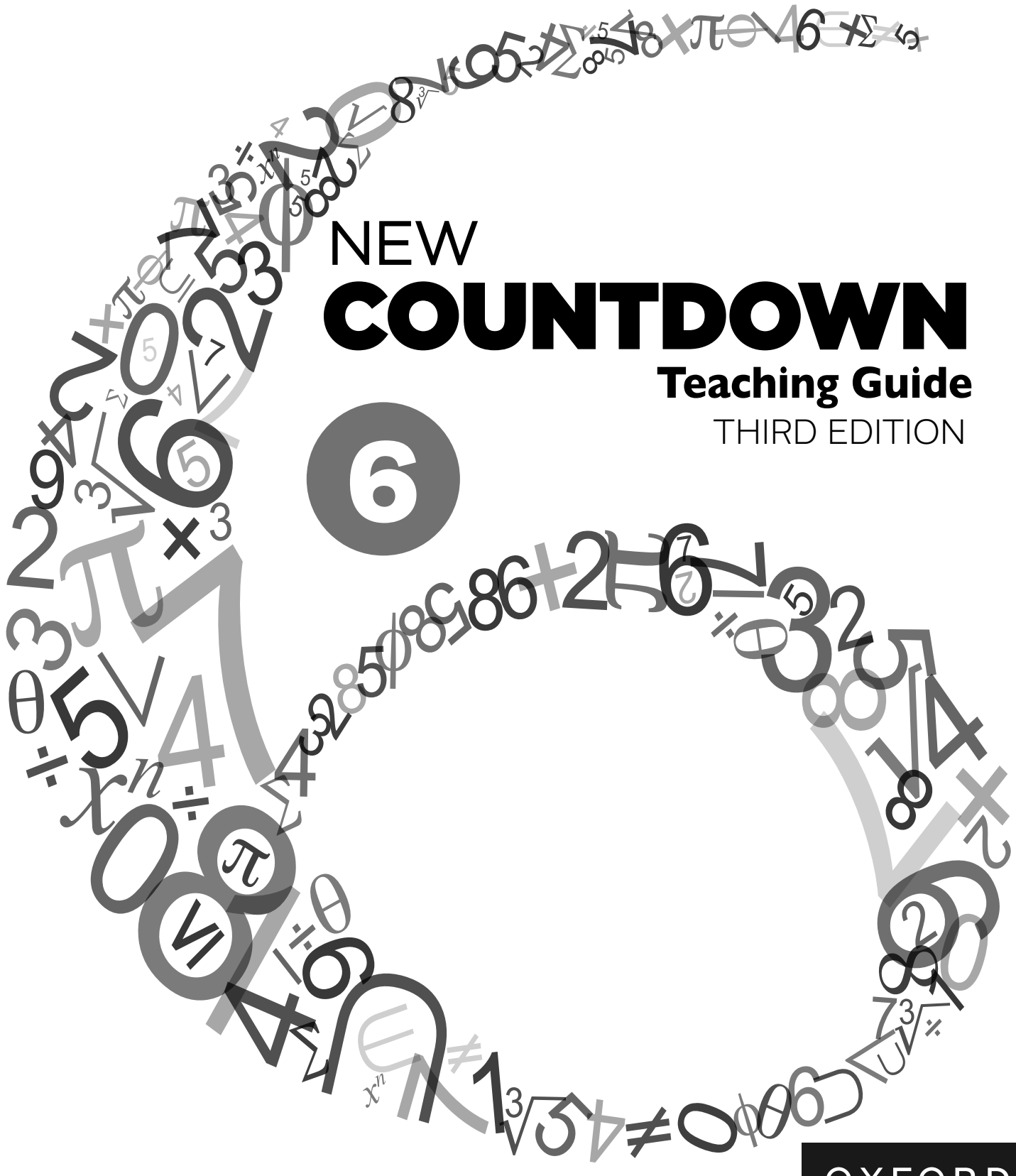

NEW COUNTDOWN

Teaching Guide

THIRD EDITION

6

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CONTENTS

Introduction

Welcome, users of the Countdown series. Countdown has been the choice of Mathematics teachers for many years. This Teaching Guide has been specially designed to help them teach mathematics in the best possible manner. It will serve as a reference book to streamline the teaching and learning experience in the classroom.

Teachers are entrusted with the task of providing support and motivation to their students, especially those who are at the lower end of the spectrum of abilities. In fact, their success is determined by the level of understanding demonstrated by the least able students.

Teachers regulate their efforts and develop a teaching plan that corresponds to the previous knowledge of the students and difficulty of the subject matter. The more well-thought out and comprehensive a teaching plan is, the more effective it is. This teaching guide will help teachers streamline the development of a lesson plan for each topic and guide the teacher on the level of complexity and amount of practice required for each topic. It also helps the teacher introduce effective learning tools to the students to complete their learning process.

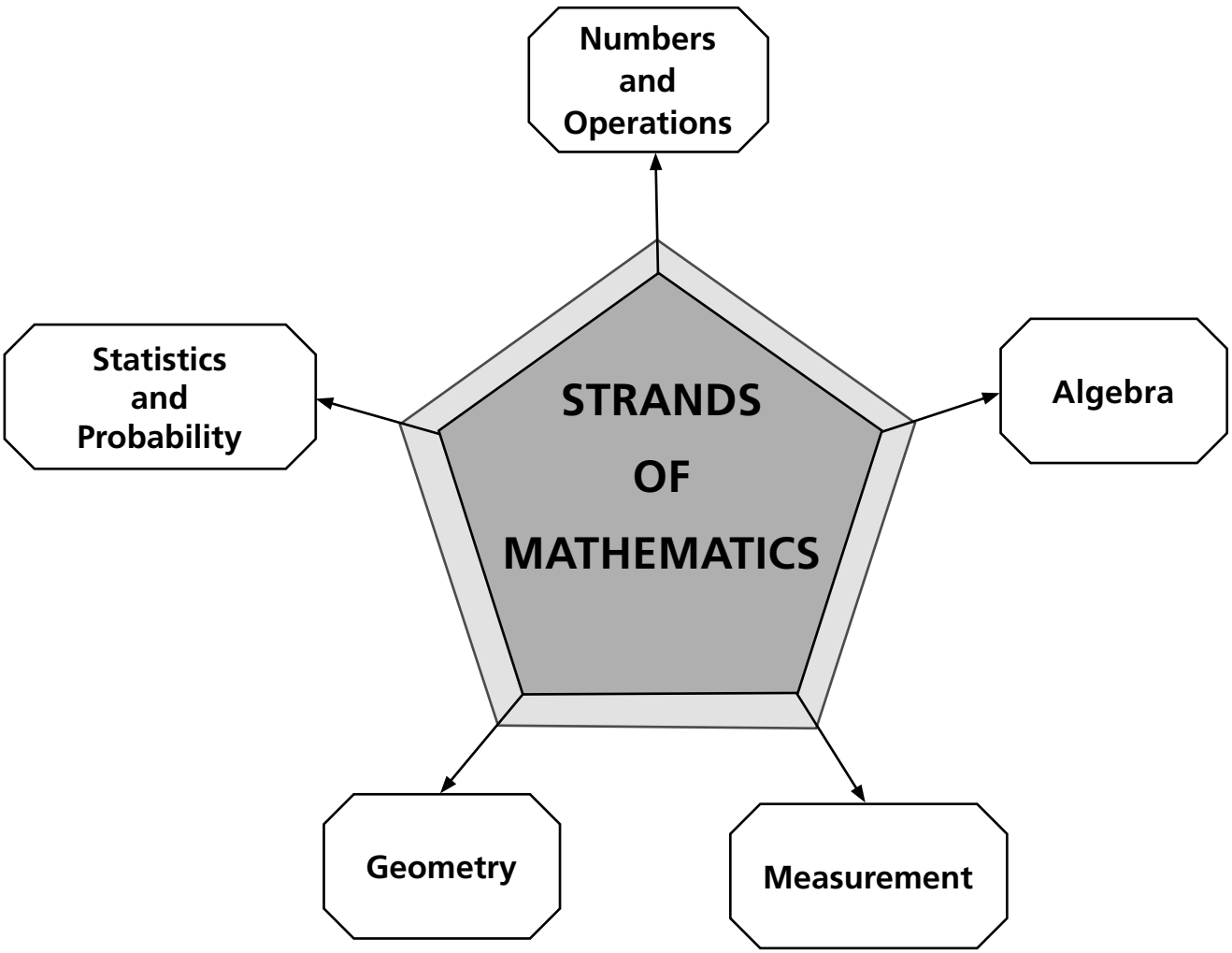
Shazia Asad

Curriculum

Strands and Benchmarks

Pakistan National Curriculum for Mathematics 2022

The Pakistan National Curriculum for Mathematics 2022 is based on these five strands:



Towards greater focus and coherence of a mathematical programme

A comprehensive and coherent mathematical programme needs to allocate proportional time to all strands. A composite strand covers number, measurement and geometry, algebra, and information handling.

Each strand requires a focussed approach to avoid the pitfall of a broad general approach. If, say, an algebraic strand is approached, coherence and intertwining of concepts within the strand at all grade levels is imperative. The aims and objectives of the grades below and above should be kept in mind.

"What and how students are taught should reflect not only the topics that fall within a certain academic discipline, but also the key ideas that determine how knowledge is organised and generated within that discipline."

William Schmidt and Richard Houang (2002)

Strands and Bench marks of the Pakistan National Curriculum 2022

	Grade 6	Grade 7	Grade 8
Strand	**Benchmarks:**		
Domain A: **Numbers and Operations**	Students will be able use language, notation and Venn diagrams to describe sets and their elements, operate with real numbers, their properties and identify absolute value of real numbers, apply commutative ,associative and distributive laws on real numbers , compare, arrange and round off real numbers to required degree of accuracy, calculate factors, multiples, HCF and LCM, square roots and cube roots, ratio, rate, proportion, percentages, profit, loss, discount, Zakat, Ushr, commission, Taxes, insurance, partnership and Inheritance and apply all of these concepts in real life contexts.		
Domain B:	**Benchmarks**:		
Algebra	Students will be able to recognise and manipulate number patterns, use letters to represent numbers, expand, simplify, factorise, evaluate and manipulate algebraic expressions, use algebraic identities, interpret and plot graphs of linear equations, solve linear and simultaneous linear equations and linear inequalities and apply all these concepts in real life context.		
Domain C:	**Benchmarks**:		
Measurement	Students will be able to convert between different units of measure, solve problems involving speed, distance, time, area and perimeter of 2D shapes, surface area and volume of 3D shapes and apply the Pythagorean Theorem.		

Domain D:	Benchmarks:
Geometry	Students will be able to construct lines, angles of different measure, bisectors of angles, line segments, triangles and quadrilaterals, use the properties of triangles, quadrilaterals, polygons and circles to calculate unknown angles and lengths, apply facts of congruence and similarity and analyse and apply concepts of symmetry and transformations from two and three-dimensional perspectives.
Domain E:	**Benchmarks:**
Statistics and Probability	Students will be able to collect, classify and tabulate statistical data, interpret, construct and use statistical graphs, calculate and interpret measures of central tendency and solve problems using various concepts pertaining to Experimental and Theoretical Probability.

Syllabus Matching Grid

SLOs	Domain A: Numbers and Operations	Covered in NCD 6
M-06-A-01	Identify: • factors of up to 3-digit numbers • multiples of up to 2-digit numbers • prime factors of numbers up to 4 digits and express them index notation	Unit 3
M-06-A-02	Identify base and exponent and express numbers given in expanded form in index notation and vice versa	Unit 4
M-06-A-03	Find HCF and LCM of two or three numbers (up to 3 digits) using: – prime factorisation – division method	Unit 4
M-06-A-04	Solve real-life word problems involving HCF and LCM	Unit 4
M-06-A05	Recognise, identify, and represent integers (positive, negative, and neutral integers) and their absolute or numerical value.	Unit 2
M-06-A06	Arrange a given list of integers and their absolute values in ascending and descending order.	Unit 2
M-06-A07	Add and subtract up to 2 digits like and unlike integers and verify commutative and associative laws (where applicable).	Unit 2
M-06-A-08	Multiply up to 2 digits like and unlike integers and verify commutative, associative and distributive laws.	Unit 2
M-06-A-09	Divide like and unlike integers	Unit 2
M-06-A-10	Recognise the order of operations and use it to solve mathematical expressions involving whole numbers, decimals, fractions, and integers	Unit 2

M-06-A-11	Express one quantity as a percentage of another, compare two quantities by percentage and increase or decrease a quantity by a given percentage	Unit 6
M-06-A-12	Solve real-life word problems involving percentages	Unit 6
M-06-A-13	Explain rate as a comparison of two quantities where one quantity is 1	Unit 5
M-06-A-14	Calculate ratio of two numbers (up to 3 digits) and simplify ratios	Unit 5
M-06-A-15	Explain and calculate continued ratio	Unit 5
M-06-A-16	Solve real-life word problems involving ratio and rate	Unit 5
M-06-A-17	Recognise and calculate squares of up to 2-digit numbers	Unit 2
M-06-A-18	Use language, notation, and Venn diagrams to represent different types of sets and their elements. (finite, infinite, empty, singleton and universal set)	Unit 1
SLOs	**Domain B: Algebra**	
M-06-B-01	Recognise simple patterns from various number sequences	Unit 7
M-06-B-02	Continue a given number sequence and find: - term to term rule - position to term rule	Unit 7
M-06-B-03	Solve real-life word problems involving number sequences and patterns	Unit 7
M-06-B-04	Explain the term algebra as an extension of arithmetic, where letters, numbers, and symbols are used to construct algebraic expressions	Unit 7
M-06-B-05	Evaluate algebraic expressions by substitution of variables with numerical values	Unit 7
M-06-B-06	Manipulate simple algebraic expressions using addition and subtraction	Unit 7
M-06-B-07	Simplify algebraic expressions	Unit 7
M-06-B-08	Recognise and construct linear equations in one variable	Unit 8
M-06-B-09	Solve linear equations involving integers, fractions, and decimal coefficients	Unit 8
M-06- B-10	Solve real-life word problems involving linear equations	Unit 8
SLOs	**Domain C: Measurement**	
M-06-C-01	Calculate the area of a path (inside or outside) a rectangle or square, parallelogram, triangle, and trapezium	Unit 12
M-06-C-02	Solve real-life word problems involving perimeter and area	Unit 12
M-06-C-03	Calculate the surface area and volume of cubes and cuboids	Unit 13:
M-06-C-04	Solve real-life word problems involving the surface area and volume of cubes and cuboids	Unit 13

SLOs	Domain D: Geometry	
M-06-D-01	Recognise and identify 3-D shapes (i.e., cube, cuboid, cone, cylinder, sphere, hemisphere, and cone) with respect to their characteristics	Unit 9
M-06-D-02	Reflect an object using grid paper and a pair of compasses and find the line of reflection by construction	Unit 10
M-06-D-03	Identify and differentiate between parallel lines, perpendicular lines, and transversal	Unit 9
M-06-D-04	Identify adjacent angles and find unknown angles related to parallel lines and transversals (corresponding, alternate, and vertically opposite angles).	Unit 9
M-06-D-05	Recognise rotational symmetry, find the point of rotation and order of rotational symmetry	Unit 9
M-06-D-06	Construct angles of specific measures (30°, 45°, 60°, 75°, 90°, 105°, and 120°) and bisect angles using a pair of compasses	Unit 10
M-06-D-07	Construct a perpendicular (from a point on the line and outside the line) and a perpendicular bisector	Unit 10:
SLOs	**Domain E: Statistics and Probability**	
M-06-E-01	Draw, read, interpret horizontal and vertical multiple bar graphs, and pie charts (including real life word problems)	Unit 14
M-06-E-02	Identify and organise different types of data (i.e., discrete, continuous, grouped and ungrouped)	Unit 14
M-06-E-03	Calculate the mean, median, and mode for ungrouped data and solve related real-life word problems	Unit 14
M-06-E-04	Explain experiments, outcomes, sample space, events, equally likely events and probability of a single event. Differentiate the outcomes that are equally likely and not equally likely to occur (including real-life word problems).	Unit 14

Teaching and Learning

Guiding Principles

1. Students explore mathematical ideas in ways that maintain their enjoyment of and curiosity about mathematics, help them develop depth of understanding, and reflect real-world applications.
2. All students have access to high quality mathematics programmes.
3. Mathematics learning is a lifelong process that begins and continues in the home and extends to school, community settings, and professional life.
4. Mathematics instruction both connects with other disciplines and moves toward integration of mathematical domains.
5. Working together in teams and groups enhances mathematical learning, helps students communicate effectively, and develops social and mathematical skills.
6. Mathematics assessment is a multifaceted tool that monitors student performance, improves instruction, enhances learning, and encourages student self-reflection.

Principle 1

Students explore mathematical ideas in ways that maintain their enjoyment of and curiosity about mathematics, help them develop depth of understanding, and reflect real-world applications.

- The understanding of mathematical concepts depends not only on what is taught, but also hinges on the way the topic is taught.
- In order to plan developmentally appropriate work, it is essential for teachers to familiarise themselves with each individual student's mathematical capacity.
- Students can be encouraged to muse over their learning and express their reasoning through questions such as;
  – *How did you work through this problem?*
  – *Why did you choose this particular strategy to solve the problem?*
  – *Are there other ways? Can you think of them?*
  – *How can you be sure you have the correct solution?*
  – *Could there be more than one correct solution?*
  – *How can you convince me that your solution makes sense?*
- For effective development of mathematical understanding students should undertake tasks of inquiry, reasoning, and problem solving which are similar to real-world experiences.
- Learning is most effective when students are able to establish a connection between the activities within the classroom and real-world experiences.
- Activities, investigations, and projects which facilitate a deeper understanding of mathematics should be strongly encouraged as they promote inquiry, discovery, and mastery.
- Questions for teachers to consider when planning an investigation:
  – *Have I identified and defined the mathematical content of the investigation, activity, or project?*
  – *Have I carefully compared the network of ideas included in the curriculum with the students' knowledge?*
  – *Have I noted discrepancies, misunderstandings, and gaps in students' knowledge as well as evidence of learning?*

Principle 2

All students have access to high quality mathematics programmes.

- Every student should be fairly represented in a classroom and be ensured access to resources.
- Students develop a sense of control of their future if a teacher is attentive to each student's ideas.

Principle 3

Mathematics learning is a lifelong process that begins and continues in the home and extends to school, community settings, and professional life.

- The formation of mathematical ideas is a part of a natural process that accompanies pre-kindergarden students' experience of exploring the world and environment around them. Shape, size, position, and symmetry are ideas that can be understood by playing with toys that can be found in a child's playroom, for example, building blocks.
- Gathering and itemising objects such as stones, shells, toy cars, and erasers, leads to discovery of patterns and classification. At secondary level research data collection, for example, market reviews of the stock market and world economy, is an integral continued learning process. Within the environs of the classroom, projects and assignments can be set which help students relate new concepts to real-life situations.

Principle 4

Mathematics instruction connects with other disciplines and moves toward integration of mathematical domains.

An evaluation of maths textbooks considered two critical points. The first was, did the textbook include a variety of examples and applications at different levels so that students could proceed from simple to more complex problem-solving situations?

And the second was whether algebra and geometry were truly integrated rather than presented alternately.

- It is important to understand that students are always making connections between their mathematical understanding and other disciplines in addition to the connections with their world.
- An integrated approach to mathematics may include activities which combine sorting, measurement, estimation, and geometry. Such activities should be introduced at primary level.
- At secondary level, connections between algebra and geometry, ideas from discrete mathematics, statistics, and probability, establish connections between mathematics and life at home, at work, and in the community.
- What makes integration efforts successful is open communication between teachers. By observing each other and discussing individual students teachers improve the mathematics programme for students and support their own professional growth.

Principle 5

Working together in teams and groups enhances mathematical learning, helps students communicate effectively, and develops social and mathematical skills.

- The Common Core of Learning suggests that teachers 'develop, test, and evaluate possible solutions'.
- Team work can be beneficial to students in many ways as it encourages them to interact with others and thus enhances self-assessment, exposes them to multiple strategies, and teaches them to be members of a collective workforce.

- Teachers should keep in mind the following considerations when dealing with a group of students:
  - *High expectations and standards should be established for all students, including those with gaps in their knowledge bases.*
  - *Students should be encouraged to achieve their highest potential in mathematics.*
  - *Students learn mathematics at different rates, and the interest of different students' in mathematics varies.*
- Support should be made available to students based on individual needs.
- Levels of mathematics and expectations should be kept high for all students.

Principle 6

Mathematics assessment in the classroom is a multifaceted tool that monitors student performance, improves instruction, enhances learning, and encourages student self-reflection.

- An open-ended assessment facilitates multiple approaches to problems and creative expression of mathematical ideas.
- Portfolio assessments imply that teachers have worked with students to establish individual criteria for selecting work for placement in a portfolio and judging its merit.
- Using observation for assessment purposes serves as a reflection of a students' understanding of mathematics, and the strategies he/she commonly employs to solve problems and his/her learning style.

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Use appropriate tools strategically.
5. Attend to precision and format.
6. Express regularity in repetitive reasoning.
7. Analyse mathematical relationships and use them to solve problems.
8. Apply and extend previous understanding of operations.
9. Use properties of operations to generate equivalent expressions.
10. Investigate, process, develop, and evaluate data.

Lesson Planning

Before starting lesson planning, it is imperative to consider teaching and the art of teaching.

FURL

First **U**nderstand by **R**elating to day-to-day routine, and then **L**earn. It is vital for teachers to relate fine teaching to real-life situations and routine.
'R' is re-teaching and revising, which of course falls under the supplementary/continuity category.
Effective teaching stems from engaging every student in the classroom. This is only possible if you have a comprehensive lesson plan.
There are three integral facets to lesson planning: curriculum, instruction, and evaluation.

1. **Curriculum**

   A syllabus should pertain to the needs of the students and objectives of the school. It should be neither over-ambitious, nor lacking. (One of the major pitfalls in school curricula arises in planning of mathematics.)

2. **Instructions**

   Any method of instruction, for example verbal explanation, material aided explanation, or teach-by-asking can be used. The method adopted by the teacher reflects his/her skills. Experience alone does not work, as the most experienced teachers sometime adopt a short-sighted approach; the same could be said for beginner teachers. The best teacher is the one who works out a plan that is customised to the needs of the students, and only such a plan can succeed in achieving the desired objectives.

3. **Evaluation**

   The evaluation process should be treated as an integral teaching tool that tells the teachers how effective they have been in their attempt to teach the topic. No evaluation is just a test of student learning; it also assesses how well a teacher has taught.

   Evaluation has to be an ongoing process; during the course of study formal teaching should be interspersed with thought-provoking questions, quizzes, assignments, and classwork.

Long-term Lesson Plan

A long-term lesson plan extends over the entire term. Generally schools have coordinators to plan the big picture in the form of Core Syllabus and Unit Studies.
Core syllabi are the topics to be covered during a term. Two things which are very important during planning are the 'Time Frame' and the 'Prerequisites' of the students.
An experienced coordinator will know the depth of the topic and the ability of the students to grasp it in the assigned time frame.

Suggested Unit Study Format

Weeks	Dates	Months	Days	Remarks

Short-term Lesson Planning

A short-term plan is a day-to-day lesson plan, based on the sub-topics chosen from the long-term plan.

Features of the Teaching Guide

The Teaching Guide contains the following features. The headings through which the teachers will be led are explained as follows.

Specific Learning Objectives

Each topic is explained clearly by the author in the textbook with detailed explanation, supported by worked examples. The guide will define and highlight the objectives of the topic. It will also outline the learning outcomes and objectives.

Suggested Time Frame

Timing is important in each of the lesson plans. The guide will provide a suggested time frame. However, every lesson is important in shaping the behavioural and learning patterns of the students. The teacher has the discretion to either extend or shorten the time frame as required.

Prior Knowledge and Revision

It is important to highlight any background knowledge of the topic in question. The guide will identify concepts taught earlier or, in effect, revise the prior knowledge. Revision is essential, otherwise the students may not understand the topic fully.

The initial question when planning for a topic should be how much do the students already know about the topic? If it is an introductory lesson, then a preceding topic could be touched upon, which could lead on to the new topic. In the lesson plan, the teacher can note what prior knowledge the students have of the current topic.

Real-life Application and Activities

Today's students are very proactive. The study of any topic, if not related to practical real-life, will not excite them. Their interest can easily be stimulated if we relate the topic at hand to real-life experiences. Activities and assignments will be suggested which will do just that.

Flash cards based on the concept being taught will have more impact.

Summary of Key Facts

Facts and rules mentioned in the text are listed for quick reference.

Frequently Made Mistakes

It is important to be aware of students' common misunderstandings of certain concepts. If the teacher is aware of these they can be easily rectified during the lessons. Such topical misconceptions are mentioned.

Sample Lesson Plan

Planning your work and then implementing your plan are the building blocks of teaching.

Teachers adopt different teaching methods/approaches to a topic.

A sample lesson plan is provided in every chapter as a preliminary structure that can be followed. A topic is selected and a lesson plan written under the following headings:

Topic

This is the main topic/sub-topic.

Specific Learning Objectives

This identifies the specific learning objective/s of the sub-topic being taught in that particular lesson.

Suggested Duration

Suggested duration is the number of periods required to cover the topic. Generally, class dynamics vary from year to year, so flexibility is important.

The teacher should draw his/her own parameters, but can adjust the teaching time depending on the receptivity of the class to that topic. Note that introduction to a new topic takes longer, but familiar topics tend to take less time.

Key vocabulary

List of mathematical words and terms related to the topic that may need to be pre-taught.

Method and Strategy

This suggests how you could demonstrate, discuss, and explain a topic.

The introduction to the topic can be done through starter activities and recap of previous knowledge which can be linked to the current topic.

Resources (Optional)

This section includes everyday objects and models, exercises given in the chapter, worksheets, assignments, and projects.

Written Assignments

Finally, written assignments can be given for practice. It should be noted that classwork should comprise sums of all levels of difficulty, and once the teacher is sure that students are capable of independent work, homework should be handed out. For continuity, alternate sums from the exercises may be done as classwork and homework.

Supplementary Work (Optional): A project or assignment could be given. It could involve group work or individual research to complement and build on what students have already learnt in class.

The students will do the work at home and may present their findings in class.

Evaluation

At the end of each sub-topic, practice exercises should be done. For further practice, the students can be given a practice worksheet or a comprehensive marked assessment.

1 INTRODUCTION TO SETS

Specific Learning Objectives

In this unit students will learn:

- about sets and use language of sets
- to use set notation: Descriptive, Tabular, and Set-builder notation
- how to represent a set by a Venn diagram
- about different types of sets and their elements: Finite and infinite sets, Empty set, Singleton set, Universal Set

Suggested Time Frame

3 to 4 periods

Prior Knowledge and Revision

Sets are being introduced for the first time. They do have prior knowledge of sets though, as multiplication is introduced in the form of grouping numbers as sets.

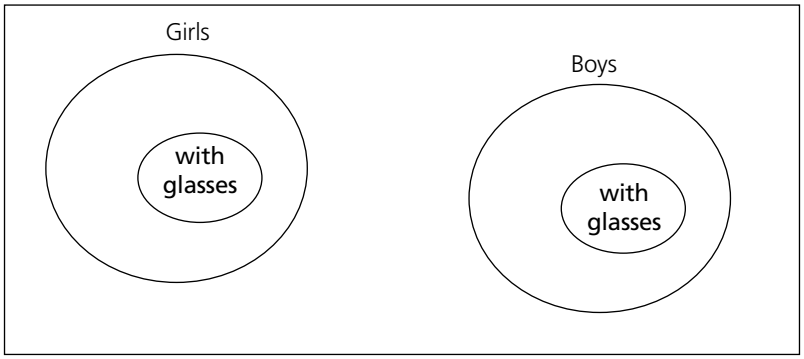
For example, 4 times 3 is taught as four sets of 3. These can be shown with the help of beads, bottle caps, stationery items, etc.

In earlier years students have seen Venn diagrams as lowest common multiple sets, where the multiples of two numbers are put in Venn diagrams with common values in the middle of the Venn diagram.

It is advised to mention the above facts when introducing sets, especially multiplication. This will create a link and connection to the chapter.

Any link with prior knowledge brings in continuity and connectivity.

For example, when introducing the topic of sets, ask students to group themselves in different sets of girls and boys and then within each set, make a separate set of those who wear glasses.



Real-life Application and Activities

This chapter is an ideal starter to the syllabus, as students can be involved in activities. Assignments can be given which ask them to create their own Venn diagrams using their friends and family as elements.

Summary of Key Facts

- Sets are commonly denoted with a capital letter. The elements of a set are enclosed within curly brackets and separated by commas, such as A = {a, b, c, d, e}.
- Sets have a few or an infinite number of elements or may not have any element.
- The symbol $\in$ is used to show that a particular number or an item is an element of a set, and the symbol $\notin$ shows that a particular number or an item is not an element of a set.
- Set can be written in three different ways: tabular notation, descriptive notation, and set-builder notation.
- There are special types of sets, such as universal set, finite set, infinite set, singleton set, empty set. The empty set is denoted by { } or ϕ.
- A universal set is denoted by $\mathbb{U}$.
- A set can also be represented graphically using a Venn diagram.

Frequently Made Mistakes

Sets are considered to be associated with Venn diagrams only, not realising that the Venn diagram is just a depiction tool. The study of sets has to be treated later as day-to-day real-life situations. Therefore this should be treated as a branch of mathematics that is like arithmetic story sums, but with different depiction.

Sample Lesson Plan

Topic:

Types of sets

Specific Learning Objectives

Students will be able to differentiate between different type of sets:

finite and infinite sets, unit/ singleton sets.

Suggested Duration

1 period

Key Vocabulary

set, element, member, finite, infinite, unit set, singleton set,

Method and Strategy

Activity

Sets should be introduced with a 5 minute brainstorming quiz to create as many finite and infinite, unit/ singleton sets as possible. For example, planets of our galaxy, stars in the universe, prime numbers, multiples of 3 less than 20, etc. Students should be encouraged to suggest elements and types of sets.

A group quiz can be created where flash cards of different types of sets can be named and each member of every group picks a card and gives an example of the type of set named on the card.

Written Assignments

Exercises 1D and MCQ 1 can be given as an assignment for classwork and homework. Revision 1 specific question can be done in class as a marked assignment prior to a formal assessment test. This is a comprehensive review and misconceptions formed, can easily be clarified by the teacher during its correction.

Evaluation

A similar worksheet can be made by the teacher, by changing the numbers in sums from test 1, or by taking other examples.

2 INTEGERS

Specific Learning Objectives

In this unit students will learn:

- to recognise, identify, and represent integers (positive, negative, and neutral integers) and their absolute or numerical value
- to arrange a given list of integers and their absolute values in ascending and descending order
- to add and subtract up to 2 digits like and unlike integers
- to verify commutative and associative laws for integers (where applicable)
- to multiply up to 2 digits like and unlike integers
- to verify commutative, associative, and distributive laws of multiplication for integers
- to divide like and unlike integers
- to recognise the order of operations and use it to solve mathematical expressions involving whole numbers, decimals, fractions, and integers
- to recognise and calculate squares of numbers up to 2 digits

Suggested Time Frame

2 to 3 periods

Prior Knowledge and Revision

Students are familiar with whole numbers and natural numbers and understand their commutative, associative, and distributive properties.

RECALL

The students could be asked to revise the rules of BODMAS. If not introduced earlier, explain it in the following way.

B is for brackets
O is for order (exponents/ power, square root, cube root)
D is for division
M is for multiplication
A is for addition
S is for subtraction

The order of the operations is set by this rule.

There are three types of brackets and they are to be written in the order given below:

box brackets [ ], curly brackets { }, and parenthesis ( )

[{ ( ) }]

The content of the innermost brackets is attempted first.

Example

[{17 + (6 – 3)} ÷ 10]

Solve the parenthesis brackets first,

= [{17 + 3} ÷ 10] (then the curly bracket)

= [20 ÷ 10] (in the end the box bracket)

= 2

Starter Activity

A fun game can be played. Divide students are divided into pairs and give them a set of flash cards and a dice. Each number on the dice can be assigned an operation.

If a student gets a 6, the operation can be addition, or so on.

They have to roll the dice and pick out two flash cards and apply the operation. They get 2 minutes to take as many turns and note the numbers and answer. The pair that gets the most correct answers wins.

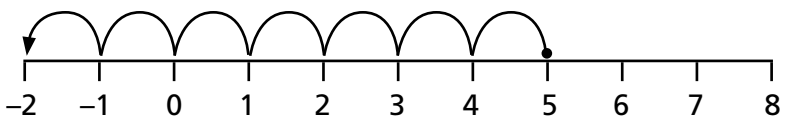
Use only three operations addition, subtraction and multiplication in the game.

At this stage point out that addition and subtraction of integers can be done on a number line.

Example

5 – 7 = – 2

Draw the number line on the board and point out that as you are moving 7 steps to the left from 5, the answer is – 2.



Real-life Application and Activities

When introducing the number line, the teacher should stress that there are infinite numbers continuing at both ends of the number line. To explain infinity he/ she can relate it to the galaxies and universe and the beginning and end of time.

When dealing with negative integers he/ she can give an example of temperature: when it gets very cold in the northern regions, the temperature goes below zero to acquire negative values. Similarly, it can be pointed out that in a bank balance, credit and dept are respectively plus and minus amounts, and sometimes we overdraw and end up with a negative balance. Profit and loss can also be mentioned.

Examples:

- The temperature in Kashmir in January fell below zero to –5 C°.
- If the balance of my account is minus Rs 5000, I owe the bank Rs 5000.
- A lot of quizzes can be given by drawing a number line on the board and asking questions. The students can do a group activity in which they can draw a timeline for the Greeks and Romans on chart paper. The concepts of CE and BCE can be related to positive and negative numbers respectively.

Summary of Key Facts

- An integer can be positive or negative, while zero is neither positive or negative.
- The set of positive integers Z+ is the same as the set of natural numbers N. Therefore, N = Z+.
- The number line includes 0. Positive numbers are placed on the right side of 0 while negative numbers appear on the left side.
- On a number line, the number on the right of another number is always greater than the number on the left.
- Integers can be arranged in ascending and descending order.
- Integers are added, subtracted, multiplied, and divide by using certain rules.
- Integers satisfy the closure property of addition.
- Integers satisfy the commutative property of addition, that is a + b = b + a.
- Integers satisfy the associative property of addition, (a + b) + c = a + (b + c)
- Commutative property and associative property do not work for subtraction and division of integers.
- The additive identity of integers is zero.
- For every integer, there exists an integer such that their sum is zero. Each is known as the additive inverse of the other.
- In multiplication and division two positive signs or two negative signs give a positive answer, while one negative sign and one positive sign (in any order) gives a negative answer.
- Integers satisfy the closure property of multiplication.
- Integers satisfy the commutative property of multiplication, that is a × b = b × a
- Integers satisfy the associative property of multiplication, that is (a × b) × c = a × (b × c)
- The multiplicative identity of integers is one.
- For every integer except zero, there exists a number such that their product is one. Each is known as the multiplicative inverse of the other.
- Integers satisfy the distributive property of multiplication over addition:
  a × (b + c) = a × b + a × c
- Distributive property does not work for division of integers.
- A perfect square is obtained when an integer is multiplied by itself.

Frequently Made Mistakes

Students tend to get confused when dealing with negative integers. The fact that two negatives give a positive product and a negative and a positive integer give a negative product has to be taught with a lot of oral work.

Sample Lesson Plan

Topic

Integers

Specific Learning Objectives

Students will be able to multiply numbers using rules.

Suggested Duration

1 Period

Key Vocabulary

positive and negative integer, product, multiplicand, multiplier

Method and Strategy

Activity

Students should know that the product of two positive integers will always be positive. Likewise, the product of two negative integers will also be positive. Only when a negative and a positive integers are multiplied, the product is negative.

These facts can be enhanced by playing a five minutes game.

Write a set of jumbled numbers on half of the board and on the other half of the board write a set of jumbled answers.

The teacher will call out a question by choosing numbers written on the board. For example, what is $4 \times (-4)$? The students have to spot the answer and highlight it.

The group that highlights the most correct answers in a time limit of 30 seconds wins.

Written Assignments

From Exercise 2C choose sums that can be given for classwork and homework .

Evaluation

Quizzes should be given in class to check if the students have learnt and understood the rules of operations.

An assessment should be given at the end of the topic. It should consist of sums involving the properties of multiplication of integers.

The sums of Exercises 2c can be altered by changing the numbers to form the test.

3 FACTORS AND MULTIPLES

Specific Learning Objectives

In this unit students will learn:

- to find factors of numbers up to 3 digits
- to find multiples of numbers up to 2 digits
- to apply the tests of divisibility for numbers 2, 3, 4, 5, 6, 8, 9, and 10
- to differentiate between prime numbers and composite numbers

Suggested Time Frame

2 to 3 periods

Prior Knowledge and Revision

Before introducing factors and multiples the teacher should revise the times tables and how the product is the multiple of a particular number and the multiplicands are the factors of the product.

Example:

3 times 7 are 21, where 21 is the product, therefore, the multiple. 3 and 7 are the multiplicands and thus the factors of 21.

For the test of divisibility, the teacher can talk about numbers ending with even numbers, (i.e. 0, 2, 4, 6, and 8) and point out that they are completely divisible by 2. Similarly, numbers ending with 5 or zero are completely divisible by 5.

Real-life Application and Activities

The students can be introduced to sequencing and arrangements. For example, the teacher can spot tiles on the floor and say that every fifth square is coloured or different which means that the arrangement is in multiples of 5 (or any other arrangement that can be pointed out). If each period is of 30 minutes, the teacher can point out that the bell rings every 30 minutes so it is an arrangement of 30s.

Starter Activity

Encourage students to participate in a mental maths quiz of multiples where flash cards of multiples of 3s, 5s, and 6s or any other set, are prepared. The teacher calls out a number, for example, 3. Students start looking through the flash cards until they find a multiple of 3 and shout 'BINGO'!. Repeat this for other numbers too. This mental mathS activity sharpens the skill to identify multiples and will only take a minute or two.

Activity

The difference between multiples and factors has to be made clear. The fact that factors form finite sets and multiples form infinite sets is important.

Groups of students can be given cards with numbers from 1 to 50. The teacher can ask the students to sort them into two sets of multiples, for example, those of 3 and 7, and then shuffle them and quickly line up the factors of say 21 or 28. The group that completes the activity first is given a point; this can be repeated for different numbers.

Summary of Key Facts

- Factor of a number leaves no remainder when it divides the number.
- A number always has a limited number of factors.
- A prime number has only two distinct factors —1 and the number itself.
- A composite number has more than two factors.
- The factor of a dividend can be a ‘prime number’ or a ‘composite number’.
- The rules of divisibility are used to check whether a number is completely divisible by 2, 3, 4, 5, 6, 8, 9, or 10.
- A multiple is a dividend into which a factor can divide.
- A number can have unlimited number of multiples.
- Twin primes are pairs of prime numbers with a difference of two.
- A prime triplet is a set of three successive prime numbers, the numbers differing by 2.

Frequently Made Mistakes

The most common mistake is that students think that '1' is a prime number. If this mistake is not corrected at the beginning, they will face problems in solving sums involving multiples and factors.

Sample Lesson Plan

Topic

Prime numbers

Specific Learning Objectives

Students will be able to differentiate between composite numbers and prime numbers.

Suggested Duration

1 period

Key Vocabulary

composite number, prime number

Method and Strategy

Students know the definition of prime numbers. When explaining factors, composite numbers and prime numbers, the teacher should make clear the difference between them.

In order to find HCF and LCM by the long division method, prime numbers are used.

Take a vinyl sheet of 120 cm by 120 cm and use electric tape to make ten columns and ten rows on it. Use a permanent marker to write numbers 1 to 100 in the spaces formed. Place it on the floor of the classroom and ask the students to stand around it.

Use plain flash cards of the same size as each number box.

Follow the steps on page 53 of the textbook.

Start excluding the composite numbers one-by-one by placing a flash card over them to block them from view.

After the fifth step, the sieve reveals all the prime numbers between 1 and 100.

Ask the students to note them in their notebooks.

Written Assignments

Twin-prime numbers are prime numbers with a difference of two between them.

Ask students to list as many sets as possible in their notebooks from the prime numbers between 1 and 100.

Evaluation

An assessment can be conducted with multiple choice questions and definitions.

Sums from Exercise 3B, MCQ 3, and Revision 2 can be used to form an assessment to assess the students' learning.

4 FACTORISATION: HCF AND LCM

Specific Learning Objectives

In this unit students will learn:

- to identify base and exponent and express numbers given in index notation and vice versa
- to find prime factors of numbers up to 4 digits and express them in index notation
- to find HCF of 2 or three numbers up to 3 digits by using prime factorisation and long division method
- to find LCM of 2 or three numbers up to 3 digits by using prime factorisation and long division method
- to solve real-world word problems related to HCF and LCM

Suggested Time Frame

4 to 5 periods

Prior Knowledge and Revision

The difference between factors and multiples has already been explained in the earlier chapter. There is no need for quizzes or activities, as it is a continuation of the earlier topic.

Real-life Application and Activities

Prime factorisation is like a tree with branches. Factor trees are easy to make on soft-boards. Students can also build such factor trees with real trees in the playground with numbers hanging from the branches as prime factors. Students enjoy breaking down a number into its factors, that is the breaking down composite numbers into their prime factors.

Example

120
/ \
2 × 60
/ \
2 × 2 × 30
/ \
2 × 2 × 2 × 15
/ \
2 × 2 × 2 × 3 × 5

Factors of 120 are: $2 \times 2 \times 2 \times 3 \times 5$ or $2^3 \times 3 \times 5$

The students should understand that they need to continue with breaking down the composite factors till they cannot be broken down any further. Another point to emphasise is the prime index, that is, if the same factor occurs more than once, powers should be introduced.

HCF AND LCM both require the composite number to be broken down and then the HCF is found by circling the smaller common numbers and the LCM is found by circling the largest common powered factor and the uncommon numbers.

Example

Find the LCM and HCF of 42, 48, and 54.

2	42, 48, 54
2	21, 24, 27
2	21, 12 ,27
2	21, 6, 27
3	21, 3, 27
3	7, 1, 9
3	7, 1, 3
7	7, 1, 1
	1, 1, 1

LCM = $2^4 \times 3^3 \times 7 = 3024$

2	42, 48, 54
3	21, 24, 27
	7, 8, 9

HCF = 2 x 3 = 6

Example

Find the HCF and LCM of 36 and 54.

Factors of 36 = $2^2 \times 3^2$

Factors of 54 = 2×3^3

HCF = $2 \times 3^2 = 18$

LCM= $2^2 \times 3^3 = 108$

Find both the HCF and LCM as a quiz on the board. Divide the students into 3 groups and ask them to solve the questions simultaneously.

Discuss real-life applications; LCM is associated with buses coming to the station at regular intervals and the first common time for the arrival of two buses would be the LCM of their interval times. Similarly, given two containers of different capacities you can find one which contains both of their maximum capacity. This can be practically done by bringing containers in the classroom. Do examples 6 and 7 on page 63 of NCD textbook in class. Example 6 requires a measuring tape and threads measuring 360 cm and 840 cm and 120 cm.

Summary of Key Facts

- A prime number has only two distinct factors and a composite number has more than two factors.
- Repeated multiplications of the same number can be written in index notation.
- The highest common factor (HCF) can be calculated either by factorisation method or by long division method.
- The least common multiple (LCM) can be calculated either by factorisation method or by division method.
- The product of two numbers equals the product of their HCF and LCM.

Frequently Made Mistakes

Students make mistakes in finding the prime factors as they are not quick at using the test of divisibility. Also, when using the prime factorisation and division methods, they get confused in the selection of common and uncommon factors to find the HCF and LCM. It is important to calculate the HCF and LCM of numbers together once both have been introduced.

Sample Lesson Plan

Topic

HCF and LCM

Specific Learning Objectives

Students will be able to find the relationship between HCF and LCM of two numbers.

Suggested Duration

1 period

Key Vocabulary

factors, prime factors, Highest Common Factor (HCF), multiples, Lowest Common Multiple (LCM), long division method

Method and Strategy

Activity

Ask the students to find the HCF and LCM of two numbers. Ask them to multiply the two numbers and also multiply the HCF and LCM of these numbers. The students will discover that both the products are the same. The first student to work out the sum and discover this fact should be applauded.

Written Assignments

Students can do Q # 11 to 14 of Exercise 4B as classwork.

A similar assignment can be done for homework where they find the HCF and LCM of five pairs of numbers and prove this relationship by finding the products and equating them. The students should be encouraged to select their own pairs of numbers.

Evaluation

A five minute quiz at the beginning of every lesson on the topic previously taught can be given. For example, in the second lesson students can be asked to make the factor tree of 56 and 124 and find the HCF.

Homework and class assignments may be marked and points awarded, for correct proofs.

5 RATIO AND RATE

Specific Learning Objectives

In this unit students will learn:

- to express ratio as comparison of two quantities that are measured in same units
- to calculate ratio of two numbers up to 3 digits
- to simplify ratio
- to explain and calculate continued ratio
- to explain that rate is a comparison of two quantities where one quantity is 1
- that rate is a comparison of two quantities where one quantity is 1
- to solve real-world word problems involving ratio and rat

e Suggested Time Frame

4 to 5 periods

Prior Knowledge and Revision

Students have been doing rate questions from earlier levels where they were asked to calculate the value of multiple values if the value of one is given. They have also learnt about equivalent fractions and comparing fractions.

A small oral quiz can be held in class to introduce the chapter in which short questions on these topics can be asked. The teacher should congratulate those who give quick, accurate answers.

Real-life Application and Activities

During the introduction of the topic, the teacher can give the students some short survey assignments.

Starter Activity

- Ratio of the weights of two students
- Ratio of the number of students in Grade 6 and Grade 7
- Ratio of amounts of money spent by two students in lunch break
- **Topic Activity**

The teacher can choose to do a baking activity in school or ask students to do it at home under adult supervision.

The recipe to make cookies requires:

100 gm of flour,

50 gm of sugar,

1 teaspoon of baking powder, and

2 tablespoons of butter.

This recipe is enough for ten cookies. Ask the students to make 30 cookies. In order to do so, they will have to multiply all proportions by 3.

It should be emphasised that the ingredients are in a ratio to each other and that they were proportionally increased.

Summary of Key Facts

- A ratio is a relation which one quantity bears to another quantity of the same kind with regard to their magnitudes.
- A ratio remains unaltered when both the terms are multiplied or divided by the same number.
- A unit rate is a ratio that compares two related quantities in different units and the second unit is 1 (meaning per).
- In a unit rate, the denominator is always 1. Therefore, to find unit rate, divide the denominator with the numerator in such a way that it becomes 1.

Frequently Made Mistakes

Students understand the concept of ratios being fractions but tend not to link it properly to the fact that just like fractions, the values should have the same unit and property.

Examples

You cannot form a ratio of weight of one student to the height of the other.

Similarly, students tend to forget conversion of the units. For example, the weight of Ali in kg can not be compared to the weight of Sara in pounds.

Sometimes, they overlook the fact that ratios have to be in the simplest form and need to be reduced.

For example, 6 : 10 is actually 3 : 5.

Sample Lesson Plan

Topic

Unit rate

Suggested Duration

1 period

Specific Learning Objectives

Students will be able to calculate unit rate of given quantities.

Key Vocabulary

rate, per, unit, quantity

Method and Strategy

Activity

As an individual activity (for 1 to 2 minutes) teacher will ask students to make a list of real-life examples where unit rate is applicable along with vocabulary words. During the time the teacher will also compile her own list. To start with, an example of grocery store will be given. In the end let students share their ideas which will lead to the fact that unit rate shows up in so many different fields.

Teacher will prepare a set of 'Unit Rate Task Cards' as shown and ask students to work in pairs. These set of task cards may include 5 to 10 questions, with an increase in level of difficulty. For more able students' cards that have more than one correct answer will be included

Sample: Unit Rate Task Card		
Q1.	Which is more, 12 for 5 or 10 for 4?	
Q2.	Which is less, Rs 5 for 4 hrs or Rs 3 for 4?	
Q3.	Which is more, 3 per 4 or 2 per 3?	
Q4.	Which ore, 6 per 8 or 15 per 20?	
Q5.	Which is more, 30 km per 2 hrs or 60 km per 4?	

Once they have solved all questions the teacher will call out answers one by one. For each correct answer they get one point. Finally, their points will be compared and the person with the most points wins.

Students not only get to practice the skills of finding unit rates, but at the same time enjoy the activity.

Written Assignment

Exercise 5 Q # 16 – 20 will be done in class and MCQ Q6, Q7 as home assignment.

Worksheets will be made with mixed sums of unit rate and students will then solve them for further practice.

Evaluation

In each lesson a quiz of five sums will be given to check whether the students are making conceptual errors. In this topic they tend to make careless errors too. Once sure that the students are on board and understand the concept of unit rate, the teacher will proceed. At the end of the chapter, a combined assessment of both concepts taught will be given to ensure that the students completely understand both.

6 FINANCIAL ARITHMETIC: PERCENTAGES

Specific Learning Objectives

In this unit students will learn:

- to express one quantity as a percentage of another
- to compare two quantities by percentage
- to increase or decrease a quantity by a given percentage
- to solve real-world word problems involving percentages

Suggested Time Frame

This is a very important topic; basic percentages and arithmetic calculations will be time consuming. At least 8 periods should be assigned to this chapter.

Prior Knowledge and Revision

Brainstorming session on percentages can be done. The teacher should be reminded that per cent means out of 100. In order to find the percentage of a value, it has to be multiplied by 100. Similarly, if a percentage has to be converted to a fraction or decimal, it has to be divided by 100.

Real-life Application and Activities

Relating mathematics to real-life situations is easy when teaching this topic.
The teacher can give the students a shopping list as an activity.

Example

Items	Shopping List	Price List
1	5 packets of orange juice	3 packets of orange juice cost Rs 60
2	10 cans of beans	2 cans of beans cost Rs 200
3	12 packets of potato chips	5 packets of potato chips cost Rs 150

The students should be asked to find the individual value of each item and then calculate the total cost. Finally find out the amount to be paid if 10% discount is given on the total value.

The teacher can then ask them to go to the supermarket with their parents and bring in the receipt. The students can then swap the receipts and use them to create their own word problems.

The teacher can bring in advertisements from newspapers and magazines to show them various offers.

Example

Bumper sale

3 packets of biscuits for the price of two OR **BUY ONE GET ONE FREE**

These practical examples will help them relate to and connect with the topic better. Students could even be encouraged to manage their pocket money and create a ledger of their savings and expenditure for a week.

Summary of Key Facts

- 'Per cent' means the ratio of a given number to hundred.
- The symbol % is used to denote percentage.
- To compare numbers, quantities, or measures we express one quantity as a percentage of another quantity.
- Percentage = $\frac{\text{First quantity}}{\text{Second quantity}} \times 100\%$
- To represent a quantity as a percentage of another quantity, both quantities should be expressed in the same unit.
- Percentages can be used for comparison.
- The change in value of quantity over a period of time, is expressed as a percentage increase or decrease in the original value.
- Percentage increase = $\frac{\text{Increase}}{\text{Original Value}} \times 100\%$
- Percentage decrease = $\frac{\text{Decrease}}{\text{Original Value}} \times 100\%$

Frequently Made Mistakes

Students get confused when calculating increase and decrease percentages. It must be explained that percentages are a ratio of the subject to the original or total amount multiplied by 100%.

Everyday story sums where they have to find the rate of one value, get multiple values as answers, and then find the total causes some confusion. If they are taught to write the data clearly and solve the question step by step, they will avoid such errors.

Sample Lesson Plan

Topic

Percentage Change: Percentage increase or decrease of a measure

Suggested Duration

1 period

Specific Learning Objectives

Students will be able to calculate percentage increase or decrease of the given quantities.

Key Vocabulary

fraction, percentage, increase, decrease, calculate

Method and Strategy

Activity

Students are already familiar with the concept of percentage and how they are used in everyday life. For example, calculating grades through marks percentages, discounts during sales and interest rates at banks, calculating tax rates and so on.

As an introduction to percentage change, two numbers will be written on board. Students will be asked to find the difference and find the percentage increase or percentage decrease. Then it will be explained that this is known as percentage change. Goods are bought at a certain price and sold for a different price. The percentage change can be calculated to find out the profit or loss the item has made.

To clarify the concept of percentage change (increase/ decrease) 'Activity Cards' will be distributed among students.

Sample: Activity Card

To increase or decrease an amount by a percentage, first calculate the percentage of the amount and then either add this answer to increase the quantity or subtract the answer to decrease the quantity.

1. Increase Rs 60 by 10%
2. Decrease 85 kg by 20%
3. Decrease Rs 1200 by 15%
4. Increase 200 litres by 8%

For making calculation easy students will be told a simple trick to. calculate percentage increase/ decrease using the **multiplier method**.

Step 1: First see what the overall percentage will be after the figure has had its percentage increase or decrease added or subtracted.

Step 2: Convert this amount to a decimal.

Step 3: Multiply by the number in question to get the final answer.

Example 1: What is the multiplier for 12% increase?

Solution: A 12% increase means that overall percentage will be 100% + 12% = 112% 112% as a decimal = 112 ÷ 100 = 1.12

Example 2: What is the multiplier for 35% decrease?

Solution: A 35% decrease means that overall percentage will be 100% 35% = 65%65% as a decimal = 65 ÷ 100 = 0.65

Written Assignment

Exercise 6B Q # 5 – 10 will be done as classwork and homework.

Worksheets will be made with mixed sums of unit rate and students will then solve them for further practice.

Evaluation

In each lesson a quiz of five sums will be given to check whether the students are making conceptual errors. In this topic they tend to make careless calculation errors or sometimes do not use the initial value for division. Once sure that the students are on board and understand the concept of unit rate, the teacher will proceed. At the end of the chapter, a combined assessment of both concepts taught will be given to ensure that the students understand all the concepts fully.

7 INTRODUCTION TO ALGEBRA

Specific Learning Objectives

In this unit students will learn:

- to explain that the term algebra is an extension of arithmetic, where letters, numbers, and symbols are used to construct algebraic expressions
- to evaluate algebraic expressions by substitution of variables with numerical values
- to manipulate simple algebraic expressions using addition and subtraction
- to simplify algebraic expressions
- to recognise simple patterns from various number sequences
- to continue a given number sequence and find:
  - * term to term rule
  - * position to term rule
- solve real-world word problems involving number sequences and patterns

Suggested Time Frame

This is a new topic; at least 6 to 8 periods should be assigned to it.

Prior Knowledge and Revision

Students are being introduced for the first time to this branch of mathematics; they have no prior knowledge of algebra. However, the teacher can introduce a game where instead of adding just numbers, we assign letters to the subjects being added.

Example

Let's assign 'p' for potatoes and 'q' for oranges, so to get the sum of 3 potatoes and 5 oranges the answer would be: $3p + 5q$.

Real-life Application and Activities

The teacher can talk about Egyptian hieroglyphs and ancient languages which used symbols, so we can consider algebra to be a language of mathematics.

The teacher can ask the students to research various ancient languages and their symbols.

Summary of Key Facts

- A sentence is a set of words or symbols that conveys some meaning.
- A sentence that is either true or false is known as a statement.
- A variable is a symbol that represents a quantity the value of which is not known.
- A term that has a fixed value and appears separately from a variable is called a constant.
- Any numeral, variable, or combination of numerals and variables, connected by one or more signs of fundamental operations (+, –, ×, or ÷) is known as an algebraic expression.
- The numbers or letters separated by operators in an algebraic expression are called terms.
- The symbol or number appearing before the variable used in algebraic term is called its coefficient.
- If two terms differ only in their numerical or literal coefficients, or do not differ at all, they are called like terms. Differing terms are called unlike terms.
- The process of substituting numbers for variables in an algebraic expression to obtain the answer is called evaluation.
- In algebra, like terms can be added together to give a single term, but unlike terms cannot be added.
- Simplification is the process of writing an algebraic expression by grouping like terms without changing the value of the algebraic expression.
- To continue a given number sequence, we apply a term to term rule.

Frequently Made Mistakes

When adding or subtracting terms, students are confused by the signs, and sometimes forget to change the sign of the entire expression when subtracting terms. Rules of the signs have to be learnt.

Students tend to have no difficultly with the order of operations (BODMAS) but sometimes get confused with the order of the brackets.

Sample Lesson Plan

Topic

Algebra

Specific Learning Objectives

Students will be able to add and subtracting like and unlike terms.

7

Suggested Duration

1 period

Key Vocabulary

variable, coefficient, constants, like terms, unlike terms

Method and Strategy

Activity

Write the following example on board and explain clearly.

Example

In the following expression:

$4x + 3y + 7$

4 and 3 are coefficients,

x and y are variables, and

7 is the constant.

- Like terms can be added or subtracted. Unlike terms cannot be added or subtracted.

Example

- $4xy$ and $5xy$ are like terms, hence they can be added: $4xy + 5xy = 9xy$.
- $4x$ and $5y$ are unlike terms and cannot be added or subtracted.
- The BODMAS rule should be applied when simplifying terms and the brackets ( ), { }, [ ] in algebra. The vinculum ($\overline{a + b}$) has a horizontal bar above the term, and has to be attempted before the brackets.
- Laws of integers taught in the earlier chapter using the number line are also applicable when simplifying algebraic expressions.

This chapter is all about practice. Lots of timed worksheets could be given for which the students can set their own time limits and see how many sums they can do in a minute.

The teacher writes twenty sums on the board or hands students a worksheet. She/ he calls out the time and the students begin; after a minute she/ he asks them to stop. Answers are reviewed by peer checking and the student with most correct answers is awarded a point.

Written Assignments

Exercise 7B, Q 6 (i) to (iv) and Q 7 (i) to (iv) to be done in class and Q 6 (v) to (vii) and Q 7 (v) to (vii) at home.

Evaluation

The students enjoy this topic. A lot of mini-tests can be given during the course of the chapter. A big assessment can be completed after the next chapter. Assessing the students with a short quiz in each lesson is important. This will help the teacher to gauge whether he/she needs to move ahead or spend more time on current topics.

8 LINEAR EQUATIONS

Specific Learning Objectives

In this unit students will learn:

- to recognise linear equation in one variable
- to construct linear equations in one variable
- to solve linear equations involving integers, fractions, and decimal coefficients
- to solve realworld word problems involving linear equations

Suggested Time Frame

4 periods

Prior Knowledge and Revision

Students have been introduced to algebraic terminology and the simplification process along with rules of the operations. Revision as such is not needed as it's a continuation of, and directly linked to Unit 7.

Real-life Application and Activities

The word problems can be done as real-life situations where equations can be constructed for students with different situations.

Example

If Ali is a student in the class and he has a sister Myra 12 years younger than him then, an equation relating their ages can be formed.

Denote Ali by x and Myra by y.

$x - 12 = y$

Or $x = y + 12$

Similar facts about students can be used and various characteristics (age, height, number of absentees in a class, etc.) can be used to form equations.

Bring a weighing balance to class to explain the concept of equilibrium and hence, equations.

Summary of Key Facts

- An algebraic equation is a statement that expresses a relationship of equality between two or more expressions.
- A linear equation has variables, (such as x, y, or z; or a, b, or c) raised to 'the power of 1'.
- In an equation, the two expressions on both sides of '=' are always equal.
- The linear equation in which the exponent of the variable is 1, is known as first degree equation.
- To maintain the equilibrium, add, take away, multiply, or divide by the same number to both the scales.

Frequently Made Mistakes

Students make mistakes when transposing, and jumble the laws when dealing with signs.

Sample Lesson Plan

Topic

Linear equations

Specific Learning Objectives

Students will be able expressions, construct equations, and solve them.

Suggested Duration

1 period

Key Vocabulary

term, variable, coefficient, constant, expression, Left Hand Side (LHS), Right Hand Side (RHS)

Method and Strategy

Activity

A weighing balance is brought to the class and is demonstrated that for the pans to be in equilibrium, equal weights should be placed on both sides. Thus, if oranges are put on the LHS, weights of equal mass should be placed on the RHS.

Example

Sara's father weighs twice as much as her, and Sara's weight is 45 kg. If her father's weight is denoted by x, then:

$2x = 45$

Hence, Sara's father weighs 90 kg.

Written Assignments

Exercise 8 Q 3 to 6 will be done in class. Q 7 to 11 will be given for homework.

Evaluation

Once the students are well-versed in transposing and solving equations, a surprise class test can be taken of Qs 15 to 18 of Exercise 8. The test can be marked and corrections can be done.

GEOMETRY: LINES AND ANGLES

Specific Learning Objectives

In this unit students will learn:

- to recognise and identify 3D shapes (cube, cuboid, cone, cylinder, sphere, hemisphere) with respect to their characteristics
- to identify adjacent angles
- to identify and differentiate between parallel lines, perpendicular lines, and a transversal
- to find unknown angles related to parallel lines, and transversal (corresponding angles, alternate angles, interior angles and vertically opposite angles
- to recognise rotational symmetry
- to find the point of rotation and order of rotational symmetry

Suggested Time Frame

8 periods

Prior Knowledge and Revision

Students have been exposed to geometry since kindergarten level. In fact, they love shapes. The students need to be curious about their environment and understand that mathematics is all around us.

The teacher can hold a brainstorming session and ask them various questions before starting this unit.

- How many vertices does a sphere or football have?
- How many surfaces or faces are there on a cuboid pencil box?
- Is the corner of the room where the two walls and the floor meet a point?
- Have you ever noticed the shapes formed on the surface of the water when you throw a pebble in a pond?

Students know that angles and their different types. They also have knowledge of measuring angles, if not of constructing them.

Real-life Application and Activities

In order to explain the concepts of a line, line segment, and rays, explain the concept of infinity. This can be linked to the fact that the number line extends at both ends to infinity and has both positive and negative numbers.

Hold one end of a length of yarn or rope and give the other end to a student who can take it all the way out of the class and out of sight. Explain that one end is going on and on to infinity.

Hold a rope with one end in each hand. Explain that this length is bounded by two end points. Ask them to use a measuring tape to measure, the dimensions of the floor of their class.
A scale for the room can be provided such that every 60 cm can be represented on paper by 2 cm.

Students can be given chart paper to produce congruent drawings of books of different sizes. The room dimensions, the floor, and the walls can be drawn by specifying a scale factor. Not only will they understand line segments and end points better through this activity, but they will also understand surfaces and how they are connected to each other.
As they do the drawings, the teacher can stress that they first make a point then a line segment, and point out that when two to four line segments intersect each other, they form planes and two dimensional surfaces.

Starter Activity

The teacher can give them a timed activity in which they are given three minutes to identify and note down all the angles as they can spot in the classroom.

The teacher can first revise the following key angle facts, and then time them and see how many observations are made.

- Angles are formed by two rays.
- The two rays meet at one point which is called the vertex.
- An angle is denoted by the sign $\angle$.
- When labelling an angle by three letters in upper case, the middle letter should denote the vertex.
- A protractor is used to measure an angle.

Example

When a door opens, an angle is formed.

The walls in a room meet at right angles.

An angle is formed between the blades of a fan.

The table legs are right angles to the floor.

Summary of Key Facts

- A line segment is a series of points that is bound at both ends.
- A line is a series of points that extends infinitely in both directions.
- A plane is flat and goes on to infinity in all directions.
- A point has no length, breadth, or height. A geometrical point indicates only a position; it has no dimensions.

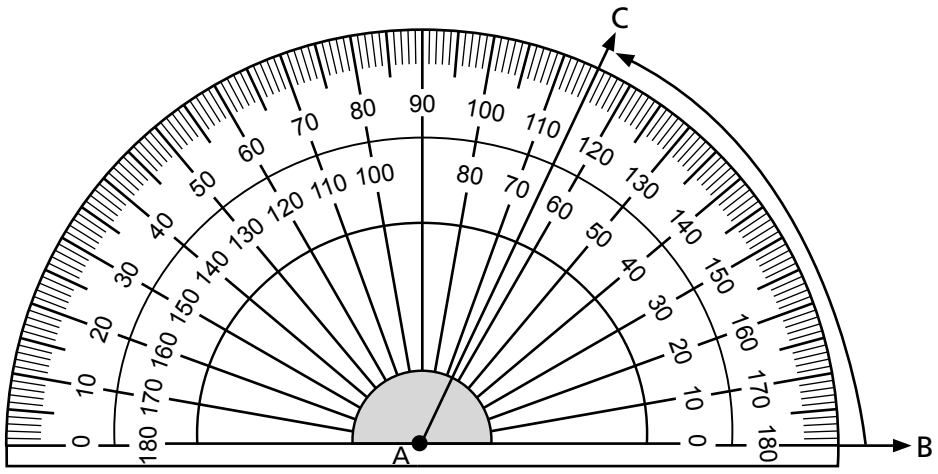
- A ray starts from a definite source and extends to infinity on the other side.
- A ray is a part of a line with one endpoint with the other point extending infinitely.
- Three or more points lying on the same straight line are known as collinear points.
- The points not lying on the same straight line are known as non-collinear points.
- If 2 or more lines pass through a point, they are called concurrent lines.
- The lines which do not pass through the same point are called nonconcurrent points.
- A cube is a three-dimensional object bounded by six equal square plane surfaces. It has 6 faces, 12 edges, and 8 vertices.
- A sphere has no faces, vertices, or edges. Every point on the surface of the sphere is at an equal distance from the centre.
- A cylinder has 3 faces (two circles and one rectangle), two circular edges, and 0 vertices.
- A cone has 2 faces (a flat circular face and a curved face), one vertex, and one circular edge.
- An angle refers to the space (in degrees) between two intersecting lines or surfaces at, or close to, the point where they meet.
- Two angles are adjacent if they have a common vertex, common arm, and both arms of the angle lie on the opposite side of the common arm.
- Two angles are complementary if they are adjacent and their sum is 90°.
- Two angles are supplementary if they are adjacent and their sum is 180°.
- Vertically opposite angles are equal.
- Perpendicular lines are two lines that intersect at 90°.
- Two lines which have the same distance between them and do not intersect are called parallel lines.
- A line that intersects atleast two or more lines is called a transversal.
- Exterior angles lie outside the parallel line and interior angles lie between the parallel lines.
- If two parallel lines are cut by a transversal, the corresponding angles formed are equal in size.
- If a transversal intersects two parallel lines, the alternate angles are equal in size.
- If a transversal intersects two parallel lines, the sum of the interior angles on the same side of the transversal is equal to 180°.
- When a shape is rotated about a fixed point by an angle of 360°, it is one complete rotation.
- The point about which the shape has been rotated is called the centre of rotation.
- The number of times the shape matches the original shape in one complete rotation of 360° is called the order of rotation.
- Every shape has a rotational symmetry of order 1, as it will always come back to its original position after one complete rotation of 360°.

Frequently Made Mistakes

Students generally find this unit easy and tend not to make mistakes. However, the teacher should emphasise correct use of new terms and accurate drawings.

Students often misread the protractor while constructing or measuring angles since the values

begin from both ends of the protractor. The teacher should stress that whenever the protractor is placed on the base ray, the reading should be done from zero that touches the base ray.



$\angle CAB = 65°$

Sample Lesson Plan

Topic

Geometry

Specific Learning Objectives

Students will be able to identify the differences between a line, a line segments, and a ray.

Suggested Duration

1 period

Key Vocabulary

line, ray, line segment, infinity, and end point

Method and Strategy

Activity

Once the students have learnt the three definitions, divide them into groups of three. Provide them with chart paper, rope or yarn, marker, tape, and scissors. Ask them to choose one of them and on one sheet of chart paper three students cut and paste the line, line segment, or ray. Point out to them that the line segment's end points can be highlighted at the ends of the rope with a marker, and arrows cut out for the line and ray.

Written Assignments

Q # 1 to 6 of Exercise 9A will be done in class after the activity. Q7 to 10 to done at home.

Evaluation

A small test of the definitions can be given. This test can take the form of multiple choice questions or fill in the blanks.

Sample Lesson Plan

Topic

Angles

Specific Learning Objectives

Students will be able to differentiate between complementary and supplementary angles at a point, and vertically opposite angles.

Suggested Duration

1 period

Key Vocabulary

adjacent, complementary, supplementary, vertically opposite angles.

Method and Strategy

Activity

A quiz will be conducted. The teacher will make flash cards of different types of angles and as he/ she shows a card, the students will write down the name of the type of angle. This is a good activity to speed up recognition of different types of angles.

The teacher will use his/ her hands and show complementary angles by putting her two arms perpendicular to each other. For supplementary angles the arms are joined in a straight line. The teacher can cross his/ her arms to make vertically opposite angles.

Written Assignments

Q# 6 (i) to (v) and Q#7 (i) to (iv) Exercise 9B will be done in class. For homework, students will be given an assignment to write five sets of complementary and supplementary angles.

Exercise 9B Q# 6 (vii) to (x) and Q# 7 (v) to (viii) will be given as home assignment.

Evaluation

There are many facts to be learnt in this unit where recognition and recall will be tested.

A comprehensive worksheet can be made to assess the students' skills and learning.

10 PRACTICAL GEOMETRY

Specific Learning Objectives

In this unit students will learn:

- to construct a perpendicular bisector of the line using a pair of compasses
- to construct a perpendicular from a point on the line using a pair of compasses
- to construct a perpendicular from a point outside the line using a pair of compasses
- to bisect angles using a pair of compasses
- to construct angles of the given measures: 30°, 45°, 60°, 75°, 90°, 105°, and 120° using a pair of compasses
- to reflect an object using grid paper and a pair of compasses and find the line of reflection by construction

Suggested Time Frame

3 to 4 periods

Prior Knowledge and Revision

Students have learnt the geometric terminology and this unit is a direct continuation, hence no revision is required. They have drawn angles in previous grade and are familiar with the use of the protractor and ruler.

Real-life Application and Activities

The teacher can ask them to role play civil engineers or architects. The teacher can explain that this work involves the practical use of maths.

Summary of Key Facts

- A perpendicular bisector is a line segment which bisects another line segment at 90° and divides it into two equal parts.
- An angle bisector is a line segment that divides the angle into two equal parts.

- When a line divides a shape into two identical halves, the shape is symmetrical and it has reflection symmetry.
- The line dividing the shape is called the line of symmetry.
- All regular polygons have as many lines of symmetry as there are sides in them.

Frequently Made Mistakes

Students tend to use unsharpened pencils when drawing lines and constructing shapes. The teacher should teach students how to hold a compasses as they tend to hold it incorrectly. The compasses are held from the top tip; care should be taken that the points of the pencil and the compasses are aligned.

Sample Lesson Plan

Topic

Perpendicular bisector

Specific Learning Objectives

Students will be able to constructing a perpendicular line bisector.

Suggested Duration

1 period

Key Vocabulary

perpendicular, point of intersection, bisector

Method and Strategy

Activity

Students will be asked to do the construction on chart paper. This can be done as a group activity.

Students will be asked to construct a line segment $\overline{AB}$ of length 12 cm.

Then, using a protractor, they will be shown how to construct a perpendicular bisector on the board.

A length of more than half the length of the line segment is taken and arcs are drawn above and below the line segment. The students will be asked to imagine that they are drawing a date tree above and below the line.

The points where the arcs at the top and bottom intersect each other are joined by a line using a ruler.

The halves of the line segment are measured and groups that get two exactly congruent halves are awarded points.

This can be repeated at least five times and the group with the most points wins.

Written Assignments

Exercise 10B Q# 4 (i) and (ii) will be done in class Q# 4 (iii), (iv), and (v) to be done for homework in their notebooks.

Evaluation

A short assessment on construction can be given. Marks should be given for neat, accurate, and correctly labelled diagrams.

Also students skill in using a protractor, ruler, and a pair of compasses will be tested.

11 TRIANGLES

Specific Learning Objectives

In this unit students will learn:

- to classify triangles:
  - ❒✳✳✳ * according to their sides
  - * according to their angles
- about the properties of the triangles:
  - * interior angles of a triangle add up to 180°
  - * the size of the exterior angle of a triangle is equal to the sum of the size of the opposite interior angles
  - * the sum of the lengths of any two sides is always greater than the third side
- about the properties of the isosceles triangles:
  - * angles opposite equal sides of a triangle are equal
  - * sides opposite equal angles of a triangle are equal

Suggested Time Frame

4 to 5 periods

Prior Knowledge and Revision

Students are familiar with triangles. They know that a triangle is a closed figure bounded by three sides and has three angles. Since this is a continuation of line segments, and angles and triangles are formed using these, it's an easy concept to explain.

The teacher can give a quick oral quiz on definitions of different types of angles and line segments.

Students can be asked to come to the board to draw the various angles without using a protractor.

The teacher can then combine the line segments drawn on the board to form a triangle.

In a 5-minute brainstorming session, students can identify triangles around them.

Examples

- Fin of a shark
- Mountains and hills
- Pyramids with triangular faces
- Sail of a boat

Real-life Application and Activities

The table on page 170 fo the NCD textbook and 199 should be explained. Triangles are classified according to their sides and angles. Different types of triangles are identified according to their specific properties.

Chart paper cut outs of the six types of triangles can be made. The students can be divided into 6 groups and assigned one triangle each. They should be provided with scissors, marker, a 12" ruler, protractor, pencil, and eraser.

Ten minutes should be given to make the cut-out once the triangle type has been assigned. The cut outs can then be displayed on soft boards and points can be awarded to the groups.

Summary of Key Facts

- A scalene triangle has all three sides of unequal length, and three angles of different sizes.
- An isosceles triangle has two sides of equal length and two angles of equal size.
- Angles opposite equal sides of an isosceles triangle are equal. Conversely, the sides opposite equal angles of an isosceles triangle are equal.
- An equilateral triangle has three equal sides and three angles of equal size.
- A triangle that has three acute angles is known as an acute-angled triangle.
- A triangle that has one angle equal to 90° is known as a right-angled triangle.
- A triangle with one obtuse angle is known as an obtuse-angled triangle.
- An exterior (or external) angle is the angle between one side of a triangle and the extension of an adjacent side.
- The sum of the interior angles of a triangle is always 180°.
- Size of the exterior angle of a triangle is equal to the sum of the sizes of the opposite interior angles.

Frequently Made Mistakes

The students generally enjoy this topic. If the students learn the properties of triangles well, mistakes are very rare. Students sometimes do not observe that the exterior angle is not just any angle formed outside the triangle but one that is formed by the collinear extension of the side of a triangle.

Sample Lesson Plan

Topic

Triangles

Specific Learning Objectives

Students will be able to

- apply properties of a triangle
- calculate sum of interior angles of a triangle
- solve problems based on relationship between exterior and interior angles of a triangle

Suggested Duration

1 period

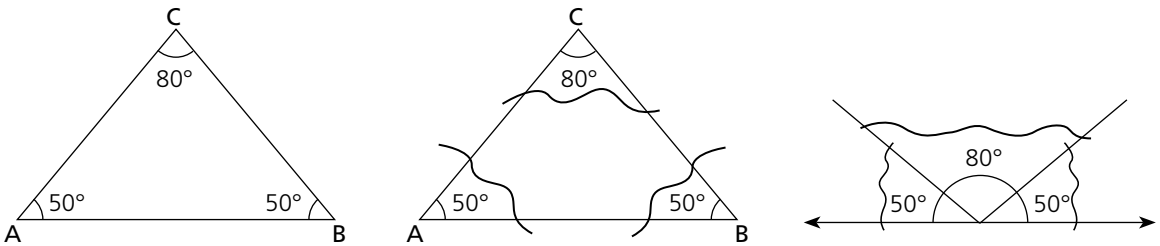
Key Vocabulary

interior angles, exterior angles

Method and Strategy

Activity

The property that the sum of the three interior angles of a triangle is 180° can be practically demonstrated by giving students cut-outs of various sizes of triangles. Each student will be handed a cut-out of one of the six types of triangles studied. They will be asked to label the triangle and then identify its type first. Then, they will cut out the three angles and glue them in their notebooks adjacent to each other. The students will notice that all three angles can be pasted in a straight line, proving that the three interior angles of a triangle add up to 180°.



This activity will be repeated by cutting out an exterior angle from another cut-out of a triangle with an extended side and cutting and pasting the two opposite interior angles on top of the exterior angle. When the students prove these properties practically themselves, they understand and retain the concept better.

Students will be asked to write the property proved under the angles glued in their notebooks.

Written Assignment

Q # 6 to 9 of Exercise 11B to be done in class and Q# 10 to 13 to be given for homework to ascertain whether they have learnt and understood the properties through the activity.

Evaluation

Short pop quizzes in the beginning of each class can be taken. The teacher can write five questions on the board and ask them to complete the quiz in five minutes. In this way the retention of the information about the properties and different types of triangles can be checked. An assessment can be given in which the students are asked to draw six types of triangles using a protractor, compasses and a ruler. Multiple choice questions can be given on the properties of the angles of the triangles.

12 PERIMETER AND AREA

Specific Learning Objectives

In this unit students will learn:

- to calculate the area of a path (inside or outside) a rectangle or a square
- to calculate the area of a parallelogram
- to calculate the area of a triangle
- to calculate the area of trapezium
- to solve real-world word problems related to perimeter and area

Suggested Time Frame

5 to 6 periods

Prior Knowledge and Revision

Students know that the space enclosed by two dimensions is called the area of a figure.

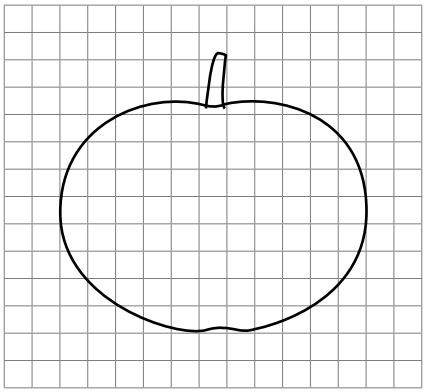
This chapter deals with the transition from one dimensional to two dimensional figures. Brain storming session to identify surfaces around the classroom or in the playground. The walls, surfaces of tables, shelves, floor, and board etc. can be pointed out to show that they have two-dimensions surfaces.

Real-life Application and Activities

Explain that the area of irregular objects is found by tracing them onto squared paper and then counting the squares. An interesting activity can be done to demonstrate this.

Ask students to bring to class a picture of their favourite cartoon character or any other picture of their choice.

Example:



The teacher should make sure the picture doesn't exceed the size of a sheet of A4 paper. Then ask the students to trace their picture onto the squared paper and count the squares to find its area in square units.

Similarly, the formulas of a rectangle and a square can be explained.

Area of rectangle = length × breadth

Area of square = side × side = s^2

These formulas can be explained by drawing a rectangle and square on squared paper and finding their areas by counting the squares. Once the students have found the area, the teacher can count the number of squares in the length and breadth and multiply them to show that the answer is the same and it is a faster route to finding the area. The teacher should explain that formulas are devised to make our lives easier.

Students can then be given measuring tapes and the areas of their book pages, surfaces of the table, and board can be found. Students can work in groups for this task.

The teacher should prepare a worksheet in the form of a table where a column for each surface is given in which length and breadth are found and noted and then the area formula is applied and the answer is given in square cm. Students are given ten minutes to do this activity and then worksheets are handed in and the groups are marked on their accuracy and neatness.

Summary of Key Facts

- Perimeter of any quadrilateral is the sum of all the sides.
- Perimeter of any square is 4l, where 'l' is the length of each side.
- The perimeter of a rectangle = 2(l + b), where l and b are the length and the breadth, respectively.
- Area is the amount of space covered by a surface.
- Area of a square (A) = side (s) × side (s)
- Side of a square (s) = $\frac{\text{(Area of a square (A)}}{\text{(Side of a square (s)}}$
- Area of a rectangle = length × breadth = l × b
- Length of a rectangle (l) = $\frac{\text{(Area of a rectangle (A)}}{\text{(Breadth of a rectangle (b)}}$

- Breadth of a rectangle (b) = $\frac{\text{(Area of a rectangle (A)}}{\text{(Length of a rectangle (l)}}$
- Area of border = Area of larger rectangle – Area of smaller rectangle.
- Area of parallelogram = base × altitude
- Area of a triangle = $\frac{1}{2}$ (base ×height
- A trapezium is a quadrilateral with only one pair of parallel sides.
- Area of a trapezium = $\frac{1}{2}$ (Sum of parallel sides)×altitude

Frequently Made Mistakes

Students get confused when manipulating the formula to find a dimension when given an area. Explain that this should be treated as an algebraic expression with the unknown dimension represented by the 'x' variable and the other value transposed to find the answer. Also, it should be pointed out that the units for all values should be uniform.

Example

Area = 36 cm^2

Breadth = 0.04 m = 4 cm (Students should be careful with units and their conversions.)

A = length × breadth

36 = length × 4

Length = $\frac{36}{4}$ = 9 cm

Sample Lesson Plan

Topic

Area

Specific Learning Objectives

Students will be able to find the area of a border of equal thickness enclosed by two squares or rectangles.

Suggested Duration

1 period

Key Vocabulary

external area, internal area, inner length, outer length, inner breadth, outer breadth

Method and Strategy

Activity

This is a difficult concept for students. Ample practice will be done for finding areas using the formulas before this is introduced.

The fact that the border is of equal widths will be pointed out. Identification of the inner length and breadth and the outer length and breadth will be done. In order to find the inner dimensions, the widths are subtracted twice from the outer dimensions. Similarly, the width is added twice to the inner dimensions to get the outer dimensions.

Once the dimensions are tabulated, inner and outer areas are found and subtracted to get the area of the border.

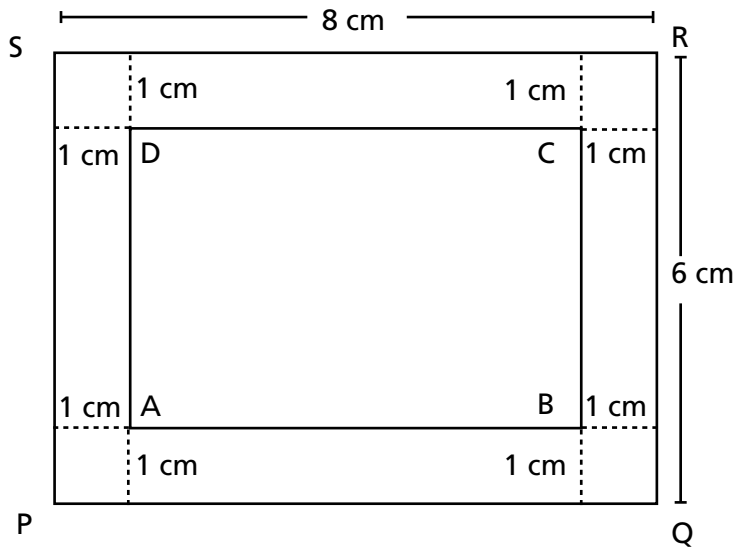
Finding the measurements of the inner rectangle ABCD

Length of AB

= 8 cm – 1 cm – 1 cm = 6 cm

Length of BC

= 6 cm – 1 cm – 1 cm = 4 cm



A fun activity will be done.

Students will be asked to cut out two rectangles from sheet of different colured chart paper:

rectangle 1 with a length of 10 cm and a breadth of 5 cm, and

rectangle 2 with a length of 14 cm and a breadth of 9 cm.

The cut-outs will be of two different colours. Students will be asked to stick the smaller rectangle onto the larger one. Students calculate the areas of the two rectangles and then subtract these two areas to get the area of the border.

Likewise, a rug could be brought to the lesson and its dimensions and area can be measured using a measuring tape. The teacher marks an area on the floor where the rug is placed and subsequently the marked area of the floor is also measured. The students can then calculate the area not covered by the rug.

Written Assignments

Q # 1 and 2 of Exercise 12C will be done in class. The students will write the data carefully and then do the working. Q# 3 and 4 will be given for homework.

Evaluation

This is an important topic. A lot of short tests will be given to assess students' understanding and learning. Once the teacher is confident, the next topic will be explained.

A comprehensive assessment comprised of finding area of irregular shapes on squared paper, finding the missing dimension using the given area, word problems to find the cost of cementing or tiling using the unitary method, and border questions will be given.

13 VOLUME AND SURFACE AREA

Specific Learning Objectives

In this unit students will learn:

- to calculate the volume of a cube and a cuboid
- to calculate the surface area of a cube and a cuboid
- to solve real-world word problems involving volume and surface area of cubes and cuboids

Suggested Time Frame

4 to 6 periods

Prior Knowledge and Revision

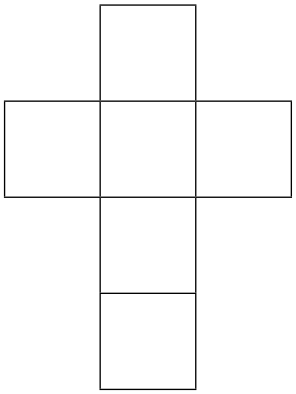
Students are familiar with the concept of volume. They know that all 3D figures have volume. It is the space contained by the length, breadth, and the third dimension, height.

Hold a quick quiz in which 3D objects in the classroom are identified by their name, surfaces, edges, and vertices.

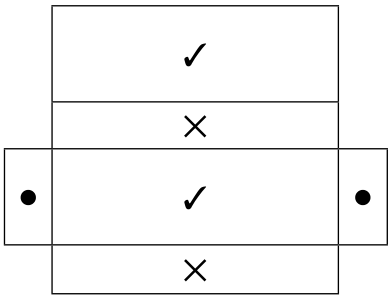
The moment a square or rectangular face acquires thickness or height it becomes a 3D figure with volume. The best example would be to lift a page of a book and show it to be a rectangle with length and breadth. Close the book and show the height or thickness of the book: the pages have become a cuboid which is a 3D figure.

Real-life Application and Activities

The identification of dimensions of cubes and cuboids is very important as the students need to identify them and then substitute the values in the formulas. The best way to ensure that the students understand this is to make net diagrams of a cube and a cuboid. The teacher should draw the net diagram on chart paper and ask the students to cut, fold, and tape the shapes.



Net diagram of a cube
Since all sides are equal, all the faces are equal in area and dimensions.



Net diagram of a cuboid
Since dimensions are different, opposite faces, are the same in area and dimensions.

Summary of Key Facts

- Volume is the amount of space occupied by any 3D object.
- Volume of 3D objects is measured in cubic centimetres, cubic metres, or cubic kilometres.
- A cube is a special cuboid whose length, breadth, and height are equal.
- Volume of a cube (V) = length (l) × length (l) × length (l)
- A cuboid is a solid bounded by six rectangular plane faces. It has eight corners or vertices, and 12 edges.
- A vertex is formed by the intersection of 3 edges.
- An edge is formed by intersection of two planes.
- An edge also connects 2 vertices.
- Volume of a cuboid = length × breadth × height
- The area of the surfaces of a 3D solid is known as its surface area.
- The surface area of a 3D object is the sum of the areas of each of its surfaces.
- Total surface area of a cuboid = $2[(l \times b) + (b \times h) + (l \times h)]$
- Total surface area of a cube = $\frac{6}{2}$

Frequently Made Mistakes

The students find this topic very difficult. They tend to use the wrong formula or wrong conversion units. Care should be taken that they not only understand and then learn the formulas, but are also confident converting the units.

Sample Lesson Plan

Topic

Surface area of a cube

Specific Learning Objectives

Students will be able to calculate surface area of cubes.

Suggested Duration

1 Period

Key Vocabulary

cubes, surface area, faces, edges

Method and Strategy

Activity

Cubes are objects for which all three dimensions are equal. Students will be asked to bring any everyday cube shaped object to school, it could be a box of chocolates or a toy box. Students will be asked to feel and count the faces of the object; they will all feel the faces and point out that there are 6 equal faces. Since all dimensions are the same, $2\ (l \times b)\ +\ 2(l \times h)\ +\ 2\ (b \times h)$ simply translates to $2l^2\ +\ 2l^2\ +\ 2l^2\ =\ 6l^2$

The formula for finding the surface area of a cube is $6l^2$.

Written Assignments

Q# 9 and 10 of Exercise 13 will be done in class and six sums as homework, where the teacher can ask them to find the surface area of cubes measuring 2, 3, 4, 5, 6, 7, 8, 9, and 10 cm each.

Evaluation

This is an extremely critical unit where the conceptual, practical, and practice aspects are to be kept in mind. Quizzes will be given after every concept taught. Only if the majority of the students score well, will the teacher proceed to a new topic. Word problems of surface area, costing, and finding the missing dimension with the help of volume will also be given.

A comprehensive assessment including applications of formulas for volume and total surface area, and more importantly, word problems will be given.

14 DATA HANDLING

Specific Learning Objectives

In this unit students will learn:

- to identify and organise grouped and ungrouped data
- to identify and organise discrete and continuous data
- to draw, read, and interpret horizontal and vertical multiple bar graphs
- to draw, read, and interpret pie charts
- to solve real-world word problems related to multiple bar graphs and pie charts
- to calculate the mean, median, and mode for ungrouped data
- to solve real-world word problems related to mean, median, and mode
- to explain experiment, outcomes, sample space, events, equally likely events and probability of a single event
- to differentiate the outcomes that are equally likely and not equally likely to occur
- to solve real-world word problems related to probability

Suggested Time Frame

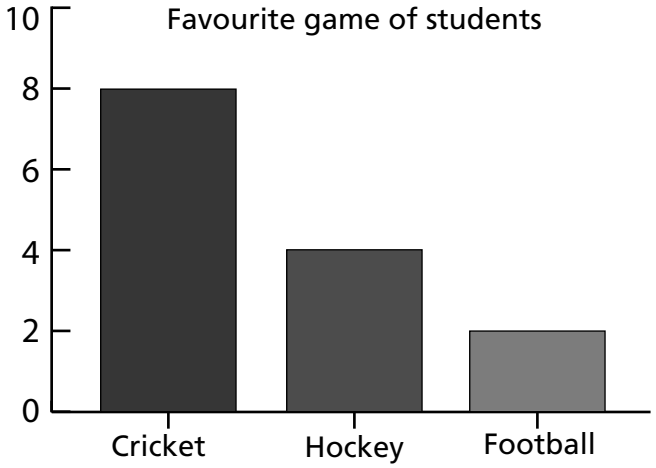
3 to 4 periods

Prior Knowledge and Revision

Students have interpreted line graphs and bar graphs in earlier classes.

The teacher can draw line graphs on the board and ask questions. It could be a line graph depicting the temperature of their city on the last 7 days.

The students and the teacher can draw a bar graph of their favourite game.



Real-life Application and Activities

The teacher can measure the heights of a group of five students and then represent the findings on a bar graph on the board. This can also be done on chart paper and displayed on the soft board for a week.

The students can then be divided into groups and each group can be given a different set of data and asked to draw a vertical or horizontal bar graph on chart paper. The groups can then be marked on accuracy, presentation, and labelling of the graph.

The teacher should then set a homework assignment of finding out the height of each family member and representing the information on a horizontal bar graph in their notebooks.

Summary of Key Facts

- Mean = $\frac{\text{(Sum of all values of the data)}}{\text{(Total number of values)}}$
- Median is defined as the middle value of a data when the data is arranged in ascending or descending order.
- Mode is the value which occurs most frequently in a given data.
- Numerical data is the data that is in the form of numbers and not in descriptive form, about a specific topic or subject.
- Data collection refers to the methods used to collect data from different sources for a particular purpose.
- Data collected by quantity is called quantitative data.
- Data collected by quality is called qualitative data.
- Discrete data is the type of data that contains different values, that is, it has clear difference between the values.
- Discrete data is information that is collected, countable, and only a limited number of values is possible.
- Bar graphs and pie charts are mostly used to represent discrete data.
- Continuous data is numerical data that is about accuracy. It is measurable, includes any value within the preferred range, and will change over time.

- Continuous data is represented by line graphs.
- Data which is organised into groups or classes is called group data.
- Ungrouped data is data that is not grouped into classes or groups.
- A graph is a pictorial representation of relationships between any two quantities.
- A line graph is a type of chart which displays information as a series of data points connected by straight line segments.
- In a bar graph, numerical data is represented by horizontal or vertical rectangles called bars.
- Multiple bar graph shows relation between different values of data. Each data value is represented by a column in the graph. In multiple bar graph, multiple data points of each category of data are shown with the addition of columns.
- A pie chart is a diagram that uses sectors of a circle to display data. The circle is divided in sectors showing the portions of the total of each type.
- Probability is the measure of the chance of an event happening.
- Probability of an event = $\frac{\text{(Number of favourable outcomes)}}{\text{(Total number of possible outcomes)}}$
- The list of all possible outcomes is known as the sample space.
- An experiment is a procedure that can be infinitely repeated and has well defined set of possible outcomes.
- Events that have the same probability (for likelihood) of occurring are called equally likely.
- When the sample space consists of outcomes which do not have an equal chance of occurrence, then these outcomes are not equally likely outcomes.

Frequently Made Mistakes

Special emphasis should be placed on scale drawing, labelling, and accuracy. Students tend to forget this aspect and can be careless in their presentation. It should be stressed that the bars are of equal widths and the intervals between them should also be uniform.

Sample Lesson Plan

Topic

Measure of central tendency

Specific Learning Objectives

Students will be able to calculate mean, median, and mode of the given data.

Suggested Duration

1 period

Key Vocabulary

data, arrange, ascending order, descending order, mean, median, middle value, most, occurring value, mode

Method and Strategy

Activity

Teacher will prepare 1-digit and 2-digit cards and bring to class. 7 students will be asked to draw one card each, which will be pasted on board. First the students will add these numbers and then divide by 7 to get the mean. Next, they will arrange these numbers in ascending order and find the middle value that is median. Finally, they will find the most occurring number in the set of data that is mode.

Repeat the activity with 8 number cards. Teacher will explain that method for finding mean and mode remains the same, while for finding median with even number of values differs. That is divide the middle two values by 2.

Few more examples to collect data to find the mean, median, and mode.

Pair activity – give a dice to each pair. Instruct them that one child will throw the dice 7 times and the other 10 times. Make two separate lists of the data.

Repeat the activity by throwing 2 dice together 9 times and then 12 times to make a 2-digit number.

Whole class activity – ask each child what their age is and write the data on the board.

Whole class activity – ask each child how many siblings they have and write the data on the board.

Written Assignments

Exercise 14A Q # 1, 2, 3 (i), (ii), (iii) will be done in class and Q # 3 (iv), (v), (vi) will be given for homework.

Evaluation

TIn each lesson a quiz of five sums will be given to check whether the students are making conceptual errors. In this topic they to forget to arrange data in ascending or descending order before calculating the median or make careless calculation errors. Once sure that the students are on board and understand the concept of measures of central tendency, the teacher will proceed. At the end of the chapter, a combined assessment of all three concepts taught will be given to ensure that the students understand all the concepts fully.

Assessment

A teacher's journey involves three stages Exposition, Practice, and Consolidation.

Exposition is the setting forth of content, and the quality and extent of the information relayed.

Practice involves problem solving, reasoning and proof, communication, representations, and correction.

Assessment is the final stage of **consolidation** of the process of learning.

Assessment of teaching means taking a measure of its effectiveness.

Assessments

Students can be evaluated on various criteria and by multiple methods (Oral or written, projects, tests/ examinations, etc.) during or at the end of a session year.

Assessment is a mandatory part of the teaching and learning process. It cannot be treated isolated from the teaching and learning process. It helps both teachers and learners to judge and evaluate their efforts and pace of learning.

In mathematics it becomes more essential, as mathematical concepts are linked with each other. Concepts grasped during one teaching session serve as a basis for the learning of upcoming concepts. Teachers use assessments for several purposes such as pre-assessing the learners' need, providing relevant instruction, assessing the intended learning outcomes, placement of the learners in different groups, diagnosis of weaknesses and strengths of the learners, adjustment of teaching strategies/ techniques and promotion of the learners to the next grade. Major functions of the assessment are instructional planning, feedback, making decision, and selection of appropriate resources and strategies to move forward. In short the prime purpose of any assessment is to improve students' learning.

Types of Assessments

Assessment is classified according to its purpose, such as:

- Assessment for Learning (AFL)
- Assessment of Learning (AOL)

Formative Assessments:

These are commonly used as 'assessments for learning.' Formative assessments are conducted throughout teaching practice. They show evidence oo student's learning and are helpful feedback for the teachers to adjust their instructional methods to reduce the learning gaps for students.

In Assessment for Learning the teacher provides students with a feedback and support for improvement. The purpose for teachers is to:

- gather evidence of student achievement consistently, fairly, and over short periods of learning time, basically through informal methods
- monitor students' progress towards the defined learning goals
- define teaching adjustments and next steps for teaching to help students reach their potential
- adjust teaching to help students according to their potential

The most common forms of assessment for learning (formative assessment) are:

In-class activities where students present their findings informally and provide feedback on peer assessments, observations of students non-verbal feedback, homework exercises, questioning (open and closed), quiz, projects, selected responses (may include MCQs, true: false, matching short answers, fill-in-the-blanks, etc), open-ended tasks, performance assessments, process-focused assessments, discussions between student and teacher, answering specific questions, students reflections, students feedback collected through self-assessments etc.

Summative Assessments

These are also known as 'assessments of learning.' Summative assessments check for learners' achievement at the end of the lesson, chapter/ unit, or course. Usually, although not necessarily, these involve formal tests or exams. They are commonly used for grading and ranking students.

Assessment of Learning (Summative)

This assessment leads to the evaluation of student learning. It accurately summarises and communicates to parents, individual students, teachers, other teachers, school leaders and policymakers what students know and can do concerning the overall curriculum expectations.

The teacher assesses a student's summative work at the end of a learning period, to determine to what degree (at what level) the student has achieved the learning goal.

The purpose for teachers is to:

- provide evidence of students' achievement during a specific class and often at the end of a learning unit
- provide assessment data for evaluation
- make judgments about the quality of students learning on the set curriculum expectations
- provide a value (pass/ fail) to that quality of learning achieved by the students
- record and report student's achievements to all stakeholders including parents, teachers, school and senior management as well as students themselves
- use this data as assessment data for the evaluation of student learning

The most common forms of assessment of learning (summative assessment) are:

class tests, end of unit tests, monthly tests, mid-year/ annual examinations, standardized tests, multiple choice questions (MCQ), structured papers, presentations (peer or tutor – assessed in controlled environments etc.

Bloom's Cognitive Domains

The cognitive domains given below are used for assessment purpose:

- Knowing: Knowledge
- Applying: Understanding and Application
- Reasoning: Analysis, Synthesis, and Evaluation

Knowing:

Knowing refers to students need to be efficient with the basic knowledge or concept on the recall of mathematical language, basic facts or mathematical concepts, symbolic representation, spatial relations, simple procedures and application of the definitions

Action verbs to knowing are:

- Recall
- Identify
- Interpret
- Describe
- Recognize
- Measure
- Represent
- Explain
- State
- Arrange/ Order

Applying:

Applying refers to students need to be efficient with the application of mathematics in range of contexts. Students need to apply mathematical knowledge of facts, skills and procedures or understanding of mathematical concepts to create representations.

Problem solving is central to applying domain, with an emphasis on more familiar and routine tasks. Problem solving is referred to the real-life problems or concerned with the purely mathematical questions involving numeric or algebraic expressions, functions, equations, geometrical shapes or figures and statistical data sets.

Action Verbs to applying are:

- Examine
- Compute
- Collect
- Differentiate
- Add
- Subtract
- Multiply
- Divide
- Rotate
- Reflect
- Translate
- Enlarge
- Interpret
- Manipulate
- Plot
- Factorise

Reasoning:

Reasoning involves logical and systematic thinking. It includes intuitive and deductive reasoning based on patterns and regularities that can be used to arrive at solutions to problems set in unfamiliar situations. Such problems may be referred to purely mathematical or may have real life settings. For example, the reasoning involves ability to observe and make conjectures. It also involves logical deductions based on specific assumptions and rules.

Action verbs for Reasoning are:

- Analyse
- Predict
- Construct
- Evaluate
- Compare
- Express
- Demonstrate
- Verify
- Solve
- Differentiate

Content Domain

Content domain is the body of knowledge, skills or abilities that are being measured or examined by a test, experiment or research study. It may cover all aspects of the subject area as well as be well-defined objectives.

In secondary level mathematics (Grade VI – VIII), strands and bench marks of the National Curriculum (2022) are based on the following content domains:

Numbers and Operations

- Algebra
- Measurement
- Geometry
- Statistics and Probability

Evaluation:

An ideal and fair evaluation involves a plan that is comprehensive. It covers a broad spectrum of all aspects of mathematics. The assessment papers should test every aspect of the topics thought. These can be demarcated into categories: basic, intermediate, and advanced content. The advanced content should be minimal as it tests the most able students only.

Multiple choice questions, also known as fixed choice or selected response items, required students to identify the correct answer from a given set of possible options.

Structured questions assess various aspects of students' understanding: knowledge of content and vocabulary, reasoning skills, and mathematical proofs.

All-in-all the teaching's assessment of students' ability must be based on classroom activity, informal assessment, and final evaluation at the end of a topic and/or the year.

Cognitive domains play vital role in the development of assessment. To assess the student's in secondary classes the following ratio of cognitive domains are used.

Cognitive Domains/ Skills	Percentage weightage	Comprises of	Covers
Knowing:	**20%**	Recall	Recall definition, terminology, unit of measurement, geometric shapes and notations
		Describe	Description of numbers, expressions, quantities and shapes by their attributes and properties
		Convert	Conversion of numbers and quantities from one form to another
		Recognise/ Identify	Recognition of numbers, expressions, quantities, shapes and properties
		Arrange/order	Arrange numbers, expressions, quantities and shapes by common properties
		Measures	Measure geometrical shapes, lines, angles and graphs
Applying:	**40%**	Determine	Determine appropriate operations, strategies and tools for solving problems for which there are commonly used methods of solution
		Apply	Application of some rules, algorithm/ formula
		Manipulate	Manipulation of terms, and rules in to simpler form
		Compute	Carry out algorithmic procedure for +, -, x, ÷ or combination of theses with numbers, fractions, decimal and carry out straight forward algebraic expressions
Cognitive Domains/ Skills	**Percentage weightage**	**Comprises of**	**Covers**

Reasoning:	**40%**	Construct	Construction of tables, geometrical figures and graphs
		Demonstrate	Demonstration of properties of numbers and geometrical figures
		Evaluate	Evaluation of numerical values from expressions, equations, formulas and graphs
		Explain	Explanation of terminologies, formulas, algorithms and properties with reasoning
		Calculate	Calculation of quantities, expressions by using appropriate mathematical operations, formulas and techniques
		Solve	Solution of real-life situations using various mathematical strategies
		Verify	Verification of rules, identities and properties

To develop an assessment tool, a Table of Specification is used to align objectives, instructions and assessment. For example, following table explain weightage of specific topics with respect to different strands in accordance with the curriculum.

Unit Wise Weightage to be used for Table of Specification for Grade VI

Sr. #	Strand	Title	Weightage	Total	Cognitive Domains/ Skills
1	**Numbers and Operations**	Sets	1%	49%	**K: 20%** **A: 40%** **R: 40%**
2		Integers	25%		
3		Factors and Multiples	9%		
4		Ratio and Rate	9%		
5		Financial Mathematics	5%		
6	**Algebra**	Introduction to Algebra	9%	15%	**K: 20%** **A: 40%** **R: 40%**
7		Linear Equations	6%		
8	**Geometry**	Geometry	6%	14%	**K: 20%** **A: 40%** **R: 40%**
9		Practical Geometry	7%		
10		Transformations	1%		
11	**Measurement**	Mensuration	10%	10%	**K: 20%** **A: 40%** **R: 40%**

Sr. #	Strand	Title	Weightage	Total	Cognitive Domains/ Skills
12	**Statistics and Probability**	Data Handling	7%	12%	**K: 20%** **A: 40%** **R: 40%**
13		Probability	5%		
		Total Weightage	100%	100%	

Key: **Knowing (K)** **Applying (A)** **Reasoning (R)**

[Acknowledgement: Text related to assessment is with reference to Pakistan National Curriculum 2022.]