Teaching Guide

7

MATHS WISE

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CONTENTS

USING THIS TEACHING GUIDE

This teaching guide provides lesson plans for each unit. Each lesson starts with activities that can be completed within a specified time before the main lesson is taught. Working on starter activities help prepare the students for the more formal lessons and is an informal introduction to the topic at hand without straight away barraging them with new concepts.

While devising these activities, make sure that they can be done within a reasonable time span and that the recourses that are to be used are easily available.

Time required for completing each lesson is also given but can change depending upon the students' learning capabilities.

The guide refers to the textbook pages where necessary and exercise numbers when referring to individual work or practice session or homework.

This is not a very difficult guide to follow. Simple lesson plans have been devised with ideas for additional exercises and worksheets. Make sure that lessons from the textbook are taught well. Planning how to teach just makes it easier for the teacher to divide the course over the entire year.

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UNIT 1

SETS

Lesson 1

Topic: Different form of sets
Time: 40 minutes (1 period)

Objective

To enable students to: express sets in different forms

Starter activity

What is a set?

The following sets will be written on the board and students will be asked to answer.

1. {2, 3, 5, 7}
2. {5, 10, 15, 20...}
3. {1, 2, 3, 4, 6, 12}
4. {juniper, oak, peepal, neem}
5. {lion, tiger, cheetah, wolf}

In which form are sets 1, 2 and 3 written?

In which form are sets 4 and 5 written?

Tell the students that in the previous class, they learnt to represent a set in two forms, tabular and descriptive.

Main lesson

Explain to the students that a set can be represented in three forms.

1. Tabular form
2. Descriptive form
3. Set-builder notation form

In the last form, that is the set-builder notation, the members of a set are represented by a small letter for example, 'x', then a symbol 'l' which stands for 'such that' is put and then a property is stated which clearly defines the members of the set.

Example 1

If A = {2, 3, 5, 7, 11...}

In the set-builder notation it is written as:

A = $\{x|x\xi P\}$

The symbol 'ξ' indicates the element of a set, 'P' indicates the prime numbers and it is read as 'A is the set of all x such that x is a prime number:

Example 2

If B = {1, 2, 3, 6, 18}, the set of all factors of 18, then in the set-builder notation it is written as B = $\{x|x$ is a factor of 18}

Example 3

If A = {1, 2, 3, 4 ...15} then in the set-builder notation it is written as:

A = $\{x|x\xi N, 0 < x < 15\}$

This set may also be written as:

A = $\{x|x\xi N, 1 \leq x \leq 15\}$

and it is read as, 'A is the set of all x such that x is a natural number and x is either greater than or equal to 1 and either less or equal to 15.

Practice session

1. Give a worksheet to the students to write these sets in a tabular form:
    a) Set of provinces of Pakistan
    b) Set of oceans of the world
    c) Set of continents
    d) Set of all prime numbers between 30 and 50
    e) Set of common divisors of 50 and 75

2. Write down the following sets in a descriptive form:
    a) {4, 6, 8, 10, 12, 14, 15, 16, 18, 20}
    b) {London, Lahore, Lancaster}
    c) {violet, indigo, blue, green, yellow, orange, red}
    d) {1, 3, 5, 7...}

3. Write down the following sets in the set-builder notation:
   a) C = {the set of all prime numbers}
   b) A = {all possible numbers formed by the digits 3, 7, 2}
   c) D = {all square numbers between 1 and 50

Individual activity

Give the students, Exercise 1a, 1 and 2 and help them solve it.

Homework

Exercise 1a question 3 will be given as homework.

Lesson 2

Topic: Types of sets
Time: 1 period (40 minutes)

Objective

To enable students to express the types of sets

Starter activity

Write the following sets on the board to give the concept of types of sets:

A = {1, 2, 3, 4, 5, …50}
B = {1, 2, 3, 4, 5, …}
C = { } or set of students of class VII having horns
D = {1, 3, 5, 7, …} and E = {2, 4, 6, 8, …}
G = {1, 2, 3, 4, 6, 12} and H = {1, 2, 3, 6, 18}
J = {3, 4, 5} and K = {x, y, z}
M = {5, 6, 7} and N = {6, 7, 5}

Main Lesson

After having written the sets on the board, ask the following questions:

1. How many members or elements are there in set A?

A: Set A contains 50 elements. We can count the elements of set A. A set containing a fixed number of elements is called a finite set.

2. How many elements are there in set B?

A: We cannot count. The sign ellipsis… indicates continuity to an unnamed number and so the elements are uncountable. It is an infinite set.

3. Are there any elements in set C? Would there be any girl or boy in class VII having horns?

A: No, set C does not contain any elements. Humans don't have horns. When there are no elements, the set is called an empty set or a null set and it is represented by an empty bracket or the symbol ø.

4. Are the sets D and E the same?

A: No, set D is a set of odd numbers and set E is a set of even numbers. The members of Set E are exactly divisible by 2 while those of set D are not completely divisible by 2. Sets which have no common elements between them are called disjoint set.

5. Do you see any element common in set G and H?

A: Yes 1, 2, 3, and 6 are common; they are found in both the sets. G and H are called overlapping sets.

6. Are the elements of set J and K equal and the same?

A: The numbers of elements are same but they are different from each other. Such sets are called equivalent set and when the members and elements are the same they are called equal sets as shown by the sets M and N.

Individual activity

Exercise1a, questions 4, 5 and 6 will be done in class. The teacher should observe the students work and guide them.

Homework

Give some revision exercises and ask the students to prepare a chart showing types of sets with examples of their own.

Lesson 3

Topic: Universal set, complements of a set, union, intersection and difference of two or more sets.

Time: One period

Objectives

To enable students to define universal set and complement of set, to find union, intersection and difference of sets.

Starter activity

Write the following sets on the board to give the concept of universal set and complement of a set:

A = {1, 2, 3, 4, 5 ... 20}
B = {1, 3, 5, 7, 9, 11, 13, 17, 19}
C = {2, 4, 6, 8, 10, 12, 14, 16, 18, 20}
D = {2, 3, 5, 7, 11, 13, 17, 19}

Ask the following questions to explain the universal set and complement of a set:

1. Which is the biggest set?

A: Set A

2. Are all the elements of set B, C and D the elements of set A?

A: Yes

A set consisting of all the elements occurring in a problem under consideration is called the universal set and it is denoted by ∪.

In other words universal set is a super set of every set occurring together in problems. In the above four sets, A is the super set or universal set.

Set B, C and D are called complements of a set being denoted by B', C', D'

i.e. B' = ∪ \ B   B' = ∪ − B
C' = ∪ \ C   C' = ∪ − C
D' = ∪ \ D   D' = ∪ − D

Main Lesson

Explain union of two sets by giving the following examples:

If A = {1, 2, 3, 4, 5} and B = {2, 4, 6, 8, 10}

then AUB will be:

A∪B = {1, 2, 3, 4, 5} ∪ {2, 4, 6, 8, 10}

therefore A∪B or B∪A will be {1, 2, 3, 4, 5, 6, 8, 10}

Note: Common elements are not written twice.

A set containing all the elements of two sets is called the union of two sets.

∪ is the symbol of union.

A∪B = B∪A, this property is called commutative property of union.

Explain intersection of two sets by the following example:

If set A = {1, 3, 5, 7} and B = {3, 5, 7, 8, 9, 10} then A∩B = {3,7}

A set which contains all the common elements of two sets is called intersection of two sets. ∩ is the symbol of intersection.

Difference of two sets

Example

If set A = {10, 11, 12} and B = {10, 11, 12, 13} then A − B or A\B = { } but B − A will be {10, 11, 12, 13} − {10, 11, 12} or B − A = {13}

− or / denotes the difference of two sets.

Practice session

If ∪ = {1, 2, 3, 4, 5, ...15}
A = {1, 3, 5, 7}
B = {2, 4, 8, 10}
C = {3, 6, 9, 12, 15}
D = {1, 2, 3, 4, 6, 12}

then find,

a) A' b) A − B c) D' d) B∩C
e) A∪D f) C − B

Individual activity

Exercise 1b will be done in the class, (without the Venn diagrams). Help the students do it.

Homework

If U = {a, b, c, d, e, f, g, h}
A = {a, b, c, d}
C = {e, f}
D = {b, d, e, g}

then find,

a) C' b) C − D c) A∪B d) B∩D

Lesson 4

Topic: Venn diagrams and operation on sets
Verify different properties of sets
Time: 2 periods

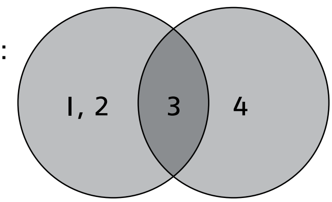
Objective

To enable students to represent union or intersection of two sets through Venn diagrams.

Starter activity

Example 1

The following diagrams will be drawn on the board:



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

1. What do you see in this figure?
2. Why the digit '3' is in the centre?
3. Why are both the circles shaded?

Main Lesson

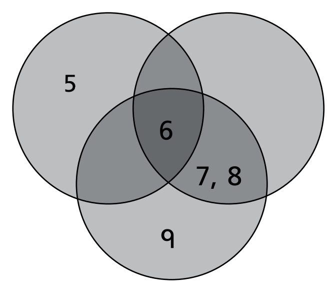
Explain to the students that in the above two sets, $A \cup B = \{1, 2, 3, 4\}$

Shading of both the circles shows that $A \cup B = B \cup A$

Hence union of two sets is commutative.

Example 2

Union of 3 sets



If $A = \{5, 6\}$

$B = \{6, 7, 8\}$

$C = \{6, 7, 8, 9\}$

Proceeding as $(A \cup B) \cup C$

$A \cup B = \{5, 6\}\ \mathrm{U}\ \{6, 7, 8\} = \{5, 6, 7, 8\}$

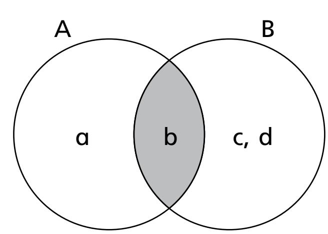
$(A \cup B) \cup C = \{5, 6, 7, 8\} \cup \{6, 7, 8, 9\}$

$= \{5, 6, 7, 8, 9\}$

Hence operation of union of 3 sets is associative.

Intersection of sets

Example 1



If $A = \{a, b\}$

$B = \{b, c, d\}$

then $A \cap B = \{b\}$

and also $B \cap A = \{b\}$

represents $A \cap B = \{b\}$

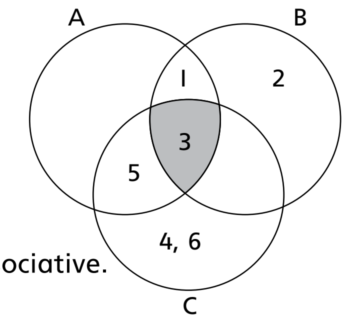
$A \cap B = B \cap A = \{b\}$

Hence the intersection of two sets is commutative.

Example 2

If $A = \{1, 3, 5\}$, $B = \{1, 2, 3\}$ and $C = \{3, 4, 5, 6\}$
then $A \cap B = \{1, 3, 5\} \cup \{1, 2, 3\}$
$A \cap B = \{1, 3\}$
$(A \cap B) \cap C = \{1, 3\} \cap \{3, 4, 5, 6\} = \{3\}$
$B \cap C = \{1, 2, 3\} \cap \{3, 4, 5, 6\} = \{3\}$
$A \cap (B \cap C) = \{1, 3, 5\} \cap = \{3\} = \{3\}$

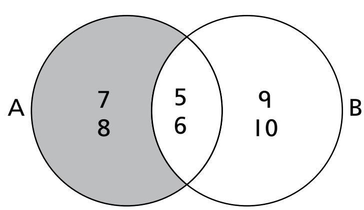
Hence the operation of intersection of 3 sets in also associative.



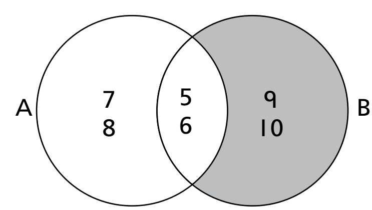
The set difference

Example

The Venn diagram shows that:
If $A = \{5, 6, 7, 8\}$ and $B = \{5, 6, 9, 10\}$
then,
$A - B = \{7, 8\}$ all elements of set A which are not in B
$B - A = \{9, 10\}$ all elements of B which are not in A



$A - B = \{7, 8\}$
shows $A - B$



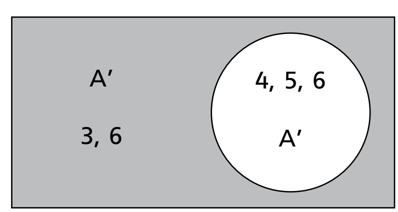
$B - A = \{9, 10\}$
shows $B - A$

Complement of a set

Example

The Venn diagram on the right shows that:

If $U = \{3, 4, 5, 6, 7\}$
$A = \{4, 5, 7\}$
then $A' = \{3, 6\}$
i.e. $U - A = A'$



represents $A' = \{3, 6\}$

Practice session

Show by Venn diagram the following:

If $A = \{a, b, c, d\}$ and $B = \{a, c, e, f\}$ then show:

a) $A \cup B$ b) $A - B$ c) $B \cap A$

If $\cup = \{1, 2, 3, 4, 5, 6\}$, $X = \{1, 3, 5\}$, $Y = \{2, 4, 5\}$ then show:

a) X' b) Y'

Individual activity

Taking the example from the textbook p. 14, help the students solve it.

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

then show,

1. a) $A \cup B$
   b) $A \cap B$
   c) A'
   d) $A - B$
2. a) Verify $A \cap B \neq A - B$
   b) $A' \cap B'$
   c) $A' - B'$
3. Exercise 1b
   Q1. a, b, c
   Q2. a and d

Homework

Give exercise 1b, questions 1d and 1e and questions 2, all parts of b and c as homework.

UNIT 2

RATIONAL NUMBERS

Topic: Rational Numbers
Time: 3 periods (each of 40 min)

Objectives

To enable students to:

- define a rational number
- perform different operations on rational numbers
- find additive and multiplicative inverse of a rational number, reciprocal of a rational numbers
- verify associative, commutative and distributives properties of rational numbers

Lesson 1

Starter activity

Draw a number line on the board and ask the students the following questions:

1. How many sets of number are there on the number line?
2. Name the two sets of numbers on the number line.
3. {0, 1, 2, 3 ...} Name the sets of the numbers.
4. Is 0 a negative or a positive number?
5. Are the negative numbers smaller than zero?
6. Is the sum of two natural numbers always natural?
7. Is the product of two natural numbers always natural?
8. When a natural number is subtracted from another natural number, is the result always a natural number?
9. When 2 is divided by 5 we get $\frac{2}{5}$. Is $\frac{2}{5}$ a natural number?
10. What is $\frac{2}{5}$ called? Does this number belong to any of the system of number just discussed?

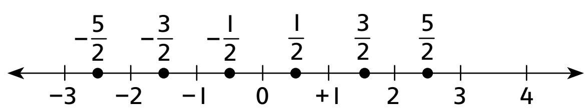
Main lesson

The number $\frac{2}{5}$ is called a rational number. Any number which can be expressed in the form of a fraction $\frac{a}{b}$ where 'a' and 'b' are integers and $b \neq 0$ is known as a rational number, and 'a' may be equal to zero.

Some examples are given to make this clearer.

$\frac{2}{3}, -\frac{1}{4}, \frac{5}{6}, -\frac{3}{5}$, 0, 6, −3 etc. are all rational numbers, and hence positive integers, negative integers, zero and common fractions are called rational numbers.

Dividing the number between each pair of consecutive integers in two equal parts, we get the representation of the numbers $-\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}$ and so on.



Hence every rational number can be expressed on a number line.

Explain irrational number with the help of following:

When $\frac{22}{7}$ is divided, we get:

$\frac{22}{7} = 3.14285714$ (the value of π)

It is not completely divisible as the process of division goes on and on. It cannot be expressed as the quotient of two integers and hence is an unreasonable number. That is why they are called irrational numbers ($\sqrt{3}$, $\sqrt{5}$, π).

Activity

1. Which of the following is a rational number?
   a) 3 b) $\frac{2}{0}$ c) $\frac{3}{1}$ d) $-\frac{3}{1}$ e) $\frac{0}{3}$ f) $\frac{0}{0}$
2. Write down the following rational numbers as integers:
   a) $\frac{8}{1}$ b) $-\frac{6}{1}$ c) $-\frac{5}{1}$ d) $\frac{-20}{-1}$ e) $\frac{-13}{-6}$
3. Write down the rational numbers whose numerator is (−5) 3 and whose denominator is 17−4.
4. Are $\sqrt{4}$, $\sqrt{9}$ irrational numbers? If not, give your reasons.

Practice session

Students will be asked to do 2, 3 of exercise 2a in class. Help them do it.

Homework

Give exercise 2a questions 4 and 5 as homework.

Lesson 2: Operations on rational numbers

Objectives

To enable students to:

- perform 4 basic operations on rational numbers
- verify commutative property of rational numbers.

Starter activity

Ask some questions similar to the ones given below to introduce the session.

1. What is the sum of 4 and 5?
2. Is the sum of 4 and 5 and 5 and 4 equal?
3. Is the sum of $\frac{3}{4}$ and $\frac{4}{3}$ equal to the sum of $\frac{4}{3}$ and $\frac{3}{4}$?
   $\frac{3}{4} + \frac{4}{3} = \frac{4}{3} = \frac{3}{4}$
4. Is subtracting 3 from 5 and subtracting 5 from 3 the same?
   $5 - 3 \neq 3 - 5$
5. $3 + 0 = 3$ and $0 + 3 = 0$
   (zero in called the additive identity)

Main lesson

Addition

$\frac{2}{5} + \frac{1}{5} + \frac{3}{5} = \left(\frac{2 + 1 + 3}{5}\right) = \frac{6}{5}$

When two or more rational numbers are added, the sum is also a rational number. Thus we can say that rational numbers are closed under addition and addition is commutative as shown in the above example: 3 + 4 = 4 + 3. Changing the order of numbers does not effect the result.

$\frac{5}{6} + \frac{3}{5} = \frac{3}{5} + \frac{5}{6}$

$\frac{25 + 18}{30} = \frac{18 + 25}{30} = \frac{43}{30}$

In general if a, b, c and d are integers and $b \neq 0$ then

$\frac{a}{b} + \frac{c}{d} = \frac{c}{d} + \frac{a}{b}$

This property of rational numbers is known as the commutative property of addition.

Subtraction

Subtract 5 from 8

$8 - 5 = 3$

Subtract 8 from 5 = $5 - 8 = -3$

This example shows that the difference of two rational numbers is also a rational number and therefore rational numbers are also closed under subtraction.

But $8 - 5 \neq 5 - 8$ or $\frac{5}{6} - \frac{1}{6} \neq \frac{1}{6} - \frac{5}{6}$

So the commutative property does not hold for subtraction of rational numbers.

Multiplication

$3 \times 5 = 5 \times 3 = 15$

$\frac{4}{9} \times \frac{5}{6} = \frac{5}{6} \times \frac{4}{9} = \frac{10}{27}$

This implies that:

1. Rational numbers is closed under multiplication.
2. Multiplication is commutative for rational numbers.

Example 1

$\frac{3}{5} \times 1 = \frac{3}{5}$, $8 \times 1 = 8$

1 is called the multiplicative identity or the identity element for multiplication for rational numbers.

Division

Dividing a rational number by a non-zero rational number.

$8 \div 2$ or $\frac{8}{2} = 4 \rightarrow$ rational

$2 \div 8$ or $\frac{2}{8} = \frac{1}{4} \rightarrow$ rational

We can, therefore, say that rational numbers are closed with respect to division as the quotient is also a rational number but, $\frac{8}{2} \neq \frac{2}{8}$.

Example 2

$\frac{3}{4} \div \frac{5}{8}$

$= \frac{3}{4} \times \frac{8}{5} = \frac{6}{5}$ and $\frac{5}{8} \div \frac{3}{4}$

$= \frac{5}{{}_{2}\cancel{8}} \times \frac{\cancel{4}}{3} = \frac{5}{6}$

Division of two rational numbers is not commutative.

Activity

Additive and Multiplicative inverse will be explained to the students with the help of the following activity:

$\frac{a}{b} + \left(-\frac{a}{b}\right) = 0$

$-\frac{a}{b}$ is the additive inverse of $\frac{a}{b}$

- If −3 is an additive inverse of +3, then −2 is the additive inverse of ________?
- Additive inverse of $\frac{4}{5}$ is ________?

Multiplicative inverse in also called Reciprocal

Multiplicative inverse of a is $\frac{1}{a}$

- What is the reciprocal of q?
- Multiplicative inverse of $\frac{2}{5}$ is ________

  $\frac{2}{5}$ and $\frac{5}{2}$ are reciprocal of each other.

Individual activity

Give exercise 2b questions 1 and 3 all parts. Help the students to solve them.

Homework

Find the value of:

a) $\frac{-6}{7} - \frac{-2}{7}$ b) $\frac{7}{24} - \frac{11}{36}$ c) $\frac{4}{15} \times \frac{3}{8}$

Give exercise 2b questions 2a to j as homework.

Lesson 3

Topic: Associative and distributive properties of rational numbers
Time: one period

Objective

To enable students to verify associative and distributive property for rational numbers.

Main lesson

Example 1

Find the sum of $\frac{1}{2}$, $\frac{2}{3}$ and $\frac{3}{4}$.

$\left(\frac{1}{2} + \frac{2}{3}\right) + \frac{3}{4}$

L.C.M of 2 and 3 = 6

$\left(\frac{3 + 4}{6}\right) + \frac{3}{4}$

$\frac{7}{6} + \frac{3}{4}$

LCM = 12

$\frac{14 + 9}{12} = \frac{17}{12}$

$\frac{1}{2} + \left(\frac{2}{3} + \frac{3}{4}\right)$

$\frac{1}{2} + \left(\frac{8 + 9}{12}\right)$

$\frac{1}{2} + \frac{17}{12}$

LCM = 12

$\frac{6 + 17}{12} = \frac{23}{12}$

By adding the numbers in any order, we get the same result. It can be shown for any three rational numbers.

This property is known as the associative property for rational numbers.

Example 2

$\left(\frac{3}{4} - \frac{1}{2}\right) - \frac{1}{3}$

$\left(\frac{3}{4} - \frac{2}{4}\right) - \frac{1}{3}$

$\left(\frac{3 - 2}{4}\right) - \frac{1}{3}$

$\frac{1}{4} - \frac{1}{3}$

$\frac{3 - 4}{12} = -\frac{1}{12}$

$\frac{3}{4} - \left(\frac{1}{2} - \frac{1}{3}\right)$

$\frac{3}{4} - \left(\frac{3}{6} - \frac{2}{6}\right)$

$\frac{3}{4} - \frac{1}{6}$

$\frac{9 - 2}{12} = \frac{7}{12}$

Subtraction is not associative for rational numbers.

Example 3

Multiplication is associative for rational numbers:

$\frac{3}{5} \times \left(\frac{\cancel{2}^{1}}{5} \times \frac{4}{\cancel{6}_{3}}\right)$

$\frac{\cancel{3}^{1}}{5} \times \frac{4}{\cancel{15}_{5}} = \frac{4}{25}$

$= \frac{\cancel{12}^{4}}{\cancel{75}_{25}}$ (dividing by 3)

$\left(\frac{3}{5} \times \frac{2}{5}\right) \times \frac{4}{6}$

$\frac{\cancel{6}^{1}}{25} \times \frac{4}{\cancel{6}_{1}} = \frac{4}{25}$

Note that division is not associative.

Example 4

Multiplication is distributive over addition and subtraction for rational numbers:

$$\frac{7}{9} \times \left\{\left(\frac{3}{10} + \left(-\frac{1}{5}\right)\right)\right\}$$

$$\frac{7}{9} \times \left(\frac{3-2}{10}\right)$$

$$\frac{7}{9} \times \frac{1}{10} = \frac{7}{90}$$

$$\frac{7}{9} \times \left(\frac{3}{10} + -\frac{1}{5}\right)$$

$$\frac{21}{90} + \frac{-7}{45}$$

$$\frac{21-14}{90} = \frac{7}{90}$$

Practice session

State the property followed in each of the following examples:

a) $-\frac{2}{3} \times \left(\frac{3}{7} \times \frac{-5}{7}\right) = \left(\frac{-2}{3} \times \frac{3}{7}\right) \times \frac{-5}{7}$

b) $\frac{-3}{5} \times \frac{4}{7} = \frac{4}{7} \times \frac{-3}{5}$

c) $\frac{4}{5} \times \left(\frac{2}{3} + \frac{-4}{9}\right) = \left(\frac{-4}{5} + \frac{2}{3}\right) + \left(\frac{-4}{5} \times \frac{-4}{9}\right)$

Individual activity

Give a worksheet to students with questions similar to the ones given below.
Simplify:

a) $\frac{3}{7} + \frac{5}{9} - \frac{-2}{3}$

b) $\frac{-4}{11} + \frac{-2}{3} - \frac{-5}{9}$

c) $\left(-\frac{8}{5} \times \frac{3}{4}\right) + \left(\frac{7}{8} \times \frac{-16}{25}\right)$

d) $\left(\frac{7}{25} \times \frac{-15}{28}\right) - \left(-\frac{3}{5} \times \frac{4}{9}\right)$

Homework

Test whether each of the rational numbers are equivalent:

1. a) $\frac{5}{25}, \frac{25}{125}$ b) $\frac{23}{15}, \frac{12}{13}$ c) $\frac{15}{18}, \frac{26}{24}$
2. Saleem bought 8 blue and 7 red ribbons. What fraction of the total ribbons are red?
3. Arrange in an ascending order.

   $\frac{4}{5}$, 3, 2.28, $\frac{-8}{5}$, $1\frac{1}{4}$

UNIT 3

DECIMALS

Topic: Decimals
Time: 2 periods

Objectives

To enable students to:

- convert decimals to rational numbers
- differentiate between terminating and non-terminating decimals
- differentiate between recurring and non-recurring decimals.

Starter activity (10 min)

Ask questions like the ones given below to refresh students' memory:

- What are whole numbers?
- Which numbers are called rational numbers?
- What do you mean by a decimal fraction?
- Separate the numbers in groups of terminating or recurring numbers: $\frac{4}{8}$, 175, 2.602, $3\frac{8}{9}$, 9178.25, $\frac{56}{7}$ etc.
- How do we convert a decimal fraction into a rational number, for example, 0.35, 0.6, 2.173?
- How do we convert a rational number into a decimal fraction? Convert $\frac{5}{8}$ and $\frac{2}{7}$ into decimal fractions.

- Let the students come to the board and perform the division.

1.
```
     0.625
8)  5.0000
   -4 8
      20
    -16
      40
     -40
      xx
```

2.
```
   0.2857142
7)2.0000
  14
   60
   56
    40
    35
     50
     49
      10
       7
      30
```

Ask the students what do they notice in the above two examples. Discuss examples from the textbook pages 27 and 28.

Lesson 1
(15 minutes)

Using textbook pages 27 and 29, explain and give the definitions of terminating decimals and non-terminating decimals. Give the rule and explain whether a given fraction is a terminating type of decimal or non-terminating. Explain the terms non-terminating or recurring decimals.

Practice Session
(10 minutes)

- Write some decimal fractions on the board and call the students at random to convert decimals into rational members, for example, 0.9, .027, 13.162 etc.
- Write some rational members on the board and ask the students to find which ones are terminating and which non-terminating or recurring decimals.
- Apply the rule to: $\frac{7}{8}$, $\frac{15}{4}$, $\frac{14}{15}$, $8\frac{9}{25}$, $\frac{23}{24}$, $\frac{15}{14}$ etc. (check the factors of the denominators in each case.)

Individual work
(20 minutes)

Give exercise 3a from the textbook as classwork.

Homework

Students should be given some sums from sources other than the textbook.

Recapitulation

Revise the rules to find the terminating and recurring decimals; differentiate between the two.

Lesson 2

Topic: Approximation
Time: 1 period

Objective

To enable students to:

- estimate numbers and measures
- how to round off numbers to a specified degree of accuracy
- the concept of rounding off.

Starter activity
(10 minutes)

Show some pictures to the children and ask them to make a guess of the number of objects or articles in the picture. (Show charts of fruits, vegetables, flowers etc.)

Ask them to make an estimate of the weight of some objects like a boy, a car etc. Compare the answers.

Main Lesson
(10 minutes)

Using textbook pages 29 and 30, explain approximate value of numbers, measures etc. and rounding off to one place, two places, or three places.

Practice session
(10 minutes)

Solve examples on the board with participation from the class (divide up to 2 places, 3 places etc.)

Write a few decimals and ask the students to give the answer rounded off to one decimal place, 2 decimal places etc.

For example, 0.275, 0.432, 16.892

Individual work
(20 minutes)

Give exercise 3b from the textbook to be done individually by each student. Help them solve it.

Homework

Give some sums for students to do at home.

Recapitulation

Revise terminating and recurring decimals; convert rational numbers to decimals giving the answer to a specified number of places.

UNIT 4

EXPONENTS

Topic: Laws of Exponents
Time: 2 periods

Objectives

To enable students to:

- write a number in index notation
- identify base and exponent
- evaluate expressions given in the index form
- deduce laws of exponents using rational numbers
- recognize zero exponent and negative exponent.

Starter activity
(10 minutes)

Write some numbers in index form and ask questions as given below.

10^5, 4^6, 3^4 $(18)^3$ etc.

What do you mean by 10^5?

What is 3^4 equal to?

How do we read 4^6?

What is the method of writing numbers in the form 10^5, 3^4, 4^6 called? (exponential or index form)

What is the base in 10^5, 3^4 and 4^6?

What is the power of 10, 3 and 4?

What is the other term used to express power of a number?

What do you mean by a^6?

What is a? What is the exponent?

How do we write $a \times a \times a \times a \times a$ and $(-a) \times (-a) \times (-a) \times (-a) \times (-a) = ?$

Main lesson
(10 minutes)

Using textbook pages 33 to 36, explain the terms base, exponent and when the base is negative with examples from the textbook.

1. $(-3)^4$

$(-3)^4 = (-3) \times (-3) \times (-3) \times (-3)$

$= (-1) \times 3 \times (-1) \times (-1) \times 3 \times (-1) \times 3$

$= \quad - \times - \qquad - \times -$

$+ \qquad +$

$+$

$(-3)^4 = 3^4$

If we multiply two negative integers, the result is positive.

2. $(-3)^5 = (-3) \times (-3) \times (-3) \times (-3) \times (-3)$

$(-1) \times 3 \times (-1)(3) \times (-1) \times 3 \times (-1) \times 3 \times (-1) \times 3$

$- \times - \qquad - \times - \qquad - \times -$

$(+) \quad \times \quad (+) \qquad (-)$

$(+) \quad \times \quad (-)$

$-$

The product of a positive and a negative integer is negative.

We can generalize with the following notations:

$(-a)^4 = a^n$ when 'n' is an even number
$(-a)^n = -a^n$ when n is an odd number

Give more examples and write the product with student participation.

$(-4)^2 = 4^2$ 2 is an even number
$(-4)^3 = 4^3$ 3 is an odd number

$(-5)^6 = 5^6$ the power or exponent is even
$(-5)^7 = -5^7$ the power or exponent is odd

$(6)^5 = 6^5$ and $(-6)^4 = 6^4$
$(-6)^5 = -6^5$

Consider $3^4 \times 3^2$. We can write it as:

$= (3 \times 3 \times 3 \times 3) \times (3 \times 3)$ or
$= 3^{4+2}$
$= 3^6$

Now take $a^4 \times a^3$. We can write it as:

$= (a \times a \times a \times a \times a) \times (a \times a \times a)$
$= a^{4+3} = a^7$

We can generalize this by using:

$a^m \times a^n = a^{m+n}$

We call it the law of product of powers.

Now let us consider: $2^3 \times 5^3$

Here the base is different but the exponent is the same. We can write it as:

$(2 \times 5)^3$ or $a^m \times b^m = (a \times b)^m$

This law is called the law of power of product.

Quotient Law

What is meant by quotient? When a number is divided by another number the result is called the quotient.

$125 \div 25 = \frac{125}{25} = 5; \frac{125}{5} = 25$ or 5^2

Now divide 5^3 by 5^2

$= \frac{5^3}{5^2}$

$\frac{5^4}{5^2} = \frac{5 \times 5 \times 5 \times 5}{5 \times 5} = 5 \times 5 = 5^2$

or

$5^{4-2} = 5^2 = 25$

This rule can also be generalized by taking it as:

$a^m \div a^n = a^{m-n}$

When the base is different and the power is the same.

Example

$8^3 \div 2^3 = \frac{8^3}{2^3} = \left(\frac{8}{2}\right)^3 = (4)^3 = 6^4$

In general we can write it as:

$a^m \div b^m = \left(\frac{a}{b}\right)^m$

Power Law

When a number in an exponential form is raised to another power, we simply multiply the exponent with the power. For example,

$(4^3)^2 = 4^{3 \times 2} = 4^6$

To generalize $(a^m)^n = a^{mn}$

From the above examples, we get the laws of indices which are:

1. $a^m \times a^n = a^{m+n}$
2. $\frac{a^m}{a^n} = a^{m-n}$
3. $(a^m)^n = a^{mn}$
4. $a^m \times b^m = (a \times b)^m$
5. $\frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$

$(-a)^m = a^m$ (when m is an even number)

$(-a)^n = -a^n$ (when n is an odd integer)

Zero exponent

When 5 is divided by 5, what is the result?

$\frac{5}{5} = 1$ if we apply the laws of indices here:

$\frac{5^1}{5^1} = 5^{1-1} = 5^0 = 1$

Let us take another example:

$\frac{5^2}{5^2} = \frac{25}{25} = 1$ or by the laws of indices

$\frac{5^2}{5^2} = 5^{2-2} = 5^0 = 1$

Hence any number raised to power zero is always equal to 1.

This can be written as:

$\frac{a^3}{a^3} = a^{3-3} = a^0 = 1$

so $x^0 = 1$, $y^0 = 1$ or any integer raised to the power zero is 1.

Negative exponent

By definition, $\frac{1}{8} = \frac{1}{2^3} = 2^{-3}$ (we read it as 2 raised to the power minus 3)

We generalize this as: $a^{-3} = \frac{1}{a^3}$

Let us take an example.

$5^6 \times 5^{-3}$

$5^6 \times \frac{1}{5^3}$ (since $5^{-3} = \frac{1}{5^3}$ by definition)

$= \frac{5^6}{5^3} = 5^{6-3} = 5^3$

Practice session
(10 minutes)

Worksheets will be given for practice. Help the students as they solve these problems.

1. Indicate the base and the exponent.

   a) 5^3 b) $(28)^2$ c) $2x$ d) 10^6 e) a^{15}

2. Apply laws of indices and write in the form of a^n.

   a) $4^3 \times 4^5$ b) $12^3 \times 3^3$ c) $\frac{14^5}{14^2}$ d) $\frac{25^4}{5^4}$

   e) $(6^2)^4$ f) $a^5 \times a^{-5}$ g) $9^7 \times 9^{-5}$

3. Rewrite as positive indices:

   a) x^{-4} b) 11^{-6} c) $a^{-2} \times a^{-3}$ d) $7^{-4} \times 7^{-2}$

4. Write in an index form:

   a) $3 \times 3 \times 3 \times 3 \times 3$ b) $2 \times 2 \times 5 \times 5 \times 5$

   c) $\frac{7 \times 7 \times 7}{5 \times 5 \times 5}$ d) $\left(\frac{4 \times 4}{4 \times 4 \times 4}\right)^3$

Individual work
(30 minutes)

Give Exercise 4a as class work.

Homework

Give some questions based on laws of indices.

Simplify using laws of indices. Verify the laws of indices for integers.

1. $(am)^n = a^{mn}$. Verify if this is true for $a = 5$, $m = 3$, $n = 2$
2. $a^m \times b^m = (ab)^m$ when $a = 5$, $b = 7$, $m = -2$
3. $\frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$ when $a = 4$, $m = 3$
4. $\frac{x^2}{x^{-1}} = x^3$
5. $y^{10} \times y^{-10}$

Recapitulation

Laws of indices will be revised. Identify the laws applied.

UNIT 5

SQUARE ROOT OF A POSITIVE NUMBER

Lesson 1

Topic: Perfect square
Time: 1 Period

Objective

To enable students to define a perfect square.

Starter activities

Activity 1

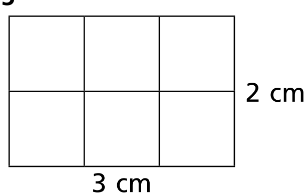


Fig. A

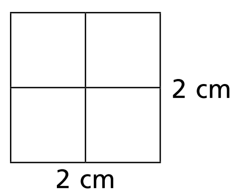


Fig. B

Name the figures drawn on the board. Figure A is a rectangle.

- What is the length and bread of the rectangle? Show that its length is 3 cm and breadth is 2 cm.
- What is its area? $l \times b = 3\text{ cm} \times 2\text{ cm} = 6\text{ cm}^2$
- Is the length and breadth of figure B equal?

When the length and breadth of a figure is equal what is it called? It is called a square.

- What is the area of figure B?

  $l \times l$ or $s \times s = 2\text{ cm} \times 2\text{ cm} = 4\text{ cm}^2$

  Figure B is a perfect square because its length and breadth are equal.

Activity 2

- What are the factors of the following numbers?

  9, 18, 25, 16, 20,

  $3 \times 3 = 9$, $4 \times 4 = 16$, $3 \times 6 = 18$, $4 \times 5 = 20$, $5 \times 5 = 25$
- Which of these numbers do you think are square numbers?

  9, 16 and 25 are square numbers, because both the factors are the same.
- Is 7 a square number? How can you make a square of it?

  No, 7 is a prime number. We can square it as follows:

  $7 \times 7 = 49$ or $7^2 = 49$

Main Lesson

When a number is multiplied by itself, the product is called the square of that number.

The square is called the Power of that number.

$8^2 = 64$ and $6^2 = 36$

because $8 \times 8 = 64$ and $6 \times 6 = 36$

8 is the square root of 64. What is the square root of 36?

The symbol used for square root is √ and it is called Radical and the number whose square root is to be found is called Radicand.

Radical $\leftarrow \sqrt{64} \rightarrow$ Radicand

We read it as 64, the square root of 64.

Note the square of an odd number is always odd.

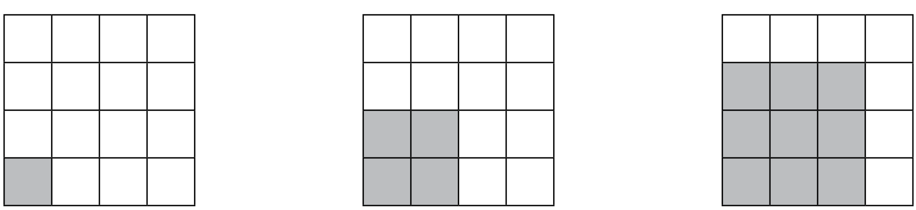
$3 \times 3 = 9$, $5 \times 5 = 25$, $7 \times 7 = 49$

The square of an even number is always even.

$4 \times 4 = 16$ or $8 \times 8 = 64$, $10 \times 10 = 100$

Practice session

1. Draw the following squares and find the area of the shaded portion.



2. Complete the tables from the textbook page 39.

Table A

	Number	Squares
a)	13	
b)	14	
c)	15	
d)	16	

Table B

	Square Numbers	Square Root
a)	36	
b)	144	
c)	100	
d)	121	

Individual activity

1. Pick out the square numbers from the following:

   23, 12, 110, 121, 56, 81, 72, 20, 99, 100

2. Find the square root of the following numbers:

   a) $\sqrt{169}$ b) $\sqrt{225}$ c) $\sqrt{400}$

Give exercise 5a questions 2 and 3 to be done in the class. Help the students with the exercises.

Homework

1. Find the area of a square with a length of 4.5 cm.
2. Complete the following:

   a) 9^2 = ____________ b) 70^2 = ____________ c) 1.1^2 = ____________

Lesson 2

Topic: Square root
Time: 1 period

Objectives

To enable students to:

- find out whether a given number is a perfect square
- apply the different properties of a perfect square

Starter activity

Ask the following questions:

1. What are the prime factors of:

   a) 8 b) 27

   The prime factors are:

   $8 = 2 \times 2 \times 2 = 2^3$ and $27 = 3 \times 3 \times 3 = 3^3$

2. What are the prime factors of 16?

   $2 \times 2 \times 2 \times 2 = 2^4$

3. What are the prime factors of 144?

   $144 = 16 \times 9$ or 12×12
   $16 \times 9 = 2 \times 2 \times 2 \times 2 \times 3 \times 3$
   $= 2^4 \times 3^2$

Main lesson

Explain to the students by giving the examples from the textbook page 40 that the prime factors of 8 and 27 do not have even powers i.e., $8 = 2^3$ and $27 = 3^3$.

But the prime factors of 16 and 144 have even powers.

$16 = 2 \times 2 \times 2 \times 2^4$
$144 = 2^4 \times 3^2$

Therefore, a number is a perfect square when all its prime factors have even indices (power is also called indices).

Properties of square number will be explained by giving the examples from the textbook page 41.

Property 1: Square of an even number is always even. Any even number can be written as 2n where 'n' is any integer:

$(2n^2) = 4n^2$ or $2 \times 2 \times n \times n$
$(20)^2 = 20 \times 20 = 400$
$(160)^2 = 160 \times 160 = 25600$

Property 2: Square of an odd number is always odd. Any odd number can be written as (2n + 1) where 'n' is an integer: $(2n + 1)^2$

Example: If $n = 3$, then $(2 \times 3 + 1)^2 = (6 + 1)^2 = 7^2 = 49$
and if $n = 5$, then $(2n + 1)^2 = (2 \times 5 + 1)^2 = (10 + 1)^2 = 11^2 = 121$

Property 3: Square of a proper fraction is less than the fraction itself.

Example: $\left(\frac{1}{2}\right)^2 = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}; \frac{1}{4} < \frac{1}{2}$

$\frac{2}{3} = \frac{2}{3} \times \frac{2}{3} = \frac{4}{9}; \frac{4}{9} < \frac{2}{3}$

Property 4: Square of a decimal fraction is less than 1.

Example: 0.4 is a decimal fraction and less than 1 and its square is also less than 1.

$(0.4)^2 = 0.4 \times 0.4 = 0.16$

or $0.4 = \frac{4}{10}$ and $\left(\frac{4}{10}\right)^2 = \frac{4}{10} \times \frac{4}{10} = \frac{16}{100} = 0.16$

Therefore, $0.4 > 0.16$ and $\frac{40}{100} > \frac{16}{100}$

Practice session

1. Which of the following numbers is a perfect square? Explain with working:

   a) 25 b) 39 c) 44 d) 81 e) 64

2. Which is greater?

   a) .1 or $(.1)^2$ b) $\frac{2}{5}$ or $\left(\frac{2}{5}\right)^2$

Individual activity

Give Exercise 5a questions 1, 2 and 3 for students to solve in the class. Select a few to be done in the class. Help them do it.

Homework

Give exercise 5a questions 1g, 1h, 1i, and 1j and 3h, 3i, and 3j as homework.

Recapitulation

To revise the lesson, ask these questions in the class:

1. Are the powers of prime factor of square even?
2. What is the sum of the squares of 5 and 3?
3. Is the sum of $(5)^2$ and $(3)^2$ a perfect square?
4. What does the symbol √ stand for?
5. What is the square root of 25, 36, and 100?

Lesson 3

Topic: Square root
Time: 2 periods (80 minutes)

Objectives

To enable students to find the square root by (i) factorization method (ii) division method

Starter activity

Is 36 a perfect square? What are its prime factors?
Is 96 a perfect square? What are its prime factors?

Students should be able to answer these questions as the numbers are small.

Main lesson

Explain Prime factorization or square root by prime factorization to the students with the help of the examples given on the textbook page 44.

Example 1

Find the square root of 256 first by the factorization method, and then by the division method.

Factorization method

Short division by prime numbers only.

$$\begin{array}{r|r}
2 & 256 \\ \hline
2 & 128 \\ \hline
2 & 64 \\ \hline
2 & 32 \\ \hline
2 & 16 \\ \hline
2 & 8 \\ \hline
2 & 4 \\ \hline
2 & 2 \\ \hline
 & 1
\end{array}$$

$\sqrt{256} = \sqrt{\overline{2 \times 2} \times \overline{2 \times 2} \times \overline{2 \times 2} \times \overline{2 \times 2}}$

$= 2^8$

It is easy to make 4 pairs of 2 to get the product or divide the power '8' by 2 = 4

$2 \times 2 \times 2 \times 2 = 16$

$\sqrt{256} = 16$

i.e. $256 = 16^2$

Division method

$$\begin{array}{lrr|r}
 & & & 16 \\ \cline{4-4}
 & & 1 & \hat{2}\overline{56} \\
\text{add the same} & + & 1 & 1\downarrow \\ \cline{2-4}
 & & 26 & 156 \\
 & & 6 & -156 \\ \cline{2-4}
 & & & \text{x}
\end{array}$$

$\sqrt{256} = 16$

Mark off the digits from right to left.
2 is single, divide it by a square number whose square is less or equal to 2.

1. Write 1 as a divisor and quotient.
2. Subtract 1 from 2; the remainder is 1.
3. Bring down the next pair i.e., 56. Now the dividend is 156.
4. In 156, the first digit is 6 so try with 4 or 6. $4 \times 4 = 16$ and $6 \times 6 = 36$

$$\begin{array}{r}
24 \\
\times 4 \\ \hline
96
\end{array}
\qquad
\begin{array}{r}
26 \\
\times 6 \\ \hline
56
\end{array}$$

The square root of a 3-digit number will always be a 2-digit number.

Example 2

Find the square root of 6084 by division.

6084 is a 4-digit number so it has 2 pairs.

	78
7	6084
+ 7	−49
148	1184
+ 8	1184
156	xx

Perfect square which is less than 60 is 49.

$7 \times 7 = 49$

The first digit of 1184 is 4.

To get 4, we will check by putting 2 or 8 with 14.

$$\begin{array}{r} 142 \\ \times\ 2 \\ \hline 284 \end{array} \qquad \begin{array}{r} 148 \\ \times\ 8\ ✓ \\ \hline 1184\ ✓ \end{array}$$

$\sqrt{6084} = 78$
$6084 = 78^2$
$6084 = 78 \times 78$

8 is the right number

Example 3

Find the square root of 10.3041

	3.21
3	10.3041
+ 3	− 9
62	130
+ 2	124
641	641
+ 1	− 641
642	x

- First pair is 10.
  3^2 is less than 10
- The next pair is 30.
  Bring it down with 1=130
- $62 \times 2 = 124$;
  124 is < then 130
- Bring down the next pair i.e., 41
  now the dividend is 641
  The first digit is 1
  $1 \times 1 = 1$ and $9 \times 9 = 81$
  $641 \times 1 = 641$

$\sqrt{10.3041} = 3.21$
Because $3.21 \times 3.21 = 10.3041$

Practice session

Find the square root by division method and factorization method.

a) 289 b) 196 c) 324 d) 1.69 e) 2.56

Individual activity

As class practice, give Exercise 5b, questions 1a to 1f and 2a to 2f. Guide the students.

Homework

Give exercise 5b questions1 g to 1j and 2g to 2j as homework.

Recapitulation

1. How many pairs you can make with a 6 digit number?
2. The first digit of the square root of 256 is ______________.
3. The first digit of the square root of 400 is ______________.

Lesson 4

Topic: Problems involving square root
Time: 2 periods

Objective

To enable students to solve real-life problems

Starter activity

Start the session by asking questions like:

1. There are 36 students in a class.
   a) Can you arrange them in a square?
   b) How many rows will you form?
   c) How many students will there be in each row?

   Hence: number of rows = number of students in each row.

   $x = x$
   $x \times x = 36$
   $x^2 = 36$
   $x = 6$

   Number of rows = 6
   Number of students in each = 6

2. There are 70 students in a class. The teacher wants the students to sit in a square frame. Can 70 students form a square?

   No, 70 is not a perfect square. What is the solution?

   Take away 6 students and send them to another classroom.

   $70 - 6 = 64$

3. Is 64 a perfect square number? Yes.
   How many rows can you make of it? 8 rows because 8 × 8 = 64
4. How many students will be there in each row? There will be 8 students.

Main lesson

Real-life problems involving square root will be explained to the students with the help of the example given on the textbook page 48.

Example

Let the number of students = x
Each child gives x number of two rupee coin = Rs $2x$
Total contribution = $x \times 2x = 2x^2$
$2x^2 = 1250$

$$x^2 = \frac{\overset{625}{\cancel{1250}}}{\cancel{2}}$$

$x^2 = 625$

$x = \sqrt{625}$

$x = 25$

Therefore, the number of students is 25 and each contributed 25 two rupee coins.

Example 2

Find the greatest and smallest 5-digit numbers which are a perfect square.

Solution

Greatest 5-digit number is 99 999
Smallest 5-digit number is 10 000
The smallest 5-digit number is a perfect square itself because,

100 × 100 = 10 000
$100^2 = 10\ 000$

But 99 999 is not a perfect square. We will find this by the division method and the remainder will be subtracted from 99 999.

	316
3	$\hat{9}9999$
+3	−9
61	×99
+ 1	61
626	3899
6	3756
632	143 Remainder

99 999 − 143 = 99856

99 856 is a perfect 5-digit square

$\sqrt{99\,856} = 316$

Individual activity (Day 1)

Give Exercise 5c question1a to 1e, question 3a to 3c and questions 4 and 5.

Homework

Give questions 1f to 1j of Exercise 5c and questions 6 and 7 as homework.

Individual activity (Day 2)

Exercise 5c, question 2 will be explained and the students will complete the exercise.

Homework

Give exercise 5c, questions 10, 11, and 12 as homework.

Recapitulation

To revise the lessons, give questions like these:

1. How many rows with equal number of plants in each row can you make with 121 plants?
2. Is the smallest 4-digit number a perfect square?

UNIT 6

DIRECT AND INVERSE PROPORTION

Lesson 1

Topic: Direct and inverse proportion
Time: 1 period

Objective

To enable students to solve problems related to direct and inverse proportion

Starter activity

Ask a few questions to recall direct and inverse proportion.

1. Asma bought 15 m of cloth and Nida bought 12 m of the same cloth.

   Asma pays more than Nida as the more the cloth, the more is the amount paid. Nida bought 3 m less than Asma. She will pay a lesser amount.
2. Nadia works 8 hours a day while Amir works 10 hrs a day. Who gets paid more?

   Amir's income will be more. More the time he works, more the amount he gets.
3. More jobs more the employment
4. What happens when there is strike in the city?

   Everything is shut down. It means more strikes lesser production.
5. If you are late for office, how will you drive the car, fast or slow?
   The less the time, faster the speed.

Main lesson

With the help of the starter activity, explain to the students that, a change in one variable brings a change in the other. Things depend on each other if two quantities are related so that a change in one causes a change in the other.

We have seen from example in the starter activity that there are two types of variations: Direct and inverse

Example 1

Proportion method

If the cost of 12 toy cars is Rs 1500, find the cost of (a) 8 cars (b) 3 cars.
Let the required cost be x.

	No. of cars	Cost in (Rs)
Start	12 ↓	1500 ↓
	8	x
	less the no. of cars	less the cost

The direction of both the arrows is the same. The problem involves direct variation.

$12 : 8 : : 1500 : x$

$12 \times x = 8 \times 1500$

$\frac{12x}{12} = \frac{\cancel{8}^{2} \times \cancel{2500}^{500}}{\cancel{3}\ \cancel{12}} = 1000$

$x = 1000$

Ans: Cost of 8 cars is Rs 1000

Unitary method

Cost of 12 cars = Rs 1500

Cost of 1 car = $\frac{1500}{12} = 125$

Cost of 1 car = Rs 125
Cost of 8 cars = $125 \times 8 = 1000$
Cost of 8 cars = Rs 1000

Example 2 from textbook page 54 will be explained on the board.

Proportion method

No. of people	days
↑ 6	9 ↓
10	x
More the people	less the time

The arrows are showing opposite directions.

∴ It is an inverse variation.

$10 : 6 :: 9 : x$

$10 \times x = 6 \times 9$

$\frac{10x}{10} = \frac{\overset{3}{\cancel{6}} \times 9}{\cancel{10}_{5}} = \frac{27}{5}$

10 men take $5\frac{2}{5}$ days.

Unitary method

6 people can paint a wall in 9 days.

I will paint in $6 \times 9 = 54$ days.

If the number of men decreases, the time increases.

10 men require:

$\frac{\overset{3}{\cancel{6}} \times 9}{\cancel{10}_{5}} = 27\frac{2}{5}$

10 men take less time i.e. $5\frac{2}{5}$ days

Practice session

Give some mental exercises.

1. Cost of 3 chairs is Rs 900. What will be the cost of 7 chairs?
2. A top can fill a tank in 10 hours. If two tops are open at the same time to fill it, how long it will take to fill the tank?

Individual activity

Give Exercise 6a questions1, 2 and 3 for students to do in class.

Homework

1. Cost of a dozen bananas is Rs 60. Find the cost of 8 bananas.
2. 8 men can complete a work in 15 days. How much time will 5 men take to complete the same work?

Recapitulation

For a quick revision, ask some mental questions.

1. How many types of variations are there?
2. Give some examples of an inverse variation from real-life.
3. If the speed of a train is fast, will it take less or more time to reach its destination.

Lesson 2

Topic: Compound proportion
Time: 1 period

Objective

To enable students to solve real-life problems involving more than two relations

Starter activity

Asking a few simple questions at the start of the lesson will make the students ready to learn it in detail.

If 14 men do a job in 8 days working 4 hrs daily, how many hours a day must 35 men work to do it?

1. How many units you see in this question?

   Three units: men, days, and hours

2. What do you have to find out?

   Hours

3. Are the units, days and hrs, in inverse or direct proportion?

   More days worked, lesser hours are needed and vice versa. So it is an inverse proportion.

4. What about men and days? Are they direct or inverse?

   They are also in inverse proportion, that is, if more men work, lesser days would be needed.

Main lesson

Explain to the students that when more than two ratios are involved in a problem it is called a compound proportion. Next, take question 3 on page 56 of the textbook as an example to explain this.

Proportion Method

worker	depth (ft)	hour
↑40	20 ↓	3 ↓
25	35	x

Method 1

Worker and hour (inverse), dig 35 feet (work) for x hours (direct proportion, more work more time.)

$$\left.\begin{array}{l}25 : 40\\ 20 : 35\end{array}\right\} 3 : x$$

$25 \times 20 \times x = 40 \times 35 \times 3$

$$\frac{25 \times 20 \times x}{25 \times 20} = \frac{{}^{2}\cancel{40} \times \cancel{35}^{7} \times 3}{{}_{5}\cancel{25} \times \cancel{20}_{1}} = \frac{42}{5} = 8.4 \text{ hrs}$$

Method 2

40 workers dig a 25 feet deep hole in 3 days
1 worker would dig: $40 \times 3 = 120$ hrs

25 workers will dig in $\dfrac{{}^{24}\cancel{120}}{25_{5}}$

Therefore, 25 workers dig a 1 foot hole in: $\dfrac{{}^{6}\cancel{24}}{5} \times \dfrac{1}{\cancel{20}_{5}} = \dfrac{6}{25}$

25 workers will dig a 35 feet hole in $\dfrac{6}{\cancel{25}_{5}} \times {}^{7}\cancel{35} = \dfrac{42}{5} = 8.4$ hours

Practice session

30 men drink 12 gallons of water in 4 days. Find how many gallons 50 men will drink in 30 days?

men	days	water (gallons)
↑ 30	40 ↑	12 ↑
50	30	x
more men		more water

less days (time decreases) water quantity decreases, all direct.
More examples from pages 56 and 57 will be explained.

Individual activity

Give exercise 6a, questions 4, 5, 6 and 7 to be done in the class.

Homework

Give exercise 6a questions 8, 9, and 10 as homework.

Lesson 3

Topic: Continued proportion
Time: 1 period

Objective

To enable students to define continued proportion

Starter activity

Asma wants to enlarge a painting which is in the ratio of 1 : 2 to 2 : 4

1 : 2 : : 2 : 4 or 1 : 2 = 2 : 4

This is called continued proportion. 1, 2 and 4 are three quantities of the same kind in continued proportion.

The second quantity i.e. '2' in this case is called the mean proportion.

The third quantity '4' in this case is called third proportional to the first and the second quantity.

Practice session

if a, b, c are in the proportion such that the ratio of (a to b) is equal to the ratio of b to c, then we will write it as:

a : b : : b : c ⟶ extreme

mean

1. Which is the second proportion?
2. What is it called?
3. Which is the third proportional?
4. Is the product of mean = product of extreme?

Example 1

Find x in the ratio:

$8 : x : : 4 : 6$

$$
\begin{aligned}
\text{product of mean} &= \text{product of extreme} \\
x \times 4 &= 8 \times 6 \\
4x &= 48 \\
x &= \frac{\cancel{48}^{12}}{\cancel{4}} \\
x &= 12
\end{aligned}
$$

mean extreme

$$
\begin{aligned}
12 \times 4 &= 8 \times 6 \\
48 &= 48
\end{aligned}
$$

Example 2

Find the mean proportional of 4, 9.

Solution

let the mean be x

$4 : x : : x : 9$

$x \times x = 4 \times 9$

$x^2 = 36$

$x = \sqrt{36}$

$x = 6$

$6 \times 6 = 4 \times 9$

$36 = 36$

Example 3

Find the third proportional.

8, 16

first second

Let the third proportional be x

f s s third

$8 : 16 : : 16 : x$

$8 \times x = 16 \times 16$

$8x = 16 \times 16$

$x = \dfrac{\overset{2}{\cancel{16}} \times 16}{\cancel{8}} = 32$

$8 \times x = 16 \times 16$

$8 \times 32 = 16 \times 16$

$256 = 256$

Individual activity

As for continued proportion no exercise is given, so a reference book (Get Ahead Mathematics for class 8) will be followed.

Find x in the following proportion.

1. a) $3 : 4 : 6 : x$ b) $2 : 5 : : x : 10$
2. Find the mean proportional of:
   a) 10, 40 b) 6, 96
3. Find the third proportional of:
   a) 3, 9 b) 8, 16 c) 5, 10

Homework

Find x in the following:

1. $3 : 4 :: 6 : x$ 2. $7 : 14 :: 3 : x$ 3. $7 : x :: x : 112$

Lesson 4

Topic: Time and distance
Time: 1 period

Objective

To enable students to solve real-life problems involving time and distance.

Starter activity

1. Rafi goes to school by car. The distance from his home to school is 15 km. The time he takes without stopping is 25 minutes. What do you think is the speed of the car?

   Speed = $\frac{d}{t}$ = 15/25 = 3/5 = 0.6 km
   or 15 km = 15000 m
   $\frac{\overset{600}{\cancel{15000}}}{\cancel{25}_{1}}$ = 600 meters
   600 meters/minutes
2. What is speed?
   Speed is the distance covered by a moving object.
3. If a car travels 18 km in 15 minutes its speed is ________ km/hr.
4. A train running at a speed of 42.5 km/hr travels ________ km in 10 minutes.
5. Activity table on page 60 of the textbook will be done.

Main Lesson

Distance, Time and speed will be explained by giving the examples.
What type of variation are these?

Distance	and	Time
More the distance		More the time (Direct)
Slower the speed		More the time
Faster the speed		Lesser the time

Example 1 will be explained from the textbook page 60.

A man is walking 7 km/hr. How long will he take to cover a distance of 42 km?

Method 1 (Unitary method)

The man covers 7 km is 1 hour

1 km in $\frac{1}{7}$ hours

42 km in $\frac{1}{\cancel{7}} \times \cancel{42}^{6} = 6$ hours

Method 2

Using the formula,

$$\text{Time} = \frac{\text{Distance}}{\text{Speed/n}}$$

$$= \frac{\cancel{42}^{6}}{\cancel{7}} = 6 \text{ hours}$$

Method 3 (Proportion method)

Let the time taken be x hour

speed distance (km)	time
7	1
42	x

$7x = 42$

$x = \frac{\cancel{42}^{6}}{\cancel{7}}$

$x = 6$ hours

Example 2 page 61 from the textbook will be explained by all the methods.

Individual activity

Give exercise 6b questions 1, 2, 3, 4 to be done in the class.

Homework

Give exercise 6b questions 5, 6 and 7 as homework.

Recapitulation

Ask questions similar to the ones give below, so that the concepts are recalled.

1. What type of variation is distance and time?
2. If a boy wants to reach his school in 10 minutes by car from his usual time, what should the speed be?
3. If your speed is slow you need more time or less time.

UNIT 7

PROFIT AND LOSS

Lesson 1

Topic: Profit and loss
Time: 2 periods

Objective

To enable students to recall terms like selling price, cost price, profit, loss and discount.

Starter activity

Ahmad bought a chair for Rs 800 and sold it for Rs 960. Find his profit.

1. What is the cost price of the chair? Rs 800
2. What is the selling price of the chair? Rs 960
3. Did Ahmed gain or lose on selling the chair? He gained because the selling price is greater than the cost price.
4. What profit did he gain?

   960 − 800 = 160

   The profit is Rs 160.

   Give the formula for finding the profit or loss.

   C.P. − S.P. = loss
   S.P. − C.P. = gain or profit
   C.P. + gain = S.P.
   S.P. − gain = C.P.

Main lesson

Profit percentage will be explained with the help of following examples.

Example 1

Atif bought a television for Rs 12000 and sold it for Rs 14000. Find the actual profit and the profit percentage.

Solution

C.P. = Rs 12000
S.P. = Rs 14000
Profit = S.P − C.P
14000 − 12000 = 2000
The actual profit is Rs 2000

Profit % = $\frac{\text{Profit}}{\text{C.P.}}$ × 100 (profit or loss is always calculated on C.P.)

$\frac{\overset{1}{\cancel{2000}}}{\underset{3}{\cancel{6}}\cancel{12000}} \times \overset{50}{\cancel{100}} = \frac{50}{3}$

Profit % = $16\frac{2}{3}$%

Example 2

Method 1

Sarah bought a watch for Rs 1000 and she sold it for a loss of 5%. Calculate the selling price and the loss.

5% = $\frac{5}{100}$ If the C.P. is Rs 100 then the loss is 5.

C.P. − loss = S.P.
100 − 5 = 95

But the actual C.P. of the watch is Rs 1000

C.P − S.P
100 − 95
1000 − x?

S.P = $\frac{10\cancel{00} \times 95}{1\cancel{00}}$ = 950

S.P = Rs 950
Actual loss = 1000 − 950 = 50
The loss is Rs 50

Method 2

5% of 1000

$\frac{5}{100}$ × 1000 = 50 loss

C.P. − loss = S.P.
1000 − 50 = Rs 950
S.P. = Rs 950

Practice session

Students will be divided into groups and given worksheets to solve.

1. Wasif bought a book for Rs 70 and sold it for Rs 80. Find his profit percentage.
2. Raza bought a CD at Rs 120 and sold it at a gain of 8%. Calculate the selling price.
3. Rehan sold a book for Rs 160 at a gain of 10%. Find the C.P. of the book.

Individual activity

Students will be asked to solve the table in Exercise 3 on page 70 of the textbook.

Homework

Day 1

1. Ali bought a ball for Rs 60 and sold it for Rs 85. What did he gain?
2. Rehan bought a table for Rs 850 and sold it for Rs 700. Find his loss percentage.

Day 2

1. Amna bought a pack of chocolates for Rs 360 and sold it for Rs 400. Find the profit %.
2. The selling price of a car is Rs 375 000 and the loss on it is Rs 28 850. Find C.P. of the car.
3. By selling a doll for Rs 480, a toy shop gains a profit of 8%. Find the C.P. of the doll.

Lesson 2

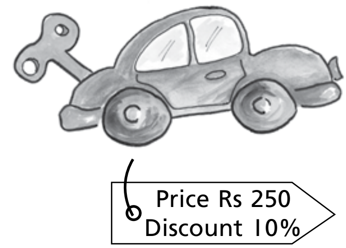
Topic: Marked price, discount %, real-life problems involving profit and loss
Time: 2 periods

Objective

To enable students to solve problems involving discount, profit and loss, marked price, C.P. and S.P.

Starter activity

Mrs Zafar went to buy some items from a shop and she finds that there is a discount given on each item.



1. What is the price printed on the tag of each item.
2. What is the printed price on the tag called? It is called marked price.
3. What is the discount given on the frock? It is 5%.

Discount means reduction on the marked price. When a person buys any item on sale he/she has to pay less than the marked price.

After explaining the terms discount and marked price, explain how to solve real-life problems.

Main lesson

Explain the examples given on pages 68, and 69 of the textbook.

Method 1

Zainab bought a dress marked at Rs 1800 after a discount of 10%. How much did Zainab pay for the dress?

Marked price = Rs 1800
Discount = 10%

If the marked price (M.P.) is Rs 100, the discount is Rs 10.
If the marked price is Rs 1800 the discount will be

$\frac{10}{1\cancel{00}} \times 18\cancel{00} = 180$ discount
MP − Discount
Zainab pays 1800 − 180 = 1620

Method 2

MP − Discount = selling price

100 − 10 = 90

If the M.P. is Rs 100, the selling price is Rs 90.

If the M.P. is Rs 1800, S.P. will be:

MP	SP
100	90
1800	x

$100x = 1800 \times 90$

$x = \frac{18\cancel{00} \times 90}{1\cancel{00}} = 1620$

Explain all the examples given in the textbook of unit 7 on pages 69, 70, 71 and 72.

Individual activity

Let the students solve problems from Exercise 7a from the textbook.

Homework

Give some of the questions from Exercise 7a as homework.

Lesson 3

Topic: Taxes
Time: 2 periods

Objective

To enable students to solve real-life problem involving taxes i.e. property tax, sale tax and general tax.

Starter activity

Arrange a few items on a table, for example, a pack of biscuits, a jam bottle and a masala packet.

Select any of the items and ask a student to read out to the class, its price and tax as written on its label. Repeat with other items and other students. Explain the property tax, sales tax etc. as given in the textbook. Ask, and then explain why property and other taxes must be paid. Explain each type of tax with the help of examples.

Main lesson

Mr Aslam rented out his house for Rs 30 000 and 2 shops at Rs 8000 per shop per month. Calculate the amount of property tax at the rate of 5% premium.

Example 1

Property tax is given yearly.

House rent = 30 000
Rent of two shops = 2 × 8000 = 16000
Total income = 30 000 + 16000 = 46000
Rate of tax = 5%
Yearly income = 46000 × 12 = 552000

5% mean if the income is Rs 100 the tax is Rs 5
5% of 552000

$\frac{5}{1\cancel{00}} \times 5522000 = 27600$

He has to pay Rs 27600 as property tax.

Example 2

General sale tax

What amount would Mr Faraz have to pay as tax if he sold a refrigerator for Rs 56 800 at the rate of 20%?

Cost of the refrigerator = 56800
Rate of percentage = 20%

$\% = \frac{20}{100}$

20% of 56800 = $\frac{20}{100} \times 56800 = 11360$

Mr Faraz will have to pay Rs 11360.

Individual work

Give Exercise 7b to be done in the class.

Homework

1. Razia paid Rs 2500 as property tax at the rate of 2%. Find the amount of property.
2. Find the commission of an agent at a rate of 10% if he sold a house for Rs 37 5000.
3. Goods worth Rs 8000 were sold in a shop. What amount will the shopkeeper have to pay when the GST is 15%?

Lesson 4

Topic: Zakat and Ushr
Time: 2 periods

Objective

To enable students to understand the terms Zakat and Ushr and solve related problems.

Starter activity

Explain the importance of Zakat and Ushr. The rate of Zakat and Ushr is always constant.

Main lesson

Example 1

The yearly income of a man is Rs 280 000. He spends Rs 220 000 every year. What amount of Zakat he has to pay?

Zakat is always given on saving (yearly)
Income − Expenditure = saving
280 000 − 220 000 = 60 000

Rate of Zakat = $2\frac{1}{2}\% = \frac{1}{40}$

$\frac{5}{2}\%$ of 60 000

$\frac{5}{\cancel{2}} \times \frac{1}{1\cancel{00}} \times \overset{300}{\cancel{60000}} = 1500 = 1500$

He will have to pay Rs 1500 as Zakat.

Example 2

Yearly saving of Amna is Rs 40 500 and she owned some gold jewellery costing Rs 250 000. Find the amount of Zakat she has to pay.

Total saving = 40 500 + 250 000 = 290 500

$2\frac{1}{2}\%$ of 290 500

$\frac{5}{2} \times \frac{1}{1\cancel{00}} \times 2905\cancel{00} = \frac{14525}{2} = 7262.5$

Amount of Zakat = Rs 7262.50

Example 3

Ahmad earns Rs 40 000 from his farm produce. What amount will he have to pay as Ushr?

Amount earned Rs 40000

Rate of Ushr = $\frac{1}{10}$ or one tenth

Total Ushr due $\frac{1}{10}$ of 40000

$\frac{1}{1\cancel{0}} \times 4000\cancel{0} = 4000$

He has to pay Rs 4000 as Ushr.

Individual activity

Give exercise 7c to be done in the class.

Homework

Give a worksheet comprising of problems similar to the examples given above to be done as homework.

Recapitulation

Ask questions similar to the ones given below to help students revise the lesson.

1. What is the rate of Zakat?
2. What is saving?
3. When do we have to pay Zakat?
4. What is Ushr?

UNIT 8 ALGEBRAIC EXPRESSIONS

Lesson 1

Topic: Algebraic Expressions
Time: 2 periods

Objectives

To enable students to:

- define and identify algebraic expressions (terms, constants, variable)
- differentiate between constant and variable
- identify types of polynomials with respect to terms (monomial, binomial, trinomial)
- perform mathematical operations in algebra (addition, subtraction, multiplication)

Starter activity (10 minutes)

Test previous knowledge by asking questions about algebraic expressions written on the board:

What is a constant? Give examples.
What is a variable? Give examples.
What is an expression? Give examples.
How do we define a polynomial?
Which of the expressions are polynomials?
What is a monomial, binomial or a trinomial expression?
Find the sum of $a + a + a$, $a + b - 2a + 2b$ etc.

Main lesson
(15 minutes)

Using textbook pages 80 to 82, explain like and unlike teams giving examples.

Like terms

$2x$, $-3x$, $4x$ or $2a^2$, $4a^2$, $-7a^2$ are like terms (terms in which the base and the exponents are the same).

Unlike Terms

Although the base is the same but the exponents are different.

$2a^2$, a^3, $5a$; $2a^3$, $3b^3$, $-4c^3$; x, xy, $2x^2y$ are examples of unlike terms.

Explain addition and subtraction of algebraic expressions giving examples.

- Like terms can be added to and subtracted from one another. To add like terms, simply add the coefficients of the terms. Thus to add $4x$, $3x$, $-2x$ simply add the coefficients 4, 3 and -2 i.e.

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

  Hence $4x + 3x - 2x = 5x$

Give more examples $3x^2 + 2x + 5$, $4x^2 + 8x + 3$ etc.

Explain the vertical and horizontal methods of addition and subtraction as given on the textbook page 80.

Give and explain rules of signs for addition with examples (apply the same rules for integers)

- The sum of two positive terms is also a positive term:

  $(+3x) + (+5x) = +8x$ (give some more examples)

- The sum of two negative terms is also a negative term:

  $(-3x) + (-5x) = -8x$ (give more examples)

- The sum of a positive and a negative term is equal to the difference of their coefficients and will be given the sign of the greater coefficient.

  $(-3x) + (+5x) = +2x$

  $(-8x) + (+6x) = -2x$ (give more examples)

Subtraction of algebraic expressions

To subtract a polynomial expression from another polynomial expression, change the sign of the expression that has to be subtracted and follow the rules of signs for addition.

1. Subtract $3x$ from $5x$
   $5b - (+3b) = 5x - 3x = 2x$

2. Subtract $-2x$ from $6x$
   $6x - (-2x) = 6x + 2x = 8x$ or vertically as:

$$\begin{array}{rr} & 6x \\ (-) & \mp\, 2x \\ \hline & +\, 8x \\ \hline \end{array} \quad (-2x \text{ is changed to } +2x)$$

3. Subtract $4x$ from $-7x$
   $-7x - (+4x) = -7x - 4x = -11x$

4. Subtract $-7x$ from $-4x$
   $-7x - (-4x) = -7x + 4x + -3x$

Work out more examples on the board using both methods (horizontal and vertical).

Multiplication of polynomials

Explain with the help of examples the multiplication of polynomials and give the rules of signs.

To multiply a polynomial by another polynomial, multiply the coefficients and add the powers of variables with the same base.

$(3x^2) \times (2x) = (3 \times 2)(x)^{2+1} = 6x^3$
$(-3x^2) \times (-2x) = (-3 \times -2)(x)^{2+1} = 6x^3$
$(-3x^2) \times (2x) = (-3 \times 2)(x)^{24} = -6x^3$
$(3x^2) \times (-2x) = (3 \times -2)(x)^{2+1} = -6x^3$

Rules of signs

By the above examples we get the rules of signs.

- The product of two positive terms is also a positive term $(+) \times (+) = +$
- The product of two negative terms is a positive term $(-) \times (-) = +$
- The product of a positive and a negative term is always a negative term $(+) \times (-) = -$

Multiplication of a binomial by a monomial expression

Multiply each term of the binomial with the given monomial.

1. $(4x + 2y^2) \times 3x$
   $(4x \times 3x) + (2x^2 \times 3x)$
   $= (4 \times 3)(x)^{1+1} + 2 \times 3)(x)^{2+1}$
   $= 12x^2 + 6x^3$

2. $(3a^2 + 7b) \times -5a$
   $= (3a^2 \times 5a) + (7b \times 5a)$
   $= (3 \times -5)(a)^{2+1} + (7 \times -5)(b \times a)$
   $= -15a^3 - 35ab$

Give some more examples.

Multiplication of a trinomial expression by a monomial expression.

$(4x^2 - 2x + 5) \times (2x)$
$(4x^2 \times 2x) + (-2x \times 2x) + (5 \times 2x)$
$= (4 \times 2)(x^{2+1}) + (-2 \times 2)(x^{1+1}) + (5 \times 2)(x)$
$= 8x^3 + (-4x^2) + (10x)$
$= -8x^3 - 4x^2 + 10x$

Hence to multiply a trinomial by a monomial, multiply each term of the trinomial with the given monomial.

To multiply a binomial with a binomial/trinomial, multiply each term of one binomial expression by each term of the other binomial/trinomial expression and add the like terms.

Explain the example from the textbook.

$(a + 2)\ (a^2 - 3a + 4)$
$= a(a^2 - 3a + 4) + 2(a^2 - 3a + 4)$
$= a^3 - 3a^2 + 4a + 2a^2 - 6a + 8$
$= a^3 - 3a^2 + 2a^2 + 4a - 6a + 8$ (arrange the like terms)
$= a^3 - a^2 - 2a + 8$ (simplify the like terms)

Like addition and subtraction, multiplication can be done horizontally (as above) or vertically.

Vertical method

$$\begin{array}{rrrrl}
 & a^2 & -\ 3a & +\ 4 & \\
 & & a & +\ 2 & \\
\hline
a^3 & -\ 3a^2 & +\ 4a & & \text{(multiply by a)} \\
 & +\ 2a^2 & -\ 6a & +\ 8 & \text{(multiply by 2 and place the like terms under the like terms)} \\
\hline
a^3 & -\ a^2 & -\ 2a & +\ 8 & \text{(like terms added)} \\
\hline
\end{array}$$

Practice session (10 minutes)

More examples of each type will be worked out on the board by the students.

Give worksheets for the practice of rules of signs.

1. $(-3a) \times (-5a^2)$
2. $(7a) \times (-6b)$
3. $(4x^2) \times (7x)$
4. $(2a + 3b) \times (-6a)$
5. $(-5p^4) \times (2p^2)$
6. $(-8c + 3d) \times (-5cd)$

Individual work (30 minutes)

Let the students solve Exercise 8*a* from the textbook. Word problems from daily life situations based on addition, subtraction multiplication will be given.

Homework

Give at least 3 sums of each (addition, subtraction and multiplication will be given) including word problems for homework.

Recapitulation

Reuse horizontal and vertical methods (addition, subtraction and multiplication) and discuss areas of difficulty. Revise rules of signs of addition and multiplication.

Lesson 2

Topic: Factorization
Time: (2 periods)

Objectives

To enable students to:

- understand and explain the meaning of factorization; compare and recognize various types of expressions and factorize
- apply suitable techniques to factorize the expressions using algebraic identities; factorize by making groups.

Starter activity
(10 minutes)

Write some expressions and ask questions:

- 2 × 3 = ______ what is the product of 2 and 3
- 5 × 7 = ______ what is the product of 5 and 3
- 4 × ______ = 28, with what number should 4 multiplied to get 28?
- In 6 × 7 = 42, which number is the product and which numbers are the factors?

Write some algebraic expressions and ask questions.

What are the factors of:

ab, x, $2x$, $a^2 - 4$, $a^2 + 2ab + b^2$ etc.

Main lesson
(15 minutes)

Refer to textbook pg 91 and explain the terms product and factors and the meaning and techniques of factorization.

Factorization: Reverse process of expansion

To factorize an expression means to find the factors of which it is the product.

Write a few more expressions and ask the students to give their factors.

$a^2 - 2ab + b^2$, $x^2 - 25$

(give a hint to apply the identities they have learnt)

Recall the Identities

Identities are very useful in finding the factors of expressions which are perfect squares or difference of two squares. Explain the steps to factorize (textbook page 91).

Besides the identities, there is another way of factorizing algebraic expression which is by making groups.

- Write the expression $x\ + 4x$ (extract the common factor) = $x(x + 4)$
- $3a^3 - 6ab$ (common factors) $3a(a^2 - 2b)$
- $ac + bc + ad + bd$

All the terms in the expression does not contain any common factor.

Divide the expression in two groups.

$ac + bc + ad + bd$

The lines under the terms show their grouping.

Take away the common factor from each group.

$c(a + b) + d(a + b)$

c is common in the first group while d is common in the second group.

Now $(a + b)$ is the common factor in both the groups. Taking it away, only c and d are left.

Hence

$$\begin{aligned} & ac + bc + ad + bd \\ &= c(a + b) + d(a + b) \\ &= (a + b)\ (c + d) \end{aligned}$$

Write the expression $(x + 3)\ (x + 4) = x\ + 7x + 12$

Recall the process or techniques of expanding expressions having their first terms alike.

Now to factorize expressions like $x^2 + 7x + 12$, find the sets of factors of the constant 12

$12 = 12 \times 1,\ 6 \times 2,\ 4 \times 3$

The middle term is $7x$. Which set of factors of 12 gives the sum 12?

$12 + 1 + 13 \neq 7,\ 6 + 2 = 8 \neq 7,\ 4 + 3 = 7$

Now 4 + 3 = 7, so we can write

$$x^2 + 7x + 12 = \underline{x^2 + 3x} + \underline{4x + 12} \qquad \text{since } (7x = 3x + 4x)$$
$$x(x + 4) + 3(x + 4)$$
$$= (x + 4)\,(x + 3)$$

Similarly, work out few more examples on the board with student participation.

$x^2 - 5x + 6$, $x^2 + 5x + 6$,
factor of + 6 = (2 × 3), (−2 × −3)

$x^2 - x - 6$, $x^2 + x - 6$
factor of −6 = $(-2x + 3)$ or $(-3x + 2)$

Practice session (10 minutes)

Worksheets can be given that could include matching the product with the factors.

1. Product / Factor

Product	Factor
$2ab$	$(4m + d)^2$
$x^2 + ax + 20$	$(p - 7)\,(p + 10)$
$4x^2 - 9y^2$	$2 \times a \times b$
$4x^3y - 8x^2y$	$(x + 4)\,(x + 5)$
$4a^2 - 20ab + 25b^2$	$(2x - 3y)\,(2x + 3y)$
$16m^2 + 24m^2 + 9$	$4x^2y(x - 2)$
$p^2 - 17p + 70$	$(2a - 5b)^2$

2. Apply Identities and factorize:

   $x^2 + 2xy + y^2$, $p^2 - 5pq - 14q^2$, $x^2 - y^2$, $m^2 - 2mn + n^2$, $m^4 - n^4$

Individual work (30 minutes)

Give exercise 8*c*, selected question of each technique of factorization to be done in class.

Homework

Give complete Exercise 8*c* as homework.

Recapitulation

Factorization of algebraic expressions can be done by:

- applying algebraic identities

  $(a + b)^2 = a^2 + 2ab + b^2$
  $(a - b)^2 = a^2 - 2ab + b^2$
  $a^2 - b^2 = (a - b)\,(a + b)$
  $(x + a)(x + b) = x^2 + x(a + b) + ab$

- by extracting common factors from all the terms

  $ab + ac + ad$
  $= a(b + c + d)$

- by grouping terms

  $ax + bx + ay + by$
  $x(a + b) + y(a + b)$
  $= (a + b)(x + y)$

- by breaking up the middle term and grouping

  $x^2 + 3x - 10$
  $x + 5x - 2x - 10$
  $x(x + 5) - 2(x + 5)$
  $(x + 5)(x - 2)$

Lesson 3

Topic: Algebraic Identities
Time: 2 periods

Objectives

To enable students to:

- define and differentiate algebraic equations and algebraic identities
- recognize and apply algebraic identities in expanding binomial expressions
- establish and apply algebraic identities in solving problems (evaluation)

Starter activity
(10 minutes)

Give activity sheets to refresh the previous knowledge.

Activity sheet

- Separate the polynomial expressions and equations.

  $2x + 3$, $4x$, $a + 5 = 11$, $x^2 - 4xy + 5y^2$,
  $2^x - 15 = 5$, $9a^2 - 25b^2$, $a^2 + 2ab + b^2$, $(a - b)^2 = 9$
  8, $ax - by - 1$

- Find the product:

  $3 \times a$ = ______________
  $2x \times -4$ = ______________
  $2(x + 3)$ = ______________
  $(x - 1)(2x + 3)$ = ______________
  $(a - b)(a + b)$ = ______________

- Find the product of (expand) without actual multiplication.
  1. $(x - 1)(x + 1)$
  2. $(x - 5)(x + 5)$
  3. $(a + b)^2$

Main lesson
(15 minutes)

We can find the product of (or expand) binomial expression or trinomial expression applying algebraic identities. Let us see what an algebraic identity means.

If $3(x + 4) = 10$, then what is the value of x?

Here $x = 2$. If we put $x = 3$ or any other number, the statement or the equation will not be true.

Explain by putting different values of x.

Now take $(x - 1)(x + 1) = x^2 - 1$

By actual multiplication $(x - 1)(x + 1)$

$$= (x)^2 + x(6) - (x)(1) + (1)^2$$
$$= x^2 - 1$$

or $(a - 2)(a + 2) = (a)^2 - (2)^2$

$$= a^2 - 4$$

By actual multiplication, $(a - 2)(a + 2) = (a)(a) + 2(a) - 2(a) + (-2)(2)$

$$= a^2 + 2a - 2a - 2a - 4$$
$$= a^2 - 4$$

that is, if we multiply two binomial expressions.

The product of the sum and difference of two binomial expressions is always equal to the difference of their squares.

Such an equation becomes an identity and provides us a rule for expanding expression without actually going through the process of multiplication. Give the definitions of algebraic equations and identities and introduce the four basic algebraic identities using textbook pages 84 and 85.

Identity 1

$$(x + a)(x + b) = x^2 + x(a + b) + ab$$
$$= x^2 + ax + bx + ab$$

Rule: product of two binomial expressions having the first terms alike = square of the 1st term + (1st term) (sum of the constants) + (product of the constants)

Work out some more examples with student participation.

Identity 2

$(x + a)(x - a) = x^2 - a^2$

Rule: product of the sum and difference of two terms = square of the 1st term − square of the 2nd term

Identity 3

$(a + b)^2 = a^2 + 2ab + b^2$
$(a + b)(a + b) = a^2 + 2ab + b^2$

Rule: product of the square of the sum of two terms = (square of the 1st team) + (twice the product of 1st + 2nd term) + (square of the 2nd term)

Identity 4

$(a - b)^2 = a^2 - 2ab + b^2$
$(a - b)(a - b) = a^2 - 2ab + b^2$

Rule: product of the square of the difference of two terms = (square of the 1st term) − (twice the product of 1st + 2nd term) + (square of the 2nd term)

Work out some more examples of each identity on the board with student participation.

These identities can be proved geometrically. Explain the geometrical proofs of the identities using textbook pages 86 and 87. Activity sheets will be given to the students for group work.

Practice session (15 minutes)

Worksheet will be given.

1. Match the following identities:

a)	$(a - b)^2$	$x^2 + 2xy + y^2$
b)	$(4a + 3b)(4a - 3b)$	$x^2 + 4xy + 4y^2$
c)	$(x + 2y)^2$	$a^2 - 2ab + b^2$
d)	$(p - q)(p + q)$	$m^2 - 3m - 10$
e)	$(m + 2)(m - 5)$	$p^2 - q^2$
f)	$(x + y)^2$	$16^2 - 9b^2$

2. Complete the following:

a) $(x - 4)(x - 7) = x^2 + x\,(\_\_\_\_\_\_) + \_\_\_\_\_\_$
b) $(p - q)^2 = \_\_\_\_\_\_ - pq + q^2$
c) $(a + b)^2 = a^2 + \_\_\_\_\_\_ + b^2$

d) (   ) (   ) = $x^2 - 16$

e) $71 \times 69 = (70 + 1)(\quad)$

f) $(405)^2 = (400 + \_\_\_\_\_)^2$

Also let the students solve examples from the textbook pages 87, 88, 89 on the board.

Individual work
(20 minutes)

Give exercise 8*b* from the textbook page 89, (select 4 sums each type) to be done in the class.

Homework

Give exercise 8*b* to be completed at home.

Recapitulation

Discuss algebraic identities and their application. Tests may be conducted to check students' understanding. Explain areas of difficulties again.

UNIT 9

LINEAR EQUATIONS

Lesson 1

Topic: Linear equation
Time: 1 period

Objectives

To enable students to:

- recognize and form algebraic equations
- define a linear equation.

Starter activity

Activity 1

As a starter, give this example and then ask questions as given.

Asif bought a pencil box for Rs 75 and has Rs 20 left with him. Form an expression.

1. How many rupees does Asif have? It is not given, therefore let the amount he has be Rs x.
2. How many rupees did he spend? Rs 75
3. Write an expression to show the amount he has spent. ($x - 75$)
4. How many rupees are actually left with him? Rs 20. The expression therefore becomes:

   $x - 75 = 20$

   It is called an equation because here the two expressions ($x - 75$) and 20 are equal.

   An equation is like a balance where both the sides are equal.

Activity 2

Form equations for the following:

1. When 8 in added to a number the result is 32.

   Let the number be x

   $x + 8 = 32$

2. Salma is 3 years younger than her brother. Form an expression.

   Let her brother's age be x years.
   Since she is 3 years younger, she is $(x - 3)$

3. The sum of a, b and c is Rs 50. Form an equation.

   $a + b + c^3 = 50$

4. Name the variables used in question 3.

   Ans. a, b and c^3

5. What powers do they have?

   Ans. The powers of a and b is1 while the power of c is 3.

6. Find the sum of 2a, 2a and 5c

   $2a + 2a + 5c = 4a + 5c$

What powers do a, b, and c have? The powers of a, b, and c is one. When in an equation, all the variables have their powers as one then it is said to be a linear equation.

Practice session

Which of the following equations are linear?

1. $a + b + c = 60$
2. $8a - 3b = 2c^3$
3. $x^3y^3z^3 = 45$
4. $2p - 3q = 3$
5. $7a - 8 = 10$

Individual activity

Give exercise 9a question 1 to be done in the class.

Homework

Write down the following statements in an equation form.

1. When a is divided by 5, the quotient is 10.
2. If 20 is subtracted from a number, the result is 7.
3. If 8 is multiplied by c and 5 is added to the product, the result is 12.
4. Sarah has Rs 10 more than her brother. Write an expression.

Recapitulation

1. Is $x - y = 35$, an expression?
2. $2a + 5c + 8y$
   a) What is the coefficient of c?
   b) What are a, c and y called?
3. $3x^2 - 4y$
   a) What power does x have?
   b) What is the power of y?

Lesson 2

Topic: Linear equation (solving equation)
Time: 2 periods

Objectives

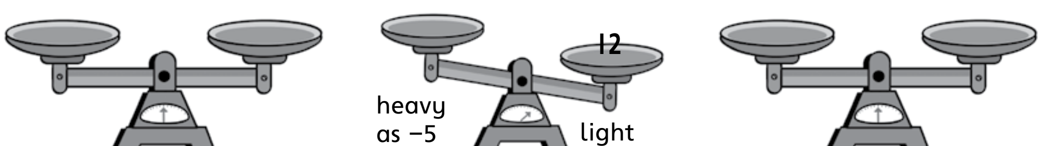
To enable students to:

- solve simple linear equations
- use additive and multiplication inverse to find the solution set

Starter activity

Draw a diagram of a balance on the board and ask the following questions to give the concept of equation to find the value of x, y any variable by using additive and multiplicative inverse.

Example 1



In figure 1, both the pans have equal weight.

Since we have to keep variables in one pan and the numbers in the other pan, we have to take away 5 from the pan by adding −5 in that pan.

Therefore in figure 2 when we add −5 (which is an additive inverse of 5) it has more weight.

In figure 3, we see that −5 has been added to 12. Both the pans now have equal weight.

$x + 5 - 5 = 12 - 5$
$x = 7$
Solution set = 7

Example 2

$3x - 4 = 17$
$= 3x - 4 + 4 = 17 + 4$ (Inverse of -4 is $+ 4$)
We add 4 to both sides.

$= 3x = 21$
$\frac{3x}{3} = \frac{21}{3}$ (Both sides divided by 3)
(multiplicative inverse)

$x = 7$
Solution set = 7

Verification
$3x - 4 = 17$
$3(7) - 4 = 17$
$21 - 4 = 17$
$17 = 17$

Example 3

$\frac{y}{12} = 3$

$\frac{y}{12} \times 12 = 3 \times 12$ (multiplying both sides by 12)

$y = 36$
Solution set = {36}

Example 4

$5(a + b) = 70$
$5a + 30 = 70$
$5a + 30 - 30 = 70 - 30$ (subtracting 30 from both sides)
$5a = 40$
$\frac{5a}{5} = \frac{40}{50}$ (dividing both sides by 5)
$a = 8$
Solution set = 8

Practice session

Call students to the board one by one to solve some equations.

Individual activity

Give Exercise 9b from the textbook to be done in the class.

Homework

Give Exercise 9b, 13 to 16 as homework.

Recapitulation

1. What is a linear equation?
2. Is $3x^2 + 4y$ a linear equation?
3. What is the value of y in equation $3y = 12$?
4. What is the additive inverse of 8, + 5, and 1?

Lesson 3

Topic: Equations containing unknown quantities on both the sides
Time: 2 periods

Objectives

To enable students to:

- solve equation containing unknown quantities on both sides
- solve real-life problems.

Main Lesson

Explain the example given on page 99 on the board and ask questions related to it.

Example 1

Mona's age is 17 more than 3 times the age of her child, Sara. Her father is the same age as her mother but his age is 3 less than eight times Sara's age. What is Sara's and her parents' age?

Since Mona is 17 more than 3 times age of Sara, we first suppose Sara's age to be x years.

Step 1 Suppose Sara is x years old, 3 times Sara's age is $3x$
Step 2 Mona is 17 more than $3x$, so Mona is $(3x + 17)$
Step 3 Since the father is 3 less than 8 times Sara's age, so the father's age $(8x - 3)$
Step 4 $3x + 17 = 8x - 3$ (bring the like terms together)

$3x - 8x = -3 - 17$

$-5x = -20$

$x = \frac{20}{5} = 4$

$x = 4$

Sara is 4 years old.

Mona's age $= 3x + 17 = 3(4) + 17 = 29$

Father's age $= 8x - 3 = 8(4) - 3 = 29$

They are 29 years old.

Example 2

Asma is twice as old as her daughter Meera. 15 years ago, she was 5 times as old as her daughter. Find their present ages.

Let the daughter's age be x years.

Since mother is twice the age of daughter, the mother is $2x$ years.

15 years ago:

Daughter's age was $(x - 15)$
Mother's age was $(2x - 15)$
Mother was 5 times the age of the daughter
$2x - 15 = 5(x - 15)$
$2x - 15 = 5x - 75$
$2x - 5x = -75 + 15$
$-3x = -60$
$x = \frac{\cancel{60}^{2}}{\cancel{3}}$
$x = 20$
Daughter's present age is 20 years.
Mother's age $2x = 2(20) = 40$ years.
Explain all the examples given on page 100 of the textbook to clarify the concept.

Practice session

Call some students to the board to solve problems.

Individual activity

Give exercise 9c to be done in the class.

Homework

Solve the following equations:

1. $9x + 4 = 3x - 9$
2. $2(5 - 2x) = 4(2 - 3x)$
3. Susan is 10 years older than her brother. In three years times she will be twice as old as her brother. What are their present ages?

Lesson 4

Topic: Fractional equation
Time: 2 periods

Objective

To enable students to solve fractional equations.

Main lesson

Fractional equations will be explained to the students with the help of the examples given on the textbook page 101.

Example 1

$$\frac{2b+5}{7} - \frac{4}{5} = \frac{2b-3}{3}$$

Step 1 Find out the LCM of 7, 5 and 3. LCM: 105

Step 2 Multiply each fraction by 105.

$$\overset{15}{\cancel{105}}\left(\frac{2b+5}{\cancel{7}}\right) - \frac{4}{\cancel{5}}\,(\overset{21}{\cancel{105}}) = \frac{2b-3}{\cancel{3}}(\overset{35}{\cancel{105}})$$

$$30b + 75 - 84 = 70b - 105$$

Step 3 Bring the like terms together.

$$30b - 70b = -105 + 9$$

$$-40b = -96$$

$$b = \frac{\cancel{96}^{\cancel{24}^{12}}}{\cancel{40}_{\cancel{10}_{5}}} = \frac{12}{5}$$

$$b = \frac{12}{5}$$

Solution set $= 2\frac{2}{5}$

Practice session

Students will be divided into groups of four and they will be given a worksheet to solve by sharing their knowledge.

Call students in turns to the board to solve the equations given. Make sure that the rest of the class observes the steps carefully so they can note them or even pin point if any mistake is committed.

Worksheet

Solve:

1. $\frac{5a}{3} + 6 = \frac{2a}{3}$
2. $\frac{3a}{4} + 9 = \frac{5a}{3}$
3. $\frac{6y+8}{5} = \frac{3y-10}{8}$

Individual work

Give Exercise 9d to be done in the class.

Homework

Give Exercise 9d questions 8 to 10 as homework.

Lesson 5

Topic: Real-life problems leading to simple equation
Time: 2 periods

Objective
To enable students to solve real-life problems involving simple equations

Starter activity
I think of a number and add 8 to it and the answer is 40. Find the number.'

Let the number be 'x'

I add 8 to it i.e. $x + 8$

Since the sum of $x + 8 = 40$

The equation is also, $x + 8 = 40$

$x + 8 - 8 = 40 - 8$ (by adding −8 to both sides)
$x = 32$

The number is 32.

Example 2
The sum of 3 times a number and 6 is equal to the sum of the number and 18. Find the number.

Let the number be 'x'

3 times the number = $3x$

When 6 is added to $3x$ the sum is 18.

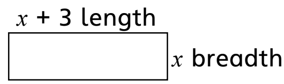
$= 3x + 6 = 18$
$3x + 6 - 6 = 18 - 6$
$3x = 12$
$x = \frac{\cancel{12}^{4}}{\cancel{3}}$
$x = 4$
The number is 4.

Main lesson
All the examples given in the textbook will be explained to the students.

Example 1
The length of a rectangle is 3 cm more than its breadth. If the perimeter of the rectangle is 12 cm, find the area of the rectangle.

Step 1

Draw a rectangle.



Let the breadth be x cm

Length = $x + 3$

Perimeter = 12 cm

Perimeter of rectangle = 2 (L + B)

$2(x + 3 + x) = 12$
$2(2x + 3) = 12$
$4x + 6 = 12$
$4x + 6 - 6 = 12 - 6$
$x = \frac{\cancel{6}^{3}}{\cancel{4}_{2}}$
$x = \frac{3}{2} = 1.5$ cm
Breadth = 1.5 cm
Length = $x + 3 = 1.5 + 3 = 4.5$ cm
$2(1.5 + 4.5) = 12$
$2(6) = 12$
P = 12 hence proved.

Practice session

Divide the students into groups, and give a worksheet to solve problems by sharing their knowledge.

Individual activity

Give Exercise 9e 1–5 to be done in the class.

Homework

Give Exercise 9e 10, 11 and 12 as homework.

Recapitlation

Give a small quiz to revise the important concepts and terms. Discuss any concept that the students may have not understood.

UNIT 10 FUNDAMENTALS OF GEOMETRY

Lesson 1

Topic: Properties of angles
Time: 2 periods

Objectives

To enable students to:

- identity and define adjacent angles, complementary angles, supplementary angles, vertically opposite angles
- calculate the measures of the angles applying properties of angles
- solve real-life problems related to properties of angles

Starter activity
(10 minutes)

Activity 1

Display charts with angles formed by objects and instruments from daily life and ask questions.

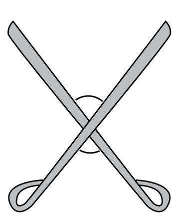


Figure 1

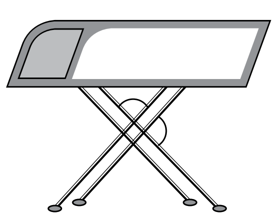


Figure 2

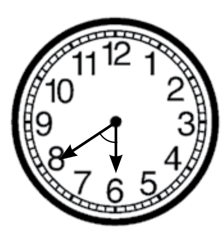


Figure 3

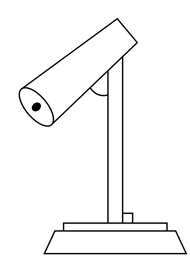


Figure 4

- Name the type of angle formed in each of the above figures. (right, acute, obtuse, reflex)

- Name the instrument used to measure an angle.
- What is the unit of measuring an angle?
- How do we define acute angle, obtuse angle or right angle etc?

Give the students activity sheets and let them work in groups to measure and find the sum. They should answer other questions.

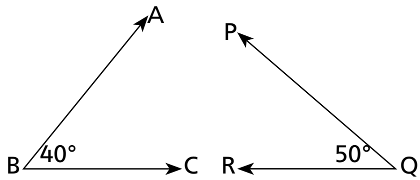


Figure 1

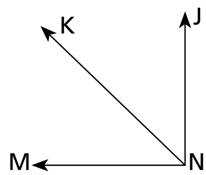


Figure 2

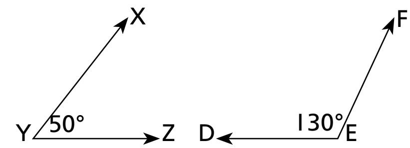


Figure 3

- What is the sum of angles in figure 1?
- What is the measure of ∠MNK and ∠JNK. Write their sum.
  ∠MNK + ∠JNK _______ + _______ = _______
- Measure the angles in fig 3 and write their sum. _______ + _______ =
- Which of the figures represent pair of complementing/supplementary angle?

Activity 2

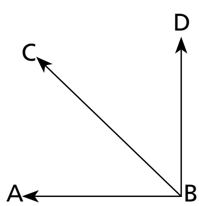


Figure 1

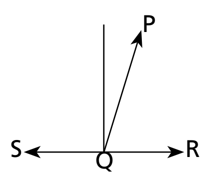


Figure 2

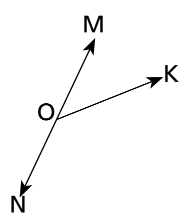


Figure 3

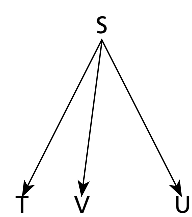


Figure 4

Name the angles in each of the figures given above.

Figure 1 ∠ABC, ∠CBD
Figure 2 ∠PQS, ∠PQR
Figure 3 ∠MOK, ∠NOK
Figure 4 ∠TSV, ∠VSU

Name the vertex of angles in figure 1.

Name the arms of each of the angle in the figure 1.

arms of ∠ABC, $\overleftrightarrow{BA}$ + $\overleftrightarrow{BC}$
arms of ∠CBD, $\overleftrightarrow{BC}$ + $\overleftrightarrow{BD}$

Which is the common arm?

What do we call the angles with a common vertex and a common arm?

Main lesson
(15 minutes)

Give the conditions of complementary angles and explain with the help of a figure drawn or the board.
In figure 1, the ∠ABD and ∠CBD share a common vertex (B) and a common arm ($\overleftrightarrow{BC}$). The uncommon arms $\overleftrightarrow{BA}$ + $\overleftrightarrow{BD}$ lie on the opposite sides of the common arm.

Such a pair of angles is called adjacent angles.

Also discuss the vertex and common and uncommon arms of the other figures.

Measure the angles in figures 2 and 3.

∠PQS + ∠PQR = 180° (sum of the angles is 180°, they are supplementary angles)

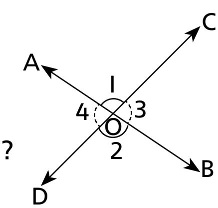
∠MOK + ∠NOK = 180°

∠PQS + ∠PQR are adjacent angles, and their sum is 180°, so they are called adjacent supplementary angles.

- Are the angles ABC and CBD supplementary?
- What do you say about fig 4?

Draw two intersecting lines on the board and ask questions.

- How many angles are there?
- Name all the angles four angles.
- Name the pairs of adjacent angles, are they supplementary?



What types of angles are:
1. ∠AOC + ∠BOD
2. ∠AOD + ∠BOC

They are not adjacent. They share only a common vertex and pairs of arms form (opposite rays) straight lines. We call them vertically opposite angles or vertical angles.

Measure each of the vertical angle. Are they equal in measure? (Call some students to the board to measure the angles.) Give the definition and properties of vertical angles.

Practice session
(10 minutes)

Worksheet will be given.

1. Identify the following pairs of angles.

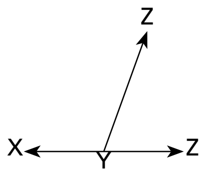


Figure 1

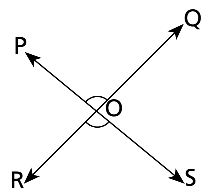


Figure 2

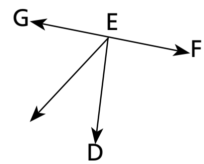


Figure 3

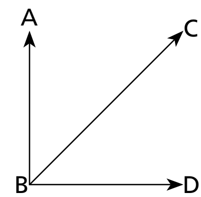
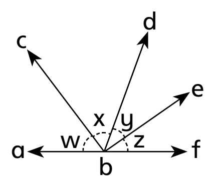


Figure 4

2. Find the complement and supplement of textbook pg 109, 110
3. Draw any two triangles, ΔABC and ΔPQR. Measure each angle and find the sum of all the angles. Is it 180° in each case?
4. Measure each angle in the figure given below and find the sum. Is the sum = 180°?



5. What conclusion do you draw from figures 3 and 4?

Individual work

Give exercise 10a. Selected questions (1 to 3) to be done in the class.

Homework

Give Exercise 10a questions 4 to 15 as homework.

Recapitulation

Revise the definitions and properties of angle. Summarize properties of angles.

Lesson 2

Topic: Congruent and similar shapes
Time: 2 periods

Objectives

To enable students to:

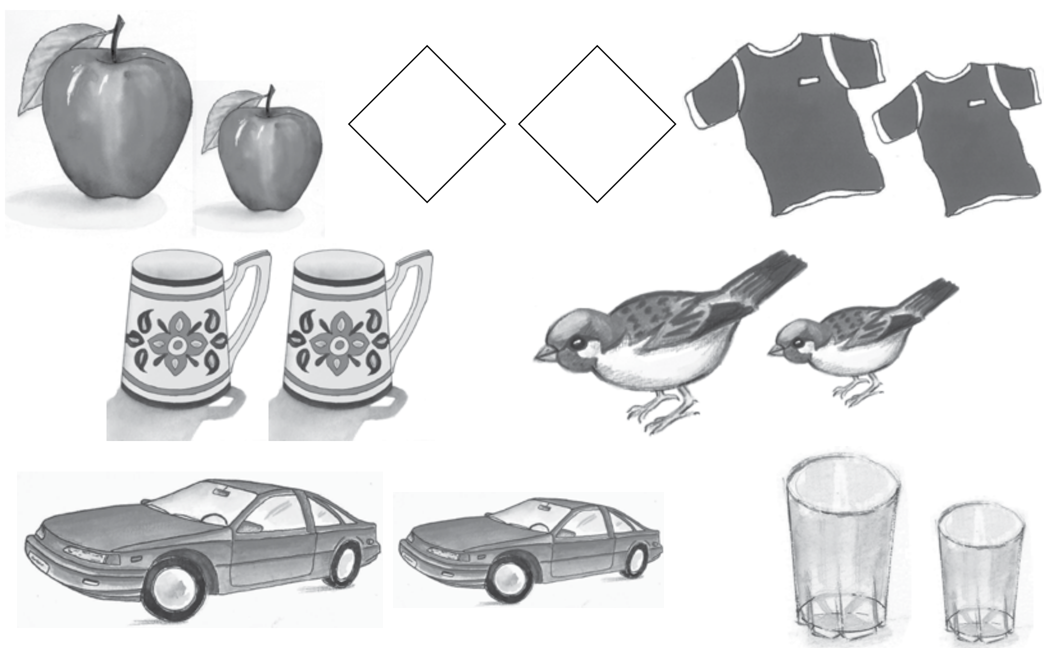
- identify congruent figures

- identify similar figures
- apply properties of congruency to prove the congruency of two triangles
- similarity of two figures under given conditions
- solve problems involving congruency and similarity in daily life situations

Starter activity
(10 minutes)

Activity 1

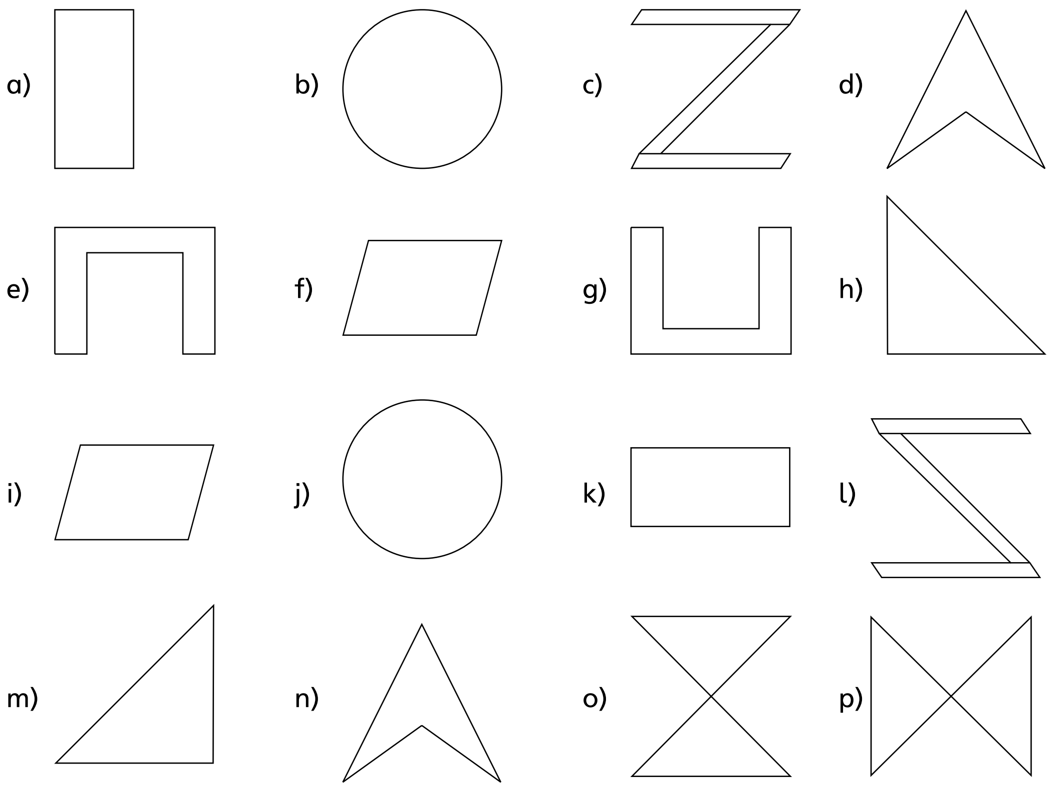
Display charts with pictures of congruent and similar objects and ask questions.



1. Which pairs of the figures have the same size?
2. Which pairs of pictures look alike?
3. If two shapes have the same size, what do we call them?
4. What do we call two objects which look alike?

Activity 2

Give a worksheet with pictures of similar and congruent shapes and ask the students to separate them and draw them in their respective columns.



Main lesson
(15 minutes)

Using textbook pages 114 and 115, give the definitions of congruent and similar shapes (in particular triangles), the elements of a triangle, (3 sides + 3 angles) and properties of congruent triangles.

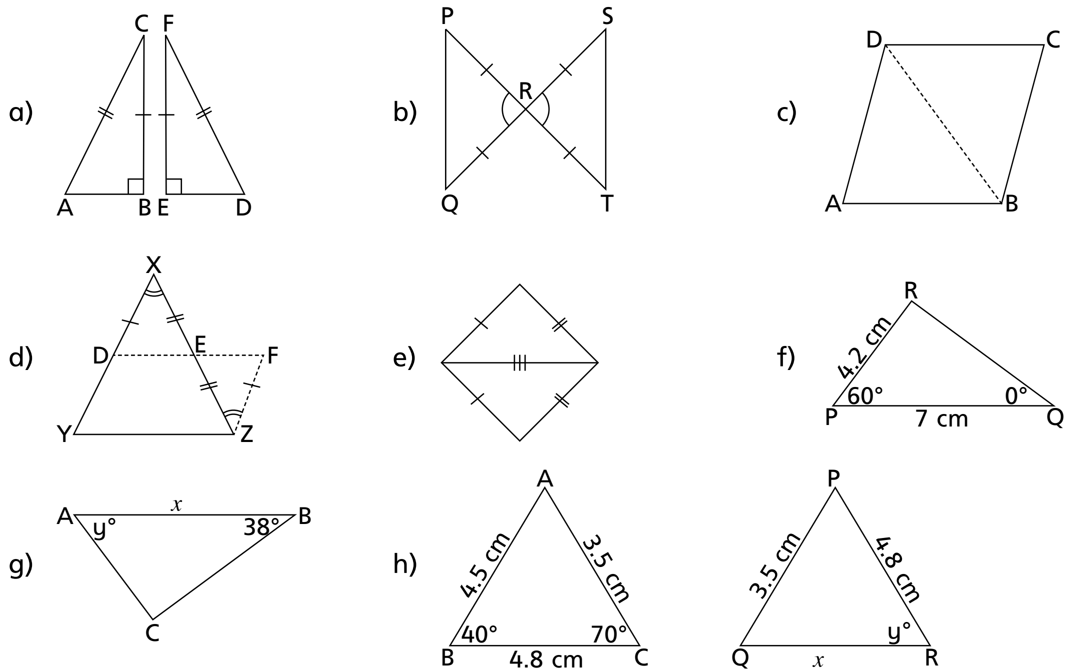
Congruency cases will be explained with examples.

Case 1: side/side/side property (SSS)
Case 2: angle/angle/side property (AAS)
Case 3: side/angle/side property (SAS)
Case 4: right/angle/hypotenuse and side (RHS)

Symbols used to denote congruency and similarity properties of congruency will be verified by making the students construct the triangles practically.

Practice session

By using the properties of the SSS, SAS, AAS and RHS, state whether a congruency property is present in each pair. Study the figure and find the values of x and y.



Individual work (20 minutes)

Give Exercise 10b from the textbook to be done in the class.

Verify the properties by constructing the triangles and superimposing them.

Verification of the other geometrical properties of triangles as given in examples on pages 116 and 118 of the textbook will be worked out.

Homework

Give exercise 10b, questions 7 to 14 as homework.

Recapitulation

- What is a triangle?
- How many elements does it have?
- What is the sum of the angles of a triangle?
- What are the conditions necessary for two triangles to be congruent?
- State two cases proving that two triangles are congruent.
- Discuss the areas of difficulty of the students.
- A short test should be conducted to check the understanding of the students.

UNIT 11

PRACTICAL GEOMETRY

Lesson 1

Topic: Line Segments
Time: 2 periods

Objectives

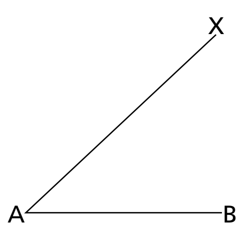
To enables students to:

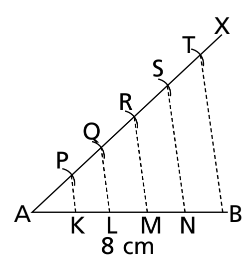
- define a line segment
- divide a line segment into a given number of equal parts
- to divide a line segment internally in a given ratio

Starter activity (15 minutes)

Ask questions to recall the basics of geometry.

- What is a point?
- What is a line? How many end-points does a line have?
- What is a line segment, how many end-points does a line segment have? Can we measure a line segment, a line?
- Draw a line segment AB 8 cm long. At point A, draw an angle BAX of any measure. From $\overline{AX}$, cut off segments such that AP = PQ = QR = RS = ST = 1 cm. Join T to B as shown below.





Now draw SN, RM, QL and PK parallel to TB. Measure the segments AK, KL, LM, MN and NB. Are they equal? Can you divide a line segment of any length into a given number of equal parts?

Main lesson
(15 minutes)

We can divide a line segment into a given number of equal parts by using the same method.

Explain the procedure using textbook pages 124 and 125. A line segment can also be divided internally in a given ratio. This method is also explained in steps on pages 126 and 127 of the textbook.

Practice session
(10 minutes)

Give worksheets with line segments of different lengths and ask the students to divide them into given number of equal parts (3, 4, 5 parts etc).

Individual work
(20 minutes)

Give Exercise 11a pages 127 and 128 to be done in the class.

Homework

Give a worksheet comprising of definitions of important terms and making an angle and forming line segments on it.

Recapitulation

Revise the concepts taught.

Lesson 2

Topic: Construction of Triangles
Time: 1 period

Objectives

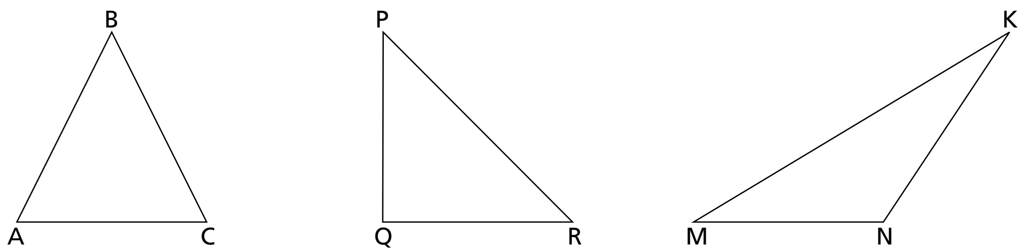
To enable students to:

- construct a triangle when perimeters and ratio among the sides are given
- construct an equilateral triangle when base is given
- construct an equilateral triangle when the attitude is given
- construct an isosceles triangle when the base and a base angle is given.
- construct an isosceles triangle when the vertical angle and altitude is given.

Starter activity

Ask the following questions to recall:

- How many elements does a triangle have?
- Name the different types of triangles with respect to angles, with respect to sides.
- Give activity sheets with some triangles drawn on them and ask students to measure the angles and sides of each triangle.



- Measure the lengths of each side of the triangles.
- What is the ratio of the sides of ΔABC, ΔPQR, and ΔMNK? (AB : BC : CA). Similarly, write the ratios of sides of the other triangles.
- What is the perimeter of ΔABC, ΔPQR, and ΔMNK?
- Measure the angles of ΔABC, $\angle A$ =__________, $\angle B$ = __________, $\angle C$= __________
- What is the sum of $\angle A + \angle B + \angle C$? Similarly, find $\angle P + \angle Q + \angle R$ and $\angle M + \angle N + \angle K$.
- Construct a triangle WXY where sides are in the ratio 2 : 3 : 4 and the perimeter is 18 cm.

Main lesson

Using textbook pages 128 to 134, explain the steps of construction of the triangles under given conditions Case I, Case II, Case III, Case IV, Case V and Case VI.

Practice session

Assist the students to work on the examples from the textbook.

Individual work

Give Exercise 11b, selected questions to be done in the class.

Homework

Give remaining questions from exercise 11b as homework.

Recapitulation

Ask questions that will help recall the lesson.

What is a triangle? What are the different types of triangles?
What is perimeter?
What are base angles? What is a vertical angle?
What is the altitude of a triangle?

Lesson 3

Topic: Quadrilaterals
Sub Topic: Parallelogram
Time: I period

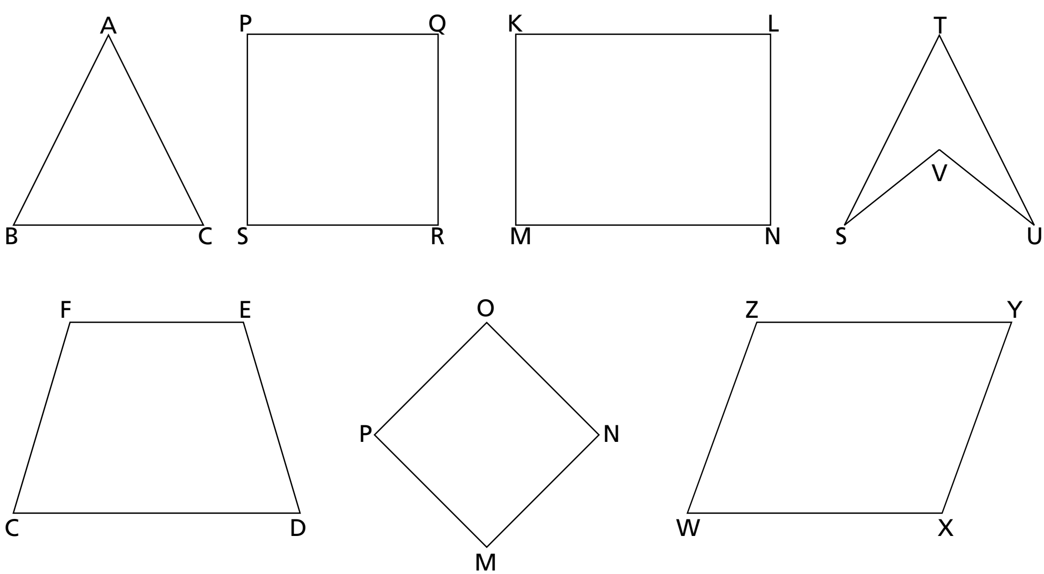
Objectives

To enable students to:

- define a quadrilateral
- define a differentiate types of quadrilaterals
- construct parallelogram under given conditions

Starter activity

Display charts with types of polygons and then ask questions like:



- What is a polygon? What is a quadrilateral?
- What is a three-sided figure called?
- What is a squarel? How many elements are there in a square?
- Which of the figures is a rectangle?
- What are the properties of a square?
- What measurements are required to construct a square, a rectangle?
- What is a parallelogram, how do we define it?

Main lesson

Using textbook pages 135 to136, explain and give the definitions of types of quadrilaterals specifically parallelogram.

- Give the components of a parallelogram
- Properties of a parallelogram
- Method of constructing a parallelogram
- Construction of a parallelogram when measurements of two adjacent sides and the angle between them are given (Case I). Explain the steps of construction as given on textbook page 137.
- Explain the steps of construction of a parallelogram when two adjacent sides and a diagonal are given as shown on page 138.

Practice session

Give worksheets to:
- identify the quadrilaterals and name them
- measure the sides and angles of each figure
- name the congruent sides in each figure
- construct the parallelograms from the data given (use examples from the textbook)

Individual work

Give Exercise 11c selected questions to be done in the class.

Homework

Construct squares, rectangle, rhombus and parallelograms with the given data and write the properties of each figure.

Recapitulation

Discuss and define properties of kinds of quadrilateral. Revise construction of parallelograms.

UNIT 12

CIRCLES

Lesson 1

Topic: Circle (different parts of circle) and circumference
Time: 2 periods

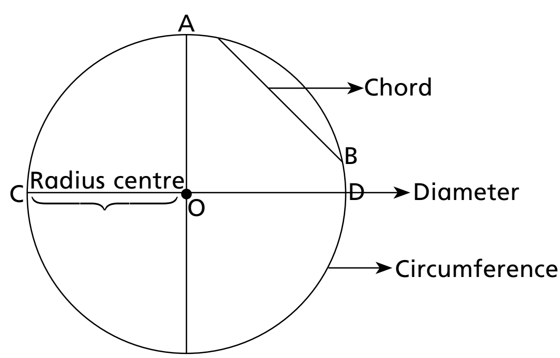
Objectives

To enable students to:

- recall the different terms associated with circle
- express pi (π) as the ratio between the circumference and the diameter of a circle

Starter activity

Draw a circle on the board and ask the students to label the diagram. Ask the following questions:



1. Define a circle.
2. What is a radius?

3. Which line divides the circle into two equal parts?
4. Which is the shortest line of a circle joining the two points of a circle?
5. Can you draw a number of chords in any circle?
6. What is the outline of the circle called?
7. Does a circle have many radii?
8. Does a circle have many diameters?
9. We can draw an infinite number of diameters and radii, what are they called?
10. What is an arc?

Main Lesson

Ratio between the circumference and the diameter of a circle will be explained to the students by giving activities.

Step 1

Ask the students to draw circles with different radii, and to draw diameters as well.

Step 2

Ask them to measure the outline of the circle (circumference) with the help of a thread and note down its measurement.

Step 3

Ask them to measure the diameter with the same thread, and note down the measure.

Step 4

Divide the circumference by the diameter $\frac{c}{d}$ $\frac{\text{circumference}}{\text{diameter}} = \pi$.

Call some students to write their answers on the board. They will note that their answers are approximately the same even though they have taken different radii. It will be explained to the students that the circumference of the circles with different radii will be different but the ratio $\frac{c}{d}$ in each case will be the same and this ratio is denoted by π and the approximate value is $\frac{22}{7}$ or 3.141.

Hence we have,

$\frac{c}{d} = \pi$

since $d = 2r$

Therefore, $c = \pi d$ or $\pi 2r$

$\Rightarrow c = 2\pi r$

Example 1

Find the circumference of the circle whose radius is 3.5 cm.

$c = 2\pi r$

$c = 2 \times \frac{22}{\cancel{7}} \times \cancel{3.5}^{.5} = 22.0$

$c = 22$ cm

Example 2

Find the radius of a circle whose circumference is 22 cm.

$c = 2\pi r$

$22 = 2 \times \frac{22}{7} \times r$

$22 = \frac{44r}{7}$

$r = \frac{7}{\cancel{44}_2} \times \cancel{22}^1 = \frac{7}{2}$

$r = 3.5$ cm

Example 3

Radius of a cycle wheel is 14 cm. Find the number of rotations that it makes in 12.1km.

one complete rotation = length of circumference

$c = 2\pi r$

12.1 km = 12.1 × 100 000 = 1 210 000 cm

$c = 2 \times \frac{22}{\cancel{7}} \times \cancel{14}^2 = 88$ cm

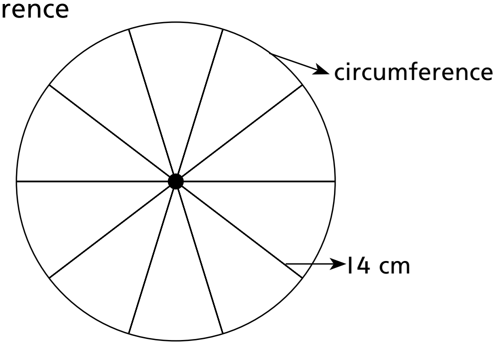
One rotation = 88 cm

or 88 cm covered in one rotation.

1 cm is covered in $\frac{1}{88}$ rotation

1 210 000 cm is covered in $\frac{\cancel{1\,210\,000}^{\cancel{110\,000}^{13\,750}}}{\cancel{88}_{8_1}}$

Number of rotations = 13 750



cycle wheel

Individual activity

Students will be asked to complete the activity table given on the textbook page 142 and a few questions will be given.

Homework

1. Find the radius of a circle with a circumference of:

   a) 42 cm   b) 5.6 cm   c) 2.8 cm

2. Give exercise 12a questions 7 and 8 from the textbook as homework.

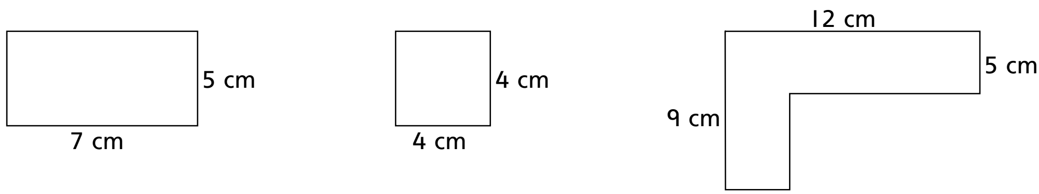
Lesson 2

Time: 2 periods
Topic: Area of a circle

Objective

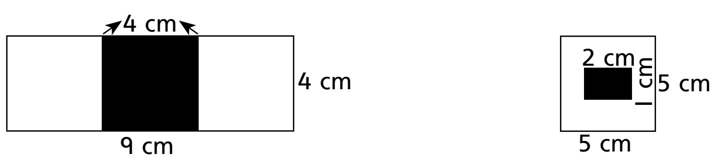
To enable students to find the area of a circle with different radii.

Draw the following figures on the board and ask the students to find the area.



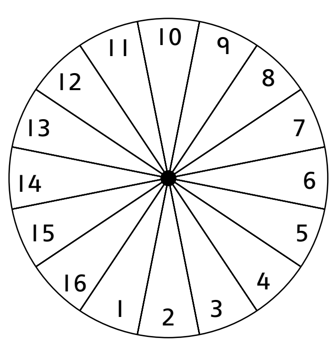
Activity 2

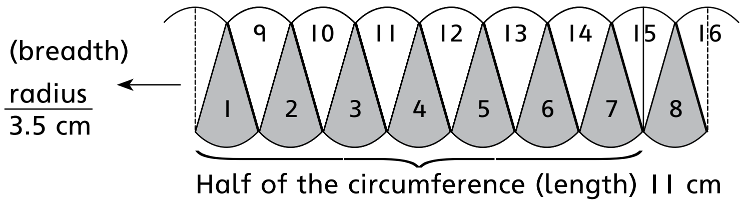
Find the area of the un-shaded part.



Main lesson

Activity 3





Step 1: A large circle will be drawn on the board to explain how to find out the length and breadth of a circle (as it has curved outline) to find the area of a circle. (The above activity will help them in finding the area of a circle).

Step 2: Area of circular region will be divided into 16 triangular regions.

Step 3: Alternate regions or parts will be shaded by one colour and will mark them as 1, 2, 3, 4, 5, 6, 7, 8 and the un-shaded will be marked or as 9, 10, 11, 12, 13, 14, 15, 16.

Step 4: Triangular regions i.e. 16 triangles will be cut along the boundaries.

Step 5: The entire shaded region will be kept in a row.

Step 6: The entire un-shaded region will be kept between shaded regions.

Step 7: The remaining once piece, will be divided into two equal parts and will be pasted or kept on either side.

This arrangement gives almost a rectangular region with length equal to half the circumference and breadth equal to the radius of the circle.

Area = Length × Breadth

$= \frac{1}{2}(2\pi r) \times r$

Area $= \pi r^2$

This gives the formula for area of a circular region of radius r. Area of a circular region is πr^2.

Area of rectangle = l × b

$3.5 \times 11 = 38.5 \text{ cm}^2$

Area of a circle $= \pi r^2$

$= \frac{22}{\cancel{7}} \times \overset{.5}{\cancel{3.5}} \times 3.5 = 38.5 \text{ cm}^2$

Hence proved that the area of the circle is approximately the same when its triangular pieces are arranged in a rectangular shape is l × b = r^2.

Practice session

Divide the students into groups of four. Each group will be asked to do the same activity with different radii by taking two coloured papers. Ask them to show the different steps as explained to find out the area of the circle.

Individual activity

Give a worksheet to each student to solve.

Worksheet

1. Find the area of a circular plate with a radius of:
   a) 7 cm   b) 5.6 cm
2. Find the diameter of a circular plate with an area of 616 sq cm.
3. What is the area of a circular disc with a diameter of 6.3 cm?.

Homework

Give Exercise 12a question 1 as homework.

Recapitulation

1. If the radius of a circle is 2.1 cm, what will be its:
   a) circumference   b) area
2. What is the value of pi?
3. If the diameter of a circle is 3.5 cm what will be its:
   a) radius   b) circumference   c) area

Students will be completing Exercise 12a by sharing their knowledge with each other.

UNIT 13

SURFACE AREA AND VOLUME

Topic: Surface Area of a cylinder
Time: 2 periods

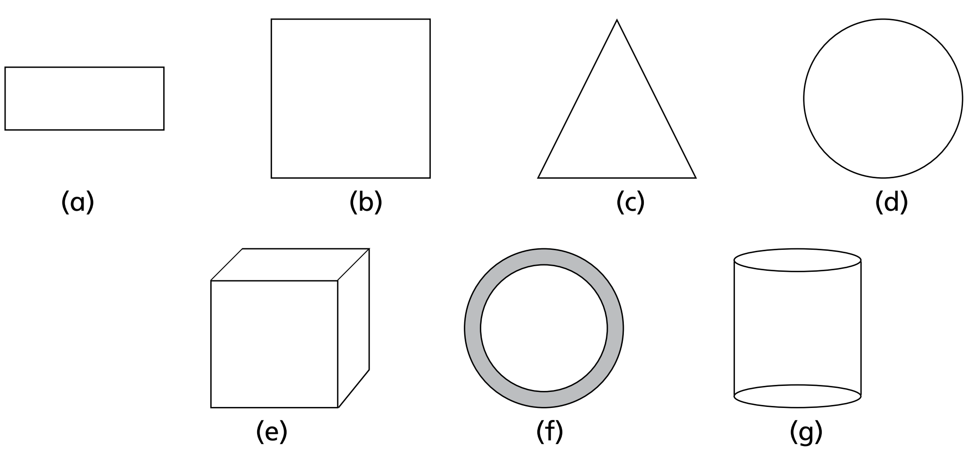
Objectives

To enable students to:

- identify solids, faces of solids
- define and calculate surface area of solids
- define a cylinder
- calculate the surface area of a cylinder; solve real-life problems related to surface area

Starter activity (10 minutes)

Display charts (or models) of some flat surface objects and solid objects. Ask some questions to start the lesson.



- Name the shapes of the objects (figures)
- What do you mean by the area of a rectangle?
- How do we calculate the area of a rectangle?
- Give the formula of the area of a triangle.
- What is the circumference of a side?
- How do we calculate the circumference of a circle?
- What is the unit of measuring area of a flat shape?
- How many faces does a cuboid have?
- What is the shape of each face?
- How can we calculate the area of a cuboid?

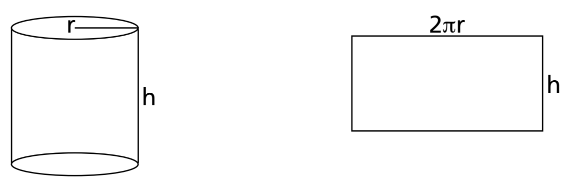
Main lesson
(15 minutes)

Using textbook pages 146 to 147, explain what a cylinder is.

Explain the total surface area of solids (cuboids, cylinders).

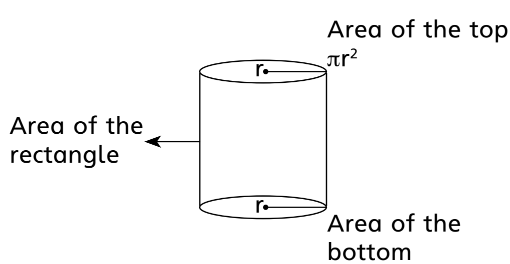
A cylinder is a solid with a circle as its uniform cross section (a stack of coins will give a good concept)

To calculate the surface area of a cylinder performs this activity.



Take a rectangular paper sheet and wrap it around a cylinder and then open it. What do you notice?

Area of the curved surface of the cylinder = Area of the rectangular paper covering it.



Area of a rectangle = $l \times b$, what is the length of the rectangle?

Length of the rectangle = circumference of the circle. (Cross-section of the cylinder)

Hence the length of the rectangle = $2\pi r$

Area of the curved surface of the cylinder = $2\pi rh$

(area of the rectangle = $l \times b$; here $l = 2\pi r$ and $b = h$)

The total surface area of a closed cylinder will be.

(Area of the top circle + area of the bottom circle) + Area of the curved surface
= $2\pi r^2 + 2\pi rh$ or $2\pi r (r + h)$ simplified.

Give the unit of measuring surface area of solids.

Practice session
(15 minutes)

Divide the students into groups and give cylindrical objects (wooden cylinders) and shoe boxes (cuboids) and have them try out the examples given in the textbook.

To find the total surface area of the cylinders, cuboids, solve a few problems with student participation.

Individual work
(20 minutes)

Give Exercise 13a of the textbook to be done in the class.

Homework

Collect 5 cylindrical objects (cans, tins etc. and find the surface area of each.

Recapitulation

To recall the lesson, give worksheets with questions like:

- What are three dimensional figures?
- How do we calculate the area of solids?
- Write the formula to calculate the surface area of a cylinder?

UNIT 14

INFORMATION HANDLING

Lesson 1

Topic: Frequency Distribution; Pie Charts
Time: 2 periods

Objectives

To enable students to:

- explain the terms raw data and organized data
- differentiate between raw data and organized data
- collect and classify data in a manageable way
- explain steps involved in classification of data
- define terms used in information handling: frequency, distribution table (ungrouped and grouped) discrete and continuous data, class intervals (continuous and discontinuous intervals), tally marks, frequency, lower limit, upper limit
- illustrate data through pie charts, bar graphs
- analyze, interpret and obtain information

Starter activity
(Time 10 minutes)

Display a chart showing marks obtained by a group of students in a mathematics test and ask the questions like the following:

22, 17, 7, 13, 10, 11, 15, 17, 18, 9
11, 10, 12, 19, 18, 12, 16, 15, 17, 19
15, 17, 20, 16, 10, 17, 20, 10, 13, 15

- What is the highest score of the class?
- What is the lowest score?
- How many students are there in the class?
- How many students scored 17 marks etc.

Display the same information in the form of a table.

Marks scored	No. of students
7	1
9	1
10	4
11	2
12	2
13	2
15	4
16	2
17	5
18	2
19	2
20	2
22	1

Main Lesson
(10 minutes)

Explain the importance of data presentation and the methods of collecting data (questionnaire, interviews, observations etc.)

Activity 1

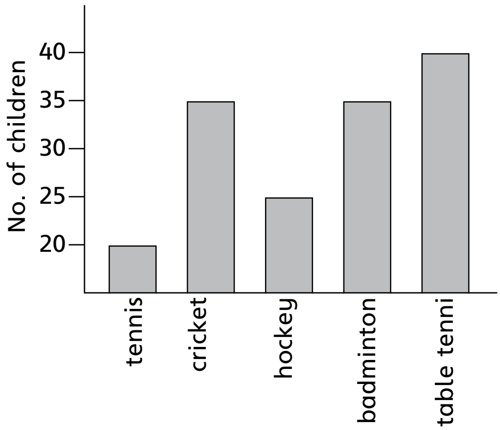
Ask from each student the month of the year in which they were born and note it on the board.

Dec	Feb	April	June	June	March	Dec
Aug	Dec	Jan	Aug	Oct	Dec	May
Sept	Dec	July	July	May	Nov	Sept
Dec	Jan	April	May	Nov	March	Sept
Feb	Nov	Sept	Aug	July	May	Sept

- Explain the purpose of collecting and organizing data.
- Explain the steps on the board and prepare the table. Also, explain tally marks, frequency and discrete frequency table.

Activity 2

Distribute activity sheets, with bar graphs or pie graphs showing some information and ask questions like these:



- Which is the most popular disk?
- How many students like mango juice?
- Which in the favourite sports of the students?
- How many like to play football?
- Which is most unpopular game?

Main lesson

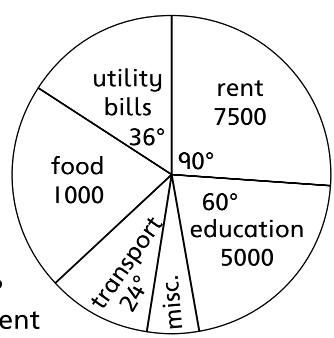
For showing students on how to prepare graphs, refer to pages 153, 154, and 155 of the textbook and explain the steps.

In bar graphs, explain the x-axis (date) and y-axis (frequency); width and length of the bars. In pie graphs or pie charts as they are also called, explain the method of calculating angle of sector. Explain the steps involved in making the pie graph, title, key etc.

Practice session (15 minutes)

1. Give worksheets with graphs drawn and let the students study them and answer questions.

The pie chart on the right shows information of a family's expenditure for a month.



- How much do they spent on food?
- What portion of their income is spent on education?
- What is the degree of sector for miscellaneous expenses?
- Calculate the degree of sector of food.
- How much is left for miscellaneous expenses if the income per month is Rs 30 000/-?

2. Give 5 examples of each of: discrete data and continuous data.

Individual work

Give Exercise 14a questions 1 to 3 to be done in the class.

Homework

Give some relevant data and ask the students to draw both a bar graph and a pie-chart.

Lesson 2

Topic: Frequency table
Time: 1 period

Formation of frequency table (grouped data). Explain the reason for grouping data, group or class intervals, size of the class interval, number of classes, continuous or discontinuous intervals, lower limit or upper limit of each class. Explain the process of formation of frequency distribution table by grouping the data. Refer to examples on pages 156 and 157 of the textbook.

Number of groups or class

The data must be divided into at least 5 groups. When the data is large, we can have more then 5 classes say 10 to 15 also.

Total number of values =? Pick up the largest value; pick up the smallest value

Find the difference of the largest or smallest value.

Divide the difference by the number of groups you wish to have, this gives the size of the class interval.

Example

In a data with 50 values, the largest value is 48, the smallest is 7.

Difference is = 48 – 7 = 41

No. of groups you wish to have = 6

Size of the class interval: $\frac{41}{6}$ = 6.6 approximately 7.

Explain and discuss range of the class interval; lower limit and upper limit of each; class interval.

Give activity sheets, with activities like the one on pages 156 and 157 of the textbook. Students can work in groups of three.

Practice session (10 minutes)

Study the table and answer the questions:

Scores	No. of students
1–3	12
4–6	18
7–9	25
10–12	13

- Find the table number of students.
- How many students achieved scores in 4–6 class interval?
- What is the upper limit of the 4th class?
- What is lower limit of the last class?
- Which class has the highest frequency?
- What type of table is this (Continuous or discontinuous)?
- What is the range of the class intervals?
- Into how many groups is the data divided?
- How many students scored points from 7 to 12?

Individual work

Give Exercise 14a, questions 4 to 8 to be done in the class.

Homework

Collect information for the number of people living in the household of your class fellows and prepare a frequency table.

State, which of the following data are discrete or continuous?

- The number of telephone calls made
- The ages of students of a class
- The distance your class fellows travel to school
- The different type of fruits in an orchid
- The number of members of a family
- Time taken to boil 10 eggs

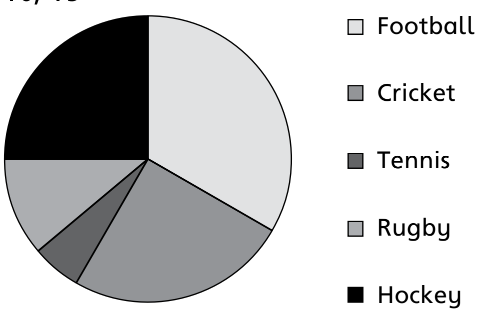
Recapitulation

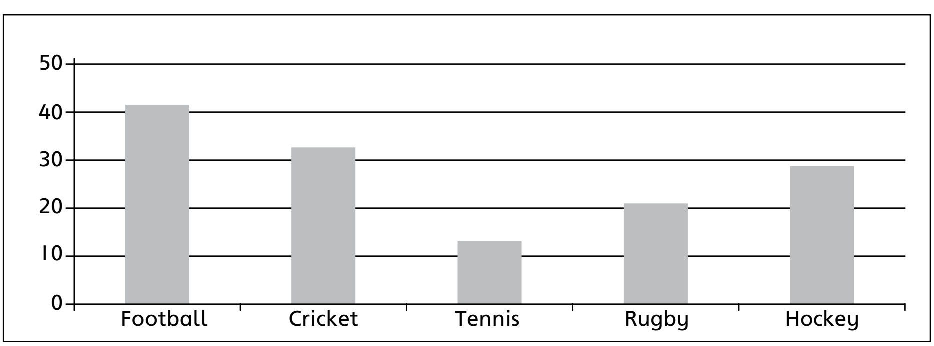
- Difference between discrete and continuous data.
- Revise the terms used in preparation of a frequency table.
- Calculate the angle of sector and draw pie chart.
- Worksheets will be given to assess students understanding of the topic.

ANSWERS

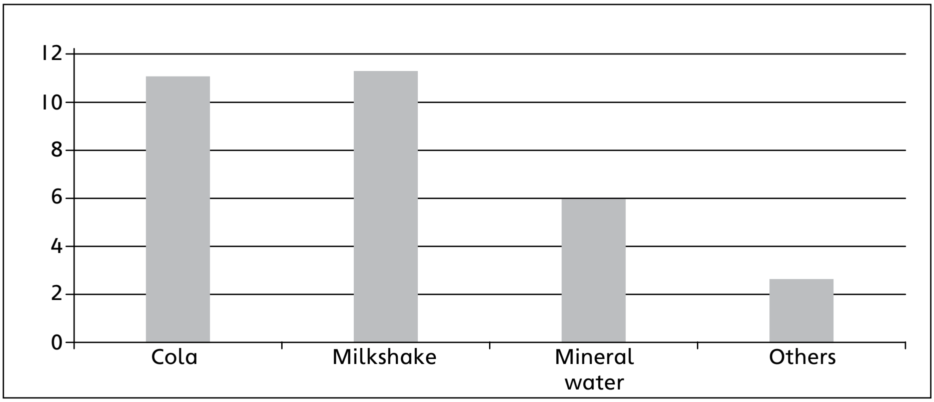
Getting ready for Class 7

1. a) −4 b) −2 c) −2 d) 27
2. a) 6.7 b) 9.96 c) 2570 d) 9100
3. 7.2250 g
4. a) 700 m^2 b) 20 cm^2 c) 1260 m^2
   d. Incomplete data
5. 72°, 90°, 18°
6. a) 5850 g b) 0.77, 1.15, 1.53
7. a) 40% b) $33\frac{1}{3}$%
8. 1.7280 cm^3, Rs 29.38
9. 1000,000 cm^3
10. 1000,000 m^2
11. a) 729 cm^3 b) 4.8 m
12. 36
13. a) 21.6 km/h b) 36 km c) 0.0972 hours
14. 10, 15
15.





16. a) cola 136.6°, milkshake 111.7°, mineral water 74.5°, others 37.2°
    b) cola 37.93%, milkshake 31.03%, mineral water 20.69%, others 10.34%
    c)



17. $4x^2 - 8x + 4$
18. 12 workers
19. 60 g
20. Rs 1106
21. a) 166.66 g, 333.3 g, 400g, 100g b) 100g, 200g, 240g, 60g
22. a) −15.5 b) 5.2 c) 7 d) y e) 32
23. a) 64 = 13 + 15 + 17 + 19
    b) 125 = 21 + 23 + 25 + 27 + 29
    c) 216 = 31 + 33 +35 +37 + 39 + 41
    d) 343 = 43 + 45 + 47 + 49 + 51 + 53 + 55
    e) 512 = 57 + 59 + 61 + 63 + 65 + 67 + 69 + 71
    f) 729 = 73 + 75 + 77 + 79 + 81 + 83 + 85 + 87 + 89
24. a) 224 b) 448 c) 896 d) 1792 e) 3584
25. 400
26. Rs 195,000,000
27. L.C.M. = 254,016,00, H.C.F. = 4
28. 800 cm
29. a) {Karachi, Lahore, Quetta and Peshawar}
    b) {violet, indigo, blue, green, yellow, orange and red}
    c) {North America, Asia, South America, Africa, Australia, Antartica, Europe}
    d) {151, 157, 163, 167, 173, 179}
    e) { }
30. a) infinite b) { } c) equivalent d) equivalent
    e) singleton f) finite
31. Bag B
32. 1.275

Unit 1: Sets

Exercise 1a

1. a) a) A= {x : x is a number formed by any two digits from 1, 2, 5}
   b) A= {12, 15, 21, 25, 51, 52}
   n(A)= 6

   b) a) B = {x : x is a digit of $(101)^3$}
   b) B = {0, 1, 3}
   n(B) = 3

   c) a) C = {x : x is a perfect cube, $x < 25$}
   b) C = {1, 8}
   n(C) = 2

   d) a) D = { is a square number, $101 < x < 200$}
   b) D = {121, 144, 169, 196}
   n(D) = 4

2. a) a) A = {all square numbers less than 101}
   b) A= {1, 4, 9, 16, 25, 36, 49, 64, 81, 100}
   n(A) = 10

   b) a) B = { all the angles of a pentagon ABCDE}
   b) B = {<A, <B, <C, <D, <E}
   n(B) = 5

   c) a) C = {all the months of the year}
   b) C = {Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sept, Oct, Nov, Dec}
   n(C) = 12

   d) D = {all the digits in the square root of 144 : 4489}
   D = {1, 2, 6, 7}
   n(D) = 4

   e) a) E = {All letters used as roman numerals}
   b) E = {I, V, X}
   n(E) = 3

3. a) a) A = {signs of mathematical operation}
   b) A = {x : x is a sign of mathematical operation}

   b) a) B = {Days of the week starting with the letter "T"}
   b) B = {x : x is a day whose name starts with "T"}

   c) C = {colours of the lights in a traffic signal}
   C = {x : x is a colour of the lights in a traffic signal}

d) D = {sides of right-angled triangles that prove the Pythagora's theorem}
D = {x : x sides of a right-angled triangle that proves the Pythagora's theorem}

e) a) E = {numbers less than 17 which are in increasing powers of 2}
b) E = {x : x is 2^n, $x < 7$}

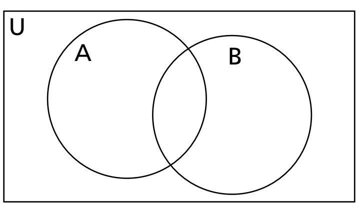
4. a) Non-empty and Infinite
b) Non-empty and Infinite
c) Non-empty and Infinite
d) Non-empty and Finite
e) Non-empty and Finite

5. a) Overlapping
b) Overlapping
c) Disjoint
d) Disjoint

6. a) False
b) False
c) True
d) True
e) True

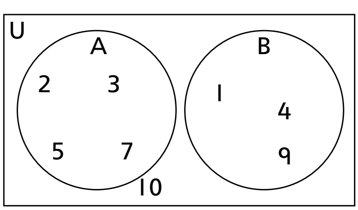
Exercise 1b

1. a)



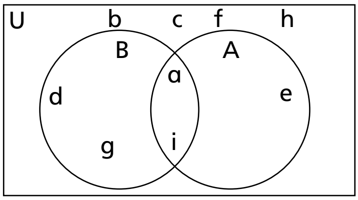
A∩B = {students who play both chess and cricket}
A∪B = {students who play chess and students who play cricket}
A−B = {students who play cricket and not chess}
B−A = {students who play chess and not cricket}

b)



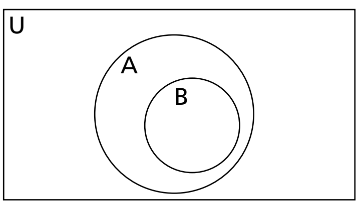
A∩B = {}
A∪B = {1, 2, 3, 4, 5, 7, 9}
A−B = {2, 3, 5, 7}
B−A = {1, 4, 9}

c) All the letters in the word DIAGRAM are not in the Universal Set. This question is incorrect.



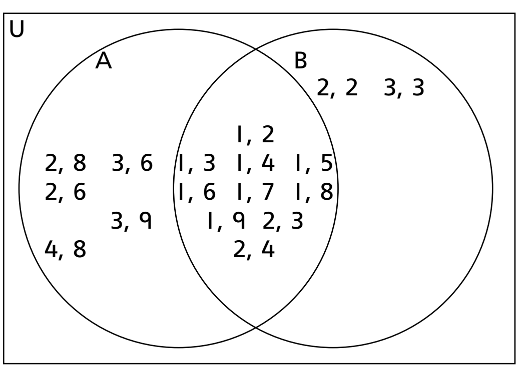
A∩B = {a, i}
A∪B = {a, d, e, g, i}
A−B = {d, g}
B−A = {e}

d)



A∩B = {all the jeans in the shop}
A∪B = {all the lowers in the shop}
A−B = {all the lowers except the jeans in the shop}
B−A = {}

e)



A∩B = {1,2; 1, 3; 1, 4; 1, 5; 1, 6; 1, 7; 1, 8; 1, 9; 2, 3; 2, 4}
A∪B = {1, 2; 1, 3; 1, 4; 1, 5; 1, 6; 1, 7; 1, 8; 1, 9; 2, 2; 2, 3; 2, 4; 2, 6; 2, 8; 3, 3; 3, 6; 3, 9; 4, 8}
A−B = {2, 6; 2, 8; 3, 6; 3, 9; 4, 8}
B−A = {2, 2; 3, 3}

2. a i) U = { 11, 12, 13, 14, 15, 16, 17, 18, 19}
A = {11, 12, 13, 14}
B = {11, 16, 19, 20}

ii) A∪B = {11, 12, 13, 14, 16, 19, 20}
A∩B = {11}
A′ = {15, 16, 17, 19, 20}
B′ = {12, 13, 14, 15, 17}
A−B = {12, 13, 14}
B−A= {16, 19, 20}

iii) A∪B = {11, 12, 13, 14, 16, 19, 20} and A′ = {15, 16, 17, 19, 20}
The elements are different in both the sets.
Hence, A∪B ≠ A′.

b) i) U = {a, b, c, d, e, f, g, h, j, k, l}
A = {a, b, c, d, e}
B= {f, g, h}

ii) A∪B = {a, b, c, d, e, f, g, h}
A∩B = {}
A′ = {f, g, h, j, k, l}
B′ = {a, b, c, d, e, j, k, l}
A−B = {a, b, c, d, e}
B−A = {f, g, h}

iii) Proof: A = {a, b, c, d, e}
B′ = {a, b, c, d, e, j, k, l}
A∩B′ = {a, b, c, d, e,}
Hence, A∩B′ = A

iv) Disjoint sets

c) i) X = {20, 30, 40, 60, 90}
Y = {20, 30}

ii) X∪Y = {20, 30, 40, 60, 90}
X∩Y = {20, 30}
X′ = {10, 50, 70, 80}
Y′ = {10, 40, 50, 60, 70, 80, 90}
X−Y = {40, 60, 90}
Y−X = { }

iii) Proof: Y = {20, 30}
X = {20, 30, 40, 60, 90)
Y − X = { }, Hence proved

iv) Y is a subset of X

d) i) $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15\}$
$P = \{1, 2, 3, 6, 9\}$
$Q = \{1, 2, 4, 5, 8, 10, 11\}$
$R = \{1, 3, 4, 5, 7\}$

ii) $P \cup Q = \{1, 2, 3, 4, 5, 6, 8, 9, 10, 11\}$
$P \cap Q = \{1, 2\}$
$R \cup P = \{1,2, 3, 4, 5, 6, 7, 9\}$
$P \cup Q \cup R = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11\}$

iii) No

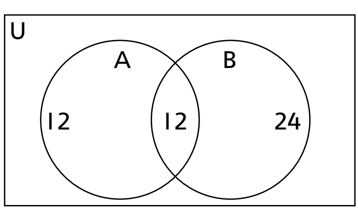
iv) $P \cup (Q \cup R)' = \{1, 2, 3, 6, 9, 12, 13, 14, 15\}$ and
$P \cup (Q' \cap R') = \{1, 2, 3, 6, 9, 12, 13, 14, 15\}$
Therefore $P \cup (Q \cup R)' = P \cup (Q' \cap R')$

e) i) $U = \{\alpha, \beta, \gamma, \lambda, \delta, \varphi, \psi, a, \mu, \eta\}$
$A = \{\alpha, \gamma, \lambda\}$
$B = \{\alpha, \beta\}$

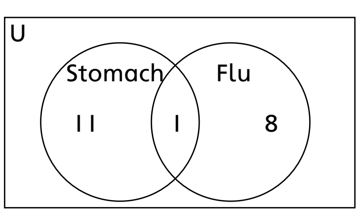
ii) $A \cup B \cup C = \{\alpha, \beta, \gamma, \lambda, \delta, \varphi, \psi, a\}$
$A \cap B = \{\alpha\}$
$B \cap C = \{\beta\}$
$A' = \{\beta, \delta, \varphi, \psi, a, \mu, \eta, a\}$
$B' = \{\gamma, \lambda, \delta, \psi, a, \mu, \eta\}$
$C' = \{\alpha, \gamma, \lambda, \varphi, \mu, \eta\}$

iii) No

iv) Set A and Set C are disjoint sets.

3. a) 

b) 12 c) 24 d) 48

4. a) 

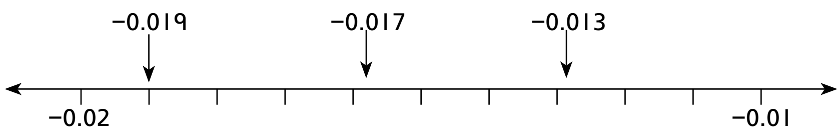
b) 24 people

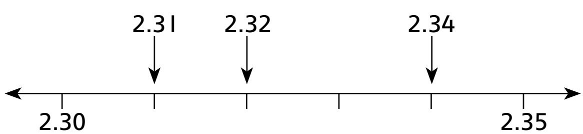
Unit 2: Rational Numbers

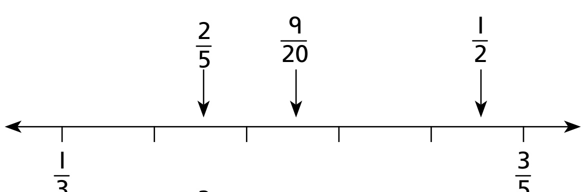
Exercise 2a

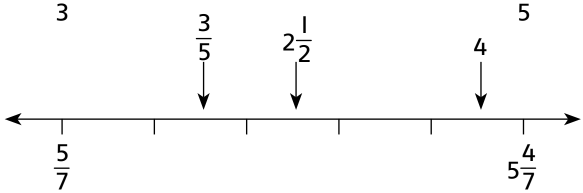
1. a) False. 0 is neither positive nor negative.
   b) True
   c) False. It will be on the left side.
   d) True
   e) False. Whole numbers are a subset of a set of integers.
   f) True.
   g) False. 1 is the multiplicative identity of the set of rational numbers.
   h) True.
   i) False. The result is a rational number.
   j) True.

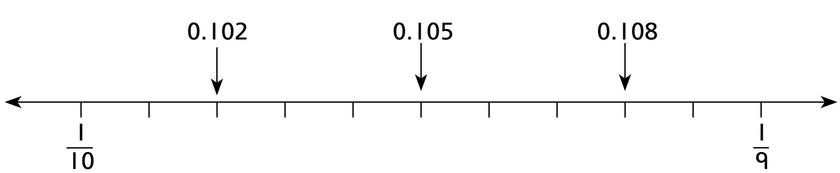
2. a) 237, −237, −273, −327, −723
   b) $\frac{3}{9}, \frac{2}{9}, \frac{1}{9}, -\frac{7}{9}, -1\frac{1}{9}, -2, -2, -3$
   c) $\frac{3}{2}, \frac{3}{2}, \frac{2}{3}, \frac{2}{3}, \frac{3}{20}, \frac{1}{13}$
   d) 8.8, 8.8088, 8.808, 8.088, 8.08
   e) 0.56767, 0.567567, 0.567, 0.567

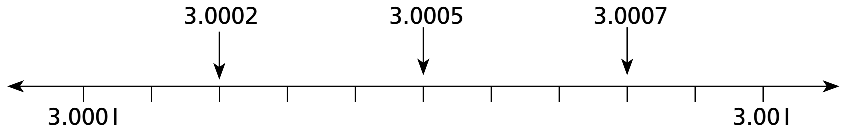
3. a)


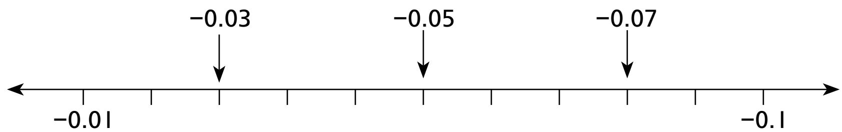
b)


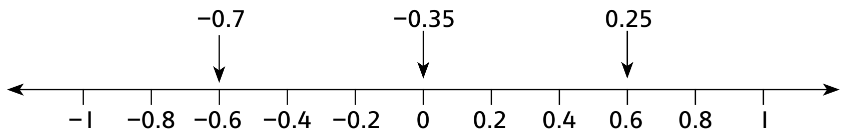
c)


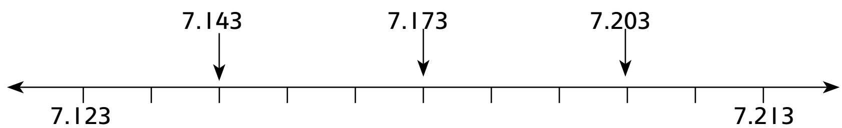
d)


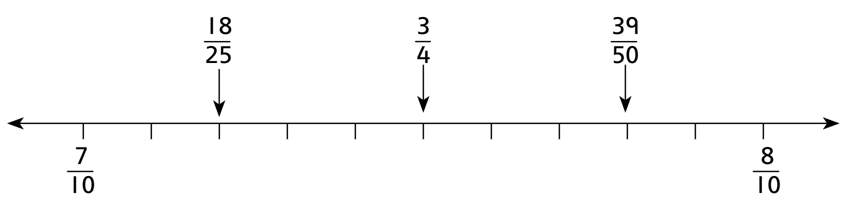
e)


f) 

g) 

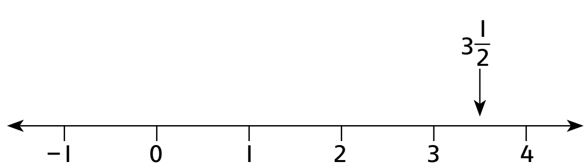
h) 

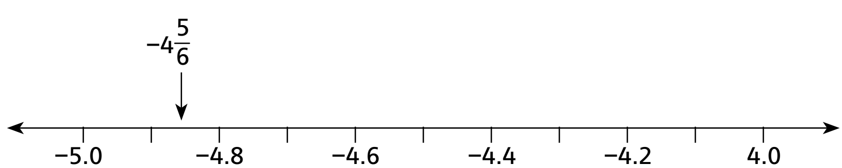
i) 

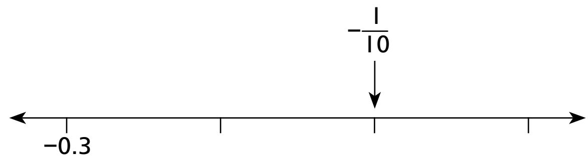
j) 

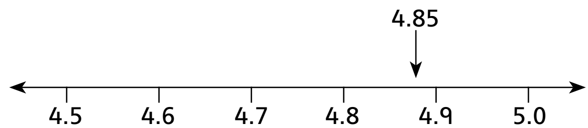
4. a) $\frac{1}{5}$ b) $-1\frac{1}{4}$ c) $3\frac{33}{1000}$

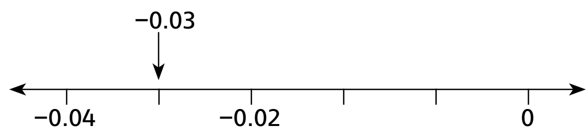
d) $-5\frac{203}{1000}$ e) $404\frac{101}{2500}$

5. a) 

b) 

c) 

d) 

e) 

Exercise 2b

1. a) -67 b) $\frac{7}{9}$ c) 2.13
   d) $\frac{39}{220}$ e) -5.86

2. a) =, Commutative property of addition
   b) =, Commutative property of addition
   c) =, Commutative property of multiplication
   d) =, Commutative property of addition
   e) =, Commutative property of multiplication
   f) ≠, Division of rational numbers is not commutative
   g) ≠, Subtraction is not commutative
   h) ≠, Division of rational numbers is not commutative
   i) ≠, Division of rational numbers is not commutative
   j) ≠, Subtraction is not commutative

3. a) $7, -\frac{1}{7}$ b) $-\frac{9}{17}, \frac{17}{9}$ c) $-43, \frac{1}{43}$
   d) $\frac{4}{5}, -\frac{5}{4}$ e) $\frac{2}{9}, -\frac{9}{2}$ f) $1.34, -\frac{50}{67}$
   g) $\frac{1}{6}, -6$ h) $0.008, -\frac{1}{125}$ i) $-1\frac{6}{7}, -\frac{7}{13}$

Unit 3: Decimals

Exercise 3a

1. a) 0.4 b) −1.3 c) −2.35
   d) 11.75 e) 0.92

2. a) $\frac{1}{250}$ b) $-5\frac{1}{25}$ c) $-75\frac{7}{50}$
d) $\frac{7}{1000}$ e) $43\frac{111}{500}$

3. a) Non-terminating b) Terminating c) Terminating
d) Recurring e) Non-terminating f) Terminating
g) Non-terminating h) Non-terminating i) Non-terminating
j) Recurring

Exercise 3b

1. a) 2.01 b) 14.28 c) 0.07 d) 46.46
e) 5.50 f) 17.38 g) 0.01 h) 12.12
i) 271.11 j) 0.10

2. a) 3.27 b) 9.8 c) 46.494 d) 4.1
e) 11.112 f) 97.1 g) 0.01 h) 24.425
i) 2.9 j) 2.7758

3. a) 18.922 b) 65.122 c) 75.639 d) 12.760
e) 5.660

Unit 4: Exponents

Exercise 4a

1. a) 34 b) 53 c) 24 d) 312
e) 312 f) 38 g) 67 h) 1
i) 6−10 j) 81 k) 156

2. a) 256 b) $\frac{1}{256}$ c) 512 d) $\frac{1}{16}$
e) 0.000001 f) 0.00694 g) 0.03125 h) 1
i) 0.00000000000001048576 j) 0.005102

3. a) 16 b) $\frac{1}{25}$ c) 2 d) 36
e) $\frac{1}{16}$ f) $14\frac{1}{64}$ g) 0.015625 h) 0.1036
i) 15 j) 36

4. $9 \times 4^{-2} \times 3^{-2} \times \sqrt{4^2} = \frac{1}{4}$
$9 \times 4^{-2} \times 3^{-2} \times \sqrt{4^2} \neq 1$

5. a) $\frac{1}{b^3}$ b) $a^2 \times b^3$ c) $\frac{b}{a^4 \times c^5}$

d) $\frac{1}{a} + \frac{1}{b} = \frac{1}{c}$ e) $\frac{1}{a^{14} \times b^{25}}$

6. a) $\frac{3b}{2a^2}$ b) $(ab)^5$ c) $a^7 \times b \times c^{-1}$

d) $\left(\frac{a}{b}\right)^{10}$ e) $\frac{2a^4c}{3a^3}$ f) $\frac{1}{a^{20}b^{16}}$

g) $a^{-24}b^{32}c^8 + a^4c^{-4}$ h) 5^2 i) $\frac{1}{1 - n}$

9. a) 4.25 b) −3.25

Unit 5: Square Root of a Positive Number

Exercise 5a

1. a) Is a perfect square b) Not a perfect square
c) Is a perfect square d) Not a perfect square
e) Is a perfect square f) Not a perfect square
g) Is a perfect square h) Is a perfect square
i) Not a perfect square j) Is a perfect square

2. a) Odd b) Odd c) Even
d) Even e) Even f) Odd
g) Even h) Odd i) Odd
j) Odd

3. a) Lesser than original b) Greater than original
c) Lesser than original d) Greater than original
e) Greater than original f) Greater than original
g) Lesser than original h) Lesser than original
i) Greater than original j) Lesser than original

Exercise 5b

1. a) 16 b) 24 c) 34 d) 45
e) 50 f) 66 g) 72 h) 86
i) 99 i) 256

2. a) 56 b) 89 c) 115 d) 246
e) 2.35 f) 30.1 g) 5.281 h) 91.02
i) 8.554 j) 12.54

Exercise 5c

1. a) 2.6 b) 6.24 c) 1.47 d) 3.25
   e) 8.9 f) 4.05 g) 12.01 h) 22.1
   i) 5.112 j) 19.22

2. a) 256, 3 b) 576, 5 c) 2916, 2 d) 361, 11
   e) 2025, 3

3. a) 0.89 b) 16.71 c) 11.91

4. 107
5. 23.076
6. 546.75 and 1640.25
7. 34.81 cm^2
8. Greatest 5-digit number is 99856 and smallest 5-digit number is 100000
9. 520 rows
10. 24 rows
11. a) 13 rows b) 5 eggs
12. Rs 1289.0625 per m^2

Unit 6: Direct and Inverse Proportion

Exercise 6a

1. a) Vary directly b) Vary directly
   c) Do not vary directly d) Do not vary directly
   e) Vary directly f) Vary directly
   g) Do not vary directly h) Do not vary directly
2. 1350 days
3. 35 more people
4. 14 people
5. 182 minutes
6. 1 hour and 18 minutes
7. 11 more people will be required.
8. 2.25 hours
9. 9 chefs
10. 42.3 minutes more
11. 1.72 hours
12. 1 hour
13. 25
14. 3125

Exercise 6b

1. 0.004 km/hour
2. 490.5 km
3. 10:37 a.m.
4. 6.36 seconds, 7.968 seconds
5. 37.5 m
6. 1.26km/hour
7. The car

Unit 7: Profit and Loss

Exercise 7a

1. Rs 1,875,000
2. Rs 112,50
3. Marked Price = Rs 600, Selling Price = Rs 480
4. Rs 6,860
5. a) 27.8% b) He needs to sell 12 watches
6. Rs 4861.11
7. Rs 3193.04
8. Gain = 10.8%
9. Total cost of Manufacturing = Rs 160
   Profit = 56.25%
10. Selling price per cup = Rs 67.20
11. Rs 2615.0
12. Rs 696,220.30

Exercise 7b

1. Rs 8,100
2. Rs 5,185
3. 10%
4. Rs 12,750
5. Rs 26,400

Exercise 7c

1. Rs 10,750
2. Rs 820,000
3. Rs 26,400
4. Rs 255,000
5. Annual Income = Rs 492,000, Annual Savings = Rs 72,000, Zakat = Rs 18,000

Chapter 8: Algebraic Expressions

Exercise 8a

1. a) Expression b) Constant c) Expression
   d) Variable e) Expression f) Literal
   g) Expression h) Constant i) Variable
   j) Literal
2. a) Polynomial b) Binomial c) Trinomial
   d) Trinomial e) Monomial f) Binomial
   g) Polynomial h) Binomial i) Monomial
   j) Trinomial

3. a) $-11\frac{3}{4}ab$ b) $5\frac{3}{7}p + \frac{4}{7}q$ c) $-6\frac{1}{2}p^3 + 4\frac{3}{5}q^3 + r^3$
   d) $6m^4 - 8m^3 + 3\frac{2}{9}m^2 + 21m + 3$
   e) $9a^2b - 2ab^2 + 5ab + 2y^2 - \frac{5}{y^2} + 9$

4. a) $2y^2 - \frac{5}{y^2} + 9$ b) $2x^2 - 6x + xy - 3$ c) $-\frac{10}{a} - \frac{2}{b}$
   d) $-8\frac{3xy}{z}$ e) $6a^3b^3c^3 - a^2b^2c^2 - 7.5abc$

5. a) $\frac{8}{3}x4y^{-1}$ b) $\frac{1}{4}x^7$
   c) $-x^5 + 5x^4 - 4x^3 + x^2$ d) $p^{-5} + 3p^{-4} + 4p^{-3} - 7p^{-2}$
   e) $-\frac{16}{3}a^8 + \frac{28}{3}a^7 - \frac{8}{15}a^6$ f) Same question as (e)
   g) $-\frac{3}{4}x^5 - \frac{3}{2}x^4 + \frac{3}{4}x^3$ h) $m^5 - 4m^4 + 4m^3 - 4m^2 + 5m - 6$
   i) $x^3 + 4x^3y + 13x^2y^2 - 2x^2y - xy^2 + 10xy^2 - 2y^3$
   j) $x^4 + 4x^2y - 5x^2y^2 + 4xy^{-1} + 16x - 20y$
   k) $-\frac{4}{9}a^3 - \frac{8}{27}a^3b^2 + \frac{6}{12}ab^2 - \frac{6}{12}a^2b - \frac{12}{36}a^2b^3 + \frac{9}{16}b^3$

6. a) $-6a^2 - 3ab^2 - 2b^2$ b) $-2x^3 + 5x^2 - 21x + 20$
   c) $-3a^2 - 2$ d) $p^4 - 2p^3 + p^2 + p$
   e) $\frac{4}{3}x^3 - \frac{5}{3}x^2 - 5x$ f) $0.0833x^2 - 0.5x^3$
   g) $15y^2 - 16xy - 6x - 15x^2$ h) $3x + 20xy + 35y + 25y^2$
   i) $\frac{1}{4}xy + xz + yz + \frac{1}{4}z$ j) $6x3 + 6x2y - 3y2 + 7y2 + x2y$

7. $-2x^3 - 2y^3 - 2z^3$
8. $9ab - 5a^2b^2$
9. $\frac{7}{4} - m^2 + 9mn$
10. $\frac{1}{8}x^3 + 2y^3 - \frac{7}{8}z^3$

Exercise 8b

1. a) $a^2 - 3a - 10$ b) $x^4 + \frac{11}{4}x^2 + \frac{3}{2}$
   c) $x^2y^2 + \frac{11}{6}xy + \frac{4}{6}$ d) $p^4q^4r^9 + \frac{62}{9}p^2q^2r^3 - \frac{7}{9}$
   e) $\frac{p^2}{9} - \frac{q^2}{16}$ f) $49a^2b^2 - \frac{1}{49}$
   g) $a^2b^2c^2 - \frac{x^2y^2z^2}{9}$ h) $x^{36} - y^{36}$
   i) $\frac{49x^2y^2}{z^2} - \frac{z^2}{x^2y^2}$ j) $1764 - \frac{x^2}{1764}$
   k) $25a^2 + 70ac + 49c^2$ l) $\frac{p^2}{25} - \frac{12p}{5} + 36$
   m) $x^2y^2z^2 - \frac{2}{3}xyz + \frac{1}{9}$ n) $\frac{a^2b^2}{d^2} - 4\frac{abc}{d} + 4c^2$
   o) $\frac{16}{81} + \frac{8}{9x} + \frac{1}{x^2}$ p) $\frac{4}{9} - \frac{4}{3mn} + \frac{1}{m^2n^2}$
   q) $x^4 + 2x^2y^2 + y^4$ r) $p^9 - 2p^3q^3 + q^9$
   s) $pq^2r^2 - \frac{6p^2qr}{x} + \frac{9}{x^2}$ t) $4x^4 - 4 + \frac{1}{x^4}$
   u) $\frac{1}{x^2y^2} + \frac{2p^2}{xy} + p^4$ v) $\frac{49p^2}{r^2s^2} + 14prs + r^4s^4$

2. a) $5p^2 + 14pq + 34q^2$ b) $a^2b^2 + 7ab - 2c^2$ c) $-\frac{3}{4}x^2y^2 - xy - \frac{3}{4}$
   d) $2x^2 - 2 + \frac{2}{x^2}$ e) $3m^4 - 3m^2 - 8\frac{3}{4}$

3. a) Solved as an example b) $25a^2 - 300a + 900$
   c) $a^4 + 2a^2b^2 + b^4 - 2a^2c^2 - 2b^2c + c^4$ d) $4m^2 + 28mn + 49n^2 - r^2$
   e) $m^4 - n^4 - 2n^2r^2 - r^2$ f) $-4x^2 + 9y^2 + 16x - 16$
   g) $\frac{p^2}{9} + \frac{pq}{6} + \frac{q^2}{16} - \frac{pqr}{30} + \frac{r^2}{25}$

4. a) $-4xy$ b) $-59ab$ c) $-\frac{1}{2}xy$
   d) $+1$ e) $+\frac{6}{xy}$

5. a) $3y, 9y^2$ b) $-\frac{1}{2x^2}, \frac{1}{4x^4}$ c) $6y, 36y^2, 49x^2$
   d) $\frac{\sqrt{90y^2}}{5}, \frac{x^4}{9},$ e) $\frac{2\sqrt{90x^2y^2}}{12}, x, y$

6. a) 9801 b) 1008016 c) 0.9604
   d) 4020025 e) 1.002001 f) 9996
   g) 1.2208 h) 24.96 i) 1596
   j) 6596.6884

7. a) 19 b) 5 c) 95 d) 130321

8. a) 23 b) $\sqrt{21}$ c) $5\sqrt{21}$ d) 527

9. a) 3 b) $\sqrt{5}$ c) $3\sqrt{5}$ d) $21\sqrt{5}$

10. $\sqrt{274}$

11. a) 9 b) 65 c) 63
    d) 4095 e) 4095

12. a) 27 b) $\sqrt{29}$ c) $5\sqrt{29}$
    d) 727 e) $135\sqrt{29}$

13. a) $\sqrt{14}$ b) $\sqrt{10}$ c) $\sqrt{2 + \sqrt{14}}$
    d) $\sqrt{\frac{10}{2 + \sqrt{14}}}$ e) 142

Exercise 8c

1. $(3a + 4b)^2$ 2. $(2x - 5)^2$ 3. $(p + 4q)^2$

4. $\left(x + \frac{1}{x}\right)^2$ 5. $(2x + 6y)^2$ 6. $(3a - 7)^2$

7. $(x^2 + 2y^2)^2$ 8. $(3x^3 - 2y^3)^2$ 9. $(9 + x^4)^2$

10. $\left(2x - \frac{1}{4}\right)^2$ 11. $(11 - 3y^3)^2$ 12. $(5 - 2x^5)^2$

13. $(abc - x)^2$ 14. $(2p^2q^2 + 1)^2$ 15. $\left(\frac{1}{ab} - c\right)^2$

16. $\left(\frac{1}{2} - \frac{x}{c}\right)^2$ 17. $(a - 2b)(a + 2b)$ 18. $(a^2 - b^2)(a^2 + b^2)$

19. $(3x - 5y)(3x + 5y)$ 20. $(6ab - c)(6ab + c)$ 21. $\left(\frac{x}{2} - 1\right)\left(\frac{x}{2} + 1\right)$

22. $\left(\frac{pq}{r^2} - r\right)\left(\frac{pq}{r^2} + r\right)$ 23. $(p^4 - q^4)(p^4 + q^4)$ 24. $(16x^2 - y^2)(16x^2 + y^2)$

25. $\left(\frac{1}{m^8} - \frac{1}{n^8}\right)\left(\frac{1}{m^8} + \frac{1}{n^8}\right)$ 26. $(\{a + b\} - c)(\{a + b\} + c)$

27. $(\{2x + 3y\} - 4z)(\{2x + 3y\} + 4z)$

28. $(p - \{q + r\})(p + \{q + r\})$

29. $(m - \{n - p\})(m + \{n - p\})$

30. $\frac{a^2}{4} - x^2 - \frac{1}{x^2} + 2$

31. $\{(a + b) - (x + y)\}\{(a + b) + (x - y)\}$

32. $\{(2m + 1) - (2n - 5p)\}\{(2m + 1) + (2n - 5p)\}$

33. $\{(11 + x) - c^2\}\{(11 + x) + c^2\}$

34. $\left\{\left(2x + \frac{1}{2x}\right) - 12\right\}\left\{\left(2x + \frac{1}{2x}\right) + 12\right\}$

35. $\left\{\left(p^2 - \frac{1}{p^2}\right) - 3\right\}\left\{\left(p^2 - \frac{1}{p^2}\right) + 3\right\}$

Unit 9: Linear Equations

Exercise 9a

1. Expression
2. Linear Equation
3. Linear Equation
4. Equation
5. Expression
6. Expression
7. Expression
8. Equation
9. Expression
10. Linear Equation

Exercise 9b

1. $t = 2.5$
2. $j = 2$
3. $y = 6$
4. $w = 72$
5. $m = -14$
6. $k = 0.1$
7. $x = 0.7$
8. $x = -3$
9. $t = \frac{1}{2}$
10. $t = 17$
11. $x = -4$
12. $t = \frac{7}{4}$
13. $t = 1$
14. $t = 8$
15. $y = -2$
16. $x = \frac{13}{30}$

Exercise 9c

1. $a = -4\frac{1}{2}$
2. $b = \frac{7}{12}$
3. $c = -6\frac{3}{4}$
4. $d = 4\frac{1}{3}$
5. $e = 0.3571$
6. $f = \frac{23}{22}$
7. $g = 7\frac{1}{2}$
8. $h = 3\frac{4}{9}$
9. $i = 1$

Exercise 9d

1. $a = 56$
2. $b = -\frac{19}{26}$
3. $c = 17\frac{2}{3}$
4. $d = \frac{22}{18}$
5. $e = -\frac{2}{3}$
6. $f = -\frac{8}{7}$

7. 1916 8. 2685 9. 4138

10. $j = -\frac{147}{230}$

Exercise 9e

1. 9
2. 72, 74, 76
3. 123, 125, 127, 129
4. Sonia = 11 kg, Jasmin = 44 kg and Azhar = 67 kg
5. Son's age = 14 years, Father's age = 42 years
6. 6 cans of cola, 12 cans of orange juice and 2 cans of lemonade
7. 6 km
8. 173.25 cm^2
9. 9 km
10. 114.1, 69.9
11. Adil's age = 20 years old and Babar's age = 10 years
12. A = Rs. 1322.224 and B = Rs. 1652.78
13. 150 liters

Unit 10: Fundamentals of Geometry

Exercise 10a

1. a) 220°, ∠'s around a point
   b) 35°, complementary ∠'s
   c) x = 70°, supplementary angle, opposite angle, opposite angle
   d) x = 27°, adjacent angles

2. a) ∠DOE = 16°, ∠COD = 32°, ∠BOC = 48°, ∠AOB = 84°
   b) Incorrect question. Angles not given.
   c) Incorrect question. Angles not given.
   d) ∠AOD = 145.5°, ∠DOB = ∠AOC = 41.8°, ∠BOC = 131.2°
   d) ∠AOC = 36°, ∠FOD = 90°, ∠BOE = 54°

3. a) ∠A = 90°, ∠B = 44°, ∠C = 46°
   b) x = 70.5°
   c) x80°, y = 40°, z = 50°
   d) D = x = 40°, A = $2x$ = 80°, B = $2x - 10$ = 70°, E = $2x + 30$ = 110°
   e) A = x = 45°

4. 144°
5. 72.5°, 107.5°
6. 72°, 18°

7. 22.5°, 67.5°
8. 67.5°, 112.5°
9. 53°, 127°
10. 40°, 40°, 140°, 140°
11. 36°, 54°, 72°, 90°, 108°
12. 80°, 50°
13. 50°, 58°, 72°
14. 88°, 32°, 60°
15. X = 10°
16. BAC = 75°

Exercise 10b

1. a) Congruent b) Similar c) Similar
   d) Congruent e) Congruent

2. Similar (SAS Property)

3. i) (ASS Property) ii) (SAS Property)

4. (AAS property)

5. (SSS property)

Unit 11: Practical Geometry

Practical Geometry involves construction of figures only. As such, it is not included in the answer key.

Unit 12: Circles

Exercise 12a

1.

	Radius	Diameter	Circumference	Area
a)	7 cm	14 cm	43.98 cm	153.94 cm^2
b)	21 m	42 m	131.95m	1385.44 cm^2
c)	2.67 cm	5.34 cm	16.77 cm	22.4 cm^2
d)	5.33 cm	10.66 cm	33.5 cm	89.25 cm^2
e)	7.035 cm	14.07 cm	44.2 cm	155.48 cm^2
f)	7.05 m	14.1 m	44.3 m	156 m^2
g)	15.28 cm	30.56 cm	96 cm	733.5 cm^2
h)	4.2 m	8.4 m	26.39 m	55.42 m^2

2. Rs 7.159
3. Rs 11,440
4. 643 cm
5. 2654.1 m^2
6. 576.798 m^2
7. 113740 revolutions
8. 73 revolutions
9. 300 revolutions
10. 294 circular shapes, 0.053%
11. 28.26 cm^2
12. 7.7 cm^2
13. 18246.6 m^2, 16173.9 m^2
14. 37981.44 cm
15. a) 769.3 cm^2 b) 3.495 cm^2 c) 76.93 cm^2
    d) 307.72 cm^2

Unit 13: Surface Area and Volume

Exercise 13a

1.

	Radius of base	Height	Volume	Total Surface area
a)	7.7cm	4.2 cm	781.9 cm^3	575.4 cm^2
b)	84 cm	0.012 cm	280 cm^3	44318.01 cm^2
c)	4.14 cm	10 cm	540 cm^3	367.63 cm^2
d)	14 cm	11.05 cm	6804.9 cm^3	2204 cm^2

2. 59400 cm^3
3. 1.71 gcm^3
4. 0.046 cm. The values provided are not realistic and too advanced for a Class 7 student.
5. 18000 cm
6. 0.0003822 cm
7. 845.6 cm^2
8. 0.87 cm
10. 9143.68 cm^3, 11703.91 g
11. 0.471 m
12. 1.04 m

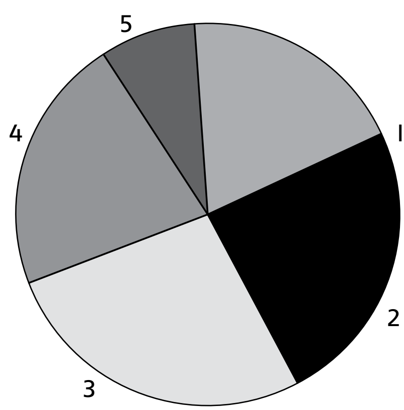
Unit 14: Information Handling

Exercise 14a

1. a)

Data	Tally	Frequency
1	~~IIII~~	5
2	~~IIII~~ I	6
3	IIII	4
4	III	3
5	II	2

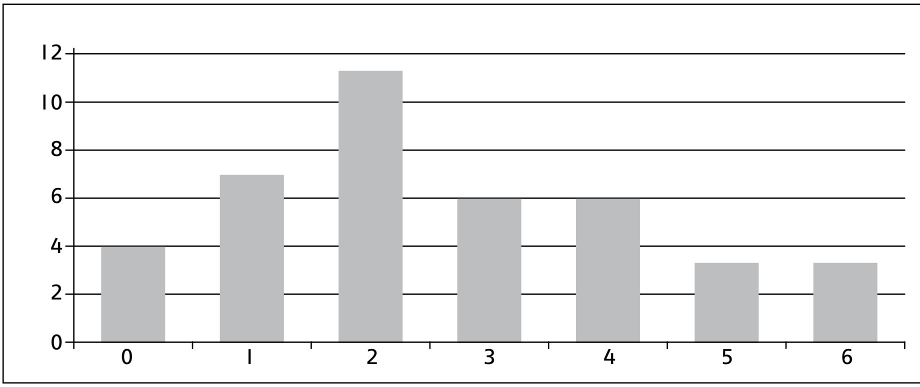
b) Families with pets



2. a)

Data	Tally	Frequency
0	IIII	4
1	~~IIII~~ II	7
2	~~IIII~~ ~~IIII~~ I	11
3	~~IIII~~ I	6
4	~~IIII~~ I	6
5	III	3
6	III	3

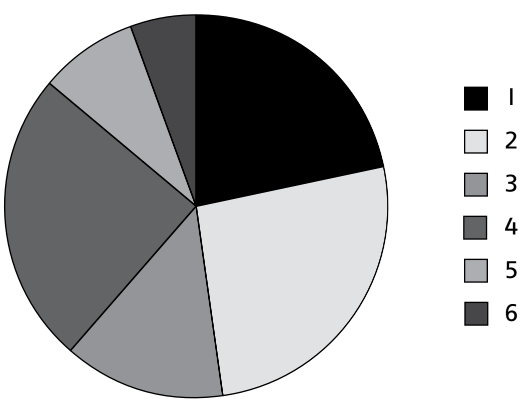
b)



3. a)

Data	Tally	Frequency
1	卌 II	7
2	卌 III	8
3	卌 I	6
4	卌 II	7
5	II	2
6	I	1

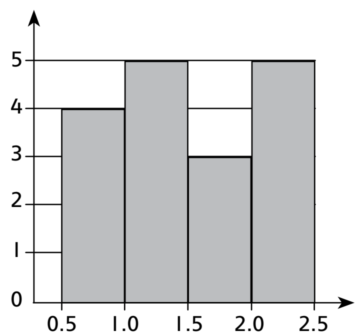
b)



4. a)

Class Intervals	Frequency
0 – 0.5	0
0.5 – 1.0	4
1.0 – 1.5	5
1.5 – 2.0	3
2.0 – 2.5	5

b)



End of the year review

1. L.C.M. is 134400 and H.C.F. is 4.
2. 12.9 sec.
3. a) 34.78 b) 0.65 c) 2.08 d) 78.18
   e) 9.91
4. He did not gain or lose in the transaction.
5. a) $2ab^3 - 2ab^2$ b) $x^5 - 7x^3 + 2$ c) 4
   d) $x^6 - y^{16}$ e) $1 - a - 2a^2 - a^4$ f) $3g^2f^2h^2 + h^2g^2 - 8gfh + 16f^2$
   g) $a^2 + 0.18a - 0.7ab - 1.4b^2 + 0.36b - 0.072$
   h) $-8a6y5$ i) $a^2 + b^2 - 4a^2b^2$ j) $\frac{1}{x^2} - 9 - \frac{1}{y^2}$
6. a) $x = 38.84$ b) $x = 1$ c) $x = 2.5$ d) $x = \frac{3}{4}$
   e) $x = 5$ f) $x = 5$ g) $x = 0$ h) $x = \frac{3}{5}$
   i) $x = 3$ j) $x = -1$
7. $x = 75$

8. The cost is Rs 55533

13. a) 2511415.525 miles b) 1255707.76 miles/hr

14. a) 94.44 m/sec b) 0.105 sec

15. a) $\frac{1}{45x^3}$ b) $\frac{1}{2a^5bc^6}$ c) $\frac{b}{2a^2}$ d) $\frac{10x^2y}{4}$

16. 8 cm

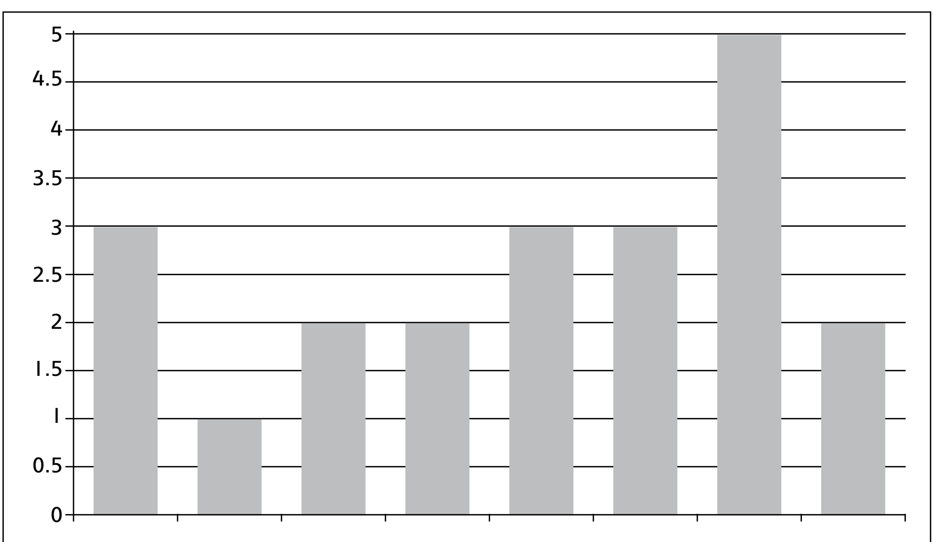
17. Yes

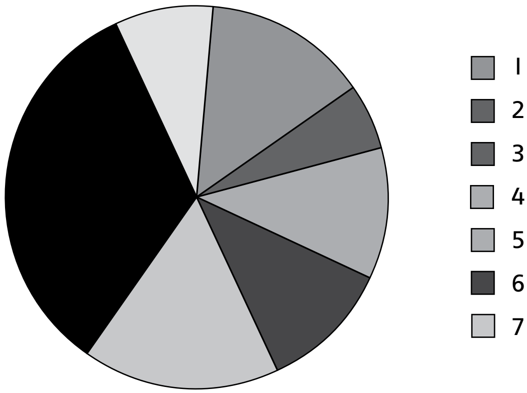
18. 157.477 cm

19. a)

Data	Frequency
0	3
2	1
3	2
4	2
5	3
6	3
7	5
8	2

b)





20. 50%

22. $\frac{9}{10}, \frac{7}{8}, \frac{11}{10}$

23. Perimeter = 28 cm. Area = 56.72 cm^2

24. 3.14 km

25. 21.66 secs.

26. 20 minutes

NOTES