1

Sets

1.01 Introduction

Indian mathematicians have a lot of contribution in the field of mathematics by giving the world, Numbers, their calcualtions and the decimal system. Numbers are the base of mathematics the first natural numbers were discovered followed by whole numbers, integers, rational and irrational numbers, real numbers and complex numbers. Zero has a big importance in decimal system. We cannot think of any innovation or research in science without zero.

The concept of set serves as a fundamental part of the present day mathematics. Today this concept is being used in almost every branch of mathematics. Sets are used to define the concepts of relation and functions.

1.02 Set and Its Representation

In everyday life, we often speak of collections of objects of a particular kind, such as,

(i) a pack of cards
(ii) a cricket team
(iii) a crowed of Indian women
(iv) tall children in the class
(v) Collection of natural numbers
(vi) Collection of real numbers

We note that each of the above example is a well-defined collection of objects in the sense that we can definitely decide whether a given particular object belongs to a given collection or not: whereas in (iv) the criterion of defining the tall children may vary from people to people, so (iv) cannot be defined as a proper collection of objects.

Definition : A set is a well-defined collection of objects.

The following points may be noted:

(i) Objects, elements and members of a set are synonym terms.
(ii) Sets are usually denoted by capital letters A, B, C, X, Y, Z, etc.
(iii) The elements of a set are represented by small letters a, b, c, x, y, z, etc.

If a is an element of a set A, we say that "a belongs to A", $a \in A$, here $\in$ (epsilon) is the Greek symbol.

If b is not an element of a set A, we write $b \notin A$ and read "b does not belong to A"

for example, $2 \in N$, $1 \cdot 5 \notin N$.

Representation of a set

There are two methods of representing a set:

1. Tabular or Roster from
2. Set Builder from

1. Tabular or Roster from

In roster from, all the elements of a set are listed, the elements are being separated by commas and are enclosed within brackets { }. For example, the set of all odd positive integers less than 10 is represented by A then $A = \{1, 3, 5, 7\}$ and there $3 \in A$ but $4 \notin A$:

$$N = \{1, 2, 3, ...\} \text{ and } Z = \{..., -3, -2, -1, 0, 1, 2, 3, ...\}$$

Other Examples–

(i) The set of all natural numbers which divides 32 is {1, 2, 4, 8, 16, 32}

(ii) The days of the week (Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday)

(iii) The set of all vowel in English alphabet {a, e, i, o, u}

(iv) The set of letters in the word 'classroom' is represented as $\{c, \ell, a, s, r, o, m\}$

Note: It may be noted that while writing the set in roster form an element is not generally repeated, i.e., all the elements are taken as distinct. This explains in example (iv) .

2. Set Builder Form

In set-builder from, all the elements of a set possess a single common property which is not possessed by any element outside the set. Example (i) above can represented as {x : x is a natural number which divides 32}

The above description of the set is read as "the set of all x such that x is a number which divides 32.

Similarly $N = \{x : x$ is a natural number$\}$

In the following table sets are represented in both forms.

Roster or Tabular Form	**Set Builder Form**
{1,2,3,6,7,14,21,42}	{x : x, is a natural number which divides 42}
{1,4,9,16}	{x : x, is a perfect square less then 25}
{a,e,i,o,u}	{x : x is a vowel in the English alphabet}
{s,c,h,o,l}	{x : x, is a alphabet used in word school}
{4,5,6,7,8,9}	{x : x is a natural number and $3 < x < 10$}

Illustrative Examples

Example 1. Write the set {x : x is a positive integer and $x^2 < 40$} in the roster form.

Solution : The required numbers are 1, 2, 3, 4, 5, 6. because these are those integers whose squares is less than 40. So, the given set in the roster form is {1, 2, 3, 4, 5, 6}.

Example 2. Write the set A = { 1, 4, 9, 16, 25, ... } in set-builder form.

Solution : Here each number of the set is a square fo natural number, so we may write the set A as A = {x : x is the square of a natural number}

Alternatively, we can write $A = \{x : x = n^2, n \in N\}$

Example 3. Write the set $\left\{\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \frac{5}{6}\right\}$ in the set-builder form.

Solution : We see that each member in the given set has the numerator one less than the denominator. Also, the numerators begin from 1 and do not exceed 5. Hence, in the set-builder form the given set is

$$\left\{ x : x = \frac{n}{n+1}, n \in N \text{ and } 1 \le n \le 5 \right\}$$

1.03 Different Types of Sets

Empty or Null Set

Consider the set

(i) A = {x : x is a natural number, $2 < x < 3$ }

(ii) B = {x : x is a natural number such that $x^2 - 2 = 0$}

(iii) C = {x : x is an even prime number greater than 2}

(iv) D = {x : x is a natural number whose square is 3}

We observe that these sets do not contain any element.

Definition: A set which does not contain any element is called the *empty set* or the *null set* or the void set. This is also called as zero set because in this number of element is zero. In roster from these by { }

The empty set is denoted by the symbol ϕ or {it means in curly bracket donot write anything so that denotes the empty set.}

Singleton set

Consider the following set-

$A = \{2\}$, $B = \{\ x\ : x$ is a natural number, $x - 5 = 0\ \}$, $C = \{\phi\}$, $D = \{x : 3 < x < 5,\ x \in N\}$

We observe that these sets contains only one element. Such type of sets are called singleton set.

Definition : *A set which contains only one element is called as singleton set.*

Finite and infinite Sets

Consider the following sets

A = {a,e, i,o,u}, B = {1, 4, 9, 16}, C = { } or ϕ

D= {the members of football team in your school}

and E= {x : x is a natural number}

Here the elements in the set A, B, D are finite and C does not contain any element where as E does not contain finite number of lements.

Definition : A set which is empty or consists of a definite number of elements is called *finite* otherwise, the set is called *infinite*.

When we represent a set in the roster form, we write all the elements of the set within brackets { }. It is not possible to write all the elements of an infinite set within brackets { } because the numbers of elements of such as set is not finite. So, we represent some infinite set in the roster form by writing a few elements which clearly indicate the structure of the set followed (or preceded) by three. All infinite set can not describe in roster form dots.

Above examples A, B, C and D are finite and E is an infinite set. For any set A, n(A) represents the total number of elements in set A for example-

$$n(A) = 5,\ n(B) = 4,\ \ n(C) = 0,\ n(D) = 11$$

Since E is an infinite set so its number cannot be written down.

Equal Sets

Consider the following sets

A = { 0},

B = {x : $x - 5 = 0$ },

C = {x : $x^2 - 25 = 0$},

D = {x : $x < 5$ and $x > 15$ },

E = {–5, 5 }

and F = { } or ϕ

Here, Number of elements in set A and B are same but elements are different. So set A is not equal to B. The set C representes in roster form as $C = \{-5, 5\}$. So set C and E have same elements. So C and E are equal. Again is set D there is no element because any number which is less than 5 and greater than 15 is not possible. So D is an empty set then D and F are equal set.

Definition : Two sets A and B are said to be *equal* if they have exactly the same elements and we write A = B and real as "A is equal to B". Otherwise, the sets are said to be *unequal* and we write $A \neq B$

Note: A set does not change if one or more elements of the set are repeated.

1.04 Subset

Consider the following sets-

A = set of all science students in your school,

B = set of all science students in your class.

We note that every elements of B is also an element of A, we say that B is subset of A

Definition : The set B is said to be a subset of a set A if every element of B is also an element of A. In other words it is represented as $B \subset A$ read as 'B is a subset of A'

(i) The set Q of rational numbers is a subset of the set R of real numbers, and we write $Q \subset R$

(ii) Let A = { 1, 3, 5} and B = { x : x is an odd natural number less than 6}. Then $B \subset A$ and $A \subset B$, therefore A = B.

(iii) Let A = { a, e, i, o, u} and B = { a, b, c, d}. Then A is not a subset of B, also B is not a subset of A.

(iv) Thus $N \subset Z \subset Q \subset R \subset C$

We may note that for set A to be a subset of B, all that is needed every element of A is in B. It is possible that every element of B may or may not be in A. If its so happens that every element of B is also in A, then we shall also have $B \subset A$. In this case, A and B are the same sets so that we have $A \subset B$ and $B \subset A$ $\Leftrightarrow$ A = B, where $\Leftrightarrow$ is a symbol for two way implications, and is usually read as *if and only if* (briefly written as 'iff'). It follows from the above definition that every set A *is a subset of itself*, i.e., $A \subset A$. Since the empty set ϕ has no elements, we agree to say that ϕ *is a subset of every set.*

Let A and B be two sets. If $A \subset B$ and $A \neq B$, then A is called a *proper subset of* B and B is called *superset* of A. For example,

Q is proper subset of R and R, is superset of Q

Subset of *R* as an interval

Let $a, b \in R$ and $a < b$. Then the set of real numbers $\{x : a < x < b\}$ is called an *open interval* and is denoted by (a, b). All the real numbers between a and b belong to the open interval (a, b) but a, b themselves do not belong to this interval. The interval of all real numbers $\{x : a \leq x \leq b\}$ which contains the end point also is called *closed interval* and is denoted by [a, b]. All numbers from a to b lie between the internal. Similarly the following internal be defined. Thus

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

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

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

$[a, b) = \{x : a \le x < b\}$

Universal set

Usually, in a particular context, we have to deal with the elements and subsets of a basic set which is relevant to that particular context. For example, while studying the system of numbers, we are interested in the set of natural numbers and its subsets such as the set of all prime numbers, the set of rational numbers, and so forth. This basic set is called the "*Universal Set*". The universal set is usually denoted by U. For example, for the set of all integers, the universal set can be the set of rational numbers or, for that matter, the set R of real numbers.

Power set

If $A = \{a, b\}$ and $\phi, \{a\}, \{b\}, \{a, b\}$ all are subset of A. Then $\{\phi, \{a\}, \{b\}, \{a, b\}\}$ be the set of all subsets. The collection of all subsets of a set is called the *power set* of A. It is denoted by P(A). In P(A). Thus, as in above, if $A = \{a, b\}$, then P(A) = $\{\phi, \{a\}, \{b\}, \{a, b\}\}$. Also, note that $n(A) = m$ $n[P(A)] = 4 = 2^2$. In general, if A is a set with $n(A) = m$, then it can be shown that $n[P(A)] = 2^m$

Exercise 1.1

1. Fill the appropriate symbol $\in$ or $\notin$

   (i) $3 \ldots \{1,2,3,4,5\}$ (ii) $2 \cdot 5 \ldots N$ (iii) $0 \ldots$ Q

2. Fill the appropriate symbol $\subset$ or $\not\subset$ and make it correct statement

   (i) $\{2,3,4\} \ldots \{1,2,3,4,5\}$

   (ii) $\{a,e,o\} \ldots \{a,b,c\}$

   (iii) $\{x : x$ is an equilateral triangle in a plane$\} \ldots \{x : x$ is a triangle in the same plane$\}$

   (iv) $\{x : x$ is an even natural number$\} \ldots \{x : x$ is an integer$\}$

3. Examine whether the following statements are true or false:

   (i) $\{a, b\} \subset \{b, a, c\}$

   (ii) $\{a, e\} \subset \{x : x$ is a vowel in the English alphabet$\}$

   (iii) $\{1, 2, 3\} \not\subset \{1,3,2,5\}$

   (iv) $\{x : x$ is an even natural number less than $6\} \not\subset \{x : x$ is a natural number which divides $36\}$

4. Write down all the subsets of the following sets

   (i) $\{a\}$ (iii) $\{1,2,3\}$ (ii) $\{a,b\}$ (iv) ϕ

5. Write the following as intervals

   (i) $\{x : x \in R, -3 < x < 6\}$ (ii) $\{x : x \in R, -4 \le x \le 8\}$

   (iii) $\{x : x \in R, 4 < x \le 9\}$ (iv) $\{x : x \in R, -6 \le x < -1\}$

6. Write the following intervals in set-builder form

   (i) $(-4,0)$ (iii) $[6,8]$ (ii) $[-3, 7)$ (iv) $(3, 10]$

7. Given the sets A = {1, 3, 5}, B = {2, 4, 6} and C = {2, 4, 6, 8} which of the following may be considered as universal set (s) for all the three sets A, B and C

   (i) {0,1, 2, 3, 4, 5, 6} (ii) {1, 2, 3, 4, 5, 6, 7, 8}

   (iii) {0,1, 2, 3, 4, 5, 6, 7, 8, 9, 10} (iv) ϕ

1.05 Operations on Sets

In earlier classes, we have learnt how to perform the operations of addition, subtraction, multiplication and division on numbers. Each one of these operations was performed on a pair of numbers to get another number, Now, we will study on the following operations that can be done for two sets

(i) Union of sets (ii) Intersection of sets

(iii) Difference of sets (iv) Complements of sets

(i) Union of Sets

Think about sets $A = \{1, 2, 3, 4, 5, 6\}$ and $B = \{3, 5, 7, 9, 11\}$. Here we see that some elements are same but some are different. If we make a set $C = \{1, 2, 3, 4, 5, 6, 7, 9, 11\}$. The union of A and B is the set which consists of all the elements of A and all the elements fo B, the common elements being taken only once. The symbol $\cup$ is used to denote the *union symbolically, we write* $A \cup B$ *and usually read as 'A union B'.*

Definition : The union of two sets A and B is the set C which consists of all those elements which are either in A or in B (including those which are in both).

The union of two sets can be represented by $A \cup B$

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

Example : Let A = { 1, 2, 3, 4, 5, 6} and B = {3, 5, 7, 9, 11}, then

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

Properties of Operation of Union

(i) $A \cup \phi = A$ (Law of identity element ϕ is the identity of $\cup$)

(ii) $A \cup B = B \cup A$ (Commutative law)

(iii) $A \cup A = A$ (Idempotent law)

(iv) $(A \cup B) \cup C = A \cup (B \cup C)$ (Associative law)

(v) $U \cup A = U$

(ii) Intersection of Sets

We conclude by observing the given sets A and B that elements 3 and 5 are elements of both sets and a set can be constructed $D = \{3, 5\}$ from this, so the above set is called as intersection set of elements. And this can be defined as follows. The intersection of sets A and B is the set of all elements which are common to both A and B. The symbol $\cap$ is used to denote the *intersection*. The intersection of two sets A and B is the set of all those elements which belong to both A and B. Symbolically, we read as 'A intersection B' then

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

than above example $A \cap B = \{3, 5\}$; 3 and 5 have common element in both sets.

If A and B are two sets such that $A \cap B = \phi$, then A and B are called *disjoint sets.*

There are no elements which are common to A and B then

$$A \cap B = \{ \ \} \text{ or } \phi$$

Properties of Intersection of Sets

(i) $A \cap \phi = \phi,\ U \cap A = A$ (Law of ϕ and U)

(ii) $A \cap B = B \cap A$ (Commutative law)

(iii) $A \cap A = A$ (Idempotent law)

(iv) $(A \cap B) \cap C = A \cap (B \cap C)$ (Associative law)

(v) $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$ (Distributive law)

(iii) Difference of sets

We can see by observing the sets $A = \{1, 2, 3, 4, 5, 6\}$ and $B = \{3, 5, 7, 9, 11\}$ that 1, 2, 4, 6 are those elements of set A whcih do not exists in sets B. So these indicated as $A - B = \{1, 2, 4, 6\}$ and similarly we get $B - A = \{7, 9, 11\}$.

Definition: The difference of the sets A and B in this order is the set of elements which belong to A but not to B. Symbolically, we write A – B and read as "A minus B". Thus

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

From abhove sets it is clear that $A - B \neq B - A$ which shows that the difference of sets operation does not follow the commutative law.

(iv) Complement of a Set

If we denote a universal set $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ and $A = \{2, 4, 6\}$ then remaining all elements except element of A, we get a new set from remmaining elements, we write it as U–A because in this there is no element of A. Hence, this is called as complement set of A with respect to U.

Definition : Complement set of any set is set obtained by removing the element of given set from the universal set. Let U be the univrsal set and A is a subset of U. Then the complement of A is the set of all elements of U which are not the elements of A. Symbolically, we write A' to denote the complement of A with respect to U. Thus

A' = $\{x : x \in$ U and $x \notin A\}$. Obviously A' = U – A

For example

U = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10 } and A = {2, 4, 6} then A' = {1, 3, 5, 7, 8, 9, 10}

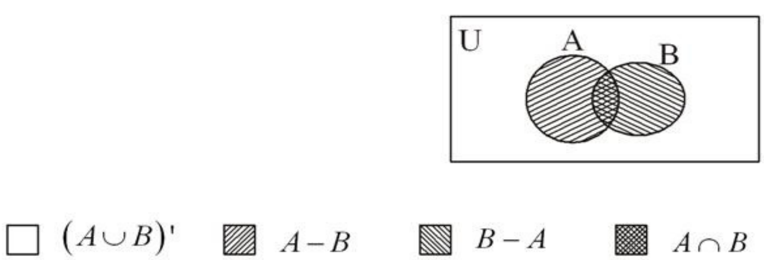
1.06 Representation of Initial Operations on Sets by Venn Diagram

Most of the relationships between sets can be represented by means of diagrams which are known as *Venn diagrams*. Venn diagrams are named after the English logician, John Venn (1834-1883). These diagrams consist of rectangles and closed curves usually circles.

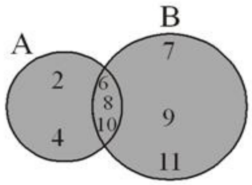
The universal set is represented usually by a rectangle and its subsets by circles. In Venn diagrams, the elements of the sets are wirtten in their respective circles.

Illustrative Examples

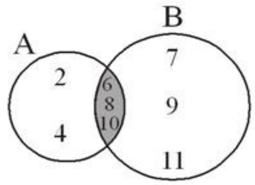
Example 4. The operations of sets are represented in the respective manner.



Example 5. If A = { 2, 4, 6, 8, 10} and B = { 6, 7, 8, 9, 10, 11} then $A \cup B$ and $A \cap B$ can be represented as



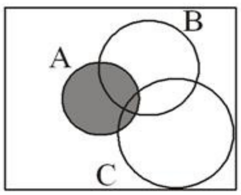
$A \cup B = \{2,4,6,7,8,9,10,11\}$



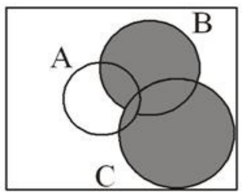
$A \cap B = \{6,8, 10\}$

Example 6. If A, B and C are three sets then show through Venn Diagram

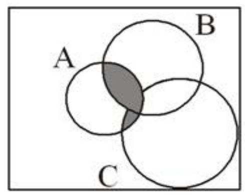
$A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$



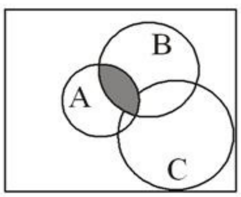
A



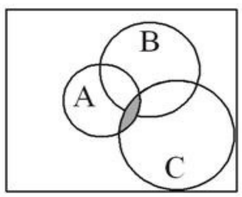
$B \cup C$



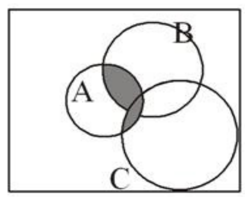
$A \cap (B \cup C)$



$A \cap B$



$A \cap C$



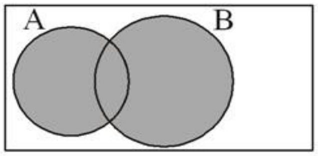
$(A \cap B) \cup (A \cap C)$

Thus diagramatically it proves that $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

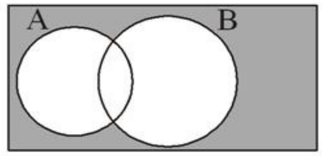
Example 7. If U is a Universal set and A and B are any two sets then represent the following using Venn Diagram

(i) $(A \cup B)'$ (ii) $A' \cup B'$

Solution : (i) $(A \cup B)'$

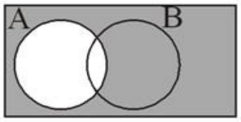


$(A \cup B)$

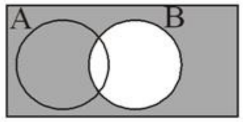


$(A \cup B)'$

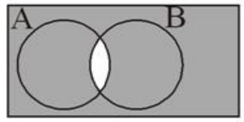
(ii) $A' \cup B'$



A'



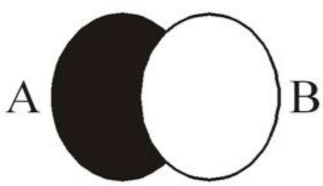
B'



$A' \cup B'$

Miscellaneous Exercise – 1

1. The solution of the equation $x^2 + x - 2 = 0$ in roster form is
   (A) $\{1,2\}$ (C) $\{-1,2\}$ (B) $\{-1, -2\}$ (D) $\{1, -2\}$
2. The roster form of B = {y : y is vowel in english alphabet}
   (A) {a,e,i,o} (C) {a, e, o,u} (B) {a,o,u} (D) {a,e,i,o,u}
3. The set builder form of set A = {1, 4, 9, 16, 25, . . . }
   (A) {x : x and odd natural number} (B) {x : x an even natural number}
   (C) {x : x a square of natural number} (D) {x : x is a prime natural number}
4. Which of the following is infinite set
   (A) $\{x : x \in N \text{ and } (x-1)(x-2) = 0\}$ (B) $\{x : x \in N \text{ and } x^2 = 4\}$
   (C) $\{x : x \in N \text{ and } 2x - 1 = 0\}$ (D) $\{x : x \in N \text{ and } x \text{ is Prime}\}$
5. If A = {0}, B = $\{x : x > 15 \text{ and } x < 5\}$, C = $\{x : x - 5 = 0\}$, D = $\{x : x^2 = 25\}$,
   E = {x : x is the positive integer root of the equation $x^2 - 2x - 15 = 0$} then find the pair of Equal sets
   (A) A, B (C) B, C (B) C,D (D) C,E
6. Which of the following is true for the sets ϕ, A = { 1, 3 }, B = {1, 5, 9}, C = {1, 5, 7, 9}
   (A) $A \subset B$ (B) $B \subset C$ (C) $C \subset B$ (D) $A \subset C$
7. If A= { 2, 4, 6, 8} and B = {1, 4, 7, 8} then A – B and B – A are respectively
   (A) {2,6}; {1,7} (B) {1,7}; {4,8} (C) {1,7}; {2,6} (D) {4,8} ; {1,7}
8. Which of the following is true?
   (A) $A \cap B = \phi \Rightarrow A = \phi$ or $B = \phi$ (B) $A - B = \phi \Rightarrow A \subset B$
   (C) $A \cup B = \phi \Rightarrow A \subset B$ (D) None of these
9. If $A \cap B = \phi$ then
   (A) $A - B = \phi$ (B) $A - B = A$ (C) $A \cup B = \phi$ (D) A – B = B
10. The shaded part of the Venn Diagram represents



   (A) $A \cup B$ (B) $A \cap B$ (C) A – B (D) B – A
11. If A = { 1, 2, 3, 4, 5, 6}, B = { 2, 4, 6, 8 } then the value of A – B is
   (A) { 1,3,5,8} (B) {1,3,5} (C) {1,2,3,4,5,6,8} (D) { }
12. Which amongst the following statements is true?
   (A) { 2, 3, 4, 5 } and { 3, 6 } are disjoint sets

(B) { a, e, i, o, u } and { a, b, c, d } are disjoint sets

(C) { 2, 6, 10, 14 } and { 3, 7, 11, 15} are disjoint sets

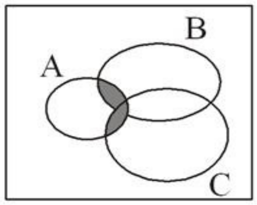
(D) { 2, 7, 10 } and { 3, 7, 11} are disjoint sets

13. If U = {1, 2, 3, 4, 5, 6}, A = {2, 3} and B = {3, 4, 5} then which amongst the following is true

(A) $(A \cup B)' = \{2, 3, 4, 5\}$ (B) B – A = {4,5}

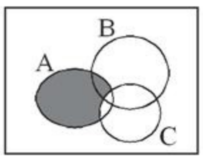
(C) A – B = {2,4,5} (D) (A ∪ B) = {3}

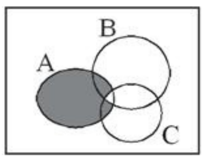
14. The shaded part of the Venn Diagram represents

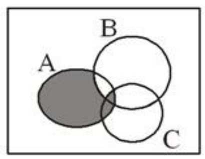


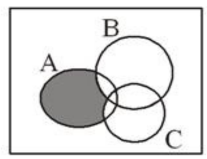
(A) $(A \cap B) \cap C$ (B) $(A \cup B) \cap C$ (C) $(A \cap B) \cup C$ (D) $(A \cap B) \cup (A \cap C)$

15. The Venn Diagram fo the set $A - (B \cap C)$ represents

(A) 

(B) 

(C) 

(D) 

16. Which of the following collection represents a set? Explain.

(i) The collection of even natural numbers less then 8.

(ii) The collection of metro cities in India.

(iii) The collection of various geometrical figures.

(iv) The collection of all integers which divides 46.

(v) The collection of of Worlds 10 best batsmen in Cricket.

(vi) The collection of all even integers.

(vii) The collection of all books wirtten by Poet Kalidas.

(viii) The collection of all legends who contributed in the Indian culutre.

17. Write the following set in a roster form:

(i) $A = \{x : x \in N, 2 \le x \le 9\}$

(ii) B = { $x : x$ two digit natural number sum of whose digits is 6}

(iii) C = The set of all letters of the word MATHEMATICS}

(iv) D = { $x : x$ is a prime number less then 50 }

18. If A = {1, 2, 3, 4, 5, 6}, B = {2, 3, 4} and C = { 4, 6, 8, 10} then put the appropriate symbols

(i) 4…A , 5…B (ii) 2…A, 3…B, 4…C

(iii) B…A, A…C (iv) A – B …C

(v) A…B = B (vi) B – C … {2}

(vii) B ∩ C = {…} (viii) B ∪ C – A = {…}

19. Give two examples of each

(i) Empty set. (ii) Finite set. (iii) Infinite set. (iv) Universal set.

20. If A = {a, b, c, d}, B = {p, q, r} and C = { a, b, p, q} then check the validity of following

(i) A –B = C (ii) B – C ≠ A

(iii) B –A = ϕ (iv) (A ∪ B) –C = { c, d, r}

(v) (A ∪ B) ∩ C = C

21. If A = ϕ then how many elements does P(A) have?

22. Write the following sets in the intervals

(i) $\{ x : x \in R, a < x < b\}$ (ii) $\{ x : x \in R, 3 < x \le 5 \}$

(iii) $\{ x : x \in R, 0 \le x < 8\}$ (iv) $\{ x : x \in R, -1 \le x \le 5\}$

23. Write the following intervals in the set builder form

(i) (2, 5) (ii) [0, 7) (iii) [2, 10] (iv) (–5, 0]

24. If $A = \{x : x \in N, 2 \le x \le 9\}$ and B = { x : x two digit natural number sum of whose digits is 8} then find the following set

(i) $A \cup B$ (ii) $A \cap B$ (iii) $A - B$ (iv) $(A-B) \cup (B-A)$

25. If U = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10},A = {1, 2, 3, 4, 5, 6}, B = {2, 3, 4} and C = { 4, 6, 8, 10} then find the following sets:

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

26. If U = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, A = {1, 2, 3, 4, 5, 6} and B = {2, 3, 4} then prove that

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

27. Represent the following sets through Venn diagram:

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

28. Prove the following using Venn diagram

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

Important Points

1. A set is a well-defined collection of objects.
2. We represent a set to capital letters of english alphabet and its element from small letter. if a is an element of set A, then write it as $a \in A$ and if a is not element of set A then write it as $a \notin A$
3. A set can be written from the following methods
   (i) In tabular or roster form: Writing all elements putting commas between them and don't repeat then and write in curly brackets.
   (ii) Set-Builder from: Write the properties of elements in curly bracket
4. Various types of sets.
   (i) Empty set : A set in which there is no element is presented by ϕ .
   (ii) Finite and infinte set : A set in which number of elements is finite called finite set other wise called as infinite set. $n(A) = A$ total elements.
   (iii) Universal set (U): If a set is subset of a given set then set is called as universal set.

5. Processes in sets:

(i) Union of set A and B or $(A \cup B)$: $A \cup B = \{x : x \in A \text{ or } x \in B\}$

(ii) Interesection of set A and B or $(A \cap B)$: $A \cap B = \{x : x \in A \text{ and } x \in B\}$

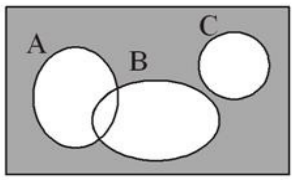
(iii) Difference of set A and B is $(A - B)$: $A - B = \{x : x \in A \text{ and } x \notin B\}$

(iv) Complement set of Set A is (A') : $A' = U - A$

6. Set A, is called as subset $(A \subset B)$ of set B if for every $a \in A, \Rightarrow a \in B$.

7. Power set of A, $P(A)$: $P(A) = \{S; S \subset A\}$ i.e. collection of subsets of A.

8. Representation of sets by a big rectangle and other sets by circles inside this if any elements are common from two sets then represent two circle by intersecting them each other think about this following venu diagram



Here, rectangle denotes universal set whose other elements are subset. Set A and B are indicated by intersecting circles, i.e. some elements are common in both and set C is at different place, hence no element of C lies in set A or B.

Answers

Exericse 1.1

1. (i) $\in$ (ii) $\notin$ (iii) $\in$

2. (i) $\subset$ (ii) $\not\subset$ (iii) $\subset$ (iv) $\not\subset$

3. (i) True (ii) True (iii) False (iv) True

4. (i) $\{\phi, \{a\}\}$ (ii) $\{\phi, \{1\}, \{2\}, \{3\}, \{1, 2\}, \{1, 3\}, \{2, 3\}, \{1, 2, 3\}\}$

(iii) $\{\phi, \{a\}, \{a,b\}\}$ (iv) ϕ

5. (i) $(-3, 6)$ (ii) $[-4, 8]$ (iii) $(4, 9]$ (iv) $[-6, -1)$

6. (i) $\{x : x \in R, -4 < x < 0\}$ (ii) $\{x : x \in R, 6 \le x \le 8\}$

(iii) $\{x : x \in R, -3 \le x < 7\}$ (iv) $\{x : x \in R, 3 < x \le 10\}$

7. (ii) and (iii)

Miscellaneous-1

1. D **2.** D **3.** C **4.** D **5.** D **6.** B

7. A **8.** B **9.** B **10.** C **11.** B **12.** C

13. B **14.** D **15.** B **16.** (i), (iv), (vi), (vii)

17. A = (2, 3, 4, 5, 6, 7, 8, 9), B = (15, 24, 33, 42, 51),

C = (M, A, T, H, E, I, C, S)   D = (1, 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47)

18. (i) $\in, \notin$ (ii) $\in, \in, \in$ (iii) $\in, \notin$ (iv) $\neq$ (v) $\cap$

(vi) $\neq$ (vii) 4   (viii) {8, 10}

19. Examples given as per the definations in the book

20. (i) False   (ii) True   (iii) False   (iv) True   (v) True

21. 1

22. (i) (a, b)   (ii) (3, 5]   (iii) [0, 8)   (iv) [–1, 5]

23. (i) $\{x : x \in R,\ 2 < x < 5\}$ (ii) $\{x : x \in R,\ 0 \le x < 7\}$

(iii) $\{x : x \in R,\ z \le x \le 10\}$ (iv) $\{x : x \in R,\ -5 < x \le 0\}$

24. (i) {2, 3, 4, 5, 6, 7, 8, 9, 17, 26, 35, 44, 53, 62, 71}

(ii) ϕ (iii) A   (iv) $A \cup B$

25. (i) B (ii) {2, 3, 4, 6, 8, 10}   (iii) {1, 5, 7, 8, 9, 10}   (iv) {7, 8, 9, 10}