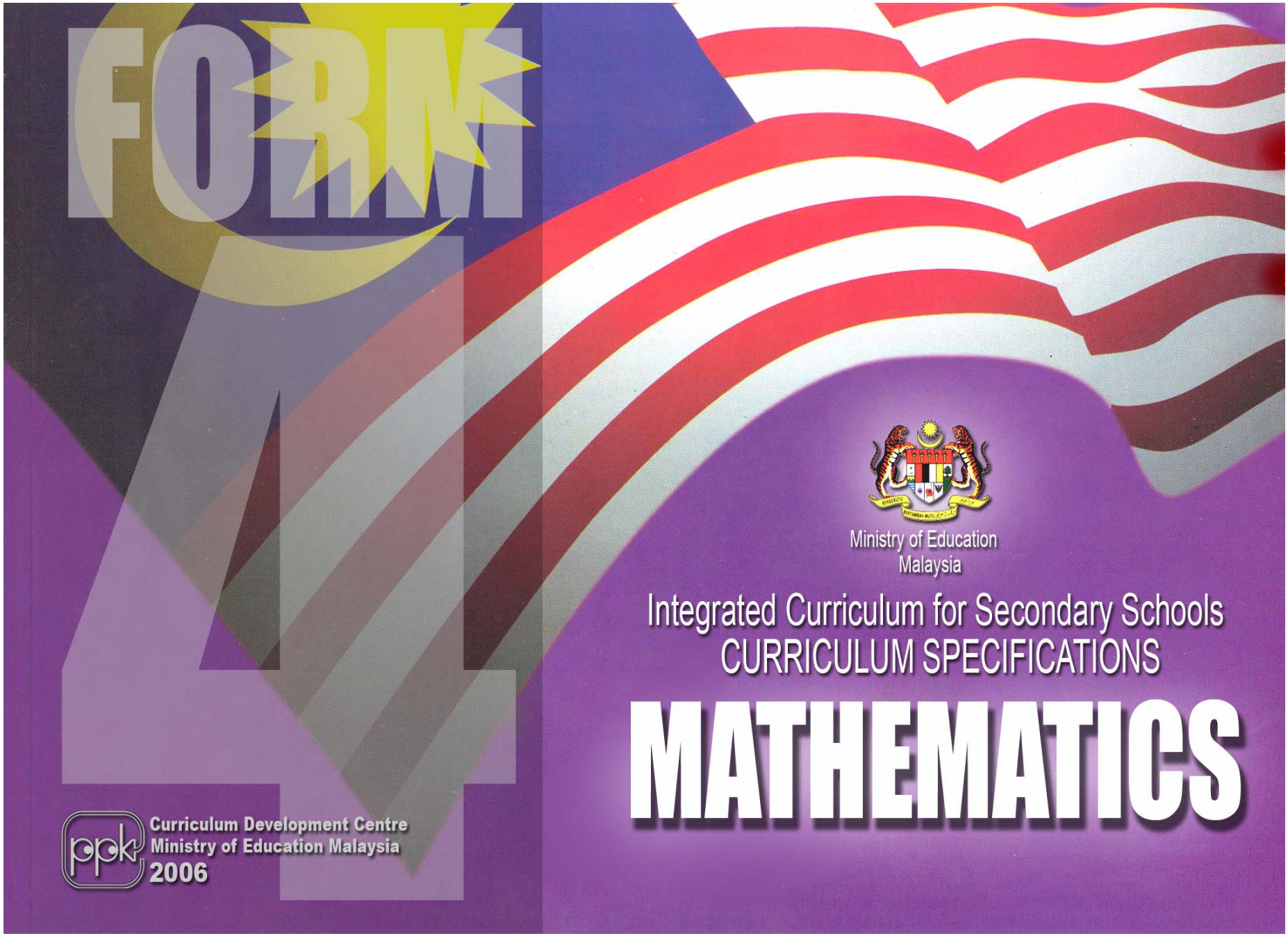
FORM
4
Ministry of Education
Malaysia
Integrated Curriculum for Secondary Schools
CURRICULUM SPECIFICATIONS
MATHEMATICS
Curriculum Development Centre
Ministry of Education Malaysia
2006

Integrated Curriculum for Secondary Schools

Curriculum Specifications

MATHEMATICS
FORM 4

Curriculum Development Centre

Ministry of Education Malaysia

2006

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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 ongoing effort towards further 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 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 betterment of the family, the society and the nation at large.

PREFACE

Science and technology plays a critical role in realising Malaysia's aspiration to become a developed nation. Since mathematics is instrumental in the development of scientific and technological knowledge, the provision of quality mathematics education from an early age in the education process is thus important. The Malaysian school curriculum offers three mathematics education programs, namely Mathematics for primary schools, Mathematics and Additional Mathematics for secondary schools.

The Malaysian school mathematics curriculum aims to develop mathematical knowledge, competency and inculcate positive attitudes towards mathematics among pupils. Mathematics for secondary schools provides opportunities for pupils to acquire mathematical knowledge and skills, and develop higher order problem solving and decision making skills to enable pupils to cope with daily life challenges. As with other subjects in the secondary school curriculum, Mathematics aims to inculcate noble values and love for the nation in the development of a holistic person, who in turn will be able to contribute to the harmony and prosperity of the nation and its people.

Beginning 2003, English is used as the medium of instruction for Science and Mathematics subjects. The policy to change the medium of instruction for Science and Mathematics subjects follows a phased implementation schedule and is expected to be completed by 2008.

In the teaching and learning of Mathematics, the use of technology especially ICT is greatly emphasised. Mathematics taught in English, coupled with the use of ICT, provide greater opportunities for pupils to improve their knowledge and skills in mathematics because of the richness of resources and repositories of knowledge in English. Pupils will be better able to interact with pupils from other countries, improve their proficiency in English and thus make the learning of mathematics more interesting and exciting.

The development of this Mathematics syllabus is the work of many individuals and experts in the field. On behalf of the Curriculum Development Centre, I would like to express much gratitude and appreciation to those who have contributed in one way or another towards this initiative.

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INTRODUCTION

A well-informed and knowledgeable society well versed in the use of mathematics to cope with daily life challenges is integral to realising the nation's aspiration to become an industrialised nation. Thus, efforts are taken to ensure a society that assimilates mathematics into their daily lives. Pupils are nurtured from an early age with the skills to solve problems and communicate mathematically, to enable them to make effective decisions.

Mathematics is essential in preparing a workforce capable of meeting the demands of a progressive nation. As such, this field assumes its role as the driving force behind various developments in science and technology. In line with the nation's objective to create a knowledge-based economy, the skills of Research & Development in mathematics is nurtured and developed at school level.

As a field of study, Mathematics trains the mind to think logically and systematically in solving problems and making decisions. This discipline encourages meaningful learning and challenges the mind, and hence contributes to the holistic development of the individual. To this end, strategies to solve problems are widely used in the teaching and learning of mathematics. The development of mathematical reasoning is believed to be closely linked to the intellectual development and communication ability of pupils. Hence, mathematics reasoning skills are also incorporated in the mathematics activities to enable pupils to recognize, build and evaluate mathematics conjectures and statements.

In keeping with the National Education Philosophy, the Mathematics curriculum provides opportunities to pupils from various backgrounds and levels of abilities to acquire mathematical skills and knowledge. Pupils are then able to seek relevant information, and be creative in formulating alternatives and solutions when faced with challenges.

The general Mathematics curriculum has often been seen to comprise of discrete areas related to counting, measurement, geometry, algebra and solving problems. To avoid the areas to be continually seen as separate and pupils acquiring concepts and skills in isolation, mathematics is linked to everyday life and experiences in and out of school. Pupils will have the opportunity to apply mathematics in different contexts, and see the relevance of mathematics in daily life.

In giving opinions and solving problems either orally or in writing, pupils are guided in the correct usage of language and mathematics registers. Pupils are trained to select information presented in mathematical and non-mathematical language; interpret and represent information in tables, graphs, diagrams, equations or inequalities; and subsequently present information clearly and precisely, without any deviation from the original meaning.

Technology in education supports the mastery and achievement of the desired learning outcomes. Technology used in the teaching and learning of Mathematics, for example calculators, are to be regarded as tools to enhance the teaching and learning process and not to replace teachers.

Importance is also placed on the appreciation of the inherent beauty of mathematics. Acquainting pupils with the life-history of well-known mathematicians or events, the information of which is easily available from the Internet for example, will go a long way in motivating pupils to appreciate mathematics.

The intrinsic values of mathematics namely thinking systematically, accurately, thoroughly, diligently and with confidence, infused throughout the teaching and learning process; contribute to the moulding of character and the inculcation of positive attitudes towards mathematics. Together with these, moral values are also introduced in context throughout the teaching and learning of mathematics.

Assessment, in the form of tests and examinations helps to gauge pupils' achievements. The use of good assessment data from a variety of sources also provides valuable information on the development and progress of pupils. On-going assessment built into the daily lessons allows the identification of pupils' strengths and weaknesses, and effectiveness of the instructional activities. Information gained from responses to questions, group work results, and homework helps in improving the teaching process, and hence enables the provision of effectively aimed lessons.

AIM

The mathematics curriculum for secondary schools aims to develop individuals who are able to think mathematically, and apply mathematical knowledge effectively and responsibly in solving problems and making decisions; and face the challenges in everyday life brought about by the advancement of science and technology.

OBJECTIVES

The mathematics curriculum for the secondary school enables pupils to:

1 understand definitions, concepts, laws, principles, and theorems related to Number, Shape and Space, and Relationship;

2 widen the use of basic operations of addition, subtraction, multiplication and division related to Number, Shape and Space, and Relationship;

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 problems; and
- making decisions.

4 communicate mathematically;

5 apply knowledge and 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 acquire mathematical knowledge and develop skills effectively and use them responsibly;

9 inculcate a positive attitude towards mathematics; and

10 appreciate the importance and beauty of mathematics.

CONTENT ORGANISATION

The Mathematics Curriculum content at the secondary school level is organised into three main areas, namely: Number; Shape and Space; and Relationship. Mathematical concepts related to the respective area, are further organised into topics. These topics are arranged in a hierarchical manner such that the more basic and tangible concepts appear first and the more complex and abstract concepts appear subsequently.

The **Learning Area** outlines the scope of mathematical knowledge, abilities and attitudes to be developed in pupils when learning 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 pupils 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 pupils 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 measurable 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 pupils 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 pupils show progression in acquiring 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 acquisition 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 pupils 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, pupils 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 pupils to reinforce and strengthen their knowledge and understanding of mathematics to a deeper level. Through effective communication, pupils will become efficient in problem solving and be able to explain their conceptual understanding and mathematical skills to their peers and teachers.

Pupils who have developed the skills to communicate mathematically will become more inquisitive and, in the process, gain confidence. Communication 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 skills 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 pupils;
- Identifying pupils' interests;

- Identifying suitable teaching materials;
- Ensuring active learning;
- Stimulating meta-cognitive skills;
- 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 pupils, pupils and pupils, and pupils and object.

Some of the more effective and meaningful oral communication techniques in the learning of mathematics are as follows:

- Story-telling and 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, pupils 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 journals;
- Keeping scrap books;
- Keeping folios;
- 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 pupils 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 pupils 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 pupils'. Emphasis on logical thinking, during mathematical activities opens up pupils' minds to accept mathematics as a powerful tool in the world today.

Pupils are encouraged to estimate, predict and make intelligent guesses in the process of seeking solutions. Pupils 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 pupils 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 pupils 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, pupils will have to learn and memorise too many concepts and skills separately. By making connections, pupils 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, pupils 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 pupils 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 pupils 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 pupils will be able to access knowledge or skills and informations independently according to their own pace. This will serve to stimulate pupils' interests and develop a sense of responsibility towards their learning and understanding of mathematics.

Technology however does not replace the need for all pupils to learn and master the basic mathematical skills. Pupils 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

The belief on how mathematics is learnt influence how mathematical concepts are to be taught. Whatever belief the teachers subscribe to, the fact remains that mathematical concepts are abstract. The use of teaching resources is therefore crucial in guiding pupils to develop matematical ideas. Teachers should use real or concrete materials to help pupils 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 pupils 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 pupils to 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:

- Pupils-centered learning that is interesting;
- Different learning abilities and styles of pupils;
- 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 pupils. 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 pupils 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 pupils' performances.

1 LEARNING AREA: STANDARD FORM

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand and use the concept of significant figure.	Discuss the significance of zero in a number.	(i) Round off positive numbers to a given number of significant figures when the numbers are: a) greater than 1, b) less than 1.	Rounded numbers are only approximates. Limit to positive numbers only.	significance significant figure relevant round off accuracy
	Discuss the use of significant figures in everyday life and other areas.	(ii) Perform operations of addition, subtraction, multiplication and division, involving a few numbers and state the answer in specific significant figures.	Generally, rounding is done on the final answer.	
		(iii) Solve problems involving significant figures.		
2 Understand and use the concept of standard form to solve problems.	Use everyday life situations such as in health, technology, industry, construction and business involving numbers in standard form. Use scientific calculator to explore numbers in standard form.	(i) State positive numbers in standard form when the numbers are: a) greater than or equal to 10, b) less than 1.	Another term for standard form is scientific notation.	standard form single number scientific notation
		(ii) Convert numbers in standard form to single numbers.		
		(iii) Perform operations of addition, subtraction, multiplication and division, involving any two numbers and state the answers in standard form.	Include two numbers in standard form.	
		(iv) Solve problems involving numbers in standard form.		

2 LEARNING AREA: QUADRATIC EXPRESSIONS AND EQUATIONS

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand the concept of quadratic expression.	Discuss the characteristics of quadratic expressions of the form $ax^2 + bx + c = 0$, where a, b and c are constants, $a \neq 0$ and x is an unknown.	(i) Identify quadratic expressions.	Include the case when $b = 0$ and/or $c = 0$.	quadratic expression constant constant factor
		(ii) Form quadratic expressions by multiplying any two linear expressions.	Emphasise that for the terms x^2 and x, the coefficients are understood to be 1.	unknown highest power expand
		(iii) Form quadratic expressions based on specific situations.	Include everyday life situations.	coefficient term
2 Factorise quadratic expression.	Discuss the various methods to obtain the desired product.	(i) Factorise quadratic expressions of the form $ax^2 + bx + c$, $b = 0$ or $c = 0$.		factorise common factor
		(ii) Factorise quadratic expressions of the form $px^2 - q$, p and q are perfect squares.	1 is also a perfect square.	perfect square
	Begin with the case $a = 1$. Explore the use of graphing calculator to factorise quadratic expressions.	(iii) Factorise quadratic expressions of the form $ax^2 + bx + c$, a, b and c not equal to zero.	Factorisation methods that can be used are: • cross method; • inspection.	cross method inspection common factor complete factorisation
		(iv) Factorise quadratic expressions containing coefficients with common factors.		

2 LEARNING AREA: QUADRATIC EXPRESSIONS AND EQUATIONS

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
3 Understand the concept of quadratic equation.	Discuss the characteristics of quadratic equations.	(i) Identify quadratic equations with one unknown.		quadratic equation general form
		(ii) Write quadratic equations in general form i.e. $ax^2 + bx + c = 0$.		
		(iii) Form quadratic equations based on specific situations.	Include everyday life situations.	
4 Understand and use the concept of roots of quadratic equations to solve problems.		(i) Determine whether a given value is a root of a specific quadratic equation.		substitute root
	Discuss the number of roots of a quadratic equation.	(ii) Determine the solutions for quadratic equations by: a) trial and error method, b) factorisation.	There are quadratic equations that cannot be solved by factorisation.	trial and error method
	Use everyday life situations.	(iii) Solve problems involving quadratic equations.	Check the rationality of the solution.	solution

3 LEARNING AREA: SETS

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand the concept of set.	Use everyday life examples to introduce the concept of set.	(i) Sort given objects into groups.	The word set refers to any collection or group of objects.	set element
		(ii) Define sets by: a) descriptions, b) using set notation.	The notation used for sets is braces, { }. The same elements in a set need not be repeated. Sets are usually denoted by capital letters. The definition of sets has to be clear and precise so that the elements can be identified.	description label set notation denote
		(iii) Identify whether a given object is an element of a set and use the symbol $\in$ or $\notin$.	The symbol $\in$ (epsilon) is read "is an element of" or "is a member of". The symbol $\notin$ is read "is not an element of" or "is not a member of".	
	Discuss the difference between the representation of elements and the number of elements in Venn diagrams.	(iv) Represent sets by using Venn diagrams.		Venn diagram empty set

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
	Discuss why { 0 } and { ∅ } are not empty sets.	(v) List the elements and state the number of elements of a set.	The notation $n(\mathbf{A})$ denotes the number of elements in set **A**.	equal sets
		(vi) Determine whether a set is an empty set.	The symbol ∅ (phi) or { } denotes an empty set.	
		(vii) Determine whether two sets are equal.	An empty set is also called a null set.	
2 Understand and use the concept of subset, universal set and the complement of a set.	Begin with everyday life situations.	(i) Determine whether a given set is a subset of a specific set and use the symbol ⊂ or ⊄ .	An empty set is a subset of any set. Every set is a subset of itself.	subset
		(ii) Represent subset using Venn diagram.		
		(iii) List the subsets for a specific set.		
	Discuss the relationship between sets and universal sets.	(iv) Illustrate the relationship between set and universal set using Venn diagram.	The symbol ξ denotes a universal set.	universal set
		(v) Determine the complement of a given set.	The symbol $\mathbf{A}'$ denotes the complement of set **A**.	complement of a set
		(vi) Determine the relationship between set, subset, universal set and the complement of a set.	Include everyday life situations.	

3 LEARNING AREA: SETS

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
3 Uerform operations on sets: • the intersection of sets, • the union of sets.	Discuss cases when: • **A** ∩ **B** = ∅, • **A** ⊂ **B.**	(i) Determine the intersection of: a) two sets, b) three sets, and use the symbol ∩. (ii) Represent the intersection of sets using Venn diagram. (iii) State the relationship between a) **A** ∩ **B** and **A**, b) **A** ∩ **B** and **B**. (iv) Determine the complement of the intersection of sets; (v) Solve problems involving the intersection of sets. (vi) Determine the union of: a) two sets, b) three sets, and use the symbol ∪. (vii) Represent the union of sets using Venn diagram. (viii) State the relationship between a) **A** ∪ **B** and **A**, b) **A** ∪ **B** and **B**. (ix) Determine the complement of the union of sets.	Include everyday life situations. Include everyday life situations.	intersection common elements

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
		(x) Solve problems involving the union of sets.	Include everyday life situations.	
		(xi) Determine the outcome of combined operations on sets.		
		(xii) Solve problems involving combined operations on sets.	Include everyday life situations.	

4 LEARNING AREA: MATHEMATICAL REASONING

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand the concept of statement.	Introduce this topic using everyday life situations. Focus on mathematical sentences.	(i) Determine whether a given sentence is a statement. (ii) Determine whether a given statement is true or false.	Statements consisting of: • words only, e.g. "Five is greater than two"; • numbers and words, e.g. "5 is greater than 2"; • numbers and symbols, e.g. $5 > 2$	statement true false mathematical sentence mathematical statement mathematical symbol
	Discuss sentences consisting of: • words only, • numbers and words, • numbers and mathematical symbols.	(iii) Construct true or false statements using given numbers and mathematical symbols.	The following are not statements: • "Is the place value of digit 9 in 1928 hundreds?" • $4n - 5m + 2s$ • "Add the two numbers." • $x + 2 = 8$	
2 Understand the concept of quantifiers "all" and "some".	Start with everyday life situations.	(i) Construct statements using the quantifier: a) all, b) some.	Quantifiers such as "every" and "any" can be introduced based on context.	quantifier all every any

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
		(ii) Determine whether a statement that contains the quantifier "all" is true or false.	*Examples*: • All squares are four sided figures. • Every square is a four sided figure. • Any square is a four sided figure.	some several one of part of
		(iii) Determine whether a statement can be generalised to cover all cases by using the quantifier "all".	Other quantifiers such as "several", "one of" and "part of" can be used based on context.	
		(iv) Construct a true statement using the quantifier "all" or "some", given an object and a property.	*Example*: **Object**: Trapezium. **Property**: Two sides are parallel to each other. **Statement**: All trapeziums have two parallel sides. **Object**: Even numbers. **Property**: Divisible by 4. **Statement**: Some even numbers are divisible by 4.	negate contrary object

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
3 Perform operations involving the words "not" or "no", "and" and "or" on statements.	Begin with everyday life situations.	(i) Change the truth value of a given statement by placing the word "not" into the original statement.	The negation "no" can be used where appropriate. The symbol "~" (tilde) denotes negation. "~*p*" denotes negation of *p* which means "not *p*" or "no *p*". The truth table for *p* and ~*p* are as follows: *p* | ~*p* True | False False | True	negation not p no p truth table truth value
		(ii) Identify two statements from a compound statement that contains the word "and".	The truth values for "*p* and *q*" are as follows: *p* | *q* | *p* and *q* True | True | True True | False | False False | True | False False | False | False	and compound statement

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
		(iii) Form a compound statement by combining two given statements using the word "and". (iv) Identify two statement from a compound statement that contains the word "or". (v) Form a compound statement by combining two given statements using the word "or". (vi) Determine the truth value of a compound statement which is the combination of two statements with the word "and". (vii) Determine the truth value of a compound statement which is the combination of two statements with the word "or".	The truth values for "*p* or *q*" are as follows: *p* | *q* | *p* or *q* True | True | True True | False | True False | True | True False | False | False	or

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
4 Understand the concept of implication.	Start with everyday life situations.	(i) Identify the antecedent and consequent of an implication "if p, then q".	Implication "if p, then q" can be written as $p \Rightarrow q$, and "p if and only if q" can be written as $p \Leftrightarrow q$, which means $p \Rightarrow q$ and $q \Rightarrow p$.	implication antecedent consequent
		(ii) Write two implications from a compound statement containing "if and only if". (iii) Construct mathematical statements in the form of implication: a) If p, then q, b) p if and only if q.		

		(iv) Determine the converse of a given implication.
		(v) Determine whether the converse of an implication is true or false.
			The converse of an implication is not necessarily true.
			Example 1:
			If $x < 3$, then
			$x < 5$ (true)
			Conversely:
			If $x < 5$, then
			$x < 3$ (false)
				converse

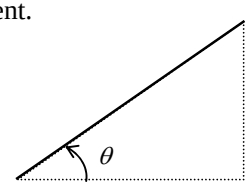
LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
			Example 2: If *PQR* is a triangle, then the sum of the interior angles of *PQR* is 180°. (true) Conversely: If the sum of the interior angles of *PQR* is 180°, then *PQR* is a triangle. (true)	
5 Understand the concept of argument.	Start with everyday life situations.	(i) Identify the premise and conclusion of a given simple argument.	Limit to arguments with true premises.	argument premise conclusion
		(ii) Make a conclusion based on two given premises for: a) Argument Form I, b) Argument Form II, c) Argument Form III.	Names for argument forms, i.e. **syllogism** (Form I), **modus ponens** (Form II) and **modus tollens** (Form III), need not be introduced.	

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
	Encourage students to produce arguments based on previous knowledge.	(iii) Complete an argument given a premise and the conclusion.	Specify that these three forms of arguments are deductions based on two premises only. *Argument Form I* **Premise 1**: All *A* are *B*. **Premise 2**: *C* is *A*. **Conclusion**: *C* is *B*. *Argument Form II*: **Premise 1**: If *p*, then *q*. **Premise 2**: *p* is true. **Conclusion**: *q* is true. *Argument Form III*: **Premise 1**: If *p*, then *q*. **Premise 2**: Not *q* is true. **Conclusion**: Not *p* is true.	
6 Understand and use the concept of deduction and induction to solve problems.	Use specific examples/activities to introduce the concept.	(i) Determine whether a conclusion is made through: a) reasoning by deduction, b) reasoning by induction.		reasoning deduction induction pattern

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
		(ii) Make a conclusion for a specific case based on a given general statement, by deduction.		special conclusion general statement general conclusion
		(iii) Make a generalization based on the pattern of a numerical sequence, by induction.	Limit to cases where formulae can be induced.	specific case numerical sequence
		(iv) Use deduction and induction in problem solving.	Specify that: making conclusion by deduction is definite; making conclusion by induction is not necessarily definite.	

5 LEARNING AREA: THE STRAIGHT LINE

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand the concept of gradient of a straight line.	Use technology such as the Geometer's Sketchpad, graphing calculators, graph boards, magnetic boards or topo maps as teaching aids where appropriate. Begin with concrete examples/daily situations to introduce the concept of gradient.  Discuss: • the relationship between gradient and tan θ, • the steepness of the straight line with different values of gradient. Carry out activities to find the ratio of vertical distance to horizontal distance for several pairs of points on a straight line to conclude that the ratio is constant.	(i) Determine the vertical and horizontal distances between two given points on a straight line. (ii) Determine the ratio of vertical distance to horizontal distance.		straight line steepness horizontal distance vertical distance gradient ratio

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
2 Understand the concept of gradient of a straight line in Cartesian coordinates.	Discuss the value of gradient if: • P is chosen as (x_1, y_1) and Q is (x_2, y_2), • P is chosen as (x_2, y_2) and Q is (x_1, y_1).	(i) Derive the formula for the gradient of a straight line.	The gradient of a straight line passing through $P(x_1, y_1)$ and $Q(x_2, y_2)$ is: $m = \frac{y_2 - y_1}{x_2 - x_1}$	acute angle obtuse angle inclined upwards to the right inclined downwards to the right undefined
		(ii) Calculate the gradient of a straight line passing through two points.		
		(iii) Determine the relationship between the value of the gradient and the: a) steepness, b) direction of inclination of a straight line.		
3 Understand the concept of intercept.		(i) Determine the x-intercept and the y-intercept of a straight line.	Emphasise that x-intercept and y-intercept are not written in the form of coordinates.	x-intercept y-intercept
		(ii) Derive the formula for the gradient of a straight line in terms of the x-intercept and the y-intercept.		
		(iii) Perform calculations involving gradient, x-intercept and y-intercept.		

5 LEARNING AREA: THE STRAIGHT LINE

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
4 Understand and use equation of a straight line.	Discuss the change in the form of the straight line if the values of m and c are changed. Carry out activities using the graphing calculator, Geometer's Sketchpad or other teaching aids. Verify that m is the gradient and c is the y-intercept of a straight line with equation $y = mx + c$.	(i) Draw the graph given an equation of the form $y = mx + c$. (ii) Determine whether a given point lies on a specific straight line. (iii) Write the equation of the straight line given the gradient and y-intercept. (iv) Determine the gradient and y-intercept of the straight line which equation is of the form: a) $y = mx + c$, b) $ax + by = c$. (v) Find the equation of the straight line which: a) is parallel to the x-axis, b) is parallel to the y-axis, c) passes through a given point and has a specific gradient, d) passes through two given points.	Emphasise that the graph obtained is a straight line. If a point lies on a straight line, then the coordinates of the point satisfy the equation of the straight line. The equation $ax + by = c$ can be written in the form $y = mx + c$.	linear equation graph table of values coefficient constant satisfy parallel point of intersection simultaneous equations

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
	Discuss and conclude that the point of intersection is the only point that satisfies both equations. Use the graphing calculator and Geometer's Sketchpad or other teaching aids to find the point of intersection.	(vi) Find the point of intersection of two straight lines by: a) drawing the two straight lines, b) solving simultaneous equations.		
5 Understand and use the concept of parallel lines.	Explore properties of parallel lines using the graphing calculator and Geometer's Sketchpad or other teaching aids.	(i) Verify that two parallel lines have the same gradient and vice versa.		parallel lines
		(ii) Determine from the given equations whether two straight lines are parallel. (iii) Find the equation of the straight line which passes through a given point and is parallel to another straight line. (iv) Solve problems involving equations of straight lines.		

6 LEARNING AREA: STATISTICS

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand the concept of class interval.	Use data obtained from activities and other sources such as research studies to introduce the concept of class interval.	(i) Complete the class interval for a set of data given one of the class intervals.		statistics class interval data grouped data
		(ii) Determine: a) the upper limit and lower limit, b) the upper boundary and lower boundary of a class in a grouped data.		upper limit lower limit upper boundary lower boundary size of class interval
		(iii) Calculate the size of a class interval.	Size of class interval = [upper boundary – lower boundary]	frequency table
		(iv) Determine the class interval, given a set of data and the number of classes.		
	Discuss criteria for suitable class intervals.	(v) Determine a suitable class interval for a given set of data.		
		(vi) Construct a frequency table for a given set of data.		
2 Understand and use the concept of mode and mean of grouped data.		(i) Determine the modal class from the frequency table of grouped data.		mode modal class
		(ii) Calculate the midpoint of a class.	Midpoint of class = $\frac{1}{2}$ (lower limit + upper limit)	mean midpoint of a class

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
		(iii) Verify the formula for the mean of grouped data. (iv) Calculate the mean from the frequency table of grouped data. (v) Discuss the effect of the size of class interval on the accuracy of the mean for a specific set of grouped data.		
3 Represent and interpret data in histograms with class intervals of the same size to solve problems.	Discuss the difference between histogram and bar chart.	(i) Draw a histogram based on the frequency table of a grouped data.		uniform class interval histogram
	Use graphing calculator to explore the effect of different class interval on histogram.	(ii) Interpret information from a given histogram.		vertical axis horizontal axis
		(iii) Solve problems involving histograms.	Include everyday life situations.	
4 Represent and interpret data in frequency polygons to solve problems.		(i) Draw the frequency polygon based on: a) a histogram, b) a frequency table.	When drawing a frequency polygon add a class with 0 frequency before the first class and after the last class.	frequency polygon
		(ii) Interpret information from a given frequency polygon.		
		(iii) Solve problems involving frequency polygon.	Include everyday life situations.	

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
5 Understand the concept of cumulative frequency.		(i) Construct the cumulative frequency table for: a) ungrouped data, b) grouped data. (ii) Draw the ogive for: a) ungrouped data, b) grouped data.	When drawing ogive: • use the upper boundaries; • add a class with zero frequency before the first class.	cumulative frequency ungrouped data ogive
6 Understand and use the concept of measures of dispersion to solve problems.	Discuss the meaning of dispersion by comparing a few sets of data. Graphing calculator can be used for this purpose.	(i) Determine the range of a set of data. (ii) Determine: a) the median, b) the first quartile, c) the third quartile, d) the interquartile range, from the ogive. (iii) Interpret information from an ogive.	For grouped data: Range = [midpoint of the last class – midpoint of the first class]	range measures of dispersion median first quartile third quartile interquartile range

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
	Carry out a project/research and analyse as well as interpret the data. Present the findings of the project/research. Emphasise the importance of honesty and accuracy in managing statistical research.	(iv) Solve problems involving data representations and measures of dispersion.		

7 LEARNING AREA: PROBABILITY I

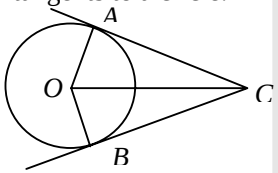
Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand the concept of sample space.	Use concrete examples such as throwing a die and tossing a coin.	(i) Determine whether an outcome is a possible outcome of an experiment. (ii) List all the possible outcomes of an experiment: a) from activities, b) by reasoning. (iii) Determine the sample space of an experiment. (iv) Write the sample space by using set notations.		sample space outcome experiment possible outcome
2 Understand the concept of events.	Discuss that an event is a subset of the sample space. Discuss also impossible events for a sample space.	(i) Identify the elements of a sample space which satisfy given conditions.	An impossible event is an empty set.	event element subset empty set
		(ii) List all the elements of a sample space which satisfy certain conditions using set notations.		impossible event
	Discuss that the sample space itself is an event.	(iii) Determine whether an event is possible for a sample space.		
3 Understand and use the concept of probability of an event to solve problems.	Carry out activities to introduce the concept of probability. The graphing calculator can be used to simulate such activities.	(i) Find the ratio of the number of times an event occurs to the number of trials.	Probability is obtained from activities and appropriate data.	probability
		(ii) Find the probability of an event from a big enough number of trials.		

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
	Discuss situation which results in: • probability of event = 1. • probability of event = 0. Emphasise that the value of probability is between 0 and 1. Predict possible events which might occur in daily situations.	(iii) Calculate the expected number of times an event will occur, given the probability of the event and number of trials. (iv) Solve problems involving probability. (v) Predict the occurrence of an outcome and make a decision based on known information.		

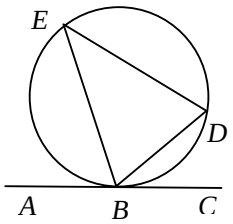
8 LEARNING AREA: CIRCLES III

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand and use the concept of tangents to a circle.	Develop concepts and abilities through activities using technology such as the Geometer's Sketchpad and graphing calculator.	(i) Identify tangents to a circle.		tangent to a circle circle
		(ii) Make inference that the tangent to a circle is a straight line perpendicular to the radius that passes through the contact point.		perpendicular radius circumference semicircle
		(iii) Construct the tangent to a circle passing through a point: a) on the circumference of the circle, b) outside the circle.		
		(iv) Determine the properties related to two tangents to a circle from a given point outside the circle.	Properties of angle in semicircles can be used. Examples of properties of two tangents to a circle:  $AC = BC$ $\angle ACO = \angle BCO$ $\angle AOC = \angle BOC$ ΔAOC and ΔBOC are congruent.	congruent

8 LEARNING AREA: CIRCLES III

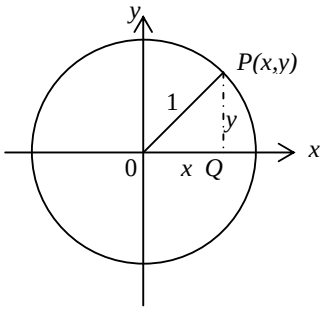
Form 4

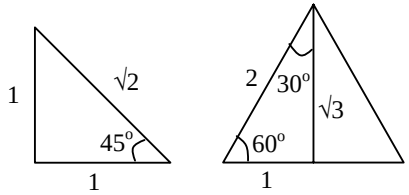
LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
		(v) Solve problems involving tangents to a circle.	Relate to Pythagoras' Theorem	
2 Understand and use the properties of angle between tangent and chord to solve problems.	Explore the property of angle in alternate segment using Geometer's Sketchpad or other teaching aids.	(i) Identify the angle in the alternate segment which is subtended by the chord through the contact point of the tangent.		chords alternate segment major sector subtended
		(ii) Verify the relationship between the angle formed by the tangent and the chord with the angle in the alternate segment which is subtended by the chord.	$\angle ABE = \angle BDE$ $\angle CBD = \angle BED$	
		(iii) Perform calculations involving the angle in alternate segment.		
		(iv) Solve problems involving tangent to a circle and angle in alternate segment.		
3 Understand and use the properties of common tangents to solve problems.	Discuss the maximum number of common tangents for the three cases.	(i) Determine the number of common tangents which can be drawn to two circles which: a) intersect at two points, b) intersect only at one point, c) do not intersect.	Emphasise that the lengths of common tangents are equal.	common tangents

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
	Include daily situations.	(ii) Determine the properties related to the common tangent to two circles which: a) intersect at two points, b) intersect only at one point, c) do not intersect.		
		(iii) Solve problems involving common tangents to two circles.		
		(iv) Solve problems involving tangents and common tangents.	Include problems involving Pythagoras' Theorem.	

9 LEARNING AREA: TRIGONOMETRY II

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand and use the concept of the values of $\sin\theta$, $\cos\theta$ and $\tan\theta$ ($0° \le \theta \le 360°$) to solve problems.	Explain the meaning of unit circle.  Begin with definitions of sine, cosine and tangent of an acute angle. $\sin\theta = \frac{PQ}{OP} = \frac{y}{1} = y$ $\cos\theta = \frac{OQ}{OP} = \frac{x}{1} = x$ $\tan\theta = \frac{PQ}{OQ} = \frac{y}{x}$	(i) Identify the quadrants and angles in the unit circle. (ii) Determine: a) the value of *y*-coordinate, b) the value of *x*-coordinate, c) the ratio of *y*-coordinate to *x*-coordinate of several points on the circumference of the unit circle. (iii) Verify that, for an angle in quadrant I of the unit circle: a) $\sin\theta$ = *y*-coordinate, b) $\cos\theta$ = *x*-coordinate, c) $\tan\theta = \frac{y\text{-coordinate}}{x\text{-coordinate}}$. (iv) Determine the values of: a) sine, b) cosine, c) tangent of an angle in quadrant I of the unit circle.	The unit circle is the circle of radius 1 with its centre at the origin.	quadrant sine θ cosine θ tangent θ

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
	Explain that the concept $\sin\theta$ = y-coordinate , $\cos\theta$ = x-coordinate, $\tan\theta = \frac{y\text{-coordinate}}{x\text{-coordinate}}$ can be extended to angles in quadrant II, III and IV.  	(v) Determine the values of: a) sin θ, b) cos θ, c) tan θ, for $90° \le \theta \le 360°$.		
		(vi) Determine whether the values of: a) sine, b) cosine, c) tangent, of an angle in a specific quadrant is positive or negative.	Consider special angles such as 0°, 30°, 45°, 60°, 90°, 180°, 270°, 360°.	
	Use the above triangles to find the values of sine, cosine and tangent for 30°, 45°, 60°. Teaching can be expanded through activities such as reflection.	(vii) Determine the values of sine, cosine and tangent for special angles. (viii) Determine the values of the angles in quadrant I which correspond to the values of the angles in other quadrants.		

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
	Use the Geometer's Sketchpad to explore the change in the values of sine, cosine and tangent relative to the change in angles.	(ix) State the relationships between the values of: a) sine, b) cosine, and c) tangent of angles in quadrant II, III and IV with their respective values of the corresponding angle in quadrant I.		
		(x) Find the values of sine, cosine and tangent of the angles between 90° and 360°.		
		(xi) Find the angles between 0° and 360°, given the values of sine, cosine or tangent.		
	Relate to daily situations.	(xii) Solve problems involving sine, cosine and tangent.		

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
2 Draw and use the graphs of sine, cosine and tangent.	Use the graphing calculator and Geometer's Sketchpad to explore the feature of the graphs of $y = \sin\theta, y = \cos\theta, y = \tan\theta$. Discuss the feature of the graphs of $y = \sin\theta, y = \cos\theta, y = \tan\theta$. Discuss the examples of these graphs in other areas.	(i) Draw the graphs of sine, cosine and tangent for angles between 0° and 360°. (ii) Compare the graphs of sine, cosine and tangent for angles between 0° and 360°. (iii) Solve problems involving graphs of sine, cosine and tangent.		

10 LEARNING AREA: ANGLES OF ELEVATION AND DEPRESSION

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand and use the concept of angle of elevation and angle of depression to solve problems.	Use daily situations to introduce the concept.	(i) Identify: a) the horizontal line, b) the angle of elevation, c) the angle of depression for a particular situation.		angle of elevation angle of depression horizontal line
		(ii) Represent a particular situation involving: a) the angle of elevation, b) the angle of depression using diagrams.	Include two observations on the same horizontal plane.	
		(iii) Solve problems involving the angle of elevation and the angle of depression.	Involve activities outside the classroom.	

11 LEARNING AREA: LINES AND PLANES IN 3-DIMENSIONS

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
1 Understand and use the concept of angle between lines and planes to solve problems.	Carry out activities using daily situations and 3-dimensional models.	(i) Identify planes.		horizontal plane vertical plane 3-dimensional normal to a plane orthogonal projection space diagonal
	Differentiate between 2-dimensional and 3-dimensional shapes. Involve planes found in natural surroundings.	(ii) Identify horizontal planes, vertical planes and inclined planes.		
		(iii) Sketch a three dimensional shape and identify the specific planes.		
		(iv) Identify: a) lines that lie on a plane, b) lines that intersect with a plane.		
		(v) Identify normals to a given plane.		
	Begin with 3-dimensional models.	(vi) Determine the orthogonal projection of a line on a plane.		
		(vii) Draw and name the orthogonal projection of a line on a plane.	Include lines in 3-dimensional shapes.	
		(viii) Determine the angle between a line and a plane.		
	Use 3-dimensional models to give clearer pictures.	(ix) Solve problems involving the angle between a line and a plane.		

11 LEARNING AREA: LINES AND PLANES IN 3-DIMENSIONS

Form 4

LEARNING OBJECTIVES *Pupils will be taught to…*	SUGGESTED TEACHING AND LEARNING ACTIVITIES	LEARNING OUTCOMES *Pupils will be able to…*	POINTS TO NOTE	VOCABULARY
2 Understand and use the concept of angle between two planes to solve problems.	Use 3-dimensional models to give clearer pictures.	(i) Identify the line of intersection between two planes. (ii) Draw a line on each plane which is perpendicular to the line of intersection of the two planes at a point on the line of intersection. (iii) Determine the angle between two planes on a model and a given diagram. (iv) Solve problems involving lines and planes in 3-dimensional shapes.		angle between two planes