



KENYA INSTITUTE OF CURRICULUM DEVELOPMENT
A Skilled and Ethical Society

SENIOR SCHOOL CURRICULUM DESIGN

CORE MATHEMATICS

GRADE 11

OCTOBER, 2025

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NATIONAL GOALS OF EDUCATION

Education in Kenya should:

1. Foster nationalism and patriotism and promote national unity.

Kenya's people belong to different communities, races and religions, but these differences need not divide them. They must be able to live and interact as Kenyans. It is a paramount duty of education to help young people acquire this sense of nationhood by resolving conflicts and promoting positive attitudes of mutual respect which enable them to live together in harmony and foster patriotism in order to make a positive contribution to the life of the nation.

2. Promote the social, economic, technological and industrial needs for national development.

Education should prepare the youth of the country to play an effective and productive role in the life of the nation.

a) Social Needs

Education in Kenya must prepare children for changes in attitudes and relationships which are necessary for the smooth progress of a rapidly developing modern economy. There is bound to be a silent social revolution following in the wake of rapid modernization. Education should assist our youth to adapt to this change.

b) Economic Needs

Education in Kenya should produce citizens with the skills, knowledge, expertise and personal qualities that are required to support a growing economy. Kenya is building up a modern and independent economy which is in need of an adequate and relevant domestic workforce.

c) Technological and Industrial Needs

Education in Kenya should provide learners with the necessary skills and attitudes for industrial development. Kenya recognizes the rapid industrial and technological changes taking place, especially in the developed world. We can only be part of this development if our education system is deliberately focused on the knowledge, skills and attitudes that will prepare our young people for these changing global trends.

3. Promote individual development and self-fulfillment

Education should provide opportunities for the fullest development of individual talents and personality. It should help children to develop their potential interests and abilities. A vital aspect of individual development is the building of character.

4. Promote sound moral and religious values.

Education should provide for the development of knowledge, skills and attitudes that will enhance the acquisition of sound moral values and help children to grow up into self-disciplined, self-reliant and integrated citizens.

5. Promote social equality and responsibility.

Education should promote social equality and foster a sense of social responsibility within an education system which provides equal educational opportunities for all. It should give all children varied and challenging opportunities for collective activities and corporate social service irrespective of gender, ability or geographical environment.

6. Promote respect for and development of Kenya's rich and varied cultures.

Education should instil in the youth of Kenya an understanding of past and present cultures and their valid place in contemporary society. Children should be able to blend the best of traditional values with the changing requirements that must follow rapid development in order to build a stable and modern society.

7. Promote international consciousness and foster positive attitudes towards other nations.

Kenya is part of the international community. It is part of the complicated and interdependent network of peoples and nations. Education should therefore lead the youth of the country to accept membership of this international community with all the obligations and responsibilities, rights and benefits that this membership entails.

8. Promote positive attitudes towards good health and environmental protection.

Education should inculcate in young people the value of good health in order for them to avoid indulging in activities that will lead to physical or mental ill health. It should foster positive attitudes towards environmental development and conservation. It should lead the youth of Kenya to appreciate the need for a healthy environment.

THE SENIOR SCHOOL IN THE COMPETENCY BASED CURRICULUM

Senior School is the fourth level of Basic Education in the Competency Based Curriculum (CBC) that the learner shall proceed to after the Pre-Primary School, Primary School and Junior School levels. The essence of Senior School is to offer learners a pre-tertiary/university/ pre-career experience in which the learners have an opportunity to choose pathways, tracks and subjects where they shall have demonstrated interest and/or potential at the earlier levels. Senior School comprises three years of education for learners generally in the 16-18 years age bracket and lays the foundation for further education and training at the tertiary level and the world of work. In the CBC vision, learners exiting this level are expected to be *engaged, empowered and ethical citizens* ready to participate in the socio-economic development of the nation.

At this level, the learner shall take seven (7) learning areas as recommended by the *Presidential Working Party on Educational Reforms* (PWPER, 2023). These shall comprise **four compulsory learning areas** namely: English, Kiswahili, Essential Mathematics/Core Mathematics and Community Service Learning (CSL). Learners will choose between Core Mathematics (for learners pursuing the Science Technology Engineering and Mathematics Pathway) and Essential Mathematics (for learners pursuing the non-STEM pathways). The learner will select three learning areas depending on their career choice, aptitude, interest and personality with guidance by the Senior School career teacher.

LEARNING OUTCOMES FOR SENIOR SCHOOL

By the end of Senior School, the learner should be able to:

1. communicate effectively and utilise information and communication technology across varied contexts,
2. apply mathematical, logical and critical thinking skills for problem solving,
3. apply basic research and scientific skills to manipulate the environment and solve problems,
4. exploit individual talents for leisure, self-fulfilment, career growth, further education and training,
5. uphold national, moral and religious values and apply them in day-to-day life,
6. apply and promote health care strategies in day-to-day life,
7. protect, preserve and improve the environment for sustainability,
8. demonstrate active local and global citizenship for harmonious co-existence,
9. demonstrate appreciation of diversity in people and cultures,
10. manage pertinent and contemporary issues responsibly.

TABLE 1: LIST OF SUBJECTS AT SENIOR SCHOOL

Core Subjects	Arts & Sports Science	Social Sciences	Science, Technology, Engineering & Mathematics (STEM)
1. English 2. Kiswahili/KSL 3. Core Mathematics/ Essential Mathematics 4. Community Service Learning (CSL)	5. Sports and Recreation 6. Music and Dance 7. Theatre and Film 8. Fine Arts	9. Literature in English 10. Indigenous Languages 11. Fasihi ya Kiswahili 12. Sign Language 13. Arabic 14. French 15. German 16. Mandarin Chinese 17. Christian Religious Education 18. Islamic Religious Education 19. Hindu Religious Education 20. Business Studies 21. History and Citizenship 22. Geography	23. Biology 24. Chemistry 25. Physics 26. General Science 27. Agriculture 28. Computer Studies 29. Home Science 30. Aviation 31. Building Construction 32. Electricity 33. Metalwork 34. Power Mechanics 35. Woodwork 36. Media Technology 37. Marine and Fisheries Technology

Note:

- Physical Education (PE) and Information Communication and Technology (ICT) will be offered to all learners to facilitate learning, enjoyment and acquisition of life skills.
- Every school shall offer Pastoral/Religious Programme of Instruction (P/RPI) to enhance moral, spiritual and character development of the learners.
- There shall be one (1) lesson for personal or group study to deepen knowledge and enhance skills in areas of choice by the learners.

Table 2 provides guidelines on distribution of lessons at Senior School.

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TABLE 2: LESSON DISTRIBUTION AT SENIOR SCHOOL

Subjects	No of Lessons Per Week (40 minutes per lesson)
Core Subjects 4	
1. English	5
2. Kiswahili	5
3. Essential Mathematics/Core Mathematics	5
4. Community Service Learning	3
Elective Subjects	
5. Elective 1	5
6. Elective 2	5
7. Elective 3	5
* Physical Education	3
* ICT Skills	2
*PPI	1
* Learner Personal /Group Study	1
Total Number of Lessons	40

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ESSENCE STATEMENT

In Senior School, Core Mathematics builds on the competencies acquired by the learner from Junior school. This Mathematics will focus on developing learners' critical, creative and logical reasoning as well as abstraction skills. By abstract thinking the learner will develop the ability to identify patterns and relationships, generalize from specific samples to rules and principles that apply to a wider range of situations, and create concepts and models that represent larger ideas.

Core Mathematics will include concepts in numbers, algebra, measurements, and in geometry; constructions, navigation, and graphical methods. In transformations, the course will have shears, translations and stretch beyond reflection and rotation. The Euclidian geometry is critical to understanding the phenomenon of plane and solid geometry. In addition, Statistics and Probability are useful in research analysis, organization and presentations skills for making informed decisions. Overall, this course will enable learners to derive laws and formulas from first principles to develop higher order thinking, creative thinking and problem solving skills. For holistic development and wellbeing of learners Pertinent and Contemporary Issues such as Life Skills, Citizenship and Education for Sustainable Development as well as Values are integrated into this Mathematics course for use in day to day life.

Core Mathematics will play a pivotal role in supporting other subjects particularly in Science, Technology and Engineering fields but also in other learning areas. It will enhance the learner's skills in using mathematics effectively, efficiently and critically to make informed decisions including the choice of projects for experiential learning that can lead to innovations and inventions. More importantly, the subject will provide opportunities to learners to prepare for post-school options of further training in careers such as medical fields, engineering, researchers, physicists, actuarial scientists as well as entrepreneurship.

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SUBJECT GENERAL LEARNING OUTCOMES

By the end of the course the learner should be able to:

- a) Acquire numerical computational skills, concepts and competencies for continuous learning and application of Mathematics,
- b) Develop critical and creative thinking, logical reasoning, and communication skills for problem solving,
- c) Use Mathematical concepts and skills to support other learning areas for further training, research and career development,
- d) Build confidence and interest in Mathematics for lifelong learning,
- e) Evaluate and make financial decisions and transactions in real life situations,
- f) Model geometric structures in real life situations,
- g) Collect, analyze and present data to inform and solve problems in real life situations,
- h) Use digital technologies for Mathematical manipulations, explorations and innovations, and for further learning,
- i) Appreciate the aesthetic value of Mathematics in different contexts.

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SUMMARY OF STRANDS AND SUB STRANDS

Strand	Sub-strand
1.0 Numbers and Algebra	1.1 Quadratic Expressions and Equations
	1.2 Irrational numbers
	1.3 Linear Inequalities
	1.4 Logarithms II
	1.5 Formulae and Variations
	1.6 Sequences and Series
	1.7 Matrices (I)
2.0 Measurements and Geometry	2.1 Approximation and Errors
	2.2 Angle Properties of a Circle
	2.3 Commercial Arithmetic
	2.4 Circles, Chords and Tangents
	2.5 Trigonometry (II)
	2.6 Graphical Methods
3.0 Statistics and Probability	3.1 Permutations and combinations
	3.2 Probability II
4.0 Calculus	4.1 Functions
	4.2 Differentiation (I)

STRAND 1: NUMBERS AND ALGEBRA**Sub-strand 1: Quadratic Expressions and Equations**

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
1.0 Numbers and Algebra	1.1 Quadratic Expressions and Equations - <i>Perfect squares</i> - <i>completing squares</i> - <i>Quadratic formula</i> - <i>Solution of quadratic equations using the quadratic formula</i> - <i>Solution of simultaneous equations, one linear and one quadratic by substitution</i> - <i>Application of quadratic equations</i>	By the end of the sub-strand, the learner should be able to: - identify perfect squares in quadratic expressions and equations, - solve quadratic equations by completing square method, - derive the quadratic formula using completing square, - solve quadratic equations using the quadratic formula, - solve simultaneous equations involving linear and quadratic equations,	The learner is guided to: - work with peers to factorise quadratic expressions and select perfect squares, - discuss the process of completing squares in quadratic equations, - use completing square method to determine the roots of quadratic equations, - work with peers to obtain the quadratic formula from the general quadratic equation, - discuss and interpret the discriminant ($b^2 - 4ac$) in a quadratic equation, - use the quadratic formula to find the roots of quadratic equations,	How are quadratic equations applied in day to day life?

		f) apply quadratic equations in real-life situations, g) appreciate the application of quadratic equations in real-life situations.	- follow the steps in working out simultaneous equations involving linear and quadratic equations, - discuss in a group to form and solve quadratic equations from roots and real life situations.	
Core Competencies to be developed: - Critical thinking and problem solving: the learner follows the steps in working out simultaneous equations involving linear and quadratic equations. - Communication and collaboration: the learner collaborates and obtains the quadratic formula from the general quadratic equation.				
Values: - Unity: the learner collaborates and obtains the quadratic formula from the general quadratic equation. - Respect: the learner works with others to interpret the discriminant in a quadratic equation.				
Pertinent and Contemporary Issues (PCIs): Social cohesion: the learner discusses in a group to form and solve quadratic equations in real life situations.				

Sub-strand 2: Irrational Numbers

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
1.0 Numbers and Algebra	1.2 Irrational numbers - Irrational numbers - Simplification of irrational numbers - Operations on irrational numbers - Rationalisation of irrational numbers	By the end of the sub-strand, the learner should be able to: a) identify irrational numbers in from set of real numbers, b) simplify irrational numbers in different situations, c) perform operations on irrational numbers in different situations, d) rationalise irrational numbers in different situations, e) apply irrational numbers in different situations, f) reflect on the use of irrational numbers in mathematical computations.	The learner is guided to: - use a set of real numbers to distinguish between rational and irrational numbers, - work with peers simplify irrational numbers in form of fractions and non-fractions, - carry out operations involving addition, subtraction and multiplication of irrational numbers, - work with peers generate conjugates of irrational numbers and use them to simplify the denominator with irrational number, - solve irrational numbers from real life situations, - use digital devices and other resources to learn more on application of irrational numbers in real life.	How are irrational numbers used in daily life?

Core Competencies to be developed:

- Critical Thinking and Problem Solving: the learner works with others to come up with ways of simplifying irrational numbers.
- Communication and Collaboration: the learner discusses with peers on how to identify conjugates of irrational numbers.

Values:

Unity: the learner cooperates with others as they simplify irrational numbers.

Pertinent and Contemporary Issues (PCIs):

Peer Education: the learner discusses with peers how to identify conjugates of irrational numbers.

Sub-strand 3: Linear Inequalities

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
1.0 Numbers and Algebra	1.3 Linear Inequalities <i>- Simple and compound inequality statements</i> <i>- Linear inequality in two unknowns</i> <i>- Graphical representation of linear inequalities</i> <i>- Graphical solutions of simultaneous linear inequalities</i> <i>- Simple linear inequalities from inequality graphs</i>	By the end of the sub-strand, the learner should be able to: a) solve compound inequalities in one unknown, b) represent linear inequalities in two unknowns graphically, c) solve the linear inequalities in two unknowns graphically, d) form simple linear inequalities from inequality graphs, e) apply inequalities to real life situations. f) appreciate the use of inequalities in real life.	The learner is guided to: ● work with peers to obtain inequality expressions from compound inequality statements, ● draw graphs of compound inequalities on a Cartesian plane and shade the unwanted region, ● use graphs to identify the region satisfying the inequality statements, ● work with peers to generate the simple linear inequalities from inequality graphs, ● relate the inequality symbols to the speed limits signs on the roads, ● use digital resources to represent linear inequalities graphically.	How are linear inequalities used in day to day life?

Core Competencies to be developed: • Critical thinking and problem solving: the learner analyses compound inequalities then represent them on a number line. • Communication and collaboration: the learner collaborates with peers to draw graphs of compound inequalities on a Cartesian plane.
Values Responsibility: the learner follows procedures in drawing graphs of linear inequalities involving two unknowns.
Pertinent and Contemporary Issues (PCIs) Road safety: the learner relates the inequality symbols to the speed limits signs on the roads,

Sub-strand: Logarithms II

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
1.0 Numbers and Algebra	1.4 Logarithms II <i>-Logarithmic notation</i> <i>-The laws of logarithms (addition, subtraction power rule and roots)</i> <i>-Simplification of logarithmic expressions</i> <i>-Solution of logarithmic equations</i> <i>-Applications of logarithmic laws</i>	By the end of the sub-strand, the learner should be able to: - relate index form to logarithmic notation, - simplify logarithmic expressions using laws of logarithms, - solve logarithmic equations in different situations, - apply laws of logarithms in different situations, - explore the use of logarithms in real life situations.	The learner is guided to: • express a number in logarithmic notation using powers and bases, • work with peers to derive the laws of logarithms by relating them to the laws of indices, • work with peers to simplify logarithmic expressions using the laws of logarithms, • use laws of logarithms to simplify equations involving unknown indices and bases, • discuss applications of logarithms in numerical calculations, • use digital devices to learn more on the applications of laws of logarithms.	Why are logarithms important?

Core Competencies to be developed: • Critical thinking and problem solving: the learner derives the laws of logarithms by relating them to the laws of indices. • Communication and collaboration: the learner discusses with peers the relationship between index form and logarithmic notation.
Values: • Unity: the learner works with others in groups to simplify logarithmic expressions. • Respect: the learner recognises the input of every member of the group as they discuss with peers on how to simplify logarithmic expressions using varied examples.
Pertinent and Contemporary Issues (PCIs): Social cohesion: the learner works out varied examples in groups by applying laws of logarithms.

Sub-strand 5: Formulae and variations

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
1.0 Numbers and Algebra	1.5 Formulae and Variations <i>- Changing the subject of the formula</i> <i>- Direct, inverse, partial and joint variations</i> <i>- Graphs of direct and inverse variation</i> <i>- Applications of variations.</i>	By the end of the sub-strand, the learner should be able to: - rewrite a formula to change the subject in different situations, - solve direct and inverse variations from real life situations, - solve combined, joint and partial variations in different situations, - draw graphs of direct and inverse variations, - apply variations to real life situations, - appreciate the use of variations in day-to-day life.	The learner is guided to: • work with peers to manipulate a formula and change its subject, • work out value of quantities that vary directly and inversely from given situations, • work out the constant of proportionality in a variation, • work with peers to identify situations that bear joint, combined and partial variations such as formulas from given statements, • work with peers to work out value of quantities that bears combines, joint and partial variations, • plot the graphs from tables generated from equations of direct and inverse variations, • work out tasks involving partial and joint variations,	How is formula and variations applied in real life situations?

			discuss applications of variations in day to day life such as planning activities and events.	
Core Competencies to be developed: - Creativity and imagination: the learner plots the graphs of direct and inverse variations. - Critical thinking and Problem solving: the learner critically analyses a formula in order to change its subject.				
Values: Unity: the learner collaborates with peers to establish relationships between variables in variations.				
Pertinent and Contemporary Issues (PCIs): Life skills and values: the learner comes up with solution involving partial and joint variations				

Sub-strand 6: Sequence and Series

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
1.0 Numbers and Algebra	1.6 Sequences and Series - Number Sequences - Arithmetic sequence - Geometric sequence - Arithmetic and geometric progression - Sum of Arithmetic and geometric progression - Sum to infinity in G.P - Application of Arithmetic and Geometric Progressions	By the end of the sub-strand, the learner should be able to: - determine an nth term in a number sequence, - determine terms and common difference in an arithmetic sequence and series, - compute the terms and common ratio in a geometric sequence and series, - determine the sum of terms in arithmetic and geometric series, - apply sequences and series to real-life situations,	The learner is guided to: - work with peers to establish a rule for given number sequence to work out the required term for given arithmetic or geometric series, - discuss first term and the common difference in an arithmetic progression and use then to determine the u, - work out terms and the common ratio in a geometric progression, - work with peers to derive the general formula for getting the nth term in an arithmetic and geometric progressions,	How is sequences and series used in real-life situations?

		f) appreciate the use of sequences and series in real life.	• derive the formula for the sum of terms of an arithmetic and geometric, • work out the sum of terms for AP and GP series, • work out tasks involving sequences and series, • use digital devices to learn more on sequences and series.	
Core Competencies to be developed: • Critical thinking and problem solving: the learner generates a formula for the n^{th} term of an AP and a GP and present to peers. • Digital literacy: the learner works with digital devices generating various sequences and series.				
Values: • Unity: the learner discusses in a group on how to determine the first term and the common difference and hence predict the consecutive terms in a given AP. • Respect: the learner recognises the input of every member as they discuss and work out the sum of n terms for a given AP and GP series.				
Pertinent and Contemporary Issues (PCIs): • Road safety: list down simple number patterns, including the traffic lights intervals. • Social awareness: Effective communication- the learner communicates effectively during discussions for the determination of the first term and common ratio and hence predict in peers the consecutive terms in a given GP.				

Sub-strand 7: Matrices (I)

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
1.0 Numbers and Algebra	1.7 Matrices (I) -Types of matrices (<i>column matrix, row matrix, square matrix, rectangular matrix, null matrix and identity matrix</i>) -Properties of a matrix (<i>elements in a matrix, order of a matrix, compatibility of two or more matrices</i>)	By the end of the sub-strand, the learner should be able to: a) identify types of matrices using rows and columns b) determine properties of a matrix from rows and columns, c) perform addition and subtraction of compatible matrices, d) multiply compatible matrices in different situations, e) Compute the determinant of a 2 by 2 matrix, f) determine the inverse of a 2 by 2 matrix, g) solve linear equations in two unknowns using matrix method,	The learner is guided to: • work with peers to recognise column matrix, row matrix, square matrix, rectangular matrix, null matrix and identity matrix, • discuss with peers and identify the position of elements and order of matrices, • work with peers to recognise compatible matrices then carry out addition and subtraction of compatible matrices, • work out multiplication of a matrix by a scalar and a matrix by a matrix, • work out the determinant of a 2 by 2 matrix and identify singular matrix, • work with peers to obtain the inverse of a 2 by 2 matrix,	How is the knowledge of matrices used in real life?

		h) explore the use of matrices in real life situations.	• practice solving equations involving two unknowns using matrices, • interpret real life cases, form equations in two unknowns and obtain solutions using matrices, • use digital devices or other resources to learn more on the use of matrices in real life situations.	
Core Competencies to be developed: • Critical thinking and problem solving: As the learner interprets real life cases, forms equations involving two unknowns and solves them using matrices. • Communication and collaboration: The learner exhibits teamwork by contributing to group decision making as they discuss and practice solving equations involving two unknowns				
Values: • Unity: as the learner cooperatively discusses with peers and identifies the elements and order of matrices • Respect: as the learner accepts and recognises the input of every member of the group as they work out the determinant of a matrix and identify singular matrix.				
Pertinent and Contemporary Issues (PCIs): Social cohesion: as the learner peacefully discusses in groups and practices solving equations involving two unknowns using matrices.				

Suggested Assessment Rubric

Level Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
Ability to identify perfect squares in quadratic expressions and equations and solve quadratic equations using completing square method	The learner accurately identifies perfect squares in quadratic expressions and equations and solves them using the completing square method with varied examples.	The learner accurately identifies perfect squares in quadratic expressions and equations and solves them using the completing square method as expected.	The learner identifies perfect squares in quadratic expressions or equations or partially solves them using the completing square method	The learner identifies perfect squares in simple expressions or equations
Ability to derive the quadratic formula from first principles and solve quadratic equations using the formula method.	The learner accurately derives the quadratic formula from first principles and solves quadratic equations using the formula method with varied examples.	The learner accurately derives the quadratic formula from first principles and solves quadratic equations using the formula method.	The learner derives the quadratic formula from first principles or solves quadratic equations using the formula method.	The learner accurately derives the quadratic formula from first principles
Ability to identify irrational numbers, simplify irrational numbers and perform	The learner correctly identifies irrational numbers, simplifies them and performs operations on irrational	The learner correctly identifies irrational numbers, simplifies irrational numbers, and	The learner identifies irrational numbers and simplifies basic forms, or performs operations	The learner identifies irrational numbers

Level Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
operations on irrational numbers.	numbers in varied contexts.	performs operations on irrational numbers.	with irrational numbers.	
Ability to identify conjugates of irrational numbers and rationalise surds.	The learner correctly identifies conjugates of irrational numbers and expertly rationalises complex surds using examples.	The learner correctly identifies conjugates of irrational numbers and rationalises surds.	The learner identifies conjugates of irrational numbers or rationalise surds, making errors in simplification.	The learner identifies conjugates of irrational numbers
Ability to solve compound inequalities in one unknown, illustrate inequalities on a number line and on a Cartesian plane.	The learner correctly solves complex compound inequalities in one unknown, and accurately illustrates inequalities on number lines and Cartesian planes with precision.	The learner correctly solves complex compound inequalities in one unknown, and accurately illustrates inequalities on number lines and Cartesian planes.	The learner correctly solves complex compound inequalities in one unknown, or accurately illustrates inequalities on number lines and Cartesian planes.	The learner correctly solves complex compound inequalities in one unknown, or accurately illustrates inequalities on number lines.
Ability to represent linear inequalities in two unknowns graphically, solve linear inequalities in two unknowns graphically and form simple linear	The learner accurately represents linear inequalities in two unknowns graphically, solves linear inequalities in two unknowns graphically and forms simple	The learner accurately represents linear inequalities in two unknowns graphically, solves linear inequalities in two unknowns graphically and forms simple	The learner represents linear inequalities in two unknowns graphically or solves linear inequalities in two unknowns graphically	The learner represents linear inequalities in two unknowns graphically

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Level Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
inequalities from inequality graphs.	linear inequalities from inequality graphs of varied scenarios.	linear inequalities from inequality graphs.		
Ability to relate the index form to logarithmic notation and derive the laws of logarithms.	The learner correctly and comprehensively relates the index form to logarithmic notation and derives the laws of logarithms.	The learner correctly relates the index form to logarithmic notation and derives the laws of logarithms as expected.	The learner relates the index form to logarithmic notation or derives the laws of logarithms.	The learner relates the index form to logarithmic notation
Ability to simplify logarithmic expressions, solve logarithmic equations and apply laws of logarithms.	The learner correctly simplifies logarithmic expressions, solves challenging logarithmic equations, and applies laws of logarithms to varied contexts.	The learner correctly simplifies logarithmic expressions, solves logarithmic equations, and applies laws of logarithms	The learner simplifies logarithmic expressions or solves basic logarithmic equations,	The learner simplifies logarithmic expressions
Ability to make a variable subject of a formula, compute direct and inverse variations.	The learner correctly and comprehensively makes a variable the subject of formulas and computes both direct and inverse variations.	The learner correctly makes a variable the subject of formulas and computes direct and inverse variations	The learner makes a variable the subject of formulas and computes either direct or inverse variations.	The learner makes a variable the subject of simple formulas

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Level Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
Ability to draw graphs to represent direct and inverse variations.	The learner accurately draws graphs to represent direct and inverse variations with precision.	The learner accurately draws graphs to represent direct and inverse variations	The learner accurately draws graphs to represent direct or inverse variations	The learner draws graphs to represent direct
Ability to work out partial and joint variations and apply variations to solve equations involving variations.	The learner correctly works out partial and joint variations and applies them to solve equations involving variations of varied scenarios.	The learner correctly works out partial and joint variations and applies them to solve equations involving variations	The learner correctly works out partial or joint variations or applies them to solve equations involving variations	The learner works out partial or joint variations.
Ability to identify simple number patterns, determine a term in a number sequence, the first term and common difference in an arithmetic sequence.	The learner correctly identifies simple number patterns, determines a term in a sequence, the first term and common difference in arithmetic sequences of varied cases.	The learner correctly identifies simple number patterns, determines a term in a sequence, the first term and common difference in arithmetic sequences	The learner partially identifies simple number patterns or determines a term in a sequence or the first term or common difference in arithmetic sequences	The learner identifies simple number patterns or determines a term in arithmetic sequences
Ability to determine the first term and	The learner accurately determines the first term and common ratio	The learner accurately determines the first	The learner determines the first term or	The learner determines the first term in geometric sequences

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Level Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
common ratio in a geometric sequence.	in geometric sequences of varied cases.	term and common ratio in geometric sequences	common ratio in geometric sequences	
Ability to derive the formula for the sum of n terms of an arithmetic and geometric series and apply the knowledge of sequences and series.	The learner correctly derives the formula for the sum of n terms of an arithmetic and geometric series and apply the knowledge of sequences and series in various cases.	The learner correctly derives the formula for the sum of n terms of an arithmetic and geometric series and apply the knowledge of sequences and series	The learner partially derives the formula for the sum of n terms of an arithmetic or geometric series	The learner derives the formula for the sum of n terms of an arithmetic series
Ability to determine the properties of a matrix, carry out addition, subtraction and multiplication of matrices.	The learner correctly determines the properties of a matrix, carries out addition, subtraction and multiplication of matrices using examples.	The learner correctly determines the properties of a matrix, carries out addition, subtraction and multiplication of matrices	The learner partially determines the properties of a matrix, carries out addition, subtraction or multiplication of matrices	The learner determines the properties of a matrix, carry out addition
Ability to determine the determinant of a 2 by 2 matrix, determine the inverse of a 2 by 2 matrix and solve	The learner correctly and comprehensively determines the determinant of a 2 by 2 matrix, determines the	The learner correctly determines the determinant of a 2 by 2 matrix, determines the inverse of a 2 by 2	The learner determines the determinant of a 2 by 2 matrix or the inverse of a 2 by 2 matrix	The learner determines the determinant of a 2 by 2 matrix,

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Level Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
equations with two unknowns using matrix method.	inverse of a 2 by 2 matrix and solve equations with two unknowns using matrix method.	matrix and solve equations with two unknowns using matrix method		

STRAND 2: MEASUREMENTS AND GEOMETRY**Sub-strand 1: Approximation and Errors**

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
2.0 Measurements and Geometry	2.1 Approximation and Errors - <i>Estimation and approximations</i> - <i>Absolute, Relative and Percentage errors</i> - <i>Round off (significant figures decimal places)</i> - <i>Truncation errors</i> - <i>Propagation of errors</i>	By the end of the sub-strand the learner should be able to: - determine errors from measurements of quantities, - determine absolute, relative and percentage errors from measurements, - compute round off and truncation errors from measurements, - determine maximum and minimum errors from limits in measurements, - perform propagation of errors using limits of measurements, - appreciate the use of approximations and	The learner is guided to: - estimate measurement of quantities and compare with the actual values, - work with peers to calculate absolute, relative and percentage errors using the estimates and actual measurements, - work out the absolute errors resulting from rounding off numbers to a given decimal places and significant figures, - work with peers to truncate numbers to a given significant figures and decimal places working out errors associated with them,	Why are quantities approximated?

		errors in real life situations.	- work out the maximum and minimum errors from real life situations, - use limits to carry out propagation of errors involving addition, subtraction, multiplication and division of quantities, - discuss effects of approximations and errors when planning for a journey to enhance road safety on the road during the journey.	
Core Competencies to be developed: - Communication and collaboration: the learner discusses effects of approximations and errors when planning for a journey to enhance road safety. - Digital literacy: the learner uses digital devices such as calculators to propagate errors.				
Values: - Responsibility: the learner takes accurate measurements and makes estimations and approximations. - Integrity: the learner works in a group to report the correct measurements and give correct approximations.				
Pertinent and Contemporary Issues (PCIs): - Promoting Social Cohesion: the learner collaborates in group activities to estimate and approximate errors in different situations. - Road safety: the learner discusses effects of approximations and errors when planning for a journey to enhance road safety.				

Sub-strand 2: Angle Properties of a Circle

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
2.0 Measurements and Geometry	2.2 Angle Properties of a Circle - Arc, chord and segment - Angle subtended by the same arc - Angle subtended by the same chord - Angles in a semicircle - Cyclic quadrilateral	By the end of the sub-strand the learner should be able to: - identify an arc, chord, and segment in a circle, - relate angles subtended by the same arc at the circumference, - relate the angle subtended by an arc at the centre and at the circumference, - determine angles subtended by a chord and a diameter at the circumference, - determine angles in a cyclic quadrilateral,	The learner is guided to: - use circular shapes or objects to recognise arcs, chords, and segments of a circle, - model circle, mark an arc on the circumference of the circle. Use the arc to subtend different angles at the circumference of the circle then compare the angles, - Use a model of a circle, subtend an angle at the centre and at the circumference, measure the angles and compare them, - Work with peers to use a chord to subtend angles at the centre and at the circumference in the same segment to establish the relationship, - subtend angles from the diameter to the circumference	How is the knowledge of angle properties of a circle used in day to day life?

		f) apply the angle properties of a circle in different situations, g) reflect on the use of angle properties of a circle in different situations.	in both segments, measure the angles and draw conclusions, • inscribe a quadrilateral into a circle, establish the relationship of the angles in the quadrilateral, • use digital devices and other resources to learn more on angle properties of a circle, • discuss the safety precautions taken when using construction instruments.	
Core Competencies to be developed: • Critical Thinking and Problem Solving: the learner collaborates with peers to use circular shapes or objects to recognise arcs, chords, and segments of a circle. • Digital literacy: the learner uses digital devices and other resources to learn more on angle properties of a circle.				
Values: • Unity: the learner collaborates with peers to use circular shapes or objects to recognize arcs, chords, and segments of a circle. • Respect: the learner collaborates with peers to draw a chord, subtend angles at the circumference, measure the angles and establish the relationship.				
Pertinent and Contemporary Issues (PCIs): Safety: the learner discusses the safety precautions taken when using construction instruments.				

Sub-strand 3: Commercial Arithmetic

Strand	Sub Strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
2.0 Measurements and Geometry	2.3 Commercial Arithmetic - Simple Interest - Compound interest - Appreciation - Depreciation - Hire purchase (to include rate of interest, carrying charge, instalments. - Income tax	By the end of the sub-strand the learner should be able to: - compute simple interest using the simple interest formula, - derive compound interest formula using the step by step method, - determine compound interest using the compound interest formula, - determine the value of appreciation and depreciation of assets,	The learner is guided to: • work out with peers to work out simple interest charged on goods period of time, • use the step by step method to generate the compound interest formula, • use compound interest formula to compute interest and a mount charged at annual and semi-annual, • use digital devices and other resources to calculate compound interest, • work with peers identify items whose values appreciate to work out the appreciation, • work with peers identify items whose values depreciate and work out the depreciation,	Why is commercial arithmetic important in our day to day transactions?

		e) determine the cost of goods in hire purchase, f) compute income tax using taxation table, g) apply commercial arithmetic concepts in day to day life, h) appreciate the use of commercial arithmetic in real-life situations.	- discuss the meaning of carrying charge, monthly instalment and deposit as used in hire purchase, - calculate the cost of items and the rate of interest charged on goods bought on hire purchase, - discuss the meaning of gross income, taxable income, tax reliefs, PAYE and net income then calculate income tax using taxation table, - discuss with peers the importance of paying taxes to the government, - use digital devices to learn more on commercial arithmetic.	
Core Competencies to be developed: - Digital literacy: the learner uses digital devices and other resources to calculate income tax in real life situations. - Citizenship: the learner discusses with peers the importance of paying taxes to the government.				
Values: - Patriotism: the learner discusses with peers the importance of paying taxes to the government. - Unity: the learner uses the step by step method to generate the compound interest formula.				
Pertinent and Contemporary Issues (PCIs): - Good governance and integrity: the learner appreciates the concept of calculation of income tax a - Social-economic and environmental issues :Financial Literacy: the learner calculates the value of items as they appreciate and depreciate using the compound interest formula.				

Sub-strand 4: Circles, chords and tangents

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
2.0 Measurements and Geometry	2.4 Circles, Chords and Tangents - chords and tangents - Lengths of tangents and intersecting chords - Properties of chords and tangents - Construction of tangents to a circle - Direct and transverse common tangents to two circles	By the end of the sub-strand the learner should be able to: a) determine the length of intersecting chords and tangent to a circle, b) construct a tangent to a circle at a given point, c) construct direct and transverse common tangents to two circles, d) determine the relationship of angles in the alternate segment, e) construct an inscribed, circumscribed and escribed circles on a triangle, f) determine the centroid and orthocentre of a triangle,	The learner is guided to: - model circles using items such as wires and use the circle to work out lengths of intersecting chords and a tangent, - collaborate with peers to deduce the properties of a chord and a tangent from construction, - work with peers to work out the lengths of intersecting chord and tangents, - work with peers to draw a tangent to a circle at a given point using geometrical instruments, - wok with peers to draw a direct common tangent to two circles,	How is the knowledge of tangents useful day to day life?

	- <i>Angles in alternate segment</i> - <i>Contact of Circles</i> - <i>Circumscribed, inscribed and escribed circles</i> - <i>Centroid and orthocentre</i>	g) apply angles chords and tangents to real life situations, h) appreciate the use of circles, chords and tangents in real life situations.	• work with peers to draw a transverse common tangent to two circles, • deduce relationship of angles in alternate segments using drawings and models, • draw triangles and bisect the sides to identify the circumcentre, and hence draw the circumcircle, • draw a triangle and bisect the interior angles to identify the in-centre and hence draw the inscribed circle, • draw a triangle and bisect two exterior angles to identify the ex-centre and hence draw the escribed circle and compare with peers, • locate the centroid and orthocentre of a triangle, • discuss the applications of angles, chords and tangents in situations such as pulley belts,	
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			• apply digital resources to construct chords and tangents to a circle.	
Core Competencies to be developed: • Critical Thinking and Problem Solving: learner draws a transverse common tangent to two circles • Learning to learn: the learner collaborates to deduce the relationship of angles in alternate segments				
Values: • Unity: the learner collaborates to deduce the relationship of angles in alternate segments. • Respect: the learner shares in peers a triangle and bisect two exterior angles to identify the ex-centre and hence draw the escribed circle.				
Pertinent and Contemporary Issues (PCIs): • Social cohesion: as the learner collaborates to deduce relationship of angles in alternate segments • Safety: as the learner handles sharp geometrical instruments to construct the tangents				

Sub-strand 5: Trigonometry (II)

Strand	Sub-strand	Specific Learning Outcomes	Suggested Experiences	Suggested Key Inquiry Question(s)
2.0 Measurements and Geometry	2.5 Trigonometry (II) - Unit circle - Trigonometric ratios from unit circle - Angles greater than 90°, negative angles - Radian measure - Conversion of degrees to radians and vice versa - Graphs of $(\sin x, \cos x, \tan x)$ - $360^\circ < x < 360^\circ$	By the end of the sub-strand the learner should be able to: - determine trigonometric ratios of angles using a unit circle, - determine trigonometric ratios of angles greater than 90° in different situations, - determine trigonometric ratios of negative angles in different situations, - solve trigonometric equations involving trigonometric ratios the range 0° to 360°, - convert angles from degrees to radians and vice versa in different situations,	The learner is guided to: - work with peers to draw a unit circle and use it to obtain trigonometric ratios, - work out the trigonometric ratios of angles greater than 90° from the unit circle, - work out trigonometric ratios of negative angles from the unit circle, - collaborate with peers to work out trigonometric equations involving single trigonometric ratios in the range 0° to 360° - collaborate with peers to convert angles from degrees to the radian, - discuss with peers to convert angles from radians to degrees, - generate tables of values for trigonometric functions using	why is the knowledge of trigonometry important?

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- Deriving sine and cosine rules - Trigonometric solution of triangles, - Application of Sine and Cosine Rules	- draw graphs of trigonometric functions in degrees and radians, - derive sine and cosine rules using triangles, - solve triangles using the sine and cosine rule - appreciate use of trigonometry in real life situations.	calculators or mathematical tables, - plot graphs of trigonometric functions using a suitable scale, - work with peers to derive sine and cosine rules from triangles, - work out sides and angles in a triangle using sine and cosine rules, - use digital devices to draw graphs of trigonometric functions.	
Core Competencies to be developed: - Communication and Collaboration: the learner collaborates with peers to convert angles from degrees to the radian. - Critical thinking and problem solving: the learner works with peers to derive sine and cosine rules from triangles			
Values - Responsibility: the learner takes care of the education resources used in trigonometry such mathematical tables and calculators. - Respect: the learner accommodates the views of group members during the discussion with peers to convert angles from radians to degrees.			
Pertinent and Contemporary Issues (PCIs): Socio-economic and environmental issues: the learner exhibits environmental conservation by using locally available resources to make a chart of the unit circle.			

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Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question
2.0 Measurements and Geometry	2.6 Graphical Methods - Graph of quadratic equations - Graphical solution of simultaneous equations, one linear and one quadratic - Graphs of cubic relation - Average rate of change - Rate of change at an instant - Empirical data and their graphs - Line of best fit - Reduction of non-linear to linear - Equation of a circle - Conic curves - circle - parabola	By the end of the sub-strand, the learner should be able to: a) solve quadratic and cubic equations graphically, b) solve simultaneous equations of a linear and a quadratic and cubic equations graphically, c) determine average rate of change and average rate of change at an instant from a graph, d) draw graphs of empirical data and line of best fit in different situations, e) convert nonlinear equation to linear	The learner is guided to: • draw graphs of quadratic and cubic equations and determine their roots, • draw graphs of linear and quadratic equations and determine the roots, • work out average rate of change from graphical representation of equations, • discuss with peers then work out instantaneous rate of change from graphs, • collaborate with peers to plot empirical data and draw line of best fit, • work with peers to convert a given nonlinear relation to linear,	How are relations presented in real life?

		form in different situations, f) determine constants in nonlinear equations in different situations, g) determine the centre, radius and equation of a circle in different situations, h) draw graphs of circles and parabolas in different situations, i) promote the use of graphical solutions to day to day life.	• work with peers to determine constants in non-linear relations using graphs of linear relations, • work out the coordinates of the centre of a circle and its radius from an equation, • work out the equation of the circle using coordinates of the centre, • generate tables of values from equations of circles and parabolas, • use digital resources to draw graphs of different relations.	
Core Competencies to be developed: • Digital literacy: the learner uses digital resources to draw graphs of different relations. • Self-Efficacy: the learner clearly describes the procedure defined in drawing graphs of linear and quadratic equations.				
Values: • Responsibility: the learner cares for own drawing resources and those of others while plotting points and drawing graphs. • Integrity: the learner individually draws graphs of given relations from a table of values and gives honest results.				
Pertinent and Contemporary Issues (PCIs): Effective communication: the learner discusses with others to work out an instantaneous rate of change from graphs.				

Suggested Assessment Rubric

Levels Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
Ability to determine absolute, relative and percentage errors from measurements.	The learner accurately determines absolute, relative and percentage errors from measurements in varied contexts.	The learner accurately determines absolute, relative and percentage errors from measurements	The learner partially determines absolute, relative and percentage errors from measurements	The learner determines absolute, from measurements
Ability to compute round off and truncation errors.	The learner accurately computes round-off and truncation errors, of various contexts.	The learner accurately computes round-off and truncation errors	The learner partially computes round-off or truncation errors	The learner computes round-off errors
Ability to calculate maximum and minimum errors from measurements and computations.	The learner accurately calculates maximum and minimum errors from measurements and computations from various cases.	The learner accurately calculates maximum and minimum errors from measurements and computations	The learner partially calculates maximum or minimum errors from measurements	The learner calculates maximum errors from measurements
Ability to identify an arc, chord and segment of a circle and relate angle subtended by the arc at the circumference.	The learner correctly identifies arcs, chords, and segments of a circle and comprehensively relates the angle subtended by the arc at the circumference.	The learner correctly identifies arcs, chords, and segments of a circle and relates the angle subtended by the arc at the circumference.	The learner identifies arcs, chords, or segments of a circle	The learner arc or chord of a circle

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Levels Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
Ability to relate angle subtended by the same arc at the centre and at the circumference and determine the angles subtended by a chord and a diameter at the circumference of a circle.	The learner accurately and comprehensively relates the angle subtended by the same arc at centre and circumference and determines angles subtended by chords and diameters at the circumference of a circle.	The learner accurately relates the angle subtended by the same arc at the centre and circumference and determines angles subtended by chords and diameters at the circumference of a circle.	The learner partially relates the angle subtended by the same arc at centre or circumference or determines angles subtended by chords and diameters at the circumference of a circle.	The learner relates the angle subtended by the same arc at centre or circumference of a circle.
Ability to determine angles in a cyclic quadrilateral and apply the angle properties of a circle.	The learner accurately determines angles in a cyclic quadrilateral and applies angle properties of circles using examples.	The learner accurately determines angles in a cyclic quadrilateral and applies angle properties of circles	The learner partially determines angles in a cyclic quadrilateral or applies angle properties of circles	The learner determines angles in a cyclic quadrilateral
Ability to calculate simple interest, derive compound interest formula and compute compound interest using the compound interest formula.	The learner accurately calculates simple interest, derives the compound interest formula and computes compound interest using varied examples.	The learner accurately calculates simple interest, derives the compound interest formula and computes compound interest	The learner calculates simple interest or derives the compound interest formula or computes compound interest	The learner calculates simple interest.

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Levels Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
Ability to determine the value of appreciation and depreciation of assets.	The learner accurately determines appreciation and depreciation values of assets using relevant examples.	The learner accurately determines appreciation and depreciation values of assets	The learner partially determines appreciation or depreciation values of assets	The learner determines appreciation values of assets
Ability to determine the cost of goods in hire purchase and compute income tax using taxation tables.	The learner accurately determines hire purchase costs and computes income tax using taxation tables, using varied scenarios.	The learner accurately determines hire purchase costs and computes income tax using taxation tables.	The learner partially determines hire purchase costs or computes income tax using taxation tables.	The learner determines hire purchase costs.
Ability to prepare a single and two column cash books.	The learner accurately prepares single and two-column cash books of varied transactions.	The learner accurately prepares single and two-column cash books	The learner prepares single or two-column cash books	The learner prepares single column cash books
Ability to determine the length of intersecting chords and tangent to a circle and construct a tangent to a circle.	The learner accurately determines lengths of intersecting chords and tangents to a circle and constructs precise tangents with precision.	The learner accurately determines lengths of intersecting chords and tangents to a circle and constructs a tangent to a circle.	The learner partially determines lengths of intersecting chords or tangents to a circle or constructs a tangent to a circle.	The learner determines lengths of intersecting chords
Ability to construct direct and transverse	The learner accurately constructs direct and transverse common	The learner accurately constructs direct and	The learner constructs direct or transverse	The learner constructs direct common tangents to

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Levels Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
common tangents to two circles.	tangents to two circles with precision.	transverse common tangents to two circles	common tangents to two circles	two circles
Ability to construct inscribed, circumscribed and escribed circles of a triangle.	The learner accurately constructs inscribed, circumscribed and escribed circles of a triangle with precision.	The learner accurately constructs inscribed, circumscribed and escribed circles of a triangle	The learner constructs any 2 of; inscribed or circumscribed or escribed circles of a triangle	The learner constructs any 1 of; inscribed or circumscribed or escribed circles of a triangle
Ability to determine the centroid and orthocentre of a triangle.	The learner accurately determines the centroid and orthocentre of a triangle with precision	The learner accurately determines the centroid and orthocentre of a triangle	The learner determines either the centroid or orthocentre of a triangle	The learner determines the centroid of a triangle
Ability to determine trigonometric ratios of angles greater than 90° and negative angles from the unit circle.	The learner accurately determines trigonometric ratios for angles greater than 90° and negative angles from the unit circle using examples.	The learner accurately determines trigonometric ratios for angles greater than 90° and negative angles from the unit circle	The learner determines trigonometric ratios for angles greater than 90° or negative angles from the unit circle	The learner accurately determines trigonometric ratios for angles greater than 90° from the unit circle
Ability to convert angles from degrees to radians and vice versa,	The learner correctly converts angles from degrees to radians and vice versa and draws graphs of	The learner correctly converts angles from degrees to radians and vice versa and draws	The learner converts angles from degrees to radians or vice versa or draws graphs of	The learner converts angles from degrees to radians or vice versa

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Levels Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
and draw graphs of trigonometric functions in degrees and radians.	trigonometric functions in degrees and radians. for various angles.	graphs of trigonometric functions in degrees and radians	trigonometric functions in degrees and radians	
Ability to derive sine and cosine rules from first principles using triangles and solve triangles using sine and cosine rules.	The learner correctly and systematically derives sine and cosine rules from first principles using triangles and solves triangles using sine and cosine rules.	The learner correctly derives sine and cosine rules from first principles using triangles and solves triangles using sine and cosine rules	The learner correctly derives sine or cosine rules from first principles using triangles or solves triangles using sine and cosine rules	The learner derives sine or cosine rules from first principles using triangles
Ability to determine trigonometric ratios of angles from unit circle, angles greater than 90° and negative angles.	The learner accurately determines trigonometric ratios of angles from the unit circle, angles greater than 90° and negative angles in various scenarios	The learner accurately determines trigonometric ratios of angles from the unit circle, angles greater than 90° and negative angles.	The learner determines trigonometric ratios for angles from the unit circle and angles greater than 90°	The learner determines trigonometric ratios for angles from the unit circle.
Ability to draw graphs of trigonometric functions in degrees and radians.	The learner accurately draws graphs of trigonometric functions in degrees and radians, using examples.	The learner accurately draws graphs of trigonometric functions in degrees and radians	The learner draws graphs of trigonometric functions in degrees or radians	The learner partially draws graphs of trigonometric functions in degrees

STRAND 3.0 STATISTICS AND PROBABILITY**Sub-strand 1: Permutation and Combinations**

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
3.0 Statistics and Probability	3.1 Permutations and combinations - Factorial notation - Permutations - Combinations - Application of permutations and combinations	By the end of the sub strand, the learner should be able to: a) express a natural number in factorial notation, b) perform permutations involving real life situations, c) perform combinations involving real life situations, d) apply permutations and combinations to real life situations, e) explore the use of permutations and combinations in real life situations.	The learner is guided to: - work with peers to explore and express natural numbers in factorial notation - discuss life situations involving permutations, - work out permutations using real life cases, - discuss real life situation involving combinations, - use different objects to come up with different combinations then work out combinations based in real life situations, - work with peers to research the application of permutations and combinations in real life situations.	1. How are permutations used in day-to-day life? 2. Where is combination used in day-to-day life?

Core Competencies to be developed: • Critical thinking and problem-solving: the learner works out the number of combinations based on real life situations, • Learning to learn: the learner carries out research on application of permutations and combination in real life situations
Values: Unity: the learner works with peers to explore and express the factorial of a natural number, $n!$
Pertinent and Contemporary Issues (PCIs): Integrity: the learner applies laid down procedure in carrying out research on application of permutation and combination in real life situations.

Sub-strand 2: Probability

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
3.0 Statistics and Probability	3.2 Probability II (8 lessons) - Theoretical probability - Discrete and continuous probability - Laws of probability - Combined events: - mutually exclusive - independent events - Tree diagrams	By the end of the sub-strand the learner should be able to: - determine theoretical probability in different situations, - determine discrete and continuous probabilities in different situations, - apply laws of probability to predict likelihood of events, - determine probability of mutually exclusive and independent events, - calculate probabilities using tree diagrams, - appreciate the application of probability in day-to-day life.	The learner is guided to: • discuss with peers the real-life situations where theoretical probability occurs, • work with peers to differentiate between discrete and continuous probability in daily life, • work with peers to work out discrete and continuous probabilities, • discuss applications of the laws of probability, • work with peers to compute tasks involving mutually exclusive events and independent events • discuss in a group, situations where laws of probability are used to determine probabilities of independent events,	How is the knowledge of probability important?

			- work with peers to use tree diagram to work out probabilities of combined events, - use digital devices and other resources to research more on applications of probability in real life situations.	
Core Competencies to be developed: - Critical thinking and problem solving: the learner working with peers draws and uses tree diagrams to work out probabilities of combined events. - Communication and collaboration: -Teamwork: the learner collaborates with peers to compute tasks involving independent events. - Digital literacy: the learner uses digital devices and other resources to research more on applications of probability.				
Values: - Social Justice: - Equity: the learner fosters fairness during group discussions involving situations where laws of probability are used to determine probabilities of independent events. - Responsibility: - Accountability: the learner engages in assigned roles when carrying out experiments involving real life situations to deduce conditional probability.				
Pertinent and Contemporary Issues (PCIs): - Financial literacy: the learner discusses in a group situation where laws of probability are used to determine probabilities of independent events such as weather forecast, football leagues, and elections. - Road safety: the learner discusses situations where laws of probability are applied to determine mutually exclusive events such as choices of safe means of road transport.				

Suggested Assessment Rubric: Permutation and Combinations				
Levels Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
Ability to determine the factorials of natural numbers, perform permutations and combinations.	The learner accurately determines the factorials of natural numbers and performs permutations and combinations of varied scenarios.	The learner accurately determines the factorials of natural numbers and performs permutations and combinations	The learner determines the factorials of natural numbers or performs permutations or combinations	The learner determines the factorials of natural numbers
Ability to compute theoretical probability, discrete and continuous probabilities.	The learner accurately computes theoretical probability, discrete and continuous probabilities of varied scenarios	The learner accurately computes theoretical probability, discrete and continuous probabilities	The learner computes any 2 of; theoretical probability, discrete and continuous probabilities	The learner computes any 1 of; theoretical, discrete and continuous probabilities
Ability to apply laws of probability to predict likelihood of events.	The learner accurately and comprehensively applies laws of probability to predict likelihood of events in varied situations.	The learner accurately applies laws of probability to predict likelihood of events	The learner applies any 2 laws of probability to predict likelihood of events	The learner applies any 1 law of probability to predict likelihood of events
Ability to determine the probability of combined events and calculate probabilities using tree diagrams.	The learner accurately determines probabilities of combined events and calculates probabilities using tree diagrams of varied scenarios.	The learner accurately determines probabilities of combined events and calculates probabilities using tree diagrams	The learner determines probabilities of combined events or calculates probabilities using tree diagrams	The learner determines probabilities of combined events

STRAND 4: CALCULUS**Sub-strand 1: Functions of a single variable**

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
4.0 Calculus	4.1 Functions (8 lessons) <i>-Domain and Range</i> <i>-Function notation</i> <i>-Type of functions</i> <i>-Algebraic functions only (polynomials, rational)</i> <i>-Inverse functions</i> <i>-Limits of polynomials</i> <i>-Evaluation of functions</i>	By the end of the sub-strand the learner should be able to: a) identify relations and the different types of mappings b) identify functions and their properties, c) determine the range and domain of functions, d) compute the value of a function in different situations, e) determine the inverse of a function of polynomials and trigonometric ratios, f) evaluate limits of polynomial functions in different situations g) apply functions to real life situations,	The learner is guided to: • use illustrations to identify relations and the different types of mappings, • work with peers to brainstorm on the meaning of function, domain and range, • work with peers to identify a domain and range of functions, • work with peers to obtain the value of a function using simple relations, • discuss the inverse of numbers and fractions and relate them to inverse of functions, • work out the inverse of function equations of polynomials and trigonometric ratios,	How are functions applied in daily life?

		h) appreciate the use of functions in real life situations.	• work with peers to obtain limits of polynomials, • discuss the uses of functions and limits in mathematics computations, • use digital devices to learn more on applications of functions.	
Core Competencies to be developed: • Communication and collaboration: the learners collaborate with peers to work out the inverse of functions. • Critical thinking and problem solving: the learner works with peers to brainstorm on the meaning of function, domain and range.				
Values: • Respect: the learner accepts diverse opinions as she/he discusses in a group and with illustrations identifies the different types of mappings. • Unity: the learner cooperates and collaborates with peers to work out the inverse of functions.				
Pertinent and Contemporary Issues (PCIs): Social Cohesion- the learner collaborates with peers to work out the inverse of functions.				

Sub-strand 2: Differentiation

Strand	Sub-strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Question(s)
4.0 Calculus	4.2 Differentiation (I) (10 lessons) - Average and Instantaneous rate of change - Gradient of a curve at a point - Gradient of $y = xn$ (where n is a positive integer) - First Principles of Derivatives - Equations of gradients and normal - Application of derivatives to kinematics. (maxima and minima not	By the end of the sub-strand the learner should be able to: a) compute average and instantaneous rates of change in different situations, b) calculate the gradient a curve at point, c) relate the delta notation to rate of change in curve, d) determine the derivatives of polynomial functions, e) determine the equations of tangents and normal to a curve, f) apply derivatives to kinematics in different situations,	The learner is guided to: - work with peers to discuss how to find the gradient of a straight line, - collaborate with peers to draw a tangent to a curve, - use the gradient of a tangent to a curve to work out the average and instantaneous rate of change, - link delta notation to the rate of change at small intervals, - work out tasks involving equations of tangents and normal to a curve, - work with peers to deduce the gradient function of curves,	How is differentiation applied in real life?

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	required at this grade)	g) appreciate the use of differentiation in real life.	- work with peers to calculate the derivatives of functions using the first principle, - work with peers to obtain velocity, displacement and time from the equations relating to motions, - use digital devices and other resources to learn more on differentiation.	
Core Competencies to be developed: - Critical thinking and problem solving: the learner deduces the gradient function of a curve - Digital literacy: the learner uses digital devices and other resources to learn more on differentiation				
Values: Unity: the learner works with peers to calculate the derivatives of functions using the first principle,				
Pertinent and Contemporary Issues (PCIs) social cohesion: the learner works with peers to find gradient functions				

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Suggested Assessment Rubric: Functions and Limits				
Levels Indicators	Exceeds Expectation	Meets Expectation	Approaches Expectation	Below Expectation
Ability to identify relations, types of mappings, functions and their properties,	The learner accurately and comprehensively identifies relations, types of mappings, functions and their properties.	The learner accurately identifies relations, types of mappings, functions and their properties.	The learner identifies any 2 of; relations, types of mappings, functions or their properties.	The learner identifies any 1 of; relations, types of mappings or functions.
Ability to determine the range, domain value, inverse and limits of functions.	The learner accurately and comprehensively determines the range, domain, value, inverse and limits of functions.	The learner accurately determines the range, domain, value, inverse and limits of functions.	The learner determines any 3 of; the range, domain, value, inverse and limits of functions.	The learner determines any 2 of; the range, domain, value, inverse and limits of functions.
Ability to determine average and instantaneous rates, gradient of a curve and relate the delta notation to rate of change in a curve.	The learner accurately determines average and instantaneous rates of change, gradients of curves and relates delta notation to rates of change in varied scenarios.	The learner accurately determines average and instantaneous rates of change, gradients of curves and relates delta notation to rates of change	The learner determines any 3 of; average or instantaneous rates of change or gradients of curves or relates delta notation to rates of change	The learner determines any 2 of; average or instantaneous rates of change or gradients of curves,
Ability to determine the	The learner accurately determines derivatives of	The learner accurately determines derivatives	The learner determines any 2 of; derivatives of	The learner determines any 1

derivatives of functions, equations of tangents and normal to a curve.	functions, equations of tangents and normal to a curve using varied examples.	of functions, equations of tangents and normal to a curve.	functions or equations of tangents or normal to a curve.	of; derivatives of functions or equations of tangents to a curve.
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APPENDIX 1: SUMMARY OF STRANDS AND SUB STRANDS

	Strand	Sub-strand	Suggested Learning Resources	Suggested Assessment Methods	Suggested Non-Formal Activities
1	Numbers and Algebra	Quadratic Expressions and Equations	Calculators	Project written test Oral and written quizzes Peer assessments Oral questions Check list Journals Practical work Observation	Clubs and societies Field trips Mathematics Symposiums Science and Engineering Fair Mathematics club
		Irrational numbers	Calculator		
		Linear Inequalities	- Graphs - Geometrical set - calculator		
		Logarithms II	- calculator - mathematical table		
		Formulae and Variations	- Grid boards - Geometrical equipment - Graph paper - Stop watch - Calculator - Ruler or tape measure		
		Sequences and Series	- Objects on different sizes - Strings - Measuring instruments - Stop watch		

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		Matrices (I)	- Tables and charts - Pictures of objects arranged in rows and columns - Calculators		
2	Measurements and Geometry	Approximation and Errors	- Measuring instruments like measuring cylinder, metre rule, tape measure, - Calculator - Stop watch		
		Angle Properties of a Circle	- Geometrical instruments - Drawing book - Circular objects and rings - Strings		
		Commercial Arithmetic	- Sample cash book - Income tax table from KRA - Sample pay slips - Pictures showing cash price and hire purchase prices		
		Circles, Chords and Tangents	- Geometrical instruments - Drawing book - Circular objects and rings		

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			• Strings		
		Trigonometry (II)	• Graph paper • Geometrical set/tools • Graph boards		
		Graphical Methods	• Graph paper • Geometrical set/tools • Graph boards		
3	Statistics and probability	Permutations and combinations	• Assorted objects • calculator		
		Probability II	• Dice • coins • glass marbles of different colours • calculators		
4	Calculus	Functions	• Graph paper • charts • Calculator		
		Differentiation (I)	• Graph paper • Ropes • Stop watch • Ruler • Calculator		

APPENDIX 2: GENERAL RESOURCES

The following ICT tools may be used in learning and teaching of Mathematics at this level:

1. Learner digital devices (**LDD**)
2. Teacher digital devices (**TDD**)
3. Mobile phones
4. Digital clocks
5. Television sets
6. Videos and animations
7. Cameras
8. Projectors
9. Radios
10. Learners books
11. Teachers guides
12. Teachers hand book
13. Internet
14. Manilla papers
15. Realia