



Republic of Zambia

**Ministry of Education, Science, Vocational Training and Early Education**

# **“O” Level Mathematics Syllabus**

**Grades 10 to 12**



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## **VISION**

Quality, lifelong education for all which is accessible, inclusive and relevant to individual, national and global needs and value systems.

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<b>PREFACE</b> .....	<b>i</b>
<b>Introduction</b> .....	<b>iii</b>
<b>Time and Period allocation</b> .....	<b>iv</b>
<b>Assessment Scheme</b> .....	<b>iv</b>
<b>Rationale</b> .....	<b>iv</b>
<b>General Outcomes</b> .....	<b>v</b>
<b>GRADE 10</b> .....	<b>1</b>
<b>GRADE 11</b> .....	<b>6</b>
<b>GRADE 12</b> .....	<b>8</b>
<b>Grades 10 to 12 “O” Level Mathematics Scope And Sequence</b> .....	<b>i</b>

## **PREFACE**

The syllabus was produced as a result of the Curriculum review process carried out by the Ministry of Education, Science, Vocational Training and Early Education under the auspices of the Curriculum Development Centre (CDC). The curriculum reform process started way back in 1999 when the Ministry of Education commissioned five (5) curriculum studies which were conducted by the University of Zambia. These studies were followed by a review of the lower and middle basic and primary teacher education curriculum. In 2005 the upper basic education National survey was conducted and information from learners, parents, teachers, school managers, educational administrators, tertiary institutions traditional leaders civic leaders and various stakeholders in education was collected to help design a relevant curriculum.

The recommendations provided by various stakeholders during the Upper Basic Education National survey of 2005 and National symposium on curriculum held in June 2009 guided the review process.

The review was necessitated by the need to provide an education system that would not only incorporate latest social, economic, technological and political developments but also equip learners with vital knowledge, skills and values that are necessary to contribute to the attainment of Vision 2030.

The syllabus has been reviewed in line with the Outcome Based Education principles which seek to link education to real life experiences that give learners skills to access, criticize analyse and practically apply knowledge that help them gain life skills. Its competences and general outcomes are the expected outcomes to be attained by the learners through the acquisition of knowledge, skills, techniques and values which are very important for the total development of the individual and the nation as a whole.

Effective implementation of Outcome Based Education requires that the following principles be observed: clarity of focus, Reflective designing, setting high expectations for all learners and appropriate opportunities.

It is my sincere hope that this Outcome Based syllabus will greatly improve the quality of education provided at Grade 10 to 12 level as defined and recommended in various policy documents including Educating Our Future`1996 and the `Zambia Education Curriculum Framework `2013.

Chishimba Nkocha  
Permanent Secretary

**MINISTRY OF EDUCATION,SCIENCE, VOCATIONAL TRAINING AND EARLY EDUCATION.**

## **Acknowledgement**

The syllabus presented here is a result of broad-based consultation involving several stakeholders within and outside the education system.

Many individuals, institutions and organizations were consulted to gather their views on the existing syllabus and to accord them an opportunity to make suggestions for the new syllabus. The Ministry of Education wishes to express heartfelt gratitude to all those who participated for their valuable contributions, which resulted in the development of this syllabus.

The Curriculum Development Centre worked closely with other sister departments and institutions to create this document. We sincerely thank the Directorate of Teacher Education and Specialized Services, the Directorate of Planning and Information, the Directorate of Human Resource and Administration, the Directorate of Open and Distance Education ,the Examinations Council of Zambia, the University of Zambia, schools and other institutions too numerous to mention, for their steadfast support.

We pay special tribute to co-operating partners especially JICA and UNICEF for rendering financial technical support in the production of the syllabus.

C.N.M Sakala (Mrs)

Director-Standard and Curriculum

**MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL TRAINING AND EARLY EDUCATION**

## Introduction

### Suggested Teaching Methodology

- The syllabus encourages a learner-centred approach or pedagogy. This involves learners to learn Mathematics in context of multipart, comprehensive and practical problems. Under such learning situations learners may be put in groups and required to identify what they already know, what they need to know and how and where to access new information that may lead to resolution of the problem.
- The Problem-Based Learning (PBL) in mathematics may include the four core area specific outcomes, thinking process, skills and values with the aim of nurturing wise citizens who are responsible in decision-making for sustainable and responsible development.
- The role of the teacher may be that of a facilitator of learning who provides appropriate scaffolding of that process by asking probing questions, providing appropriate resources and leading class discussions as well as designing student's assessments. The strategy strives to transform the traditional teacher centred mathematics classroom situation into student centred environment completely where learners are allowed to construct new knowledge through, the specific outcomes learned, thinking processes such as communication, interconnections, reasoning, representations, problem solving and other similar ones: both mathematics and non-mathematical positive as well as universal values.
- The teaching of **Ordinary Level Mathematics** should expose learners to practical applications of mathematics in everyday life. Learners should be exposed to do more of practical work as much as necessary through contextual reference to the local environment.
- use of computer related software for mathematics should be encouraged and the teacher should encourage learners to use available mathematics software.
- Learners may be exposed to situation where they can provide assistance and support to their peer in learning groups. The opportunities may help to evaluate their peers and conduct self-assessment that helps them to shoulder responsibility for their learning.



### **Time and Period allocation**

Time allocation for this syllabus is will require at seven-40 minutes periods per week to complete.

### **Assessment Scheme**

Continuous assessment will be emphasised by using various methods of testing according to topics and themes at various levels. The examinations council of Zambia will prepare detailed procedures on how continuous assessment will be conducted by the teachers. The Examinations Council will also develop examination syllabus to provide teachers with guidelines on the objectives to be tested. The scheme of assessment will consists of school based assessment and final examination that will be conducted by the Examinations Council of Zambia.

School based assessment will be in the form of tests. Tests will be in the form of diagnostic, aptitude, achievement, oral, practice, attitude and performance, exercises, assignments, discussions, investigation, project work etc. School based assessment shall contribute towards certification of all learners.

### **Rationale**

Mathematics is an important tool for the development and improvement of a person's intellectual competence in logical reasoning, spatial visualization, analysis and abstract thought. When learners have acquired enough knowledge in mathematics they develop numeracy, reasoning, thinking skill and problem solving skills. Mathematics is very important not only in science and technology that is vital for the development of the country but also in everyday life and workplace. Mathematics would equip the learner to live in modern age of Science and technology and enable the learner to contribute to the social and economic development of the country and the world at large. Mathematics plays a vital role in the development of highly skilled and technologically based manpower. Mathematics also prepares and enhances the learners' prospect of employment and further education as it also plays a key role as a tool for other learning areas and subject. Mathematics relates to all subjects and provides necessary mathematical pre-requisites for further education. Other subjects in science and technology heavily depend on mathematics concepts. In order for Zambia to comfortably reach the 2010 millennium goals there has to be a deliberate emphasis on mathematics education.

Mathematics can also be an interesting subject as it can also be a subject of enjoyment and excitement. This offers learners and students an opportunity for creative work and moments of joy and pleasure. It is very interesting for students and indeed all learners when they discover ideas and insights that would help them pursue mathematics even outside school walls.

The study of mathematics will build up understanding and appreciation of basic mathematical concepts and computational skills in order to apply them in everyday life. Mathematics aims at developing clear mathematical thinking and expression in a learner and also develop ability to recognize problem and to solve them with related mathematical knowledge and skills.

Through the study of mathematics learners will develop ethical values necessary for accountability in financial matters. It will develop in them the skills of interpreting and financial information. It will help learners acquire skills for planning, budgeting and effective decision-making.

### **General Outcomes**

- To build an understanding and appreciation of basic mathematical concepts and computational skills in order to apply them in everyday life.
- Through the study of mathematics learners will develop ethical values necessary for accountability in financial matters. It will develop in them the skills of interpreting and financial information. It will help learners acquire skills for planning, budgeting and effective decision-making.

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## GRADE 10

General Outcomes	Key Competences
<ul style="list-style-type: none"><li>▪ Provide clear mathematical <b>thinking</b> and expression in the learner</li><li>▪ Develop the learners' mathematical <b>knowledge and skills</b></li><li>▪ Enrich the learners' <b>understanding</b> of mathematical concepts in order to facilitate further study of the discipline</li><li>▪ Build up an appreciation of mathematical concepts so that the learner can <b>apply</b> these for problem solving in everyday life.</li><li>▪ Enable the learner <b>represent</b>, interpret and use data in a variety of forms</li><li>▪ Inculcate a desire to <b>develop different career paths</b> in the learners</li></ul>	<ul style="list-style-type: none"><li>▪ Assimilate necessary mathematical concepts for use in everyday life such as environment and other related disciplines.</li><li>▪ Think mathematically and accurately in problem solving skills and apply these skills to formulate and solve mathematical and other related problems.</li><li>▪ Develop necessary skills needed to apply mathematical concepts and skills in other disciplines.</li><li>▪ Produce imaginative and creative work from mathematical concepts and ideas.</li><li>▪ Develop abilities and ideas drawn from mathematics to reason logically, communicate mathematically, and learn independently without too much supervision (self-discipline).</li><li>▪ Development positive attitudes towards mathematics and use it in other subjects such as science and technology.</li><li>▪ Apply mathematical tools such as information and communication technology in the learning of other subjects.</li><li>▪ Use mathematics for enjoyment and pleasure.</li><li>▪ Develop understanding of algebra, geometry, measurements and shapes.</li></ul>

**GRADE 10**

TOPIC	SUBTOPICS	SPECIFIC OUTCOMES	KNOWLEDGE	SKILLS	VALUES
10.2 SETS	10.2.1 Set Operations	10.2.1.1 Carry out operations on sets. 10.2.1.2 Apply higher operations on sets	<ul style="list-style-type: none"> <li>Operations on sets.</li> <li>Numerical problems involving sets</li> <li>Applying higher operations on sets (numerical problems involving sets )</li> </ul>	<ul style="list-style-type: none"> <li><b>Identification</b> of operations on sets</li> <li><b>Comparing</b> numerical problems involving sets</li> <li><b>Computations</b> involving sets.</li> </ul>	<ul style="list-style-type: none"> <li><b>Appreciation</b> of set operations.</li> <li><b>Curiosity</b> in computations.</li> </ul>
10.3 INDEX NOTATION	10.3.1 Indices	10.1.5.1 Apply laws of indices 10.1.5.2 Simplify positive, negative and zero indices 10.1.5.3 Simplify fractional indices 10.1.5.4 Solve equations involving indices	<ul style="list-style-type: none"> <li>Laws of indices</li> <li>Double indices</li> <li>Multiplicative inverse</li> <li>Fractions with negative indices</li> <li>Equations involving indices</li> <li>Problems involving application of indices</li> </ul>	<ul style="list-style-type: none"> <li><b>Identification</b> of indices with same base.</li> <li><b>Simplification</b> using indices.</li> <li><b>Application</b> of indices to simplify multiplication and division.</li> </ul>	<ul style="list-style-type: none"> <li><b>Curiosity</b> in using indices to solve problems.</li> <li><b>Appreciation</b> of using indices.</li> <li><b>Logical thinking</b> in simplifying using indices.</li> </ul>
10.4 ALGEBRA	10.3.1 Basic Processes	10.3.1.1 Expand and simplify expressions 10.3.1.3 Factorise algebraic expressions 10.3.1.5 Simplify Algebraic fractions	<ul style="list-style-type: none"> <li>Expansion and simplification of expressions</li> <li>Factorisation by using common factors, grouping terms, factors of quadratic expressions and difference of two square</li> <li>Addition , subtraction ,</li> </ul>	<ul style="list-style-type: none"> <li><b>Simplification</b> of expressions</li> <li><b>Identification</b> of common factors, factors of quadratic expressions and difference of two square</li> <li><b>Computation</b> of</li> </ul>	<ul style="list-style-type: none"> <li><b>Orderliness</b> in factorisation of algebraic expressions</li> <li><b>Logical thinking</b> in factorising quadratics.</li> </ul>

TOPIC	SUBTOPICS	SPECIFIC OUTCOMES	KNOWLEDGE	SKILLS	VALUES
			multiplication and division of algebraic fractions <ul style="list-style-type: none"> <li>• Lowest common multiple</li> </ul>	algebraic fractions applying the four rules.	
10.5 MATRICES	10.5.1 Transpose of a matrix 10.5.2 Multiplication of matrices 10.5.3 Inverse of a matrix	10.5.1.1 Find a Transpose of a matrix 10.5.2.1 Multiply matrices (up to 3x3 matrices) 10.5.2.2 Calculate the determinant of a 2 by 2 matrix 10.5.3.1 Find the inverse of a 2 by 2 matrix 10.5.3.1 Solve systems of linear equations in two variables 10.5.3.2 Apply matrices to solve real life problems	<ul style="list-style-type: none"> <li>• Transpose of a matrix</li> <li>• Multiplying matrices (up to 3x3 matrices)</li> <li>• The null (zero) and identity matrices</li> <li>• Determinant and Inverse of a 2x2 matrix</li> <li>• Singular matrices</li> <li>• Solving systems of linear equation in two variables using matrices</li> <li>• Cramer's Rule</li> <li>• Applying matrices to solve real life problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Interpretation</b> of transpose of a matrix.</li> <li>• <b>Comparison</b> of matrices.</li> <li>• <b>Computation</b> of matrices</li> <li>• <b>Application</b> of matrices in solving linear equations.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Appreciation</b> of matrices.</li> <li>• <b>Awareness</b> of solving linear equations using matrices.</li> </ul>
10.6 SIMILARITY AND CONGRUENCY	10.6.1 Application of Ratio and Proportion 10.6.2 Areas and Volumes of Similar figures	10.6.2.1 Calculate the scale on a map 10.6.2.2 Calculate length and area using a given scale and vice versa 10.6.2.3 Calculate areas and volumes of similar figures 10.6.2.4 Apply ratio, proportion, to solve problems on similarity and congruence	<ul style="list-style-type: none"> <li>• Representative Fraction (Scale)</li> <li>• Calculating length and area using a given scale and vice versa</li> <li>• Calculating areas and volumes of similar figures</li> <li>• Applying ratio, proportion, similarity and congruence in solving real life problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Computation</b> of representative fractions (RFs).</li> <li>• <b>Representation</b> of measurements on the map.</li> <li>• <b>Application</b> of ratio, proportion, similarity and congruence in solving real life problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Judgement</b> of virtual and actual distances</li> <li>• <b>Accuracy</b> in computation</li> </ul>

TOPIC	SUBTOPICS	SPECIFIC OUTCOMES	KNOWLEDGE	SKILLS	VALUES
10.7 TRAVEL GRAPHS	10.7.1 Distance time graphs 10.7.2 Velocity Time graphs	10.7.1.1 Compute average speed, distance and time 12.2.2.1 Determine acceleration and retardation/deceleration 12.2.2.2 Draw travel graphs 12.2.2.3 Calculate the distance under a velocity time graph 10.7.2.4 Relate area under the graph to distance travelled	<ul style="list-style-type: none"> <li>• Scalar and vector quantities</li> <li>• Average speed</li> <li>• Distance/displacement</li> <li>• Acceleration and deceleration/retardation</li> <li>• Drawing travel graphs</li> <li>• Distance/area under a velocity time graph</li> <li>• Concept of similarity</li> <li>• Explaining why the area under the graph represents distance travelled</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Identification</b> of Scalar and vector quantities</li> <li>• <b>Computation</b> of average speed, distance and time using travel graphs.</li> <li>• <b>Relation</b> between area under the graph to distance travelled.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Curiosity</b> in using travel graphs.</li> <li>• <b>Awareness</b> of vector and scalar quantities.</li> <li>• <b>Appreciation</b> of relating area under the graph to distance travelled</li> </ul>
10.7 SOCIAL AND COMMERCIAL ARITHMETIC	10.7.1 Investments	10.1.7.1 Carry out calculations that involve Shares, dividends and investment Bonds	<ul style="list-style-type: none"> <li>• Shares, dividends and Investment Bonds</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Interpretation</b> of Shares, dividends and Investment Bonds.</li> <li>• <b>Calculations</b> involving Shares, dividends and Investment Bonds.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Appreciation</b> of Shares, dividends and Investment Bonds.</li> </ul>
10.8 BEARINGS	10.4.4 Bearings and Scale Drawing	10.4.4.1 Draw/sketch diagrams to represent position and direction 10.4.4.2 Use bearing and scale drawing in real life	<ul style="list-style-type: none"> <li>• Scale drawing</li> <li>• Three figure bearings</li> <li>• Solving problems involving bearing and scale drawing from real life problems</li> <li>• Angles</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Communication</b> through diagrams to represent position and direction</li> <li>• <b>Computation</b> involving bearing</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Awareness</b> of bearing and scale drawing</li> <li>• <b>Appreciation</b> of bearings.</li> </ul>

TOPIC	SUBTOPICS	SPECIFIC OUTCOMES	KNOWLEDGE	SKILLS	VALUES
			<ul style="list-style-type: none"> <li>Measuring instruments</li> </ul>	and scale drawing. <ul style="list-style-type: none"> <li><b>Application</b> of bearing and scale drawing from real life problems.</li> </ul>	
10.9 SYMMETRY	11.5.2 Symmetry of solids	10.9.1 Determine order of rotational symmetry 10.9.2 Determine symmetry of solids 10.9.3 Determine plane symmetry	<ul style="list-style-type: none"> <li>Point, Rotational and Plane Symmetry</li> <li>Centre of rotation</li> <li>Order of symmetry in three dimension</li> <li>Plane and axis of symmetry</li> </ul>	<ul style="list-style-type: none"> <li><b>Identification</b> of symmetry of solids.</li> <li><b>Determination</b> of plane symmetry</li> </ul>	<ul style="list-style-type: none"> <li><b>Awareness</b> of order of symmetry in three dimensions</li> </ul>
10.10 COMPUTER AND CALCULATOR	10.10.1 Functions on a Calculator 10.10.2 Basic components of a computer 10.2.2 Algorithms 10.2.3 Methods of implementing an algorithm	10.2.1.1 Demonstrate the use of different functions on a calculator 10.10.2.1 Describe components of a computer 10.2.2.1 Describe various methods of implementing an algorithm 10.2.3.1 Outline problem solving stages	<ul style="list-style-type: none"> <li>Using different functions on a calculator</li> <li>Describing Components of a computer (i.e. Input, Process and Output Parts/devices)</li> <li>Definition of an algorithm</li> <li>Algorithm (sequence , decision loops)</li> <li>Methods of implementing an algorithm (flow charts and pseudo codes)</li> <li>Stages of problem solving (define a problem , analysis method of solution, write a computer program,</li> </ul>	<ul style="list-style-type: none"> <li><b>Identification</b> of basic components of a computer.</li> <li><b>Interpretation</b> of functions on a calculator</li> <li><b>Modelling</b> of simple algorithms</li> <li><b>Implementation</b> of algorithms in programming.</li> <li><b>Coding</b> simple computer programs.</li> </ul>	<ul style="list-style-type: none"> <li><b>Logical thinking</b> in designing flow charts.</li> <li><b>Appreciation</b> of use of computer and calculator</li> </ul>

TOPIC	SUBTOPICS	SPECIFIC OUTCOMES	KNOWLEDGE	SKILLS	VALUES
			document the program)		

## GRADE 11

General Outcomes	Key Competences
<ul style="list-style-type: none"> <li>▪ Provide clear mathematical <b>thinking</b> and expression in the learner</li> <li>▪ Develop the learners' mathematical <b>knowledge and skills</b></li> <li>▪ Enrich the learners' <b>understanding</b> of mathematical concepts in order to facilitate further study of the discipline</li> <li>▪ Build up an appreciation of mathematical concepts so that the learner can <b>apply</b> these for problem solving in everyday life.</li> <li>▪ Enable the learner <b>represent</b>, interpret and use data in a variety of forms</li> <li>▪ Inculcate a desire to <b>develop different career paths</b> in the learners</li> </ul>	<ul style="list-style-type: none"> <li>▪ Assimilate necessary mathematical concepts for use in everyday life such as environment and other related disciplines.</li> <li>▪ Think mathematically and accurately in problem solving skills and apply these skills to formulate and solve mathematical and other related problems.</li> <li>▪ Develop necessary skills needed to apply mathematical concepts and skills in other disciplines.</li> <li>▪ Produce imaginative and creative work from mathematical concepts and ideas.</li> <li>▪ Develop abilities and ideas drawn from mathematics to reason logically, communicate mathematically, and learn independently without too much supervision (self-discipline).</li> <li>▪ Development positive attitudes towards mathematics and use it in other subjects such as science and technology.</li> <li>▪ Apply mathematical tools such as information and communication technology in the learning of other subjects.</li> <li>▪ Use mathematics for enjoyment and pleasure.</li> <li>▪ Develop understanding of algebra, geometry, measurements and shapes.</li> </ul>



TOPIC	SUB TOPIC	SPECIFIC OUTCOME	KNOWLEDGE	SKILLS	VALUES
11.1 APPROXIMATIONS	11.11.5 Relative and absolute error	11.11.5.1 Work with relative and absolute errors	<ul style="list-style-type: none"> <li>Relative error</li> <li>Limits</li> <li>Absolute error</li> <li>Tolerance</li> <li>Percentage error</li> <li>Estimation</li> </ul>	<ul style="list-style-type: none"> <li><b>Interpretation</b> of relative and absolute error.</li> <li><b>Computation</b> of absolute and relative error.</li> <li><b>Comparison</b> of measurements.</li> </ul>	<ul style="list-style-type: none"> <li><b>Accuracy</b> in finding relative and absolute error.</li> </ul>
11.2 SEQUENCES AND SERIES	11.2.1 Arithmetic progression 11.2.2 Geometric progression	11.2.3.1 Identify an arithmetic progression (AP) 11.2.3.2 Find the nth term of the AP 11.2.3.3 Find the sum of an AP 11.2.3.4 Find the arithmetic mean 11.2.4.1 Identify a geometric progression (GP) 11.2.4.2 Find the nth term of a GP 11.2.4.3 Find the geometric mean 11.2.4.4 Find the sum of a geometric progression 11.2.4.5 Find the sum to infinity of a Geometric progression	<ul style="list-style-type: none"> <li>Arithmetic and Geometrical Progressions.</li> <li>The nth terms of AP and GP</li> <li>Sums of APs and GPs</li> <li>Arithmetic and geometric means</li> <li>Sum to infinity of a Geometric progression</li> </ul>	<ul style="list-style-type: none"> <li><b>Identification</b> of arithmetic and geometrical Progressions.</li> <li><b>Ordering</b> of Arithmetic and Geometrical Progressions.</li> <li><b>Computation</b> of Arithmetic and Geometrical Progressions.</li> </ul>	<ul style="list-style-type: none"> <li><b>Accuracy</b> in computing progressions.</li> <li><b>Appreciation</b> of the nth term of the progression.</li> <li><b>Prediction</b> of the nth term.</li> </ul>
11.3 COORDINATE GEOMETRY	11.6.1 Length of a straight line between two points 11.6.2 The mid point 11.6.3 Gradient 11.6.4 Equation of a straight line	11.6.1.1 Calculate the length of a straight line 11.6.1.2 Calculate the mid-point of two points 11.6.1.3 Calculate the gradient of a line segment 11.6.4.1 Find the equation of a straight line	<ul style="list-style-type: none"> <li>Length (distance formula)</li> <li>Mid point</li> <li>Gradient</li> <li>Gradient point form</li> <li>Gradient Intercept form</li> </ul>	<ul style="list-style-type: none"> <li><b>Interpretation</b> of distance and gradient formula.</li> <li><b>Calculation</b> of gradient of a line segment.</li> </ul>	<ul style="list-style-type: none"> <li><b>Curiosity</b> in using distance and gradient formula.</li> <li><b>Recognition</b> of distance and gradient formula.</li> </ul>

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	KNOWLEDGE	SKILLS	VALUES
	11.6.5 Parallel and perpendicular lines	11.6.5.1 Find the gradients of parallel and perpendicular lines 11.6.5.2 Use gradients of parallel and perpendicular lines to find equations	<ul style="list-style-type: none"> <li>• Double intercept form</li> <li>• Parallel lines</li> <li>• Perpendicular lines</li> </ul>		
11.4 RELATIONS AND FUNCTIONS	11.14.9 Inverse functions 11.4.3 Composite functions 11.14.11 Application	11.14.9.1 Find inverses of one- to-one functions 11.4.3.1 Simplify composite functions 11.14.11.1 Solve problems involving linear functions	<ul style="list-style-type: none"> <li>• Formula, functional notation, set builder notation</li> <li>• Inverse functions</li> <li>• Composite functions</li> <li>• Problems involving linear functions</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Identification</b> of inverse of a function.</li> <li>• <b>Representation</b> of composite functions.</li> <li>• <b>Problem solving</b> involving linear functions.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Logical thinking</b> in solving inverse and composite functions.</li> <li>• <b>Appreciation</b> of functions.</li> </ul>
11.5 QUADRATIC FUNCTIONS	11.5.1 Introduction to Quadratic Functions	11.5.1.1 Explain the quadratic function and its graph 11.5.1.2 Sketch the graph of a quadratic function	<ul style="list-style-type: none"> <li>• Meaning of quadratic function and its graph</li> <li>• Sketching the graph</li> <li>• Maximum and minimum Roots/zeros</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Identification</b> of a quadratic function.</li> <li>• <b>Interpretation</b> of Maximum and minimum of function.</li> <li>• <b>Drawing</b> of function graphs.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Neatness</b> in sketching graphs.</li> <li>• <b>Logical thinking</b> in determining the turning points.</li> <li>• <b>Accuracy</b> in finding the roots.</li> </ul>
11.6 QUADRATIC EQUATIONS	11.6.2 Introduction to Quadratic equations 11.6.2 Solutions of quadratic	11.3.1.2 Explain the meaning of the quadratic equation 11.3.3.2 Solve quadratic equations by graphical method 11.6.1.2 Solve quadratic equations	<ul style="list-style-type: none"> <li>• Meaning of quadratic equation</li> <li>• Solving quadratic equations by Factorisation,</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Identification</b> of method of quadratic</li> <li>• <b>Computation</b> of quadratic</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Logical thinking</b> in computing quadratic equations.</li> <li>• <b>Accuracy</b> in</li> </ul>

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	KNOWLEDGE	SKILLS	VALUES
	equations	using factorisation method 11.3.2.1 Solve quadratic equations using completing of square method 11.3.3.1 Solve quadratic equations using quadratic formula method 11.3.4.1 Apply quadratic equations to solve real life problems	graphical method, completion of squares and quadratic formula • Application of quadratic equations	equations using various methods.	finding quadratic roots.
11.7 VARIATION	11.7.1 Introduction to variation 11.7.2 Direct and Inverse Variation 11.7.3 Joint and Partial Variation 11.7.4 Graphs 11.7.5 Applications	11.15.1.1 Describe variation 11.15.2.1 Distinguish between direct and inverse variation 11.15.3.1 Distinguish between joint and partial variation 11.15.4.1 Draw and Interpret graphs of variation 11.7.5.1 Solve problems involving variations	• Describing variation (Notation and Constant) • Distinguishing between direct and inverse variation • Distinguishing between Joint and Partial variation • Graphs of variation • Solving problems involving variations	• <b>Interpretation</b> of variation • <b>Problem solving</b> involving variations • <b>Comparison</b> between joint and partial variation. •	• <b>Appreciation</b> of variation in • <b>Logica thinking</b> in calculating
11.8 CIRCLE THEOREMS	11.7.3 Properties of a circle 11.7.2 Angle properties	11.7.3.1 Analyse the parts of a circle 11.7.2.1 Solve problems using angle properties of a circles 11.7.6.1 Solve problems involving tangent properties	• Parts a circle (chord, segment, arc, sector, radius, diameter) • Angle in the same segment • Angle at the centre twice one at the circumference • Angle in a semicircle • Cyclic quadrilateral	• <b>Identification</b> of parts of a circle (chord, segment, arc, sector, radius, diameter) • <b>Computation</b> involving angle properties of a circle. • <b>Interpretation</b> of	• <b>Curiosity</b> I using circle theorems. • <b>Appreciation</b> of angle property of a circle.

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	KNOWLEDGE	SKILLS	VALUES
			(opposite sides) <ul style="list-style-type: none"> <li>• Alternate segments</li> <li>• Tangent properties of a circle</li> <li>• External angle of a cyclic Quadrilateral equal to the opposite interior angle</li> </ul>	circle theorems.	
11.9 CONSTRUCTION AND LOCI	11.9.1 Construction 11.9.2 Locus 11.9.3 Loci in two dimensions 11.9.4 Loci in three dimension	11.9.1.1 Construct line and angle bisectors 11.9.1.2 Explain the meaning of Locus 11.9.1.3 Describe locus of point in two and three dimensions 11.9.1.4 Construct locus of point in two dimensions	<ul style="list-style-type: none"> <li>• Line and angle bisectors</li> <li>• Finding the centre of circle</li> <li>• Constructing a tangent from a point to a circle</li> <li>• meaning of Locus</li> <li>• Locus of points in two and three dimensions (equidistant from a Point and two fixed points, from two intersecting line, from a Straight line)</li> <li>• Locus of points which subtends a constant angle</li> <li>• Locus of points such that the area of triangles is constant</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Identification</b> of loci of points.</li> <li>• <b>Construction</b> locus of point in two and three dimensions.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Accuracy</b> in construction.</li> <li>• <b>Neatness</b> in constructing lines and points.</li> <li>• <b>Appreciation</b> of loci.</li> </ul>

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	KNOWLEDGE	SKILLS	VALUES
11.10 TRIGONOMETRY	11.10.1 Introduction to Trigonometry 11.10.1 Trigonometric ratios 11.10.4 Sine and Cosine rules 11.10.5 Area of a triangle	11.10.1.1 Relate right angled triangle to the three trigonometric ratios 11.10.1.2 Describe the three trigonometric ratios on a right angled triangle 11.10.1.3 Calculate sides and angles of a right angled triangle 11.10.2.1 Work with special angles ( $60^\circ$ , $45^\circ$ and $30^\circ$ ) 11.10.4.1 Find sides and angles of non right angled triangles 11.10.5.1 Calculate areas of a non right angled triangle 11.10.7.1 Determine the signs of the three trigonometric ratios in the quadrants 11.10.7.2 Draw graphs for sine, cosine and tangent curves 11.10.7.3 Solve trigonometric equations 11.10.7.4 Use trigonometry to solve practical problems	<ul style="list-style-type: none"> <li>Sine, cosine and tangent ratios on a right angled triangle (Opposite, adjacent and hypotenuse sides)</li> <li>Three trigonometric ratios in quadrants</li> <li>Sides and angles of right angled triangles using the three trigonometric ratios</li> <li>Special angles (<math>60^\circ</math>, <math>45^\circ</math> and <math>30^\circ</math>)</li> <li>Finding sides and angles of non right angled triangles using the sine and cosine rule.</li> <li>Calculating area of a non right angled triangle using the sine rule.</li> <li>Using of Mathematical tables and scientific calculators</li> <li>Determining signs of the three trigonometric ratios</li> </ul>	<ul style="list-style-type: none"> <li>Comparison</li> <li><b>Identification</b> of trigonometric ratios.</li> <li><b>Interpretation</b> Opposite, adjacent and hypotenuse sides</li> <li><b>Computation</b> of sides and angles of a right angled triangle.</li> <li><b>Determination</b> of the signs of the three trigonometric ratios in respective quadrants</li> <li><b>Application</b> of trigonometry in rel life situations.</li> </ul>	<ul style="list-style-type: none"> <li><b>Appreciation</b> of trigonometry ratios.</li> <li><b>Curiosity</b> in using cosine and sine rules.</li> <li><b>Logical thinking</b> in computing trigonometric problems.</li> </ul>

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	KNOWLEDGE	SKILLS	VALUES
			in the quadrants <ul style="list-style-type: none"> <li>Graphs of (<math>y = \sin \theta</math>, <math>y = \cos \theta</math> and <math>y = \tan \theta</math>)</li> <li>Application of trigonometry (Include three dimensional figures) (Include: Bearings)</li> </ul>		
11.12 MENSURATION	11.12.1 Area 11.8.2 Volume	11.12.1.1 Calculate the area of a sector 11.12.1.2 Calculate surface area of three dimensional figures 11.8.3.1 Calculate volume of prisms 11.8.3.4 Solve problems involving area and volume	<ul style="list-style-type: none"> <li>Area of a sector</li> <li>Surface area of three dimensional figures (pyramid and cone)</li> <li>Volume of solids (cone, rectangular and triangular pyramids. Include: frustum)</li> <li>Solving problems involving area and volume.</li> </ul>	<ul style="list-style-type: none"> <li><b>Interpretation</b> of sector of a circle.</li> <li><b>Computation</b> of the area and volume of figures.</li> <li><b>Relation</b> between area and volume.</li> </ul>	<ul style="list-style-type: none"> <li><b>Appreciation</b> of area and volume of figures.</li> <li><b>Accuracy</b> in calculations of volume and area.</li> </ul>
11.13 PROBABILITY	11.12.3 Laws of probability 11.12.4 Tree Diagrams and grid	11.12.3.1 Compute probabilities using the laws of probability 11.12.4.1 Calculate probabilities using tree diagrams and grids. 11.12.4.2 Calculate probabilities of mutually exclusive events and compound events 11.12.4.3 Find probabilities of	<ul style="list-style-type: none"> <li>Addition and Multiplication Laws</li> <li>Calculating probabilities using tree diagrams and grids.</li> <li>Calculating expected values, Independent and dependent events, Mutually</li> </ul>	<ul style="list-style-type: none"> <li><b>Computation</b> of probabilities using the laws of probability</li> <li><b>Interpretation</b> tree diagrams and grids to calculate probabilities.</li> <li>Communication</li> <li><b>Analysis</b> of</li> </ul>	<ul style="list-style-type: none"> <li><b>Curiosity</b> in using laws of probabilities.</li> <li><b>Logical thinking</b> in calculating probabilities.</li> </ul>

TOPIC	SUB TOPIC	SPECIFIC OUTCOME	KNOWLEDGE	SKILLS	VALUES
		<p>independent events</p> <p>11.12.4.5 Apply probability to real life problems</p>	<p>exclusive events, conditional events and Compound events.</p> <ul style="list-style-type: none"> <li>• Continuous sample space.</li> </ul>	<p>mutually exclusive events, compound and independent events.</p>	
11.14 STATISTIC	<p>11.14.2 Cumulative frequency tables</p> <p>11.14.3 Measures of dispersion</p>	<p>12.7.2.1 Construct cumulative frequency tables using grouped and ungrouped data</p> <p>12.7.2.2 Draw cumulative frequency curves</p> <p>12.7.2.3 Draw relative cumulative curves</p> <p>12.7.3.2 Calculate the range, inter quartile range, and semi inter quartile range</p> <p>12.7.3.3 Calculate the percentiles</p> <p>12.7.3.4 Calculate variance and standard deviation for ungrouped and grouped data</p>	<ul style="list-style-type: none"> <li>• Constructing Cumulative frequency tables</li> <li>• Drawing Cumulative frequency curves (ogive)</li> <li>• Drawing Relative cumulative frequency curves</li> <li>• Calculating the range, inter quartile range, semi inter quartile range and Percentiles</li> <li>• Calculating variance and standard deviation for ungrouped and grouped data</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Drawing</b> cumulative tables and frequency curves.</li> <li>• <b>Computation</b> of measures of dispersion.</li> <li>• <b>Interpretation</b> of cumulative curves.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Logical thinking</b> in computation of measures of dispersion</li> <li>• <b>Appreciation</b> of cumulative and frequency curves.</li> </ul>

## GRADE 12

### General Outcomes

- Provide clear mathematical **thinking** and expression in the learner
- Develop the learners' mathematical **knowledge and skills**
- Enrich the learners' **understanding** of mathematical concepts in order to facilitate further study of the discipline
- Build up an appreciation of mathematical concepts so that the learner can **apply** these for problem solving in everyday life.
- Enable the learner **represent**, interpret and use data in a variety of forms
- Inculcate a desire to **develop different career paths** in the learners

### Key Competences

- Assimilate necessary mathematical concepts for use in everyday life such as environment and other related disciplines.
- Think mathematically and accurately in problem solving skills and apply these skills to formulate and solve mathematical and other related problems.
- Develop necessary skills needed to apply mathematical concepts and skills in other disciplines.
- Produce imaginative and creative work from mathematical concepts and ideas.
- Develop abilities and ideas drawn from mathematics to reason logically, communicate mathematically, and learn independently without too much supervision (self-discipline).
- Development positive attitudes towards mathematics and use it in other subjects such as science and technology.
- Apply mathematical tools such as information and communication technology in the learning of other subjects.
- Use mathematics for enjoyment and pleasure.
- Develop understanding of algebra, geometry, measurements and shapes.



TOPIC	SUB TOPIC	SPECIFIC OUTCOME	KNOWLEDGE	SKILLS	VALUES
12.1 GRAPHS OF FUNCTIONS	12.1.1 Cubic functions 12.1.2 Inverse functions	12.1.1.1 Draw graphs of cubic functions 12.1.1.2 Use graphs to find solutions 12.1.1.3 Determine gradients of curves 12.1.1.4 Estimate areas under curves 12.1.2.1 Draw graphs of inverse functions 12.1.2.2 Application of graphs of functions	<ul style="list-style-type: none"> <li>• Drawing Graphs of cubic functions</li> <li>• Finding Zeros of the function, Solutions of graphs</li> <li>• Determining Gradients of curves</li> <li>• Turning points and their nature (Maximum and minimum)</li> <li>• Area under the graph (Counting square, Trapezium)</li> <li>• Drawing Graphs of inverse functions</li> <li>• Exponential graphs</li> <li>• Applying graphs of functions</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Identification</b> of a cubic function.</li> <li>• <b>Interpretation</b> of gradients and areas under curves.</li> </ul> <b>Drawing</b> graphs of cubic and inverse functions.	<ul style="list-style-type: none"> <li>• <b>Neatness</b> in sketching graphs.</li> <li>• <b>Logical thinking</b> in determining area under the curve.</li> <li>• <b>Accuracy</b> in finding the turning points.</li> </ul>
12.2 LINEAR PROGRAMMI NG	12.2.1 Linear programming	12.2.1.2 Draw graphs of linear equations and inequations in one and two variables (as a recap) 12.2.1.3 Shade the wanted and unwanted regions 12.2.1.3 Describe the wanted or unwanted regions. 12.2.1.3 Determine maximum	<ul style="list-style-type: none"> <li>• Drawing graphs of linear equations and inequations in one and two variables (as a recap)</li> <li>• Shading the wanted and unwanted regions</li> <li>• Describing the wanted or unwanted region</li> <li>• Finding Values in the feasible region</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Interpretation</b> of the wanted or unwanted regions.</li> <li>• <b>Shading</b> of the unwanted region.</li> <li>• <b>Determination</b> of maximum and minimum values.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Logical thinking</b> in finding the wanted region.</li> <li>• <b>Planning</b> when using graph paper.</li> </ul>

		<p>and minimum values</p> <p>12.2.1.4 Use the search line to determine the maximum and minimum values</p> <p>12.2.1.5 Apply knowledge of linear programming in real life</p>	<ul style="list-style-type: none"> <li>Using the Search line to determine the maximum and minimum values</li> <li>Applying knowledge of linear programming in real life</li> </ul>	<ul style="list-style-type: none"> <li><b>Application</b> of linear programming in real life situation.</li> </ul>		
12.3	TRAVEL GRAPHS	12.3.1 Velocity - time graphs (Curves)	12.3.1.1 Calculate the displacement in a velocity - time graph	<ul style="list-style-type: none"> <li>Distance/area under the graph in a velocity - time graph</li> </ul>	<ul style="list-style-type: none"> <li><b>Representation</b> of velocity-time graphs.</li> <li><b>Interpretation</b> of displacement in a velocity - time graph.</li> </ul>	<ul style="list-style-type: none"> <li><b>Curiosity</b> in using velocity-time graphs</li> </ul>
12.4	VECTORS IN TWO DIMENSIONS	<p>12.4.1 Introduction to vectors</p> <p>12.4.2 Addition and subtraction</p> <p>12.4.3 Translations</p> <p>12.4.4 Scalar multiplication</p> <p>12.4.5 Collinearity</p> <p>12.4.6 Vector geometry</p>	<p>12.4.1.1 Describe a vector</p> <p>12.4.1.2 Represent and denote a vector</p> <p>12.4.2.1 Add and subtract vectors</p> <p>12.4.3.1 Apply translations on vectors and find magnitude</p> <p>12.4.4.1 Multiply vectors by scalars</p> <p>12.4.5.1 Determine collinearity of points</p> <p>12.4.6.1 Solve geometrical problems involving vectors</p>	<ul style="list-style-type: none"> <li>Describing a vector (direction and magnitude)</li> <li>Zero and Free vectors</li> <li>Representing and denoting</li> <li>Adding and subtracting vectors (triangular and parallelogram laws)</li> <li>Resultant vectors</li> <li>Multiplying vectors by scalars</li> <li>Translation (Position vectors)</li> <li>Component form</li> <li>Calculating Magnitude/Modulus of</li> </ul>	<ul style="list-style-type: none"> <li><b>Representation</b> of vector quantities</li> <li><b>Computation of</b> vector related problems</li> <li><b>Application</b> of vector in <b>Problem solving</b></li> </ul>	<ul style="list-style-type: none"> <li><b>Appreciation</b> of sense of direction</li> <li><b>Logical thinking</b> in solving vector problems.</li> <li><b>Creativity</b> in design</li> </ul>

			<ul style="list-style-type: none"> <li>vectors</li> <li>• Collinearity and parallelism</li> <li>• Ratios (Mid - point theorem)</li> <li>• Vector geometry</li> </ul>			
12.5 L TRANSFORMATIO NS	GEOMETRICA  TRANSFORMATIO NS	12.5.1 Introduction to transformation 12.5.2 Translation 12.5.3 Reflection. 12.5.4 Rotation. 12.5.5 Enlargement 12.5.6 Stretch 12.5.7 Shear 12.5.8 Combined transformations	12.5.1.1 Explain the concept of transformation 12.5.2.1 Use a column vector to translate an object 12.5.3.1 Reflect objects by different methods 12.5.4.1 Rotate objects by different methods 12.5.5.1 Enlarge objects by different methods 12.5.6.2 Stretch objects by different methods 12.5.6.3 Shear objects by different methods 12.5.8.1 Solve problems involving combined transformations 12.5.8.2 Find area scale factors of a stretch by determinant method	<ul style="list-style-type: none"> <li>• Explaining the concept of transformation (Object and Image)</li> <li>• Translation ( Translation vector, Mediator)</li> <li>• Reflection ( mirror lines and matrices of reflections)</li> <li>• Rotations (by construction and matrix methods)</li> <li>• Rotations ( Finding centre, angle and direction )</li> <li>• Finding matrix of rotation</li> <li>• Enlargement (by construction and matrix methods)</li> <li>• Finding the centre, scale factor and matrix of enlargement</li> <li>• Stretch (by construction and matrix methods)</li> <li>• Finding the centre, scale factor, invariant line</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Interpretation</b> the concept of transformation</li> <li>• <b>Comparison</b> between different forms of transformation.</li> <li>• <b>Computation</b> involving transformations.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Appreciation</b> of transformations</li> <li>• <b>Logical thinking</b> in solving transformations.</li> <li>• <b>Creativity</b> in designing.</li> </ul>

				<ul style="list-style-type: none"> <li>and matrix of stretch</li> <li>• Shear (by construction and matrix methods)</li> <li>• Finding the shear factor, invariant line and matrix of shear</li> <li>• Area scale factor</li> <li>• Determinant of a matrix</li> <li>• Inverse transformations</li> </ul>		
12.6	EARTH GEOMETRY	12.6.1 Introduction to Earth Geometry 12.6.2 Small and great circles 12.6.3 Latitudes and Longitudes 12.6.4 Distance along latitudes and longitudes 12.6.5 Speed in Knots and time	12.6.1.1 Explain the concept of Earth Geometry 12.6.2.1 Distinguish between small and great circles 12.6.3.1 Calculate distance along parallels of latitudes and longitude in kilometres and nautical miles 12.6.3.2 Calculate the shortest distance between two points on the surface of the earth 12.6.5.1 Calculate speed in knots and time	<ul style="list-style-type: none"> <li>• Explaining the concept of Earth Geometry and its significance</li> <li>• Southern and Northern hemispheres ( South and North Poles)</li> <li>• Great Circles(the equator and all longitudes)</li> <li>• The Greenwich and Equator</li> <li>• Small Circles(latitudes)</li> <li>• Centre of the earth</li> <li>• Length ,chord , arc and sector</li> <li>• Angular distance</li> <li>• Line of axis of the Earth</li> <li>• Circumference of the earth</li> <li>• Standard units of distances in degrees and miles (1° of latitude represents 60 nautical miles/or 110.9 Km)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Application</b> of the relationship of earth geometry in real life.</li> <li>• <b>Computation</b> of distances of latitudes and longitudes.</li> <li>• <b>Location</b> of points on the globe.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Appreciation</b> of the concept of earth geometry.</li> <li>• <b>Curiosity</b> in exploring earth geometry.</li> <li>• <b>Team work</b> through cooperative learning</li> </ul>

			<ul style="list-style-type: none"> <li>• Conversion of distance in kilometre and nautical mile</li> <li>• Longitude and time</li> <li>• Greenwich Mean Time</li> <li>• Solving problems involving Earth Geometry in real life</li> </ul>		
12.7 INTRODUCTION TO CALCULUS	12.7.1 Differentiation 12.7.2 Integration	12.7.1.1 Explain concept of differentiation 12.7.1.3 Differentiate functions from first principles. 12.7.1.4 Use the formula for differentiation 12.7.1.8 Calculate equations of tangents and normals 12.7.2.1 Explain integration 12.7.2.3 Find Indefinite integrals 12.7.2.2 Evaluate simple definite integrals 12.7.2.3 Find the area under the curve	<ul style="list-style-type: none"> <li>• Explaining the concept of differentiation</li> <li>• Differentiating functions from first principles ( Limits)</li> <li>• Product rule; chain rule and quotient rule (<math>y = ax^n</math>; <math>\frac{dy}{dx} = nax^{n-1}</math>)</li> <li>• Indefinite integrals</li> <li>• Arbitrary constant</li> <li>• Definite integrals</li> <li>• Stationary points</li> <li>• Secant</li> <li>• Tangents</li> <li>• Normal</li> <li>• Explain integration as the reverse of differentiation</li> <li>• Rule of integration <math>\left(\frac{dy}{dx} = ax^n; \int ax^n dx = \frac{ax^{n+1}}{n+1} + c\right)</math></li> <li>• Area under the curve</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Interpretation</b> of differentiation and integration</li> <li>• <b>Application</b> of definite integrals.</li> <li>• <b>Estimation</b> of area under the curve.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Appreciation</b> of calculus.</li> <li>• <b>Curiosity</b> in differentiating and integrating.</li> <li>• <b>Critical thinking</b> in using rules for differentiation and integration.</li> </ul>

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## GRADES 10 TO 12 “O” LEVEL MATHEMATICS SCOPE AND SEQUENCE

The table below shows the coverage of the syllabus in Mathematics from Grades 10 to 12. It is important for a teacher to refer to this table from time to time to know the knowledge that the learners already have or need to have at various levels of learning of the subject.

DOMAIN	TOPIC	SPECIFIC OUTCOME		
		GRADE 10	GRADE 11	GRADE 12
• ALGEBRA	• SETS	<ul style="list-style-type: none"> <li>• Carry out operations on sets.</li> <li>• Apply higher operations on sets</li> </ul>	•	•
	• LINEAR PROGRAMMING	•	•	<ul style="list-style-type: none"> <li>• Draw graphs of linear equations and inequations in one and two variables (as a recap)</li> <li>• Shade the wanted and unwanted regions</li> <li>• Describe the wanted or unwanted regions.</li> <li>• Determine maximum and minimum values</li> <li>• Use the search line to determine the maximum and minimum values</li> <li>• 12.2.1.5 Apply knowledge of linear programming in real life</li> </ul>
	• ALGEBRA	• Expand and simplify	•	•

		<ul style="list-style-type: none"> <li>expressions</li> <li>• Factorise algebraic expressions</li> <li>• Simplify Algebraic fractions</li> </ul>		
	<ul style="list-style-type: none"> <li>• MATRICES</li> </ul>	<ul style="list-style-type: none"> <li>• Find a Transpose of a matrix</li> <li>• Multiply matrices (up to 3x3 matrices)</li> <li>• Calculate the determinant of a 2 by 2 matrix</li> <li>• Find the inverse of a 2 by 2 matrix</li> <li>• Solve systems of linear equations in two variables</li> <li>• Apply matrices to solve real life problems</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
	<ul style="list-style-type: none"> <li>• QUADRATIC EQUATIONS</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Explain the meaning of the quadratic equation</li> <li>• Solve quadratic equations by graphical method</li> <li>• Solve quadratic equations using factorisation method</li> <li>• Solve quadratic equations using completing of square method</li> <li>• Solve quadratic equations using quadratic formula method</li> <li>• Apply quadratic</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>



			equations to solve real life problems	
	• VARIATION	•	<ul style="list-style-type: none"> <li>• Describe variation</li> <li>• Distinguish between direct and inverse variation</li> <li>• Distinguish between joint and partial variation</li> <li>• Draw and Interpret graphs of variation</li> <li>• Solve problems involving variations</li> </ul>	•
• FUNCTIONS	• QUADRATIC FUNCTIONS	•	<ul style="list-style-type: none"> <li>• Explain the quadratic function and its graph</li> <li>• Sketch the graph of a quadratic function</li> </ul>	•
	• INTRODUCTION TO CALCULUS	•	•	<ul style="list-style-type: none"> <li>• Explain concept of differentiation</li> <li>• Differentiate functions from first principles.</li> <li>• Use the formula for differentiation</li> <li>• Calculate equations of tangents and normals</li> <li>• Explain integration</li> <li>• Find Indefinite integrals</li> <li>• Evaluate simple definite integrals</li> <li>• Find the area under the curve</li> </ul>

<ul style="list-style-type: none"> <li>• GEOMETRY</li> </ul>	<ul style="list-style-type: none"> <li>• COORDINATE GEOMETRY</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Calculate the length of a straight line</li> <li>• Calculate the mid-point of two points</li> <li>• Calculate the gradient of a line segment</li> <li>• Find the equation of a straight line</li> <li>• Find the gradients of parallel and perpendicular lines</li> <li>• Use gradients of parallel and perpendicular lines to find equations</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
	<ul style="list-style-type: none"> <li>• VECTORS IN TWO DIMENSIONS</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Describe a vector</li> <li>• Represent and denote a vector</li> <li>• Add and subtract vectors</li> <li>• Apply translations on vectors and find magnitude</li> <li>• Multiply vectors by scalars</li> <li>• Determine collinearity of points</li> <li>• Solve geometrical problems involving vectors</li> </ul>
	<ul style="list-style-type: none"> <li>• SIMILARITY AND CONGRUENCY</li> </ul>	<ul style="list-style-type: none"> <li>• Calculate the scale on a map</li> <li>• Calculate length and area using</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>

		<ul style="list-style-type: none"> <li>a given scale and vice versa</li> <li>• Calculate areas and volumes of similar figures</li> <li>• Apply ratio, proportion, to solve problems on similarity and congruence</li> <li>•</li> </ul>		
	<ul style="list-style-type: none"> <li>• GEOMETRICAL TRANSFORMATIONS</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Explain the concept of transformation</li> <li>• Use a column vector to translate an object</li> <li>• Reflect objects by different methods</li> <li>• Rotate objects by different methods</li> <li>• Enlarge objects by different methods</li> <li>• Stretch objects by different methods</li> <li>• Shear objects by different methods</li> <li>• Solve problems involving combined transformations</li> <li>• Find area scale factors of a stretch by determinant method</li> </ul>
	<ul style="list-style-type: none"> <li>• 12.6 EARTH GEOMETRY</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Explain the concept of Earth Geometry</li> <li>• Distinguish between small and great circles</li> <li>• Calculate distance along parallels of</li> </ul>

				latitudes and longitude in kilometres and nautical miles <ul style="list-style-type: none"> <li>• Calculate the shortest distance between two points on the surface of the earth</li> <li>• Calculate speed in knots and time</li> </ul>
	<ul style="list-style-type: none"> <li>• BEARINGS</li> </ul>	<ul style="list-style-type: none"> <li>• Draw/sketch diagrams to represent position and direction</li> <li>• Use bearing and scale drawing in real life</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
	<ul style="list-style-type: none"> <li>• CIRCLE THEOREMS</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Analyse the parts of a circle</li> <li>• Solve problems using angle properties of a circles</li> <li>• Solve problems involving tangent properties</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
	<ul style="list-style-type: none"> <li>• SYMMETRY</li> </ul>	<ul style="list-style-type: none"> <li>• Determine order of rotational symmetry</li> <li>• Determine symmetry of solids</li> <li>• Determine plane symmetry</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
	<ul style="list-style-type: none"> <li>• CONSTRUCTION AND LOCI</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Construct line and angle bisectors</li> <li>• Explain the meaning of Locus</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>

			<ul style="list-style-type: none"> <li>• Describe locus of point in two and three dimensions</li> <li>• Construct locus of point in two dimensions</li> </ul>	
	<ul style="list-style-type: none"> <li>• 11.10 TRIGONOMETRY</li> </ul>	•	<ul style="list-style-type: none"> <li>• Relate right angled triangle to the three trigonometric ratios</li> <li>• Describe the three trigonometric ratios on a right angled triangle</li> <li>• Calculate sides and angles of a right angled triangle</li> <li>• Work with special angles (<math>60^\circ</math>, <math>45^\circ</math> and <math>30^\circ</math>)</li> <li>• Find sides and angles of non right angled triangles</li> <li>• Calculate areas of a non right angled triangle</li> <li>• Determine the signs of the three trigonometric ratios in the quadrants</li> <li>• Draw graphs for sine, cosine and tangent curves</li> <li>• Solve trigonometric</li> </ul>	•

			<ul style="list-style-type: none"> <li>equations</li> <li>• Use trigonometry to solve practical problems</li> </ul>	
<ul style="list-style-type: none"> <li>• MEASURES</li> </ul>	•	•	<ul style="list-style-type: none"> <li>• Calculate the area of a sector</li> <li>• Calculate surface area of three dimensional figures</li> <li>• Calculate volume of prisms</li> <li>• Solve problems involving area and volume</li> </ul>	•
	<ul style="list-style-type: none"> <li>• PROBABILITY</li> </ul>	•	<ul style="list-style-type: none"> <li>• Compute probabilities using the laws of probability</li> <li>• Calculate probabilities using tree diagrams and grids.</li> <li>• Calculate probabilities of mutually exclusive events and compound events</li> <li>• Find probabilities of independent events</li> <li>• Apply probability to real life problems</li> </ul>	•
<ul style="list-style-type: none"> <li>• MEASURES AND CALCULATIONS</li> </ul>	<ul style="list-style-type: none"> <li>• TRAVEL GRAPHS</li> </ul>	•	•	<ul style="list-style-type: none"> <li>• Calculate the displacement in a</li> </ul>

				velocity - time graph
	<ul style="list-style-type: none"> <li>• TRAVEL GRAPHS</li> </ul>	<ul style="list-style-type: none"> <li>• Compute average speed, distance and time</li> <li>• Determine acceleration and retardation/deceleration</li> <li>• Draw travel graphs</li> <li>• Calculate the distance under a velocity time graph</li> <li>• Relate area under the graph to distance travelled</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
	<ul style="list-style-type: none"> <li>• SOCIAL AND COMMERCIAL ARITHMETIC</li> </ul>	<ul style="list-style-type: none"> <li>• Carry out calculations that involve Shares, dividends and investment Bonds</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
	<ul style="list-style-type: none"> <li>• SEQUENCES AND SERIES</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Identify an arithmetic progression (AP)</li> <li>• Find the nth term of the AP</li> <li>• Find the sum of an AP</li> <li>• Find the arithmetic mean</li> <li>• Identify a geometric progression (GP)</li> <li>• Find the nth term of a GP</li> <li>• Find the geometric mean</li> <li>• Find the sum of a geometric progression</li> <li>• Find the sum to infinity of a Geometric</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>

			progression	
	<ul style="list-style-type: none"> <li>• COMPUTER AND CALCULATOR</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrate the use of different functions on a calculator</li> <li>• Describe components of a computer</li> <li>• Describe various methods of implementing an algorithm</li> <li>• Outline problem solving stages</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
	<ul style="list-style-type: none"> <li>• APPROXIMATIONS</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Work with relative and absolute errors</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
	<ul style="list-style-type: none"> <li>• INDEX NOTATION</li> </ul>	<ul style="list-style-type: none"> <li>• Apply laws of indices</li> <li>• Simplify positive, negative and zero indices</li> <li>• Simplify fractional indices</li> <li>• Solve equations involving indices</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
<ul style="list-style-type: none"> <li>• RELATIONS</li> </ul>	<ul style="list-style-type: none"> <li>• 12.1 GRAPHS OF FUNCTIONS</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Draw graphs of cubic functions</li> <li>• Use graphs to find solutions</li> <li>• Determine gradients of curves</li> <li>• Estimate areas under curves</li> <li>• Draw graphs of inverse functions</li> <li>• Application of graphs of functions</li> </ul>
	<ul style="list-style-type: none"> <li>• RELATIONS AND FUNCTIONS</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Find inverses of one-to-one functions</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>



			<ul style="list-style-type: none"> <li>• Simplify composite functions</li> <li>• Solve problems involving linear functions</li> </ul>	
<ul style="list-style-type: none"> <li>• STATISTICS</li> </ul>	<ul style="list-style-type: none"> <li>• STATISTIC</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Construct cumulative frequency tables using grouped and ungrouped data</li> <li>• Draw cumulative frequency curves</li> <li>• Draw relative cumulative curves</li> <li>• Calculate the range, inter quartile range, and semi inter quartile range</li> <li>• Calculate the percentiles</li> <li>• Calculate variance and standard deviation for ungrouped and grouped data</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>