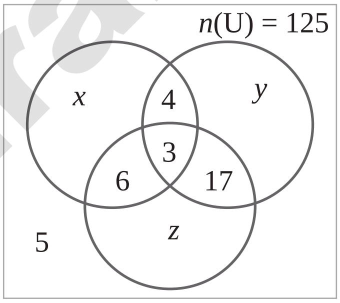
$400 + x + 130 + x + 100 + x + 120 - x + 100 - x + 80 - x + x = 1000$

$\therefore 930 + x = 1000$

$x = 1000 - 930 = 70$

$\therefore$ 70 farmers grew all the three crops

11. In the adjacent diagram, if n(U) = 125, y is two times of x and z is 10 more than x, then find the value of x, y and z.

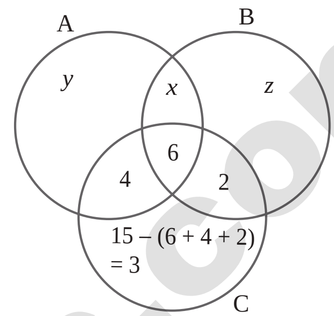


Sol.

$n(U) = 125$
$y = 2x$
$z = x + 10$
$\therefore x + y + z + 4 + 17 + 6 + 3 + 5 = 125$
$x + 2x + x + 10 + 35 = 125$
$4x + 45 = 125$
$4x = 125 - 45$
$4x = 80$
$x = 20$
$\therefore y = 2x = 2 \times 20 = 40$
$z = x + 10 = 20 + 10 = 30$
Hence $x = 20; y = 40; z = 30$

12. Each student in a class of 35 plays atleast 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 (Hint: Use Venn diagram)

Sol.



A – Chess

B – Carrom

C – Table Tennis

$n(A) = 22$

$n(B) = 21$

$n(C) = 15$

$n(A \cap C) = 10$

$n(B \cap C) = 8$

$n(A \cap B \cap C) = 6$

$$y = 22 - (x + 6 + 4) = 22 - (x + 10)$$
$$= 22 - x - 10 = 12 - x$$
$$z = 21 - (x + 6 + 2) = 21 - (8 + x)$$
$$= 21 - 8 - x = 13 - x$$
$$y + z + 3 + x + 2 + 4 + 6 = 35$$
$$12 - x + 13 - \cancel{x} + 15 + \cancel{x} = 35$$
$$40 - x = 35$$
$$x = 40 - 35 = 5$$

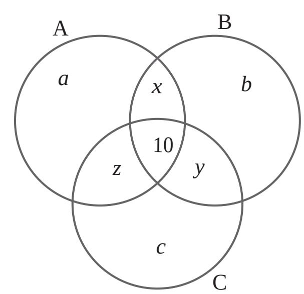
(i) Number of students who pay only chess and Carrom but not table tennis = 5

(ii) Number of students who play only chess = $12 - x = 12 - 5 = 7$

(iii) Number of students who play only carrom = $13 - x = 13 - 5 = 8$

13. 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?

Sol.



A – by bus

B – by bicycle

C – on foot

$n(A) = 25$

$n(B) = 20$

$n(C) = 30$

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

$$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$$
$$50 = 25 + 20 + 30 - (10 + x) - (10 + y) - (10 + z) + 10$$
$$50 = 75 - \cancel{10} - x - 10 - y - 10 - z + \cancel{10} = 75 - 20 - (x + y + z)$$
$$= 55 - (x + y + z)$$
$$x + y + z = 55 - 50 = 5$$

$\therefore$ The number of students who come to school exactly by two modes of transport = 5.

Exercise 1.7

MULTIPLE CHOICE QUESTIONS :

1. **Which of the following is correct?**

(1) $\{7\} \in \{1,2,3,4,5,6,7,8,9,10\}$ (2) $7 \in \{1,2,3,4,5,6,7,8,9,10\}$

(3) $7 \notin \{1,2,3,4,5,6,7,8,9,10\}$ (4) $\{7\} \not\subseteq \{1,2,3,4,5,6,7,8,9,10\}$

[Ans. (2) $7 \in \{1,2,3,4,5,6,7,8,9,10\}$]

2. **The set $P = \{x \mid x \in \mathbb{Z}, -1 < x < 1\}$ is a** ***[HY-'23]***

(1) Singleton set (2) Power set (3) Null set (4) Subset

Hint : P = {0} **[Ans. (1) Singleton set]**

3. **If $U = \{x \mid x \in \mathbb{N}, x < 10\}$ and $A = \{x \mid x \in \mathbb{N}, 2 \leq x < 6\}$ then $(A')'$ is**

(1) {1,6,7,8,9} (b) {1,2,3,4} (c) {2,3,4,5} (d) { }

Hint : $(A')' = A = \{2, 3, 4, 5\}$ **[Ans. (3) {2,3,4,5}]**

4. **If $B \subseteq A$ then $n(A \cap B)$ is** ***[QY-'23; April-'23 & '24]***

(1) $n(A - B)$ (2) $n(B)$ (3) $n(B - A)$ (4) $n(A)$

Hint : $B \subseteq A \Rightarrow A \cap B = B$ **[Ans. (2) n(B)]**

5. **If A= {x,y,z} then the number of non-empty subsets of A is** ***[HY-'19]***

(1) 8 (2) 5 (3) 6 (4) 7

Hint : Number of non-empty subsets = $2^3 - 1 = 8 - 1 = 7$ **[Ans. (4) 7]**

6. **Which of the following is correct ?**

(1) $\varnothing \subseteq \{a,b\}$ (2) $\varnothing \in \{a, b\}$ (3) $\{a\} \in \{a, b\}$ (4) $a \subseteq \{a, b\}$

Hint : Empty set is an improper subset **[Ans. (1) $\varnothing \subseteq \{a,b\}$]**

7. **If $A \cup B = A \cap B$, then** ***[HY-'23; April-'25]***

(1) $A \neq B$ (2) $A = B$ (4) $A \subset B$ (4) $B \subset A$

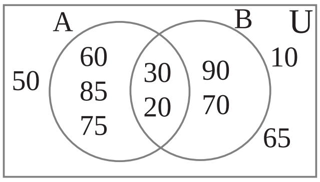
[Ans. (2) A = B]

8. **If $B - A$ is B, then $A \cap B$ is** ***[QY-'19]***

(1) A (2) B (3) U (4) $\varnothing$

Hint : $B - A = B \Rightarrow$ A and B are disjoint sets. **[Ans. (4) $\varnothing$]**

9. **From the adjacent diagram $n[P(A \Delta B)]$ is**



(1) 8 (2) 16

(3) 32 (4) 64

Hint : $A \Delta B = \{60, 85, 75, 90, 70\}$

$\Rightarrow n(A \Delta B) = 5$

$\Rightarrow n(P(A \Delta B)) = 2^5 = 32$ **[Ans. (3) 32]**

10. **If $n(A) = 10$ and $n(B) = 15$, then the minimum and maximum number of elements in $A \cap B$ is**

(1) 10,15 (2) 15,10 (3) 10,0 (4) 0,10

[Ans. (4) (0,10)]

11. **Let A = {∅} and B = P(A), then A∩B is** *[HY-'23]*

(1) { ∅, {∅} } (2) {∅} (3) ∅ (4) {0}

Hint : P(A) = {∅{∅}} **[Ans. (2) {∅}]**

12. **In a class of 50 boys, 35 boys play Carom and 20 boys play Chess then the number of boys play both games is** *[HY-'19; QY-'23]*

(1) 5 (2) 30 (3) 15 (4) 10

Hint : $n(A\cup B) = n(A) + n(B) - n(A\cap B) \Rightarrow 50 = 35 + 20 - n(A\cap B) \Rightarrow n(A\cap B) = 5$

[Ans. (1) 5]

13. **If U = {x : $x \in \mathbb{N}$ and x < 10}, A ={1, 2, 3, 5, 8} and B = {2, 5, 6, 7, 9}, then n[(A∪B)′] is**

(1) 1 (2) 2 (3) 4 (4) 8 *[April-'25]*

Hint :

U = {1, 2, 3, 4, 5, 6, 7, 8, 9}
A = {1, 2, 3, 5, 8}
B = {2, 5, 6, 7, 9}
A ∪ B = {1, 2, 3, 5, 6, 7, 8, 9}
(A ∪ B)′ = {4},
n (A ∪ B)′ = 1 **[Ans. (1) 1]**

14. **For any three sets P, Q and R, P−(Q∩R) is** *[HY-'9; QY-'23]*

(1) P − (Q ∪ R) (2) (P ∩ Q) − R
(3) (P − Q) ∪ (P − R) (4) (P − Q)∩(P − R)

Hint : P – (Q ∩ R) = (P − Q) ∪ (P − R) **[Ans. (3) (P − Q)∪(P − R)]**

15. **Which of the following is true?** *[QY-'23]*

(1) A−B = A ∩ B (2) A − B = B − A
(3) (A∪B)′ = A′∪ B′ (4) (A ∩ B)′ = A′∪ B′

Hint :
(1) (A – B) = A ∩ B ✗
(2) A – B = B – A ✗
(3) (A ∪ B)′ = A′ ∪ B′ ✗
(4) (A ∩ B)′ = A′ ∪ B′ ✓ **[Ans. (4) (A ∩ B)′ = A′∪ B′]**

16. **If n(A∪B∪C) = 100, n(A) = 4x, n(B) = 6x, n(C) = 5x, n(A ∩ B) = 20, n(B ∩ C) = 15, n(A ∩ C)=25 and n(A ∩ B ∩ C)= 10 , then the value of x is**

(1) 10 (2) 15 (3) 25 (4) 30

Hint :

$$n(A\cup B\cup C) = n(A) + n(B) + n(C) - n(A\cap B) - n(B\cap C) - n(C\cap A) + n(A\cap B\cap C)$$
$$100 = 4x + 6x + 5x - 20 - 15 - 25 + 10$$
$$100 = 15x - 60 + 10$$
$$100 = 15x - 50$$
$$\therefore 15x = 100 + 50 = 150$$
$$x = 10$$

[Ans. (1) 10]

17. **For any three sets A, B and C, (A − B) ∩ (B − C) is equal to** *[QY-'19; April-'24]*

(1) A only (2) B only (3) C only (4) ϕ

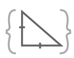
Hint : (A – B) ∩ (B – C) is equal to ϕ **[Ans. (4) ϕ]**

18. **If J = Set of three sided shapes, K = Set of shapes with two equal sides and L = Set of shapes with right angle, then J ∩K ∩ L is**

(1) Set of isoceles triangles (2) Set of equilateral triangles

(3) Set of isoceles right triangles (4) Set of right angled triangles

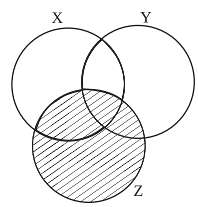
Hint : J = 

K = 

L = 

[Ans. (3) Set of isoceles right triangles**]**

19. **The shaded region in the Venn diagram is**



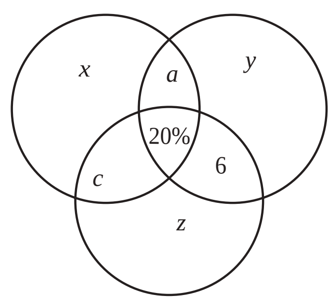
(1) Z – (X∪Y) (2) (X∪Y)∩Z (3) Z – (X∩Y) (4) Z∪(X∩Y)

Hint : Z – (X∩Y) **[Ans. (3) Z – (X∩Y)]**

20. **In a city, 40% people like only one fruit, 35% people like only two fruits, 20% people like all the three fruits. How many percentage of people do not like any one of the above three fruits?**

(1) 5 (2) 8

(3) 10 (4) 15



Hint :

$$40 + 35 + 20 + x = 100\%$$
$$95\% + x = 100\%$$
$$x = 5\%$$

[Ans. (1) 5]

TEXT BOOK ACTIVITIES

Activity - 1

1. **Discuss and give as many examples of collections from your daily life situations, which are sets and which are not sets.**

Sol. **Which are sets**

(i) Collection of pen (ii) Collection of dolls

(iii) Collection of books (iv) Collection of red flower etc.

Which are not sets

(i) Collection of good students in a class.

(ii) Collection of beautiful flowers in a garden etc.

Activity - 2

Write the following sets in respective forms.

Sol.

S. No	Descriptive Form	Set Builder Form	Roster Form
1	The set of all natural numbers less than 10	**A = { x : x is a natural number less than 10}**	**A = {1, 2, 3, 4, 5, 6, 7, 8, 9}**
2	**The set of all positive integers which are multiples of 3**	{x : x is a multiple of 3, x ∈ N}	**{3, 6, 9, 12,18...}**
3	**The set of all natural even numbers. Less than 12**	**ℕ = {x : x is a natural even number, x < 12}**	{2,4,6,8,10}
4	The set of all days in a week.	**X = {Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday}**	**X = {x : x is a day in a week}**
5	**The set of all Integers**	**A = {x : x is an on Integer}**	{…–3,–2,–1,0,1,2,3…}

Activity - 4

Fill in the blanks with appropriate cardinal numbers.

Sol.

S. No	n(A)	n(B)	n(A∪B)	n(A∩B)	n(A–B)	n(B–A)
1	30	45	65	**10**	**20**	**35**
2	20	**45**	55	10	**10**	**35**
3	50	65	**90**	25	**25**	**40**
4	30	43	70	**3**	**27**	**40**

Government Exam Questions

1 Mark

1. **(A–B) ∩ (B–A) = ________.** *[QY-'23]*
(a) A (b) B (c) A∆B (d) ϕ **[Ans. (d) ϕ]**

2 Marks

1. **Let A = {x:x is an even natural number and 1 < x ≤12} and B = {x:x is a multiple of 3, x ∈ N and x ≤ 12 be two sets}. Find A ∩ B.** *[QY-'19]*

Sol. A = {2,4,6,8,10,12} B = {3,6,9,12} A ∩ B = {6,12}

2. **Write the set of letters of the following words in Roster form :** *[HY-'19; QY-'23]*
(i) ASSESSMENT (ii) PRINCIPAL *[April-'24]*

Sol. (i) ASSESSMENT (ii) PRINCIPAL
X= {A, S, E, M, N, T} Y={P, R, I, N, C, A, L}

3. **Let U = {a, b, c, d, e, f, g, h}, A = {b, d, e, h} find A′ ∪ B′.** *[HY-'19]*

Sol. A′ ∪ B′ = {a, c, e, g} ∪ {b, c, f, g} = {a, b, c, e, f, g}

4. **Find the number of subsets and number of proper subsets of a set X = {a, b, c, x, y, z}.** *[HY-'23]*

Sol.
Given X = {a, b, c, x, y, z}.
Then, n(X) = 6
The number of subsets = $n[P(X)] = 2^6 = 64$
The number of proper subsets = $n[P(X)] – 1 = 2^6 – 1 = 64 – 1 = 63$

5. If A = {*a, b, c, d, e*}and B = {*a, e, i, o, u*} find A ∩ B.

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

6. Let A = {*b, d, e, g, h*} and B = {*a, e, c, h*} verify that *n*(A – B) = *n*(A) – *n*(A ∩ B)

Sol.

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

$A - B = \{b, d, g\}$

$n(A-B) = 3$ ... (1)

$A \cap B = \{e, h\}$

$n(A \cap B) = 2$, $n(A) = 5$

$n(A) - n(A \cap B) = 5 - 2 = 3$ ... (2)

Form (1) and (2) we get $n(A-B) = n(A) - n(A \cap B)$

7. If A = {6, 7, 8, 9} and B={8, 10, 12}, find $A \Delta B$. *[QY-'23; April-'25]*

Sol.

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

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

$A \Delta B = (A-B) \cup (B-A) = \{6, 7, 9\} \cup \{10,12\}$

$A \Delta B = \{6, 7, 9, 10, 12\}$.

8. Verify whether A = {20, 22, 23, 24} and B = {25, 30, 40, 45} are disjoint sets. *[QY-'23]*

Sol.

A = {20, 22, 23, 24},

B = {25, 30, 40, 45}

$A \cap B = \{20, 22, 23, 24\} \cap \{25, 30, 40, 45\} = \{ \}$

Since $A \cap B = \phi$, A and B are disjoint sets.

9. If P = {2,3,5,7,11} and Q = {1,3,5,11} Find A∆B. *[April-'24]*

Sol. P = {2,3,5,7,11} and Q = {1,3,5,11}

A–B = {2, 7}

B–A = {1}

$A \Delta B = (A-B) \cup (B-A) = \{2,7\} \cup \{1\}$

A∆B = {1,2,7}

5 Marks

1. If A = {0,2,4,6,8}, B = {*x*:*x* is a prime number and *x* < 11} and C = {*x*:*x* ∈ N and 5 ≤ *x* < 9}, then verify A∪(B∩C) = (A∪B)∩(A∪C). *[QY-'19]*

Sol.

A = {0,2,4,6,8} ; B = {2,3,5,7} ; C = {5,6,7,8}

$B \cap C = \{5,7\}$

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

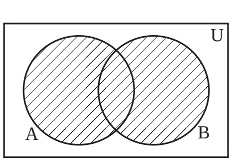
$A \cup B = \{0,2,3,4,5,6,7,8\}$

$A \cap C = \{0,2,4,5,6,7,8\}$

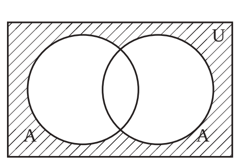
$(A \cup B) \cap (A \cup C) = \{0,2,4,5,6,7,8\}$

2. Verify (A∪B)' = A'∩B' using Venn diagrams. *[QY-'19; April-'23]*

Sol.

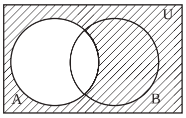


A ∪ B

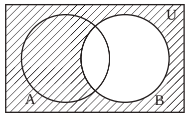


(A ∪ B)′

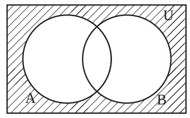
...(1)



A′



B′



$(A' \cap B')$ ...(2)

From (1) and (2), it is verified that $(A \cup B)' = A' \cap B'$

3. If A = {*a,b,c,e,u*}, B = {*a,e,i,o,u*}, find A∪B, A∩B, A–B and B–A. *[QY-'19]*

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

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

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

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

4. If P = {*x* : *x* ∈ $\mathbb{W}$ and 0 < *x* < 10}, Q = {*x* : *x* = 2*n* + 1. *n* ∈ $\mathbb{W}$ and *n* < 5} and R = {2, 3, 5, 7, 11, 13}, then verify P – (Q ∩ R) = (P – Q) ∪ (P – R)

Sol. The roster form of sets P, Q and R are *[QY-'19]*

P = {1,2,3,4,5,6,7,8,9}, Q = {1,3,5,7,9} and R={2,3,5,7,11,13}

First, we find (Q∩C) = {3,5,7}

Then, P – (Q∩R) = {1,2,4,6,8,9} ... (1)

Next, P–Q = {2,4,6,8} and

P–R = {1,4,6,8,9}

and so, (P–Q)∪(P–R) = {1,2,4,6,8,9} ... (2)

Hence from (1) and (2), it is verified that P – (Q∩R) = (P–Q) ∪ (P–R)

5. Find the value of $\sqrt[4]{400} \times \sqrt[4]{567}$. *[QY-'23]*

$\sqrt[4]{400} = \sqrt[4]{2\times2\times2\times2\times5\times5}$

$\sqrt[4]{567} = \sqrt[4]{3\times3\times3\times3\times7} = 2\sqrt[4]{5\times5}\times3\sqrt[4]{7}$

$= 2\sqrt[4]{25}\times3\sqrt[4]{7} = 6\sqrt[4]{25\times7} = 6\sqrt[4]{175}$

2	400
2	200
2	100
2	50
5	25
	5

3	567
3	189
3	63
3	21
	7

6. Verify A∩(B∪C) = (A∩B) ∪ (A∩C) using Venn diagram. *[QY & HY-'23]*

Refer Text Book Example 1.22

7. In a school, all students play either Hockey or cricket or both. 300 play Hockey. 250 play Cricket and 110 play both games. Find *[HY-'23]*

(i) the number of students who play only Hockey

(ii) the number of students who play only Cricket

Refer Text Book Example 1.30

8. A – (B∪C) = (A–B) ∩ (A–C) using Venn diagrams. *[April-'24]*

Refer Text Book Example 1.23

9. In a group of 100 students, 85 students speak Tamil, 40 students speak English, 20 students speak French, 32 speak Tamil and English, 13 speak English and French and 10 speak Tamil and French. If each student knows atleast any one of these languages, then find the number of students who speak all these three languages. *[April-'25]*

Refer Text Book Example 1.34

Additional Questions and Answers

eXeRCise 1.1

1. Let A = {0, 1, 2, 3, 4, 5}. Insert the appropriate symbol $\in$ or $\notin$ in the blank spaces.

(i) 0 ____ A (ii) 6 ____ A (iii) 3 ____ A (iv) 4 ____ A

(v) 7____ A

Sol. (i) $0 \in A$ (ii) $6 \notin A$ (iii) $3 \in A$ (iv) $4 \in A$ (v) $7 \notin A$

2. Write the following in Set-Builder form.

(i) The set of all positive even numbers.

(ii) The set of all whole numbers less than 20.

(iii) The set of all positive integers which are multiple of 3.

(iv) The set of all odd natural numbers less than 15.

(v) The set of all letters in the word 'computer'.

Sol. (i) A = {x : x is a positive even number}

(ii) B = {x : x is a whole number and $x < 20$}

(iii) C = {x : x is a positive integer and multiple of 3}

(iv) D = {x : x is an odd natural number and $x < 15$}

(v) E = {x : x is a letter in the word "Computer"}

3. Write the following sets in Roster form.

(i) $A = \{x : x \in \mathbb{N},\ 2 < x < 10\}$

(ii) $B = \{x : x \in \mathbb{Z}, -\frac{1}{2} < x < \frac{11}{2}\}$

(iii) C = {x : x is a prime number and a divisor of 6 }

(iv) $x = \{x : x = 2^n, n \in \mathbb{N}$ and $n \leq 5\}$

(v) $M = \{x : x = 2y - 1, y \leq 5, y \in \mathbb{W}\}$

Sol. (i) A = {3, 4, 5, 6, 7, 8, 9}

(ii) B = {0, 1, 2, 3, 4, 5}

(iii) C = {2, 3}

(iv) Given, $x = 2^n$, $n \in \mathbb{N}$ and $n \leq 5$.

Here n = 1, 2, 3, 4, 5

$n = 1 \Rightarrow 2^1 = 2$

$n = 2 \Rightarrow 2^2 = 4$

$n = 3 \Rightarrow 2^3 = 8$

$n = 4 \Rightarrow 2^4 = 16$

$n = 5 \Rightarrow 2^5 = 32$

X = {2, 4, 8, 16, 32}

(v) Given, $x = 2y - 1$, $y \leq 5$ and $y \in \mathbb{W}$

Here y = 0, 1, 2, 3, 4, 5

$y = 0 \Rightarrow x = 2(0) - 1 = -1$

$y = 1 \Rightarrow x = 2(1) - 1 = 2 - 1 = 1$

$y = 2 \Rightarrow x = 2(2) - 1 = 4 - 1 = 3$

$y = 3 \Rightarrow x = 2(3) - 1 = 6 - 1 = 5$

$y = 4 \Rightarrow x = 2(4) - 1 = 8 - 1 = 7$

$y = 5 \Rightarrow x = 2(5) - 1 = 10 - 1 = 9$

M = {–1, 1, 3, 5, 7, 9}

EXERCISE 1.2

1. **Find the cardinal number of the following sets.**
   (i) A = {x : x is a prime factor of 12}.
   (ii) B = { x : $x \in \mathbb{W}$, $x \leq 5$}.
   (iii) X = {x : x is an even prime number}

Sol. (i) Factors of 12 are 1, 2, 3, 4, 6, 12. So, the prime factors of 12 are 2,3.
We write the set A in roster form as A = {2,3} and hence n(A) = 2.
(ii) In Tabular form B = {0, 1,2, 3,4,5}
The set B has six elements and hence n(B) = 6
(iii) X ={2} [2 is the only even prime number]
$\therefore$ n (X) = 1

2. **State whether the following sets are finite or infinite.**
   (i) A = {x : x is a multiple of 5, $x \in$ N}.
   (ii) B = {0, 1, 2, 3, 4, ... 75}.
   (iii) The set of all positive integers greater than 50.

Sol. (i) A = {5, 10, 15, 20, ...} $\therefore$ A is an infinite set
(ii) Finite
(iii) Let X be the set of all positive integers greater than 50
Then X = {51, 52, 53, ...}
$\therefore$ X is an infinite set.

3. **Which of the following sets are equal?**
   (i) A = {1, 2, 3, 4}, B = {4, 3, 2, 1}
   (ii) A = {4, 8, 12, 16}, B = {8, 4, 16, 18}
   (iii) X = {2, 4, 6, 8}
   Y = {x : x is a positive even integer and $0 < x < 10$}

Sol. (i) Since A and B contain exactly the same elements, A and B are equal sets.
(ii) A and B has different elements.
$\therefore$ A and B are not equal sets.
(iii) X = {2, 4, 6, 8}, Y = {2, 4, 6, 8}
$\therefore$ X and Y are equal sets.

4. **Write $\subseteq$ or $\not\subseteq$ in each blank to make a true statement.**
   (i) {4, 5, 6, 7} __________ {4, 5, 6, 7, 8}
   (ii) {a, b, c} __________ {b, e, f, g}

Sol. (i) {4, 5, 6, 7} $\subseteq$ {4, 5, 6, 7, 8}
(ii) {a, b, c} $\not\subseteq$ {b, e, f, g}

5. **Write down the power set of A = {3, {4, 5}}.**

Sol. The subsets of A are
$\varnothing$, {3}, {4, 5}, {3,{4, 5}}
P(A) = {, $\varnothing$, {3}, {4, 5}, {3{4, 5}}

EXERCISE 1.3

1. Find the union of the following sets.

(i) A = {1, 2, 3, 5, 6} and B = {4, 5, 6, 7, 8} **(ii) X = {3, 4, 5} and Y = ∅**

Sol. (i) $A \cup B$ = {1, 2, 3, 4, 5 , 6, 7, 8} (ii) $X \cup Y$ = {3, 4, 5}

2. Find $A \cap B$ if (i) A = {10, 11, 12, 13}, B = {12, 13, 14, 15}, (ii) A = {5, 9, 11}, B = ∅.

Sol. (i) $A \cap B$ = {12, 13} (ii) $A \cap B = \varnothing$

3. Given the sets A = {4, 5, 6, 7} and B = {1, 3, 8, 9}, find $A \cap B$.

Sol. $A \cap B = \varnothing$

4. If A = { –2, –1, 0, 3, 4}, B = {–1, 3, 5}, find (i) A – B, (ii) B – A.

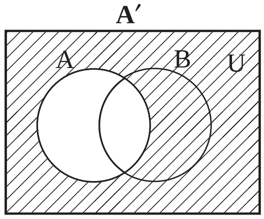
Sol. (i) A – B = {–2, 0, 4} (ii) B – A = {5}

5. If A = {2, 3, 5, 7, 11} and B = {5, 7, 9, 11, 13}, find A Δ B.

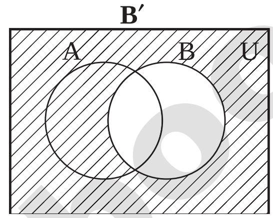
Sol. A Δ B = {2, 3, 9, 13}

6. Draw a Venn diagram similar to one at the side and shade the regions representing the following sets (i) A′, (ii) B′, (iii) $A' \cup B'$, (iv) $(A \cup B)'$, (v) $A' \cap B'$

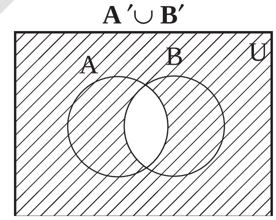
Sol. (i) A′



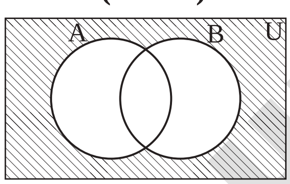
(ii) B′



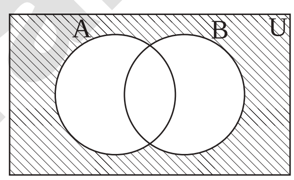
(iii) $A' \cup B'$



(iv) $(A \cup B)'$



(v) $A' \cap B'$



7. State which of the following sets are disjoint.

(i) A = {2, 4, 6, 8}, B = {*x* : *x* is an even number <10, $x \in$ N}

(ii) X = {1, 3, 5, 7, 9}, Y = {0, 2, 4, 6, 8, 10}

(iii) R = {*a, b, c, d, e*}, S = {*d, e, b, c, a*}

Sol. (i) A = {2, 4, 6, 8}, B = {2, 4, 6, 8}

$A \cap B = \{2, 4, 6, 8\} \neq \varnothing$ ∴ A and B are not disjoint sets.

(ii) $X \cap Y$ = { } = ∅, X and Y are disjoint sets.

(iii) $R \cap S = \{a, b, c, d, e\} \neq \varnothing$ ∴ R and S are not disjoint sets.

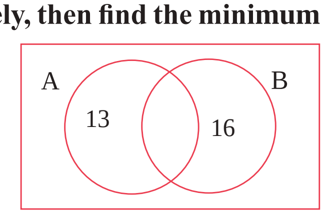
EXERCISE 1.4

1. If A and B are two sets containing 13 and 16 elements respectively, then find the minimum and maximum number of elements in $A \cup B$?

Sol. $n(A)$ = 13 ; $n(B)$ = 16

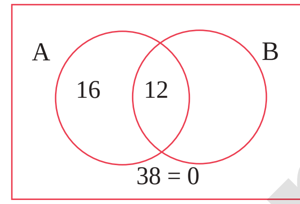
Minimum $n(A \cup B)$ = 16

Maximum $n(A \cup B)$ = 13 + 16 = 29



2. If n(U) = 38, n(A) = 16, n(A∩B) = 12, n(B′) = 20, find n(A∪B).

Sol.



n(U) = 38
n(A) = 16
n(A∩B) = 12
n(B′) = 20
n(A∪B) = ?
n(B) = n(U) – n(B′)
n(B) = 38 – 20
n(B) = 18
n(A∪B) = n(A) + n(B) – n(A∩B)
n(A∪B) = 16 – 12 + 18
n(A∪B) = 4 + 18 = 22.

Hint : n(B) = n(U) – n(B′)
= 38 – 20 = 18

3. If A = {2, 5, 6, 7} and B = {3, 5, 7, 8}, then verify the commutative property of
(i) union of sets (ii) intersection of sets

Sol. Given, A = {2, 5, 6, 7} and B = {3, 5, 7, 8}

(i) A ∪ B = {2, 3, 5, 6, 7, 8} ... (1)
B ∪ A = {2, 3, 5, 6, 7, 8} ... (2)
From (1) and (2) we have A ∪B = B ∪A
It is verified that union of sets is commutative.

(ii) A ∩ B = {5, 7} ... (3)
B ∩ A = {5,7} ... (4)
From (3) and (4) we get, A∩ B = B ∩ A
It is verified that intersection of sets is commutative.

4. If A = {*b, c, d, e*} and B = {*b, c, e,* g} and C = {*a, c, e*}, then verify A∪(B∪C) = (A∪B)∪C.

Sol. Given, A = {*b, c, d, e*} and B = {*b, c, e,* g} and C = {*a, c, e*}
Now B ∪ C = {*a, b, c, e, g*}
A ∪ (B ∪ C) = {*a, b, c, d, e, g*} ... (1)
Then, A ∪ B = {*b, c, d, e, g*}
(A ∪ B) ∪ C = {*a, b, c, d, e, g*} ... (2)
From (1) and (2) it is verified that
A ∪ (B ∪ C) = (A ∪ B) ∪ C

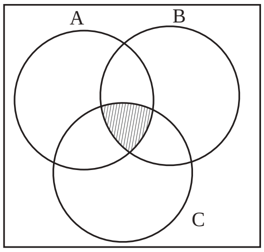
EXERCISE 1.5

1. If A = {1, 3, 5, 7, 9}, B = {*x* ; *x* is a composite number and *x* < 12} and C = {*x* : *x* ∈N and 6 < *x* < 10} then verify A ∪ (B ∩ C) = (A ∪B) ∩ (A ∪ C).

Sol. Given, A = {1, 3, 5, 7, 9} and B = {4, 6, 8, 9, 10}and C = {6, 7, 8, 9}
B ∩ C = {4, 6, 8 , 9, 10} ∩ {6, 7, 8, 9}= {6, 8, 9}
A ∪ (B ∩ C) = {1, 3, 5, 6, 7, 8, 9} ... (1)
Then (A ∪ B) = {1, 3, 5, 7, 9} ∪ {4, 6, 8, 9, 10} = {1, 3, 4, 5, 6, 7, 8, 9, 10}
(A ∪ C) = {1, 3, 5, 7, 9} ∪ {6, 7, 8, 9} = {1, 3, 5, 6, 7, 8, 9}
(A ∪ B) ∩ (A ∪ C) = {1, 3, 4, 5, 6, 7, 8, 9, 10}∩ {1, 3, 5, 6, 7, 8, 9}
= {1, 3, 5, 6, 7, 8,9} ... (2)
From (1) and (2), it is verified that
A ∪ (B ∩ C) = (A ∪ B) ∩ (A ∪ C)

2. Draw Venn diagram for A ∩ B ∩ C

Sol.



A ∩ B ∩ C

3. If P = {x : $x \in \mathbb{N}$ and $1 < x < 11$}, Q = {x: $x = 2n$, $n \in \mathbb{N}$ and $n < 6$} and R = {4, 6, 8, 9, 10, 12}, then verify P – (Q ∩ R) = (P – Q) ∪ (P – R)

Sol. The roster form of sets P, Q and R are P = {2, 3, 4, 5, 6, 7, 8, 9, 10}, Q = {2,4, 6, 8, 10} and R = {4, 6, 8, 9, 10, 12}

First, we find Q ∩ R = {4, 6, 8, 10}
Then, P – (Q ∩ R) = {2, 3, 5, 7, 9} ... (1)
Next, P – Q = {3, 5, 7, 9}
and P – R = {2, 3, 5, 7}
and so, (P – Q) ∪ (P – Q) = {2, 3, 5, 7, 9} ... (2)

Hence from (1) and (2), it verified that P – (Q ∩ R) = (P – Q) ∪ (P – R)

Finding the elements of set Q

				Given, x	=	$2n$
n	=	1	→	x	=	2 (1) = 2
n	=	2	→	x	=	2 (2) = 4
n	=	3	→	x	=	2 (3) = 6
n	=	4	→	x	=	2 (4) = 8
n	=	5	→	x	=	2 (5) = 10

Therefore, x takes values such as 2, 4, 6, 8, 10

4. If U = {x : $x \in \mathbb{Z}$, $-3 \leq x \leq 9$}, A = {x : x = 2P + 1, P ∈ $\mathbb{Z}$, $-2 \leq P \leq 3$}, B = {x : $x = q + 1$, $q \in \mathbb{Z}$, $0 \leq q \leq 3$}, verify De Morgan's laws for complementation.

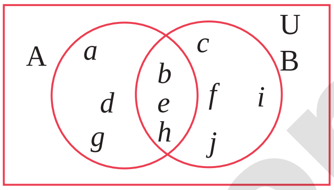
Sol. Given, U = {–3, –2, –1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9}
A = {–3, –1, 1, 3, 5, 7} and B = {1, 2, 3, 4}
Demorgan's Law (i) (A∪B)′ = A′∩B′
Now, A∪B = {–3, –1, 1, 2, 3, 4, 5, 7}
(A∪B)′ = {–2, 0, 6, 8, 9} ... (1)
Then, A′ = {–2, 0, 2, 4, 6, 8, 9} and
B′ = {–3, –2, –1, 0, 5, 6, 7, 8, 9}
A′∩B′ = {–2, 0, 6, 8, 9} ... (2)

From (1) and (2) it is verified that
(A∪B)′ = A′∩B′
Demorgan's Law (ii) (A∩B)′ = A′∪B′
Now, A∩B = {1, 3}
(A∩B)′ = {–3, –2, –1, 0, 2, 4, 5, 6, 7, 8, 9} ... (3)
Then, A′∪B′ = {–3, –2, –1, 0, 2, 4,5, 6, 7, 8, 9} ... (4)

From (3) and (4) it is verified that
(A∩B)′ = A′∪B′

EXERCISE 1.6

1. From the given Venn diagram. Find (i) A, (ii) B, (iii) A∪B, (iv) A∩B also verify that n(A∪B) = n(A) + n(B) – n(A∩B)



Sol. (i) A = {a, b, d, e, g, h}

(ii) B = {b, c, e, f, h, i, j}

(iii) A∪B = {$a, b, c, d, e, f, g, h, i, j$}

(iii) A∩B = {b, e, h}

So, n(A) = 6, n(B) = 7, n(A∪B) = 10, n(A∩B) = 3

Now, n(A) + n(B) – n(A∩B) = 6 + 7 – 3 = 10

Hence, n(A) + n(B) – n(A∩B) = n(A∪B

2. If n(A) = 12, n(B) = 17 and n(A∪B) = 21, find n(A∩B).

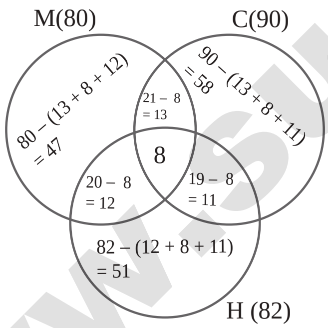
Sol. Given that n(A) = 12, n(B) = 17 and n(A∪B) = 21

By using the formula n(A∪B) = n(A) + n(B) – n(A∩B)

n(A∩B) = 12 + 17 – 21 = 8

3. In a school, 80 students like Maths, 90 students like Science, 82 students like History, 21 like both Maths and Science, 19 like both Science and History 20 like both Maths and History and 8 liked all the three subjects. If each student like atleast one subject, then find (i) the number of students in the school (ii) the number of students who like only one subject.

Sol. Let M, S and H represent sets of students who like Maths, Science and History respectively.



Then, n(M) = 80, n(S) = 90, n(H) = 82, n(M ∩ S) = 21, n(S ∩ H) = 19, n(M ∩ H) = 20, n(M ∩ S ∩ H) = 8

Let us represents the given data in a Venn diagram.

(i) The number of student in the school

= 47 + 13 + 58 + 12 + 8 + 11 + 51 = 200

(ii) The number of students who like only one subject

= 47 + 58 + 51 = 156

4. State the formula to find n(A ∪ B ∪ C).

Sol. n (A ∪ B ∪ C) = n (A) + n (B) + n (C) – n (A ∩ B) – n (B ∩ C) – n (A ∩ C) + n (A ∩ B ∩ C)

5. Verify n (A ∪ B ∪ C) = n (A) + n (B) + n (C) – n(A ∩ B) – (B ∩ C) – n(A ∩ C) + (A∩B∩C) for the following sets A ={1, 3, 5, 6, 8}, B = {3, 4, 5, 6} and C = {1, 2, 3, 6}

Sol. (A ∪ B ∪ C) = {1, 2, 3, 4, 5, 6, 8}

∴ n (A ∪ B ∪ C) = 7

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

Further, $A \cap B = \{3, 5, 6\} \Rightarrow n(A \cap B) = 3$

$B \cap C = \{3, 6\} \Rightarrow n(B \cap C) = 2$

$A \cap C = \{3, 5, 6\} \Rightarrow n(A \cap C) = 3$

Also, $A \cap B \cap C = \{3, 6\} \Rightarrow n(A \cap B \cap C) = 2$

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

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

$7 = 13 - 8 + 2$

$7 = 5 + 2$

$7 = 7$ Thus verified

EXERCISE 1.7

Multiple Choice Questions :

1. If A = {5, {5, 6}, 7} which of the following is correct?

(1) $\{5, 6\} \in A$ (2) $\{5\} \in A$

(3) $\{7\} \in A$ (4) $\{6\} \in A$

Hint : {5, 6} is an element of A. **[Ans. (1) $\{5, 6\} \in A$]**

2. If X = {*a*, {*b*, *c*}, *d*}, which of the following is a subset of X?

(1) $\{a, b\}$ (2) $\{b, c\}$

(3) $\{c, d\}$ (4) $\{a, d\}$

Hint : *b* is not an element of X. Similarly *c*. **[Ans. (4) $\{a, d\}$]**

3. If a finite set A has *m* elements, then the number of non-empty proper subset of A is

(1) 2^m (2) $2^m - 1$

(3) 2^{m-1} (4) $2(2^{m-1} - 1)$

Hint : $P(A) = 2^m$ ∴ Proper non empty subset $= 2m - 2 = 2(2^{m-1} - 1)$

[Ans. (4) $2(2^{m-1} - 1)$]

4. For any three A, B and C, A – (B ∪ C) is

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

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

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

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

[Ans. (2) $(A - B) \cap (A - C)$]

5. Which of the following is true?

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

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

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

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

[Ans. (1) $(A \cup B) = B \cup A$]

6. The shaded region in the Venn diagram is

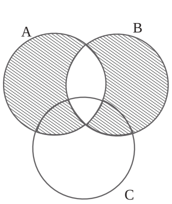
(1) $A \cup B$

(2) $A \cap B$

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

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

Hint :



[Ans. (4) $A - B \cup B - A$]

UNIT TEST

Time : 45 Minutes **CHAPTER - 1** **Marks: 25**

Section - A

(i) Answer all the questions.

(ii) Choose the correct Answer. 5 × 1 = 5

1. The set P = $\{x \mid x \in \mathbb{Z}, -1 < x < 1\}$ is a
   (1) Singleton set (2) Power set
   (3) Null set (4) Subset

2. Which of the following is correct ?
   (1) $\{7\} \in \{1,2,3,4,5,6,7,8,9,10\}$
   (2) $7 \in \{1,2,3,4,5,6,7,8,9,10\}$
   (3) $7 \notin \{1,2,3,4,5,6,7,8,9,10\}$
   (4) $\{7\} \notin \{1,2,3,4,5,6,7,8,9,10\}$

3. Which of the following is a correct statement?
   (1) $\varnothing \not\subseteq \{a, b\}$ (2) $\varnothing \in \{a, b\}$
   (3) $\{a\} \in \{a, b\}$ (4) $a \subseteq \{a, b\}$

4. If U = $\{x : x \in \mathbb{N}$ and $x < 10\}$, A = {1, 2, 3, 5, 8} and B = {2, 5, 6, 7, 9}, then $n[(A \cup B)']$ is
   (1) 1 (2) 2
   (3) 4 (4) 8

5. For any three sets A, B and C, $(A - B) \cap (B - C)$ is equal to
   (1) A only (2) B only
   (3) C only (4) ϕ

Section - B

(i) Answer only five of the following

(ii) However Question number 12 is compulsory. 5 × 2 = 10

6. 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 Internationals.
   (ii) C = $\left\{\frac{1}{2}, \frac{2}{3}, \frac{3}{4} \ldots\ldots\right\}$.

7. 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"
   (ii) C = {2, 3, 4, 5}
   D = $\{x : x \in \mathbb{W}, 1 < x < 5\}$

8. Write down the power set of the following sets.
   (i) A= $\{a, b\}$ (ii) B ={1, 2, 3}

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

10. Write the following sets in Roster form.
    (i) C = $\{x : x$ is a prime number and a divisor of 6 $\}$
    (ii) $x = \{x : x = 2n, n \in \mathbb{N}$ and $n \le 5\}$

11. Which of the following sets are equivalent?
    (i) A = {2, 4, 6, 8, 10},
    B = {1, 3, 5, 7, 9}
    (ii) X = $\{x : x \in \mathbb{N}, 1 < x < 6\}$,
    Y = $\{x : x$ is a vowel in the English Alphabet$\}$

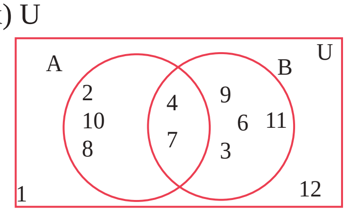
12. If A = { –2, –1, 0, 3, 4}, B = {–1, 3, 5}, find (i) A – B, (ii) B – A.

Section - C

(i) Answer only two Questions of the following.

(ii) However Question number 16 is compulsory. 2 × 5 = 10

13. 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



14. Let A and B be two overlapping sets and the universal set U.Draw appropriate Venn diagram for each of the following,
(i) $A \cup B$ (ii) $A \cap B$
(iii) $(A \cap B)'$ (iv) $(B - A)'$
(v) $A' \cup B'$ (vi) $A' \cap B'$
(vii) What do you observe from the diagram (iii) and (v)?

15. In an examination 50% of the students passed in mathematics and 70% of students passed in science while 10% students failed in both subjects. 300 students passed in atleast one subjects. Find the total number of students who appeared in the examination, if they took examination in only two subjects.

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

ANSWERS

SECTION - A

1. (1) Singleton
2. (2) $7 \in \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
3. (1) $\varnothing \not\subseteq \{a, b\}$
4. (1) 1
5. (4) ϕ

SECTION - B

6. (i) $\{x : x$ is an Indian player who scored double in one day international$\}$
(ii) $\{x : x = \frac{n}{n+1}, n \in \mathbb{N}\}$
7. (i) Equivalent sets
(ii) Unequal sets
8. (i) $\{\phi, \{1\}, \{2\}, \{3\}, \{1, 2\}, \{2, 3\}, \{1,3\}, \{1, 2, 3\}\}$
9. Thus verified
10. (i) $\{2, 3\}$;(ii) $\{2, 4, 8, 16, 32\}$
11. (i) Equivalent sets
(ii) Not equivalent set
12. (i) $\{-2, 0, 4\}$ (ii) $\{5\}$

SECTION - C

13. (i) $\{2, 4, 7, 8, 10\}$
(ii) $\{3, 4, 6, 7, 9, 11\}$
(iii) $\{2, 3, 4, 6, 7, 8, 9, 10, 11\}$
(iv) $\{4, 7\}$
(v) $\{2, 8, 10\}$
(vi) $\{3, 6, 9, 14\}$
(vii) $\{1, 3, 6, 9, 11, 12\}$
(viii) $\{1, 2, 8, 10, 12\}$
(ix) $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$
14. ***Refer Sura's Guide Exercise No.1.3, Q. No.7***
15. 1000
16. 15; 65