CHAPTER 1

Sets

NCERT FOCUS SOLUTIONS

EXERCISE - 1.1

1. (i) The collection of all months of a year beginning with J is {January, June, July}, which is well defined and hence it forms a set.
(ii) The collection of most talented writers of India is not well defined because opinions about 'most talented writers' vary from person to person and hence it does not form a set.
(iii) A team of eleven best-cricket batsmen of the world is not well defined because opinions about 'best-cricket batsmen' vary from person to person and hence it does not form a set.
(iv) The collection of all boys in your class is well defined and hence it forms a set.
(v) The collection of all natural numbers less than 100 is {1, 2, 3, 4, ..., 99}, which is well defined and hence it forms a set.
(vi) A collection of novels written by the writer Munshi Prem Chand is well defined and hence it forms a set.
(vii) The collection of all even integers is {......., –4, –2, 0, 2, 4, ...}. Which is well defined and hence it forms a set.
(viii) The collection of questions in this chapter is well defined and hence it forms a set.
(ix) A collection of most dangerous animals of the world is not well defined because opinions about 'most dangerous animals' vary from person to person and hence it does not form a set.

2. (i) Since 5 is the element of A. ∴ $5 \in A$.
(ii) As 8 is not the element of A. ∴ $8 \notin A$
(iii) As 0 is not the element of A. ∴ $0 \notin A$.
(iv) 4 is the element of A. ∴ $4 \in A$
(v) 2 is the element of A. ∴ $2 \in A$.
(vi) 10 is not the element of A. ∴ $10 \notin A$.

3. (i) Integers lying between –3 and 7 are –2, –1, 0, 1, 2, ..., 6
∴ $A = \{-2, -1, ... , 6\}$.
(ii) Natural numbers less than 6 are 1, 2, 3, 4, 5.
∴ $B = \{1, 2, 3, 4, 5\}$
(iii) Two digit natural numbers such that the sum of its digits is 8 are 17, 26, 35, 44, 53, 62, 71, 80.
∴ $C = \{17, 26, 35, 44, 53, 62, 71, 80\}$
(iv) Prime divisors of 60 are 2, 3, 5.
∴ $D = \{2, 3, 5\}$
(v) Word TRIGONOMETRY is formed by using the letters T, R, I, G, O, N, M, E, Y.
∴ E = {T, R, I, G, N, O, M, E, Y}
(vi) Word BETTER is formed by using the letters B, E, T, R
∴ F = {B, E, T, R}

4. (i) Let $A = \{3, 6, 9, 12\}$
All elements of the set are natural numbers that are multiples of 3.
∴ $A = \{x : x = 3n, n \in N \text{ and } 1 \le n \le 4\}$
(ii) Let $B = \{2, 4, 8, 16, 32\} = \{2^1, 2^2, 2^3, 2^4, 2^5\}$
∴ $B = \{x : x = 2^n, n \in N \text{ and } 1 \le n \le 5\}$
(iii) Let $C = \{5, 25, 125, 625\} = \{5^1, 5^2, 5^3, 5^4\}$
∴ $C = \{x : x = 5^n, n \in N \text{ and } 1 \le n \le 4\}$
(iv) Let $D = \{2, 4, 6, ...\}$
All elements of the set are even natural numbers.
∴ $D = \{x : x$ is an even natural number$\}$
(v) Let $E = \{1, 4, 9, ..., 100\}$
All elements of the set are perfect squares.
∴ $E = \{x: x = n^2, n \in N \text{ and } 1 \le n \le 10\}$

5. (i) $A = \{x: x$ is an odd natural number$\}$
∴ $A = \{1, 3, 5, 7, ...\}$
(ii) $B = \{x: x \text{ is an integer}, -\frac{1}{2} < x < \frac{9}{2}\}$
∴ $B = \{0, 1, 2, 3, 4\}$
(iii) $C = \{x: x \text{ is an integer}, x^2 \le 4\}$
∴ $x^2 \le 4 \Rightarrow -2 \le x \le 2$
∴ $C = \{-2, -1, 0, 1, 2\}$
(iv) $D = \{x: x$ is a letter in the word "LOYAL"$\}$
∴ D = {L, O, Y, A}
(v) $E = \{x: x$ is a month of a year not having 31 days$\}$
∴ E = {February, April, June, September, November}
(vi) $F = \{x: x$ is a consonant in the English alphabet which precedes $k\}$
∴ $F = \{b, c, d, f, g, h, j\}$

6. (i) → (c), (ii) → (a), (iii) → (d), (iv) → (b).
The sets which are in set-builder form can be written in roster form as follows:
(a) $\{x : x$ is a prime number and a divisor of $6\}$ = {2, 3}
(b) $\{x : x$ is an odd natural number less than $10\}$ = {1, 3, 5, 7, 9}
(c) $\{x : x$ is a natural number and divisor of $6\}$ = {1, 2, 3, 6}
(d) $\{x : x$ is a letter of the word MATHEMATICS$\}$ = {M, A, T, H, E, I, C, S}

EXERCISE - 1.2

1. (i) Set of odd natural numbers divisible by 2 is a null set because odd natural numbers are not divisible by 2.
(ii) Set of even prime numbers is {2} which is not a null set.

(iii) $\{x : x$ is a natural number, $x < 5$ and $x > 7\}$ is a null set because there is no natural number which satisfies $x < 5$ and $x > 7$ simultaneously.

(iv) $\{y : y$ is a point, common to any two parallel lines$\}$ is a null set because two parallel lines do not have any common point.

2. (i) The set of months of a year is finite set because there are 12 months in a year.

(ii) $\{1, 2, 3, ...\}$ is an infinite set because there are infinite elements in the set.

(iii) $\{1, 2, 3, ..., 99, 100\}$ is a finite set because the set contains finite number of elements.

(iv) The set of positive integers greater than 100 is an infinite set because there are infinite number of positive integers greater than 100.

(v) The set of prime numbers less than 99 is a finite set because the set contains finite number of elements.

3. (i) The set of lines which are parallel to the x-axis is an infinite set because we can draw infinite number of lines parallel to x-axis.

(ii) The set of letters in the English alphabet is a finite set because there are 26 letters in the English alphabet.

(iii) The set of numbers which are multiple of 5 is an infinite set because there are infinite multiples of 5.

(iv) The set of animals living on the earth is a finite set because the number of animals living on the earth is very large but finite.

(v) The set of circles having origin as (0, 0) is an infinite set because we can draw infinite number of circles with origin (0, 0) and different radii.

4. (i) $A = \{a, b, c, d\}$ and $B = \{d, c, b, a\}$ are equal sets because order of elements does not change a set.

$\therefore$ $A = B = \{a, b, c, d\}$.

(ii) $A = \{4, 8, 12, 16\}$ and $B = \{8, 4, 16, 18\}$ are not equal sets because $12 \in A$ but $12 \notin B$ and $18 \in B$ but $18 \notin A$.

(iii) $A = \{2, 4, 6, 8, 10\}$ and $B = \{x$: x is a positive even integer and $x \leq 10\}$ which can be written in roster form as, $B = \{2, 4, 6, 8, 10\}$ are equal sets.

$\therefore$ $A = B = \{2, 4, 6, 8, 10\}$.

(iv) $A = \{x$: x is a multiple of $10\}$ can be written in roster form as, $A = \{10, 20, 30, 40, ...\}$ and $B = \{10, 15, 20, 25, 30, ...\}$ are not equal sets because $15 \in B$ but $15 \notin A$.

5. (i) $A = \{2, 3\}$ and $B = \{x : x$ is a solution of $x^2 + 5x + 6 = 0\}$

Now, $x^2 + 5x + 6 = 0 \Rightarrow x^2 + 3x + 2x + 6 = 0$

$\Rightarrow (x + 3)(x + 2) = 0 \Rightarrow x = -3, -2$

$\therefore$ $B = \{-2, -3\}$

Hence, A and B are not equal sets.

(ii) $A = \{x : x$ is a letter in the word FOLLOW$\}$
$= \{F, O, L, W\}$

$B = \{y$: y is a letter in the word WOLF$\}$
$= \{W, O, L, F\}$

Hence, $A = B = \{F, O, L, W\}$.

6. From the given sets, we see that, set B and D have same elements and also set E and G have same elements.

$\therefore$ $B = D = \{1, 2, 3, 4\}$ and $E = G = \{-1, 1\}$.

EXERCISE - 1.3

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

(ii) $\{a, b, c\} \not\subset \{b, c, d\}$

(iii) $\{x : x$ is a student of Class XI of your school$\} \subset \{x : x$ is a student of your school$\}$

(iv) $\{x : x$ is a circle in the plane$\} \not\subset \{x : x$ is a circle in the same plane with radius 1 unit$\}$

(v) $\{x : x$ is a triangle in a plane$\} \not\subset \{x : x$ is a rectangle in the plane$\}$

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

(vii) $\{x : x$ is an even natural number$\} \subset \{x : x$ is an integer$\}$

2. (i) Let $A = \{a, b\}$ and $B = \{b, c, a\}$

Here every element of A is an element of B.

$\therefore$ $A \subset B$

Hence, the statement is false.

(ii) Let $A = \{a, e\}$ and $B = \{x : x$ is a vowel in the English alphabet$\}$

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

Here every element of A is an element of B

$\therefore$ $A \subset B$. Hence, the statement is true.

(iii) Let $A = \{1, 2, 3\}$ and $B = \{1, 3, 5\}$.

Here $2 \in A$ but $2 \notin B$. $\therefore$ $A \not\subset B$.

Hence, the statement is false.

(iv) Let $A = \{a\}$ and $B = \{a, b, c\}$.

Here every element of A is an element of B.

$\therefore$ $A \subset B$. Hence, the statement is true.

(v) Let $A = \{a\}$ and $B = \{a, b, c\}$.

Here the statement is false because $\{a\} \notin B$ while $\{a\} \subset B$

(vi) Let $A = \{x : x$ is an even natural number less than $6\}$

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

and $B = \{x : x$ is a natural number which divides $36\}$

$B = \{1, 2, 3, 4, 6, 9, 12, 18, 36\}$

Here every element of A is an element of B.

$\therefore$ $A \subset B$. Hence, the statement is true.

3. (i) $\{3, 4\}$ is a member of set A.

$\therefore$ $\{3, 4\} \in A$ but $3 \notin A$ & $4 \notin A$

Hence $\{3, 4\} \subset A$ is incorrect.

(ii) $\{3, 4\}$ is a member of set A.

$\therefore$ $\{3, 4\} \in A$ is correct.

(iii) Here $\{3, 4\}$ is a member of set A and $\{\{3, 4\}\}$ is a subset of A.

$\therefore$ $\{\{3, 4\}\} \subset A$ is correct.

(iv) 1 is a member of set A. $\therefore$ $1 \in A$ is correct.

(v) 1 is not a set, it is a member of set A.

$\therefore$ $1 \subset A$ is incorrect.

(vi) 1, 2, 5 are members of set A.

$\therefore$ $\{1, 2, 5\}$ is a subset of set A.

$\therefore$ $\{1, 2, 5\} \subset A$ is correct.

(vii) 1, 2, 5 are members of set A.

$\therefore$ $\{1, 2, 5\}$ is a subset of set A.

$\therefore$ $\{1, 2, 5\} \in A$ is incorrect.

(viii) 3 is not a member of set A.

$\therefore$ $\{1, 2, 3\}$ is not a subset of set A.

$\therefore$ $\{1, 2, 3\} \subset A$ is incorrect.

(ix) ϕ is not a member of set A.

$\therefore$ $\phi \in A$ is incorrect.

(x) Since ϕ is a subset of every set.

$\therefore$ $\phi \subset A$ is correct.

(xi) $\{\phi\}$ is not a subset of set A.

$\therefore$ $\{\phi\} \subset A$ is incorrect.

4. (i) Number of elements in given set = 1

Number of subsets of given set = $2^1 = 2$

$\therefore$ Subsets of given set are ϕ, $\{a\}$.

(ii) Number of elements in given set = 2

Number of subsets of given set = $2^2 = 4$

$\therefore$ Subsets of given set are ϕ, $\{a\}$, $\{b\}$, $\{a, b\}$.

(iii) Number of elements in given set = 3

Number of subsets of given set = $2^3 = 8$

$\therefore$ Subsets of given set are ϕ, $\{1\}$, $\{2\}$, $\{3\}$, $\{1, 2\}$, $\{2, 3\}$, $\{1, 3\}$, $\{1, 2, 3\}$.

(iv) Number of elements in given set = 0

Number of subsets of given set = $2^0 = 1$

$\therefore$ Subset of given set is ϕ.

5. (i) Let $A = \{x: x \in R, -4 < x \leq 6\}$

It can be written in the form of interval as $(-4, 6]$.

(ii) Let $A = \{x: x \in R, -12 < x < -10\}$

It can be written in the form of interval as $(-12, -10)$.

(iii) Let $A = \{x: x \in R, 0 \leq x < 7\}$

It can be written in the form of interval as $[0, 7)$.

(iv) Let $A = \{x: x \in R, 3 \leq x \leq 4\}$

It can be written in the form of interval as $[3, 4]$.

6. (i) The interval $(-3, 0)$ can be written in set-builder form as $\{x : x \in R, -3 < x < 0\}$.

(ii) The interval $[6, 12]$ can be written in set-builder form as $\{x : x \in R, 6 \leq x \leq 12\}$.

(iii) The interval $(6, 12]$ can be written in set-builder form as $\{x : x \in R, 6 < x \leq 12\}$

(iv) The interval $[-23, 5)$ can be written in set-builder form as $\{x : x \in R, -23 \leq x < 5\}$

7. (i) Right triangle is a type of triangle. So the set of triangles contain all types of triangles can be universal set.

$\therefore$ $U = \{x : x$ is a triangle in a plane$\}$

(ii) Isosceles triangle is a type of triangle. So the set of triangles contain all types of triangles can be universal set.

$\therefore$ $U = \{x : x$ is a triangle in a plane$\}$

8. (i) $\{0, 1, 2, 3, 4, 5, 6\}$ is not a universal set for A, B and C because $8 \in C$ but 8 is not a member of $\{0, 1, 2, 3, 4, 5, 6\}$.

(ii) ϕ is a set which contains no element. So it is not a universal set for A, B and C.

(iii) $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ is a universal set for A, B and C because all members of A, B and C are present in $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$.

(iv) $\{1, 2, 3, 4, 5, 6, 7, 8\}$ is not a universal set for A, B, and C because $0 \in C$ but 0 is not a member of $\{1, 2, 3, 4, 5, 6, 7, 8\}$

EXERCISE - 1.4

1. (i) Here $X = \{1, 3, 5\}$ and $Y = \{1, 2, 3\}$

$\therefore$ $X \cup Y = \{1, 2, 3, 5\}$

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

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

(iii) Here $A = \{x: x$ is a natural number and multiple of 3$\}$ $= \{3, 6, 9, 12, ...\}$

and $B = \{x: x$ is a natural number less than 6$\}$ $= \{1, 2, 3, 4, 5\}$

$\therefore$ $A \cup B = \{1, 2, 3, 4, 5, 6, 9, 12, 15, ...\}$

(iv) Here $A = \{x: x$ is a natural number and $1 < x \leq 6\}$ $= \{2, 3, 4, 5, 6\}$

and $B = \{x : x$ is a natural number and $6 < x < 10\} = \{7, 8, 9\}$

$\therefore$ $A \cup B = \{2, 3, 4, 5, 6, 7, 8, 9\}$

(v) Here $A = \{1, 2, 3\}$ and $B = \phi$

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

2. Here $A = \{a, b\}$ and $B = \{a, b, c\}$. All elements of set A are present in set B.

$\therefore$ $A \subset B$. Now, $A \cup B = \{a, b, c\} = B$.

3. Here A and B are two sets such that $A \subset B$.

Take $A = \{1, 2\}$ and $B = \{1, 2, 3\}$.

$\therefore$ $A \cup B = \{1, 2, 3\} = B$.

4. Here $A = \{ 1, 2, 3, 4\}$, $B = \{3, 4, 5, 6\}$, $C = \{5, 6, 7, 8\}$ and $D = \{7, 8, 9, 10\}$

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

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

(iii) $B \cup C = \{3, 4, 5, 6\} \cup \{5, 6, 7, 8\} = \{3, 4, 5, 6, 7, 8\}$

(iv) $B \cup D = \{3, 4, 5, 6\} \cup \{7, 8, 9, 10\} = \{3, 4, 5, 6, 7, 8, 9, 10\}$

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

(vi) $A \cup B \cup D = \{1, 2, 3, 4\} \cup \{3, 4, 5, 6\} \cup \{7, 8, 9, 10\}$
$= \{1, 2, 3, 4, 5, 6\} \cup \{7, 8, 9, 10\}$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

(vii) $B \cup C \cup D = \{3, 4, 5, 6\} \cup \{5, 6, 7, 8\} \cup \{7, 8, 9, 10\}$
$= \{3, 4, 5, 6, 7, 8\} \cup \{7, 8, 9, 10\} = \{3, 4, 5, 6, 7, 8, 9, 10\}$

5. (i) Here $X = \{1, 3, 5\}$ and $Y = \{1, 2, 3\}$

$\therefore$ $X \cap Y = \{1, 3\}$

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

$\therefore$ $A \cap B = \{a\}$

(iii) Here $A = \{x: x$ is a natural number and multiple of 3$\}$ $= \{3, 6, 9, 12, ...\}$

and $B = \{x: x$ is a natural number less than 6$\}$ $= \{1, 2, 3, 4, 5\}$

$\therefore$ $A \cap B = \{3\}$

(iv) Here $A = \{x : x$ is a natural number and $1 < x \leq 6\}$ $= \{2, 3, 4, 5, 6\}$

and $B = \{x : x$ is a natural number and $6 < x < 10\}$ $= \{7, 8, 9\}$ $\therefore$ $A \cap B = \phi$

(v) Here $A = \{1, 2, 3\}$ and $B = \phi$

$\therefore$ $A \cap B = \phi$.

6. Here $A = \{3, 5, 7, 9, 11\}$, $B = \{7, 9, 11, 13\}$, $C = \{11, 13, 15\}$ and $D = \{15, 17\}$

(i) $A \cap B = \{3, 5, 7, 9, 11\} \cap \{7, 9, 11, 13\} = \{7, 9, 11\}$

(ii) $B \cap C = \{7, 9, 11, 13\} \cap \{11, 13, 15\} = \{11, 13\}$

(iii) $A \cap C \cap D = \{3, 5, 7, 9, 11\} \cap \{11, 13, 15\} \cap \{15, 17\} = \phi$

(iv) $A \cap C = \{3, 5, 7, 9, 11\} \cap \{11, 13, 15\} = \{11\}$

(v) $B \cap D = \{7, 9, 11, 13\} \cap \{15, 17\} = \phi$

(vi) $A \cap (B \cup C) = \{3, 5, 7, 9, 11\} \cap \{7, 9, 11, 13, 15\}$
$= \{7, 9, 11\}$

(vii) $A \cap D = \{3, 5, 7, 9, 11\} \cap \{15, 17\} = \phi$

(viii) $A \cap (B \cup D)$
$= \{3, 5, 7, 9, 11\} \cap \{7, 9, 11, 13, 15, 17\} = \{7, 9, 11\}$

(ix) $A \cap B = \{3, 5, 7, 9, 11\} \cap \{7, 9, 11, 13\} = \{7, 9, 11\}$
$B \cup C = \{7, 9, 11, 13\} \cup \{11, 13, 15\} = \{7, 9, 11, 13, 15\}$
$(A \cap B) \cap (B \cup C) = \{7, 9, 11\} \cap \{7, 9, 11, 13, 15\} = \{7, 9, 11\}$

(x) $A \cup D = \{3, 5, 7, 9, 11\} \cup \{15, 17\} = \{3, 5, 7, 9, 11, 15, 17\}$
$B \cup C = \{7, 9, 11, 13\} \cup \{11, 13, 15\} = \{7, 9, 11, 13, 15\}$
$(A \cup D) \cap (B \cup C)$
$= \{3, 5, 7, 9, 11, 15, 17\} \cap \{7, 9, 11, 13, 15\} = \{7, 9, 11, 15\}$.

7. Here $A = \{x: x$ is a natural number$\} = \{1, 2, 3, 4, 5, ...\}$
$B = \{x: x$ is an even natural number$\} = \{2, 4, 6, ...\}$
$C = \{x: x$ is an odd natural number$\} = \{1, 3, 5, 7, ...\}$
and $D = \{x: x$ is a prime number$\} = \{2, 3, 5, 7, ...\}$

(i) $A \cap B = \{x: x$ is a natural number$\} \cap \{x: x$ is an even natural number$\}$
$= \{x: x$ is an even natural number$\} = B$.

(ii) $A \cap C = \{x: x$ is a natural number$\} \cap \{x: x$ is an odd natural number$\}$
$= \{x: x$ is an odd natural number$\} = C$.

(iii) $A \cap D = \{x: x$ is a natural number$\} \cap \{x: x$ is a prime number$\}$
$= \{x: x$ is a prime number$\} = D$.

(iv) $B \cap C = \{x: x$ is an even natural number$\} \cap \{x: x$ is an odd natural number$\} = \phi$.

(v) $B \cap D = \{x: x$ is an even natural number$\} \cap \{x: x$ is a prime number$\} = \{2\}$.

(vi) $C \cap D = \{x: x$ is an odd natural number$\} \cap \{x: x$ is a prime number$\}$
$= \{x: x$ is an odd prime number$\}$.

8. (i) Let $A = \{1, 2, 3, 4\}$ and $B = \{x: x$ is a natural number and $4 \le x \le 6\} = \{4, 5, 6\}$
$\therefore \quad A \cap B = \{1, 2, 3, 4\} \cap \{4, 5, 6\} = \{4\}$
Hence A and B are not disjoint sets.

(ii) Let $A = \{a, e, i, o, u\}$ and $B = \{c, d, e, f\}$
$\therefore \quad A \cap B = \{e\}$
Hence A and B are not disjoint sets.

(iii) Let $A = \{x : x$ is an even integer$\}$ and
$B = \{x: x$ is an odd integer$\}$
$\therefore \quad A \cap B = \phi$. Hence A and B are disjoint sets.

9. Here $A = \{3, 6, 9, 12, 15, 18, 21\}$,
$B = \{4, 8, 12, 16, 20\}$,
$C = \{2, 4, 6, 8, 10, 12, 14, 16\}$,
$D = \{5, 10, 15, 20\}$

(i) $A - B = \{3, 6, 9, 12, 15, 18, 21\} - \{4, 8, 12, 16, 20\}$
$= \{3, 6, 9, 15, 18, 21\}$

(ii) $A - C = \{3, 6, 9, 12, 15, 18, 21\} - \{2, 4, 6, 8, 10, 12, 14, 16\}$
$= \{3, 9, 15, 18, 21\}$

(iii) $A - D = \{3, 6, 9, 12, 15, 18, 21\} - \{5, 10, 15, 20\}$
$= \{3, 6, 9, 12, 18, 21\}$

(iv) $B - A = \{4, 8, 12, 16, 20\} - \{3, 6, 9, 12, 15, 18, 21\}$
$= \{4, 8, 16, 20\}$

(v) $C - A = \{2, 4, 6, 8, 10, 12, 14, 16\} - \{3, 6, 9, 12, 15, 18, 21\}$
$= \{2, 4, 8, 10, 14, 16\}$

(vi) $D - A = \{5, 10, 15, 20\} - \{3, 6, 9, 12, 15, 18, 21\}$
$= \{5, 10, 20\}$

(vii) $B - C = \{4, 8, 12, 16, 20\} - \{2, 4, 6, 8, 10, 12, 14, 16\}$
$= \{20\}$

(viii) $B - D = \{4, 8, 12, 16, 20\} - \{5, 10, 15, 20\}$
$= \{4, 8, 12, 16\}$

(ix) $C - B = \{2, 4, 6, 8, 10, 12, 14, 16\} - \{4, 8, 12, 16, 20\}$
$= \{2, 6, 10, 14\}$

(x) $D - B = \{5, 10, 15, 20\} - \{4, 8, 12, 16, 20\}$
$= \{5, 10, 15\}$

(xi) $C - D = \{2, 4, 6, 8, 10, 12, 14, 16\} - \{5, 10, 15, 20\}$
$= \{2, 4, 6, 8, 12, 14, 16\}$

(xii) $D - C = \{5, 10, 15, 20\} - \{2, 4, 6, 8, 10, 12, 14, 16\}$
$= \{5, 15, 20\}$

10. Here $X = \{a, b, c, d\}$ and $Y = \{f, b, d, g\}$

(i) $X - Y = \{a, b, c, d\} - \{f, b, d, g\} = \{a, c\}$

(ii) $Y - X = \{f, b, d, g\} - \{a, b, c, d\} = \{f, g\}$

(iii) $X \cap Y = \{a, b, c, d\} \cap \{f, b, d, g\} = \{b, d\}$

11. We know that set of real numbers contain rational and irrational numbers. So $R - Q$ = set of irrational numbers.

12. (i) Let $A = \{2, 3, 4, 5\}$ and $B = \{3, 6\}$
Now $A \cap B = \{2, 3, 4, 5\} \cap \{3, 6\} = \{3\}$.
$\because \; A \cap B \ne \phi$
Hence, A and B are not disjoint sets. So the statement is false.

(ii) Let $A = \{a, e, i, o, u\}$ and $B = \{a, b, c, d\}$
Now, $A \cap B = \{a, e, i, o, u\} \cap \{a, b, c, d\} = \{a\}$.
$\because \; A \cap B \ne \phi$
Hence, A and B are not disjoint sets. So the statement is false.

(iii) Let $A = \{2, 6, 10, 14\}$ and $B = \{3, 7, 11, 15\}$
Now $A \cap B = \{2, 6, 10, 14\} \cap \{3, 7, 11, 15\} = \phi$
Hence, A and B are disjoint sets. So the statement is true.

(iv) Let $A = \{2, 6, 10\}$ and $B = \{3, 7, 11\}$
Now $A \cap B = \{2, 6, 10\} \cap \{3, 7, 11\} = \phi$
Hence, A and B are disjoint sets. So the statement is true.

EXERCISE - 1.5

1. Here, $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$,
$A = \{1, 2, 3, 4\}$, $B = \{2, 4, 6, 8\}$ and $C = \{3, 4, 5, 6\}$

(i) $A' = U - A$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{1, 2, 3, 4\} = \{5, 6, 7, 8, 9\}$

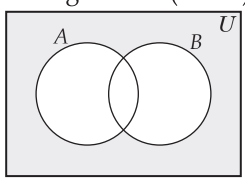
(ii) $B' = U - B$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{2, 4, 6, 8\} = \{1, 3, 5, 7, 9\}$
(iii) $A \cup C = \{1, 2, 3, 4\} \cup \{3, 4, 5, 6\} = \{1, 2, 3, 4, 5, 6\}$
$(A \cup C)' = U - (A \cup C)$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{1, 2, 3, 4, 5, 6\} = \{7, 8, 9\}$
(iv) $A \cup B = \{1, 2, 3, 4\} \cup \{2, 4, 6, 8\}$
$= \{1, 2, 3, 4, 6, 8\}$
$(A \cup B)' = U - (A \cup B)$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{1, 2, 3, 4, 6, 8\} = \{5, 7, 9\}$
(v) We know that $A' = \{5, 6, 7, 8, 9\}$
$(A')' = U - A'$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{5, 6, 7, 8, 9\} = \{1, 2, 3, 4\}$
(vi) $B - C = \{2, 4, 6, 8\} - \{3, 4, 5, 6\} = \{2, 8\}$
$(B - C)' = U - (B - C)$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{2, 8\} = \{1, 3, 4, 5, 6, 7, 9\}$.

2. (i) $A' = U - A = \{a, b, c, d, e, f, g, h\} - \{a, b, c\}$
$= \{d, e, f, g, h\}$
(ii) $B' = U - B = \{a, b, c, d, e, f, g, h\} - \{d, e, f, g\} = \{a, b, c, h\}$
(iii) $C' = U - C = \{a, b, c, d, e, f, g, h\} - \{a, c, e, g\} = \{b, d, f, h\}$
(iv) $D' = U - D = \{a, b, c, d, e, f, g, h\} - \{f, g, h, a\} = \{b, c, d, e\}$.

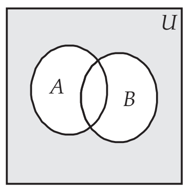
3. Here $U = \{x : x \in N\}$
(i) Let $A = \{x : x$ is an even natural number$\}$
$A' = U - A = \{x : x \in N\} - \{x : x$ is an even natural number$\}$
$= \{x : x$ is an odd natural number$\}$
(ii) Let $A = \{x : x$ is an odd natural number$\}$
$A' = U - A = \{x : x \in N\} - \{x : x$ is an odd natural number$\}$
$= \{x : x$ is an even natural number$\}$
(iii) Let $A = \{x : x$ is a positive multiple of 3$\}$
$\therefore$ $A' = U - A = \{x : x \in N\} - \{x : x$ is a positive multiple of 3$\}$
$= \{x : x \in N, x$ is not a multiple of 3$\}$
(iv) Let $A = \{x : x$ is a prime number$\}$
$A' = U - A = \{x : x \in N\} - \{x : x$ is a prime number$\}$
$= \{x : x \in N, x$ is not a prime number$\}$
or $\{x : x$ is positive composite number and $x = 1\}$.
(v) Let $A = \{x : x$ is a natural number divisible by 3 and 5$\}$
$A' = U - A = \{x : x \in N\} - \{x : x$ is a natural number divisible by 3 and 5$\}$
$= \{x : x \in N\} - \{x : x$ is a natural number divisible by 15$\}$
$= \{x : x \in N, x$ is not divisible by 15$\}$
(vi) Let $A = \{x : x$ is a perfect square$\}$
$A' = U - A = \{x : x \in N\} - \{x : x$ is a perfect square$\}$
$= \{x : x \in N, x$ is not a perfect square$\}$
(vii) Let $A = \{x : x$ is a perfect cube$\}$
$A' = U - A = \{x : x \in N\} - \{x : x$ is a perfect cube$\}$
$= \{x : x \in N, x$ is not a perfect cube$\}$
(viii) Let $A = \{x : x + 5 = 8\} = \{3\}$
$A' = U - A = \{x : x \in N\} - \{3\} = \{x : x \in N, x \neq 3\}$
(ix) Let $A = \{x : 2x + 5 = 9\} = \{2\}$
$A' = U - A = \{x : x \in N\} - \{2\} = \{x : x \in N, x \neq 2\}$
(x) Let $A = \{x : x \geq 7\} = \{7, 8, 9, 10, ...\}$
$A' = U - A = \{x : x \in N\} - \{7, 8, 9, 10, ...\}$
$= \{1, 2, 3, 4, 5, 6\} = \{x : x \in N$ and $x < 7\}$
(xi) Let $A = \{x : x \in N$ and $2x + 1 > 10\}$
$= \left\{x : x \in N \text{ and } x > \frac{9}{2}\right\}$
$\therefore$ $A' = U - A = \{x : x \in N$ and $x \leq 9/2\}$

4. Here $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$,
$A = \{2, 4, 6, 8\}$ and $B = \{2, 3, 5, 7\}$
(i) $A \cup B = \{2, 4, 6, 8\} \cup \{2, 3, 5, 7\} = \{2, 3, 4, 5, 6, 7, 8\}$
$\therefore$ $(A \cup B)' = U - (A \cup B)$
$= \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{2, 3, 4, 5, 6, 7, 8\} = \{1, 9\}$ ...(i)
$A' = U - A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{2, 4, 6, 8\}$
$= \{1, 3, 5, 7, 9\}$
$B' = U - B = \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{2, 3, 5, 7\}$
$= \{1, 4, 6, 8, 9\}$
$A' \cap B' = \{1, 3, 5, 7, 9\} \cap \{1, 4, 6, 8, 9\} = \{1, 9\}$ ...(ii)
From (i) and (ii), we have $(A \cup B)' = A' \cap B'$
(ii) $A \cap B = \{2, 4, 6, 8\} \cap \{2, 3, 5, 7\} = \{2\}$
$(A \cap B)' = U - (A \cap B) = \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{2\}$
$= \{1, 3, 4, 5, 6, 7, 8, 9\}$ ...(iii)
$A' = U - A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{2, 4, 6, 8\}$
$= \{1, 3, 5, 7, 9\}$
$B' = U - B = \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{2, 3, 5, 7\}$
$= \{1, 4, 6, 8, 9\}$
$A' \cup B' = \{1, 3, 5, 7, 9\} \cup \{1, 4, 6, 8, 9\}$
$= \{1, 3, 4, 5, 6, 7, 8, 9\}$ ... (iv)
From (iii) and (iv), we have $(A \cap B)' = A' \cup B'$

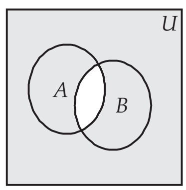
5. (i) The Venn diagram for $(A \cup B)'$.



The shaded portion represents $(A \cup B)'$.
(ii) The Venn diagram for $A' \cap B'$.

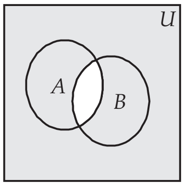


The shaded portion represents $A' \cap B'$
(iii) The Venn diagram for $(A \cap B)'$.



The shaded portion represents $(A \cap B)'$.

(iv) The Venn diagram for $A' \cup B'$.



The shaded portion represents $A' \cup B'$.

6. Here $U = \{x : x \text{ is a triangle}\}$

$A = \{x : x$ is a triangle and has at least one angle different from $60°\}$

$\therefore\ A' = U - A = \{x : x$ is a triangle$\} - \{x : x$ is a triangle and has atleast one angle different from $60°\}$

$= \{x : x$ is a triangle and has all angles equal to $60°\}$

= Set of all equilateral triangles.

7. (i) $A \cup A' = U$

(ii) $\phi' \cap A = U \cap A = A$

(iii) $A \cap A' = \phi$

(iv) $U' \cap A = \phi \cap A = \phi$

NCERT MISCELLANEOUS EXERCISE

1. Here $A = \{x : x \in R$ and x satisfies $x^2 - 8x + 12 = 0\}$

$= \{x : x \in R$ and $(x - 6)(x - 2) = 0\} = \{2, 6\}$

$B = \{2, 4, 6\}$, $C = \{2, 4, 6, 8, ...\}$ and $D = \{6\}$

Now, $A \subset B$, $A \subset C$, $B \subset C$, $D \subset A$, $D \subset B$ and $D \subset C$.

2. (i) The statement is false.

Take $A = \{1\}$, $B = \{\{1\}, 2\}$ Now $1 \in A$ and $A \in B$, but $1 \notin B$.

(ii) The statement is false.

Take $A = \{1\}$, $B = \{1, 2\}$, $C = \{\{1, 2\}, 3\}$

Now $A \subset B$ and $B \in C$ but $A \notin C$.

(iii) The statement is true.

Let $x \in A \Rightarrow x \in B$ $(\because A \subset B)$

$\Rightarrow x \in C$ $(\because B \subset C)$

Now, $x \in A \Rightarrow x \in C$ $\therefore A \subset C$.

(iv) The statement is false.

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

Now $A \not\subset B$ and $B \not\subset C$, but $A \subset C$.

(v) The statement is false.

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

Now, $1 \in A$ and $A \not\subset B$ but $1 \notin B$.

(vi) The statement is true.

Let $x \in A \Rightarrow x \in B$ $(\because A \subset B)$

Now, $x \notin B \Rightarrow x \notin A$.

3. Given that $A \cap B = A \cap C$ and $A \cup B = A \cup C$

We know that $A = A \cap (A \cup B)$ and $A = A \cup (A \cap B)$

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

$= B \cup (A \cap C)$ $[\because A \cap B = A \cap C]$

$= (B \cup A) \cap (B \cup C)$ [By distributive law]

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

$= (A \cup C) \cap (B \cup C)$ $[\because A \cup B = A \cup C]$

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

$= C \cup (A \cap B)$ [By distributive law]

$= C \cup (A \cap C)$ $[\because A \cap B = A \cap C]$

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

Hence $B = C$

4. (i) $\Rightarrow$ (ii)

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

Since $A \subset B$

$\therefore\ A - B = \phi$

(ii) $\Rightarrow$ (iii)

$A - B = \phi \Rightarrow A \subset B \Rightarrow A \cup B = B$

(iii) $\Rightarrow$ (iv)

$A \cup B = B \Rightarrow A \subset B \Rightarrow A \cap B = A$

(iv) $\Rightarrow$ (i)

$A \cap B = A \Rightarrow A \subset B$

Thus (i) $\Leftrightarrow$ (ii) $\Leftrightarrow$ (iii) $\Leftrightarrow$ (iv)

5. Let $x \in C - B \Rightarrow x \in C$ and $x \notin B$

$\Rightarrow x \in C$ and $x \notin A$ $[\because A \subset B]$

$\Rightarrow x \in C - A$

Hence $C - B \subset C - A$

6. Consider R.H.S. of $A = (A \cap B) \cup (A - B)$

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

$= A \cap (B \cup B')$ (By distributive law)

$= A \cap U = A$

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

Also consider L.H.S. of $A \cup (B - A) = (A \cup B)$

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

$= (A \cup B) \cap (A \cup A')$ (By distributive law)

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

Hence, $A \cup (B - A) = A \cup B$

7. (i) We know that if $A \subset B$, then $A \cup B = B$. Also, $A \cap B \subset A$

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

(ii) We know that if $A \subset B$, then $A \cap B = A$ Also, $A \subset A \cup B$

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

8. Let $A = \{1, 2, 3, 4\}$, $B = \{2, 3, 4, 5, 6\}$, $C = \{2, 3, 4, 9, 10\}$.

$\therefore\ A \cap B = \{1, 2, 3, 4\} \cap \{2, 3, 4, 5, 6\} = \{2, 3, 4\}$

$A \cap C = \{1, 2, 3, 4\} \cap \{2, 3, 4, 9, 10\} = \{2, 3, 4\}$

Now, we have $A \cap B = A \cap C$. But $B \neq C$.

9. Here $A \cup X = B \cup X$ for some set X

$\Rightarrow A \cap (A \cup X) = A \cap (B \cup X)$

$\Rightarrow A = (A \cap B) \cup (A \cap X)$ $[\because A \cap (A \cup X) = A]$

$\Rightarrow A = (A \cap B) \cup \phi \Rightarrow A = A \cap B$ ... (i)

Also $A \cup X = B \cup X$

$\Rightarrow B \cap (A \cup X) = B \cap (B \cup X)$

$\Rightarrow (B \cap A) \cup (B \cap X) = B$ $[\because B \cap (B \cup X) = B]$

$\Rightarrow (B \cap A) \cup \phi = B$ $[\because B \cap X = \phi]$

$\Rightarrow B \cap A = B$ ... (ii)

From (i) and (ii), we have, $A = B$.

10. Take $A = \{1, 2\}$, $B = \{1, 4\}$ and $C = \{2, 4\}$

Now, $A \cap B = \{1\} \neq \phi$, $B \cap C = \{4\} \neq \phi$ and $A \cap C = \{2\} \neq \phi$

But $A \cap B \cap C = \phi$.

mtG

BEST SELLING BOOKS FOR CLASS 11

Visit www.mtg.in for complete information