THE REPUBLIC OF UGANDA

Lower Secondary Curriculum

MATHEMATICS SYLLABUS

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

CONTENTS

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FOREWORD

This four-year syllabus for Mathematics is one of the 20 subjects of the Lower Secondary school curriculum. The Lower Secondary syllabus for Mathematics builds upon concepts, skills, attitudes and values developed at primary school level, which provide a firm foundation for further mathematical study.

Mathematics contributes to the development of critical thinking, creativity and problem-solving. The syllabus thus helps the learner to recognise and apply Mathematics to all aspects of his/her life and work. A good grasp of key mathematical concepts is essential for full and rewarding participation in society. The learner needs to be able to calculate, estimate and measure, and interpret and use data, in order to manage his/her day-to-day life and contribute effectively to the workforce. Thus, mathematical literacy is essential to all aspects of national and economic development.

The independent mathematical thinking and problem-solving skills the learner develops are essential in the study of Numbers, Geometry and Measurement, Data and Probability and Patterns and Algebra in the programme of study for all four years in the Lower Secondary cycle.

The teachers of Mathematics are required to shape the learning experiences to meet the needs and interests of all learners. Good learner textbooks, teacher's resource books and the use of guest speakers and practitioners will greatly assist teachers to achieve the objectives.

I therefore endorse this syllabus as the official document for the teaching and learning of Mathematics at the Lower Secondary School level throughout the country.

Hon. Janet K. Museveni
The First Lady and Minister for Education and Sports

ACKNOWLEDGEMENT

National Curriculum Development Centre (NCDC) would like to express its appreciation to all those who worked tirelessly towards the production of this Lower Secondary Syllabus.

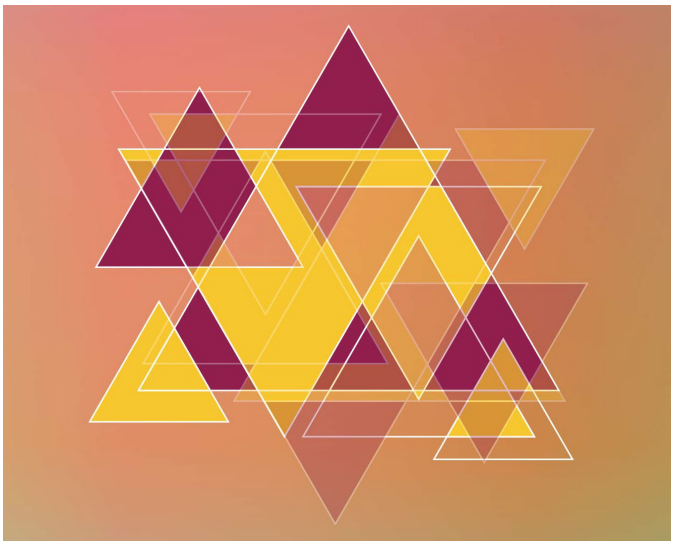
Our gratitude goes to the Ministry of Education and Sports for overseeing the development of the curriculum and taking timely decisions whenever necessary. They have worked as a team with NCDC to produce this curriculum. Their decisions have been invaluable in getting this work completed as required. Our thanks also go to our partners in education who provided the necessary guidance.

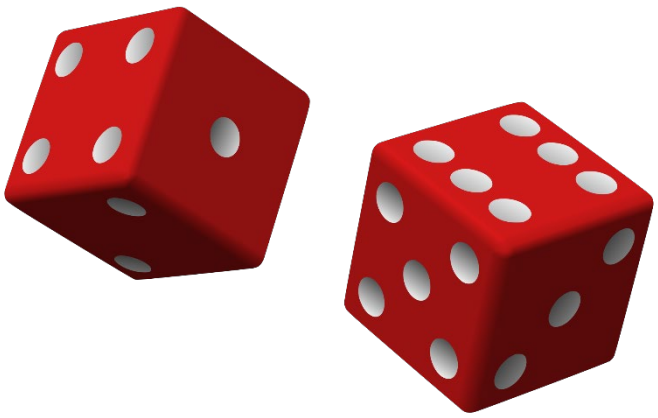
We would also like to thank the members of the public who made helpful contribution towards shaping this curriculum. Their efforts are invaluable towards having this curriculum implemented in the schools and for improved quality of education in Uganda.

The Centre is indebted to the learners and teachers who worked with NCDC specialists and consultants from Cambridge Education and Curriculum Foundation. Great thanks go to members of Mathematics Working Group who worked tirelessly to put together the necessary facts and guidance in producing this syllabus.

Furthermore, NCDC would like to thank the World Bank for funding the Lower Secondary Curriculum Reform. The funding was a component of the World Bank /Ministry of Education and Sports Uganda Post-Primary Education and Training programme.

Last but not least, NCDC would like to acknowledge all those behind the scenes who formed part of the team that worked hard to finalise the work on this syllabus.





NCDC takes responsibility for any shortcomings that might be identified in this publication and welcomes suggestions for effectively addressing the inadequacies. Such comments and suggestions may be communicated to NCDC through P.O.Box 7002 Kampala or email *admin@ncdc.go.ug* or through our *Contact Us* page on our website at *www.ncdc.go.ug*.

Grace K. Baguma
Director,
National Curriculum Development Centre

INTRODUCTION

The Uganda Vision 2040 aims to transform Uganda into a modern and prosperous country, while the NDP recognises the existing weaknesses in education, including the low efficiency and variable quality at the secondary level. The Sustainable Development Goal 4 advocates for equitable and quality education, while the National Development Plan II focuses on enhancement of human capital, development, strengthening mechanisms for quality, effective efficient service delivery and improvement of quality and relevance of skills development. The NRM Manifesto (2016-2021), emphasises continuous assessment examination systems, strengthening soft skills, which promote self-esteem, conscientiousness and a generally positive attitude to work, promoting e-learning and computer literacy in order to enhance learning outcomes. All these are lacking and where they exist, it is at a minimum level.

In alignment with the above, the Education and Sports Sector Strategic plan (2017/20) advocates for delivery of equitable, relevant and quality education for all. The current secondary school curriculum of Uganda, although highly regarded by some, is focused on the needs of a tiny group of academically oriented elites yet the needs of the majority of learners need to be the focus. The Ministry of Education and Sports (MoES), through the National Curriculum Development Centre (NCDC) therefore, undertook a review of the Lower Secondary Curriculum, aimed at providing a learning environment, opportunities, interactions, tasks and instructions that foster deep learning by putting the learner at the centre of the learning experience. This is in line with aims of secondary education in Uganda as outlined below:

The aims of secondary education in Uganda are to:

- Instil and promote national unity, an understanding of the social and civic responsibilities, strong love and care for others and respect for public property, as well as an appreciation of international relations and beneficial international co-operation;
- Promote an appreciation and understanding of the cultural heritage of Uganda including its languages;
- Impart and promote a sense of self discipline, ethical and spiritual values, personal and collective responsibility and initiative;
- Enable individuals to acquire and develop knowledge and an understanding of emerging needs of society and the economy;
- Provide up-to-date and comprehensive knowledge in theoretical and practical aspects of innovative production, modern management methods in the field of commerce and industry and their application in the context of socioeconomic development of Uganda;
- Enable individuals to develop basic scientific, technological, technical, agricultural and commercial skills required for self-employment;
- Enable individuals to develop personal skills of problem solving, information gathering and interpretation, independent reading and writing, self-improvement through learning and development of social, physical and leader- ship skills such as are obtained through games, sports, societies and clubs;
- Lay the foundation for further education;
- Enable the individual to apply acquired skills in solving problems of community, and to develop a strong sense of constructive and beneficial belonging to that community;
- Instil positive attitudes towards productive work and strong respect for the dignity of labour and those who engage in productive labour activities;
- Develop a positive attitude towards learning as a lifelong process.

BACKGROUND TO THE NEW CURRICULUM

The reform was based on the Education Sector Strategic Plan (ESSP), 2009 – 2018) which set out strategies to improve the quality and relevance of secondary education. The ESSP's sub objective 2.2 was to ensure that "Post-primary students [are] prepared to enter the workforce and higher education". This is also in line with the current strategic plan of 2017-2020. To achieve this objective, one of the ministry's strategies was to revise the curriculum and improve instruction and assessment by eliminating the short comings in the current curriculum.

The review focused on: producing a secondary school graduate who has the competences that are required in the 21st century; promoting values and attitudes; effective learning and acquisition of skills in order to reduce unemployment among school graduates.

The reform also aimed at reducing the content overload and contact hours in the classroom so as to create time for: research and project work; talent development and creativity; allowing for emerging fields of knowledge across all subjects and doing away with obsolete information. There was a need to address the social and economic needs of the country like the mining sector, tourism, services provision, science and technology development and to ensure rigorous career guidance programme to expose learners to the related subjects. This will enable learners to make informed choices as they transit and to equip them with knowledge and skills that will enhance their competitiveness in the global value chain.

To meet these requirements, the reforms are based on:

- The development of a holistic education for personal and national development based on clear shared values
- A commitment to higher standards, deeper understanding and greater opportunities for learners to succeed
- A focus on the key skills that are essential to work, to learning, and to life, and which will promote life-long learning
- An integrated approach that will develop the ability to apply learning in practical situations.

The ESSP further outlines what the reforms imply:

"This reform will necessitate a sweeping revision of the general secondary curriculum, away from strictly academic learning objectives that are thought to prepare students for erudite higher education and towards a set of competencies that serve both those who continue their education after S4 and those who choose to enter the workforce. The new curriculum will enable learners to acquire specific vocational skillsthat they can use once they enter the world of work. The new curriculum will help learners make informed decisions as citizens and family members, and it will give those who continue with their education, either immediately in S5 or later in life, the learning skills they need to think critically and study efficiently."

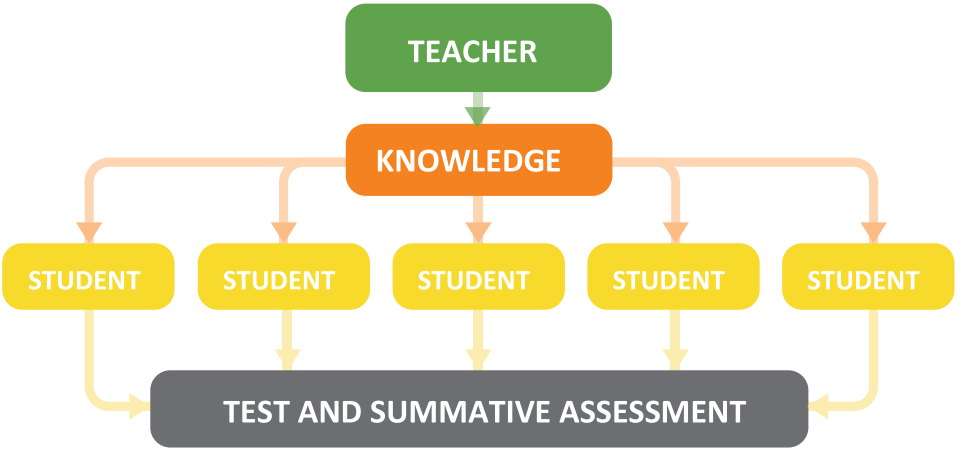
KEY CHANGES

The key change in the new curriculum is a move from a knowledge-based curriculum to a competence and skill-based curriculum. It is no longer sufficient to accumulate large amounts of knowledge. Young people need to develop the ability to apply their learning with confidence in a range of situations.
They need to be able to use knowledge creatively. A level of competence is the ability to use knowledge rather than just to acquire it. This requires an active, learner-centred rather than passive, teacher-centred approach.

This approach to teaching and learning is in support of the Sustainable Development Goals (SDG's), otherwise known as the Global Goals. These are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. The key changes in the curriculum will ensure that Uganda is making good progress towards SDG 4 in particular which aims to ensure equitable quality education and promote lifelong learning opportunities for all.

The change can be summarised in the following diagrams.

THE PREVIOUS KNOWLEDGE-BASED CURRICULUM



Knowledge-based teaching was based on transferring knowledge from the teacher to the students. The teacher had knowledge and transferred this knowledge to the students by lecturing, talking, asking them to read the text book or writing notes on the board for the students to copy and learn. Students acquired the knowledge, often without fully understanding it, and were tested at the end of a unit, term or school course to see if they had remembered it. The knowledge was based mainly on the knowledge in the subjects traditionally taught at university, and little attempt was made to make it relevant to young people's own lives. The whole education system was seen by many people as a preparation for university, but the vast majority of learners never reach university. The new curriculum will cater for this majority as well as those who later go on to university.

THE NEW COMPETENCE BASED CURRICULUM

In the new competence-based approach, the "student" becomes a "learner". The new Learning Outcomes can only be achieved through active engagement in the learning process rather than simply absorbing knowledge given by the teacher.

The teacher needs to build on the learners' own knowledge and experience and create Learning Activities through which learners can explore the meaning of what is being learned and understand how it is applied in practical situations.

Teaching and learning become a two-way process of dialogue between the Teacher and Learners. Learners also learn from each other through discussion. Assessment also becomes a two-way process of formative assessment; not just to give grades but to find out problems the learners may be having and help to solve them.

THE NEW CURRICULUM

The new curriculum focuses on four "Key Learning Outcomes" of: self – assured individuals; responsible and patriotic citizens; lifelong learners; positive contributors to society.
The curriculum emphasises knowledge, application and behavioural change. It is based on a clear set of values which must be imparted to learners during the learning process.

At the heart of every subject there are generic skills that allow development into life-long learners. Besides, there are also cross cutting issues that are embedded across subjects to enable learners understand the connections between the subjects and complexities of life.

Key Learning Outcomes

The new curriculum sets out 'Key Learning Outcomes' that sum up the expectations of the curriculum as a whole, and set out clearly the qualities that young people will develop.

By the end of the educational process, young people will become:

Self-assured individuals who:

- demonstrate self- motivation, self-management and self-esteem
- know their own preferences, strengths and limitations
- adjust their behaviour and language appropriately to different social situations
- relate well to a range of personality types

Responsible and patriotic citizens who:

- cherish the values promoted in the curriculum
- promote equity, the development of indigenous cultures and languages and appreciate other people's cultures
- apply environmental and health awareness when making decisions for themselves and their community
- are positive in their own identity as individuals and global citizens
- are motivated to contribute to the well-being of themselves, their community and the nation

Lifelong learners who:

- can plan, reflect and direct their own learning
- actively seek lifelong learning opportunities for personal and professional development

Positive contributors to society who:

- have acquired and can apply the Generic Skills
- demonstrate knowledge and understanding of the emerging needs of society and the economy
- understand how to design, make and critically evaluate products and processes to address needs
- appreciate the physical, biological and technological world and make informed decisions about sustainable development and its impact on people and the environment.

Values

The new curriculum is based on a clear set of values. These values underpin the whole curriculum and the work of schools. They are also the values on which learners need to base their lives as citizens of Uganda. The values are derived from The Uganda National Ethics and Values Policy of 2013. They are:

- Respect for humanity and environment
- Honesty; uphold and defend the truth at all times
- Justice and fairness in dealing with others
- Hard work for self-reliance
- Integrity; moral uprightness and sound character
- Creativity and innovativeness
- Social Responsibility
- Social Harmony
- National Unity
- National Consciousness and patriotism

These values are not taught directly in lessons, nor will they be assessed, but they will inform and shape all teaching and learning.

Generic Skills

The generic skills lie at the heart of every subject. They are the skills that enable the learner to access and deepen learning across the whole curriculum. They are the same skills that are sought by employers and which will unlock the world of work. They are the skills that allow young people to develop into lifelong learners who can adapt to change and cope with the challenges of life in the 21st Century.

Young people need to be able to think critically and solve problems, both at school and at work. They need to be creative and innovative in their approach to learning and life. They need to be able to communicate well in all forms, co-operate with others and also work independently. They need to be able to use functional mathematics and ICT effectively.

Critical thinking and problem-solving

- Plan and carry out investigations
- Sort and analyse information
- Identify problems and ways forward
- Predict outcomes and make reasoned decisions
- Evaluate different solutions

Creativity and innovation

- Use imaginations to explore possibilities
- Work with others to generate ideas
- Suggest and develop new solutions
- Try out innovative alternatives
- Look for patterns and make generalisations

Communication

- Listen attentively and with comprehension
- Talk confidently and explain ideas/opinions clearly
- Read accurately and fluently
- Write and present coherently
- Use a range of media to communicate ideas

Co-operation and Self-Directed Learning

- Work effectively in diverse teams
- Interact effectively with others
- Take responsibility for own learning
- Work independently with persistence
- Manage goals and time

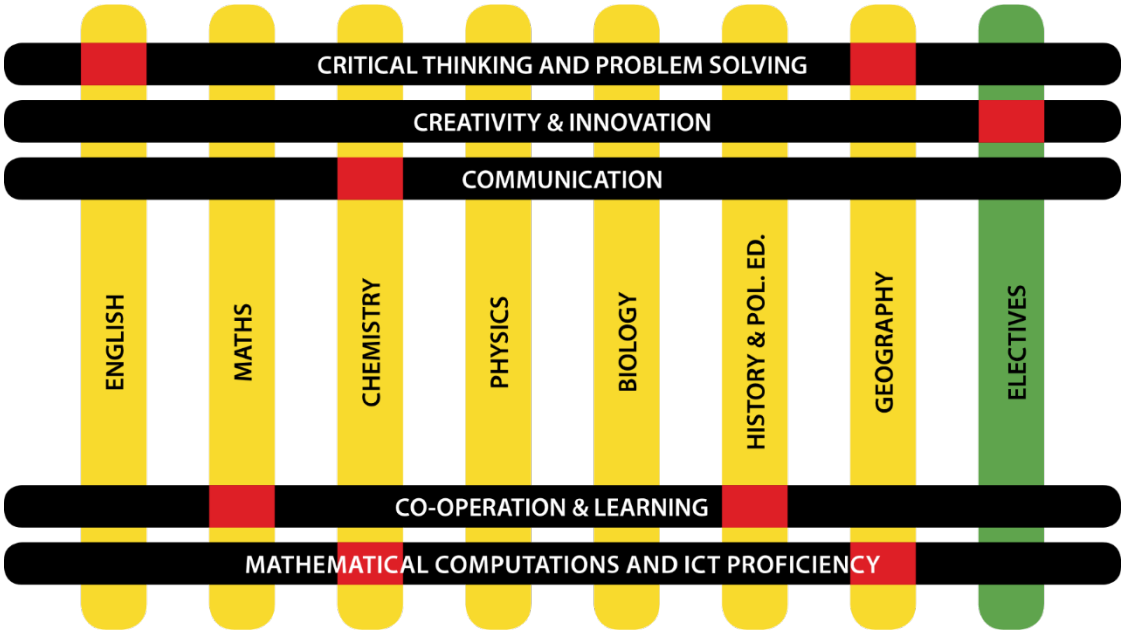
Mathematical Computations and ICT Proficiency

- Use numbers and measurements accurately
- Interpret and interrogate mathematical data
- Use mathematics to justify and support decisions
- Use technology to create, manipulate and process information
- Use technology to collaborate, communicate and refine their work

GENERIC SKILLS WITHIN MATHEMATICS

These skills are not separate subjects in themselves; they are developed within the subjects of the curriculum. They also facilitate learning within those subjects. It is when these generic skills are deployed that learning is most effective. The generic skills are a key part of the new curriculum. They have been built into the syllabuses for each of the subjects, and these subjects provide the context for the skill development. Mathematics provides a rich context for learners to communicate, co-operate, and to think critically about how the world works and to understand the world from a scientific point of view.

The Subjects also provide the contexts for progression within the skills. The same skill definitions apply to all year groups, and skills progression is provided by the increasing complexity of the subject matter within each Subject. For example, within 'critical thinking', learners begin thinking critically about the relatively simple subject matter in Senior 1 and then progress to thinking about the much more complex matters in Senior 4. Thus the progression is in the increasing complexity of the matters being thought about.



Cross-cutting Issues

There are some issues that young people need to learn about, but which are not confined to one Subject. These are the 'cross-cutting Issues' and they need to be studied across the subjects. These issues develop learners' understanding of the connections between the subjects, and so of the complexities of life.

The Cross-cutting Issues identified in the curriculum are:

- Environmental awareness
- Health awareness
- Life skills
- Mixed abilities and involvement
- Socio-economic challenges
- Citizenship and patriotism

These have been built into the syllabuses of each subject. The way in which they operate within the subject is very similar to the generic skills. Mathematics provides a very good context for considering environmental and health awareness, and to understand the complex and diverse world in which we live.

ICT Integration

Under ICT integration, ICT shall be embedded as a learning/teaching tool across all subjects. ICT teachers should endeavour to assist other subject teachers in making the ICT integration process a reality. In other subject syllabuses, ICT integration guidelines have been included. ICT integration draft framework is summarised below:

CATEGORY OF A TASK IN THE SYLLABUS	ICT APPLICATION (HOW ICT WILL BE INTEGRATED FOR THE TASK CATEGORY)
Field works	Use of cameras to take photos and record videos
Presentations in class	Use presentation application
Key words and meanings	Use online dictionary or search online
Drawing/graphics	Use publishing software, Word processor
Role play, narrations	Use audio and video recordings
Demonstrations	Use audio and video recordings and simulations
Locating and putting marks on an area	Use digital/online mapping
Present findings in graphic and written format	Use desktop publishing software or word processor
Showing data charts	Use spreadsheet software
Group discussions	Mind-mapping software
Search for extra reading materials	Download files on internet or by sharing
Writing equations and formulas	Use equation editors
Carrying out academic research	Using the Internet and other academic applications like "Encarta", "Britannica" etc.
Sharing or learning with people across the world	Forming learning networks, formation of blogs, social media, emails etc.

MATHEMATICS WITHIN THE NEW CURRICULUM

Mathematics is a compulsory subject from Senior 1 to 4

Time allocation

MATHEMATICS	SENIOR 1 & 2	SENIOR 3 & 4
	5 periods a week	5 periods a week

Rationale

Mathematics forms a key element of every learner's education. The Mathematics programme of study emphasises the essential mathematical skills that all citizens need for full and effective participation in civil, social and economic life. The programme of study focuses primarily on the needs of the majority of learners, some of who may cease formal schooling before the end of Senior Four. It will allow these learners to take a wide range of formal or informal workplace opportunities, or to proceed to other post-Senior 4 programmes.

Prior to the reform, Mathematics, throughout the Lower Secondary years was strongly geared towards the needs of the small minority of learners who might eventually go on to study Mathematics at Advanced Level and beyond. The Mathematics programme in the reformed curriculum takes care of special learning needs. It is designed to ensure that the majority of learners will leave school with a worthwhile, relevant qualification in the Mathematics that they will actually use in everyday life and work. In their daily life, knowingly or unknowingly, every human being uses and applies mathematical concepts in a wide range of contexts. Numeracy skills are essential to every aspect of both work and daily life. Mathematics has evolved across all cultures over the years, and it is still developing.

The study of Mathematics develops the learners' reasoning and logical thinking skills, and its applications cut across all Learning Areas. During the learning process, the beauty of Mathematics and its value in a wide range of contexts are recognised by the learner.

The Lower Secondary Mathematics programme of study focuses on developing mathematical understanding, logical reasoning, problem solving and analytical thought. The concepts, understandings and skills acquired will help learners to solve familiar and unfamiliar problems, giving them the flexibility they need to meet new situations as they arise. The learners will be confident with the Mathematics that they use in their day-to-day activities in the home, in the work place, in the community, and in society. They will also be ready to participate in civil life, using their mathematical skills to make informed decisions based on a sound understanding of facts, figures and opinions.

The skills and understandings that the learners acquire will be helpful throughout their lives. They will provide the essential mathematical tools required for a wide range of career paths including many of those in the fields of engineering, science or technology.

Teaching and Learning: Mathematics

The thrust of the new syllabuses is experiential and towards deeper understanding. The focus in Mathematics is on the development of understanding through mathematical enquiry and rational thought.

The new syllabus provides learners with a wide range of contexts in which to develop this understanding, and these contexts are designed to engage the interest of the learner and to provide opportunities to build life-related knowledge, experience and skills. Teachers are encouraged to go beyond the textbooks and provide as many meaningful contexts as possible. The generic skills have been integrated throughout the curriculum and can only be acquired through active approaches.

The role of the teacher is to build on learners' existing knowledge and experience, but to extend that by posing problems to the learners. This makes them think about their own ideas and experiences as well as adding new knowledge and skills to it.

Learners need to interact with real situations inside and outside the classroom. They need to look at pictures or diagrams, examine statistics, or read texts from a range of sources. They need to find out knowledge and ideas for themselves. They should then be expected to express these in their own words, not those of the teacher, and so demonstrate that they have understood what they have learnt.

In this approach, learners are encouraged to:

- Be responsible for their own learning
- Think for themselves and form their own ideas and opinions
- Become critical thinkers, ready to face new challenges and situations for themselves

Mathematics is divided into four themes that run throughout the four years of study. The following are the themes: Numbers, Geometry, Measures, Data and probability and patterns and Algebra.

THE MATHEMATICS SYLLABUS

The Mathematics syllabus is arranged in themes and topics that cover the four years of the Lower Secondary Curriculum. The recommended number of periods for each topic is indicated in Programme Planner and also in the detailed syllabus.

Programme Planner

SENIOR 1	THEME	TOPIC	DURATION (NUMBER OF PERIODS)
Term 1	Numbers	1. Number Bases	15
	Numbers	2. Working with Integers	15
	Numbers	3. Fractions, Percentages and Decimals	15
	Numbers	4. Rectangular Cartesian Coordinates in 2- Dimensions	15
Term 2	Geometry and Measures	5. Geometric Constructions Skills	12
	Patterns and Algebra	6. Sequence and patterns	12
	Geometry and Measures	7. Bearings	12
	Geometry and Measures	8. General and angle properties of geometric figures	12
	Data and Probability	9. Data collection and presentation	12
Term 3	Geometry and Measures	10: Reflection	12
	Patterns and Algebra	11. Equation of lines and curves	12
	Patterns and Algebra	12: Algebra 1	12
	Geometry and Measures	13: Business arithmetic	12
	Geometry and Measures	14: Time and time tables	12
		Total	**180**

SENIOR 2	THEME	TOPIC	DURATION (NUMBER OF PERIODS)
Term 1	Patterns and Algebra	1. Mappings and relations	15
	Patterns and Algebra	2. Vectors and translation	15
	Data and Probability	3. Graphs	15
	Numbers	4. Numerical concept 1: (indices and logarithms)	15
Term 2	Patterns and Algebra	5. Inequalities and regions	12
	Patterns and Algebra	6. Algebra 2:	12
	Geometry and Measures	7. Similarities and enlargement	14
	Geometry and Measures	8. Circle	10
	Geometry and Measures	9. Rotation	12
Term 3	Geometry and Measures	10. Length and area properties of two-dimensional geometrical figures.	15
	Geometry and Measures	11. Nets, areas and volumes of solids	15
	Numbers	12. Numerical concept 2 (indices, logarithms and surds)	15
	Data and Probability	13. Set theory	15
		Total	180

SENIOR 3	THEME	TOPIC	DURATION (NUMBER OF PERIODS)
Term 1	Patterns and Algebra	1. Equation of a straight line	15
	Geometry and Measures	2. Trigonometry 1	15
	Data and Probability	3. Data collection /display	15
	Geometry and Measures	4. Vectors	15
Term 2	Data and Probability	5. Ratios and proportions	12
	Geometry and Measures	6. Business mathematics	12
	Geometry and Measures	7. Trigonometry 2	12
	Data and Probability	8. Matrices	12
	Geometry and Measures	9. Matrix transformations	12

SENIOR 3		TOPIC	DURATION (NUMBER OF PERIODS)
Term 3	Patterns and Algebra	10. Simultaneous equations	15
	Data and Probability	11. Probability	15
	Patterns and Algebra	12. Quadratic equations	15
	Geometry and Measures	13. Circle properties	15
		Total	180

SENIOR 4		TOPIC	DURATION (NUMBER OF PERIODS)
Term 1	Patterns and Algebra	1. Composite functions	20
	Patterns and Algebra	2. Equations and inequalities	20
	Patterns and Algebra	3. Linear – programming	20
Term 2	Patterns and Algebra	4. Loci	20
	Geometry and Measures	5. Lines and planes in three dimensions	20
Term 3	All	Revision	
		Total	100

The syllabus details for all subjects are set out in three columns:

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT ACTIVITIES
The learner should be able to: The knowledge, understanding or skills expected to be learned by the end of the topic	The sort of learning activities that include the generic skills and that will help learners achieve the Learning Outcomes.	Opportunities for assessment within the learning

Teachers should base their lesson plans on the Learning Outcomes using the Suggested Learning Activities as a guide. These are not the only possible learning activities, and teachers are encouraged to extend these and devise their own that are appropriate to the needs of their class.

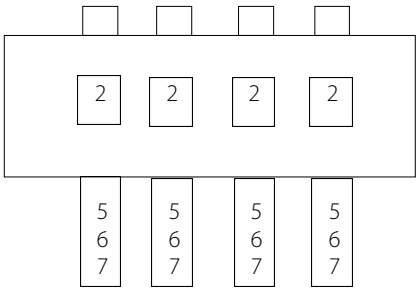
DETAILED SYLLABUS FOR MATHEMATICS

SENIOR 1: TERM 1

THEME: NUMBERS

TOPIC 1: NUMBER BASES — 15 PERIODS

Competency: Learners should be able to use their understanding of decimal place value to develop their understanding of numbers written in other bases.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: • identify numbers in any base using abacus. (k) • convert numbers from one base to another. (u) • manipulate numbers in different bases with respect to all four operations. (u s) • identify place value in different bases. (u)	• Playing number games, for example matching numbers in base two with numbers in base ten e.g. 1111 base two is matched to 15 base ten. • Imagine living in cartoon world where people have just eight digits rather than ten – what would their arithmetic be like? • Design counters in different number bases using strips threaded through card: • Prepare strips numbered 0 to 9, thread through card so a single number on each number is displayed, use to make different numbers. Change the length of the strips to investigate different number bases (e.g. 2222 in base 8). 	• Observe learners in their groups trying to identify place values of various number bases using abacus and converting numbers from one base to another. • Observe individual learners in their groups whether they are cooperative, whether they collaborate with their colleagues. • Let individual learners explain how they have identified the place values and converted numbers from one base to another e.g. How do you find p and q if $10020_{\text{base p}} = 87_{\text{base q}}$? • Complete the addition/multiplication table for different number bases.

SENIOR 1: TERM 1

TOPIC 2: WORKING WITH INTEGERS — 15 PERIODS

Competency: Learners should be able to carry out calculations with positive and negative integers.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify, read and write natural numbers as numerals and words in million, billion and trillion. (u s) b) differentiate between natural numbers and whole numbers/ integers. (u) c) identify directed numbers. (k) d) use directed numbers (limited to integers) in real life situations. (u s) e) use the hierarchy of operations to carry out the four mathematical operations on integers. (u) f) identify even, odd, prime and composite numbers. (k u) g) find the prime factorisation of any number. (k u s) h) relate common factors with HCF and multiples with LCM. (k u) i) work out and use divisibility tests of some numbers. (k, u, s, v/a)	• Order numbers and locate them on a number line • Use directed number in context e.g. temperature, height above and below sea level, floors in a building • Investigate multiples on a 1-100 square and notice that the digital root (i.e. the sum of the digits) of multiples of three is always a multiple of three, and for multiples of nine the digital root is a multiple of nine. Determine how to distinguish other multiples (e.g. 2 (even numbers), 5, 10). • Investigate the factors of numbers 1 to 30 – Which numbers have just two factors? Which numbers have an odd number of factors? • Use exactly four 4s to make as many whole number answers between 1 and 100 e.g. (4+4×4) ÷4= (4+16) ÷4=5, • recording the calculations correctly • Determine the prime factorisation of any integer	• Observe learners as they discuss in groups how they can read and write natural numbers in words and differentiate between natural and whole numbers. • Observe the interaction of learners within their groups • Nambi has four number cards: She can arrange the cards to form different numbers. For example, she can form the number 3407 3 4 0 7 What is the greatest even number Nambi can form using all four of her number cards? What is the least odd number she can form using all four of her number cards? • How many hundreds are there in one million? • What are the prime factorisations of 942 and 357? Hence find the HCF of 942 and 357, and the LCM.

SENIOR 1: TERM 1

TOPIC 3: FRACTIONS, PERCENTAGES AND DECIMALS — 15 PERIODS

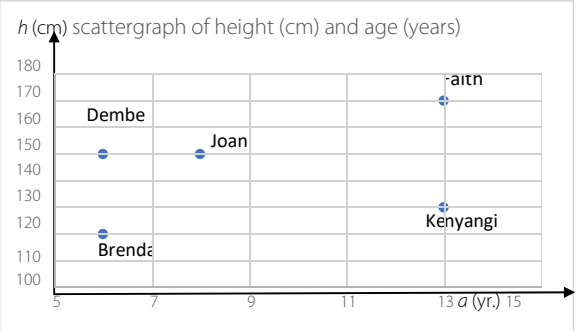
Competency: Learners should be able to understand and use fractions, decimals and percentages.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) describe different types of fractions. (k) b) convert improper fractions to mixed numbers and vice versa. (k, s) c) work out problems from real life situations. (u, s) d) add, subtract, divide and Multiplies Decimals. (u, s) e) converts fractions to decimals and vice versa. (u, s) f) identifies and classifies decimals into terminating, non-terminating and recurring decimals. (u) g) converts recurring decimals into fractions. (u, s) h) converts fractions and decimals into percentages and vice versa. (u s) i) calculates a percentage of a given quantity. (s) j) works out real-life problems involving percentages. (u, s, v/a)	• Fold paper strips to model fractions and use to determine equivalent fractions including decimals • Order and locate fractions on a number line • Understand decimals as fractions with powers of ten as a denominator (tenths, hundredths etc.) • Understand percentages as fractions with 100 as the denominator • Play games matching fractions, percentage and decimals • Identify percentages in every day contexts • Use a calculator to investigate fraction-decimal equivalence – which fractions produce terminating decimals and which fractions produce recurring decimals? • Developing strategies for converting decimals to fractions • Solve problems that involve fractions, percentages and decimals	• Let the learners explain to the group members how Moses would carry out the activity below • Observe the learners as they give the explanation. Look out for, whether the learners can listen to one another, whether they collaborate, cooperate, learn from one another, each can contribute to the explanation. a) Moses has the following cards. [3] [4] [0] [7] He also has a card with a decimal point. [.] What is the least number Moses can form using all five of his cards? b) How many 0.01s are there in: a) 1 b) 0.1 c) 10 d) 30 c) Rose achieved a score of 21 out of 25 in a mathematics test, and a score of 31out of 40 in a physics test. Did she do better in mathematics or in physics? Justify your answer.

SENIOR 1: TERM 1

TOPIC 4: RECTANGULAR CARTESIAN COORDINATES IN 2 DIMENSIONS 15 PERIODS

Competency: Learners should plot and interpret points in a range of contexts.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) draw and label the Cartesian plane. (k, s) b) identify the x– and y-axis. (k) c) read and plot points on the Cartesian plane/coordinate grid. (k, s) d) complete shapes on a coordinate grid. (k, u, s) e) choose and uses appropriate scale for a bi-variate data set. (u, s, v/a)	• In pairs, play four in a line on a coordinate grid, recording the plotted points • Draw shapes on a coordinate grid given the coordinates of one or more • Collect data (e.g. height and head circumference) from your class and plot a scatter graph	Observe learners as they try to do the below activities, look out for their cooperation in the process of getting solutions for the below question, sharing of information. 1. The heights and ages of five girls have been plotted on the scatter graph. a) Who is the tallest and how tall is she? b) Who is the same age in years as Dembe? c) How much taller is Faith than Joan?  2. Two vertices of a square are at the points (2, 1) and (6, 3). What are the coordinates of the other two vertices of the square? There are three possible answers. Find all three. Vertices

SENIOR 1: TERM 2

THEME: GEOMETRY AND MEASURES

TOPIC 1: GEOMETRIC CONSTRUCTION SKILLS — 12 PERIODS

Competency: Learners should be able use the angle properties of lines and shapes to solve problems.

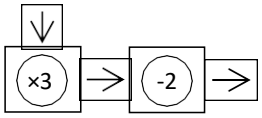
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) draw perpendicular and parallel lines. (k, s) b) construct perpendiculars, angle bisectors, mediators and parallel lines. (u, s) c) use a pair of compasses and a ruler to construct special angles. (60_0, 45_0) (u, s) d) describe a locus. (u) e) relate parallel lines, perpendicular bisector, angle bisector, straight line and a circle as loci. (k, u) f) draw polygons. (u) g) measure lengths and angles. (s) h) construct geometrical figures such as triangle, square, rectangle, rhombus, parallelogram. (u, s, v/a)	• Learners should identify perpendicular and parallel lines in the environment • Outside learners use strings and markers to create various loci e.g. equidistant from a fixed point (circle); equidistant from two fixed points (perpendicular bisector); equidistant from a line (parallel lines); equidistant from a fixed point and a line (parabola); the sum of the distance from two fixed points is a constant (ellipse) • Construct various polygons and geometric designs using geometric equipment	• Observe learners as they select the correct instruments to use. Observe their interaction, attitude towards what they are supposed to do. Can they differentiate drawing from constructing? • Let the learners explain or describe the procedure for constructing angles. • In your exercise book, construct the following angles by using a pair of compasses, ruler and pencil only. a) 30_0 f) 15_0 b) 45_0 g) 105_0 c) 60_0 h) 135_0 d) 75_0 i) 180_0 e) 90_0 j) 22.5_0 a) Accurately construct a square b) Accurately construct a regular hexagon

SENIOR 1: TERM 2

THEME: PATTERNS AND ALGEBRA

TOPIC 1: SEQUENCE AND PATTERNS — 12 PERIODS

Competency: Learners should be able to explore number patterns and sequences.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) recognise and generate number patterns. (k, u) b) explain how to generate a sequence. (u) c) use number machines to generate a sequence. (k, s) d) describe a general rule when a pattern is given. (k, u, s) e) determine terms in a sequence. (u, s)	• How many different ways can you continue the sequence that begins 2, 4, …? Explain how each sequence is generated • Make a 1 to 100 number square. a) Shade in all the multiples of 3 on the number square. b) Describe the pattern you have shaded on the number square. c) Sulai wants to shade some multiples to make a pattern of vertical lines. Which set of multiples could he use? Find as many different sets as you can. d) 3, 6 and 9 are the 1st, 2nd and 3rd multiples of 3. i) Which position in the multiples of 3 is 93? ii) Which position in the multiples of 3 is $3n$? • Put the numbers 1, 2, 3, 4, 5... into this number machine to generate a sequence.  a) Write down the first five members of the sequence. b What is the formula for the n_{th} term in the sequence? Sharon wants to shade some multiples on a 1 to 100 square to make a pattern of horizontal lines. Can she do this? Explain your answer. • Draw a double machine that could be used to generate the sequence 5, 8, 11, 14, 17….	• Observe learners in groups as they draw two different double machines that could be used to generate two different sequences, each with '3' as its first outcome number. • Observe the following; collaboration, harmony amongst the members of the groups, willingness to do the activity • Write a formula for the n_{th} term in a sequence starting 1, $\frac{1}{4}$, $\frac{1}{9}$, $\frac{1}{16}$, $\frac{1}{25}$

SENIOR 1: TERM 2

THEME: GEOMETRY AND MEASURES

TOPIC 2: BEARINGS — 12 PERIODS

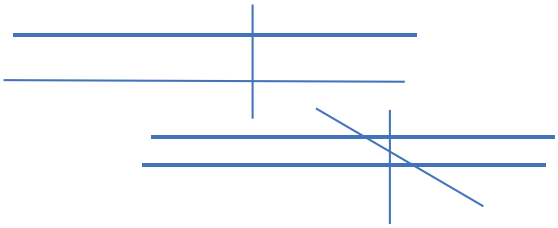
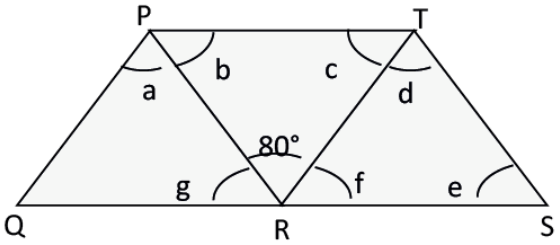
Competency: Learners should be able understand and use compass points, bearings and scale drawings.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) know the compass points. (k) b) describe the direction of a place from a given point using compass points. (u s) c) describe the bearing of a place from a given point. (k s) d) apply bearings in real life situations. (u s) e) choose and uses an appropriate scale to make an accurate drawing. (k u) f) differentiate between a sketch and a scale drawing. (u, v)	• Match compass points with bearings • Create a scale drawing of the classroom or school • Alex is facing North. He turns clockwise to face West. What angle has he turned through? • Henry's school is 4km away from his home, on a bearing of 070°. The market is 1km away from the school on a bearing of 250°. The hospital is 6km away from the market, on a bearing of 310°. What is the bearing of the hospital from Henry's home? • Make a scale drawing to find the distance and bearing of the hospital from Henry's home. Remember to state the scale you use on your drawing, and give your answer to a sensible degree of accuracy.	• Let the learners in groups, discuss and explain how they will accomplish the following task: *Two Ships leave Port Bell at the same time. One ship sails 80km on a bearing of 0300 to position A. The other ship sails 160km on a bearing of 1100 to position B.* *Use a scale drawing to find:* *a) the distance AB* *c) the bearing of B from A* • During the process of accomplishing the task, observe the communication skills of individual learners, creativity, respect for one another, sharing of information amongst themselves and other values and skills.

SENIOR 1: TERM 2

TOPIC 3: GENERAL AND ANGLE PROPERTIES OF GEOMETRIC FIGURES — 12 PERIODS

Competency: Learners should be able to use the angle properties of lines and shapes to solve problems.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify different angles. (k) b) solve problems involving angles at a point on a straight line, angles on a transversal and parallel lines. (k u s) c. know and use the angle sum of a triangle. (k u) d) state and uses angle properties of polygons when solving problems. (u s)	• Identify acute, obtuse and reflex angles. • Draw a pair of parallel lines and a transversal (see the diagram). Identify alternate, corresponding and supplementary angles  • Add another transversal to determine the angle sum of a triangle • Cut out three identical isosceles triangles from scrap card. Arrange them to form a trapezium PQST. R is the midpoint of the line QS. PQ = PR = TR = TS.  Note: the drawing is not accurate. a) Explain why PQ = PR b) Find two more lines that are equal to PQ and PR. c) Find the values of the labelled angles a, b, c, d, e, f, g • Find the angle sum of polygons by considering the minimum number of triangles within a polygon. Hence find the interior and exterior angles of regular polygons.	• Observe the learners as they carry out the following tasks • Through what angle do you turn in each of these cases? *You are facing North and you turn:* *clockwise to face SE* *anti-clockwise to face SE* *You are facing NW and you turn to face SE* • How many sides does each regular polygon have, if the exterior angle is 72_0; 24_0; 60_0; 45_0; 40_0? • Three interior angles of a pentagon are 110_0, 100_0, and 120_0 respectively. The fourth and the fifth angles are $3x_0$ and $2x_0$. Find their values. • Observe their collaboration, respect for one another and attitude towards the task.

SENIOR 1: TERM 2

THEME: DATA AND PROBABILITY

TOPIC 1: DATA COLLECTION AND PRESENTATION — 12 PERIODS

Competency: Learners should be able to collect and present different sorts of data.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) understand the differences between types of data. (k u) b) collect and represents simple data from the local environment using tally chart, bar chart (bars do not touch), pie chart and line graph. (k, u, s, v/a)	• Distinguish between qualitative and quantitative data • Distinguish between discrete and continuous data • Explore different ways of representing data – recognising possible limitations • Collect data for a purpose e.g. to solve a problem, to confirm or refute a hypothesis • Interpret representations of data	• Observe students completing the task below. *Students Mukasa and Aminah disagreed about the size of their classmates' feet.* *Mukasa said: "Most learners in Senior 1 have feet that are 15 centimetres long."* *Aminah said: "No, most of them have feet that are shorter than that."* *They measured the lengths of 30 learners' feet and recorded them:* 21, 18, 21, 16, 15, 19, 17, 15, 16, 20, 22, 17, 22, 22, 16, 16, 15, 18 a) Make a tally chart to sort the data. b) Represent the data in a suitable way. c) Who was correct? Explain your answer.

SENIOR 1: TERM 3

THEME: GEOMETRY AND MEASURES

TOPIC 4: REFLECTION — 10 PERIODS

Competency: Learners should be able to reflect shapes in a range of contexts and identify lines of symmetry.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify lines of symmetry for different figures. (k) b) reflect shapes and objects. (u s) c) apply reflection in the Cartesian plane. (u, s)	• Identify all the lines of symmetry in the letters of the alphabet written as capital letters, repeat for numbers • Use a mirror to reflect objects in a given line of symmetry • Investigate what happens to the coordinates of the image when an object is drawn on a coordinate grid and reflected in each axis and the lines y=x and y=-x	• In groups, learners should carry out the task below; Observe them as they do the task. Is there harmony in the groups? Is each learner's attitude towards the activity positive? How are they communicating to each other? Are they learning from each other? Look at their presentations. • Let each group explain to the other groups how they have carried out the task. **Task:** Plot the points A (1, 2), B (-1, 1) and C (-4, 3) on a Cartesian plane. Join up the points to create the object. After a reflection the image has points A' (2, 1), B' (1, -1) and C' (3, -4) a) Find the equation of the line of reflection.

SENIOR 1: TERM 3

THEME: PATTERNS AND ALGEBRA

TOPIC 2: EQUATIONS OF LINES — 12 PERIODS

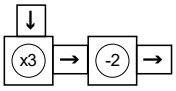
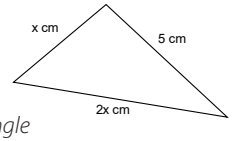
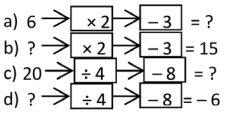
Competency: Learners should be able to understand and use linear equations and their graphs.

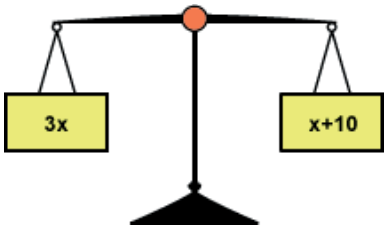
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) form linear equations with given points. (k, s) b) draw the graph of a line given its equation. (u, s)	• In pairs, play four in a line on a coordinate grid, recording the plotted points. Determine the equation for each set of points that form a straight line. • Investigate the properties of the equation of a straight line y= mx+c, by plotting the graphs using different values of m and c • How do you get parallel lines? How do you make the line steeper?	• Observe students while they work in groups on the following tasks. • Create a triangle using three straight lines. Give their equations. • A parallelogram has two sides defined by the lines x=0 and y=2x. Give the equations for two more straight lines to complete the parallelogram. • Find the equation of at least five straight lines that pass through the point (1, 1).

SENIOR 1: TERM 3

TOPIC 3: ALGEBRA 1 — 12 PERIODS

Competency: Learners should be able to form and use simple algebraic expressions.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) use letters to represent numbers. (u) b) write statements in algebraic form. (u) c) simplify algebraic expressions. (u s) d) evaluate algebraic expressions by substituting numerical values. (u s) e) manipulate simple algebraic equations in one variable and solve them. (u, s, v/a)	• Use number machines and write the equivalent algebraic expressions e.g.  *when x is put into this machine the output is 3x-2* • Thirty books are bought for sh. 10 800. Some cost UGX 400 each and the others UGX 300 each. How many books of each value are bought? • In groups, draw a triangle and label as shown. *The perimeter of the triangle is 26cm. Work out the value of x in the triangle*  	• As they discuss, observe participation in each group, presentations, methods used. • Find the missing input and output numbers in these double number machines:  • Solve the following equations a) $3p - 2 = 8$ b) $2x + 1 = 3x - 2$ • Yusuf thinks of a number, *b*. He adds 6. He multiplies the sum by 4. He subtracts twice the original number. His result is 32. a) Construct an equation to represent Yusuf's work b) Solve the equation to find Yusuf's original number.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
	• Think of a number puzzle • Understand the need to do the same thing to both sides of an equation when solving. The image of a balance can help.  	

SENIOR 1: TERM 3

THEME: GEOMETRY AND MEASURES

TOPIC 5: BUSINESS ARITHMETIC — 12 PERIODS

Competency: Learners should be able to understand and apply Business arithmetic.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) describe and calculate profit (includes all expenses incurred), loss, commission, interest, insurance and discount. (u, s) b) express profit or loss as a percentage. (u) c) solve simple interest problems. (k, s, v/a)	• Learners write their own definitions of, and how to calculate profit, loss, commission, interest, insurance and discount. • Discuss the causes of losses, why insurance is needed etc. • Let the learners set up imaginary shops in the classroom. Let the learners set the cost and selling prices. Learners can calculate the profit for each item sold. • When shopping which is the best saving: two for the price of one, one third off, pay 20% tax and then have a discount of 50%, have a discount of 50% and then pay 20% tax? • A shop has a sale, 25% off all prices. I buy a pair of shoes for sh. 60 000. What was the price of the shoes before the sale?	• Observe learners whether they are doing the work as instructed (integrity), are they willing to do the work? (positive attitude towards work). How is their presentation of the work? Are they creative and innovative? a) In a School there are 100 students, each of whom is given 3 litres of milk per week. If a half-litre pack costs UGX 1500, find the monthly milk bill (use 1 month = 4 weeks) b) A trader marked the prices of his goods 20% above the cost price and allowed a discount of 10% to the customers on the marked price. If Okot paid sh. 54 000 for a shirt, what was the marked price of the shirt? What was its cost price?

SENIOR 1: TERM 3

TOPIC 6: TIME AND TIME TABLES — 12 PERIODS

Competency: Learners should be able to understand and use time.

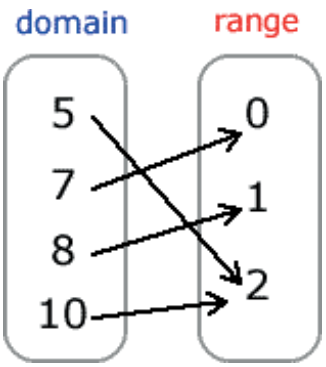
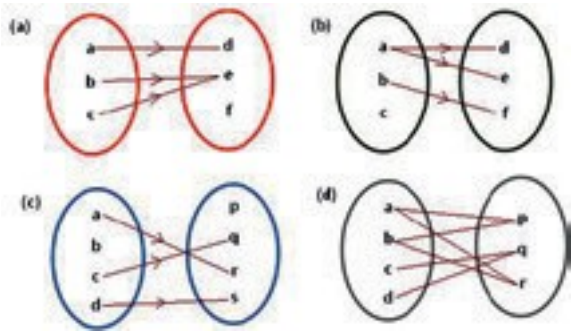
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify and use units of time. (k u s) b) use and interpret different representations of time. (u s) c) apply the understanding of time in a range of relevant real-life contexts. (u, s, v/a)	• Look at the S1 school timetable. How much time do learners spend in school? How much time is spent in lessons? What is the total time spent on each subject? • Use bus timetables to determine as much information as possible • Plan a journey and draw up a detailed itinerary using the 24-hour clock • Use a calendar to determine how many months of the year start on the same day of the week. Is this the same in every year? • How old are you in seconds (use a calculator)? If you had a celebration every million seconds, what would the date of your next celebration be?	<table><tr><th>BUS STATION</th><th>ARRIVE</th><th>DEPART</th></tr><tr><td>Soroti</td><td></td><td>20:30</td></tr><tr><td>Kumi</td><td>22:00</td><td>22:15</td></tr><tr><td>Mbale</td><td>23:30</td><td>24:00</td></tr><tr><td>Iganga</td><td>01:30</td><td>01:45</td></tr><tr><td>Jinja</td><td>02:05</td><td>02:55</td></tr><tr><td>Kampala</td><td>04:00</td><td></td></tr></table> • Look at the bus timetable. a) Where does the bus start? b) Where does it travel to? c) How long does the whole journey take from start to finish? Give your answer in hours. d) The bus travels for half the total journey time. Which should be the nearest station? e) Rona lives in Kumi. She wants to travel to Mbale. It takes 40 minutes to walk from Rona's house to the Kumi bus station. What is the latest time that Rona should leave her house? f) Give the time on the 12-hour clock when the bus will arrive at Mbale. g) What is the total time the bus spends at the bus stations on its journey? Give your answer in hours and minutes. h) Musa wants to travel from Jinja to Kumi. Can he use this bus for his journey? Explain your answer.

SENIOR 2: TERM 1

THEME: PATTERNS AND ALGEBRA

TOPIC 1: MAPPINGS AND RELATIONS — 15 PERIODS

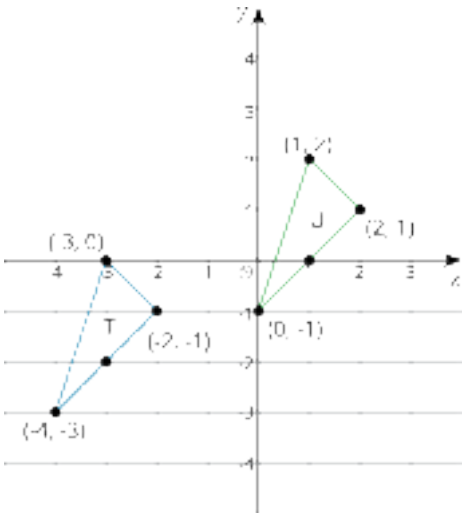
Competency: Learners should be able to understand and use arrow diagrams/mappings to represent relations and functions.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) Use arrow diagrams/mappings to represent relations and functions. (k u) b) identify domain and range of a mapping (k u) c) describe and distinguish between function and non-function mapping (u s)	 • Investigate situations where one set can be related to another and draw the mapping diagrams • Determine the features that make a mapping a function	• Observe the learners in their groups as they complete the task below. Find out the learners' attitude towards the group work, are learners communicating effectively? Are they learning from one another? Are they creative and critical? • Do these mapping diagrams represent functions? – give reasons for your answers. 

SENIOR 2: TERM 1

TOPIC 2: VECTORS AND TRANSLATION — 15 PERIODS

Competency: Learners should understand the nature of vector, manipulate and represent them in order to define translation.

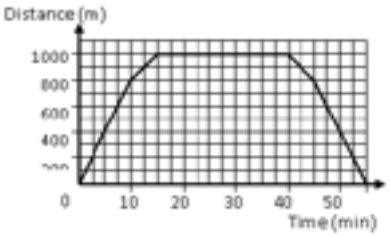
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) define translation with a vector. (k u s) b) identify scalars and vectors. (k u) c) use vector notation. (k s) d) represent vectors both single and combined geometrically. (u s)	• Distinguish scalars (magnitude only) and vectors (magnitude and direction), Investigate moving objects plotted on a coordinate grid without changing their orientation – use a vector (a) to define the translation where a represents movement parallel to the x-axis and b represents movement parallel to the y-axis. • Investigate how to 'undo' a translation; the effect of performing more than one translation – draw diagrams to illustrate findings. • Isabirye wants to swim directly across a river. The river flows at a speed of 1.5 metres per second. Isabirye can swim at a speed of 2.5 metres per second. Use a scale drawing to find out: *a) At what angle to the river bank should Isabirye face in order to swim directly across the river?* *b) What will his velocity be?*	• In groups, let the learners discuss the following task. Observe them as they discuss the task. Assess the learners on the core values and generic skills. • What is the vector that translates T to U? • What is the vector that translates U to T? 

SENIOR 2: TERM 1

THEME: DATA AND PROBABILITY

TOPIC 1: GRAPHS — 15 PERIODS

Competency: Learners should be able to plot, interpret and use graphs to solve problems.

<table>
<tr><th>LEARNING OUTCOMES</th><th>SUGGESTED LEARNING ACTIVITIES</th><th>SAMPLE ASSESSMENT STRATEGY</th></tr>
<tr>
<td>The learner should be able to:
• tabulate values from given relations. (u)
• plot and draw lines through given points. (u, s)
• chooses and uses appropriate scales. (u, s)
• draw, read and interpret the graph (e.g. Distance-Time and Speed-Time Graphs to estimate distance, speed and time). (u, s, v/a)</td>
<td>• Generate graphs for real life situations e.g. conversion graphs for currency and temperature (°C and °F), distance time graphs for journeys e.g. for the bus journey from Soroti to Kampala
<table>
<tr><th>BUS STATION</th><th>DISTANCE (KM)</th><th>ARRIVE</th><th>DEPART</th></tr>
<tr><td>Soroti</td><td></td><td></td><td>20:30</td></tr>
<tr><td>Kumi</td><td>50</td><td>22:00</td><td>22:15</td></tr>
<tr><td>Mbale</td><td>56</td><td>23:30</td><td>24:00</td></tr>
<tr><td>Iganga</td><td>107</td><td>01:30</td><td>01:45</td></tr>
<tr><td>Jinja</td><td>39</td><td>02:05</td><td>02:55</td></tr>
<tr><td>Kampala</td><td>84</td><td>0400</td><td></td></tr>
</table>
</td>
<td>• Let the learners carry out the following task in groups. Observe them as they discuss the activity. Assess the learners on the core values and generic skills.
• Atim visited her friend. The distance/time graph shows her journey.
 

a) How far did Atim walk to reach her friend's house?
b) How long did Atim stay at the house?
c) How long did it take Atim to walk back from her friend's house?
d) Draw the speed-time graph for Atim's journey</td>
</tr>
</table>

SENIOR 2: TERM 1

THEME: NUMBERS

TOPIC 1: NUMERICAL CONCEPT 1 (INDICES) — 15 PERIODS

Competency: Learners should understand and use indices and standard form.

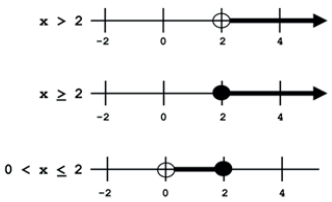
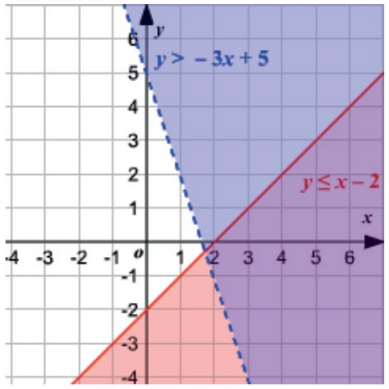
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) give approximate answers to calculations. (u, s) b) write numbers to a given number of significant figures. (u, s) c) differentiate between significant figures and decimal places. (u, s) d) express numbers in standard form. (u) e) Identify base number and index (k) f) state and apply the laws of indices in calculations. (k, u, s) g) use a calculator to find powers and roots. (k u s)	• Take a long strip of paper and successively fold in half. Complete the table below. NUMBER OF FOLDS / NUMBER OF PARTS / IN INDEX FORM 0 / 1 / 1 / 2 / 2 / 4 / 2^2 3 / / • Use a calculator to explore how indices work, establishing general rules for multiplying and dividing numbers written in index form: $n^a \times n^b$ and $n^a \div n^b$ Investigate how to 'undo' powers e.g. $4^2 = 16, \sqrt{16} = 16^{\frac{1}{2}} = 4$ $2^3 = 8, \sqrt[3]{8} = 8^{\frac{1}{3}} = 2$ • Watch the video 'powers of ten' to introduce powers of ten and standard form. How many particles in the universe? How far is it from the Earth to the moon? To the sun? • Investigate numbers that can't be written exactly on a calculator e.g. thirds, sevenths, pi • Investigate the difference between significant figures, decimal places and rounding to a given level of accuracy e.g. to the nearest hundred.	• In groups, let the learners discuss the following task and observe them as they discuss the activity. Assess the learners on the core values and generic skills. a. In 2013 the National Social Security Fund had assets of about UGX 3.4 trillion. a) How many millions are there in 3.4 trillion? b) How many ten thousand are there in 3.4 trillion? b. Akumu said, "$5^3 = 5 \times 3 = 15$." Burango said, "$5^3 = 5 \times 5 \times 5 = 225$." Who was correct? Justify your answer. c. The population census of 1969 found that the population of Uganda was 9 500 000. The population census of 2011 found that it was 32 900 000. Tushabe said, "The population rose by 23 400 000." Mariam said, "The population rose by 2.34×10^7." Who was correct? Justify your answer.

SENIOR 2: TERM 2

THEME: PATTERNS AND ALGEBRA

TOPIC 3: INEQUALITIES AND REGIONS — 12 PERIODS

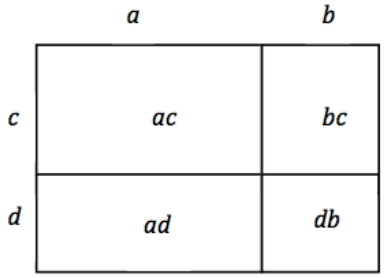
Competency: Learners should be able to represent and solve problems involving inequalities.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify and use inequality symbols. (k s) b) illustrate inequalities on the number lines. (u s) c) solve linear inequalities in one unknown. (u s) d) represent linear inequalities graphically. (k u s) e) form simple linear inequalities for regions on a graph. (u s)	• Match inequalities on a number line with their algebraic representation  • Solve linear inequalities and represent the solution on a number line. • Define regions on a coordinate graph using linear inequalities  • Play foxes and chickens – where chickens are positioned on a coordinate grid and inequalities are used as fences to protect the chickens from foxes	• Observe the learners in their groups as they carry out the activity below. Find out the learners' attitude towards the group work, integrity, are they doing the work in harmony? • During the process of the description, are learners communicating effectively? are they learning from one another? are they creative? • Solve the linear inequalities and represent the solutions on a number line *2x+7<x+10* *2x+7<x+10* • Use inequalities to define a square region that has (1, 1) at its centre.

SENIOR 2: TERM 2

TOPIC 4: ALGEBRA 2 — 12 PERIODS

Competency: Learners should understand and use indices and standard form.

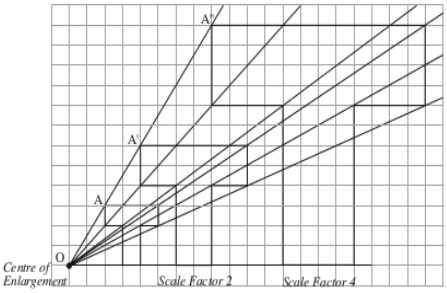
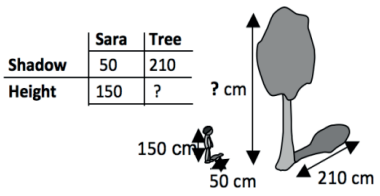
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) recognise equivalent quadratic expressions. (k u s) b) expand algebraic expressions. (k s) c) identify perfect squares. (u) d) factorise quadratic expressions. (u s) e) solve quadratic equations where the quadratic expression can be factorised. (k s)	• The sum of two numbers is 10 and their product is 21. What are the numbers? What is the connection with $x(10-x)=21$ and $x^2-10x+21=0$ and $(x-3)(x-7)=0$? • Investigate the relationship between multiplication and finding the area of a rectangle, and generalise to algebra  $(a+b)(c+d) = ac + bc + ad + bd$ • Multiply pairs of linear expressions $(x+a)$ to generate quadratic expressions recognising the special cases of perfect squares $(x+a)^2$ and the difference of two squares $x^2-a^2=(x+a)(x-a)$ • Substitute values of x in quadratic expressions and note the values when the expression is zero – link with the solutions of the quadratic equation • Investigate when quadratic expressions can be factorised to establish $x^2+(p+q)x+pq=(x+p)(x+q)$	• In pairs, let the learners discuss the following tasks. Observe them as they discuss the tasks. Assess the learners on the core values and generic skills. • Identify the perfect squares $x^2 + 2x + 1$ $x^2 + 2x + 2$ $x^2 - 6x + 8$ $4x^2 - 10x + 25$ • Use the difference of two squares to evaluate $101^2 - 99^2$ • Find the solutions of the following quadratic equations $x^2 - 5x + 6 = 0$ $x^2 + 3x - 10 = 0$ $x^2 - 6x + 8 = 0$ $x^2 - 10x + 24 = 0$

SENIOR 2: TERM 2

THEME: GEOMETRY AND MEASURES

TOPIC 1: SIMILARITIES AND ENLARGEMENT — 14 PERIODS

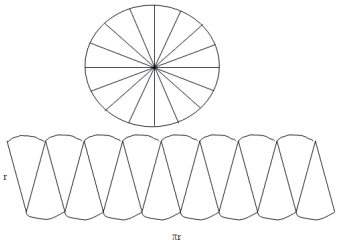
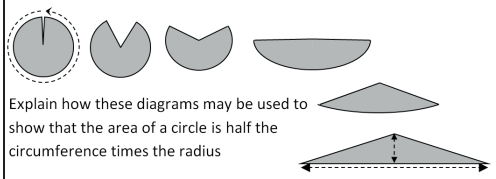
Competency: Learners should be able to understand and apply relationship between lengths, areas and volumes of similar shapes and objects.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify similar figures. (u s) b) state and use the properties of similar figures. (k u) c) define enlargement. (k) d) state the properties of enlargement to construct objects and images. (k) e) understand and use the relationship between linear, area and volume scale factors. (u s)	• Place an object in front of a lamp. What happens to the size of the shadow as the object moves closer to and further from the lamp? • Explore enlarging shapes through different centres of enlargement with different scale factors. What happens to the area of the shapes?  • Extend to 3D starting with cubes and cuboids • Establish the relationship between the linear scale factor (k) and the area scale factor(k^2) and the volume scale factor (k^3)	• Observe the learners in their groups as they discuss the tasks below. During the process, are learners communicating effectively? Are they learning from one another? Are they creative and critical? • Bayo and Sara want to find the height of a tree. They cannot climb the tree. Instead, they measure Sara's own height, the length of Sara's shadow, and the length of the tree's shadow. The table shows their results.  • What is the height of the tree? Give your answer to a reasonable degree of accuracy. • Tom has a cylindrical saucepan with diameter 18 cm. The cook at his school has a similar saucepan with diameter 72 cm. Tom can make porridge for one person in his saucepan. For how many people can the cook make porridge in the school?

SENIOR 2: TERM 2

TOPIC 2: CIRCLE — 10 PERIODS

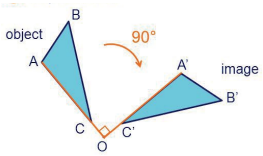
Competency: Learners should be able to understand, justify and apply the formulae for the area and circumference of a circle.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify various parts of the circle. (k) b) state and use the formulas for circumferences and area enclosed by a circle. (u)	• Collect a number of circular objects of different diameters, such as bottle tops, plates, a drum, etc. For at least five objects: • measure the diameter with a ruler and measure the circumference with string. Record the measurements in a table. Plot a graph of circumference against diameter. What do you notice? What is the relationship between the circumference and the diameter? • Introduce the ratio of circumference to diameter as pi(π) • How can you fit a circular cake on a rectangular plate? What are the least dimensions of the plate?  • Apply the formulae for circumference and area enclosed by a circle in everyday contexts.	• Observe the learners in groups as they discuss the task below. During the process of the description, are learners communicating effectively? are they learning from one another? are they creative and critical? • Let the learners give their group reports **Task:** Explain how these diagrams show that the area enclosed by a circle is half the circumference multiplied by the radius  Explain how these diagrams may be used to show that the area of a circle is half the circumference times the radius

SENIOR 2: TERM 2

TOPIC 3: ROTATION — 12 PERIODS

Competency: Learners should be able to understand and apply rotation as a transformation.

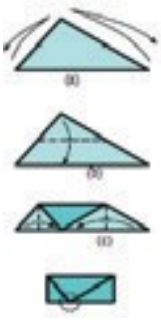
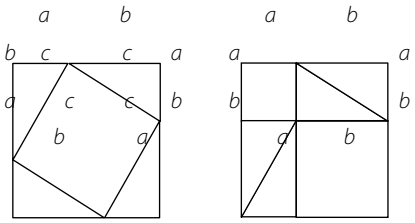
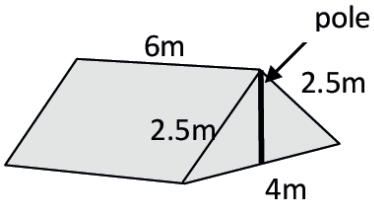
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify the order of rotational symmetry of plane figures. (k u s) b) distinguish between clockwise and anti-clock wise rotation. (k u) c) state properties of rotation as a transformation including congruence. (k u) d) determine the centre and angle of rotation. (u s) e) apply properties of rotation in the Cartesian plane. (u, s, v/a)	1. Cut out a regular polygon from card and mark one corner. Make an outline on paper. How many different ways will the card polygon fit inside the outline of the polygon? e.g. An equilateral triangle has order of rotation 3.  Repeat for other regular polygons. 2. Are there any capital letters of the alphabet that have rotational symmetry? 3. Cut shapes from scrap card, draw around the shape on a plain sheet of paper to create the object. Rotate the card shape about an identified centre of rotation (O) through an angle, and in a given direction (clockwise or anticlockwise). Draw around the card to create the image.  4. Investigate rotating different shapes on plain paper and a coordinate grid. 5. Given an object and image, construct the centre of rotation.	6. In pairs, let the learners discuss the following tasks. Observe them as they discuss. Assess the learners on the core values and generic skills. • Plot the points P (-2, 1), Q (0, 2) and R (1, 2) to form the triangle PQR on a square grid. Rotate PQR about the point (0, 0) through an angle of 90° clockwise. What are the coordinates of the image of triangle PQR after the rotation? • Determine the centre of rotation and the angle of rotation. 

SENIOR 2: TERM 3

TOPIC 4: LENGTH AND AREA PROPERTIES OF TWO-DIMENSIONAL GEOMETRICAL FIGURES

15 PERIODS

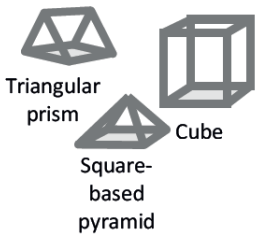
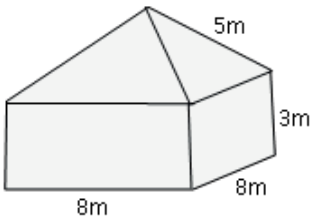
Competency: Learners should be able to understand, justify and apply area and perimeter formulae for different figures.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: • describe the length of two dimensional geometrical figures. (u) • develop, understand and state Pythagoras' theorem (k u) • apply Pythagoras' theorem to right angled and isosceles triangles. (u s) • understands the meaning of area in two dimensional geometrical figures (triangles, rectangles). (u s)	• Cut a triangle from a piece of scrap paper – fold to show how the area of a triangle is related to the area of a rectangle  Area of a triangle is $2 \times {}^{1}/_{2}$ base $\times$ ${}^{1}/_{2}$ perpendicular height • Cut a triangle from a piece of scrap paper – fold to show how 	• Observe the learners in their groups as they carry the tasks below. During the process; - Are learners communicating effectively? - Are they learning from one another? - Are they creative and critical? • A square storeroom has sides of length 2 metres and a door near one corner. What is the length of the longest pole that can be stored safely, resting on the floor of the room? • The dimensions of a tent are shown in the pole used to support the tent? What is the surface area of the tent? 

SENIOR 2: TERM 3

TOPIC 5: NETS, AREAS AND VOLUMES OF SOLIDS — 15 PERIODS

Competency: Learners should be able to make and draw 2D and 3D shapes, and explore their properties.

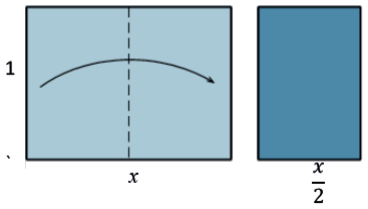
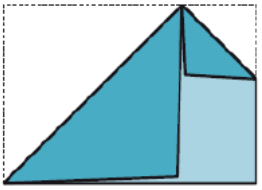
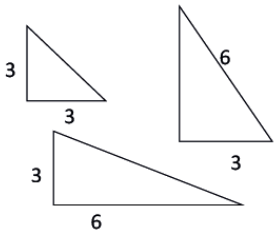
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) form nets of common solids. (u s) b) identify common solids and their properties including faces, edges and vertices. (k) c) state units of measures. (k) d) convert units from one form to another. (u) e) calculate surface areas of three-dimensional figures. (u s) f) calculate the volume of cubes and cuboids. (u s)	• Provide learners with cardboard packages and count the faces, edges and vertices. Dismantle to find the net. • How many different nets of the following solids can they create?  • Cube • Cuboids • square based pyramid • Put learners in groups to make these three shapes out of strips of wood that are all the same length. How many strips are needed for each shape? • How many different cuboids can be made from 24-unit cubes?	• Observe the learners in their groups as they carry out the task below. During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? **Task:** A tent has a cuboid base and a pyramidal roof. a) Sketch a net of the tent, and indicate the lengths of its edges. b) Calculate the surface area of the tent. c) Sketch as many different nets as you can for the tent.  *Note: Learners may discuss whether the floor of the tent is covered. Such an observation would indicate that they are thinking mathematically*

SENIOR 2: TERM 3

THEME: NUMBERS

TOPIC 2: NUMERICAL CONCEPT 2 (SURDS) — 15 PERIODS

Competency: Learners should be able to manipulate surds.

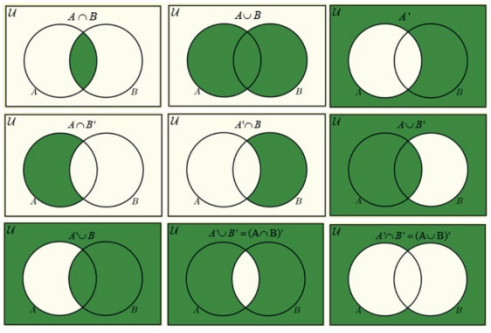
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) use surds to represent roots that cannot be represented exactly as decimals. (k, u) b) manipulate and simplify expressions with surds. (u, s, v/a)	• Investigate the lengths of diagonals in squares and rectangles e.g. square of side 1; 2×1 rectangle; 3×4 rectangle using Pythagoras' theorem. • Investigate the ratio of the side lengths of a paper. When this rectangular paper is folded in half, the resultant rectangle is similar  • Find the perimeter of the quadrilateral folded from a paper (Hint: assume the shortest side has length 1 unit) 	• Observe the learners in their groups as they carry out the tasks below. During the process, are learners communicating effectively? Are they learning from one another? Are they creative and critical? • 1. Find the missing lengths in the right-angled triangles below  • 2. Simplify and order: $\frac{5\sqrt{3}}{10}$ $\sqrt{20}-\sqrt{8}$ $\frac{6-\sqrt{3}}{2-\sqrt{3}}$ $(\sqrt{3}-1)(4-2\sqrt{3})$ $(3+\sqrt{2})^{-1}$

SENIOR 2: TERM 3

THEME: DATA AND PROBABILITY

TOPIC 2: SET THEORY — 15 PERIODS

Competency: Learners should be able to use sets to solve problems.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) describe a set and identifies elements of a set. (k, u) b) identify different types of sets and their symbols (empty set, universal set, equal set, complement set, disjoint set, intersection set, union set, subset). (k) c) determine the number of elements in a set. (u, s) d) represent and show different operations on sets by shading the different regions in a Venn diagram. (k, u, s) e) apply sets in practical situations using two and three sets. (u, s, v/a)	• Familiarise themselves with set notation Union of A and B — $A \cup B$ Intersection of A and B — $A \cap B$ Number of elements in set A — $n(A)$ "… is an element of …" — $\in$ "… is not an element of …" — $\notin$ Complement of set A — A' The empty set — $\varnothing$ Universal set — $\mathscr{E}$ A is a subset of B — $A \subseteq B$ A is a proper subset of B — $A \subset B$ A is a not a subset of B — $A \not\subseteq B$ A is a not a proper subset of B — $A \not\subset B$ • Draw and interpret diagrams to illustrate relationships between sets, apply to practical contexts 	• Observe the learners in their groups as they carry out the tasks below. During the process, are learners communicating effectively? Are they learning from one another? Are they creative and critical? • Given U= {1,2,3,4,5.6,7,8,9,10} A= {even numbers}, B= {square numbers} State n(A) and n(B). Draw a Venn diagram. Write down AuB, and (AuB)' • Ozo hosted a party with 300 guests. He served a meal with chicken (C) and meat (M). 200 guests had chicken. 130 guests had only chicken. 6 guests did not eat a meal. a) Represent this information in set notation b) Represent the information on a Venn diagram. c) How many guests ate both meat and chicken? d) How many guests had meat? • In a school there is an Arts Club, a Science Club, and a Mathematics Club. 30 learners in one class belong to at least one of the clubs. 15 belong to the Arts Club, 12 belong to the Science Club, and 13 belong to the Mathematics Club. What is the maximum number of learners that could belong to all three clubs?

SENIOR THREE

THEME: PATTERNS AND ALGEBRA

TOPIC 1: EQUATION OF A STRAIGHT LINE — PERIODS 15

COMPETENCY: Learners should be able to understand and use linear equations and their graphs

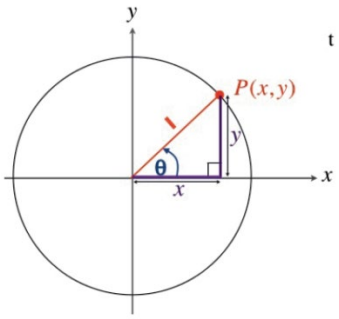
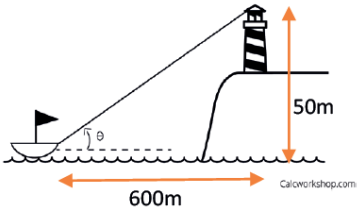
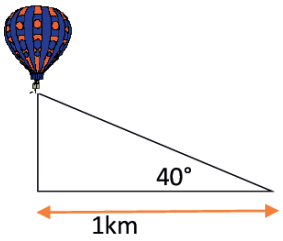
LEARNING OUTCOMES	LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: i) understand the relationship between a linear equation $y=mx+c$ and its graph. (k u) ii) determine the x and y intercepts of a given linear graph. (u s) iii) determine the gradient of a straight line. (u s) iv) state the gradient of a straight line when given the equation. (k u) v) apply the relationship of gradients of parallel and perpendicular lines to determine the equation of a straight line. (k u s)	• Consider a ladder of length 10m. a) Place the foot of the ladder at i) 8m, ii) 5m, iii) 2m from the wall and lean the ladder against the wall b) What happens to the angle between the ground and the ladder as the foot of the ladder moves closer to the wall? c) Relate the steepness of the ladder with the distance between the wall and the foot of the ladder. Explain this relationship. • Recall Senior 1, Topic 11: how does the equation $y=mx+c$ work? • Introduce gradient as a measure of steepness/rate of change • Draw a straight line and a perpendicular line on a coordinate grid. What are their equations? Try for another pair. What do you notice about the gradients? • Investigate the least number of points that need to be plotted to draw a straight line.	• Observe the learners in their groups as they carry out the tasks below. During the process, are learners communicating effectively? Are they learning from one another? Are they creative? 1. Asabi is going to plot the graphs of these six equations: $y=2x+1$, $y=3x$, $y=x+4$ 2. Y=+x=6, y=2x-5, $2y=3-x$ Without plotting the equations: Which graph will be steepest? Which will have the greatest y- intercept? Are any of the lines parallel or perpendicular? Explain your answer. Sendi drew the graphs of $2x-3=y$ and $y=7$ on the same set of axes. What are the coordinates of intersection?

SENIOR 3: TERM 1

THEME: GEOMETRY AND MEASURES

TOPIC 1: TRIGONOMETRY I — 15 PERIODS

Competency: Learners should be able to understand and use the three basic trigonometric functions.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) derive sine, cosine and tangent functions from the unit circle. (k u s) b) read and uses calculators to find values of trigonometric functions. (u s) c) use sine, cosine and tangent in calculating lengths of sides and angles of right-angled triangles. (u) d) find angles of elevation and depression. (k s)	• Draw a circle radius 1 unit (10cm) on graph paper and add axes as shown - the centre of the circle should be on an intersection of major grid lines. For different values of angle θ measure x and y, and complete the table.  • On separate graphs, plot graphs of x and y against $\theta°$ • Compute $y \div x$, plot $y \div x$ against $\theta°$	• Observe the learners in their groups as they carry out the tasks below. During the process, are learners communicating effectively? Are they learning from one another? Are they creative and critical? 1. Find the angle of elevation θ, of the top of the lighthouse.  1. Find the height above the ground of a hot air balloon, whose angle elevation from the ground 1km away, is 40°. 

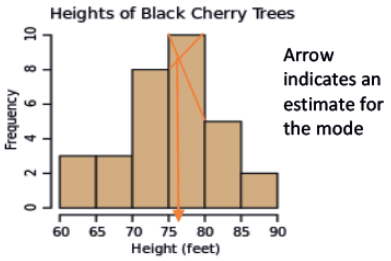
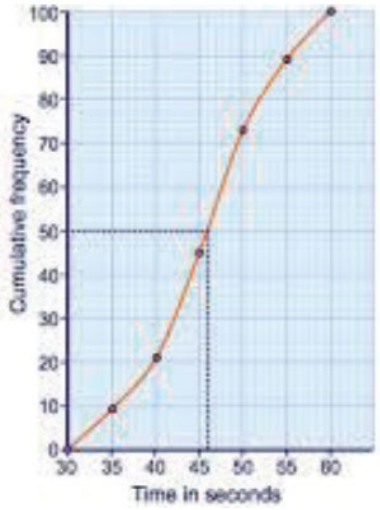
θ°	x	y
0	1.00	0.00
15		
30		0.50
45		
60	0.50	
75		
90	0.00	1.00
...		
360	1.00	0.00

SENIOR 3: TERM 1

THEME: DATA AND PROBABILITY

TOPIC 1: DATA COLLECTION /DISPLAY — 15 PERIODS

Competency: Learners should be able to collect and represent different sorts of data.

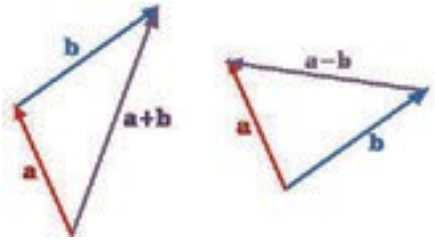
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) understand mode, mean and median, as measures of location/ central tendency and knows how to find them and when to use them. (k, u, s) b) understand range as a measure of dispersion/spread and how to find it. (k, u, s) c) draw and use frequency tables for ungrouped data. (u, s) d) draw and use frequency tables for grouped data. (u, s) e) estimate measures of location and dispersion for grouped data, (u, s) f) calculate the mean using an assumed mean, (u, s) g) draw a histogram with equal class intervals and uses it to estimate the mode. (u, s) h) draw a cumulative frequency curve(ogive) and uses it to estimate the median. (u, s, v/a)	• Class to get in height order – stand in a circle to illustrate the range (difference between tallest and shortest person). Discuss representative/typical values – find the most popular height (mode), the middle height (median), what if we were all the same height? (the mean). • Compare the advantages and disadvantages of mean, median and mode in different contexts. • Explore the need for grouping data when there are many different values. Once grouped, exact statistics (mean, median, mode, range) cannot be determined. Compare estimates from grouped data with the actual values from the raw data. • Draw a histogram and estimate the mode  • Draw a cumulative frequency graph and estimate the median • Build on Senior 1, Topic 9. Collect data for a purpose and apply techniques to draw conclusions	• Observe the learners in their groups as they carry out the task below. During the process are learners communicating effectively? Are they learning from one another? Are they creative and critical? • Which measure of central tendency would be best as a representative value for: salaries in a company workforce, crop yields, examination grades (A, B, C, D, E), measurements in a science experiment. Justify your choice. • The cumulative frequency diagram shows the time taken by 100 people to complete 10 press-ups. Find an estimate for the median time. Explain why only an estimate for the median is possible 

SENIOR 3: TERM 1

THEME: GEOMETRY AND MEASURES

TOPIC 2: VECTORS — 15 PERIODS

Competency: Learners should understand the nature of vector quantities, manipulate and represent them in order to solve problems.

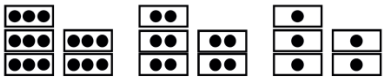
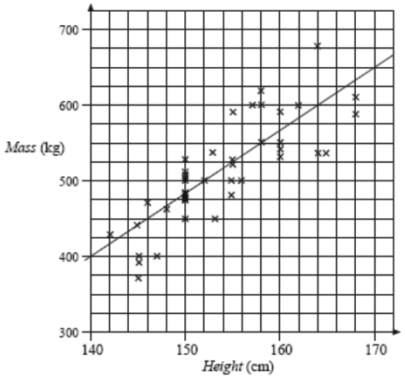
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) describe position vectors geometrically and as column vectors (k u) b) find the vector of a directed line segment when position vectors of the end points are known. (u) c) find the position vector of the mid-point of a line segment. (u) d) use vector method to divide a line proportionately internally and externally. (u s) e) use vectors to show parallelism. (u s) f) use vector methods to show co-linearity. (u s)	• Recall and review Senior 2, Topic 2, what is the difference between a vector and scalar quantity? Give examples. • Identify parallel and equal vectors. • Use vector addition and subtraction  • Explore the use of position vectors to define positions on a coordinate grid, including the midpoint of a line segment and proportional division of a line. • How can vectors be used to test for collinearity?	• Observe the learners in their groups as they carry out the tasks below. During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? • Which of the following vectors are parallel? $\binom{1}{2}, \binom{2}{1}, \binom{2}{3}, \binom{-2}{-4}, \binom{8}{16}$ Explain your answer. • Use vectors to find the midpoint of the line segment AB where A is (1, 7) and B is (-3, -3). The point (1, 1) divides the line segment AB internally in the ratio 3:4. A is (-2, 7). Use vector methods to find the coordinates of B. • Use vectors to establish whether the points (5, 2), (-3, 6) and (9, 4) are collinear.

SENIOR 3: TERM 2

THEME: PATTERNS AND ALGEBRA

TOPIC 2: RATIO AND PROPORTION — 12 PERIODS

Competency: Learners should understand ratio and proportion, and use them in a range of contexts.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) understand and apply equivalent ratios. (u s) b) understand and apply direct and inverse proportional reasoning. (u s) c) understand and apply ratio, proportion and scale. (k u s) d) draw and interpret the line of best fit when looking for a relationship in bivariate data on a scatter graph. (u s)	• Use diagrams to illustrate ratios. Look at the diagrams.  9:6 = 6:___ = ___:2 a) Use the diagrams to fill in the gaps and complete the equivalent ratios. b) Draw diagrams to show some ratios that are equivalent to 5:3 c) Simon says, "12:15 is equivalent to 3:4". Is he correct? Draw diagrams to justify your answer. • Adjust recipes e.g. 8 cakes need 400 grams of flour. How much flour for 20 cakes? How many cakes with 750 grams of flour? These are examples of direct proportion, $y \propto x$ • A rectangle has an area of 36 square units. If the dimensions of the rectangle are x and y, what is the relationship between x and y? Plot a graph to show the relationship, this is an example of inverse proportion, $y \propto \frac{1}{x}$ • Collect data from the class e.g. handspan and height. Plot a scatter graph. Draw a line of best fit. Use the line of best fit to estimate the handspan of someone joining the class with a particular height.	• Observe the learners in their groups as they carry out the tasks below. During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? • Mrs. Mukasa is a small-scale poultry farmer. It costs her UGX.250 000 to buy the feed to raise 70 broilers. • a) Mrs Mugisha wants to raise 300 broilers. How much will the feed needed to raise these broilers cost? • b) Day old broiler chicks cost UGX. 2000 each. Mrs Opio has UGX. 1 000 000 (one million shillings). She wants to buy and raise as many chicks as she can. How many should she buy? • The height and mass of horses are shown on the scatter graph. What is the equation of the line of best fit? Estimate the height of a horse of mass 600 kg. 

SENIOR 3: TERM 2

THEME: GEOMETRY AND MEASURE

TOPIC 3: BUSINESS MATHEMATICS — 12 PERIODS

Competency: Learners should understand and apply business mathematics when solving problems.

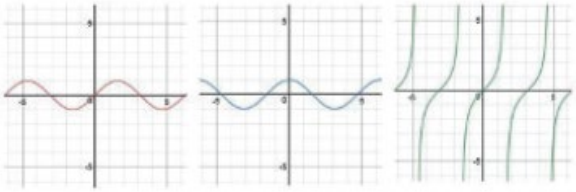
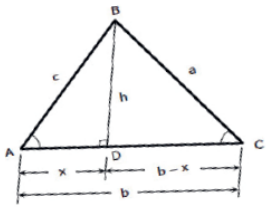
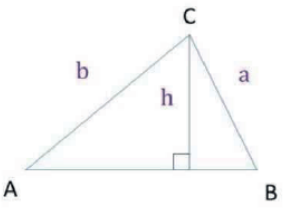
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) use a multiplier when calculating percentage change. (u s) b) calculate compound interest. (u s) c) understand and calculate depreciation and appreciation. (u s) d) understand and convert local or foreign currencies. (u s) e) understand and calculate hire purchase. (u) f) describe and determines Mortgage of assets. (u s) g) calculate income tax given income tax bands. (u, v/a)	• Review Senior 1, Topic 13. Recall the meaning of buying, selling, profit, loss, commission, discount and interest. Research and write their own definitions of mortgage, currency, income tax, appreciation and depreciation. • Explore and develop efficient ways of calculating percentage change, use a multiplier e.g. 0.8 for a decrease of 20%, 1.05 for an increase of 5% • Which is the best savings account: 1% compound interest paid monthly, 3% compound interest paid every three months, 6% compound interest paid every six months, 12% paid annually? • Consider which assets appreciate, and which depreciate. • In groups, find out about mortgages and make a poster to share with the class. Repeat for hire purchase. How much does it cost to borrow money? • You are travelling to Kenya. How much will your Ugandan money be worth in Kenya? How much does it cost to convert currency? • Draw a graph of income tax paid against annual salary using government information about income tax bands.	• Observe the learners in their groups as they carry out the tasks below. During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? • A piece of sculpture and painting together cost UGX 21 000. The painting costs twice as much as the piece of sculpture. Find the cost of the painting. • The marked price of a set of curtains is UGX 75 000, but there is a cash discount of UGX 12.50 on every sh100. Find the cash price for the curtains. • If a forex bureau buys Kenyan shilling at the rate of UGX 42 per Kenya shilling, find: • the amount in Uganda shillings paid out by the Bureau in exchange for K shillings 625. • the amount in Kenya shillings that can be exchanged for Uganda shillings 5460. • Ashok invests UGX 100 000 in a savings account that pays 10% compound interest each year. Assuming no further money is invested and no withdrawals are made, how many years does it take to double his money?

SENIOR 3: TERM 2

THEME: GEOMETRY AND MEASURE

TOPIC 4: TRIGONOMETRY 2 — 12 PERIODS

Competency: Learners should understand and apply the three basic trigonometric functions.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) determine trigonometric ratios of angles greater than 90o. (u s) b) use the graphs of trigonometric functions to determine values of sine, cosine and tangent for any angle. (u s) c) apply sine and cosine rules to solve real life problems. (k u s)	• Review the work of Senior 3, Topic 2, particularly the graphs of trigonometric functions and their relationship with the unit circle  • Use the graph to explain how values of the trigonometric functions outside the interval [-90°,90°] are related to values in that interval. Solve trigonometric equations over different intervals. • Apply the sine and cosine rules. **Derive the cosine rule by extending Pythagoras' theorem to non-right-angled triangles**  $b^2 = a^2 + c^2 - 2ac\cos B$ **Derive the sine rule by using right angled triangles**  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$	• In pairs, let the learners discuss the following tasks. Observe them as they discuss. Assess the learners on the core values and generic skills • Solve $\sin\theta = 0.5, \quad 0° \le \theta \le 720°$ $\cos\theta = \frac{\sqrt{2}}{2}, -360° \le \theta \le 360°$ $\tan\theta = -1, -180° \le \theta \le 540°$ • The hour and minute hands of a clock have lengths of 44mm and 57mm respectively. (a) Calculate the distance between the ends of the hands when the angle between the hands is 69°. (b) Calculate the angle between the hands when the ends of the hands are 32mm apart. • 3. A pole 8.3 metres long and a pole 11.5 metres long are placed on the ground with two ends in contact with each other. The distance between the other two ends is 4.7 metres. Find the angle between the two poles at the point of contact.

SENIOR 3: TERM 2

THEME: DATA AND PROBABILITY

TOPIC 2: MATRICES — 12 PERIODS

Competency: Learners should understand and use matrices.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) define a matrix and states its order. (k) b) know when matrices can be added or multiplied. (u s) c) find the determinant of a 2×2 matrix. (u s) d) find the inverse of a 2×2 matrix and understands why it may not be possible to do so. (k, u, s) e) apply knowledge of matrices in solving problems from real life situation. (u, s, v/a)	• What is a matrix? • When can matrices be added together? $A=\begin{pmatrix}2&0&1\\3&0&0\\5&1&1\end{pmatrix}\quad B=\begin{pmatrix}1&0&1\\1&2&1\\1&1&0\end{pmatrix}$ $A+B=\begin{pmatrix}2+1&0+0&1+1\\3+1&0+2&0+1\\5+1&1+1&1+0\end{pmatrix}=\begin{pmatrix}3&0&2\\4&2&1\\6&2&1\end{pmatrix}$ • When can matrices be multiplied together? $A=\begin{pmatrix}2&-1&0\\3&0&1\end{pmatrix}, B=\begin{pmatrix}1&2\\4&0\\-3&1\end{pmatrix}$ $AB=\begin{pmatrix}2-8+0&4+0+0\\3+0-3&6+0+1\end{pmatrix}=\begin{pmatrix}-6&4\\0&7\end{pmatrix}$ BA is not defined. Usually $AB \neq BA$ • The inverse matrix A^{-1} has the property that $AA^{-1}=A^{-1}A=I$. Find out how to derive the inverse matrix for 2×2 matrices. $A=\begin{pmatrix}a&b\\c&d\end{pmatrix}, A^{-1}=\frac{1}{ad-bc}\begin{pmatrix}d&-b\\-c&a\end{pmatrix}$ ad-bc=determinant of A • What happens if det $A = 0$? • Use matrices to solve pairs of linear equations in two unknowns. Explore what happens when there are no solutions.	• Observe the learners in their groups as they carry out the tasks below. During the process, are learners communicating effectively? Are they learning from one another? Are they creative and critical? • Use matrices to solve the simultaneous equations (a) $3x + 5y = 25$ $2x + 4y = 18$ (b) $7m + 3n - 46 = 0$ $30 - 3m = 5n + 40$ • Use the matrix method to show that the following pairs of simultaneous equations have no unique solutions. Why does this happen? (a) $6x - 9y = 36$ $2x - 3y = 5$ (b) $3x - 7y = 45$ $9x - 21y = 135$

SENIOR 3: TERM 2

THEME: GEOMETRY AND MEASURES

TOPIC 5: MATRIX TRANSFORMATIONS — 12 PERIODS

Competency: Learners should understand and use matrices to transform shapes on a coordinate grid.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify transformation matrices for reflection, rotation and enlargement. (k u s) b) determine the image given the object and transformation matrix, on a coordinate grid. (u s) c) identify the matrix of transformation when the object and its image are given. (u s) d) determine the inverse of a transformation matrix. (u) e) use the inverse matrix to find the object when the image is given. (u s) f) identify the relationship between area scale factor and determinant of the transformation matrix. (u) g) determines a single matrix for successive transformations. (u, v/a)	• Find the matrix corresponding to the transformation by considering the images of the point I(1, 0), J(0, 1) and K(1, 1): (a) reflection in the line x + y = 0 (b) a 90degrees anti-clockwise rotation about the origin (c) an enlargement, centre the origin, scale factor k. What do you notice about the determinant of the transformation matrix? • Plot the following five triangles on grid paper. T1 (1, 1), (5, 1), (5, 3), T2 (1, 1), (1, 5), (-1, 5) T3 (-1, 1), (-5, 1), (-5, 3) T4 (-1, -1), (-5, -1), (-5, -3) and T5 (1, -3), (1, -5), (5, -3) Describe a single transformation that maps: (a) T3 onto T1. (b) T4 onto T5 (c) T1 onto T2 (d) T4 onto T3 (e) T1 onto T4 (f) T4 onto T2, and determine the transformation matrix. Determine the transformation matrix to 'undo' each transformation. What do you notice? • Investigate combining transformations and the corresponding transformation matrices.	• Observe the learners as they carry out the tasks below. During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? 1. O (0, 0), A (3, 0), B(3, 3) and C(0, 3) are the vertices of a square OABC. A′ (4, 2), B′(6, 6) and C′(2, 4) are the vertices of OA′B′C′, the image of OABC such that the origin is invariant. Find: (a) the transformation matrix (b) the area of OA′B′C′. 2. Describe the transformations defined by the matrices $\boldsymbol{A} = \begin{pmatrix} \frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$ and $\boldsymbol{B} = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ Evaluate AB and BA. Describe the transformation each represents. A shape *P* is subject to transformation $\boldsymbol{AB}$ to give image P_{AB}. The same shape P is subject to transformation $\boldsymbol{BA}$ to give image P_{BA}. Describe the single transformation that will map P_{AB} to P_{BA}.

SENIOR 3: TERM 3

THEME: PATTERNS AND ALGEBRA

TOPIC 2: SIMULTANEOUS EQUATIONS — 15 PERIODS

Competency: Learners should understand, form and solve simultaneous equations.

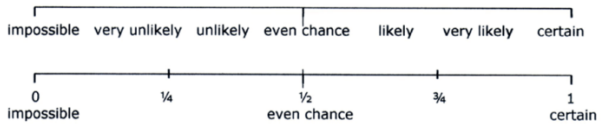
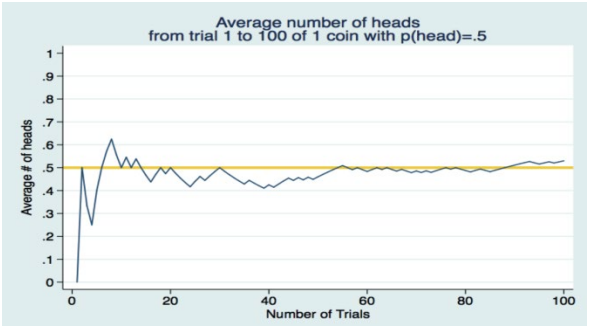
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) solves simultaneous equations using substitution. (u, s) b) solves simultaneous equations using elimination. (u, s) c) draws graphs of simultaneous equations and estimates the solution. (u, s) d) uses matrices to solve simultaneous equations. (u, s, v/a)	• Maureen buys 3 tins of peanut butter and 5 tins of margarine for UGX 32 000. Zulaika buys 6 tins of peanut butter and 8 tins of margarine for UGX 59 000. Musisi buys one tin of peanut butter and one tin of margarine. How much does he pay? • How does the set of equations 3x+5y=32 and 6x+8y=59, relate to the problem above? • Explore different methods for solving simultaneous equations including substitution, elimination and use of matrices (Senior 3, Topic 8). • Represent simultaneous equations graphically. From Senior 3, Topic 1, plot 2x – 3= y and y = 7 on the same set of axes. What are the coordinates of intersection? What do the values represent?	• Observe the learners as they work on the tasks below. During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? 1. Solve the following pairs of simultaneous equations using elimination method. *(a) 7x + 3y = 32* *3x + 12y = 78* *(b) 6y + 14 = 7x* *5x – 12 = 4y* 2. Use substitution to solve the simultaneous equations: 3x + y = -2 4x + 2y = 0 3. Draw graphs for the following pairs of simultaneous equations, which have no unique solutions. Why does this happen? a) 6x – 9y = 36 2x – 3y = 5 b) 3x – 7y = 45 9x – 21y = 135 c) x+y=3 2y=6-2x

SENIOR 3: TERM 3

THEME: DATA AND PROBABILITY

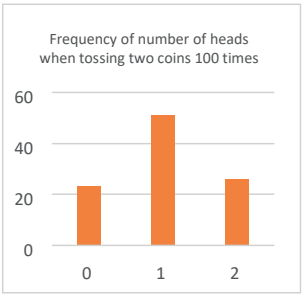
TOPIC 3: PROBABILITY — 15 PERIODS

Competency: Learners should apply their understanding of probability to solve a wide range of problems.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) understand the terms random, experiment, outcome, sample space, event and probability. (k, u) b) construct the probability space. (u, s) c) determine probabilities from experiments and real-life data. (u, s) d) differentiate between theoretical and experimental probabilities. (k, u, s). e) identify and understand mutually exclusive and independent events. (k, u) f) use probability trees to determine the probabilities of mutually exclusive and independent events. (u, s) g) use Venn diagrams to determine probabilities. (u, s, v/a)	• Discuss the likelihood of different events and order them from impossible to certain. Introduce the probability scale from 0 to 1.  • In pairs, get an unbiased coin. Mark one side of the coin as a 'head (H)' and the second side as a 'tail (T)'. Toss the coin 100 times, recording the outcome each time e.g. H, T, T, ... Plot a graph to show the proportion of heads after each throw.  What do you notice as the number of tosses increases? • Distinguish experimental and theoretical probabilities • Play the horse race game (horses numbered 1 to 12, learners select a horse, two dice are thrown, their sum determines which horse moves) • Use a possibility space to record the possible outcomes when two dice are thrown • Toss a pair of coins 100 times and record the outcomes, compare the outcomes with the possibility space. Use the possibility space to determine the theoretical probabilities.	• Observe the learners as they work on the tasks below. During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? 1. Sara has the following coins in her pocket bag: UGX 50; UGX 100; UGX 200; UGX 500; UGX 1000. She selects a coin at random to put into a charity collection box. What is the probability that she: a) gives more than UGX 200 b) has less than UGX 800 left in her bag c) has more than UGX 300 left in her bag d) gives at least 10% of the money in her bag e) gives more than one fifth of the money in her bag 2. A class has 30 girls and 40 boys. The probability that a boy selected at random is wearing stockings is 0.3. The probability that a girl selected at random is wearing stockings is 0.9. Calculate the probability that a learner selected at random from the whole class: a) is a boy b) is a girl wearing stockings c) is not wearing stockings

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY

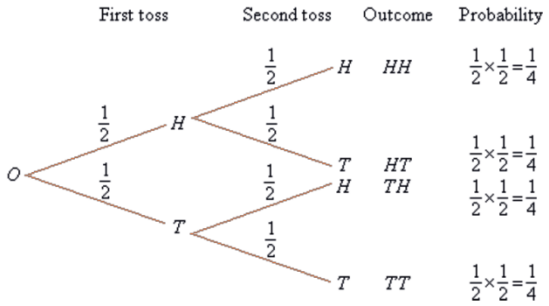
BAR CHART OF RESULTS



POSSIBILITY SPACE

		Coin 1	
		H	T
Coin 2	H	HH	HT
	T	TH	TT

- Use a tree diagram to determine the theoretical probabilities



- Apply probability in a variety of contexts including those that can be described using a Venn diagram (Senior 2, Topic 13).

3. In a school, there is an Arts Club, a Science Club, and a Mathematics Club. 30 learners in one class, each belongs to either one or two of the clubs. 15 belong to the Arts Club, 12 belong to the Science Club, and 13 belong to the Mathematics Club. Draw a Venn diagram.

   What is the probability of belonging to at least two clubs?

SENIOR 3: TERM 3

THEME: PATTERNS AND ALGEBRA

TOPIC 4: QUADRATIC EQUATIONS — 15 PERIODS

Competency: Learners should understand and solve quadratic equations and relate them to the graphs.

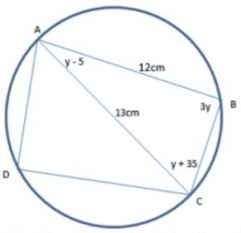
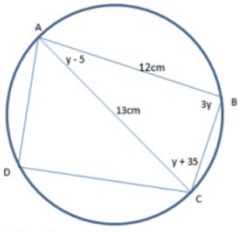
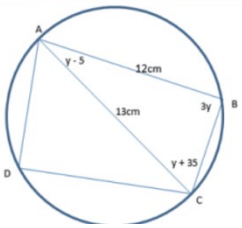
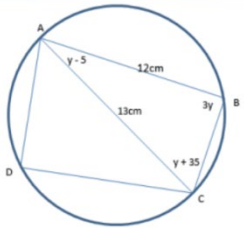
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) determine the roots of quadratic equations using factorisation, completing the square and the formula. (k u s) b) form a quadratic equation given its roots. (u s) c) make a table of values for a quadratic function and draws the graph. (k u s) d) link the solutions of a quadratic equation with its graphical representation. (k u s) e) solve simultaneous equations involving one quadratic equation and a linear equation. (u s)	• Review Senior 2, Topic 6. Create a table of values for the quadratic equations: $y=x_2$, $y=x_2-4$, $y=(x+1)_2$. Describe the transformations that link these graphs. Find the solutions to the equations $x_2=0$, $x_2=4$, $(x+1)_2=0$ How do the solutions relate to the graph? • A school has a rectangular garden with an area of 1000m2. Its length is 30m greater than its width. Find the dimensions of the garden. • Explore completing the square to solve quadratic equations and relate to graphs • Generalise completing the square to derivation of the quadratic formula for $ax^2 + bx + c = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ • Investigate when quadratic equations have two distinct, a single (repeated) and no real solutions and match to the graphs.  • Solve simultaneous equations involving a quadratic equation and a linear equation, and represent them graphically.	• Observe the learners in their groups as they work on the tasks below. During the process, are learners communicating effectively? Are they learning from one another? Are they creative and critical? 1. A room p metres long and $(p-3)$ metres wide has an area of 40m$_2$. Obtain an equation in p. Find the value of p. 2. The roots of a quadratic equation are -2 and 3, write down at least three different equations that have these roots. Sketch their graphs. 3. Try to solve $x_2 - 3x + 4 = 0$ by: i) factorising ii) completing the square iii) formula (a) For each method, state briefly the difficulty encountered. *(b)* What do you conclude about the solution set of $x_2 - 3x + 4 = 0$ (c) Draw the graph of $y=x_2 - 3x + 4$. What do you notice?

SENIOR 3: TERM 3

THEME: GEOMETRY AND MEASURES

TOPIC 6: CIRCLE PROPERTIES — 15 PERIODS

Competency: Learners should be able to understand and use circle properties to solve problems.

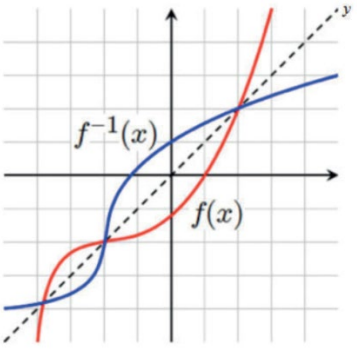
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) identify arc, chord, sector and segment. (k) b) relate angles made by an arc at the circumference and centre. (u) c) determine the tangent, chord and angle properties of the circle. (u) d) determine and uses the properties of a cyclic quadrilateral. (u s) e) find the length of the common chord for two intersecting circles. (u s) f) calculate the area of sectors and segments. (u, s, v/a)	• Recall and review Senior 2, Topic 8. • Apply the formulae for circumference (πd) and area of a circle πr_2 to find arc lengths and areas of sectors and segments. (Note use trigonometry to derive area of a triangle is $\frac{1}{2} ab \sin C$) • Cut a right-angled triangle from a piece of paper. In another piece of paper make a slit so one corner of the triangle can fit through snugly. Move the corner around, maintaining the snug fit and trace the locus of the corner. What do you notice? Repeat for the other corners.  • Find the centre of the circle. For a given chord measure the angle at the centre and the angle at the circumference of the major segment. What do you notice? Prove it. Repeat for the minor segment. • Use the results above to derive and prove the properties of cyclic quadrilaterals. • Investigate the properties of tangents to a circle. • Find the length of the common chord when two circles intersect.	• Observe the learners in their groups as they work on the task below. During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? • Solve the problems below.  AC is the diameter. Work out the circumference.  Is AC the diameter?  

SENIOR 4: TERM 1

THEME: PATTERNS AND ALGEBRA

TOPIC 1: COMPOSITE FUNCTIONS — 20 PERIODS

Competency: Learners should be able to understand and use composite functions.

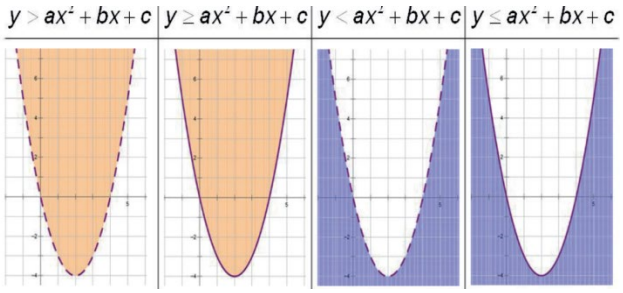
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) understand and use function notation. (k u s) b) describe and understand a composite function. (k u s) c) work out the inverse of a function and recognise the graphical relationship between a function and its inverse. (k u s)	• Recall and review Senior 2, Topic 1. • In pairs, consider the functions $f(x) = 6x$ and $g(x) = x + 5$ (a) What is $f(3)$? (b) What is $g(f(3))$? (c) What is $g(3)$? What is $f(g(3))$? Is $g(f(3))$ the same as $f(g(3))$? (d) What is $f(f(5))=f^2(5)$? Repeat for x. • Investigate the inverse function of a given function. Illustrate graphically. What do you notice? By considering the domain and range of the function and its inverse – explain why this happens. 	• Observe the learners in their groups as they work on the tasks below. During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? 1. $f(x)$ is the greatest number prime less than x. Find: *(a) f(40), (b) f(29)* 2. If $f(x) = 2x^3$ and $g(x) = x - 1$, find $h(x)= f(g(x))$ Find $h^{(-1)}(x)$, and sketch the graph of function h with its inverse. 3. Given $f(x) = 2x$ and $g(x) = x - 3$, find; (a) $f^3(x)$ (b) $f(x^3)$ (c) $g^2(x)$ (d)$g(x^2)$ (e) $gf(x)$ (f) $f(g(x))$ (g) $f(g(f(x)))$

SENIOR 4: TERM 1

THEME: PATTERNS AND ALGEBRA

TOPIC 2: EQUATIONS AND INEQUALITIES — 20 PERIODS

Competency: Learners should be able to understand, use and solve problems using equations and inequalities.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) build formula from word statements. (u s) b) re-write a given formula by changing the subject. (u s) c) solve equations and inequalities, representing the solutions on a number line or graphically as appropriate. (k u s)	a) Review and build on Senior 2, Topic 5 and Senior 3, Topics 10 and 12. b) Bayo, Ruth and John were all born on Independence Day, but in different years. Bayo is one year older than Ruth. John's age is 3 times Bayo's age. If Ruth is r years old, write down expressions for: (a) Bayo's age (b) John's age (c) How many years older than Bayo is John? Give your answer in terms of r (d) In 6 years' time, John will be 6 years older than Bayo. How old is Ruth now? a) Solve quadratic inequalities and represent the solutions on a number line. b) Extend graphing inequalities to include quadratics. 	• Observe the learners in their groups as they discuss the tasks below. During the process of the presentation, are learners communicating effectively? Are they learning from one another? Are they creative and critical? 1. Alupo thinks of a number. She carries out two calculations on the number. First, she adds 5. Then she multiplies the sum by 3. Her result is 27. What was Alupo's original number? 2. Sketch the region enclosed by the inequalities $y \leq 4-x_2$ and $y>2x-4$.

SENIOR 4: TERM 1

THEME: PATTERNS AND ALGEBRA

TOPIC 3: LINEAR PROGRAMMING — 20 PERIODS

Competency: Learners should understand and use linear programming to solve problems.

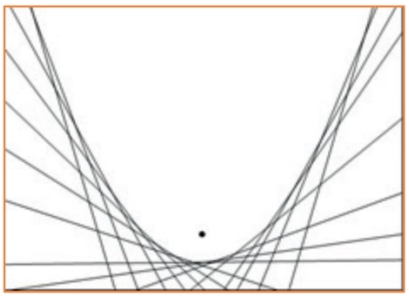
LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) form linear inequalities based on real life situations. (u, s) b) represent the inequalities on the graph and identifies the required region. (u, s) c) find and interpret the optimum solution of a set of linear inequalities in two unknowns. (u, s, v/a)	• Peter has UGX 900 000. He wants to buy some apples and oranges. Apples cost UGX 10 000 each and oranges cost UGX 600 each. He wants to buy at least 22 apples and at least 10 oranges. The number of apples bought must be more than twice the number of oranges bought. In groups, discuss how to form the inequalities that must be satisfied. Plot them on a coordinate grid and propose a solution. • Use linear programming to solve this problem: A small business makes 3-speed and 10-speed bicycles. o Factory A produces 16 3-speed and 20 10-speed bicycles each day. It costs UGX 100M each day to operate factory A. o Factory B produces 12 3-speed and 20 10-speed bicycles each day. It costs UGX 80M each day to operate factory B. An order for 96 3-speed bicycles and 140 10-speed bicycles has just arrived. How many days should each factory operate in order to fill the order at minimum cost. What is the minimum cost? • In pairs, make up a linear programming problem for your peers.	• In pairs, let the learners discuss the following task. Observe them as they discuss. Assess the learners on the core values and generic skills. 1. A mother buys x notes books at UGX 600 each and y pens for UGX 800 each. She has UGX 8000 to spend and there must be at least 4 note books and at least 4 pens. Write three inequalities in x and y that satisfy these conditions. Illustrate them graphically by shading out the unwanted regions. Write down the integer solution set. 2. A farmer has 32 acres on which to plant corn and soybean. For each acre of corn planted, the expenses are UGX 100 000, and for each acre of soybean planted it is UGX 200 000. Each acre of corn requires 100 bushels of storage and yields a profit of UGX 120 000. Each acre of soybean requires 40 bushels of storage and yields a profit of UGX 180 000. If the total amount of storage space is 1920 bushels and the farmer has only UGX 8M to pay for planting, how many acres of each crop should be planted to maximize the profit? What will the profit be?

SENIOR 4: TERM 2

THEME: PATTERNS AND ALGEBRA

TOPIC 4: LOCI — 20 PERIODS

Competency: Learners should be able to understand and apply loci.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) describe common types of loci. (k, u) b) construct loci involving points under given conditions. (u, s) c) construct intersecting loci. (u, s) d) construct loci involving inequalities. (u, s, v/a)	• Recall and review the work in Senior 1, Topic 5 on loci. • In pairs, draw a line AB 10 cm long. A variable point P is such that angle APB = 900 and AP ≤ PB. Discuss and construct the locus of P (link with Senior 3, Topic 13). • On a rectangular piece of paper, mark a point a few centimetres from the centre of one edge. Fold the edge to pass through the point multiple times – to obtain the envelope below.  • What shape is the locus? Prove it by adding a set of axes and using algebra. • On a coordinate grid plot points A (2, 3) and B (-4, 7). Construct and find the equation of the perpendicular bisector of AB. • A goat is tethered to the corner of a building. Assuming the length of the rope is less than the length of the sides of the building, sketch the locus of the area the goat can reach. What if the rope is longer than one of the sides of the building? Both sides of the building? Construct the locus in each case.	• Observe the learners in their groups as they work on the tasks below. During the process, are learners communicating effectively? Are they learning from one another? Are they creative and critical? 1. Sketch and describe the locus of point M, where M is the mid-point of a chord of length 6 cm in a circle of radius 5 cm. 2. Find the equation of the locus of P such that AP is 5 units, where A is (2, 3). 3. Construct the locus to show the area available to a cow tethered by a rope of 3m to a horizontal rail length 4m. What is the area of the locus?

SENIOR 4: TERM 2

THEME: GEOMETRY AND MEASURES

TOPIC 1 LINES AND PLANES IN THREE DIMENSIONS — 20 PERIODS

Competency: Learners should be able to understand and apply lines and planes in 3D to solve problems.

LEARNING OUTCOMES	SUGGESTED LEARNING ACTIVITIES	SAMPLE ASSESSMENT STRATEGY
The learner should be able to: a) applies Pythagoras theorem in 3D to calculate the distance between two points. (u s) b) finds the angle between a line and a plane. (u s) c) finds the angle between two planes. (u s)	• Recall and review Senior 2, Topics 10 and 11. • Collect polyhedra and for each one, record the number of faces, edges and vertices. Determine the relationship between the number of vertices, edges and faces. • Construct a square based pyramid using four equilateral triangles and a square. Use Pythagoras' theorem to determine the perpendicular height of the pyramid, check by measuring your model. • Construct a net for a square based pyramid whose perpendicular height is half the length of the square. How many of these will fill a cube? • What is the angle between the triangular faces and the square face? What is the angle between the triangular faces?	• Observe the learners in their groups as they discuss the task below. During the process of, are learners communicating effectively? Are they learning from one another? Are they creative and critical? A wireless mast is held vertically by four stays 10m long, fixed to the mast at the same height and joined to the four corners of a square on level ground. If each stay is inclined at 600 to the horizontal. Calculate the height of the top of each stay and the side length of the square

ASSESSING MATHEMATICS

Classroom based Assessment (Assessment for Learning)

Assessments are used for a wide range of purposes in schools and education systems. Just as academic lessons have different functions, assessments are typically designed to measure specific elements of learning. e.g., the level of knowledge a student already has about the concept or skill the teacher is planning to teach or the ability to comprehend and analyse different types of texts and readings. This syllabus focusses on the evaluation of progressive day-to day classroom learning; hence **Formative Assessment.**

Formative assessment refers to a wide variety of methods that teachers use to conduct in-process evaluations of student comprehension, learning needs, and academic progress during a lesson, unit, or activity. Formative assessments help teachers identify concepts that students are struggling to understand, skills they are having difficulty in acquiring, or learning standards they have not yet achieved so that adjustments can be made to lessons, instructional techniques, and academic support.

The general purpose of formative assessment is to improve learning and achievement; give educators **in-process feedback** about what students are learning or not learning so that instructional approaches, teaching materials, and academic support can be modified accordingly. Formative assessments are **usually not scored or graded,** and they may take a variety of forms, from more formal quizzes and assignments to informal questioning techniques and in-class discussions with students.

How to carry out formative assessment:

- Carried out while learning is in progress-day to day
- Focused on the learning process and the learning progress
- Viewed as an integral part of the teaching-learning process

Collaborative teachers and learners know where they are headed, understand the learning needs, and use assessment information as feedback to guide and adapt what they do to meet those needs.

Fluid-An on-going process influenced by learners needs and teacher feed back

Teacher and learners use the evidence they gather to make adjustments for continuous improvements

The general goal of formative assessment is to collect detailed information that can be used to improve instruction and student learning while it's happening. What makes an assessment "formative" is not the design of a test, technique, or self-evaluation, per se, but the way it is used. i.e., **to inform in-process teaching and learning modifications.**

Assessing the new expectations for learning

The new curriculum sets new expectations for learning, with a shift from Learning Outcomes that focus mainly on knowledge to those that focus on skills and deeper understanding. These new Learning Outcomes require a different approach to assessment.

The "Learning Outcomes" in the syllabuses are set out in terms of Knowledge, Understanding, Skills, and Attitudes. This is what is referred to by the letters k, u, s & a.

It is not possible to assess attitudes in the same way as knowledge, understanding and skills because they are more personal and variable and are long-term aspirations. This does not mean that attitudes are not important. It means that we must value things that we cannot easily assess.

So, this guidance booklet focuses on knowledge, skills and understanding. Each has its own implications for learning and assessment.

Knowledge	The retention of information.
Understanding	Putting knowledge into a framework of meaning – the development of a 'concept'.
Skills	The ability to perform a physical or mental act or operation.
Values	The inherent or acquired behaviours or actions that form a character of an individual.
Attitudes	A set of emotions, beliefs or behaviours toward a particular object, person, thing or event.

To assess knowledge, skills and understanding we need to look for different things. Knowledge can be assessed to some extent through written tests, but the assessment of skills and deeper understanding requires different approaches. Because of this, the role of the teacher in assessment becomes much more important.

Knowledge

Knowledge is the easiest to assess because it is fairly straightforward to find out whether or not a learner has retained some information: a simple question can usually find this out. We ask them to name something, or state something, or label a diagram.

Skills

Skills are the ability to perform a mental or physical operation, so we have to observe the skill being performed or look at the product, or outcome, of the skill; for example, a piece of writing, a picture or diagram.
Some skills, such as speaking or a physical education skill do not have a product so need to be observed.

Understanding

Assessing deeper understanding is much more difficult, so we usually ask learners to explain, compare or outline a process. This can be done orally (in conversation) or in writing, and will give us some idea of the extent of their understanding.

Values and Attitudes

Values and Attitudes determine how we interact with others, working in a team, meeting deadlines, being self-driven, holding democratic values, and having respect for democracy, race, gender, disability, human dignity, culture, nation, life and social justice.

ASSESSING MATHEMATICS

Examinations

There will be examinations and tests set at the end of every year. Instead, there will be a summing up of on-going teacher assessments made in the context of learning.

Formative Assessment

If assessment is to make a difference to teaching and learning, then teachers must use the information they gain from assessment to make some change to the teaching and learning process. This is formative assessment. If teaching and learning stay the same, there would have been no point in carrying out the assessment. The changes that can be made include decisions about:

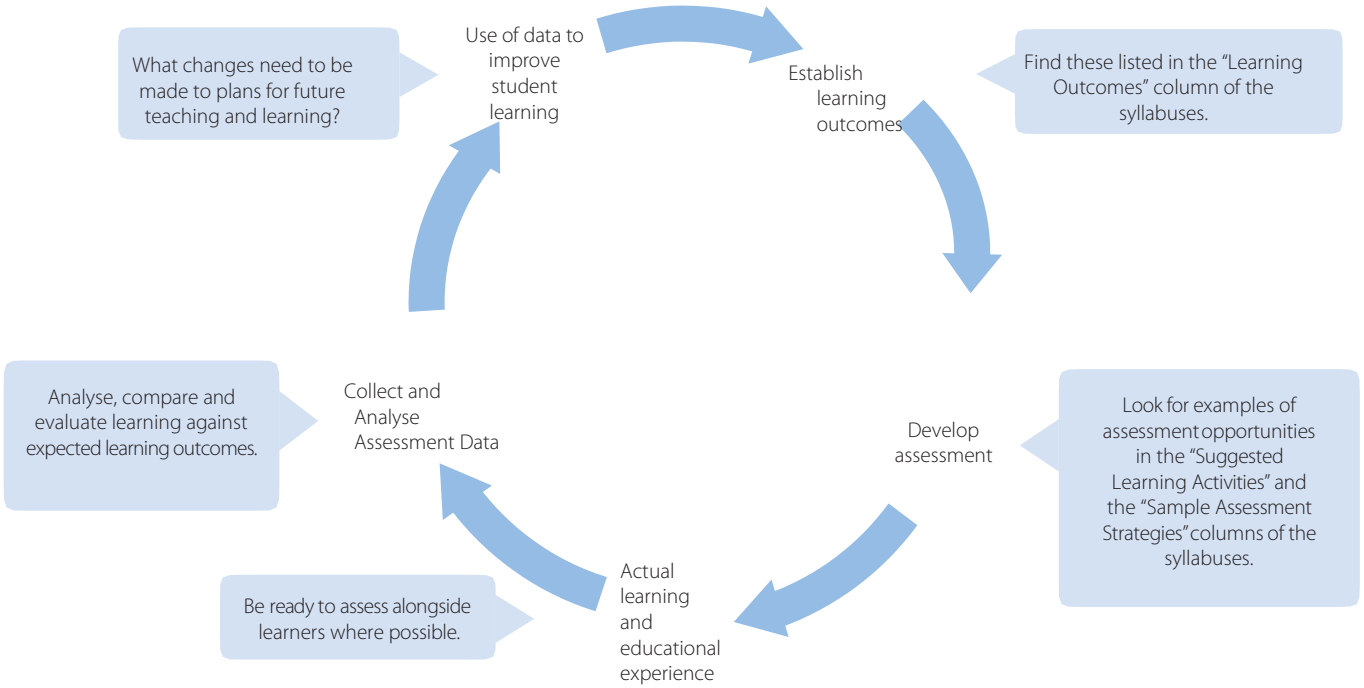
- What needs to be learned next
- Whether an element of the syllabus needs to be taught again in a different way
- Changing teaching approaches if necessary
- Identifying learners who need more support, or who are making exceptional progress
- Enabling learners to understand what they have to do to improve

The final examination at the end of Senior 4 will be very different in nature, and will focus on the learners' ability to apply their learning in new situations, rather than on the ability to recall information.

It is the use of the assessment data within this cycle to improve learning that is key to the success and impact of formative assessment.
It is this cycle that enables formative assessment to impact on learning:

- The syllabuses set out the learning outcomes
- The lessons seek to achieve these outcomes
- Assessment finds out whether or not the outcomes has been achieved
- This information guides the next steps in learning and so sets new learning outcomes

The process of teaching, making formative assessments and then changing the teaching and learning in some way can be seen as a cycle:



FORMATIVE ASSESSMENT INVOLVES USING ALL PARTS OF THE CYCLE.

How do we find the opportunity to make formative assessments?

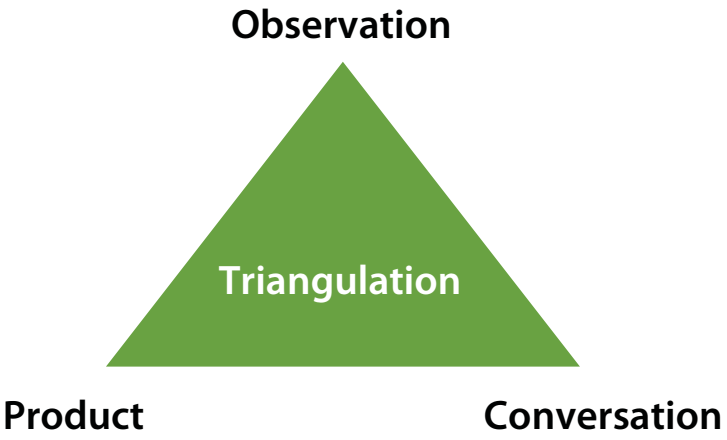
In the new curriculum, the teacher's assessment role is not to write tests for learners, but to make professional judgements about learners' learning in the course of the normal teaching and learning process. The professional judgement is about how far the learner meets the Learning Outcomes that are set out in this syllabus. To make these judgements the teacher needs to look at how well the learners are performing in terms of each Learning Outcome.

School-based formative assessment is a part of the normal teaching and learning process, and so the assessment opportunities will also occur during this normal process. It is not something that needs to be added on after learning; it is an integral part of it.

These opportunities occur in three forms and are often called:

- Observation – watching learners working (good for assessing skills and values)
- Conversation – asking questions and talking to learners (good for assessing knowledge and understanding)
- Product – appraising the learner's work (writing, report, translation, calculation, presentation, map, diagram, model, drawing, painting etc.). In this context, a "product" is seen as something physical and permanent that the teacher can keep and look at, not something that the learner says.

When all three are used, the information from any one can be checked against the other two forms of assessment opportunity (e.g. evidence from "observation" can be checked against evidence from "conversation" and "product"). This is often referred to as "triangulation".



Triangulation of assessment opportunities

To find these opportunities, look at the syllabus units. These set out the learning that is expected and give 'Sample Assessment Activities", and in doing so they contain a range of opportunities for the three forms of assessment.

ASSESSING MATHEMATICS

Generic Skills

The Generic Skills have been built into the syllabuses and are part of the Learning Outcomes. It is therefore not necessary to assess them separately. It is the increasingly complex context of the subject content that provides progression in the Generic Skills, and so they are assessed as part of the subject Learning Outcomes.

Attitudes

It is not possible to assess attitudes in the same way as knowledge, understanding and skills because they are more personal and variable and are long-term aspirations. This does not mean that attitudes are not important. It means that we must value things that we cannot easily assess.

Record keeping

Keeping detailed records of learners' individual progress is always difficult with very large numbers of pupils. For the purposes of school-based formative assessment, it is not even always necessary to keep such detailed records anyway. If feedback is given immediately and action is taken, then learning is changed and the record would soon become out of date and redundant.

Most formative class-based assessments are dynamic in that they feed straight back into the teaching and learning process. Therefore, detailed records of these are not appropriate.

What is needed is record of assessments of learners' learning made in terms of each Topic or unit. This means recording the on-going summative assessments of each unit. There is no need to make separate records of each of the Learning Outcomes because this would be very time-consuming and also unnecessary.

It is much more useful to make an overall assessment about whether or not each learner met the Learning Outcomes for each Topic as a whole.

Each Topic is made up of a number of Learning Outcomes. Therefore, teachers need to consider all the Learning Outcomes when making an overall judgement about the Topic as a whole. It is not always necessary for every individual Learning Outcome to be achieved for the Topic as a whole to be achieved. This will vary with the Subject and Topic.

By looking at the Learning Outcomes within each Topic, it is possible to identify four broad groups of learners in terms of their achievements:

Descriptor
No Learning Outcome (LO) achieved
Some LOs achieved, but not sufficient for overall achievement
Most LOs achieved, enough for overall achievement
All LOs achieved – achievement with ease

There is no need to set a test to find this out.

These overall assessments should be made on the basis of the many formative assessments that the teacher has made during the course of teaching the unit. If teachers have been working with the learners over the course of the unit, they will be able to make a broad judgment about which learners have achieved or have failed to achieve the unit's overall Learning Expectation. These "Authentic Assessments" will be more valid and valuable than a test set by the school.

Recording these overall assessments will be simple, manageable and yet valuable, and can be recorded on a sheet such as the one below in which the categories are indicated with a number.

Although a very simple process, these four categories will give rich data when a comparison is made between the learners' in each category for different subjects and units. They will also identify easily those learners who need extra support or who may not be ready to move on to the next grade at the end of a year.

If records are kept of the learning outcomes of each syllabus unit through the year, then there will be no need for an end of year test. Teachers will already have a record of those learners who have met the learning outcomes, and those who have not done so. Therefore, teachers will know if there were any learners not ready to progress to the next grade.

An overall record should be made of the individual unit assessments by subject in terms of the 4 descriptors. If numbers (0-3) are used as identifiers, then it will be possible to arrive at an overall number for a year by aggregating the identifiers for each unit.

Descriptor	Identifier
No Learning outcome achieved	0
Some LOs achieved, but not sufficient for overall achievement	1
Most LOs achieved, enough for overall achievement	2
All LOs achieved – achievement with ease	3

In the example below, the table shows the end-of-unit assessment for six learners.

Mathematics										
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**
Learner A	3	3	2	3	3	3	3	2	3	3
Learner B	2	2	3	2	3	2	2	2	3	2
Learner C	1	1	2	1	1	2	2	3	2	3
Learner D	1	1	2	1	1	2	1	1	2	1
Learner E	0	1	2	1	0	1	0	1	1	1
Learner F	0	0	1	0	0	1	0	0	1	0

This method will give much more information than using a tick. For example, at a glance it can be seen that learners A & B are achieving much higher than learners E & F. It can be seen that Learner C has improved during the year. We can even see that more learners achieved success in Topic 9 than Topic 7.

All of this is very valuable assessment information and can be used to improve learning.

This summative teacher assessment will contribute to the final grade of the School Leaving Certificate.

ASSESSING MATHEMATICS

Glossary of Key Terms

TERM	DEFINITION
Competency Curriculum	One in which learners develop the ability to apply their learning with confidence in a range of situations.
Differentiation	The design or adaptation of learning experiences to suit an individual learner's needs, strengths, preferences, and abilities.
Formative Assessment	The process of judging a learner's performance, by interpreting the responses to tasks, in order to gauge progress and inform subsequent learning steps.
Generic skill	Skills which are deployed in all subjects, and which enhance the learning of those subjects. These skills also equip young people for work and for life.
Inclusion	An approach to planning learning experiences which allows each student to feel confident, respected and safe and equipped to learn at his or her full potential.
Learning Outcome	A statement which specifies what the learner should know, under-stand, or be able to do within a particular aspect of a subject.
Process Skill	A capability acquired by following the programme of study in a particular Learning Area; enables a learner to apply the knowledge and understanding of the Learning Area.
Sample Assessment Strategy	A strategy which gives a learner the opportunity to show the ex-tent to which s/he has achieved the Learning Outcomes. This is usually pat of the normal teaching and learning process, and not something extra at the end of a topic.
Suggested Learning Activity	An aspect of the normal teaching and learning process that will enable a formative assessment to be made.

NCDC
NATIONAL CURRICULUM
DEVELOPMENT CENTRE

National Curriculum Development Centre
Ministry of Education and Sports,
P.O. Box 7002, Kampala, Uganda

Website: www.ncdc.go.ug