THIRAN

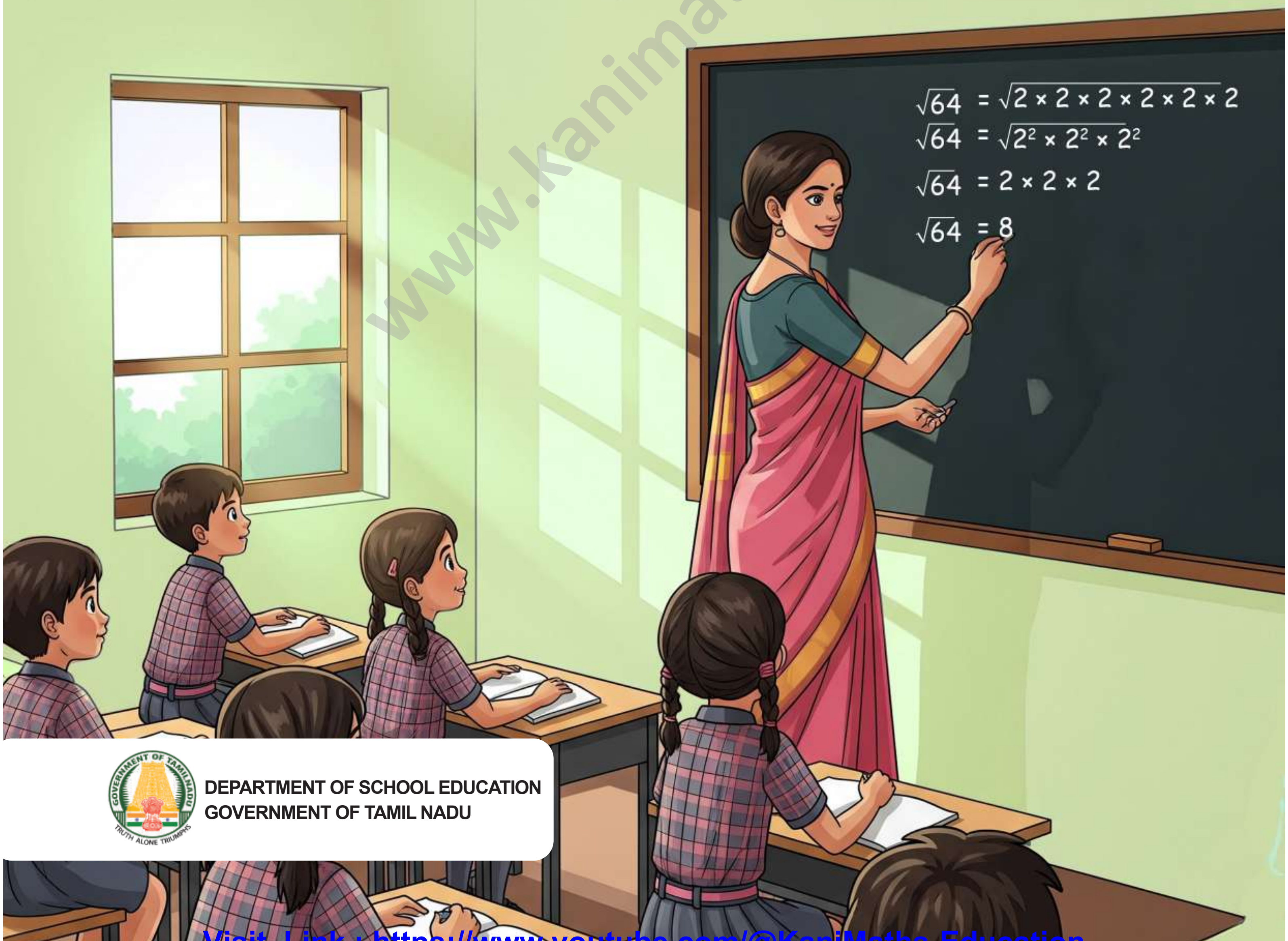
(Targeted Help for Improving Remediation & Academic Nurturing)

Teacher's Handbook

Class – 9

MATHEMATICS

2025 - 2026



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THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a **SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC** and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

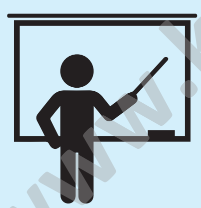
EQUALITY of status and of opportunity;

and to promote among them all

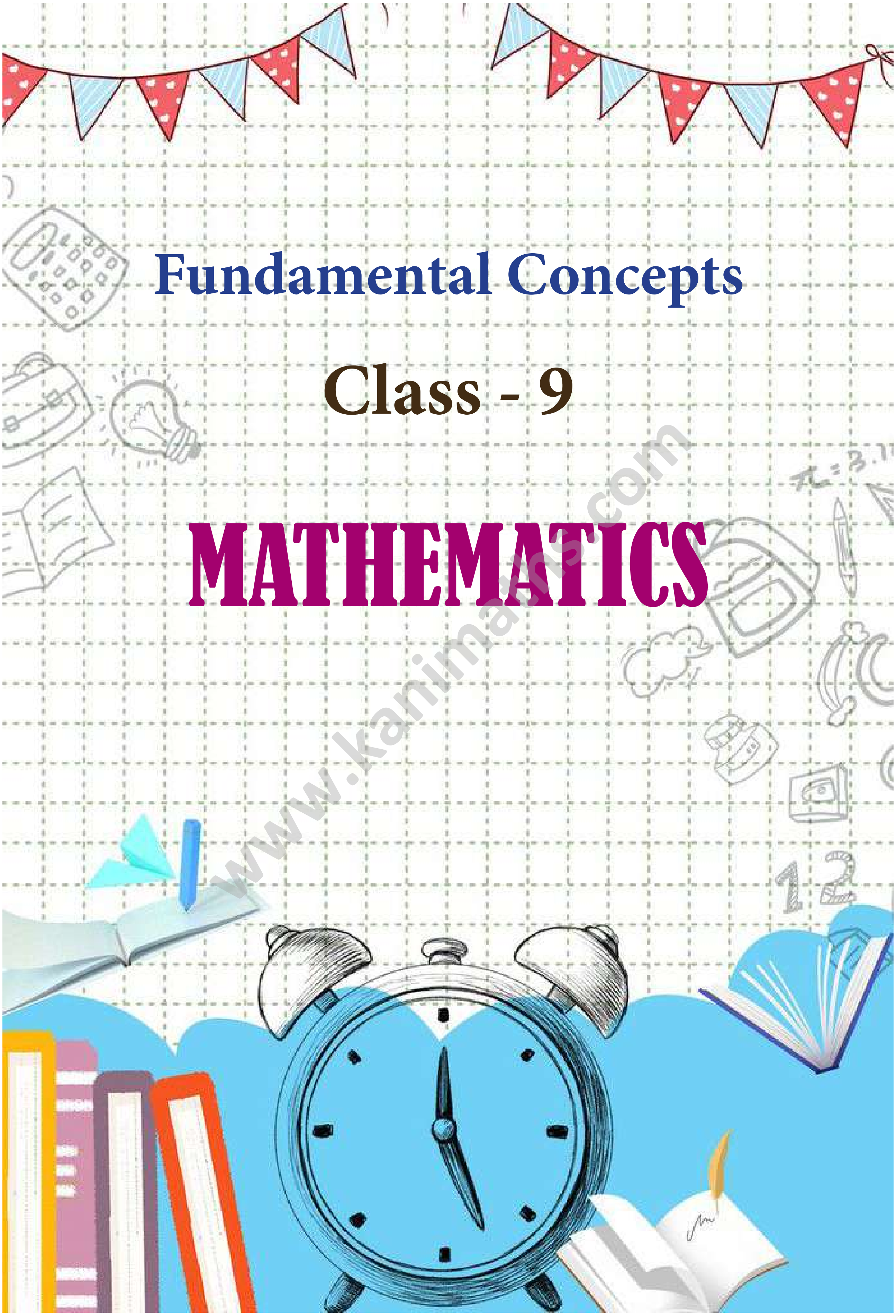
FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

Content

	**Learning Outcomes**
	**Teacher Activities**

Note to the Teacher: Make the students colour the stars after completing each module and write the date of completion of the module in their workbook.



Fundamental Concepts

Class - 9

MATHEMATICS

Content

THIRAN – Plan of Action – Fundamental Language Skills

S.No.	Title	Days	Content	Learning Outcomes
1	**Numbers and place value**	1 – 2	Introduction of numbers, place value	Reads and writes numerals for numbers up to 99 (M 201) Reads and writes numbers up to 999 using place value (M 301)
2	**Comparison of numbers**	3 – 4	bigger number - smaller number, Predecessor - Successor, ascending - descending order	Uses place value in writing and comparing two digit numbers. (M 202)
3	**Addition**	5 – 6	Addition of numbers	Solves simple daily life problems/ situations based on addition of two digit numbers (M 204) Solves simple daily life problems using addition of three digit numbers with and without regrouping, sums not exceeding 999 (M 303)
4	**Subtraction**	7 – 8	Subtraction of numbers	Solves daily life situations based on subtraction of two digit numbers (M 205) Solves simple daily life problems using subtraction of three digit numbers with and without regrouping, sums not exceeding 999 (M 303)
5	**Multiplication**	9 – 10	Multiplication of numbers	Constructs and uses the multiplication facts (tables) of 2, 3, 4, 5 and 10 in daily life situations (M 304)
6	**Square numbers**	11 – 12	Finding square numbers	Identifies the pattern in triangular number and square number (M 515)
7	**Least Common Multiple (LCM)**	13 – 14	Multiples, finding LCM	Applies HCF or LCM in a particular situation (M 603)

S.No.	Title	Days	Content	Learning Outcomes
8	**Division**	15 – 16	Division of numbers	Explains the meaning of division facts by equal grouping/ sharing and finds it by repeated subtraction. (M 306)
9	**Highest Common Factor (HCF)**	17 – 18	Factors, finding HCF	Applies HCF or LCM in a particular situation (M 603)
10	**Divisibility**	19 – 20	Divisibility by 2, 3, 4, 5, 6, 9 and 11	Proves divisibility rules of 2, 3,4, 5, 6, 9 and 11 (M 803)
11	**Number system**	21 – 22	Odd numbers - even numbers, composite and Prime numbers natural numbers, whole numbers and integers	Recognises and appreciates (through patterns) the broad classification of numbers as even, odd, prime, co-prime, etc. (M 602)
12	**Operations on integers**	23 – 24	Four basic operations on integers	Solves problem involving addition and subtraction of integers. (M 604)
13	**Fractions and decimal numbers**	25 – 26	To know fractions, types of fractions and decimal numbers	Identifies half, one-fourth, three-fourths of a whole in a given picture by paper folding and also in a collection of objects. (M 404) Converts fractions into decimals and vice versa (M 508)
14	**Basic operations on fractions**	27 – 28	Four basic operations on fractions	Solves problems on daily life situations involving addition and subtraction of fractions / decimals (M 606) Uses algorithms to multiply and divide fractions/decimals. (M 704)
15	**Measures**	29 – 30	Conversion of length, weigh and capacity measures	Relates different commonly used larger and smaller units of length, weight and volume and converts larger units to smaller units and vice versa(M 512)

1 Numbers and place value

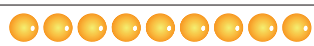
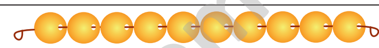
Learning Outcomes

- Reads and writes numerals for numbers up to 99 (M 201)
- Reads and writes numbers up to 999 using place value (M 301)

Teacher Activities

Activity 1: (Introduction of two digit numbers)

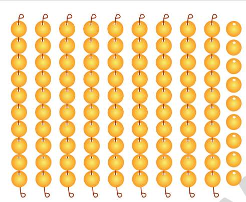
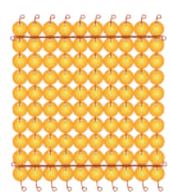
The teacher adds a bead with nine beads and introduces the number ten with ten beads. Its numeral form is '10'.

	+		=	
9		1		10

By adding the beads one by one with ten beads, he introduces the numbers 11, 12…99.

Activity 2: (Introduction - Addition of three digit numbers)

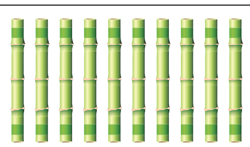
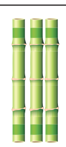
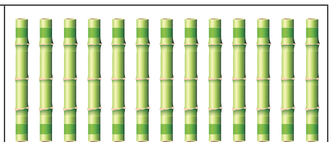
The teacher adds a bead to a collection of 99 beads and introduces the number hundred with hundred beads and its numeral form is 100.

	+		=	

By adding the beads one by one with hundred balls, he/she introduces the numbers 101, 102, 103…. 999 with its numerals.

Activity 3: (Place Value)

The teacher keeps bundled with 10 sticks and some loose sticks on the table. Teacher takes a bundle of ten sticks and 3 loose sticks on his left hand and thirteen loose stick on his right hand. He/She counts both separately and shows that the same 13 sticks are there in both the hands. With this he/she explains that 13 ones can be grouped as one ten and 3 ones.

	+		=	
10	+	3	=	13

He/She explains in 13, 3 represents 3 ones and 1 represents one ten. He/She also explains that there are ten ones in a ten. The same is repeated with different numbers and place value is explained.

Similarly, he/she introduces numbers up to 10000000 and their place value using the abacus.

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2 Comparison of numbers

Learning Outcomes

- Uses place value in writing and comparing two digit numbers.

Teacher Activities

Activity 1: (Bigger number - Smaller number)

The teacher writes two numbers say 23 and 35 on the board and explains the students to find the bigger number by comparing the number based on the concept of place value.

Step 1: Number of tens in 23 is 2
Number of tens in 35 is 3

Step 2: Now 3 tens are greater than 2 tens.
Therefore 35 is bigger than 23 and 23 is less than 35.

Next the teacher writes 42 and 47 on the board and explains the method of finding bigger number as below.

Step 1: The number of tens in 42 is 4
The number of tens in 47 is 4.

Now both the numbers have 4 tens. Now let us compare the ones.

Step 2: The number of ones in 42 is 2.
The number of ones in 47 in 7.

Step 3: Now 7 ones is bigger than 2 ones. Therefore 47 is bigger than 42 and 42 is smaller than 47.

Hence to compare two numbers first compare tens. If tens are equal then compare ones.

Activity 2: (Predecessor - Successor)

The teacher writes the number 27 on the blackboard and says that the predecessor of 27 is 26 if you subtract 1 from that number, and the successor of 27 is 28 if you add 1 to that number.

In this way, the teacher teaches the predecessor and successor of different numbers. Hence when one is subtracted from the given number, we get the predecessor of that number and one is added to a given number, we get the successor of that number.

Activity 3: (Ascending Order - Descending Order)

The teacher explains the method of arranging the numbers in ascending order as below. Teacher writes the following numbers 67, 45, 56, 38, 93 on the blackboard. The smallest number among the five is 38. Then the smallest number among the remaining four is 45. The smallest number among the remaining is 56. The smaller number of the remaining two is 67. The biggest number is 93. Now ascending order of the numbers is 38, 45, 56, 67, 93. The descending order is 93, 67, 56, 45, 38. Hence when we write the numbers from smallest to biggest, it is known as ascending order and when we write the numbers from biggest to smallest, it is known as descending order. Similarly the procedure is followed for different numbers.

3 Addition

Learning Outcomes

- Solves simple daily life problems/ situations based on addition of two digit numbers
- Solves simple daily life problems using addition of three digit numbers with and without regrouping, sums not exceeding 999

Teacher Activities

Activity 1: (Addition of two digit numbers)

The teacher writes 24 + 15 on the blackboard. First he/she represents the numbers in the place value grid. Then adding the numbers in ones place and then tens place as below. The answer is 39.

	T	O
	2	4
(+)	1	5
	3	9

Similarly he/she explains the addition of numbers with carry over.

Activity 2: (Addition of three digit numbers)

The teacher writes 315 + 224 on the blackboard. First he/she represents the numbers in the place value grid. Then adding the numbers in ones place, tens place and then hundreds place as below. The answer is 539.

	H	T	O
	3	1	5
(+)	2	2	4
	5	3	9

Similarly he/she explains the addition of numbers with carry over.

4 Subtraction

Learning Outcomes

- Solves daily life situations based on subtraction of two digit numbers
- Solves simple daily life problems using subtraction of three digit numbers with and without regrouping, sums not exceeding 999

Teacher Activities

Activity 2: (Subtraction of two digit numbers)

The teacher writes 48 – 13 on the blackboard. First he/she represents the numbers in the place value grid. Then subtracting the numbers in ones place and then tens place as below. The answer as 35.

	T	O
	4	8
(–)	1	3
	3	5

Similarly he explains the subtraction of numbers with borrowing.

Activity 2: (Subtraction of three digit numbers)

The teacher writes 485 – 132 on the blackboard. First he/she represents the numbers in the place value grid. Then subtracting the numbers in ones place, tens place and then hundreds place as below. The answer as 353.

	H	T	O
	4	8	5
(–)	1	3	2
	3	5	3

Similarly he explains the subtraction of numbers with borrowing.

5 Multiplication

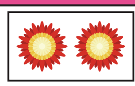
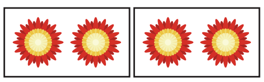
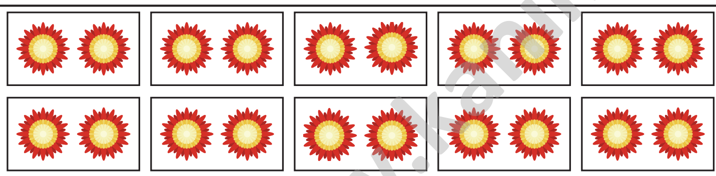
Learning Outcomes

- Constructs and uses the multiplication facts (tables) of 2, 3, 4, 5 and 10 in daily life situations

Learning Outcomes

Activity 1:

The teacher takes 10 cards with two flowers in each card keep one card on the table and says that there are two flowers, two cards on the table and says that there are four flowers and continuing the same for 10 cards. He/She consolidates on the blackboard as below.

Cards	Table	No. of Flowers
	1×2	2
	2×2	4
⋮	⋮	⋮
	10×2	20

Now the multiplication table 2 is introduced as above similarly the other multiplication tables are introduced

Activity 2:

Teacher explains multiplication problems using place holders as below

1. $\square \times 4 = 20$
2. $2 \times \square = 12$
3. $5 \times 6 = \square$

Similarly he/she did many problems and explained the multiplication of two digit numbers. For example

$$\begin{array}{r} 35 \times \\ 12 \\ \hline 70 \\ 35 \\ \hline 420 \\ \hline \end{array}$$

6 Square numbers

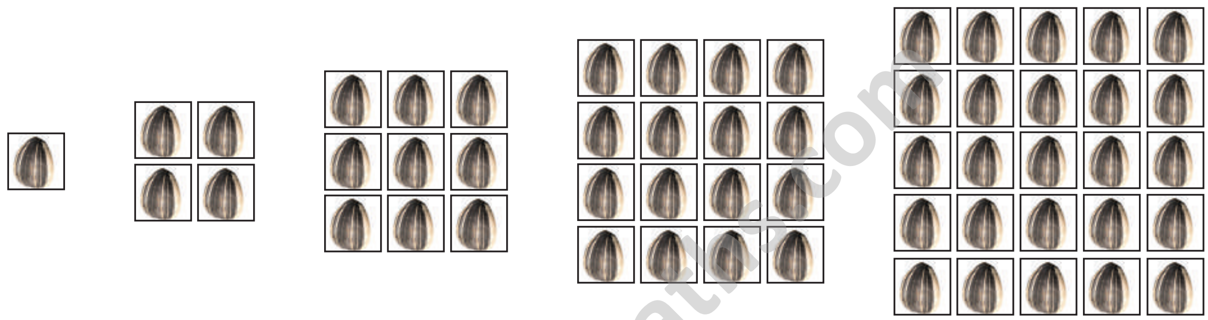
Learning Outcomes

- Identifies the pattern in triangular number and square number

Teacher Activities

Activity 1:

The teacher forms squares with seeds as below



1×1=1 2×2=4 3×3=9 4×4=16 5×5=25

He/She counts the number of seeds in each square and writes on the board. A number which forms a square is known as square numbers.

Hence when we multiply a number with itself we get square number.

Number	Square number	Number	Square number
1	1	11	121
2	4	12	144
3	9	13	169
4	16	14	196
5	25	15	225
6	36	16	256
7	49	17	289
8	64	18	324
9	81	19	361
10	100	20	400

7 Least Common Multiple (LCM)

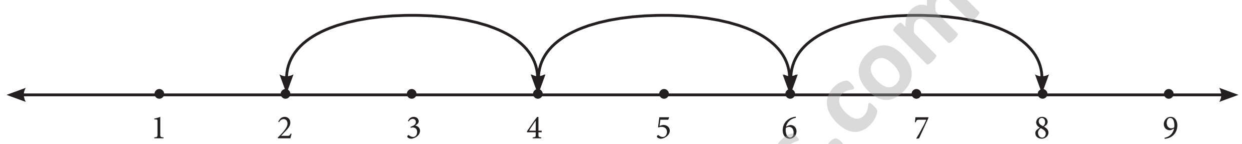
Learning Outcomes

- Applies HCF or LCM in a particular situation

Teacher Activities

Activity 1:

The teacher draws a number line on the board as below.



The teacher explains skip counting of 2's with number line He/She lists out the numbers as 2, 4, 6, 8, ... and tells these are known as multiples of 2. In this way teacher teaches multiples of different numbers.

Activity 2:

The teacher takes a sheet of a monthly calendar. In that he/she circles the multiples of 3 in green and multiples of 4 in red colour. He/She writes them on board as

Multiples of 3 = 3, 6, 9, 12, 15, 18, 21, 24, 27, 30

Multiples of 4 = 4, 8, 12, 16, 20, 24, 28.

Common Multiples of 3, 4 = 12, 24.

Least Common Multiple (LCM) = 12

Now the least common number 12 is known as the Least Common Multiple (LCM) of 3 and 4.

8 Division

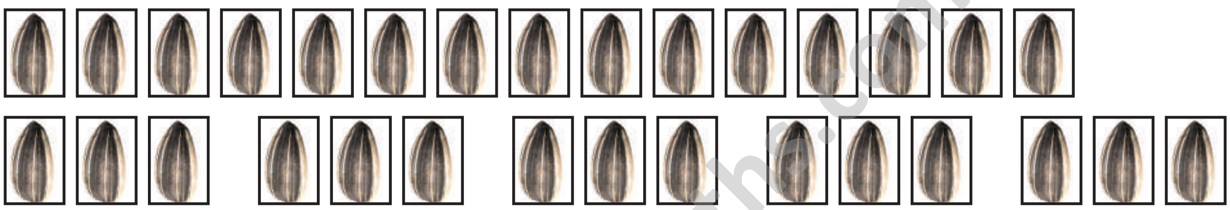
Learning Outcomes

- Explains the meaning of division facts by equal grouping/ sharing and finds it by repeated subtraction.

Teacher Activities

Activity 1: (Division)

The teachers takes fifteen seeds and keeps in groups of 3 seeds. The number of groups are five.



This is nothing but division of 15 by 3 by equal grouping.

In addition to the above he/she explains divisions on the blackboard as below

$$\begin{array}{r|l} & 5 \\ \hline 3 & 15 \\ & 15 \\ \hline & 0 \\ \hline \end{array}$$

Here,

15 is the dividend

3 is the divisor

5 is the quotient

0 is the remainder

9 Highest Common Factor (HCF)

Learning Outcomes

- Applies HCF or LCM in a particular situation.

Teacher Activities

Activity 1: (HCF)

The teacher explains the method of finding HCF of 16, 24 as below.

The multiplication facts of 16 = 1×16, 2×8, 4×4

The factors of 16 = 1, 2, 4, 8, 16

The multiplication facts of 24 one = 1×24, 2×12, 3×8, 4×6

The factors of 24 = 1, 2, 3, 4, 6, 8, 12, 24

The common factors of 16 and 24 = 1, 2, 4, 8

The Highest Common Factor = 8

HCF of 16 and 24 = 8

Activity 2:

The teacher explains the method of finding HCF of 7, 8 as below

The multiplication fact of 7 = 1×7

The factors of 7 = 1, 7

The multiplication fact of 8 = 1×8, 2×4

The factors of 8 = 1, 2, 4, 8

The common factors of 7 and 8 = 1

Hence HCF of 7 and 8 = 1

10 Divisibility

Learning Outcomes

- Proves divisibility rules of 2, 3,4, 5, 6, 9 and 11.

Teacher Activities

Activity 1:

The teacher writes the following numbers on the blackboard and divides them by 2

(i)18	(ii) 32
(iii) 21	(iv) 44
(v) 50	(vi) 66
(vii) 73	(viii) 69

The numbers divisible by 2 are 18, 32, 44, 50, 66

Observed and listed out the ones place of the above numbers are 8, 2, 4, 0 and 6

Hence he /she concludes that all the numbers having any of 0, 2, 4, 6, 8 in ones place are divisible by 2

Activity 2:

The teacher writes the following numbers on the blackboard and adds their digits as below.

$36 = 3 + 6 = 9$

$41 = 4 + 1 = 5$

$51 = 5 + 1 = 6$

$53 = 5 + 3 = 8$

$72 = 7 + 2 = 9$

$84 = 8 + 4 = 12 = 1 + 2 = 3$

He/She listed out the numbers whose sum of the digits are divisible by 3 as 36, 51, 72, 84 and verifies that the numbers are divisible by 3. Hence a number is divisible by 3 if the sum of its digits of that number is divisible by 3. Thus, explaining the divisibility of the numbers 4, 5, 6, 8, 9, 10 and 11.

11 Number system

Learning Outcomes

- Recognises and appreciates (through patterns) the broad classification of numbers as even, odd, prime, composite, etc.

Teacher Activities

Activity 1: (Division)

The teacher writes few numbers like 15, 18, 1,2,5, 9, 14, on the board. He/She expresses them into multiplication factors and write their factors as below.

15 ⟶ 1 × 15, 3 × 5;

Factors of 15 = 1, 3, 5, 15

18 ⟶ 1 × 18, 2 × 9, 3 × 6;

Factor of 18 = 1, 2, 3, 6, 9, 18

1 ⟶ 1 × 1;

Factors of 1 =1

2 ⟶ 1 × 2;

Factors of 2 =1, 2

5 ⟶ 1 × 5;

Factors of 5 = 1, 5

9 ⟶ 1 × 9, 3 × 3;

Factors of 9 =1, 3, 9

14 ⟶ 1 × 14, 2 × 7;

Factors of 14 = 1, 2, 7, 14

The teacher classified the numbers based on its factors as below

The number having only two factors (1 and the same number)	The numbers having more than two factors
2 ⟶ 1, 2 5 ⟶ 1, 5	9 ⟶ 1, 3, 9 14 ⟶ 1, 2, 7, 14 15 ⟶ 1, 3, 5, 15 18 ⟶ 1, 2, 3, 6, 9, 18

The teacher introduces that the first category namely the numbers having only two factors (1 and the same number) are called prime numbers and the second category namely the numbers having more than two factors are called composite numbers.

Prime numbers = 2, 5

Composite numbers = 9, 14, 15, 18

The number 2 is the only even prime number The number 1 is being the unit number it is neither prime nor composite.

Activity 2: (Odd number - Even number)

The teacher represents 21 and 14 using dots on the blackboard. Then he/she circles the dots in pairs for both the numbers. He/She is left with one unpaired dot for 21 and no unpaired dots for 14. He/She concludes that 21 is an odd number and 14 is an even number.

Also, he/she points out that all odd numbers end with 1, 3, 5, 7, 9 while even numbers end with 0, 2, 4, 6, 8.

Activity 3:

The numbers that are used to count the objects are called counting numbers or Natural numbers. It is denoted by N   N= { 1, 2, 3, ……..}

The smallest natural number is 1

All natural numbers except 1 have a predecessor

All natural numbers have a successor

Activity 4:

When add 0 to the natural numbers, we get the set of whole numbers. It is denoted by W

W = {0, 1, 2, 3 ....}

The smallest whole number is 0

All whole numbers except 0 have a predecessor

All whole numbers have a successor

Sum of two whole numbers is a whole number for example

(i) $25 + 30 = 55$

(ii) $13 + 0 = 13$

Difference between two whole numbers need not be a whole number For example,

(i) $42 - 15 = 37$

(ii) $32 - 43 =?$

The product of two whole numbers is a whole number for example,

(i) $13 \times 2 = 26$

(ii) $27 \times 0 = 0$

The division of two whole numbers need not be a whole number. For example,

(i) $\frac{24}{3} = 8$

(ii) $\frac{14}{3} = ?$

Activity 5:

The teacher gives two problems 5 - 3 and 3 - 5 and asks what is 3 - 5? With this the teacher introduces the need for an extension of numbers.

The extension of these numbers is called Integers which includes negative numbers,) and it is denoted by Z.

Z= {…. -3, -2, -1, 0, 1, 2, 3, ….}

The set of Integers has the following properties.

The number line for integers is

From the number line, we observe that

The numbers to the right of '0' are called positive integer and to the left of '0' are called negative integers.

0 is less than every positive integer but greater than every negative integer.

For eg: $0 < 4$ and $0 > -4$

12 Operations on integers

Learning Outcomes

- Solves problem involving addition and subtraction of integers.

Teacher Activities

Activity 1:

The teacher extended the addition table for negative integers as below.

5 + 2 = 7

4 + 2 = 6

3 + 2 = 5

2 + 2 = 4

1 + 2 = 3

0 + 2 = 2

–1 + 2 = 1

–2 + 2 = 0

–3 + 2 = –1

–4 + 2 = –2

–5 + 2 = –3

He/She made the students to read the table and practice for other numbers also. From the table he/she explained addition of Integers as below.

4 + 2 = 6; (–2) +2 = 0 ; (–4) + 2 = –2

Therefore when we add a positive integer and a negative integer, we get the difference of two integers with the sign of greater integer as the sum.

The teacher explained the addition table for negative integers as below.

2 + (–1) = 1

1 + (–1) = 0

0 + (–1) = –1

(–1) + (–1) = –2

(–2) + (–1) = –3

He/She explained adding two negative integers as similar to regular addition with negative sign as below

(–1) + (–1) = –2

(–2) + (–1) = –3

Activity 2:

The teacher explained the subtraction of integers in the following table as below

3 - 2 = 1	3-(-2)=5
2 - 2 = 0	2-(-2)=4
1 - 2 = -1	1-(-2)=3
0 - 2 = -2	0-(-2)=2
-1 -2 = -3	-1-(-2)=1
-2 -2 = -4	-2-(-2)=0
-3 -2 = -5	-3-(-2)=-1

He/She explained problems from the table as below

1-2=-1; 2-(-2) = 4;

-3-2=-5; -2-(-2)=0

Activity 3:

The teacher extended the multiplication table as below and explained multiplication of integers.

3×2=6	3×(-2)=-6
2×2=4	2×(-2)=-4
1×2=2	1×(-2)=-2
0×2=0	0×(-2)=0
-1×2=-2	-1×(-2)=2
-2×2=-4	-2×(-2)=4
-3×2=-6	-3×(-2)=6

He/She explained the following problems from the table.

$3 \times 2 = 6;$ $\quad 3 \times (-2) = -6$

$(-3) \times 2 = -6;$ $\quad (-3) \times (-2) = 6$

Activity 4:

The teacher explained division of integers with the help of multiplication tables as below.

$3 \times 2 = 6 \qquad \frac{6}{2} = 3$ and $\frac{6}{3} = 2$

$(-3) \times 2 = -6 \qquad \frac{(-6)}{2} = -3$ and $\frac{(-6)}{(-3)} = 2$

From the above, we observe that when we multiply or divide integers with same sign (either '+' or '–') we get positive integer and when we multiply or divide integers with different sign (one '+' and one '–'), we get negative integer.

13 Fractions and decimal numbers

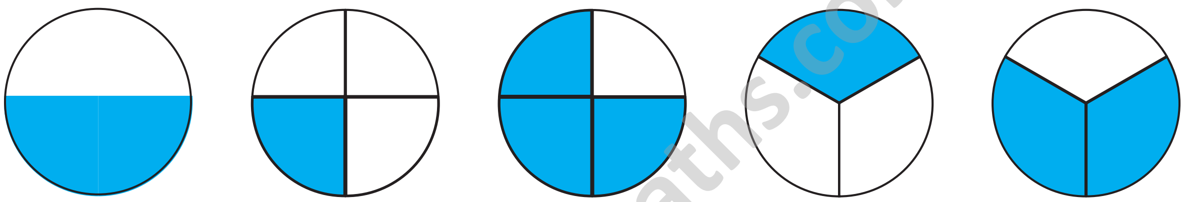
Learning Outcomes

- Identifies half, one-fourth, three-fourths of a whole in a given picture by paper folding and also in a collection of objects.
- Converts fractions into decimals and vice versa

Teacher Activities

Activity 1: Fractions

The teacher introduces simple fractions through pictures.



$\frac{1}{2}$ $\frac{1}{4}$ $\frac{3}{4}$ $\frac{1}{3}$ $\frac{2}{3}$

The teacher explains from the above pictures, a fraction is a part of a whole.

$$\text{Fraction} = \frac{\text{Numerator}}{\text{Denominator}}$$

In this, Denominator is the total number of equal parts that make up a whole and Numerator is the number of equal parts taken from a whole.

For example, in $\frac{3}{4}$, 3 is Numerator and 4 is Denominator

Activity 2: Types of fractions

The teacher writes some fraction on the board as below.

$$\frac{1}{2}, \frac{3}{4}, \frac{4}{3}, \frac{3}{2}, \frac{4}{5}, \frac{5}{2}$$

He/She compares numerator and denominator and grouped the fractions as below.

$$\frac{1}{2}, \frac{3}{4}, \frac{4}{5} \qquad \frac{4}{3}, \frac{3}{2}, \frac{5}{2}$$

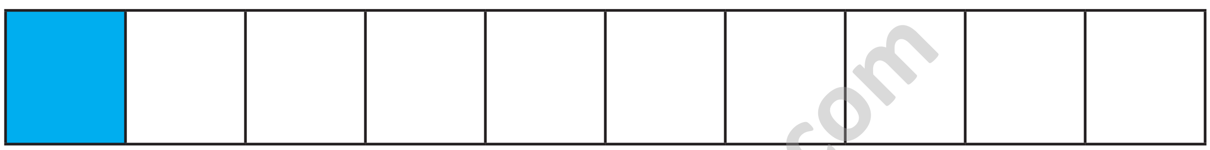
From the above examples, in a fraction, if the numerator is smaller than the denominator, then it is called as a proper fraction and if the numerator is greater than the denominator, then it is called as an improper fraction.

Mixed fraction is defined as a fraction which contains a whole number and a proper fraction.

Example : $1\frac{1}{4}$

Activity 3: Decimal numbers

The teacher introduces decimal numbers as below. He/She takes a rectangle divides it into ten equal parts and shades one part of it as below



The fraction of the shaded portion = $\frac{1}{10}$ This can be represented as 0.1 which is called decimal form of a fraction. Therefore, the fractions with denominator 10, 100, 1000, ……. can be represented in decimal form.

For example

(i) $\frac{3}{10} = 0.3$

(ii) $\frac{45}{100} = 0.45$

(iii) $\frac{7865}{1000} = 7.865$

(iv) $\frac{2}{5} = \frac{2\times 2}{5\times 2} = \frac{4}{10} = 0.4$

14 Basic operations on fractions

Learning Outcomes

- Solves problems on daily life situations involving addition and subtraction of fractions / decimals
- Uses algorithms to multiply and divide fractions/decimals.

Teacher Activities

Activity 1:

The teacher explains addition and subtraction of fractions with same denominator as below

(i) $\frac{3}{5}+\frac{1}{5}=\frac{3+1}{5}=\frac{4}{5}$ (ii) $\frac{3}{5}-\frac{1}{5}=\frac{3-1}{5}=\frac{2}{5}$

Therefore when fractions have same denominator, it is enough to add or subtract the numerator.

Activity 2:

The teacher explains addition and subtraction of fractions with different denominator as below.

(i) $\frac{2}{3}+\frac{3}{4}$ (ii) $\frac{4}{5}-\frac{3}{4}$

The multiples of 4 : 3, 6, 9, 12, 15, 18, 21, 24 ….

The multiples of 4 : 4, 8, 12, 16, 20, 24, 28, …….

The common multiple : 12, 24, ….

The Least Common Multiple : 12

The LCM of (3, 4) = 12

Let us write the equivalent fraction of $\frac{2}{3}$ and $\frac{3}{4}$ as below

$\frac{2}{3}=\frac{2\times 4}{3\times 4}=\frac{8}{12}$; $\frac{3}{4}=\frac{3\times 3}{4\times 3}=\frac{9}{12}$ Therefore $\frac{2}{3}+\frac{3}{4}=\frac{8}{12}+\frac{9}{12}=\frac{17}{12}$

(ii) $\frac{4}{5}-\frac{3}{4}$

The multiples of 5 : 5, 10, 15, 20, 25, 30, 35, 40, 45, 50.

The multiples of 4 : 4, 8, 12, 16, 20, 24, 28, 32, 36, 40.

The common multiples : 20, 40,

The Least Common Multiple : 20.

The LCM of (4,5) = 20

Let us write the equivalent fractions of $\frac{4}{5}$ and $\frac{3}{4}$ as below

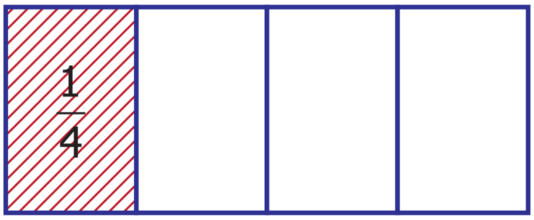
$\frac{4}{5}=\frac{4\times 4}{5\times 4}=\frac{16}{20}$; $\frac{3}{4}=\frac{3\times 5}{4\times 5}=\frac{15}{20}$

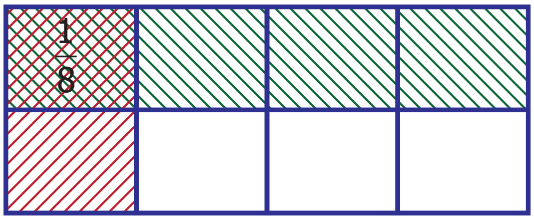
Therefore $\frac{4}{5}-\frac{3}{4}=\frac{16}{20}-\frac{15}{20}=\frac{1}{20}$

Activity 3:

The teacher explains multiplication and division of fractions as below.

$\frac{1}{2}$ of $\frac{1}{4}$ means the product of $\frac{1}{2}$ and $\frac{1}{4}$. This can be illustrated as follows. We shade 1 part out of 4 parts which represents $\frac{1}{4}$.Now divide this horizontally into 2 equal parts and shade one part of it.

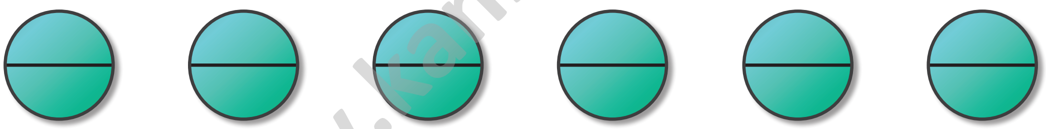




Here, the double shaded part represents the product $\frac{1}{8}$ and it is got by finding the product of the numerators and the product of denominators as follows:

$$\frac{1}{2}\times\frac{1}{4}=\frac{1\times1}{2\times4}=\frac{1}{8}$$

$6\div\frac{1}{2}$ can be explained through the following images.



We divide each circle into halves such that each part is $\frac{1}{2}$ of the whole. The number of such halves would be $6\div\frac{1}{2}$.

In the figure how many halves do you see? There are 12 halves. As one circle has 2 halves, 6 circles will have 12 halves. 6 × 2. Therefore, $6\div\frac{1}{2}=6\times2=12$.

Here, we can observe that, dividing a whole number 6 by a fraction $\frac{1}{2}$ is the same as multiplying a whole number 6 by 2, where 2 is the reciprocal of $\frac{1}{2}$ Generally, dividing a number by a fraction is the same as multiplying that number by the reciprocal of the fraction.

15 Measures

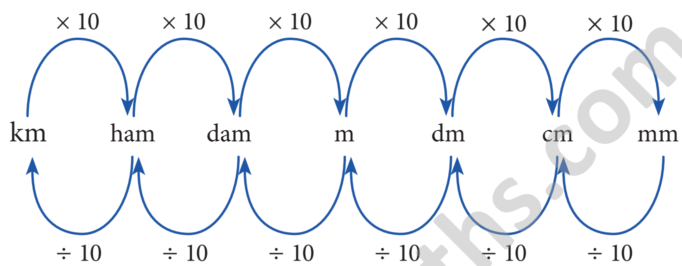
Learning Outcomes

- Relates different commonly used larger and smaller units of length, weight and volume and converts larger units to smaller units and vice versa

Teacher Activities

Activity 1:

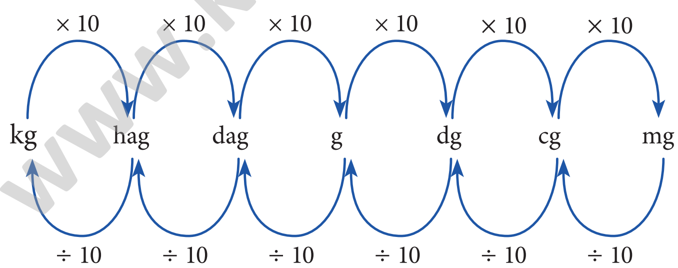
The teacher explains conversion of length measures as below.



1 km = 1000 m 1 m = 100 cm 1 m = 1000 mm 1 cm = 10 mm

Activity 2:

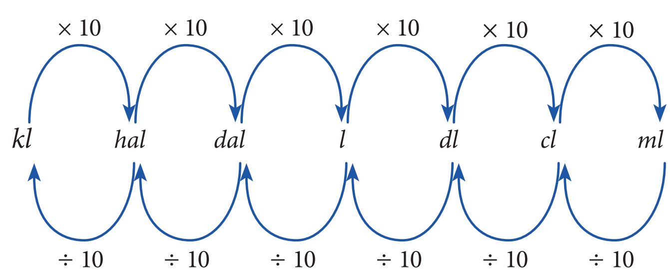
The teacher explains conversion of weight measures as below.



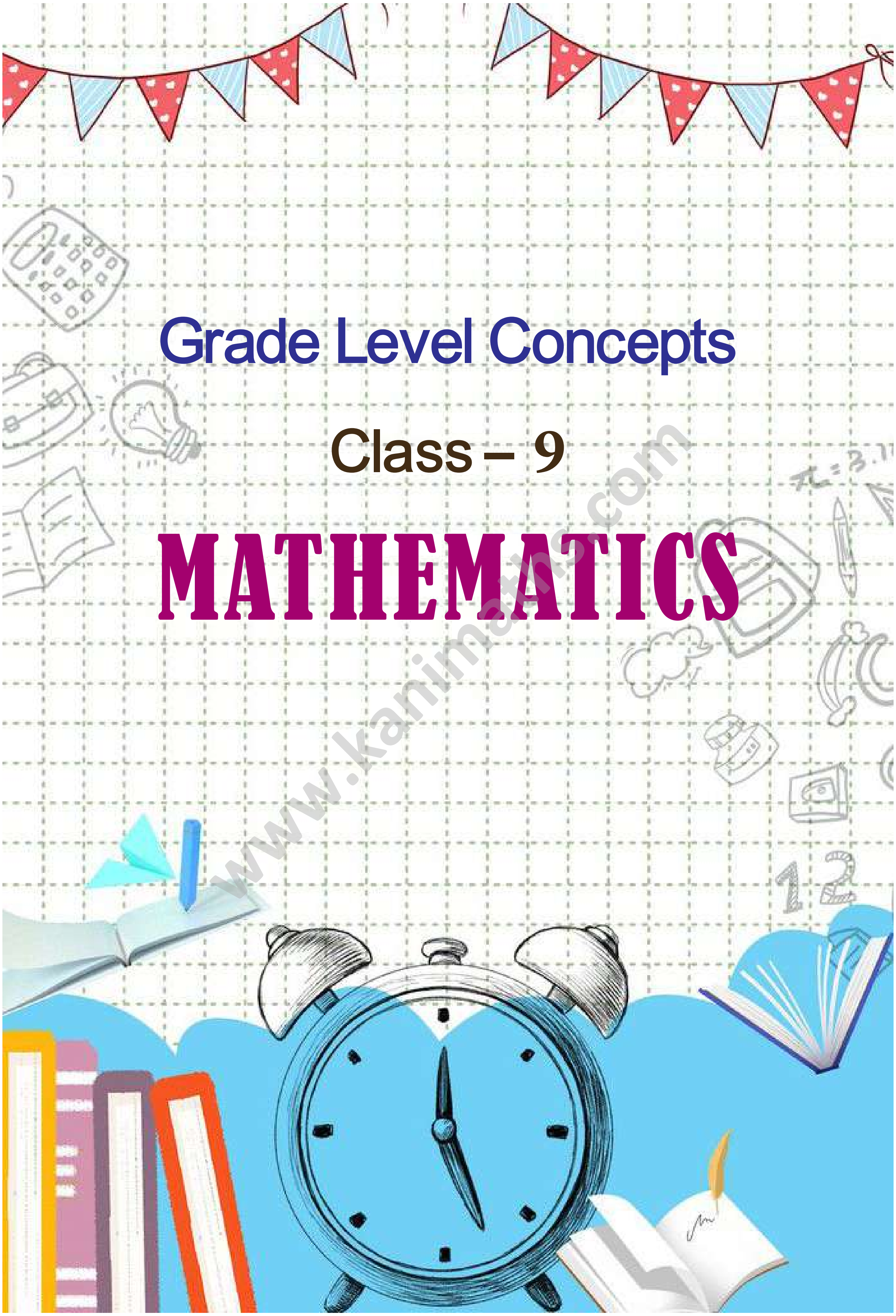
1 kg = 1000 g 1 g = 1000 *mg*

Activity 3:

The teacher explains conversion of capacity measures as below.



1 l = 1000 *ml*



Grade Level Concepts

Class – 9

MATHEMATICS

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Content

THIRAN – Plan of Action – Grade Level Concept - 9th Standard

S.No.	Title	Days	Content	Learning Outcomes
1	Rational numbers	1	Understanding rational numbers, representing rational numbers on a number line	Solves problems related to daily life situations involving rational numbers. (M 704) Finds out as many rational numbers as possible between two given rational numbers. (M 802)
2	Properties of rational numbers - I	2	To know the properties of rational numbers	Generalises properties of addition, subtraction, multiplication and division of rational numbers through patterns (M 801)
3	Properties of rational numbers - II	3		
4	Square and square root	4	Find the square and square root	finds squares, cubes and square roots and cube roots of numbers using different methods.(M 804)
5	Cube and cube root	5	Find the cube and cube root	
6	Circle and its parts	6	To know the circle and its parts	Describes geometrical ideas like line, line segment, open and closed figures, angle, triangle, quadrilateral, circle, etc., with the help of examples in surroundings (M 610)
7	Combined shapes	7	Find the area of combined shapes	
8	Three dimensional shapes	8	To know the properties of three dimensional shapes	Describes and provides examples of edges, vertices and faces of 3-D objects (M 619) Verifies Euler's relation through pattern (M 814)
9	Algebra - Basic concepts	9	To know the basic concepts of algebra	
10	Algebra - Basic operations	10	To know the basic operations of algebra	Adds/subtracts algebraic expressions (M 707) Multiplies algebraic expressions. (M 807)

S.No.	Title	Days	Content	Learning Outcomes
11	Algebraic identities	11	To know the algebraic identities	Uses various algebraic identities in solving problems of daily life (M 808)
12	Factorisation	12	Factorise the algebraic expressions	
13	Linear equations in one variable	13	To solve the linear equations in one variable	Solves puzzles and daily life problems using variables. (M 806)
14	Similar and congruent triangles	14	To know the similar and congruent triangles	
15	Pythagorean theorem	15	To solve the problems in using pythagorean theorem	
16	Types of lines on a triangle	16	To know the types of lines on a triangle	
17	Construction of quadrilateral and trapezium	17	To know the construction of quadrilateral and trapezium	
18	Construction of special quadrilaterals - I	18	To know the construction of special quadrilaterals	Calculates areas of the regions enclosed in a rectangle and a square(M 717)
19	Construction of special quadrilaterals - II	19		Verifies properties of parallelograms and establishes the relationship between them through reasoning. (M 812)
20	Statistics	20	Preparing a frequency table	

1 Rational numbers

Learning Outcome

- Solves problems related to daily life situations involving rational numbers.
- Finds out as many rational numbers as possible between two given rational numbers.

Teacher Activities :

Activity 1:

The teacher explains as below. The numbers that can be counted is called as **Natural numbers**. It is represented as **N** = {1,2,3,...}. The numbers including zero with Natural numbers are called the **whole numbers**. It is represented as **W** ={ 0,1,2,3,…}. The integers are numbers that have positive, negative and zero. It is represented as **Z** = {…-2,-1,0,1,2,3,…}

The teacher writes the following on the board.

$\frac{13}{5} = 2.6$; $-\frac{4}{12} = -\frac{1}{3}$; $-\frac{55}{20} = -\frac{11}{4}$

2.6 is a number lies between 2 and 3.

$-\frac{1}{3}$ is a number lies between 0 and –1.

$-\frac{11}{4}$ is a number lies between –2 and –3.

Hence, a ratio made by dividing an integer by another integer is called a rational number.

A rational number is represented in the form of $\frac{a}{b}$ where a and b are integers and b ≠ 0

The collection of all rational numbers is denoted by Q.

Examples : $\frac{3}{4}$, $\frac{-2}{7}$, $\frac{3}{-8}$, $-(\frac{2}{5})$

Rational numbers (or) quotient numbers: The numbers that can be expressed in the form of $\frac{p}{q}$, where p, q are integers and q ≠ 0 are known as rational numbers .It is represented as $Q = \{\frac{p}{q}, p, q \in z \quad q \neq 0\}$.

$\frac{0}{1}, \frac{0}{2}, \frac{0}{3}$ etc.., 0 are rational numbers. Also, $\frac{1}{1}, \frac{2}{2}, \frac{3}{3}, \ldots, -\frac{1}{1}, -\frac{2}{2}, -\frac{3}{3}, \ldots, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots$, are rational numbers.

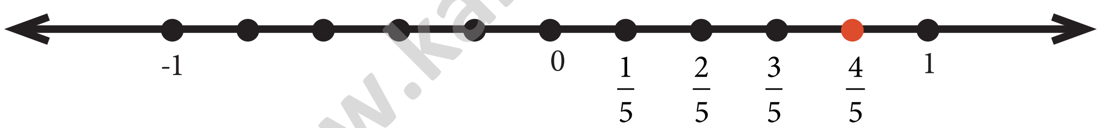
Activity 2: Representation of Rational Numbers on Number Line

Every number in mathematics can be represented on the number line. To represent the rational numbers on the number line the following points must be kept in the mind:

1. The numbers on the right side of any number on the number line is greater than the numbers on the left.
2. Any number on the left side of a number on the number line is less than the numbers on the right side.
3. Every positive number is represented on the right side of zero on the number line.
4. Every negative rational number is represented on the left side of zero on the number line.
5. An improper fraction can be converted into mixed fraction and mark it on the number line.

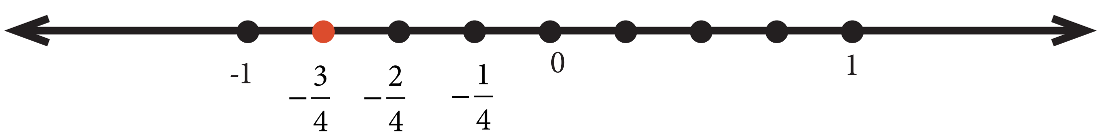
Example -1: Represent $\frac{4}{5}$ on the number line.

Solution: $\frac{4}{5}$ is proper fraction (positive integer).It lies between 0 and 1. To represent this, we can divide the number line between 0 and 1 into 5 equal parts. The fourth part of 5 parts will be $\frac{4}{5}$ and it can be represented as:



Example-2 : Represent $-\frac{3}{4}$ on the number line.

Solution: The given rational number $-\frac{3}{4}$ is negative. So, it will lie on the left of zero on the number line and will be between zero and (-1). To represent this on the number line first we need to divide number line between 0 and -1 into 4 equal parts. The third part will be $-\frac{3}{4}$.
It can be represented as:



2 Properties of rational numbers - I

Learning Outcome

- Generalises properties of addition, subtraction, multiplication and division of rational numbers through patterns

Teacher Activities

Activity 1: Addition:

(i) Closure Property:

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers, then $\left(\frac{a}{b}+\frac{c}{d}\right)$ is also a rational number.

Example: $\frac{2}{9}+\frac{4}{9}=\frac{6}{9}=\frac{2}{3}$ is a rational number.

(ii) Commutative Property:

Rational numbers always satisfy the commutative property with respect to addition.

Addition of two rational numbers is commutative. If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers, then $\left(\frac{a}{b}+\frac{c}{d}\right)=\left(\frac{c}{d}+\frac{a}{b}\right)$.

Example: $\frac{2}{9}+\frac{4}{9}=\frac{6}{9}=\frac{2}{3}$ and $\frac{4}{9}+\frac{2}{9}=\frac{6}{9}=\frac{2}{3}$, so $\frac{2}{9}+\frac{4}{9}=\frac{4}{9}+\frac{2}{9}$.

(iii) Associative Property:

Addition of rational numbers is associative.

If $\frac{a}{b},\frac{c}{d}$ and $\frac{e}{f}$ are any three rational numbers, then $\frac{a}{b}+\left(\frac{c}{d}+\frac{e}{f}\right)=\left(\frac{a}{b}+\frac{c}{d}\right)+\frac{e}{f}$

Example: $\frac{2}{9}+\left(\frac{4}{9}+\frac{1}{9}\right)=\frac{2}{9}+\frac{5}{9}=\frac{7}{9}, \left(\frac{2}{9}+\frac{4}{9}\right)+\frac{1}{9}=\frac{6}{9}+\frac{1}{9}=\frac{7}{9}$.

So, $\frac{2}{9}+\left(\frac{4}{9}+\frac{1}{9}\right)=\left(\frac{2}{9}+\frac{4}{9}\right)+\frac{1}{9}$.

(iv) Additive Identity:

If $\frac{a}{b}$ is any rational number, then $\frac{a}{b}+0=0+\frac{a}{b}=\frac{a}{b}$. Zero is the additive identity for rational numbers.

Example: $\frac{2}{7}+0=0+\frac{2}{7}=\frac{2}{7}$.

(v) Additive Inverse:

If $\frac{a}{b}$ is a rational number, then there exists a rational number $\left(-\frac{a}{b}\right)$ such that $\frac{a}{b}+\left(-\frac{a}{b}\right)=\left(-\frac{a}{b}\right)+\frac{a}{b}=0$. Here $-\frac{a}{b}$ is the additive inverse of $\frac{a}{b}$.

Example: Additive inverse of $\frac{3}{5}$ is $\left(-\frac{3}{5}\right)$. Additive inverse of $\left(-\frac{3}{5}\right)$ is $\frac{3}{5}$.

Note: Additive inverse of 0 is 0 itself.

Activity 2:

Subtraction:

(i) Closure Property:

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers, then $\left(\frac{a}{b}\right)-\left(\frac{c}{d}\right)$ is also a rational number.

Example: $\frac{5}{9}-\frac{2}{9}=\frac{3}{9}=\frac{1}{3}$ is a rational number.

(ii) Commutative Property:

Subtraction of any two rational numbers is not commutative. If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers, then $\left(\frac{a}{b}\right)-\left(\frac{c}{d}\right)\neq\left(\frac{c}{d}\right)-\left(\frac{a}{b}\right)$.

Example: $\frac{5}{9}-\frac{2}{9}=\frac{3}{9}=\frac{1}{3}$ and $\frac{2}{9}-\frac{5}{9}=-\frac{3}{9}=-\frac{1}{3}$ and $\frac{5}{9}-\frac{2}{9}\neq\frac{2}{9}-\frac{5}{9}$.

Therefore, Commutative property is not true for subtraction.

(iii) Associative Property:

Subtraction of rational numbers is not associative.

If $\frac{a}{b},\frac{c}{d}$ and $\frac{e}{f}$ are any three rational numbers, then $\frac{a}{b}-\left(\frac{c}{d}-\frac{e}{f}\right)\neq\left(\frac{a}{b}-\frac{c}{d}\right)-\frac{e}{f}$.

Example: $\frac{2}{9}-\left(\frac{4}{9}-\frac{1}{9}\right)=\frac{2}{9}-\frac{3}{9}=-\frac{1}{9}$ and $\left(\frac{2}{9}-\frac{4}{9}\right)-\frac{1}{9}=-\frac{2}{9}-\frac{1}{9}=-\frac{3}{9}$. So $\frac{2}{9}-\left(\frac{4}{9}-\frac{1}{9}\right)\neq\left(\frac{2}{9}-\frac{4}{9}\right)-\frac{1}{9}$.

Therefore, Associative property is not true for subtraction.

3 Properties of rational numbers - II

Learning Outcome

- Generalises properties of addition, subtraction, multiplication and division of rational numbers through patterns

Teacher Activities

Activity 1: Multiplication:

(i) Closure Property:

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers, then $\left(\frac{a}{b}\times\frac{c}{d}\right)=\frac{ac}{bd}$ is also a rational number.

Example: $\frac{5}{9}\times\frac{2}{9}=\frac{10}{81}$ is a rational number.

(ii) Commutative Property:

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers, then $\left(\frac{a}{b}\right)\times\left(\frac{c}{d}\right)=\left(\frac{c}{d}\right)\times\left(\frac{a}{b}\right)$.

Example: $\frac{5}{9}\times\frac{2}{9}=\frac{10}{81}$ and $\frac{2}{9}\times\frac{5}{9}=\frac{10}{81}$ So, $\frac{5}{9}\times\frac{2}{9}=\frac{2}{9}\times\frac{5}{9}$ Therefore, Commutative property is true for multiplication.

(iii) Associative Property:

If $\frac{a}{b},\frac{c}{d}$ and $\frac{e}{f}$ are any three rational numbers, then $\frac{a}{b}\times\left(\frac{c}{d}\times\frac{e}{f}\right)=\left(\frac{a}{b}\times\frac{c}{d}\right)\times\frac{e}{f}$.

Example: $\frac{2}{9}\times\left(\frac{4}{9}\times\frac{1}{9}\right)=\frac{2}{9}\times\frac{4}{81}=\frac{8}{729}$ and $\left(\frac{2}{9}\times\frac{4}{9}\right)\times\frac{1}{9}=\frac{8}{81}\times\frac{1}{9}=\frac{8}{729}$, So, $\frac{2}{9}\times\left(\frac{4}{9}\times\frac{1}{9}\right)=\left(\frac{2}{9}\times\frac{4}{9}\right)\times\frac{1}{9}$.

Therefore, Associative property is true for multiplication.

(iv) Multiplicative Identity:

If $\frac{a}{b}$ is any rational number, and $\frac{a}{b}\times1=1\times\frac{a}{b}=\frac{a}{b}$. Then 1 is multiplicative identity

Example: $\frac{5}{7}\times1=1\times\frac{5}{7}=\frac{5}{7}$

(v) Multiplication by Zero (0) :

Every rational number multiplied with 0 gives 0. If $\frac{a}{b}$ is any rational number, then $\frac{a}{b}\times0=0\times\frac{a}{b}=0$.

Example: $\frac{5}{7}\times0=0\times\frac{5}{7}=0$.

(vi) Multiplicative Inverse or Reciprocal:

For every rational number $\frac{a}{b}, b \neq 0$, there exists a rational number $\frac{b}{a}$ such that $\frac{a}{b} \times \frac{b}{a} = 1$. Then, $\frac{b}{a}$ is the multiplicative inverse of $\frac{a}{b}$. If $\frac{b}{a}$ is a rational number, then $\frac{a}{b}$ is the multiplicative inverse or reciprocal of it.

Example: i) The multiplicative inverse of $\frac{2}{3}$ is $\frac{3}{2}$. (ii) The multiplicative inverse of $\frac{1}{3}$ is 3.
(iii) The multiplicative inverse of 1 is 1. (iv) The multiplicative inverse of 0 is undefined.

Activity 2:

Division:

(i) Closure Property:

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, such that $\frac{c}{d} \neq 0$, then $\frac{a}{b} \div \frac{c}{d}$ is always a rational number.

Example: $\frac{2}{3} \div \frac{1}{3} = \frac{2}{3} \times \frac{3}{1} = 2$ is a rational number.

(ii) Commutative Property:

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, then $\frac{a}{b} \div \frac{c}{d} \neq \frac{c}{d} \div \frac{a}{b}$

Example: $\frac{2}{3} \div \frac{1}{3} = \frac{2}{3} \times \frac{3}{1} = 2$ and $\frac{1}{3} \div \frac{2}{3} = \frac{1}{3} \times \frac{3}{2} = \frac{1}{2}$ and $\frac{2}{3} \div \frac{1}{3} \neq \frac{1}{3} \div \frac{2}{3}$.

Therefore, Commutative property is not true for division.

(iii) Associative Property:

If $\frac{a}{b}, \frac{c}{d}$ and $\frac{e}{f}$ are any three rational numbers, then $\frac{a}{b} \div \left(\frac{c}{d} \div \frac{e}{f}\right) \neq \left(\frac{a}{b} \div \frac{c}{d}\right) \div \frac{e}{f}$.

Example: $\frac{2}{9} \div \left(\frac{4}{9} \div \frac{1}{9}\right) = \frac{2}{9} \div 4 = \frac{1}{8}$ and $\left(\frac{2}{9} \div \frac{4}{9}\right) \div \frac{1}{9} = \frac{1}{2} - \frac{1}{9} = \frac{7}{18}$. So $\frac{2}{9} \div \left(\frac{4}{9} \div \frac{1}{9}\right) \neq \left(\frac{2}{9} \div \frac{4}{9}\right) \div \frac{1}{9}$.

Therefore, associative property is not true for division.

(iv) Distributive Property:

(i) Distributive Property of Multiplication over Addition :

If $\frac{a}{b}, \frac{c}{d}$ and $\frac{e}{f}$ are any three rational numbers, then $\frac{a}{b} \times \left(\frac{c}{d} + \frac{e}{f}\right) = \frac{a}{b} \times \frac{c}{d} + \frac{a}{b} \times \frac{e}{f}$

Example: $\frac{1}{3} \times \left(\frac{2}{5} + \frac{1}{5}\right) = \frac{1}{3} \times \frac{3}{5} = \frac{1}{5}$ ----- (1);

$\frac{1}{3} \times \frac{2}{5} + \frac{1}{3} \times = \frac{1}{5} = \frac{2}{15} + \frac{1}{15} = \left(\frac{2+1}{15}\right) = \frac{3}{15} = \frac{1}{5}$ ----- (2);

From (1) and (2), $\frac{1}{3} \times \left(\frac{2}{5} + \frac{1}{5}\right) = \left(\frac{1}{3} \times \frac{2}{5}\right) + \left(\frac{1}{3} \times \frac{1}{5}\right) = \frac{2}{15} + \frac{1}{15} = \frac{1}{5}$.

4 Square and square root

Learning Outcome

- Finds squares, cubes and square roots and cube roots of numbers using different methods.

Teacher Activities

Activity 1:

Square number

Consider, if the side of a square is 1 unit then its square is 1 square unit. If the side of a square is 2 units then its square is 4 square units. If the side of a square is 3 units, then its square is 9 square units. A **square number** is the number we get after multiplying a number by itself. This can be written by raising the power or exponent of that number to '2'.

5^2 is said to be "5 squared" or 5 to the power of 2. The teacher explains that "25 is the square of 5". Let us find one natural number n and another natural number m such that $n = m^2$ so n is a square number

Activity 2:

Square root of a number

The square root of a number is a value in which on getting multiplied by itself gives the original value. Also, it is written as $\sqrt{n}$ or $n^{\frac{1}{2}}$.

Example: $\sqrt{81}$ is 9. Since $9 \times 9 = 81$ and $12^2 = 144$ then $\sqrt{144} = 12$

Activity 3:

Square root through prime factorization

First, resolve the given number into prime factors. Group the identical factors in pairs and then take one from them to find the square root.

Example: Find the square root of 64

2	64
2	32
2	16
2	8
2	4
2	2
	1

Solution: $\sqrt{64} = \sqrt{2 \times 2 \times 2 \times 2 \times 2 \times 2}$

$\sqrt{64} = \sqrt{2^2 \times 2^2 \times 2^2}$

$\sqrt{64} = 2 \times 2 \times 2$

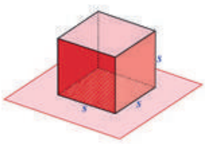
$\sqrt{64} = 8$

5 Cube and cube root

Learning Outcome

- Finds squares, cubes and square roots and cube roots of numbers using different methods.

Teacher Activities



Activity 1:

Cube numbers

In geometry, if the length, width, and height are all equal, then it will represent a **cube**. If the side of the cube is "s" then the volume of cube is $s \times s \times s = s^3$.

If you multiply a number by itself and then by itself again, the result is a cube number. It means that a cube number is a number that is the product of three identical numbers. If n is a number, its cube is represented by n^3.

Example: $5^3 = 5 \times 5 \times 5 = 125$ where 125 is cube of 5. Cube of $7 = 7^3 = 343$

$$\sqrt[3]{125} = \sqrt[3]{5^3} = (5^3)^{\frac{1}{3}} = 5^{\frac{3}{3}} = 5^1 = 5$$

Activity 2:

Cube root

The cube root of a number is the value being multiplied to itself three times produces the original value.

Example: The cube root of 27 is 3 because when 3 is cubed we get 27. The cube root number is represented by $\sqrt[3]{27}$ (or) $27^{\frac{1}{3}}$.

Example: The cube of 5 is 125, The teacher explains that the cube of 5 is $5^3 = 125$. From this, we can know that the cube root of 125 is 5.

Activity 3:

Exponents and Powers: In general terms, an expression that represents repeated multiplication of the same factor is called a power. In the number 5^2, 5 is called the base and 2 is called the exponent (also called as power). The exponent corresponds to the number of times the base is used as a factor.

Example: $a \times a \times a \times a \times a = a^5$, $3 \times 3 \times 3 \times 3 = 3^4$

Laws of Exponents: The different Laws of exponents are:

i) $a^m \times a^n = a^{m+n}$ ii) $\frac{a^m}{a^n} = a^{m-n}$ iii) $(a^m)^n = a^{mn}$ iv) $\frac{a^n}{b^n} = \left(\frac{a}{b}\right)^n$ v) $a^0 = 1$ vi) $a^{-m} = \frac{1}{a^m}$

6 Circle and its parts

Learning Outcome

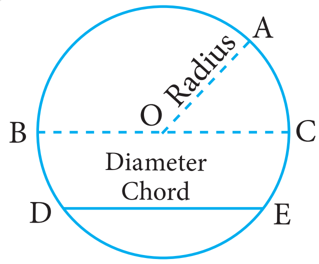
- Describes geometrical ideas like line, line segment, open and closed figures, angle, triangle, quadrilateral, circle, etc., with the help of examples in surroundings

Teacher Activities

Activity 1:

Parts of a circle: A circle is the path traced by a moving point so that its distance from a fixed point is always constant.

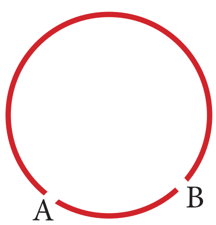
The fixed point of the circle is called its center (O) and the constant distance is called its radius (r). If any two points on a circle are joined by a line segment, then the line segment is called a chord. A chord divides a circle into two parts. A chord which passes through the center of a circle is called as a diameter.

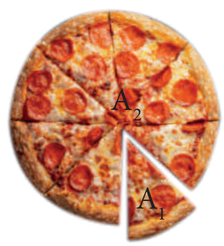


A diameter of a circle divides it into two equal parts. Diameter is the longest chord of a circle.

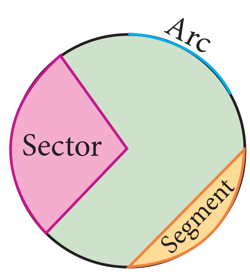
Activity 2:

Circular Arc and Circular Sector: Look at the glass bangle and the pizza given in figure. Though both are of circular shapes, the bangle indicates the boundary of the circle, whereas the pizza indicates the plane enclosed within the boundary of the circle. Thus the bangle indicates the circumference of the circle,the pizza indicates the area of the circle.





1. A part of the circumference of a circle is called a circular arc
   The plane surface that is enclosed between two radii and the circular arc of a circle is called a **sector**.
2. Each part of a circle which is divided by a chord is called a **segment**. The part which has a smaller arc is called as the **minor segment** and the part which has a larger arc is called as the **Major segment**.



3. The angle formed by a sector of a circle at its center is called the **central angle**. The central angle of each of the sectors is $= \frac{360^\circ}{n}$

7 Combined shapes

Learning Outcome

- To calculate the area and the perimeter of combined plane figures.
- To understand the representation of 3-D shapes in 2-D.

Teacher Activities

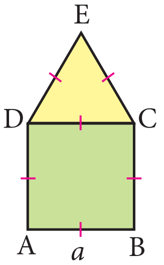
Activity 1:

Combined Shapes: We use them separately as well as two or three or more shapes combined together. Some example,

The shape of a glass window is like a semi-circle placed over a rectangle whereas the front-facing wall of a model house looks like a triangle over a square.

Thus, two or more plane figures joined with the sides of same measure give rise to combined shapes.

Activity 2:



Perimeter and Area of combined shapes: The perimeter of a combined shape is the sum of all the lengths of the sides that form a closed boundary.

To find the area of a combined shapes, split the combined shapes into known simpler shapes,find their area separately and then add them up. That is, the area of combined shapes is nothing but the sum of all the areas of the simple shapes in it.

Find perimeter and area of the combined shapes.

Perimeter of the given figure = AB + BC + CE + ED + DA = $a + a + a + a + a = 5a$ units

Area of the given figure = area of the square+ area of the triangle

$$= \text{side} \times \text{side} + \frac{\sqrt{3}}{4}a^2 = a^2 + \frac{\sqrt{3}}{4}a^2$$

8 Three dimensional shapes

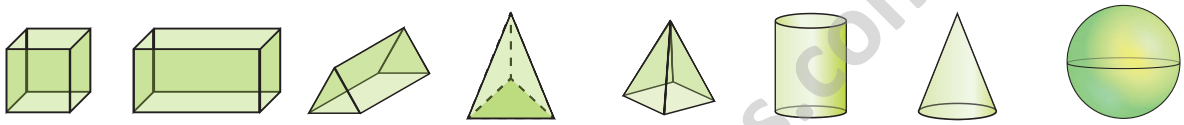
Learning Outcome

- Describes and provides examples of edges, vertices and faces of 3-D objects
- Verifies Euler's relation through pattern

Teacher Activities

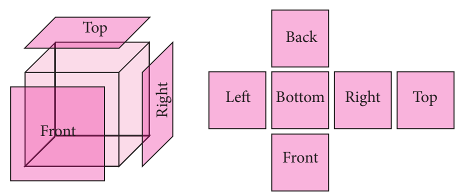
Activity 1: Three dimensional (3-D) shapes :

The shapes which have three dimensions namely length, breadth, height (depth) are called three **dimensional shapes**, simply called as **3-D shapes**. Some examples of 3-D shapes are



Cube   Cuboid   Prism   Triangular Pyramid   Square Pyramid   Cylinder   Cone   Sphere

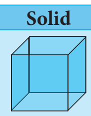
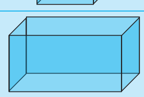
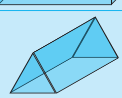
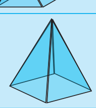
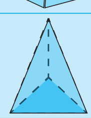
Activity 2: Faces, Edges and Vertices:



Observe the shape, what is it? A cube. A cube is made of six square shaped planes. These 6 square shaped planes of the cube are known as its faces.

A line segment which connects any two faces of a cube is called as Edge and each corner point where three edges meet is called as Vertex. So a cube has 6 faces,12 edges and 8 vertices.

Activity 3: Tabulate the number of faces (F), vertices (V) and edges (E) for the following polyhedrons. Also find F+V–E

Solid	Name	F	V	E	F+V–E
	Cuboid	6	8	12	
	Cube				
	Triangular Prism				
	Square Pyramid				
	Triangular Pyramid				

What do you observe from the above table? We observe that, F+V–E = 2 in all the cases. This is true for any polyhedron and this relation F+V–E = 2 is known as **Euler's formula**.

9 Algebra - Basic concepts

Learning Outcome

- To know variables, constants, terms, Algebraic expression, Algebraic factors, coefficients like terms & unlike terms.
- To know polynomials and its classification.

Teacher Activities

Activity 1:

Variable: Variables are quantities that can take different values.

Example: i) x, y, z, a, b, c ii) height of the students iii) temperature of different cities across the country.

Constant: Constants are quantities whose value do not change (fixed value).

Example: i) 2, -5, $\frac{3}{7}$, 11; ii) One day = 24 hours; iii) Days of week = 7;

iv) Number of alphabets in English = 26.

Term: A term is the product of factors containing both variables and constants.

Eg: $2x^2 = 2 \times x \times x$, $-3ab = -3 \times a \times b$

An algebraic expression is an expression formed by integer constants, variables and 4 fundamental mathematical operations. **Eg:** $3x^2 + 4x + 1$

Co-efficient: It is the numerical factor in a term. **Eg:** $-4a^3 - 3a + 7a - 11$ (Co-efficient of a^3 **= –4**)

Like Terms: Terms with same variable are called like terms. **Eg:** $-5a, -7a, 3xy, -2xy$

Unlike Terms: Terms with different variables are unlike terms. **Eg:** $-2y^2x, 3y, -5ab$

Degree: The term containing the highest power of the variable of an expression is called the degree. **Eg:** $-4x^3 - 3x^2 + 5x - 7$; Degree: 3

Polynomial: A Polynomial is an expression containing two or more algebraic terms. The variables contain only whole number powers. It is a special kind of algebraic expression.

Classification of Polynomials:

- Monomial - An expression with a term **Eg:** $4x, 3x^2y, -5a^3$
- Binomial - An expression with two terms **Eg:** $5x + y$; $3a - 4b$
- Trinomial - An expression with three terms **Eg:** $P^2 - 2P + 3$

10 Algebra - Basic operations

Learning Outcome

- Adds/subtracts algebraic expressions
- Multiplies algebraic expressions.

Teacher Activities

Activity 1:

Addition and Subtraction: Two or more like terms are added and subtracted. If two unlike terms are added or subtracted we get new expression.

Eg : 1. $3a + 5a = 8a$ 2. $5b^2c - 2b^2c = 3b^2c$ 3. $3x^2 + 2y^2 = 3x^2 + 2y^2$

Activity 2:

Babu went to a fruit shop to buy bananas. Let the bananas bought by Babu = x dozens.

Its price per dozen = ₹ y. So, the total amount to be paid = ₹ $x\,y$.

Babu needs 3 more dozens. The shop keeper reduced ₹ 2 per dozen. How much Babu has to pay now?

amount to be paid = $(x + 3)\,(y-2)$ [Bananas = $x + 3$, Price = ₹ $y-2$]

Algebraic multiplication is used in our day to day life.

In the above mentioned situation if Raja needs $2x^2$ bananas, the shop keeper fixes its price as $(3y^2 - 5y + 5)$ then the amount paid by Raja is

Amount = $2x^2 \times (3y^2 - 5y + 5)$

Activity 3:

Algebraic Multiplication steps

$(+) \times (+) = (+)$, $(-) \times (-) = (+)$ } Same Symbol

$(+) \times (-) = (-)$, $(-) \times (+) = (-)$ } Different Symbol

Step 1: Multiply the symbols.

Step 2: Multiply the times and its coefficients.

Step 3: Multiply the variables factors by using laws of exponents.

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

Eg: $4x \times (-5x^2y)$

$= -4 \times 5 \times x^2\, x\, y$

$= -20x^3y$

Activity 4:

$$a^m \div a^n = a^{m-n} \qquad a^0 = 1$$

(Eg:) $\dfrac{25m^3 + 15m^2}{5m^2}$

$= \dfrac{25m^3}{5m^2} + \dfrac{15m^2}{5m^2}$

$= 5m^{3-2} + 3$

$= 5m + 3$

11 Algebraic identities

Learning Outcome

- Uses various algebraic identities in solving problems of daily life

Teacher Activities

Activity 1:

Introduce the following algebraic identities to students, by preparing a chart.

Square identities: $(a+b)^2 = a^2 + 2ab + b^2$

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

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

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

Cubic identities: $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

$$(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$$

$$(x+a)(x+b)(x+c) = x^3 + (a+b+c)x^2 + (ab+bc+ca)x + abc$$

Examples: 1. Expand: $(3a-4b)^2$

$$(3a-4b)^2 = (3a)^2 - 2(3a)(4b) + (4b)^2$$

$$= 9a^2 - 24ab + 16b^2$$

2. Expand: $(x+3y)^3$

$$(x+3y)^3 = x^3 + 3x^2(3y) + 3x(3y)^2 + (3y)^3$$

$$= x^3 + 9x^2y + 3x(9y^2) + 27y^3$$

$$= x^3 + 9x^2y + 27xy^2 + 27y^3$$

3. Evaluate using algebraic identity: 98^3

$$98^3 = (100-2)^3 = 100^3 - 3(100)^2(2) + 3(100)(2)^2 - (2)^3$$

$$= 1000000 - 3(10000)(2) + 3(100)(4) - 8$$

$$= 1000000 - 60000 + 1200 - 8$$

$$= 941192$$

12 Factorisation

Learning Outcome

- Factorizes the given algebraic expression by taking the common factors.
- Factorizes the given algebraic expression by using algebraic identities.
- Factorizes the quadratic polynomial of the form.

Teacher Activities

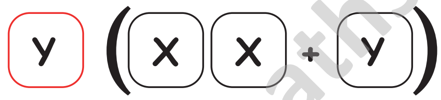
Activity 1:

Factorization by taking the common factors.

Factorise : $x^2y + y^2$

The expression can be arranged as follows using cards labeled x and y.

Among the two terms, one y is common. Differentiate with another colour. Take 'y' as common factor.



Hence, $x^2y + y^2 = y(x^2 + y)$

Activity 2:

Factorisation using algebraic identities:

Factorise : $81p^2 - 72pq + 16q^2$

$$81p^2 - 72pq + 16q^2 = (9p)^2 - 2(9p)(4q) + (4q)^2$$

Students are asked to compare the above expression with the identities chart and identify the pattern.

And hence use $(a-b)^2 = a^2 - 2ab + b^2$.

$(9p)^2 - 2(9p)(4q) + (4q)^2 = (9p-4q)^2 = (9p-4q)(9p-4q)$

Explain that factorisation can be done using algebraic identities in the above mentioned way.

Activity 3:

Factorisation of quadratic polynomial of the form $ax^2 + bx + c$.

1. $x^2 + 8x + 12$

Multiplication value (Coefficient of x^2) × (Constant) (1 × 12 = 12)	Addition value Coefficient of x = 8
1 × 12 = 12	1 + 12 = 13
2 × 6 = 12	**2 + 6 = 8**
3 × 4 = 12	3 + 4 = 7

Required pair of numbers is the bolded one in the above table.

$x^2 + 8x + 12 = x^2 + 2x + 6x + 12$ (Splitting the middle term as $2x + 6x$)

$$= x(x+2) + 6(x+2) = (x+2)(x+6)$$

13 Linear equations in one variable

Learning Outcome

- Solves puzzles and daily life problems using variables.

Teacher Activities

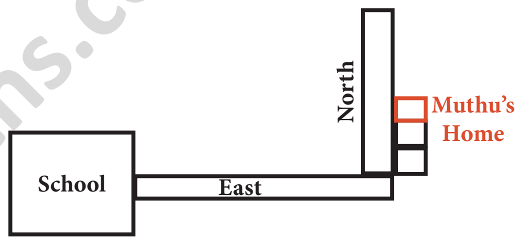
Activity 1:

- Prepare a chart with the following type of questions and trains the students. Fill in the boxes with appropriate numbers.

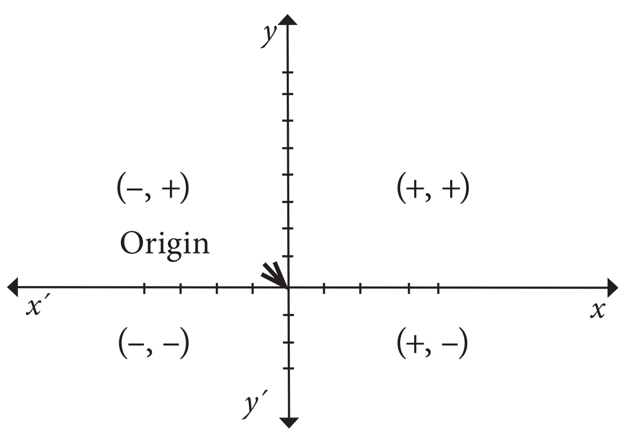
i) $\square + 5 = 8$ ii) $11 + 3 = 6 + \square$ iii) $2 \times \square = 10$ iv) $\frac{3 \times \square}{5} = 6$

Activity 2:

- The teacher asks the student(s) Where is the Muthu's home?
- Students replied, Muthu's home is from our School, take the east side road, then take the north side road, in that street third building is Muthu's home.
- Students understand the location of Muthus' home by looking at the picture aside.



- Now the teacher places a point on the blackboard and asks the students, where is the point located?
- All the students point the blackboard and shouted it is there.
- The teacher says as a student to locate Muthu's home in a clear way by pointing the location on the black board.
- The teacher explains that the location of Muthu's home with school as a starting point. Similarly teacher asks the students to locate a point between school and Muthu's home, there must be a starting point.
- That starting point is technically named as origin. Teacher also explains about *x*-axis, *y*-axis, scale, quadrants, Cartesian coordinate system, using the following picture.
- With some examples, teacher trains the students, to plot a point (x, y) in a graph sheet.
- The teacher also trains the students to plot two points and join them to make a straight line, in a graph sheet.



14 Similar and congruent triangles

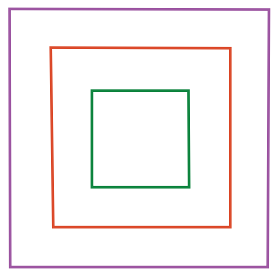
Learning Outcome

- To know the similar and congruent properties and also the basic properties of triangles.
- To understand the theorems based on these properties and apply them appropriately to problems.

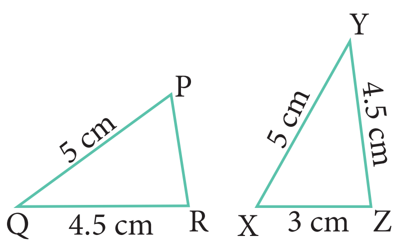
Teacher Activities

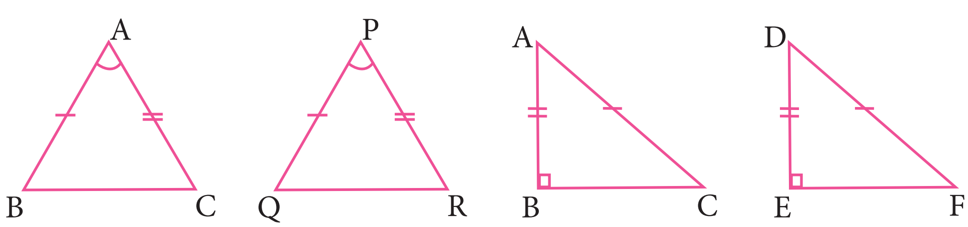
Activity 1:

Giving ₹1, ₹2, ₹10 coins to students and identifying identical and symmetrical shapes by matching the coins exactly one on the top of the other in size and shape. Reminding students that congruent figures are exactly the same in shape and size. In other words, shapes are congruent if one fits exactly over the other. Similar figures mathematically have the same shape but different sizes



Activity 2:





Triangles are given to students, to find the triangles that fit exactly in a box with several triangular shaped cards with side and angle dimensions were written on the cards. The information of triangle, S–S–S, S–A–S, A–S–A, R–H–S according to its basis and explain the congruent properties.

15 Pythagorean theorem

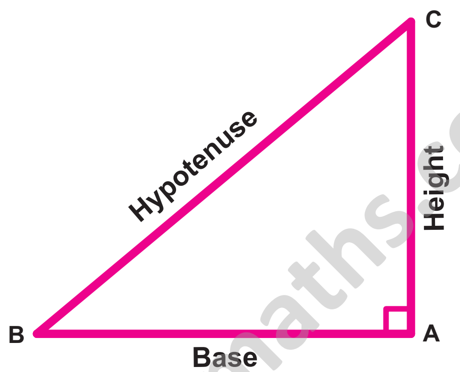
Learning Outcome

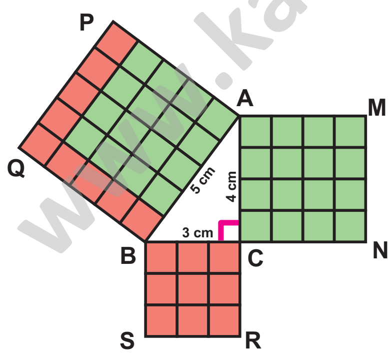
To understand the Pythagorean theorem

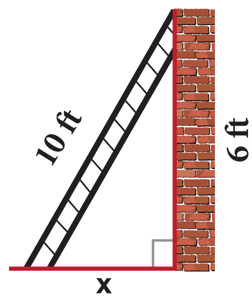
Teacher Activities

Activity 1:

Students are asked to fill the table given below: Is it possible to create any general rule based on the data obtained? Exploring as







S.No	AB	AC	BC	AB^2	AC^2	Hypotenuse ($BC^2 = AB^2 + AC^2$)
1	5 cm	12 cm	13 cm	25 cm^2	144 cm^2	169 cm^2
2	3 cm	4 cm	5 cm			
3	6 cm	8 cm	10 cm			

By filling out the table above, In a right angled triangle, the square on the hypotenuse is equal to the sum of the squares on the other two sides. i.e., In ΔABC, $\mathbf{BC^2 = AB^2 + AC^2}$. By this way Explaining the Pythagorean Theorem to students.

16 Types of lines on a triangle

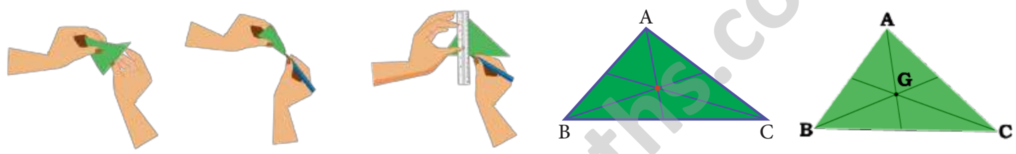
Learning Outcome

- To know and understand the concurrency of medians, altitudes, angle bisectors and perpendicular bisectors in a triangle.

Teacher Activities

Activity 1:

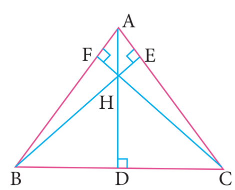
Making students pick up a triangular shaped paper. Fold it as outlined in the picture, and finally underline the scale on all three folds. If we consider those three lines as medians, we can see that all three medians pass through a point. Interpret the midpoint centre as the point where all three medians go.



By this we mean that a median of a triangle is a line segment from a vertex to the midpoint of the side opposite to that vertex, The point of concurrence of the three medians in a triangle is called its **Centroid**, denoted by the letter **G**.

Activity 2:

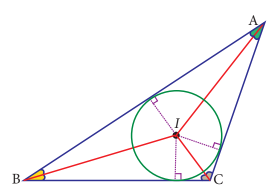
The teacher demonstrates acute angled triangle by paper folding: Making students see the vertical lines on the other two sides similarly through the paper fold. Also, making the perpendiculars of the right and right triangles visible. Do all the vertical lines of a triangle pass through a point?



Explains to students that, the three altitudes of any triangle are concurrent, the point of concurrence is known as its **Orthocentre**, denoted by the letter **H**.

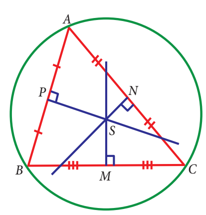
Activity 3:

The teacher recalls that the concept of an angular bisector, and also explains with the given diagram. The point of concurrence of the three angle bisectors of a triangle is called as its **incentre**, denoted by the letter **I**.



Activity 4:

The teacher draws the perpendicular bisector of the triangle and explains it to the students. The point of concurrence of the three perpendicular bisectors of a triangle is called as its **Circumcentre**, denoted by the letter **S**.

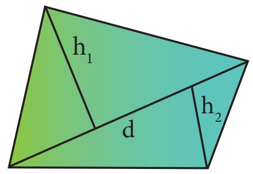


17 Construction of quadrilateral and trapezium

Learning Outcome

- Recognizes the method of finding the area of Quadrilateral and Trapezium.
- Using the compass, protractor and sets square for constructing quadrilaterals and trapezium for the given measurements.

Teacher Activities



Activity 1:

Quadrilateral

In geometry, a quadrilateral can be defined as a closed, two dimensional shape which has four straight sides. The polygon has four vertices or corners.

1. **Concave polygon:** A polygon in which atleast one interior angle is more than 180 degree, is called concave polygon.
2. **Convex polygon:** A polygon in which each interior angle is less than 180 degree, is called a convex polygon.

Properties of quadrilateral:

- A quadrilateral should be closed shape with 4 sides and two diagonals.
- All the internal angles of a quadrilateral sum up to 360° degree.

Area of Quadrilateral $= \frac{1}{2} \times d \times (h_1 + h_2)$ **square units.**

Construction of Quadrilateral:

To draw the quadrilateral using compass and sets square, to start with rough sketch diagram drawn

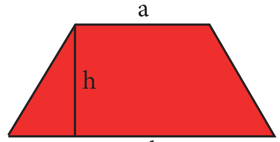
- Four sides and a diagonal
- Three sides and two diagonals

Construction of Quadrilateral

After drawing the rough sketch, using compass, protractor and sets square the quadrilateral is drawn for the given measurements,

- Four sides and an angle
- Three sides and two angles
- Two sides and three angles

Activity 2: Trapezium



A quadrilateral with a pair of opposite parallel sides is called **trapezium**.

Properties of trapezium:

- The sum of all the four angles of the trapezium is equal to 360 degrees.
- A trapezium has two parallel sides and two non-parallel sides.
- The diagonals of regular trapezium bisect each other.

Area of trapezium $= \frac{1}{2} \times h \times (a + b)$ **square units.**

Using divider and sets square the trapezium is drawn using the given measurements and its area is found

- Three sides and two diagonals
- Four sides

Using compass and protractor constructing the trapezium is drawn for the given measurements

- Three sides and an angle
- Two sides and two angles

18 Construction of special quadrilaterals - I

Learning Outcome

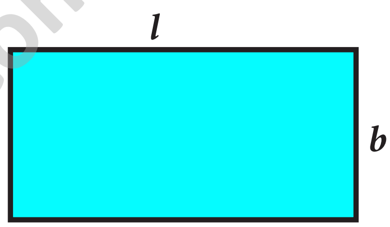
- Calculates areas of the regions enclosed in a rectangle and a square
- Verifies properties of parallelograms and establishes the relationship between them through reasoning.

Teacher Activities

Activity 3:

Rectangle : A rectangle is a parallelogram in which all angles are right angles.

Properties of rectangle:



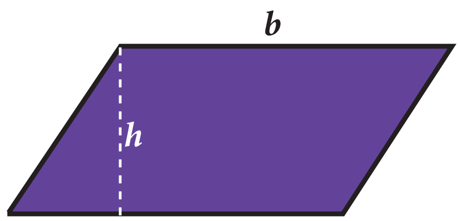
- Each interior angle is equal to 90°.
- The sum of all the interior angles is equal to 360°.
- The diagonals bisect each other.
- Both the diagonals have the same length.
- Sum of any adjacent angles is 180°.

Area of Rectangle = $l \times b$ square units.

Activity 2:

Parallelogram: A quadrilateral whose opposite sides are parallel is a parallelogram.

Properties of parallelogram:



- Opposite sides are equal and parallel.
- Diagonals bisect each other.
- Sum of any adjacent angles is 180°.

Area of parallelogram = $b \times h$ square units.

- The teacher asks the students to draw rough diagram for the given measurements.
- The teacher explains how to use the protractor and set squares to make parallelogram.
- With the help of measurements students should be insisted to find out the area of parallelogram.

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19 Construction of special quadrilaterals - II

Learning Outcome

- Calculates areas of the regions enclosed in a rectangle and a square
- Verifies properties of parallelograms and establishes the relationship between them through reasoning.

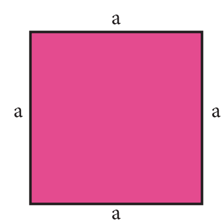
Teacher Activities

Activity 1:

Square : A square is a regular quadrilateral, which means that it has four equal sides and four equal length.

Properties of square:

- Opposite sides of a square are both parallel and equal in length.
- The diagonals of a square bisect each other and meet at 90°.
- All four angles of a square are equal.



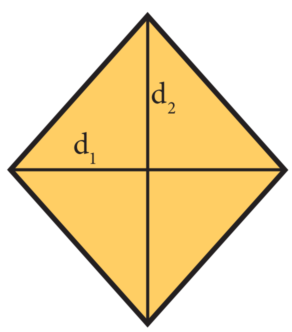
Area of Square = $a \times a$ square units.

Activity 2:

Rhombus : Rhombus is a type of quadrilateral, whose four sides have the same length.

Properties of rhombus:

- The opposite sides of rhombus are parallel and equal.
- Diagonals bisect each other at right angles.
- The sum of two adjacent angles is equal to 180°.



Area of Rhombus = $\frac{1}{2} \times d_1 \times d_2$ square units.

Draw a rhombus by using, GO = 5cm, LD = 8cm and draw rough diagram and find the area.

20 Statistics

Learning Outcome

- Construction of frequency distribution table for grouped data

Teacher Activities

Activity 1:

Frequency distribution: A frequency distribution is the arrangement of the given data in the form of the table showing frequency with which each variable occurs. There are two types of distribution table;

(i) Frequency distribution table for ungrouped data.
(ii) Frequency distribution table for grouped data.

Range: Range is the difference between the largest and the smallest values of the data given. If 5, 15, 10, 20 and 18 are the data, then range = 20–5 = 15.

Class interval: The range of the variable is grouped into number of classes, and each group is known as class interval. The difference between the upper limit (**U**) and the lower limit (**L**) of the class is known as class size.

Example: Class interval (C.I) = Upper limit – Lower limit. Marks for the C.I 10 to 20 can be written as 10-20, whose class size is 20-10=10

Activity 2:

Construction of frequency distribution table for grouped data:

The teacher gives an example to explain the construction of frequency distribution table.

Example: The marks obtained by 30 students (out of 50) in mathematics are given 43, 25, 29, 41, 45, 34, 19, 13, 18, 35, 25, 47, 36, 15, 43, 9, 25, 39, 37, 19, 42, 29, 32, 45, 41, 2, 32, 8, 17, 49.

Make a frequency distribution table and to find class interval for the above detail

Class interval	Tally marks	Frequency
0-10	|||	3
10-20	𝍸		6
20-30	𝍸	5
30-40	𝍸 ||	7
40-50	𝍸 ||||	9
	Total	30

Solution: Given number of marks = 30

Range = largest value-smallest value = 49 – 2 = 47.

The number of possible class intervals = $\frac{\text{Range}}{\text{Class size}} = \frac{47}{10} \approx 4.7 \simeq 5$

The frequency of 30 students marks have been tabulated

Class interval	0-10	10-20	20-30	30-40	40-50
Frequency	3	6	5	7	9

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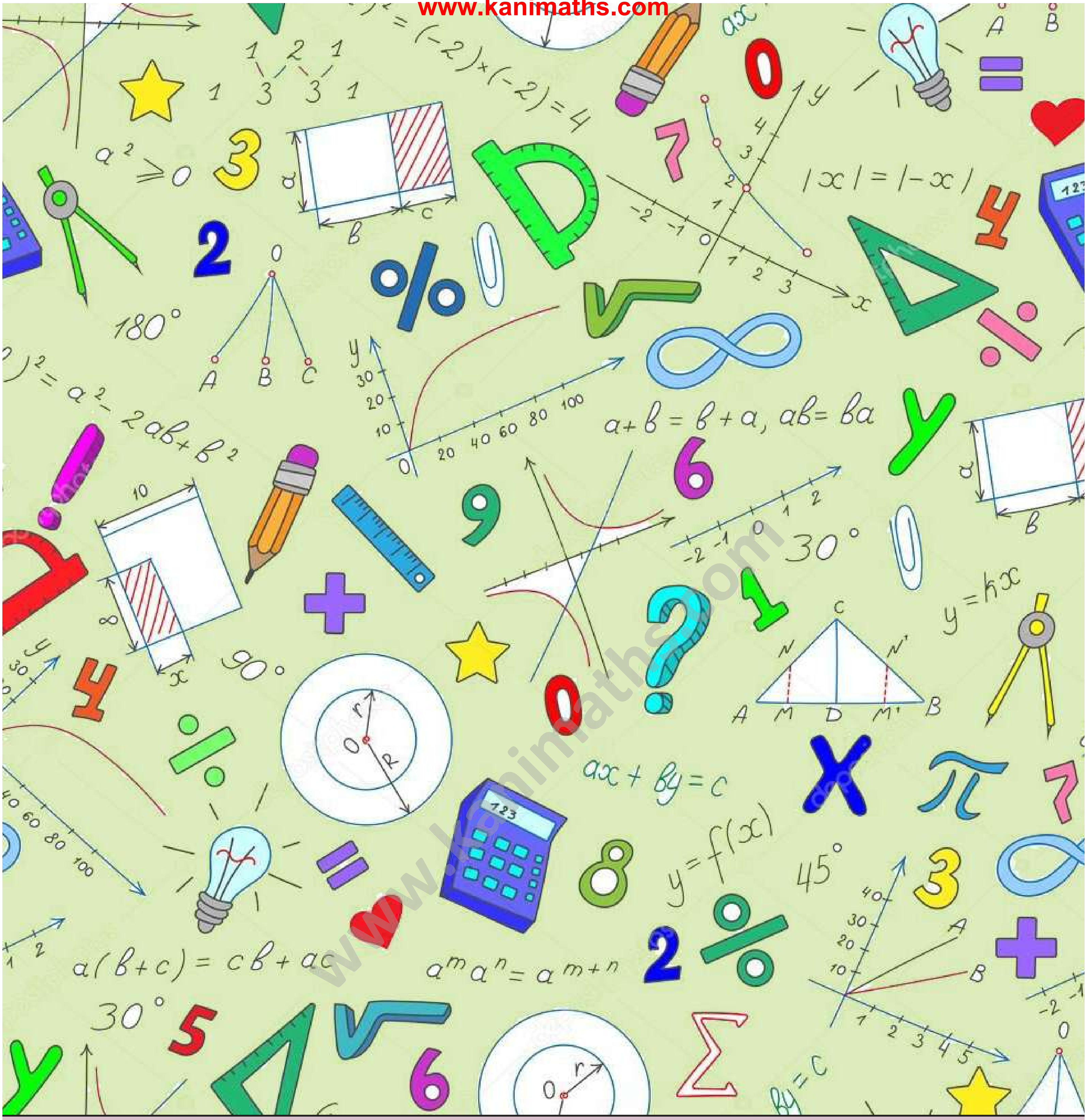

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