MINISTRY OF EDUCATION MALAYSIA

Integrated Curriculum for Secondary Schools

Curriculum Specifications
MATHEMATICS
Form 2

Curriculum Development Centre
Ministry of Education Malaysia

2002

CONTENTS

RUKUNEGARA

DECLARATION

OUR NATION, MALAYSIA, being dedicated
to achieving a greater unity of all her peoples;
to maintaining a democratic way of life;
to creating a just society in which the wealth of the nation shall be equitably shared;
to ensuring a liberal approach to her rich and diverse cultural traditions;
to building a progressive society which shall be oriented to modern science and technology;

WE, her peoples, pledge our united efforts to attain these ends guided by these principles:

BELIEF IN GOD
LOYALTY TO KING AND COUNTRY
UPHOLDING THE CONSTITUTION
RULE OF LAW
GOOD BEHAVIOUR AND MORALITY

NATIONAL PHILOSOPHY OF EDUCATION

Education in Malaysia is an on-going effort towards developing the potential of individuals in a holistic and integrated manner, so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious based on a firm belief in and devotion to God. Such an effort is designed to produce Malaysian citizens who are knowledgeable and competent, who possess high moral standards and who are responsible and capable of achieving a high level of personal well being as well as being able to contribute to the harmony and betterment of the family, society and the nation at large.

PREFACE

Science and technology plays a critical role in meeting Malaysia's aspiration to achieve developed nation status. Since mathematics is instrumental in developing scientific and technological knowledge, the provision of quality mathematics education from an early age in the education process is important.

The secondary school Mathematics curriculum as outlined in the syllabus has been designed to provide opportunities for pupils to acquire mathematical knowledge and skills and develop the higher order problem solving and decision making skills that they can apply in their everyday lives. But, more importantly, together with the other subjects in the secondary school curriculum, the mathematics curriculum seeks to inculcate noble values and love for the nation towards the final aim of developing the wholistic person who is capable of contributing to the harmony and prosperity of the nation and its people.

Beginning in 2003, science and mathematics will be taught in English following a phased implementation schedule which will be completed by 2008. Mathematics education in English makes use of ICT in its delivery. Studying mathematics in the medium of English assisted by ICT will provide greater opportunities for pupils to enhance their knowledge and skills because they are able to source the various repositories of mathematical knowledge written in English whether in electronic or print forms. Pupils will be able to communicate mathematically in English not only in the immediate environment but also with pupils from other countries thus increasing their overall English proficiency and mathematical competence in the process.

The development of this Curriculum Specifications accompanying the syllabus is the work of many individuals expert in the field. To those who have contributed in one way or another to this effort, on behalf of the Ministry of Education, I would like to express my deepest gratitude and appreciation.
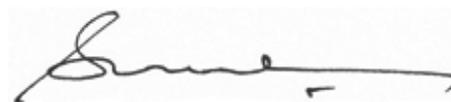
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INTRODUCTION

The vision of the country to become an industrialised nation by the end of the second decade can be achieved through a society that is educated and competent in the application of mathematical knowledge. To achieve this vision, it is important that the society must be inclined towards mathematics. Therefore, problem solving and communicational skills in mathematics have to be nurtured from an early age so that effective decisions can be made later in life.

Mathematics is instrumental in the development of science and technology. As such, the acquisition of mathematical knowledge must be intensified so as to create a skilled workforce as a requirement for a country in achieving a developed nation status. In order to create a K-based economy, research and development skills in Mathematics must be instilled at school level.

Based on the National Education Policy and the 2020 Vision, the Mathematics Curriculum has been reviewed and revised. The rationale behind this move is the need to provide Mathematical knowledge and skills to students from various backgrounds and levels of ability. Therefore, it is the country's hope that with the knowledge and skills acquired in Mathematics, students will be able to explore, discover, adapt, modify and be innovative in facing ongoing changes and future challenges. Acquisition of these skills will help propel them forward in their future careers thus benefiting the individual, society and the nation.

The Mathematics Curriculum (KBSM) is a continuum from Form 1 through Form 5. The content is categorised into three interrelated areas. These are Numbers, Shapes and Spaces, and Relationships. This categorisation is based on the fact that in any situation it is imperative that a person has knowledge and skills related to counting, be able to recognise shapes and measurements as well as recognise relationships between numbers and shapes.

AIM

The Mathematics Curriculum for secondary school aims to develop individuals who are able to think mathematically and who can apply mathematical knowledge effectively and responsibly in solving problems and making decision. This will enable the individual to face challenges in everyday life that arise due to the advancement of science and technology.

OBJECTIVES

The mathematics curriculum for the secondary school enables students to:

1. understand definitions, concepts, laws, principles and theorems related to Numbers, Shape and Space, and Relationships;

2. widen applications of basic fundamental skills such as addition, subtraction, multiplication and division related to Numbers, Shape and Space, and Relationships;

3. acquire basic mathematical skills such as:
   - making estimation and rounding;
   - measuring and constructing;
   - collecting and handling data;
   - representing and interpreting data;
   - recognising and representing relationship mathematically;
   - using algorithm and relationship;
   - solving problem; and
   - making decision.

4. communicate mathematically;

5. apply knowledge and the skills of mathematics in solving problems and making decisions;

6. relate mathematics with other areas of knowledge;

7. use suitable technologies in concept building, acquiring skills, solving problems and exploring the field of mathematics;

8. cultivate mathematical knowledge and skills effectively and responsibly;

9. inculcate positive attitudes towards mathematics; and

10. appreciate the importance and the beauty of mathematics.

CONTENT ORGANISATION

The Mathematics Curriculum at the secondary level encompasses three main areas, namely Numbers, Shape and Space, and Relationship. The topics for each area have been been arranged according to hierarchy . The basics have to be taught before abstract concepts can be introduced to students.

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The **Learning Area** outlines the scope of knowledge and skills which have to be mastered in the learning duration of the subject. They are developed according to the appropriate learning objectives and represented in five columns, as follows:

Column 1 : Learning Objectives
Column 2 : Suggested Teaching and
          Learning Activities
Column 3 : Learning Outcomes
Column 4 : Points To Note; and
Column 5 : Vocabulary.

The **Learning Objectives** define clearly what should be taught. They cover all aspects of the Mathematics curriculum programme and are presented in a developmental sequence designed to support students' understanding of the concepts and skill of mathematics.

The **Suggested Teaching and Learning Activities** lists some examples of teaching and learning activities including methods, techniques, strategies and resources pertaining to the specific concepts or skills. These are, however, not the only intended approaches to be used in the classrooms. Teachers are encouraged to look for other examples, determine teaching and learning strategies most suitable for their students and provide appropriate teaching and learning materials. Teachers should also make cross-references to other resources such as the textbooks and the Internet.

The **Learning Outcomes** define specifically what students should be able to do. They prescribe the knowledge, skills or mathematical processes and values that should be inculcated and developed at the appropriate level. These behavioural objectives are measureable in all aspects.

In the **Points To Note** column, attention is drawn to the more significant aspects of mathematical concepts and skills. These emphases are to be taken into account so as to ensure that the concepts and skills are taught and learnt effectively as intended.

The **Vocabulary** consists of standard mathematical terms, instructional words or phrases which are relevant in structuring activities, in asking questions or setting tasks. It is important to pay careful attention to the use of correct terminology and these need to be systematically introduced to students in various contexts so as to enable them to understand their meaning and learn to use them appropriately.

EMPHASES IN TEACHING AND LEARNING

This Mathematics Curriculum is arranged in such a way so as to give flexibility to teachers to implement an enjoyable, meaningful, useful and challenging teaching and learning environment. At the same time, it is important to ensure that students show progression in acquring the mathematical concepts and skills.

In determining the change to another learning area or topic, the following have to be taken into consideration:

- The skills or concepts to be acquired in the learning area or in certain topics;
- Ensuring the hierarchy or relationship between learning areas or topics has been followed accordingly; and
- Ensuring the basic learning areas have been acquired fully before progressing to more abstract areas.

The teaching and learning processes emphasise concept building and skill acqusition as well as the inculcation of good and positive values. Besides these, there are other elements that have to be taken into account and infused in the teaching and learning processes in the classroom. The main elements focused in the teaching and learning of mathematics are as follows:

1. Problem Solving in Mathematics

Problem solving is the main focus in the teaching and learning of mathematics. Therefore the teaching and learning process must include problem solving skills which are comprehensive and cover the whole curriculum. The development of problem solving skills need to be emphasised so that students are able to solve various problems effectively. The skills involved are:

- Understanding the problem;
- Devising a plan;
- Carrying out the plan; and
- Looking back at the solutions.

Various strategies and steps are used to solve problems and these are expanded so as to be applicable in other learning areas. Through these activities, students can apply their conceptual understanding of mathematics and be confident when facing new or complex situations. Among the problem solving strategies that could be introduced are:

- Trying a simple case;
- Trial and improvement;
- Drawing diagrams;
- Identifying patterns;
- Making a table, chart or systematic list;
- Simulation;

- Using analogies;
- Working backwards;
- Logical reasoning; and
- Using algebra.

2. Communication in Mathematics

Communication is an essential means of sharing ideas and clarifying the understanding of Mathematics. Through communication, mathematical ideas become the object of reflection, discussion and modification. The process of analytical and systematic reasoning helps students to reinforce and strengthen their knowledge and understanding of mathematics to a deeper level. Through effective communication students will become efficient in problem solving and be able to explain their conceptual understanding and mathematical skills to their peers and teachers.

Students who have developed the skills to communicate mathematically will become more inquisitive and, in the process, gain confidence. Communicational skills in mathematics include reading and understanding problems, interpreting diagrams and graphs, using correct and concise mathematical terms during oral presentations and in writing. The skill should be expanded to include listening.

Communication in mathematics through the listening process occurs when individuals respond to what they hear and this encourages individuals to think using their mathematical knowledge in making decisions.

Communication in mathematics through the reading process takes place when an individual collects information and data and rearranges the relationship between ideas and concepts.

Communication in mathematics through the visualisation process takes place when an individual makes an observation, analyses, interprets and synthesises data, and presents them in the form of geometric board, pictures and diagrams, tables and graphs. An effective communication environment can be created by taking into consideration the following methods:
- Identifying relevant contexts associated with environment and everyday life experience of students;
- Identifying students' interests;
- Identifying suitable teaching materials;
- Ensuring active learning;
- Stimulating meta-cognitive skills;

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- Inculcating positive attitudes; and
- Setting up conducive learning environment.

Effective communication can be developed through the following methods.

Oral communication is an interactive process that involves psychomotor activities like listening, touching, observing, tasting and smelling. It is a two-way interaction that takes place between teacher and student, student and student, and student and object. Some of the more effective and meaningful oral communication techniques in the learning of mathematics are as follows:

- Story-telling, question and answer sessions using one's own words;
- Asking and answering questions;
- Structured and unstructured interviews;
- Discussions during forums, seminars, debates and brainstorming sessions; and
- Presentation of findings of assignments.

Written communication is the process whereby mathematical ideas and information are disseminated through writing. The written work is usually the result of discussion, input from people and brainstorming activities when working on assignments. Through writing, students will be encouraged to think in depth about the mathematics content and observe the relationships between concepts. Examples of written communication activities that can be developed through assignments are:

- Doing exercises;
- Keeping journal;
- Keeping scrap books;
- Keeping folio;
- Keeping Portfolios;
- Undertaking projects; and
- Doing written tests.

Representation is a process of analysing a mathematical problem and interpreting it from one mode to another. Mathematical representation enables students to find relationships between mathematical ideas that are informal, intuitive and abstract using everyday language. For example 6xy can be interpreted as a rectangular area with sides 2x and 3y. This will make students realise that some methods of representation are more effective and useful if they know how to use the elements of mathematical representation.

3. Reasoning in Mathematics

Logical Reasoning or thinking is the basis for understanding and solving mathematical problems. The development of mathematical reasoning is closely related to the intellectual and communicative development of students. Emphasis on logical thinking, during mathematical activities opens up students minds to accept mathematics as a powerful tool in the world today.

Students are encouraged to estimate, predict and make intelligent guesses in the process of seeking solutions. Students at all levels have to be trained to investigate their predictions or guesses by using concrete material, calculators, computers, mathematical representation and others. Logical reasoning has to be absorbed in the teaching of mathematics so that students can recognise, construct and evaluate predictions and mathematical arguments.

4. Mathematical Connections

In the mathematics curriculum, opportunities for making connections must be created so that students can link conceptual to procedural knowledge and relate topics within mathematics and other learning areas in general.

The mathematics curriculum consists of several areas such as arithmetic, geometry, algebra, measures and problem solving. Without connections between these areas, students will have to learn and memorise too many concepts and skills separately. By making connections, students are able to see mathematics as an integrated whole rather than a jumble of unconnected ideas. When mathematical ideas and the curriculum are connected to real life within or outside the classroom, students will become more conscious of the importance and significance of mathematics. They will also be able to use mathematics contextually in different learning areas and in real life situations.

5. Application of Technology

The teaching and learning of mathematics should employ the latest technology to help students understand mathematical concepts in depth, meaningfully and precisely and enable them to explore mathematical ideas. The use of calculators, computers, educational software, websites in the Internet and relevant learning packages can help to upgrade the pedagogical approach and thus promote the understanding of mathematical concepts.

The use of these teaching resources will also help students absorb abstract ideas, be creative, feel confident and be able to work independently or in groups. Most of these resources are designed for self-access learning. Through self-access learning students will be able to access knowledge or skills and informations independently according to their own pace. This will serve to stimulate students' interest and develop a sense of responsibility towards their learning and understanding of mathematics.

Technology however does not replace the need for all students to learn and master the basic mathematical skills. Students must be able to efficiently add, subtract, multiply and divide without the use of calculators or other electronic tools. The use of technology must therefore emphasise the acquisition of mathematical concepts and knowledge rather than merely doing calculation.

APPROACHES IN TEACHING AND LEARNING

Various changes occur that influence the content and pedagogy in the teaching of mathematics in secondary schools. These changes demand various ways of teaching mathematics in schools. The use of teaching resources is vital in forming mathematical concepts. Teachers should use real or concrete materials to help students gain experience, construct abstract ideas, make inventions, build self confidence, encourage independence and inculcate the spirit of cooperation.

The teaching and learning materials used should contain self diagnostic elements so that pupils know how far they have understood the concepts and acquire the skills.

In order to assist students in having positive attitudes and personalities, the intrinsic mathematical values of accuracy, confidence and thinking systematically have to be infused into the teaching and learning process. Good moral values can be cultivated through suitable contexts. Learning in groups for example can help students develop social skills, encourage cooperation and build self confidence. The element of patriotism should also be inculcated through the teaching and learning process in the classroom using certain topics.

Brief historical anecdotes related to aspects of mathematics and famous mathematicians associated with the learning areas are also incorporated into the curriculum. It should be presented at appropriate points where it provides students with a better understanding and appreciation of mathematics.

Various teaching strategies and approaches such as direct instruction, discovery learning, investigation, guided discovery or other methods must be incorporated. Amongst the approaches that can be given consideration include the following:

- Student-centered learning that is interesting;
- Different learning abilities and styles of students;
- Usage of relevant, suitable and effective teaching materials; and
- Formative evaluation to determine the effectiveness of teaching and learning.

The choice of an approach that is suitable will stimulate the teaching and learning environment inside or outside the classroom. Approaches that are considered suitable include the following:

- Cooperative learning;
- Contextual learning;
- Mastery learning;
- Constructivism;
- Enquiry-discovery; and
- Future Studies.

EVALUATION

Evaluation or assessment is part of the teaching and learning process to ascertain the strengths and weaknesses of students. It has to be planned and carried out as part of the classroom activities. Different methods of assessment can be conducted. These maybe in the form of assignments, oral questioning and answering, observations and interviews. Based on the response, teachers can rectify students' misconceptions and weaknesses and also improve their own teaching skills. Teachers can then take subsequent effective measures in conducting remedial and enrichment activities in upgrading students' performance.

1. LEARNING AREA: DIRECTED NUMBERS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
1.1 Perform computations involving multiplication and division of integers to solve problems.	• Use concrete materials such as coloured chips and multiplication tables to demonstrate multiplication and division of integers. • Complete multiplication table by recognising patterns. • Solve problems related to real-life situations.	i. Multiply integers. ii. Solve problems involving multiplication of integers. iii. Divide integers. iv. Solve problems involving division of integers.	Begin multiplication involving two integers only. Relate division of integers to multiplication. Division by zero is undefined.	directed numbers multiply divide integer positive negative product quotient like sign unlike sign undefined

1. LEARNING AREA: DIRECTED NUMBERS

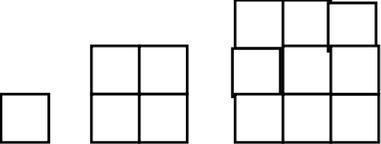| LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
1.2 Perform computations involving combined operations of addition, subtraction, multiplication and division of integers to solve problems.	• e.g. $(-2) - 3 + (-4)$ $4 \times (-3) \div (-6)$ • Students use calculators to compare and verify answers. • Solve problems related to real-life situations such as money and temperature.	i. Perform computations involving combined operations of addition, subtraction, multiplication and division of integers. ii. Solve problems involving combined operations of addition, subtraction, multiplication and division of integers including the use of brackets.	Emphasise the order of operations. Combined operations also known as mixed operations.	integer plus minus multiply divide positive negative bracket mixed operations order of operations

1. LEARNING AREA: DIRECTED NUMBERS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		fraction
1.3 Extend the concept of integers to fractions to solve problems.	• Compare fractions using: a) number lines b) scientific calculators.	i. Compare and order fractions. ii. Perform addition, subtraction, multiplication or division on fractions.	Begin with two fractions.	compare order greater than less than positive negative
1.4 Extend the concept of integers to decimals to solve problems.	• Compare decimals using: a) number lines b) scientific calculators.	i. Compare and order decimals. ii. Perform addition, subtraction, multiplication or division on decimals.	Begin with two decimals.	decimal add minus multiply divide product quotient sum difference

1. **LEARNING AREA: DIRECTED NUMBERS**

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
1.5 Perform computations involving directed numbers (integers, fractions and decimals).	• Explore addition, subtraction, multiplication and division using standard algorithm and estimation. • Perform operations on integers. e.g. $-2 + (-3) \times 4$ • Perform operations on fractions. e.g. $\left(-\dfrac{1}{4}\right) \times \left(\dfrac{3}{5} - \dfrac{1}{2}\right)$ • Perform operations on decimals. e.g. $2.5 - 1.2 \times (-0.3)$ • Perform operations on integers, fractions and decimals. e.g. $\left(-1.25 + \dfrac{2}{5}\right) \times (-4)$ • Solve problems related to real-life situations.	i. Perform addition, subtraction, multiplication or division involving two directed numbers. ii. Perform computations involving combination of two or more operations on directed numbers including the use of brackets. iii. Pose and solve problems involving directed numbers.	Emphasise the order of operations.	plus minus multiply divide positive negative

2. LEARNING AREA: SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
2.1 Understand and use the concept of squares of numbers.	• Recognise squares of numbers as the areas of the associated squares. 1^2 2^2 3^2 • Use pencil-and-paper method, mental and speed calculations to evaluate squares of numbers where appropriate.	i. State a number multiplied by itself as a number to the power of two and vice-versa.	15^2 read as: "fifteen to the power of two" "fifteen squared", or "the square of fifteen". Emphasise that a^2 is a notation for $a \times a$. Include integers, fractions and decimals. e.g. $(-8)^2 = (-8) \times (-8)$ $\left(\dfrac{3}{5}\right)^2 = \dfrac{3}{5} \times \dfrac{3}{5}$ $0.6^2 = 0.6 \times 0.6$	square product power expand expanded form

2. LEARNING AREA: SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
		ii. Determine the squares of numbers without using calculators.	Emphasise that the square of any number is greater than or equal to zero.	reasonable estimate approximation
	• Use estimation to check whether answers are reasonable. e.g. 27 is between 20 and 30. 27^2 is between 400 and 900. • Explore square numbers using calculators.	iii. Estimate the squares of numbers. iv. Determine the squares of numbers using calculators.	Emphasise the reasonableness of answers. Discuss that readings from calculators may be approximations.	

2. LEARNING AREA: SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
	• Explore perfect squares.	v. List perfect squares.	Perfect squares are whole numbers.	square
				perfect square
		vi. Determine if a number is a perfect square.	The perfect squares are 1, 4, 9, 16, 25, …	square root
				fraction
				decimal
		vii. Pose and solve problems involving squares of numbers.	Emphasise that decimals and fractions are not perfect squares.	denominator
				numerator
2.2 Understand and use the concept of square roots of positive numbers.	• Explore the concept of square roots using areas of squares.	i. State the square root of a positive number as the number multiplied by itself equals to the given number.	" $\sqrt{}$ " is a symbol for square root. $\sqrt{5}$ read as: "square root of five". $\sqrt{a^2} = a$	
		ii. Determine the square roots of perfect squares without using calculator.	Finding the square root is the inverse of squaring.	

2. LEARNING AREA: SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

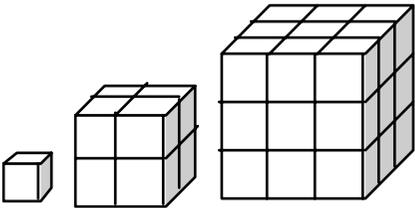| LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
		iii. Determine the square roots of numbers without using calculators.	.30 Limit to: a) fractions that can be reduced such that the numerators and denominators are perfect squares b) decimals that can be written in the form of the square of another decimals.	
	• Investigate multiplications involving square roots of: a) the same number b) different numbers.	iv. Multiply two square roots.	Emphasise that: $\sqrt{a} \times \sqrt{a} = (\sqrt{a})^2$ $= a$ $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$	

2. LEARNING AREA: SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
	• Use estimation to check whether answers are reasonable. e.g. 7 is between 4 and 9 $\sqrt{7}$ is between 2 and 3. • Use calculators to explore the relationship between squares and square roots.	v. Estimate square roots of numbers. vi. Find the square roots of numbers using calculators. vii. Pose and solve problems involving squares and square roots.	Emphasise the reasonableness of answers.	

2. LEARNING AREA: SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
2.3 Understand and use the concept of cube of numbers.	• Recognise cube of a number as the volume of the associated cube. 1^3 2^3 3^3 • Use pencil-and-paper method, speed and mental calculations to evaluate cubes of numbers.	i. State a number multiplied by itself twice as a number to the power of three and vice-versa. ii. Determine cubes of numbers without using calculators.	4^3 read as: "four to the power of three" or "four cubed" or "the cube of four". Include integers, fractions and decimals. Emphasise that a^3 is a notation for $a \times a \times a$. i. $\left(\dfrac{2}{5}\right)^3 = \dfrac{2}{5} \times \dfrac{2}{5} \times \dfrac{2}{5}$ ii. 0.2^3 $= 0.2 \times 0.2 \times 0.2$ Discuss that cubes of negative numbers are negative.	cube power negative number

2. LEARNING AREA: SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
	• Explore estimation of cubes of numbers. e.g. 0.48 is between 0.4 and 0.5 0.48^3 is between 0.064 and 0.125 • Explore cubes of numbers using calculators.	iii. Estimate cubes of numbers. iv. Determine cubes of numbers using calculators. v. Pose and solve problems involving cubes of numbers.	Emphasise the reasonableness of answers.	
2.4 Understand and use the concept of cube roots of numbers.	• Use calculators to explore the relationship between cubes and cube roots.	i. State the cube root of a number as the number multiplied by itself twice equals to the given number. ii. Determine the cube roots of integers without using calculators.	$\sqrt[3]{}$ is the symbol for cube root of a number. $\sqrt[3]{8}$ read as: "cube root of eight". Limit to numbers whose cube roots are integers, for example: ± 1, ± 8, ± 27,...	cube root equal factors integer

2. LEARNING AREA: SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
	• Explore estimation of cube roots of numbers. e.g. 20 is between 8 and 27. $\sqrt[3]{20}$ is between 2 and 3.	iii. Determine the cube roots of numbers without using calculators. iv. Estimate cube roots of numbers.	Limit to: a) Fractions that can be reduced such that the numerators and denominators are cubes of integers. b) Decimals that can be written in the form of cube of another decimal.	
	• Explore the relationship between cubes and cube roots using calculators.	v. Determine cube roots of numbers using calculators. vi. Pose and solve problems involving cubes and cube roots. vii. Perform computations involving addition, subtraction, multiplication, division and mixed operations on squares, square roots, cubes and cube roots.		

3. LEARNING AREA: ALGEBRAIC EXPRESSIONS II

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
3.1 Understand the concept of algebraic terms in two or more unknowns.	• Students identify unknowns in given algebraic terms. e.g. 3*ab* : *a* & *b* are unknowns. −3*d*^{2} : *d* is an unknown. • Use examples of everyday situations to explain algebraic terms in two or more unknowns.	i. Identify unknowns in algebraic terms in two or more unknowns. ii. Identify algebraic terms in two or more unknowns as the product of the unknowns with a number. iii. Identify coefficients in given algebraic terms in two or more unknowns. iv. Identify like and unlike algebraic terms in two or more unknowns. v. State like terms for a given algebraic term.	$a^2 = a \times a$ $y^3 = y \times y \times y$ In general y^n is n times y multiplied by itself. $2pqr$ means $2 \times p \times q \times r$ a^2b means $1 \times a^2 \times b$ $= 1 \times a \times a \times b$ $-rs^3$ means $-1 \times r \times s^3$ $= -1 \times r \times s \times s \times s$ Coefficients in the term 4*pq*: Coefficient of *pq* is 4. Coefficient of *q* is 4*p*. Coefficient of *p* is 4*q*.	algebraic term algebraic expression coefficient unknown like terms unlike terms

3. LEARNING AREA: ALGEBRAIC EXPRESSIONS II

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
3.2 Perform computations involving multiplication and division of two or more terms.	• Explore multiplication and division of algebraic terms using concrete materials or pictorial representations. e.g. Find the area of a wall covered by 10 pieces of tiles each measuring x cm by y cm. • e.g. a) $4rs \times 3r = 12r^2 s$ b) $2p^2 \div 6pq = \dfrac{2 \times p \times p}{6 \times p \times q} = \dfrac{p}{3q}$ • Perform multiplication and division such as: $6pq^2 \times 3p \div 2qr$	i. Find the product of two algebraic terms. ii. Find the quotient of two algebraic terms. iii. Perform multiplication and division involving algebraic terms.		product unknown quotient

3. LEARNING AREA: ALGEBRAIC EXPRESSIONS II

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
3.3 Understand the concept of algebraic expressions.	• Use situations to demonstrate the concept of algebraic expression. • e.g. a) Add 7 to a number: $n + 7$. b) A number multiplied by 2 and then 5 added: $(n \times 2) + 5$ or $2n + 5$. • Investigate the difference between expressions such as $2n$ and $n + 2$; $3(c + 5)$ and $3c + 5$; n^2 and $2n$; $2n^2$ and $(2n)^2$.	i. Write algebraic expressions for given situations using letter symbols. ii. Recognise algebraic expressions in two or more unknowns. iii. Determine the number of terms in given algebraic expressions in two or more unknowns. iv. Simplify algebraic expressions by collecting like terms. v. Evaluate expressions by substituting numbers for letters.	$2xy$ is an expression with 1 term. $5 + 3ab$ is an expression with 2 terms.	algebraic expression letter symbols simplify substitute evaluate like terms

3. LEARNING AREA: ALGEBRAIC EXPRESSIONS II

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
3.4 Perform computations involving algebraic expressions.	• Use situations to explain computations involving algebraic expressions. a) $8(3x - 2)$ b) $(4x - 6) \div 2$ or $\dfrac{4x - 6}{2}$ • Investigate why $8(3x - 2)$ $= 24x - 16$. • Add and subtract algebraic expressions by removing bracket and collecting like terms. • Simplify algebraic expressions such as: a) $3x - (7x - 5x)$ b) $5(x + 2y) - 3(2x - 2y)$ c) $\dfrac{1}{2}(a + 7b - c) + \dfrac{1}{3}(4 - b - 2c)$ d) $8(3x - 2) + \dfrac{4x - 6}{2}$	i. Multiply and divide algebraic expressions by a number. ii. Perform: a) addition b) subtraction involving two algebraic expressions. iii. Simplify algebraic expressions.		multiply divide add subtract simplify like terms

4. LEARNING AREA: LINEAR EQUATIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
4.1 Understand and use the concept of equality.	• Use concrete examples to illustrate '=' and '≠'. • Discuss cases such as: a) If $a = b$ then $b = a$. e.g. 2+3 = 4+1 then 4+1 = 2+3 b) If $a = b$ and $b = c$, then $a = c$. e.g. 4+5 = 2+7, then 2+7=3+6, then 4+5 = 3+6	i. State the relationship between two quantities by using the symbols '=' or '≠'.	'=' read as: "is equal to". '≠' read as: "is not equal to". Relate to the balance method for equations.	equality equals to linear algebraic terms algebraic expression

4.2 Understand and use the concept of linear equations in one unknown.	• Discuss why given algebraic terms and expressions are linear.
	
	• Given a list of terms, students identify linear terms.
	e.g. $3x$, xy, x^2
	   $3x$ is a linear term.
	
	• Select linear expressions given a list of algebraic expressions.
	e.g. $2x + 3$, $x - 2y$, $xy + 2$, $x^2 - 1$
	   $2x + 3$, $x - 2y$ are linear expressions.
		i. Recognise linear algebraic terms.
		
		ii. Recognise linear algebraic expressions.		

4.   LEARNING AREA: LINEAR EQUATIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

	• Select linear equations given a list of equations.
	
	  e.g.
	
	 $x + 3 = 5$, $x - 2y = 7$, $xy = 10$
	
	 $x + 3 = 5$, $x - 2y = 7$ are linear equations.
	
	 $x + 3 = 5$ is linear equation in one unknown.
	
	• Include examples from everyday situations.
		iii. Determine if a given equation is:
		   a) a linear equation
		   b) a linear equation in one unknown.
		
		iv. Write linear equations in one unknown for given statements and vice versa.		

4. LEARNING AREA: LINEAR EQUATIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
4.3 Understand the concept of solutions of linear equations in one unknown.	• Use concrete examples to explain solutions of linear equation in one unknown. e.g. Relate $x + 2 = 5$ to $\square + 2 = 5$. • Solve and verify linear equations in one unknown by inspection and systematic trial, using whole numbers, with and without the use of calculators.	i. Determine if a numerical value is a solution of a given linear equation in one unknown. ii. Determine the solution of a linear equation in one unknown by trial and improvement method. iii. Solve equations in the form of: a) $x + a = b$ b) $x - a = b$ c) $ax = b$ d) $\dfrac{x}{a} = b$ where a, b, c are integers and x is an unknown.	The solutions of equations are also known as the roots of the equations. Trial and improvement method should be done systematically. Emphasise the appropriate use of equals sign.	solution root of equation numerical value

4. LEARNING AREA: LINEAR EQUATIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
	• Involve examples from everyday situations.	iv. Solve equations in the form of $ax + b = c$, where a, b, c are integers and x is an unknown. v. Solve linear equations in one unknown. vi. Pose and solve problems involving linear equations in one unknown.		

5. LEARNING AREA: RATIOS, RATES AND PROPORTIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

5.1 Understand the concept of ratio of two quantities.	• Use everyday examples to introduce the concept of ratio.
	
	• Use concrete examples to explore:
	  a) equivalent ratios
	  b) related ratios.
		i. Compare two quantities in the form $a:b$ or $\dfrac{a}{b}$.
		
		ii. Determine whether given ratios are equivalent ratios.
		
		iii. Simplify ratios to the lowest terms.
		
		iv. State ratios related to a given ratio.
			Include quantities of different units.
			The ratio $3:5$ means 3 parts to 5 parts and read as: "three to five".
			
			Include:
			Given $x:y$, find:
			a) $y:x$
			b) $x:x-y$
			c) $x:x+y$
				ratio
				quantity
				equivalent
				sum
				difference
				lowest terms
				compare
				part

5. LEARNING AREA: RATIOS, RATES AND PROPORTIONS

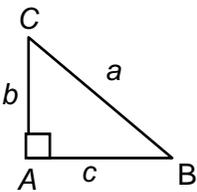| LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
5.2 Understand the concept of proportion to solve problems.	• Use everyday examples to introduce the concept of proportion. • Verify the method of cross multiplication and use it to find the missing terms of a proportion.	i. State whether two pairs of quantities is a proportion. ii. Determine if a quantity is proportional to another quantity given two values of each quantity. iii. Find the value of a quantity given the ratio of the two quantities and the value of another quantity. iv. Find the value of a quantity given the ratio and the sum of the two quantities. v. Find the sum of two quantities given the ratio of the quantities and the difference between the quantities. vi. Pose and solve problems involving ratios and proportions.	$\dfrac{a}{b} = \dfrac{c}{d}$ read as: "*a* to *b* as *c* to *d*". Begin with unitary method. Emphasise that If $\dfrac{a}{b} = \dfrac{c}{d}$ then $ad = bc$ $(b \neq 0, d \neq 0)$	proportion ratio sum difference proportional cross-multiplication

5. LEARNING AREA: RATIOS, RATES AND PROPORTIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
5.3 Understand and use the concept of ratio of three quantities to solve problems.	• Use everyday examples to introduce the concept of ratio of three quantities. • Use concrete examples to explore equivalent ratios.	i. Compare three quantities in the form $a : b : c$. ii. Determine whether given ratios are equivalent ratios. iii. Simplify ratio of three quantities to the lowest terms. iv. State the ratio of any two quantities given ratio of three quantities. v. Find the ratio of $a : b : c$ given the ratio of $a : b$ and $b : c$. vi. Find the value of the other quantities, given the ratio of three quantities and the value of one of the quantities.	Include quantities of different units. $a : b = p : q$ $b : c = m : n$ when a) $q = m$ b) $q \neq m$ Begin with unitary method.	simplify equivalent lowest terms value sum difference

5. LEARNING AREA: RATIOS, RATES AND PROPORTIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
		vii. Find the value of each of the three quantities given:		
		a) the ratio and the sum of three quantities		
		b) the ratio and the difference between two of the three quantities.		
		viii. Find the sum of three quantities given the ratio and the difference between two of the three quantities.		
		ix. Pose and solve problems involving ratio of three quantities.		

6. LEARNING AREA: PYTHAGORAS' THEOREM

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
6.1 Understand the relationship between the sides of a right-angled triangle.	• Students identify the hypotenuse of right-angled triangles drawn in different orientations. • Use dynamic geometry software, grid papers or geo-boards to explore and investigate the Pythagoras' theorem.	i. Identify the hypotenuse of right-angled triangles. ii. Determine the relationship between the lengths of the sides of a right-angled triangle. iii. Find the length of the missing side of a right-angled triangle using the Pythagoras' theorem. iv. Find the length of sides of geometric shapes using Pythagoras' theorem. v. Solve problems using the Pythagoras' theorem.	 Emphasise that $a^2 = b^2 + c^2$ is the Pythagoras' theorem. Begin with the Pythagorean Triples. e.g. (3, 4, 5) (5, 12, 13) Include combined geometric shapes.	Pythagoras' theorem hypotenuse right-angled triangle side missing side Pythagorean Triples combined geometric shape

6.   LEARNING AREA: PYTHAGORAS' THEOREM

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
6.2. Understand and use the converse of the Pythagoras' theorem.	• Explore and investigate the converse of the Pythagoras' theorem through activities.	i. Determine whether a triangle is a right-angled triangle. ii. Solve problems involving the converse Pythagoras' theorem.	Note that: If $a^2 > b^2 + c^2$, then A is an obtuse angle. If $a^2 < b^2 + c^2$, then A is an acute angle.	obtuse angle acute angle converse

7. LEARNING AREA: GEOMETRICAL CONSTRUCTIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

7.1 Perform constructions using straight edge (ruler and set square) and compass.	• Relate constructions to properties of rhombus and isosceles triangle.	i. Construct a line segment of given length.
		
		ii. Construct a triangle given the length of the sides.
		
		iii. Construct:
		   a) perpendicular bisector of a given line segment
		   b) perpendicular to a line passing through a point on the line
		   c) perpendicular to a line passing through a point not on the line.
			Emphasise on accuracy of drawing.
			
			Include equilateral, isosceles and scalene triangles.
			
			Emphasise the constructions in Learning Outcome (iii) are used to construct an angle of 90°.
				construct
				ruler
				straight edge
				set square
				protractor
				point
				line segments
				compass
				side
				perpendicular
				perpendicular bisector
				triangle
				right-angled triangle
				equilateral triangle
				isosceles triangle
				scalene triangle

7. LEARNING AREA: GEOMETRICAL CONSTRUCTIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
	• Relate the construction to the properties of equilateral triangle.	iv. Construct: a) angle of 60° and 120° b) bisector of an angle.	Emphasise the use of the bisector of an angle to construct angles of 30°, 45° and 15° and etc. Measure angles using protractors.	protractor angle equilateral bisector compass set square parallel lines parallelogram
	• Explore situation when two different triangles can be constructed.	v. Construct triangles given: a) one side and two angles b) two sides and one angle.		
		vi. Construct: a) parallel lines b) parallelogram given its sides and an angle.		

8.   LEARNING AREA: COORDINATES

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
8.1 Understand and use the concept of coordinates.	• Introduce the concept of coordinates using everyday examples. e.g. State the location of: a) a seat in the classroom b) a point on square grids. • Introduce Cartesian coordinates as a systematic w ay of marking the location of a point.	i. Identify the *x*-axis, *y*-axis and the origin on a Cartesian plane. ii. Plot points and state the coordinates of the points given distances from the *y*-axis and *x*-axis. iii. Plot points and state the distances of the points from the *y*-axis and *x*-axis given coordinates of the points. iv. State the coordinates of points on Cartesian plane.	Coordinates of origin is (0, 0). For Learning Outcomes ii – iii, involve the first quadrant only. Involve all the four quadrants.	Cartesian plane origin *x*-axis *y*-axis coordinate distance position square grid plot points quadrant horizontal vertical *x*-coordinate *y*-coordinate

8. LEARNING AREA: COORDINATES

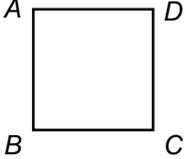| LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
8.2 Understand and use the concept of scales for the coordinate axes.	• Use dynamic geometry software to explore and investigate the concept scales. • Explore the effects of shapes of objects by using different scales. • Explore positions of places on topography maps. • Pose and solve problems involving coordinates of vertices of shapes such as: Name the shape formed by *A*(1, 5), *B*(2, 5), *C*(4, 3) and *D*(3, 3). Three of the four vertices of a square are (−1, 1), (2, 5) and (6, 2). State the coordinates of the fourth vertex.	i. Mark the values on both axes by extending the sequence of given values on the axes. ii. State the scales used in given coordinate axes where: a) scales for axes are the same b) scales for axes are different. iii. Mark the values on both axes, with reference to the scales given. iv. State the coordinates of a given point with reference to the scales given. v. Plot points, given the coordinates, with reference to the scales given. vi. Pose and solve problems involving coordinates.	Emphasise that the scales used on the axes must be uniform. Scales should be written in the form: a) 2 unit represents 3 units. b) 1 : 5.	scale mark extend sequence axes coordinate plot uniform vertex

8. LEARNING AREA: COORDINATES

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
8.3 Understand and use the concept of distance between two points on a Cartesian plane.	• Discuss different methods of finding distance between two points such as: a) inspection b) moving one point to the other c) computing the difference between the *x*-coordinates or *y*-coordinates. • Students draw the appropriate right-angled triangle using the distance between the two points as the hypotenuse.	i. Find the distance between two points with: a) common *y*-coordinates b) common *x*-coordinates. ii. Find the distance between two points using Pythagoras' theorem. iii. Pose and solve problems involving distance between two points.	Emphasise that the line joining the points are parallel to the *x*-axis or parallel to the *y*-axis. Include positive and negative coordinates. The formula for distance between two points (x_1 , y_1) and (x_2 , y_2) is $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ need not be introduced.	distance point common positive negative parallel *y*-coordinate *x*-coordinate Pythagoras' theorem.

8. LEARNING AREA: COORDINATES

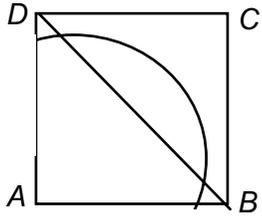| LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
8.4 Understand and use the concept of midpoints.	• Introduce the concept of midpoints through activities such as folding, constructing, drawing and counting. • Use dynamic geometry software to explore and investigate the concept of midpoints.	i. Identify the midpoint of a straight line joining two points. ii. Find the coordinates of the midpoint of a straight line joining two points with: a) common y-coordinates b) common x-coordinates. iii. Find the coordinates of the midpoint of the line joining two points. iv. Pose and solve problems involving midpoints.	The formula of midpoint for (x_1 , y_1) and (x_2 , y_2) is $(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2})$ need not be introduced. Involve shapes.	midpoint x-coordinate y-coordinate straight line

9. LEARNING AREA: LOCI IN TWO DIMENSIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
9.1 Understand the concept of two-dimensional loci.	• Use everyday examples such as familiar routes and simple paths to introduce the concept of loci. • Discuss the locus of a point in a given diagram. e.g. Describe a locus of a point equidistant from *A* and *C*. A ▢ D B C	i. Describe and sketch the locus of a moving object. ii. Determine the locus of points that are of: a) constant distance from a fixed point b) equidistant from two fixed points c) constant distance from a straight line d) equidistant from two intersecting lines.	Emphasise the accuracy of drawings. Relate to properties of isosceles triangle. Emphasise locus as: a) path of a moving point b) a point or set of points that satisfies given conditions.	accuracy route locus loci moving object equidistant points fixed point straight line perpendicular distance constant intersecting lines parallel lines condition set of points

9. LEARNING AREA: LOCI IN TWO DIMENSIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
		iii. Construct the locus of a set of all points that satisfies the condition:		
		a) the point is at a constant distance from a fixed point		
		b) the point is at equidistant from two fixed points		
		c) the point is at a constant distance from a straight line		
		d) the point is at equidistant from two intersecting lines.		

9. LEARNING AREA: LOCI IN TWO DIMENSIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
9.2 Understand the concept of the intersection of two loci.	• Use everyday examples or games to discuss the intersection of two loci. • Mark the points that satisfy the conditions: a) Equidistant from *A* and *C*. b) 3 cm from A. 	i. Determine the intersections of two loci by drawing the loci and locating the points that satisfy the conditions of the two loci.	Limited to loci discussed in Learning Objective 9.1.	locate satisfy intersection

10.   LEARNING AREA :   CIRCLES

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

10.1 Recognise and draw parts of a circle.	• Introduce the concept of circle as a locus.
	
	• Use dynamic geometry software to explore parts of a circle.
		i. Identify circle as a set of points equidistant from a fixed point.
		
		ii. Identify parts of a circle:
		   a) center
		   b) circumference
		   c) radius
		   d) diameter
		   e) chord
		   f) arc
		   g) sector
		   h) segment
		
		iii. Draw :
		   a) a circle given the radius and centre
		   b) a circle given the diameter
		   c) a diameter passing through a specific point in a circle given the centre.
				circle
				centre
				circumference
				radius
				diameter
				chord
				sector
				arc
				segment
				equidistant
				point
				fixed point

10.   LEARNING AREA :   CIRCLES

| LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
		d) a chord of a given length passing through a point on the circumference		diameter circumference sector radius centre
		e) sector given the size of the angle at the centre and radius of the circle.		
		iv. Determine the:		
		a) center		
		b) radius		
		of a given circle by construction.		

10.   LEARNING AREA : CIRCLES

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

10.2 Understand and use the concept of circumference to solve problems.	• Measure diameter and circumference of circular objects.
	
	• Explore the history of π.
	
	• Explore the value of π using dynamic geometry software.
		i. Estimate the value of π.
		
		ii. Derive the formula of the circumference of a circle.
		
		iii. Find the circumference of a circle, given its:
		
		  a) diameter
		
		  b) radius.
		
		iv. Find the:
		
		  a) diameter
		
		  b) radius
		
		  given the circumference of a circle.
		
		v. Solve problems involving circumference of circles.
			Developed through activities.
			
			The ratio of the circumference to the diameter is know n as π and read as "pi".
			
			Emphasise
			
			$\pi \approx 3.142$ or $\dfrac{22}{7}$.
				radius
				
				formula
				
				ratio
				
				constant
				
				pi
				
				approximate
				
				estimate
				
				derive
				
				circular object

10.   LEARNING AREA :   CIRCLES

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
10.3 Understand and use the concept of arc of a circle to solve problems.	• Explore the relationship between the length of arc and angle at the centre of a circle using dynamic geometry software.	i. Derive the formula of the length of an arc. ii. Find the length of arc given the angle at the centre and the radius. iii. Find the angle at the centre given the length of the arc and the radius of a circle. iv. Find the length of radius of a circle given the length of the arc and the angle at the centre. v. Solve problems involving arcs of a circle.	The length of arc is proportional to the angle at the centre of a circle. Include combined shapes.	arc angle at the centre proportional radius circumference

10. LEARNING AREA : CIRCLES

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

10.4 Understand and use the concept of area of a circle to solve problems.	• Explore the relationship between the radius and the area of a circle:
	
	a) using dynamic geometry software
	
	b) through activities such as cutting the circle into equal sectors and rearranging them into rectangular form.
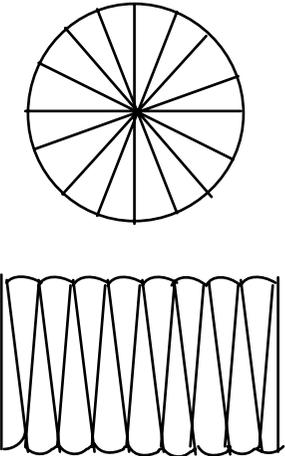	
		i. Derive the formula of the area of a circle.
		
		ii. Find the area of a circle given the:
		  a) radius
		  b) diameter.
		
		iii. Find:
		  a) radius
		  b) diameter
		  given the area of a circle.
		
		iv. Find the area of a circle given the circumference and vice versa.
		
		v. Solve problems involving area of circles.
			Include finding the area of the annulus.	area
				
				annulus
				
				radius

10.   LEARNING AREA :   CIRCLES

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
10.5 Understand and use the concept of area of sector of a circle to solve problems.	• Explore the relationship between the area of a sector and the angle at the centre of the circle using dynamic geometry software.	i. Derive the formula of the area of a sector. ii. Find the area of a sector given the radius and angle at the centre. iii. Find the angle at the centre given the radius and area of a sector. iv. Find the radius given the area of a sector and the angle at the centre. v. Solve problems involving area of sectors and area of circles.	Include combined shapes	area sector angle at the centre radius circle arc

11. LEARNING AREA : TRANSFORMATIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
11.1 Understand the concept of transformations.	• Explore concepts in transformational geometry using concrete materials, drawings, geo-boards and dynamic geometry software.	i. Identify a transformation as a one-to-one correspondence between points in a plane. ii. Identify the object and its image in a given transformation.	A one-to-one correspondence between points of a plane is also called a mapping. Include transformations in arts and nature. The object is mapped onto the image.	transformation plane object image map one-to-one correspondence translation

11.2 Understand and use the concept of translations.	• Explore translations given in the form $\begin{pmatrix} a \\ b \end{pmatrix}$.	i. Identify a translation.
		
		ii. Determine the image of an object under a given translation.
		
		iii. Describe a translation:
		
		  a) by stating the direction and distance of the movement
		
		  b) in the form $\begin{pmatrix} a \\ b \end{pmatrix}$.
			Grid papers may be used.
			
			$\begin{pmatrix} a \\ b \end{pmatrix}$
			
			a is the movement parallel to the x-axis and b is the movement parallel to the y-axis.
				orientation
				
				parallel
				
				direction
				
				distance
				
				movement

11. LEARNING AREA : TRANSFORMATIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

	• Investigate the shapes and sizes, lengths and angles of the images and the objects.	iv. Determine the properties of translation.
		
		v. Determine the coordinates of:
		  a) the image, given the coordinates of the object
		
		  b) the object, given the coordinates of the image
		
		under a translation.
		
		vi. Solve problems involving translations.
			Emphasise that under a translation, the shapes, sizes, and orientations of the object and its image are the same.	properties
				
				image
				
				shape
				
				size
				
				length
				
				angle
				
				coordinate
				
				reflection
				
				axis of reflection
				
				tracing paper

11.3 Understand and use the concept of reflections.	• Explore the image of an object under a reflection by drawing, using tracing paper, or paper folding.	i. Identify a reflection. ii. Determine the image of an object under a reflection on a given line.	The line is known as line of reflection or axis of reflection.	laterally inverted line

11.   LEARNING AREA : TRANSFORMATIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

	• Investigate the shapes and sizes, lengths and angles of the images and objects.	iii. Determine the properties of reflections.
		
		iv. Determine:
		
		   a) the image of an object, given the axis of reflection
		
		   b) the axis of reflection, given the object and its image.
		
		using the method of construction
		
		v. Determine the coordinates of:
		   a) the image, given the coordinates of the object
		
		   b) the object, given the coordinates of the image
		
		   under a reflection.
		
		vi. Describe a reflection given the object and image.
		
		vii. Solve problems involving reflections.
			Emphasise that, under a reflection
			
			a) the shapes and sizes of the object and its image are the same; and
			
			b) the orientation of he image is laterally inverted as compared to that of the object.
			
			Emphasise that all points on the axis of reflection do not change their positions.
			
			Include x-axis and y-axis as axes of reflection.	

11. LEARNING AREA : TRANSFORMATIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

11.4 Understand and use the concept of rotations.	• Explore the image of an object under a rotation by drawing and using tracing paper.	i. Identify a rotation.
		
		ii. Determine the image of an object under a rotation given the centre, the angle and direction of rotation.
		
		iii. Determine the properties of rotations.
		
		iv. Determine:
		  a) image of an object, given the centre, angle and direction of rotation
		  b) the centre, angle and direction of rotation, given the object and the image.
		using the method of construction
		
		v. Determine the coordinates of
		  a) the image, given the coordinates of the object;
		  b) the object, given the coordinates of the image
		under a rotation.
			Emphasise that under rotation; the shapes, sizes and orientations of an object and the image are the same.
			
			Emphasise that the centre of rotation is the only point that does not change its position.
			
			Include 90° and 180° as angles of rotation.
				rotation
				
				centre of rotation
				
				direction of rotation
				
				angle of rotation
				
				clockwise
				
				anticlockwise
				
				properties
				
				shape
				
				size
				
				object
				
				image
				
				coordinate

11. LEARNING AREA : TRANSFORMATIONS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
		vi. Describe a rotation given the object and image. vii. Solve problems involving rotations.		isometry congruence congruent congruency
11.5 Understand and use the concept of isometry.	• Use tracing papers to explore isometry.	i. Identify an isometry. ii. Determine whether a given transformation is an isometry. iii. Construct patterns using isometry.	Isometry is a transformation that preserves the shape and the size of the object.	shape size pattern figure
11.6 Understand and use the concept of congruence.	• Explore congruency under translations, reflections and rotations.	i. Identify if two figures are congruent. ii. Identify congruency between two figures as a property of an isometry. iii. Solve problems involving congruence.	Emphasise that congruent figures have the same size and shape regardless of their orientation	property orientation quadrilateral square rectangle rhombus parallelogram
11.7 Understand and use the properties of quadrilaterals using concept of transformations.	• Explore the properties of various quadrilaterals by comparing the sides, angles and diagonals.	i. Determine the properties of quadrilaterals using reflections and rotations.	Quadrilaterals include squares, rectangles, parallelograms, rhombus, and kites.	kite diagonal preserve

12.   LEARNING AREA : SOLID GEOMETRY II

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
12.1 Understand geometric properties of prisms, pyramids, cylinders, cones and spheres.	• Explore and investigate properties of geometric solids using concrete models.	i. State the geometric properties of prisms, pyramids, cylinders, cones and spheres.		prism pyramid cylinder cone sphere net
12.2 Understand the concept of nets.	• Explore the similarities and differences between nets of prisms, pyramids, cylinders and cones using concrete models.	i. Draw nets for prisms, pyramids, cylinders and cones. ii. State the types of solids given their nets. iii. Construct models of solids given their nets.	Net is also known as layout. Prisms include cubes and cuboids.	solid cube cuboid

12. LEARNING AREA : SOLID GEOMETRY II

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

12.3 Understand the concept of surface area.	• Explore and derive the formulae of the surface areas of prisms, pyramids, cylinders and cones.	i. State the surface areas of prisms, pyramids, cylinders and cones.
		
		ii. Find the surface area of prisms, pyramids, cylinders and cones.
		
		iii. Find the surface area of spheres using the standard formula.
		
		iv. Find dimensions:
		  a) length of sides
		  b) height
		  c) slant height
		  d) radius
		  e) diameter
		of a solid given its surface area and other relevant information.
		
		v. Solve problems involving surface areas.
			Standard formula for surface area of sphere is $4\pi r^2$ where r is the radius.	surface area
				
				dimension
				
				standard formula
				
				similarities
				
				differences
				
				base
				
				lateral side
				
				vertex
				
				edge
				
				height
				
				radius
				
				diameter
				
				slant height
				
				curve surface
				
				derive

13.   LEARNING AREA: STATISTICS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		

13.1 Understand the concept of data.	• Carry out activities to introduce the concept of data as a collection of information or facts.
	
	• Discuss methods of collecting data such as counting, observations, measuring, using questionnaires and interviews.
		i. Classify data according to those that can be collected by:
		  a) counting
		
		  b) measuring.
		
		ii. Collect and record data systematically.
				data
				
				count
				
				measure
				
				collection of data
				
				questionnaire
				
				interviews
				
				systematic
				
				record
				
				tally chart
				
				frequency

13.2 Understand the concept of frequency.	• Use activities to introduce the concept of frequency.	i. Determine the frequency of data.
		
		ii. Determine the data with:
		  a) the highest frequency
		  b) the lowest frequency
		  c) frequency of a specific value.
			Use tally charts to record data.	horizontal
				
				vertical
				
				highest
				
				lowest
				
				frequency table
				
				information

13. LEARNING AREA: STATISTICS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
		iii. Organise data by constructing: a) tally charts b) frequency tables. iv. Obtain information from frequency tables.	Use two columns or two rows to present data.	data organise pictogram tally chart column row obtain
13.3 Represent and interpret data in: i. pictograms ii. bar charts iii. line graphs to solve problems.	• Use everyday situations to introduce pictograms, bar charts and line graphs.	i. Construct pictograms to represent data. ii. Obtain information from pictograms. iii. Solve problems involving pictograms.	Include horizontal and vertical pictograms using symbols to represent frequencies. Include the use of title and keys (legend) on pictograms, bar graphs and line graphs.	key legend bar graph line graph horizontal vertical

13. LEARNING AREA: STATISTICS

LEARNING OBJECTIVES	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES	POINTS TO NOTE	VOCABULARY
Students will be taught to:		*Students will be able to:*		
		iv. Construct bar charts to represent data.	Include bar charts representing two sets of data.	
		v. Obtain information from bar charts.	Use vertical and horizontal bars. Include vertical and horizontal bar charts using scales such as:	
		vi. Solve problems involving bar charts.	a) 1 : 1 b) n, where n is a whole number.	
		vii. Represent data using line graphs.	Emphasise on the use of suitable scales for line graphs.	
		viii. Obtain information from line graphs.	Discuss on the choice of using various methods to represent data effectively.	
		ix. Solve problems involving line graphs.		

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