SAMPLE CONTENT

PERFECT

MATHEMATICS

PART - I

BASED ON TEXTBOOK AND BOARD PAPER PATTERN

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STD. IX
(Eng. Med.)

Target Publications® Pvt. Ltd.

Based on the **Latest Syllabus** prescribed by the Maharashtra State Board of Secondary and Higher Secondary Education, Pune - 04

PERFECT

Mathematics Part – I

STD. IX

Salient Features

- Written as per the **Latest Textbook and Board Paper Pattern**
- Complete coverage of the entire syllabus, which includes:
  - Solutions to all Practice Sets and Problem Sets
  - Intext and Activity/Project based questions from the textbook
- Exclusive Practice Includes:
  - Additional problems, Activities, Multiple Choice Questions (MCQs) and One mark questions
  - 'Chapter Assessment' at the end of each chapter
- Tentative marks allocation for all problems
- At the end of the book:
  - A separate section of 'Challenging Questions' is provided
- Includes Important Feature for holistic learning:
  - ***Smart Check***
- Q.R. codes provide solutions to the
  - Additional Problems for Practice.
  - Chapter Assessment.

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PREFACE

Creation of the **'Perfect Mathematics Part – I, Std. IX'** book was a rollercoaster ride. We had a plethora of ideas, suggestions and decisions to ponder over. However, our primary objective was to align book with the latest syllabus and provide students with ample practice material.

This book covers several topics in the areas of numbers, algebra, commercial mathematics and data handling. The study of these topics requires a deep and intrinsic understanding of concepts, terms and formulae. Hence, to ease this task, we present **'Perfect Mathematics Part – I, Std. IX'** a complete and thorough guide, extensively drafted to boost the confidence of students.

Before each Practice Set, short and easy explanation of different concepts with illustrations for better understanding is given. Solutions and Answers to Textual Questions and Examples are provided in a lucid manner.

Moreover, the inclusion of **'Smart Check'** enables students to verify their answers. **'Textual Activities'** covers all the Textual Activities along with their answers. **'Additional Problems for Practice'** include multiple problems to help students revise and enhance their problem solving skills. **'Solved Examples'** from textbook are also a part of this book. **'Activities for Practice'** includes additional activities along with their answers for students to practice.
'One Mark Questions' include **'Type A:** Multiple Choice Questions', **'Type B:** Solve the Following Questions' along with their answers. Every chapter ends with a **'Chapter Assessment'**. This test stands as a testimony to the fact that the child has understood the chapter thoroughly. **'Challenging Questions'** include questions that are not a part of the textbook, yet are core to the concerned subject. These questions would provide students enough practice to tackle Challenging Questions in their examination.

We have provided a tentative mark allocation for the problems in this book. However, marks mentioned are indicative and are subject to change as per the Maharashtra State Board's discretion.

A book affects eternity; one can never tell where its influence stops.

Best of luck to all the aspirants!

Publisher

Edition: Third

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.
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KEY FEATURES

Smart Check: Smart Check is a technique to verify the answers. This is our attempt to cross-check the accuracy of the answer. Smart check is indicated by ✓ symbol.

Activities for Practice: In this section we have provided multiple activities for practice in accordance with the latest paper pattern.

One Mark Questions: **Type A** consists of Multiple Choice Questions (which either require short solutions or direct application of mathematical concepts).
Type B consists of questions that require very short solutions with direct application of mathematical concepts.

Additional Problems for Practice: In this section we have provided ample practice problems for students and its **solutions are provided in QR code**. It also has Solved examples from the textbook, which are indicated by "+".

***Chapter Assessment*:** This section covers questions from the chapter for self-evaluation purpose. This is our attempt to offer students with revision and help them assess their knowledge of each chapter. **Solutions to the Chapter Assessment are provided in QR code.**

Challenging Questions: In light of the importance of specific questions in board examination, we have created a separate section of Challenging Questions for additional practice to boost the exam score

CONTENTS

Note:
- ***Smart check is indicated by ✓ symbol.***
- ***Solved examples from textbook are indicated by "+".***
- ***Intext and Activity/Project based questions from the textbook are indicated by "#".***

1 Sets

Note: Intext and Activity/Project based questions from the textbook are indicated by "#".

Let's Study

- Sets - Introduction
- Types of sets
- Venn diagrams
- Equal sets, subset
- Universal set
- Intersection and Union of sets
- Number of elements in a set

Let's Learn

Sets

1. A well defined collection of objects is called a **set.**

Examples:

i. Collection of odd natural numbers.
ii. Collection of whole numbers.

2. Sets are denoted by capital alphabets. A, B, C, ..., X, Y, Z.
3. Each object in the set is called as an **element** or a **member** of the set.

Examples:

i. The set of odd natural numbers has the elements 1, 3, 5, 7, …
ii. The set of whole numbers has the elements 0, 1, 2, 3, …

4. The elements of a set are denoted by small alphabets a, b, c, ..., x, y, z.
5. If 'r' is an element of set P, then it is written as $r \in P$ and is read as 'r' belongs to set P. If 'r' is not an element of set P, then it is written as $r \notin P$.
6. Commonly used notations:

i. **N** – Set of natural numbers
ii. **W** – Set of whole numbers
iii. **I** – Set of integers
iv. **Q** – Set of rational numbers
v. **R** – Set of real numbers.

Methods of writing sets

There are two methods of writing a set:

1. Listing method or Roster method:

In this method,

i. All the elements of the set are enclosed within curly brackets.
ii. Each element is written only once.
iii. Elements are separated by commas.
iv. The order of writing the elements is not important.

Examples:

i. A is a set of first five letters of the English alphabets.
∴ A = {a, b, c, d, e} or A = {b, d, a, c, e}
ii. L is a set of letters of the word "fatal".
∴ L = {f, a, t, l}
iii. M is a set of integers less than 5.
∴ M = {… , –3, –2, –1, 0, 1, 2, 3, 4}
iv. O is a set of even natural numbers from 1 to 100.
∴ O = {2, 4, 6, 8, … , 100}

2. Rule method or Set builder form:

In this method, elements of the set are described by specifying the property or rule that uniquely determines the elements of a set.

Examples:

i. Y = {x | x is a vowel in the English alphabet}
In the above set Y, vertical line (|) denotes 'such that'.
Set Y is read as:
"Y is the set of all 'x' such that 'x' is a vowel in the English alphabet."

ii. B = { x | $x \in$ W, $x < 10$}
Set B is read as:
"B is the set of all 'x' such that 'x' is a whole number less than 10."

\# **Example:**
Fill in the blanks given in the following table.
(Textbook pg. no. 3)

Listing or Roster Method	Rule Method or Set builder form
A = {2, 4, 6, 8, 10, 12, 14}	A = {x | x is an even natural number less than 15}
B = {4, 9, 16}	B = {x | x is a perfect square number between 1 to 20}
C = { a, e, i, o, u}	**C = {x | x is a vowel of English alphabet}**
D = {violet, indigo, blue, green, yellow, orange, red}	D = {y | y is a colour in the rainbow}
P = { –2, –1, 0, 1, 2}	P = {x | x is an integer and $-3 < x < 3$}
M = {1, 8, 27, 64, 125,......}	**M = {x | x is a cube of a positive integer}**

Practice Set 1.1

1. Write the following sets in roster form.
[1 Mark each]

i. Set of even natural numbers
ii. Set of even prime numbers from 1 to 50
iii. Set of negative integers
iv. Seven basic sounds of a sargam (sur)

Ans:

i. A = { 2, 4, 6, 8, ...}

ii. 2 is the only even prime number

∴ B = { 2 }

iii. C = {–1, –2, –3, ...}

iv. D = {sa, re, ga, ma, pa, dha, ni}

2. Write the following symbolic statements in words. **[1 Mark each]**

i. $\frac{4}{3} \in Q$ ii. $-2 \notin N$

iii. P = {p | p is an odd number}

Ans:

i. $\frac{4}{3}$ is an element of set Q.

ii. –2 is not an element of set N.

iii. Set P is a set of all p's such that p is an odd number.

3. Write any two sets by listing method and by rule method. **[2 Marks]**

Ans:

i. A is a set of even natural numbers less than 10.
Listing method: A = {2, 4, 6, 8}
Rule method: A = $\{x \mid x = 2n, n \in N, n < 5\}$

ii. B is a set of letters of the word 'SCIENCE'.
Listing method: B = {S, C, I, E, N}
Rule method: B = $\{x \mid x$ is a letter of the word 'SCIENCE'$\}$

[**Note:** *The above problem has many solutions. Students may write solutions other than the ones given.*]

4. Write the following sets using listing method. **[1 Mark each]**

i. All months in the Indian solar year.

ii. Letters in the word 'COMPLEMENT'.

iii. Set of human sensory organs.

iv. Set of prime numbers from 1 to 20.

v. Names of continents of the world.

Ans:

i. A = {Chaitra, Vaishakh, Jyestha, Aashadha, Shravana, Bhadrapada, Ashwina, Kartika, Margashirsha, Paush, Magha, Falguna}

ii. X = {C, O, M, P, L, E, N, T}

iii. Y = {Nose, Ears, Eyes, Tongue, Skin}

iv. Z = {2, 3, 5, 7, 11, 13, 17, 19}

v. E = {Asia, Africa, Europe, Australia, Antarctica, South America, North America}

5. Write the following sets using rule method. **[1 Mark each]**

i. A = {1, 4, 9, 16, 25, 36, 49, 64, 81, 100}

ii. B = {6, 12, 18, 24, 30, 36, 42, 48}

iii. C = {S, M, I, L, E}

iv. D = {Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday}

v. X = {a, e, t}

Ans:

i. A = $\{x \mid x = n^2, n \in N, n \le 10\}$

ii. B = $\{x \mid x = 6n, n \in N, n < 9\}$

iii. C = $\{y \mid y$ is a letter of the word 'SMILE'$\}$
[Other possible words: 'SLIME', 'MILES', 'MISSILE' etc.]

iv. D = {z | z is a day of the week}

v. X = $\{y \mid y$ is a letter of the word 'eat'$\}$
[Other possible words: 'tea' or 'ate']

Let's Learn

Types of Sets

1. Singleton set: A set containing exactly one element is called as a singleton set.

Examples:

i. A = {5}

ii. B = $\{x \mid x + 3 = 0\}$
Here, $x + 3 = 0$

∴ $x = -3$

∴ Set B has only one element i.e., –3

2. Empty set: A set which does not contain any element is called as an empty or a null set. It is represented as {} or ϕ (phi).

Examples:

i. A = {a|a is a natural number, 5 < a < 6}

∴ A = { } or A = ϕ

ii. B = $\{x \mid x$ is a natural number, $x < 1\}$

∴ B = ϕ

3. Finite set: If number of elements in a set are limited and countable or if it is a null set, then such set is called finite set.

Examples:

i. A = {1, 2, 3, 4, 5, 6, 7}

ii. B = $\{x \mid x$ is a day in a week$\}$

4. Infinite set: If number of elements in a set are unlimited and uncountable, the set is called as infinite set.

Examples:

i. P = {1, 2, 3, 4, 5, 6, …}

ii. W = $\{x \mid x$ is a whole number$\}$

Remember This

i. X = {0} is not a null set as '0' is an element of set X.

ii. An empty set is a finite set.

iii. The sets N, W, I, Q, R are all infinite sets.

Equal Sets

1. Two sets A and B are said to be equal, if every element of set A is in set B and every element of set B is in set A.

2. 'Set A and set B are equal sets', is symbolically written as A = B.

Examples:

If A = {1, 2, 3} and B = {1, 2, 3, 4}, then A ≠ B verify it. (Textbook pg. no. 6)

Ans: Here, 4 ∈ B but 4 ∉ A

∴ A and B are not equal sets.

i.e. **A ≠ B**

Examples:

A = {x | x is prime number and 10 < x < 20} and B = {11, 13, 17, 19}. Here A = B. Verify. (Textbook pg. no. 6)

Ans: A = {x | x is prime number and 10 < x < 20}

∴ A = {11, 13, 17, 19}

B = {11, 13, 17, 19}

∴ All the elements in set A and B are identical.

∴ A and B are equal sets.

i.e. **A = B**

Practice Set 1.2

1. Decide which of the following are equal sets and which are not ? Justify your answer.

A = {x | $3x - 1 = 2$}

B = {x | x is a natural number but x is neither prime nor composite}

C = {x | $x \in$ N, $x < 2$} **[2 Marks]**

***Solution*:**

A = {x | $3x - 1 = 2$}

Here, $3x - 1 = 2$

∴ $3x = 3$

∴ $x = 1$

∴ A = {1} …(i)

B = {x | x is a natural number but x is neither prime nor composite}

1 is the only number which is neither prime nor composite.

∴ $x = 1$

∴ B = {1} …(ii)

C = {x | $x \in$ N, $x < 2$}

1 is the only natural number less than 2.

∴ $x = 1$

∴ C = {1} …(iii)

∴ The element in sets A, B and C is identical. …[From (i), (ii) and (iii)]

∴ **A, B and C are equal sets.**

2. Decide whether set A and B are equal sets. Give reason for your answer.

A = Even prime numbers

B = {x | $7x - 1 = 13$} **[2 Marks]**

***Solution*:**

A = Even prime numbers

Since 2 is the only even prime number,

∴ A = {2} …(i)

B = {x | $7x - 1 = 13$}

Here, $7x - 1 = 13$

∴ $7x = 14$

∴ $x = 2$

∴ B = {2} …(ii)

∴ The element in set A and B is identical. …[From (i) and (ii)]

∴ **A and B are equal sets.**

3. Which of the following are empty sets? Why? **[1 Mark each]**

i. A = {a | a is a natural number smaller than zero}

ii. B = {x | $x^2 = 0$}

iii. C = {x | $5x - 2 = 0$, $x \in$ N}

***Solution*:**

i. A = {a | a is a natural number smaller than zero}

Natural numbers begin from 1.

∴ A = { }

∴ **A is an empty set.**

ii. B = {x | $x^2 = 0$}

Here, $x^2 = 0$

∴ $x = 0$ …[Taking square root on both sides]

∴ B = {0}

∴ **B is not an empty set.**

iii. C = {x | $5x - 2 = 0$, $x \in$ N}

Here, $5x - 2 = 0$

∴ $5x = 2$

∴ $x = \frac{2}{5}$

Given, $x \in$ N

But, $x = \frac{2}{5}$ is not a natural number.

∴ C = { }

∴ **C is an empty set.**

4. Write with reasons, which of the following sets are finite or infinite. **[1 Mark each]**

i. A = { x | $x < 10$, x is a natural number}

ii. B = {y | $y < -1$, y is an integer}

iii. C = Set of students of class 9 from your school.

iv. Set of people from your village.

v. Set of apparatus in laboratory

vi. Set of whole numbers

vii. Set of rational number

***Solution*:**

i. A = { x | $x < 10$, x is a natural number}

∴ A = {1, 2, 3, 4, 5, 6, 7, 8, 9}

The number of elements in A is limited and can be counted.

∴ **A is a finite set.**

ii. B = {y | $y < -1$, y is an integer}

∴ B = {..., –4, –3, –2}

The number of elements in B is unlimited and uncountable.

∴ **B is an infinite set.**

iii. C = Set of students of class 9 from your school.
The number of students in a class is limited and can be counted.
∴ **C is a finite set.**

iv. Set of people from your village.
The number of people in a village is limited and can be counted.
∴ **Given set is a finite set.**

v. Set of apparatus in laboratory
The number of apparatus in the laboratory is limited and can be counted.
∴ **Given set is a finite set.**

vi. Set of whole numbers
The number of elements in the set of whole numbers is unlimited and uncountable.
∴ **Given set is an infinite set.**

vii. Set of rational number
The number of elements in the set of rational numbers is unlimited and uncountable.
∴ **Given set is an infinite set.**

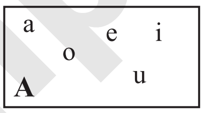
Let's Learn

Venn Diagrams

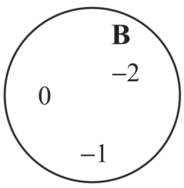
1. British logician John Venn used closed figures to represent sets. Such representations are called 'Venn diagrams'.
2. Some of the closed figures used to represent Venn Diagrams are rectangle, circle, triangle, etc.

Examples:

i. A = {a, e, i, o, u}
The set A is represented by Venn diagram as follows:



ii. B = {0, −1, −2 }
The set B is represented by Venn diagram as follows:



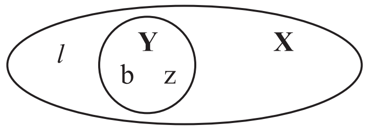
Subset

1. If every element of set Y is an element of set X, then set Y is said to be a subset of set X.
2. Symbolically, it is represented as Y ⊆ X.
It is read as 'Y is a subset of X'.

Example:

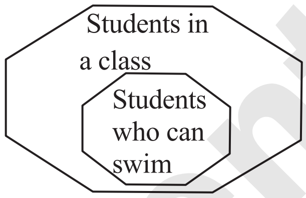
Y = {b, z} and X = {b, *l*, z}
Here, all the elements of set Y are the elements of set X.
∴ Y ⊆ X.

This can be represented by Venn diagram as follows:



Activity:

Set of students in a class and set of students in the same class who can swim, are shown by the Venn diagram.



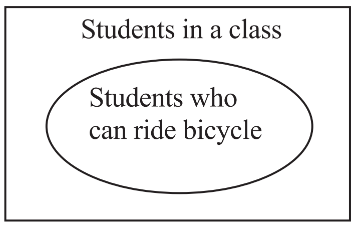
Observe the diagram and draw Venn diagrams for the following subsets.

1. i. Set of students in a class
   ii. Set of students who can ride bicycles in the same class
2. A set of fruits is given as follows.
   U = {guava, orange, mango, jackfruit, chickoo, jamun, custard apple, papaya, plum}
   Show these subsets.
   i. A = fruit with one seed
   ii. B = fruit with more than one seed.

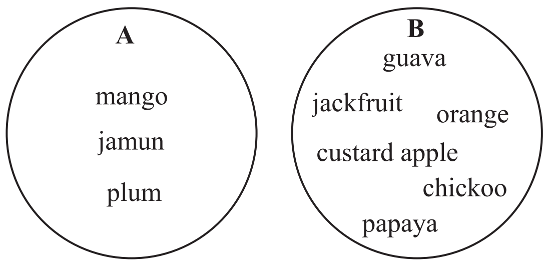
(Textbook pg. no. 8)

Ans:

1.



2. A = {mango, jamun, plum}
   B = {guava, orange, jackfruit, chickoo, custard apple, papaya}



Example:

If A = {1, 3, 4, 7, 8}, then write all possible subsets of A.

i.e. P = { 1, 3}, T = {4, 7, 8}, V = {1, 4, 8}, S = {1, 4, 7, 8}

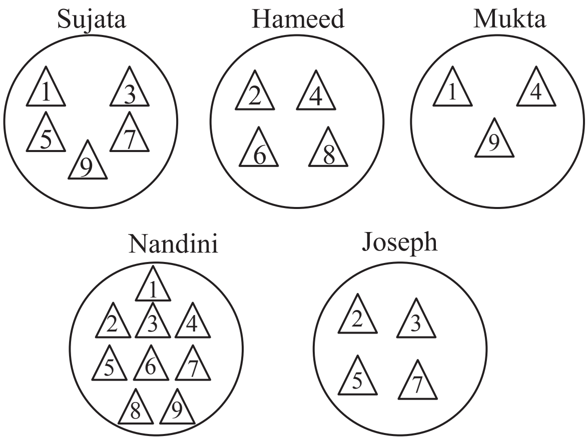
In this way many subsets can be written. Write five more subsets of set A.

(Textbook pg. no. 8)

Ans: B = { },
E = {4},
C = {1, 4},
D = {3, 4, 7},
F = {3, 4, 7, 8}

Activity:

Every student should take 9 triangular sheets of paper and one plate. Numbers from 1 to 9 should be written on each triangle. Everyone should keep some numbered triangles in the plate. Now the triangles in each plate form a subset of the set of numbers from 1 to 9.



Look at the plates of Sujata, Hameed, Mukta, Nandini, Joseph with the numbered triangles. Guess the thinking behind selecting these numbers. Hence write the subsets in set builder form. (Textbook pg. no. 9)

Ans: Sujata:
S = $\{x \mid x = 2n - 1, n \in N, x \leq 9\}$
Hameed:
H = $\{x \mid x = 2n, n \in N, x < 9\}$
Mukta:
M = $\{x \mid x = n^2, n \in N, x \leq 9\}$
Nandini:
N = $\{x \mid x \in N, x \leq 9\}$
Joseph:
J = $\{x \mid x$ is a prime number between 1 and 9$\}$

Let's Discuss

Some sets are given below.
A = { ..., –4, –2, 0, 2, 4, 6, ...}
B = {1, 2, 3, ...}
C = {..., –12, –6, 0, 6, 12, 18,.....}
D = {..., –8, –4, 0, 4, 8, ...}
I = { ..., –3, –2, –1, 0, 1, 2, 3, 4, ...}
Discuss and decide which of the following statements are true.
a. A is a subset of sets B, C and D.
b. B is a subset of all the sets which are given above. (Textbook pg. no. 9)

***Solution*:**
a. All elements of set A are not present in set B, C and D.
$\therefore$ $A \not\subseteq B$,
$A \not\subseteq C$,
$A \not\subseteq D$
$\therefore$ **Statement (a) is false.**

b. All elements of set B are not present in set A, C and D.
$\therefore$ $B \not\subseteq A$,
$B \not\subseteq C$,
$B \not\subseteq D$
$\therefore$ **Statement (b) is false.**

Remember This

i. Every set is a subset of itself i.e., $A \subseteq A$.
ii. Empty set is a subset of every set i.e., $\phi \subseteq A$.
iii. If A = B, then $A \subseteq B$ and $B \subseteq A$.
iv. If $A \subseteq B$ and $B \subseteq A$, then A = B.

Universal Set

1. A universal set is a set which contains all the objects including itself.
Sets under the consideration of universal set are the subsets of universal set
Universal set is denoted by 'U'.

Example:
A = $\{x \mid x$ is a Physics laboratory in your school$\}$
B = $\{y \mid y$ is a Chemistry laboratory in your school$\}$
C = {z | z is a Biology laboratory in your school}
U = $\{l \mid l$ is a laboratory in your school$\}$
It can be seen that $A \subseteq U, B \subseteq U, C \subseteq U$.
$\therefore$ Set U is the universal set of sets A, B and C.

2. Universal set is a set that cannot be changed once fixed for a particular solution.

3. In Venn diagram, generally universal set is represented by a rectangle.

Complement of a set

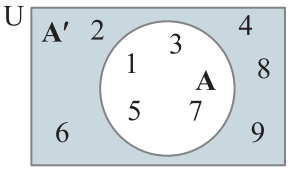
1. If U is a universal set and set A is a subset of the universal set, then set of all elements in U which are not in set A is called the complement of set A.
It is denoted by A' or A^c.

Example:

Let U = {1, 2, 3, 4, 5, 6, 7, 8, 9}
and A = {1, 3, 5, 7}
Here, set of elements present in U but not in A are 2, 4, 6, 8, 9

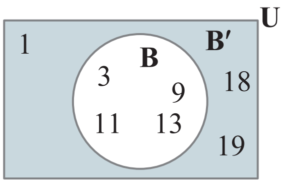
∴ A′ = { 2, 4, 6, 8, 9}
or A′ = {x | $x \in$ U and $x \notin$ A}

The shaded portion in the Venn diagram represents complement of set A.



Example:

Suppose U = {1, 3, 9, 11, 13, 18, 19}, and B = {3, 9, 11, 13}. Find (B′)′ and draw the inference. (Textbook pg. no. 10)



***Solution*:**

U = {1, 3, 9, 11, 13, 18, 19},
B = {3, 9, 11, 13} …(i)

∴ B′ = {1, 18, 19}
(B′)′ = {3, 9, 11, 13} …(ii)

∴ **(B′)′ = B** …[From (i) and (ii)]

∴ **Complement of a complement is the given set itself.**

2. Properties of a complement of a set:

i. (A′)′ = A
ii. ϕ′ = U
iii. U′ = ϕ
iv. If A ⊆ U, then A′ ⊆ U
v. Sets A and A′ do not have any common elements.

Practice Set 1.3

1. If A = {a, b, c, d, e}, B = {c, d, e, f}, C = {b, d}, D = {a, e}, then which of the following statements are true and which are false? [1 Mark each]

i.	C ⊆ B	ii.	A ⊆ D	iii.	D ⊆ B
iv.	D ⊆ A	v.	B ⊆ A	vi.	C ⊆ A

Ans:

i. C = {b, d}, B = {c, d, e, f}
C ⊆ B
False
Since, all the elements of C are not present in B.

ii. A = {a, b, c, d, e}, D = {a, e}
A ⊆ D
False
Since, all the elements of A are not present in D.

iii. D = {a, e}, B = {c, d, e, f}
D ⊆ B
False
Since, all the elements of D are not present in B.

iv. D = {a, e}, A = {a, b, c, d, e}
D ⊆ A
True
Since, all the elements of D are present in A.

v. B = {c, d, e, f}, A = {a, b, c, d, e}
B ⊆ A
False
Since, all the elements of B are not present in A.

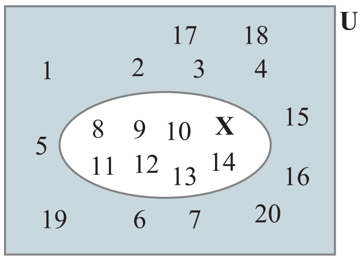
vi. C = {b, d}, A = {a, b, c, d, e}
C ⊆ A
True
Since, all the elements of C are present in A.

2. Take the set of natural numbers from 1 to 20 as universal set and show set X and Y using Venn diagram. [2 Marks each]

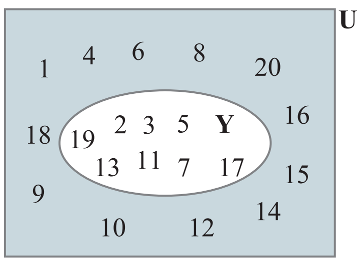
i. X = { x | $x \in$ N, and 7 < x < 15}
ii. Y = { y | $y \in$ N, y is a prime number from 1 to 20}

Ans:

i. U = {1, 2, 3, 4, ……, 18, 19, 20}
X = { x | $x \in$ N, and 7 < x < 15}
∴ X = {8, 9, 10, 11, 12, 13, 14}



ii. U = {1, 2, 3, 4, ……, 18, 19, 20}
Y = { y | $y \in$ N, y is a prime number from 1 to 20}
∴ Y = {2, 3, 5, 7, 11, 13, 17, 19}



3. **U = {1, 2, 3, 7, 8, 9, 10, 11, 12}**
P = {1, 3, 7, 10}, then

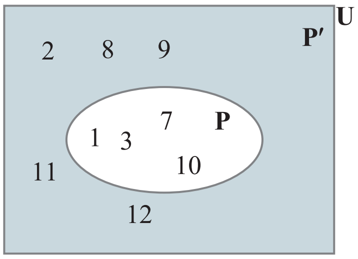
i. show the sets U, P and P′ by Venn diagram.

ii. Verify (P′)′ = P **[2 Marks]**

***Solution*:**

i. Here, U = {1, 2, 3, 7, 8, 9, 10, 11, 12}
P = {1, 3, 7, 10}

∴ P′ = {2, 8, 9, 11, 12}



ii. Here, U = {1, 2, 3, 7, 8, 9, 10, 11, 12}
P = {1, 3, 7, 10} …(i)

∴ P′ = {2, 8, 9, 11, 12}
Also, (P′)′ = {1, 3, 7, 10} …(ii)

∴ **(P′)′ = P** …[From (i) and (ii)]

4. **A = {1, 3, 2, 7}, then write any three subsets of A.** **[1 Mark]**

Ans: Three subsets of A:

i. B = {3} ii. C = {2, 1}

iii. D = {1, 2, 7}

[**Note:** *The above problem has many solutions. Students may write solutions other than the ones given.*]

5.

i. **Write the subset relation between the sets.**
P is the set of all residents in Pune.
M is the set of all residents in Madhya Pradesh.
I is the set of all residents in Indore.
B is the set of all residents in India.
H is the set of all residents in Maharashtra.

ii. **Which set can be the universal set for above sets ?** **[3 Marks]**

Ans:

i. a. The residents of Pune are residents of India.
∴ **P ⊆ B**

b. The residents of Pune are residents of Maharashtra.
∴ **P ⊆ H**

c. The residents of Madhya Pradesh are residents of India.
∴ **M ⊆ B**

d. The residents of Indore are residents of India.
∴ **I ⊆ B**

e. The residents of Indore are residents of Madhya Pradesh.
∴ **I ⊆ M**

f. The residents of Maharashtra are residents of India.
∴ **H ⊆ B**

ii. The residents of Pune, Madhya Pradesh, Indore and Maharashtra are all residents of India.

∴ **B can be the Universal set for the above sets.**

6. **Which set of numbers could be the universal set for the sets given below?** **[2 Marks each]**

i. A = set of multiples of 5,
B = set of multiples of 7,
C = set of multiples of 12

ii. P = set of integers which are multiples of 4.
T = set of all even square numbers.

Ans:

i. A = set of multiples of 5
∴ A = {5, 10, 15, …}
B = set of multiples of 7
∴ B = {7, 14, 21, …}
C = set of multiples of 12
∴ C = {12, 24, 36, …}
Now, set of natural numbers, whole numbers, integers, rational numbers are as follows:
N = {1, 2, 3, …}, W = {0, 1, 2, 3, …}
I = {…, –3, –2, –1, 0, 1, 2, 3, …}

$$Q = \left\{\frac{p}{q} \,|\, p, q \in I, q \neq 0\right\}$$

Since, set A, B and C are the subsets of sets N, W , I and Q.

∴ **For set A, B and C we can take any one of the set from N, W, I or Q as universal set.**

[**Note:** Answer given in the textbook is N, W, I any of these sets. However, as per our calculation it is N, W, I or Q.]

ii. P = set of integers which are multiples of 4.
P = {4, 8, 12, …}
T = set of all even square numbers
T = {2^2, 4^2, 6^2, …]
Since, set P and T are the subsets of sets N, W, I and Q.

∴ **For set P and T we can take any one of the set from N, W, I or Q as universal set.**

[**Note:** Answer given in the textbook is N, W, I any of these sets. However, as per out calculation it is N, W, I or Q.]

7. Let all the students of a class form a Universal set. Let set A be the students who secure 50% or more marks in Maths. Then write the complement of set A. [1 Mark]

Ans: Here, U = all the students of a class.

A = Students who secured 50% or more marks in Maths.

$\therefore$ **A′ = Students who secured less than 50% marks in Maths.**

Let's Learn

Operations on sets

1. Intersection of two sets:

If A and B are two sets, then a set of common elements in A and B is called intersection of sets A and B.

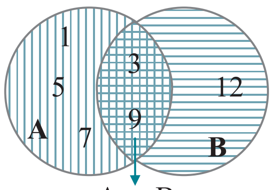
It is denoted as 'A $\cap$ B' and is read as 'A intersection B'.

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

Example:

Let A = {1, 3, 5, 7, 9} and B = {3, 9, 12}.

$\therefore$ $A \cap B = \{3, 9\}$



A $\cap$ B

Shaded part in the Venn diagram represents intersection of sets A and B.

2. Properties of Intersection of Sets:

i. $A \cap B = B \cap A$

ii. If $A \subseteq B$, then $A \cap B = A$

iii. If $A \cap B = B$, then $B \subseteq A$

iv. $A \cap B \subseteq A$ and $A \cap B \subseteq B$

v. $A \cap A' = \phi$

vi. $A \cap \phi = \phi$

vii. $A \cap A = A$

 # Activity:

Take different examples of sets and verify the above mentioned properties.

(Textbook pg. no. 12)

***Solution*:**

i. Let A = {3, 5}, B = {3, 5, 8, 9, 10}

$A \cap B = B \cap A = \{3, 5\}$

---

ii. Let A = {3, 5}, B = {3, 5, 8, 9, 10}

Since, all elements of set A are present in set B.

$\therefore$ $A \subseteq B$

Also, $A \cap B = \{3, 5\} = A$

$\therefore$ If $A \subseteq B$, then $A \cap B = A$.

iii. Let A = {2, 3, 8, 10}, B = {3, 8}

$A \cap B = \{3, 8\} = B$

Also, all the elements of set B are present in set A

$\therefore$ $B \subseteq A$

$\therefore$ If $A \cap B = B$, then $B \subseteq A$.

---

iv. Let A = {2, 3, 8, 10}, B = {3, 8},

$A \cap B = \{3, 8\}$

Since, all the elements of set $A \cap B$ are present in set A and B

$\therefore$ $A \cap B \subseteq A$ and $A \cap B \subseteq B$

---

v. Let U = {3, 4, 6, 8}, A = {6, 4}

$\therefore$ A′ = {3, 8}

$\therefore$ $A \cap A' = \{\ \} = \phi$

---

vi. $A \cap \phi = \{\ \} = \phi$

---

vii. Let A = {6, 4}

$\therefore$ $A \cap A = \{6, 4\}$

$\therefore$ $A \cap A = A$

Disjoint Sets

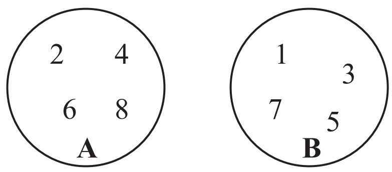
If there are no common elements in two sets, then such sets are called disjoint sets.

Example:

Let A = {2, 4, 6, 8} and B = {1, 3, 5, 7}.

Now, $A \cap B = \phi$

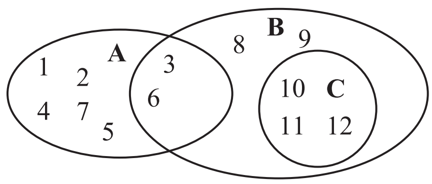
$\therefore$ A and B are disjoint sets.



The above Venn diagram represents two disjoint sets A and B.

 # Activity I:

Observe the set A, B, C given by Venn diagrams and write which of these are disjoint sets.



(Textbook pg. no. 12)

***Solution*:**

Here, A = {1, 2, 3, 4, 5, 6, 7}

B = {3, 6, 8, 9, 10, 11, 12}

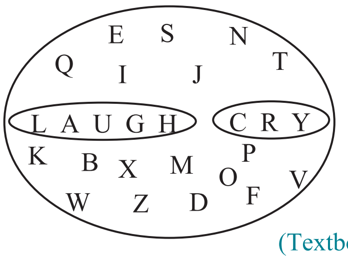
C = {10, 11, 12}

Now, $A \cap C = \phi$

$\therefore$ **A and C are disjoint sets.**

Activity II:

Let the set of English alphabets be the Universal set. The letters of the word 'LAUGH' is one set and the letter of the word 'CRY' is another set. Can we say that these are two disjoint sets? Observe that intersection of these two sets is empty.



(Textbook pg. no. 13)

***Solution*:**

Let A = {L, A, U, G, H}

B = {C, R, Y}

Now, $A \cap B = \phi$

$\therefore$ **A and B are disjoint sets.**

Union of two sets

1. If A and B are two sets, then a set containing all the elements of A and B together is called union of sets A and B.

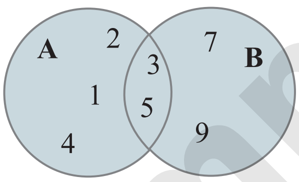
   It is denoted as '$A \cup B$' and is read as 'A union B'.

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

Example:

Let A = {1, 2, 3, 4, 5} and B = {3, 5, 7, 9}

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



$A \cup B$

The shaded portion in the Venn diagram represents $A \cup B$.

2. **Properties of Union of Sets:**

i. $A \cup B = B \cup A$

ii. If $A \subseteq B$, then $A \cup B = B$

iii. $A \subseteq A \cup B$; $B \subseteq A \cup B$

iv. $A \cup A' = U$

v. $A \cup A = A$

vi. $A \cup \phi = A$

Number of elements in a set

1. If A is any set, then the number of elements in set A is denoted by n (A).

Example:

Let A = {8, 9, 10, 11, 12}

$\therefore$ n(A) = 5

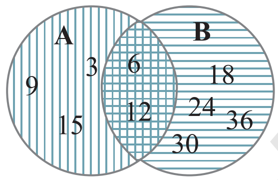
2. For an empty set, $n(\phi) = 0$

3. **Number of elements in Union and Intersection of Sets:**

   For any sets A and B,

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

\# **Verify the above rule for the given Venn diagram.** (Textbook pg. no. 14)



***Solution*:**

$n(A) = \boxed{5}$, $n(B) = \boxed{6}$

$n(A \cup B) = \boxed{9}$, $n(A \cap B) = \boxed{2}$

Now, $n(A \cup B) = 9$ …(i)

$n(A) + n(B) - n(A \cap B) = 5 + 6 - 2 = 9$ …(ii)

$\therefore$ $\mathbf{n(A \cup B) = n(A) + n(B) - n(A \cap B).}$

...[From (i) and (ii)]

\# **Example:**

A = {1, 2, 3, 5, 7, 9, 11, 13}

B = {1, 2, 4, 6, 8, 12, 13}

Verify the above rule for the given set A and set B. (Textbook pg. no. 14)

Ans: A = {1, 2, 3, 5, 7, 9, 11, 13}

B = {1, 2, 4, 6, 8, 12, 13}

$A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13\}$

$A \cap B = \{1, 2, 13\}$

n(A) = 8, n(B) = 7, $n(A \cup B) = 12$, $n(A \cap B) = 3$

$n(A \cup B) = 12$ …(i)

$n(A) + n(B) - n(A \cap B) = 8 + 7 - 3$

$= 12$ …(ii)

$\therefore$ $\mathbf{n(A \cup B) = n(A) + n(B) - n(A \cap B)}$

…[From (i) and (ii)]

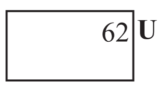
Example:

In a class of 62 students, 30 students play chess, 25 students play football and 6 students play both chess and football. Find the number of students who play neither chess nor football.

Solution:

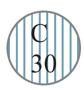
i. Let U be the set of students in the class

$\therefore$ n (U) = 62



C be the set of students who play chess

$\therefore$ n (C) = 30

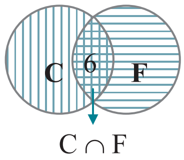


F be the set of students who play football

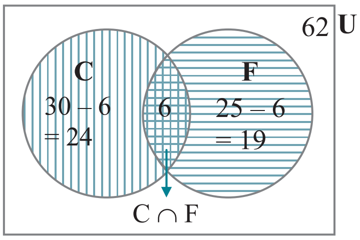
∴ n (F) = 25

6 students play both chess and football

∴ n (C ∩ F) = 6



∴ Complete Venn diagram is



ii. Shaded part in Venn diagram shows the total student who play chess or football. i.e, C ∪ F

∴ n (C ∪ F) = 24 + 6 + 19

∴ n (C ∪ F) = 49

iii. In the above Venn diagram non-shaded part shows the student who neither play chess nor football

∴ Student who neither play football nor chess
= Total student – Shaded part
= 62 – 49
= 13

∴ **13 students play neither chess nor football.**

Remember This

n(A ∪ B) = n(A) + n(B) – n(A ∩ B)
n(A) + n(B) = n(A ∪ B) + n(A ∩ B)

Practice Set 1.4

1. If n(A) = 15, n(A ∪ B) = 29, n(A ∩ B) = 7, then n(B) = ? **[2 Marks]**

***Solution*:**

Here, n(A) = 15, n(A ∪ B) = 29, n(A ∩ B) = 7

n(A ∪ B) = n(A) + n(B) – n(A ∩ B)

∴ 29 = 15 + n(B) – 7

∴ 29 – 15 + 7 = n(B)

∴ **n(B) = 21**

2. In a hostel there are 125 students, out of which 80 drink tea, 60 drink coffee and 20 drink tea and coffee both. Find the number of students who do not drink tea or coffee. **[3 Marks]**

***Solution*:**

i. Let U be the set of students in the hostel, T be the set of students who drink tea and C be the set of students who drink coffee.
n(U) = 125, n(T) = 80, n(C) = 60,
number of students who drink Tea and Coffee
= n(T ∩ C) = 20

ii. n(T ∪ C) = n(T) + n(C) – n(T ∩ C)
= 80 + 60 – 20

∴ n(T ∪ C) = 120

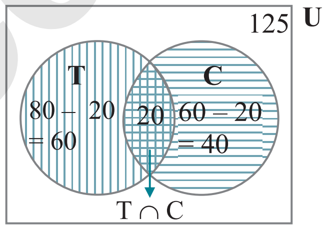
∴ 120 students drink tea or coffee
Also, there are 125 students in the hostel.

iii. Number of students who do not drink tea or coffee = n(U) – n(T ∪ C)
= 125 – 120
= 5

∴ **5 students do not drink tea or coffee.**

Alternate Method:

Let U be the set of students in the hostel, T be the set of students who drink tea and C be the set of students who drink coffee.



From Venn diagram,
Student who drinks tea or coffee
= n(T ∪ C) = 60 + 20 + 40 = 120

∴ The number of students who do not drink tea or coffee = n(U) – n(T ∪ C)
= 125 – 120 = 5

∴ **5 students do not drink tea or coffee.**

3. In a competitive exam 50 students passed in English, 60 students passed in Mathematics and 40 students passed in both the subjects. None of them failed in both the subjects. Find the number of students who passed at least in one of the subjects ? **[3 Marks]**

***Solution*:**

Let U be the set of students who appeared for the exam,
E be the set of students who passed in English and
M be the set of students who passed in Maths.

∴ n(E) = 50, n(M) = 60,
40 students passed in both the subjects

∴ n(M ∩ E) = 40

Since, none of the students failed in both subjects

$\therefore$ Total students $= n(E \cup M)$

$= n(E) + n(M) - n(E \cap M)$

$= 50 + 60 - 40$

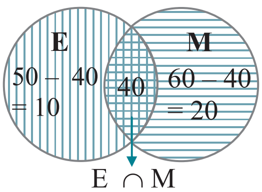
$= 70$

$\therefore$ **The number of students who passed at least in one of the subjects is 70.**

Alternate Method:

Let U be the set of students who appeared for the exam,

E be the set of students who passed in English and M be the set of students who passed in Maths.



Since, none of the students failed in both subjects

$\therefore$ Total student $= n(E \cup M)$

$= 10 + 40 + 20$

$= \mathbf{70}$

$\therefore$ **The number of students who passed at least in one of the subjects is 70.**

4. A survey was conducted to know the hobby of 220 students of class IX. Out of which 130 students informed about their hobby as rock climbing and 180 students informed about their hobby as sky watching. There are 110 students who follow both the hobbies. Then how many students do not have any of the two hobbies? How many of them follow the hobby of rock climbing only? How many students follow the hobby of sky watching only? [4 Marks]

***Solution*:**

i. Let U be the set of students of class IX,

R be the set of students who follow the hobby of rock climbing and

S be the set of students who follow the hobby of sky watching.

$\therefore$ $n(U) = 220$, $n(R) = 130$, $n(S) = 180$,

110 students follow both the hobbies

$\therefore$ $n(R \cap S) = 110$

---

ii. $n(R \cup S) = n(R) + n(S) - n(R \cap S)$

$= 130 + 180 - 110$

$\therefore$ $n(R \cup S) = 200$

$\therefore$ 200 students follow the hobby of rock climbing or sky watching.

iii. Total number of students = 220.

Number of students who do not follow the hobby of rock climbing or sky watching

$= n(U) - n(R \cup S) = 220 - 200 = \mathbf{20}$

---

iv. Number of students who follow the hobby of rock climbing only

$= n(R) - n(R \cap S) = 130 - 110 = \mathbf{20}$

---

v. Number of students who follow the hobby of sky watching only

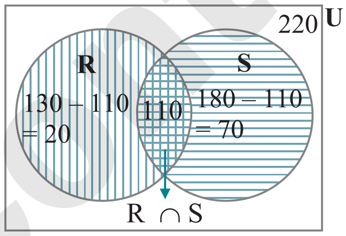
$= n(S) - n(R \cap S) = 180 - 110 = \mathbf{70}$

Alternate Method:

Let U be the set of students of class IX,

R be the set of students who follow the hobby of rock climbing and

S be the set of students who follow the hobby of sky watching.



From the Venn diagram

i. Students who follow the hobby of rock climbing or sky watching

$= n(R \cup S)$

$= 20 + 110 + 70 = 200$

---

ii. Number of students who do not follow the hobby of rock climbing or sky watching

$= n(U) - n(R \cup S)$

$= 220 - 200 = \mathbf{20}$

---

iii. Number of students who follow the hobby of rock climbing only

$= n(R) - n(R \cap S)$

$= 130 - 110 = \mathbf{20}$

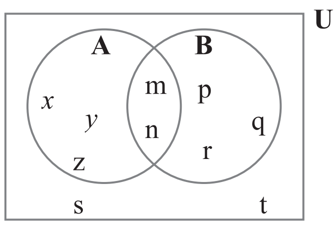
---

iv. Number of students who follow the hobby of sky watching only

$= n(S) - n(R \cap S)$

$= 180 - 110 = \mathbf{70}$

5. Observe the given Venn diagram and write the following sets. [1 Mark each]



i. A   ii. B   iii. $A \cup B$
iv. U   v. A' vi. B'
vii. $(A \cup B)'$

Ans:

i. $A = \{x, y, z, m, n\}$
ii. $B = \{p, q, r, m, n\}$
iii. $A \cup B = \{x, y, z, m, n, p, q, r\}$
iv. $U = \{x, y, z, m, n, p, q, r, s, t\}$
v. $A' = \{p, q, r, s, t\}$
vi. $B' = \{x, y, z, s, t\}$
vii. $(A \cup B)' = \{s, t\}$

Problem Set – 1

1. Choose the correct alternative answer for each of the following questions. **[1 Mark each]**

i. $M = \{1, 3, 5\}$, $N = \{2, 4, 6\}$, then $M \cap N = ?$
(A) $\{1, 2, 3, 4, 5, 6\}$ (B) $\{1, 3, 5\}$
(C) ϕ (D) $\{2, 4, 6\}$

ii. $P = \{x \mid x$ is an odd natural number, $1 < x \le 5\}$. How to write this set in roster form?
(A) $\{1, 3, 5\}$ (B) $\{1, 2, 3, 4, 5\}$
(C) $\{1, 3\}$ (D) $\{3, 5\}$

iii. $P = \{1, 2, ..., 10\}$. What type of set P is ?
(A) Null set (B) Infinite set
(C) Finite set (D) None of these

iv. $M \cup N = \{1, 2, 3, 4, 5, 6\}$ and $M = \{1, 2, 4\}$, then which of the following represent set N ?
(A) $\{1, 2, 3\}$ (B) $\{3, 4, 5, 6\}$
(C) $\{2, 5, 6\}$ (D) $\{4, 5, 6\}$

v. If $P \subseteq M$, then which of the following set represent $P \cap (P \cup M)$?
(A) P (B) M
(C) $P \cup M$ (D) $P' \cap M$

vi. Which of the following sets are empty sets?
(A) Set of intersecting points of parallel lines.
(B) Set of even prime numbers.
(C) Month of an english calendar having less than 30 days.
(D) $P = \{x \mid x \in I, -1 < x < 1\}$

Answers:

i. (C)   ii. (D)   iii. (C)
iv (B)   v. (A)   vi. (A)

Hints:

v. Here, $P \subseteq M$
$\therefore$ $P \cup M = M$
$\therefore$ $P \cap (P \cup M) = P \cap M$
$= P$ ... $[\because P \subseteq M]$

2. Find the correct option for the given question. **[1 Mark each]**

i. Which of the following collections is a set ?
(A) Colours of the rainbow
(B) Tall trees in the school campus.
(C) Rich people in the village
(D) Easy examples in the book

ii. Which of the following set represent $N \cap W$?
(A) $\{1, 2, 3,….\}$ (B) $\{0, 1, 2, 3,….\}$
(C) $\{0\}$ (D) $\{\ \}$

iii. $P = \{x \mid x$ is a letter of the word 'indian'$\}$, then which one of the following is set P in listing form?
(A) $\{i, n, d\}$ (B) $\{i, n, d, a\}$
(C) $\{i, n, d, i, a\}$ (D) $\{n, d, a\}$

iv. If $T = \{1, 2, 3, 4, 5\}$ and $M = \{3, 4, 7, 8\}$, then $T \cup M = ?$
(A) $\{1, 2, 3, 4, 5, 7\}$
(B) $\{1, 2, 3, 7, 8\}$
(C) $\{1, 2, 3, 4, 5, 7, 8\}$
(D) $\{3, 4\}$

Answers:

i. (A)   ii. (A)   iii. (B)   iv. (C)

Hints:

i. The elements of options B, C and D cannot be definitely and clearly decided.

ii. The common elements of N and W are 1 2, 3, ...

3. Out of 100 persons in a group, 72 persons speak English and 43 persons speak French. Each one out of 100 persons speak at least one language. Then how many speak only English? How many speak only French? How many of them speak English and French both? **[4 Marks]**

Solution:

i. Let U be the set of all the persons, E be the set of persons who speak English and F be the set of persons who speak French.
$\therefore$ $n(E) = 72$, $n(F) = 43$
Since, each one out of 100 persons speak at least one language
$\therefore$ $n(U) = n(E \cup F) = 100$,

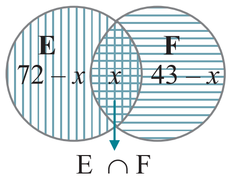
ii. $n(E \cup F) = n(E) + n(F) - n(E \cap F)$
$\therefore$ $100 = 72 + 43 - n(E \cap F)$
$\therefore$ $n(E \cap F) = 72 + 43 - 100$
$\therefore$ $n(E \cap F) = 15$
$\therefore$ Number of people who speak English and French = **15**

iii. Number of people who speak only English
$= n(E) - n(E \cap F) = 72 - 15 = \mathbf{57}$

iv. Number of people who speak only French
$= n(F) - n(E \cap F) = 43 - 15 = \mathbf{28}$

Alternate Method:

Let U be the set of all the persons,
E be the set of persons who speak English,
F be the set of persons who speak French and
x people speak both the languages.



Since, each one out of 100 persons speak at least one language.

∴ $n(U) = n(E \cup F) = 100$

∴ $72 - x + x + 43 - x = 100$

∴ $115 - x = 100$

∴ $x = 115 - 100 = 15.$

Number of people who speak English and French **= 15**

Number of people who speak only English
$= 72 - x$
$= 72 - 15$
$\mathbf{= 57}$

Number of people who speak only French
$= 43 - x$
$= 43 - 15$
$\mathbf{= 28}$

4. 70 trees were planted by Parth and 90 trees were planted by Pradnya on the occasion of Tree Plantation Week. Out of these 25 trees were planted by both of them together. How many trees were planted by Parth or Pradnya? [2 Marks]

Solution:

i. Let P be the trees planted by Parth and Q be the trees planted by Pradnya

∴ $n(P) = 70$ and $n(Q) = 90$

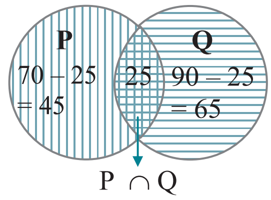
Total number of trees planted by Parth and Pradnya $= n(P \cap Q) = 25$

ii. Number of trees planted by Parth or Pradnya
$= n(P \cup Q)$
$= n(P) + n(Q) - n(P \cap Q)$
$= 70 + 90 - 25$
$= 135$

∴ **A total of 135 trees were planted by Parth or Pradnya.**

Alternate Method:

Let P be the trees planted by Parth and Q be the trees planted by Pradnya



From Venn diagram

∴ Total trees planted by parth or pradnya
$= n(P \cup Q)$
$= 45 + 25 + 65$
$= 135$

A total of 135 trees were planted by Parth or Pradnya.

5. If $n(A) = 20$, $n(B) = 28$ and $n(A \cup B) = 36$, then $n(A \cap B) = ?$ [2 Marks]

Solution:

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

∴ $36 = 20 + 28 - n(A \cap B)$

∴ $n(A \cap B) = 20 + 28 - 36$

∴ $\mathbf{n(A \cap B) = 12}$

6. In a class, 8 students out of 28 have a dog as their pet animal at home, 6 students have a cat as their pet animal, 10 students have dog and cat both, then how many students do not have dog or cat as their pet animal at home? [4 Marks]

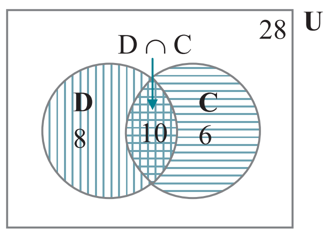
Solution:

i. Let U be the set of all the students, then $n(U) = 28$

Let D be the set of students who have dog as pet and C be the set of students who have cat as pet.

10 students have dog and cat as their pet animal

∴ $n(D \cap C) = 10$



ii. From Venn Diagram,
Number of students who have cat or dog as pet
$= n(D \cup C) = 8 + 10 + 6 = 24$

iii. Number of students who do not have dog or cat as pet
$= n(U) - n(D \cup C) = 28 - 24 = \mathbf{4}$

Smart Hint

How do you assume that 8 students have "Only" dog?

Let us consider the following:

$n(A) = 8$, $n(B) = 6$, $n(A \cap B) = 10$

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

$= 8 + 6 - 10$

$= 4$

However, $n(A \cup B)$ represents students having atleast dog or cat.

$\therefore$ $n(A \cup B)$ cannot be less than $n(A \cap B)$

7. Represent the union of two sets by Venn diagram for each of the following.

i. $A = \{3, 4, 5, 7\}$, $B = \{1, 4, 8\}$ **[1 Mark]**

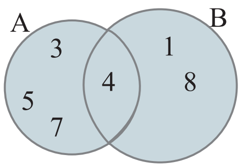
ii. $P = \{a, b, c, e, f\}$, $Q = \{l, m, n, e, b\}$ **[1 Mark]**

iii. $X = \{x \mid x$ is a prime number between 80 and 100$\}$

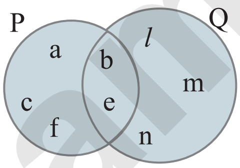
$Y = \{y \mid y$ is an odd number between 90 and 100$\}$ **[2 Marks]**

Solution:

i. $A = \{3, 4, 5, 7\}$, $B = \{1, 4, 8\}$



ii. $P = \{a, b, c, e, f\}$, $Q = \{l, m, n, e, b\}$

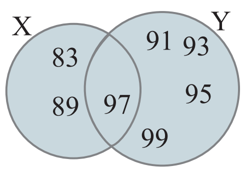


iii. $X = \{x \mid x$ is a prime number between 80 and 100$\}$

$\therefore$ $X = \{83, 89, 97\}$

$Y = \{y \mid y$ is an odd number between 90 and 100$\}$

$\therefore$ $Y = \{91, 93, 95, 97, 99\}$



8. Write the subset relations between the following sets.

X = set of all quadrilaterals.

Y = set of all rhombuses.

S = set of all squares.

T = set of all parallelograms.

V = set of all rectangles.

[3 Marks]

Solution:

i. Rhombus, square, parallelogram and rectangle all are quadrilaterals.

$\therefore$ $\mathbf{Y \subseteq X, S \subseteq X, T \subseteq X, V \subseteq X}$

[Note: Answer given in the textbook is '$S \subseteq X$, $V \subseteq X$, $S \subseteq X$, $T \subseteq X$'. However, as per our calculation, it is '$Y \subseteq X$, $S \subseteq X$, $T \subseteq X$, $V \subseteq X$'.]

ii. Every square is a rhombus, parallelogram and rectangle.

$\therefore$ $\mathbf{S \subseteq Y, S \subseteq T, S \subseteq V}$

iii. Every rhombus and rectangle is a parallelogram.

$\therefore$ $\mathbf{Y \subseteq T, V \subseteq T}$

9. If M is any set, then write $M \cup \phi$ and $M \cap \phi$. **[3 Marks]**

Solution:

Let $M = \{2, 3, 4, 8\}$ and $\phi = \{\ \}$

$\therefore$ $M \cup \phi = \{2, 3, 4, 8\}$

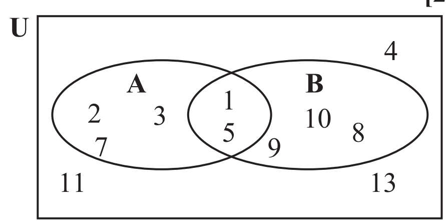
$\therefore$ $\mathbf{M \cup \phi = M}$

Also, $M \cap \phi = \{\ \}$

$\therefore$ $\mathbf{M \cap \phi = \phi}$

10. Observe the Venn diagram and write the given sets U, A, B, $A \cup B$ and $A \cap B$.

[2 Marks]



Ans:

$U = \{1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13\}$

$A = \{1, 2, 3, 5, 7\}$

$B = \{1, 5, 8, 9, 10\}$

$A \cup B = \{1, 2, 3, 5, 7, 8, 9, 10\}$

$A \cap B = \{1, 5\}$

11. If $n(A) = 7$, $n(B) = 13$, $n(A \cap B) = 4$, then $n(A \cup B) = ?$ **[1 Mark]**

Solution:

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

$= 7 + 13 - 4$

$\therefore$ $\mathbf{n(A \cup B) = 16}$

Activity I:

Fill in the blanks with elements of that set.

U = {1, 3, 5, 8, 9, 10, 11, 12, 13, 15}

A = {1, 11, 13}

B = {8, 5, 10, 11, 15}

A′ = { .... } B′ = { .... }

A ∩ B = { .... } A′ ∩ B′ = { .... }

A ∪ B = { .... } A′ ∪ B′ = { .... }

(A ∩ B)′ = { .... } (A ∪ B)′ = { .... }

Verify: (A ∩ B)′ = A′ ∪ B′, (A ∪ B)′ = A′ ∩ B′

(Textbook pg. no. 18)

***Solution*:**

U = {1, 3, 5, 8, 9, 10, 11, 12, 13, 15}

A = {1, 11, 13}

B = {8, 5, 10, 11, 15}

A′ = {3, 5, 8, 9, 10, 12, 15}

B′ = {1, 3, 9, 12, 13}

A ∩ B = {11}

A′ ∩ B′ = {3, 9, 12} …(i)

A ∪ B = {1, 5, 8, 10, 11, 13, 15}

A′ ∪ B′ = { 1, 3, 5, 8, 9, 10, 12, 13, 15} …(ii)

(A ∩ B)′ = { 1, 3, 5, 8, 9, 10, 12, 13, 15} …(iii)

(A ∪ B)′ = { 3, 9, 12} …(iv)

∴ (A ∩ B)′ = A′ ∪ B′ …[From (ii) and (iii)]

(A ∪ B)′ = A′ ∩ B′ …[From (i) and (iv)]

Activity II:

Collect the following information from 20 families nearby your house.

i. Number of families subscribing for Marathi Newspaper.

ii. Number of families subscribing for English Newspaper.

iii. Number of families subscribing for both English as well as Marathi Newspaper.

Show the collected information using Venn diagram. (Textbook pg. no. 18)

[Students should attempt the above activity on their own.]

Activities for Practice

1. Write the following set using listing method and classify into finite or infinite set. **[2 Marks]**

B = { x | x ∈ N and $2x - 4 = 0$}

$2x - 4 = 0$

∴ x = $\boxed{}$

since, $\boxed{}$ ∈ N

∴ B = { $\boxed{}$ }

∴ B is $\boxed{}$ set

2. Complete the following table **[2 Marks]**

Type of set	Example
Singleton set	A = {x | $x + 3 = 0$}
	B = {x | x is a day in a week}
Empty set	
	C = Even prime numbers
Infinite set	

3. If U = {1, 3, 5, 8, 9, 10, 11, 12, 13, 15}, A = {1, 3, 11, 12, 13}, B = {8, 5, 10, 11, 15}, then answer the following. **[2 Marks]**

i. A ∩ B = { $\boxed{}$ }

ii. A ∪ B = { $\boxed{}$ }

iii. (A ∩ B)′ = { $\boxed{}$ }

iv. (A ∪ B)′ = { $\boxed{}$ }

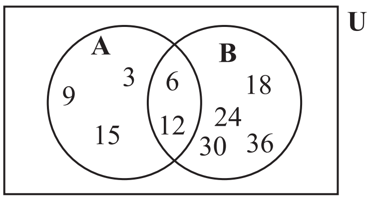
4. Let U = {2, 4, 6, 8}, A = {6, 8} and B = {4, 6}, then fill in the boxes. **[3 Marks]**

i. A′ = { $\boxed{}$ } ii. A ∩ A′ = $\boxed{}$

iii. A ∪ A′ = $\boxed{}$ iv. A ∪ ϕ = $\boxed{}$

v. A′ ∩ B = $\boxed{}$ vi. A ∩ B = $\boxed{}$

5. From the given diagram answer the following questions. **[3 Marks]**



n(A) = $\boxed{}$

n(B) = $\boxed{}$

n(A ∪ B) = $\boxed{}$ …(i)

n(A ∩ B) = 2

∴ n(A) + n(B) – n(A ∩ B) = 9 …(ii)

∴ n(A ∪ B) = $\boxed{}$ ...[From (i) and (ii)]

n(A′) = $\boxed{}$

n(B′) = $\boxed{}$.

6. In an office, there are 120 employees. Out of which 80 employees drink tea, 70 employees drink coffee and 5 do not drink any of the tea or coffee. Find the number of employees who drink both tea and coffee. **[3 Marks]**

Let U be the set of all employees in the office,

T be the set of all employees who drink tea and

C be the set of all employees who drink coffee.

$\therefore$ n(U) = $\boxed{}$, n(T) = $\boxed{}$, n(C) = $\boxed{}$

Since, 5 employees do not drink any of the tea or coffee,

$\therefore$ $n(T \cup C) = 120 - 5$

$= 115$

$n(T \cup C) =$ $\boxed{}$

…[Formula]

$\therefore$ $115 = \boxed{} + 70 - n(T \cap C)$

$\therefore$ Number of employees who drink both tea and coffee = $n(T \cap C) =$ $\boxed{}$

One Mark Questions

Type A: Multiple Choice Questions

1. Choose the listing method of the set given below

P = {*x* | *x* is a letter of the word 'MATHEMATICS'}

(A) P = {M, A, T, H, E, M, A, T, I, C, S}
(B) P = {M, M, A, A, T, T, H, E, I, C, S}
(C) P = {M, A, T, H, E, I, C, S}
(D) P = {2M, 2A, 2T, H, E, I, C, S}

2. Identify the singelton set from the following.

(A) $R = \{x \mid x \in W, x^2 = 9\}$
(B) $S = \{x \mid x \in N, -5 < x < 5\}$
(C) $T = \{x \mid x \in I, -5 < x < 5\}$
(D) $U = \{x \mid x \in I, x^2 = 9\}$

3. $M = \{x \mid x \in W, 3x + 6 = 0\}$ is a

(A) singelton set (B) null set
(C) infinite set (D) none of these

4. Which of the following sets are equal?

$P = \{ x \mid x \in W, x$ is a multiple of $2\}$
$Q = \{ x \mid x$ is an even number, $x > 1\}$
$R = \{x \mid 2x = n, n \in N\}$

(A) P and Q (B) P and R
(C) Q and R (D) P, Q and R

5. Which of the following is not a subset of the set T?

T = {1, 2, 3, 5, 7, 9, 11, 13}

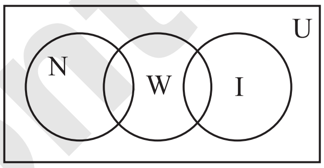
(A) ϕ
(B) {1, 2, 3}
(C) {1, 2, 3, 4, 5, 7, 9, 11, 13}
(D) {2, 5, 9, 13}

6. Which of the following is incorrect?

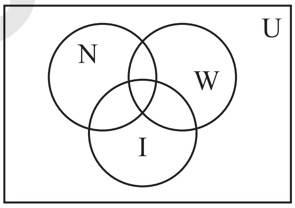
(A) $N \subseteq W$ (B) $I \subseteq Q$
(C) $Q \subseteq W$ (D) $W \subseteq R$

7. $N \subseteq W \subseteq I$ can be represented by using Venn diagram as

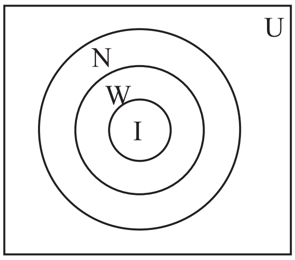
(A)



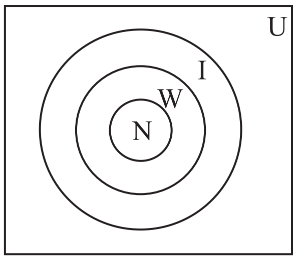
(B)



(C)



(D)



8. If A is any finite set, then the number of elements common in A and A′ are

(A) 0
(B) 1
(C) infinite
(D) cannot be determined

9. If M = {x | x is a multiple of 5}
N = {x | x is a multiple of 7},
then M $\cap$ N =
(A) {x | x is a multiple of 5}
(B) {x | x is a multiple of 7}
(C) {x | x is a multiple of 35}
(D) {x | x is a multiple of 70}

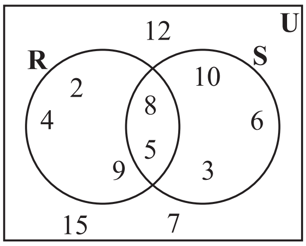
10. N $\cap$ W =
(A) 0 (B) ϕ (C) N (D) W

11. N $\cup$ W =
(A) 0 (B) ϕ (C) N (D) W

12. If P = {1, 4, 9, 16, 25}, then P $\cap$ ϕ =
(A) {1, 4, 9, 16, 25} (B) {1, 4, 9, 16}
(C) {1, 4} (D) { }

13. If M $\subseteq$ N, then (M $\cup$ N) $\cup$ (M $\cap$ N) =
(A) M (B) N (C) M′ (D) N′

14. For the Venn diagram shown below, (R $\cup$ S)′ =



(A) {8, 5}
(B) {2, 3, 4, 5, 6, 8, 9, 10}
(C) {12, 15, 7}
(D) {2, 9, 4, 10, 6, 3}

15. If n(G) = 20, n(H) = 32 and G $\cap$ H = ϕ, then n(G $\cup$ H) =
(A) 0 (B) 20
(C) 32 (D) 52

Type B: Solve the Following Questions

1. Write a set which contains letters of the word ‘ASSASSINATION’.

2. If A = {x^2 | $x \in$ N, $x \le 5$} and
B = {x^3 | $x \in$ N, $x < 6$}, then find A $\cap$ B.

3. If n(A) = 5, n(B) = 6 and n(A $\cup$ B) = 11, then find n(A $\cap$ B).

4. T = {x | x is an integer and a multiple of 12}. Check whether the given set is finite or infinite.

5. T = {x | x is an integer and a divisor of 12}. Check whether the given set is finite or infinite.

6. Write the given set using roster method.
A = {(x, y) | x, $y \in$ Z and $x + y = 3$}

7. Write the given set using listing method.
A = {(x, y) | x, $y \in$ N and $x + y = 3$}

8. Write the given set using rule method.
S = {2, 3, 5, 7, 13}

9. Write the given set using set builder form.
W = {(1, 5), (5, 1), (2, 4), (4, 2), (3, 3)}

10. Form two sets A and B such that n(A) = 3, n(B) = 4 and n(A $\cup$ B) = 5.

Additional Problems for Practice

Based on Practice Set 1.1

1. Write the following sets in roster form: **[1 Mark each]**
i. A = {x | x is a prime number which is a divisor of 30}
ii. B = {x | x is an even natural number}
iii. C = {x | x is an integer and $x^2 < 5$}
iv. F = {x | x is a letter of the word ‘LITTLE’}
v. E = {x | $x \in$ W, $x \notin$ N}
vi. D = {x | x is a square root of 81}

2. Write the following sets in set builder form: **[1 Mark each]**
i. A = {2, 4, 6, 8, 10, 12, 14}
ii. B = {5, 10, 15, 20, ….}
iii. C = {7, 7^2, 7^3, 7^4}
iv. D = {51, 53, 55, 57, 59}
v. E = {2, 3, 5, 7, 11, 13, 17, 19}

3. Write the following symbolic statements in words. **[1 Mark each]**
i. $\frac{7}{8} \in$ Q
ii. A = {x | x is an even prime number}
iii. $-3 \notin$ W

Based on Practice Set 1.2

1. Decide which of the following are equal sets and which are not ? Justify your answer. **[4 Marks]**
A = {x | $4x - 1 = 7$}
B = {x | x is a prime number but not odd}
C = {x | x is a letter of the word ‘CATARACT’}
D = {y | y is a letter of the word ‘TRAC’}
E = {z | z $\in$ N, $5 < z \le 10$}
P = {x | x is an odd natural number, $x < 8$}
Q = {y | y is an even natural number, $y < 10$}
R= {x | x = 2n, n $\in$ N and n < 5}
S = {2, 4, 6, 8}

2. Which of the following are empty sets? **[1 Mark each]**

i. $A = \{x \mid x \in I, x < 0\}$

ii. $B = \{x \mid x \in N, -1 < x < 1\}$

iii. $P = \{y \mid y \in I, y > 0\}$

iv. $D = \{x \mid x \in N \text{ and } 5x - 1 = 0\}$

v. $E = \{x \mid x \in I, x \text{ is neither positive nor negative}\}$

vi. $C = \{x \mid x \in N, x < 7 \text{ and } x > 11\}$

3. Classify the following sets into finite or infinite: **[1 Mark each]**

i. $A = \{x \mid x \text{ is a multiple of } 1\}$

ii. $C = \{x \mid x \text{ is a point on a line}\}$

iii. $D = \{1, 2, 3, 4, \ldots, 100\}$

iv. $E = \{x \mid x \in N \text{ and } x \text{ is an odd number}\}$

+4. Write the following sets using listing method and classify into finite or infinite set. **[1 Mark each]**

i. $A = \{x \mid x \in N \text{ and } x \text{ is an odd number}\}$

ii. $B = \{x \mid x \in N \text{ and } 3x - 1 = 0\}$

iii. $C = \{x \mid x \in N, \text{ and } x \text{ is divisible by } 7\}$

iv. $D = \{(a, b) \mid a, b \in W, a + b = 9\}$

v. $E = \{x \mid x \in I, x^2 = 100\}$

vi. $F = \{(a, b) \mid a, b \in Q, a + b = 11\}$

+5. Decide if the given sets are equal or not.

i. $A = \{x \mid x \text{ is a letter of the word 'listen'}\}$
$B = \{y \mid y \text{ is a letter of the word 'silent'}\}$ **[2 Marks]**

ii. $A = \{x \mid x = 2n, n \in N, 0 < x \leq 10\}$
$B = \{y \mid y \text{ is an even number}, 1 \leq y \leq 10\}$ **[3 Marks]**

iii. $C = \{1, 3, 5, 7\}$
$D = \{2, 3, 5, 7\}$ **[1 Mark]**

Based on Practice Set 1.3

1. If $A = \{1, 3, 8, 9, 10\}$, $B = \{8, 9, 10, 11\}$, $C = \{8, 9\}$, $D = \{1, 8\}$, then which of the following statements are true and which ones are false? **[1 Mark each]**

i. $A \subseteq B$ ii. $B \subseteq C$

iii. $C \subseteq B$ iv. $D \subseteq A$

v. $A \subseteq D$

2. Take the set of natural numbers from 1 to 30 as Universal set and show sets A and B using Venn diagram. **[2 Marks each]**

i. $A = \{x \mid x \in N, x \text{ is a prime number}\}$

ii. $B = \{y \mid y \in N, y \text{ is a composite number}\}$

3. Show the following set and subset using Venn diagram.
$A = \{2, 4\}$
$B = \{x \mid x = 2^n, n < 5, n \in N\}$
$C = \{x \mid x \text{ is an even natural number}, x \leq 16\}$ **[4 Marks]**

4. If $A = \{x, y\}$, write all possible subsets of A. **[1 Mark]**

5. Write the subset relations among the following sets: **[2 Marks]**
P = set of all residents in Nagpur
X = set of all residents in Vadodara
Y = set of all residents in Maharashtra
T = set of all residents in Gujarat

6. Let all the students of a class be an universal set. If 20% students play kho-kho is represented by set A, then write the complement of set A. **[1 Mark]**

+7. Write which of the following is a subset of the other.

i. $A = \{1, 2, 3, 4, 5, 6, 7, 8\}$
$B = \{2, 4, 6, 8\}$ **[1 Mark]**

ii. N = set of natural numbers.
I = set of integers. **[2 Marks]**

iii. $P = \{x \mid x \text{ is square root of } 25\}$
$S = \{y \mid y \in I, -5 \leq y \leq 5\}$ **[3 Marks]**

+8. Write the complement of set A if,
$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
$A = \{2, 4, 6, 8, 10\}$ **[1 Mark]**

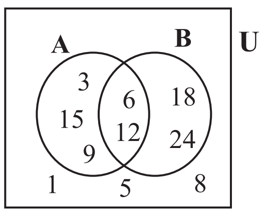
Based on Practice Set 1.4

1. If A and B are two sets such that $n(A) = 17$, $n(B) = 23$, $n(A \cup B) = 38$, then find $n(A \cap B)$. **[2 Marks]**

2. 240 students in a school were interviewed and their hobbies were noted. 150 students were interested in stamp collection, 80 took delight in reading books, 40 of them do not like either. What is the number of students who liked both stamp collection and reading books? **[3 Marks]**

3. In a class of 50 students, 35 like Physics, 30 like Mathematics and 3 like neither. How many like both the subjects? How many like Physics only? **[4 Marks]**

4.



[1 Mark each]

From the given Venn diagram, find:

i. $A \cap B$ ii. $A \cup B$

iii. $(A \cap B)'$ iv. $n(A \cap B)$

v. $A' \cup B'$

+5. Write the intersection of the following sets. **[1 Mark each]**

i. A = { 1, 3, 5, 7} B = { 2, 3, 6, 8}

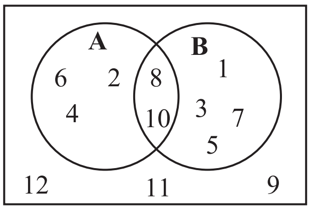
ii. A = {1, 3, 9, 11, 13} B = {1, 9, 11}

+6. Write the union of the following sets. **[1 Mark]**

A = {–1, –3, –5, 0}

B = {0, 3, 5}

+7. Observe the Venn diagram and write the following sets using listing method. **[1 Mark each]**



i. U ii. A

iii. B iv. $A \cup B$

v. $A \cap B$ vi. A′

vii. B′ viii. $(A \cup B)'$

ix. $(A \cap B)'$

+8. In a class of 70 students, 45 students like to play Cricket. 52 students like to play Kho-kho. All the students like to play atleast one of the two games. How many students like to play Cricket and Kho-kho? **[3 Marks]**

Chapter Assessment

Total Marks: 25

Q.1. A. Choose the correct alternative. [4]

i. If A = {x | x is a worker in department – I of your company},

B = {y | y is a worker in department – II of your company}, and

C = {z | z is a worker of your company}, then

(A) $C \subseteq A$ (B) $A \subseteq B$

(C) $A \subseteq C$ (D) $C \subseteq B$

ii. If U = {1, 2, 3, 4, ….} and A = {2, 4, 6, 8, ….}, then A′ = ?

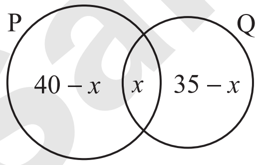
(A) {–2, –4, –6, ….}

(B) {1, 3, 5, 7, ….}

(C) {0, 1, 3, 5, ….}

(D) {0, 2, 4, 6, 8, ….}

iii. In the following Venn diagram, if $n(P \cup Q) = 70$, then x = ?



(A) 5 (B) 3

(C) 6 (D) 8

iv. Two sets A and B are disjoint if

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

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

Q.1. B. Solve the following questions. [2]

i. A = {x | $x \in W$, $x < 9$} and B = {x | $x \in N$, $x < 9$}.

Check whether the given sets are equal or not.

ii. Write the given set in set builder form.

A = {n, e, t}.

Q.2. A. Complete the following activities. (Any one) [2]

i. Write the following set using listing method and classify into empty or non-empty set.

B = { x | $x \in N$ and $2x + 8 = 0$}

$2x + 8 = 0$

∴ $x = \boxed{}$

since, $\boxed{} \in N$

∴ B = $\boxed{}$

∴ B is $\boxed{}$ set

ii. If U = {x | x is a natural number less than 13.},

A = {1, 2, 3, 4, 5, 6},

B = {3, 4, 5, 7, 8, 9}, then answer the following.

a. $A \cap B = \boxed{}$

b. Set U in listing form = $\boxed{}$

c. $A^c = \boxed{}$

d. $B^c = \boxed{}$

Q.2. B. Solve the following questions. (Any two) [4]

i. If P = {2, 4, 8, 16}, Q = {2, 8, 6} then is the statement $Q \subseteq P$ true or false. Justify.

ii. If n(A) = 8, n(B) = 14, $n(A \cup B) = 18$, then find $n(A \cap B)$.

iii. A = {–7, 5, 2} and B = $\left\{\sqrt[3]{125}, \sqrt{4}, \sqrt{49}\right\}$. Are A and B equal sets? Justify.

Q.3. A. Complete the following activities. (Any one) [3]

i. Let $U = \{10, 11, 13, 17, 19, 21, 23\}$
$A = \{10, 21\}$
$B = \{11, 13, 21, 23\}$

Then $A^c = \boxed{}$

$B^c = \boxed{}$

$A^c \cap B^c = \boxed{}$

$A \cup B = \boxed{}$

$(A \cup B)^c = \boxed{}$

$\therefore$ $(A \cup B)^c \boxed{} A^c \cap B^c$

ii. Out of 230 students, 120 students like to play football, 190 students like to play cricket and 110 students like to play both the games. How many students do not like to play any game? How many students like to play football only?

Let U be the set of all students,
F be the set of students who like football and
C be the set of students who like cricket.

$\therefore$ $n(U) = \boxed{}$
$n(F) = 120$
$n(C) = 190$
110 students like both football and cricket

$\therefore$ $n(F \cap C) = 110$

$\therefore$ $n(F \cup C) = n(F) + \boxed{} - n(F \cap C)$
$= \boxed{}$

Number of students who do not like to play any game $= n(U) - n(F \cup C)$
$= \boxed{}$

Number of students who like to play football only $= n(F) - \boxed{} = \boxed{}$

Q.3. B. Solve the following questions. (Any one) [3]

i. If $U = \{x \mid x$ is a natural number less than $15\}$ is the Universal set, $A = \{1, 3, 4, 5, 9\}$ and $B = \{3, 5, 7, 9, 12\}$, then verify: $(A \cup B)' = A' \cap B'$

ii. In a hostel there are 125 students, out of which 80 drink tea, 60 drink coffee and 20 drink tea and coffee both. Find the number of students who do not drink tea or coffee.

Q.4. Solve the following questions. (Any one) [4]

i. Let $U = \{x | x \in N, x < 10\}$,
$A = \{a | a$ is even, $a \in U\}$,
$B = \{b | b$ is a factor of 6, $b \in U\}$.
Verify that:
$n(A) + n(B) = n(A \cup B) + n(A \cap B)$.

ii. Represent sets A, B, C such that $A \subseteq B$, $A \cap C = \phi$ and $B \cap C \neq \phi$ by Venn diagram and shade the portion representing $A \cup (B \cap C)$.

Q.5. Solve the following questions (Any one) [3]

i. Write the subset relation between the sets.
N is the set of all residents in Nagpur.
M is the set of all residents in Maharashtra.
I is the set of all residents in India.

ii. In an exam 35 students cleared General Knowledge paper, 45 students cleared Logical Aptitude paper and 25 cleared both the papers. 5 students failed in both the papers. Find the number of students appeared in the exam.

Smart Recap

Notations	Read as
N	Natural numbers
W	Whole numbers
I	Intergers
Q	Rational numbers
R	Real numbers
=	Equals to
$\neq$	Not equals to
$\in$	Belongs to
$\notin$	Not belongs to

Notations	Read as
{ }	Curly braces
ϕ	Phi or empty set
| or :	Such that
$\cup$	Union
$\cap$	Intersection
$\subseteq$	Subset
$\not\subseteq$	Not a subset
A' or A^c	Complement of set A
U	Universal set

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