ACCELERATED EDUCATION PROGRAMME

MATHEMATICS

SYLLABUS

REVISED LOWER SECONDARY (Level 1 and 2)

MINISTRY OF
EDUCATION
AND SPORTS

REPUBLIC OF UGANDA

NCDC

*NATIONAL CURRICULUM
DEVELOPMENT CENTRE*

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DEVELOPMENT CENTRE*

Revised Edition

Content

Foreword

Education is a fundamental tool for the protection of conflict- and disaster-affected children and youth from harm and exploitation. This is a crucial part of UNESCO's advocacy messages. Under appropriate conditions of security, the provision of education can help protect children and youth from recruitment into fighting forces, forced labour, prostitution, drug abuse and other criminal activities. In post-conflict settings, education contributes to the reintegration into society of former soldiers and other children and youth associated with fighting forces.

Uganda's Education Act of 2008, in Part IX, Miscellaneous Provisions 49, clearly states that "there shall be non-formal education centres" for purposes of providing non-formal education. Examples of non-formal education programmes include Accelerated Education Programmes (AEPs) for the conflict areas at both primary and secondary levels, Alternative Basic Education for Karamoja (ABEK), Basic Education for Urban Poverty Areas (BEUPA), Complementary Opportunity for Primary Education (COPE) and Child-Centred Alternative Non-Formal Community Based Education (CHANCE), among others.
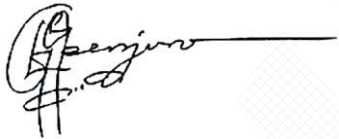
The National Curriculum Development Centre (NCDC), in collaboration with War Child Canada, embraced the Accelerated Education Programme (AEP) and has condensed the lower secondary curriculum to come up with the Lower Secondary Accelerated Education Programme appropriate to learners in refugee camps and the host communities of secondary school age (ages 16–45+).

The AEP at lower secondary school level focuses on completing learning in a shorter period of time, i.e., two years. The AEP is complementary both in providing an alternative route and in matching its curriculum to the 'official' curriculum, thus allowing learners to return to formal schooling at an opportune stage. The programme intends to promote access to education in an accelerated timeframe for disadvantaged groups, out-of-school and over-age children, and youth who missed out or had their education interrupted owing to poverty, violence, conflict or any calamity.

The goal of this programme is to provide learners with competencies equivalent to those in the formal system in an accelerated time frame, with learners either transitioning back into the mainstream education or exiting with some of the competencies required for work.

It is my hope that AEP will register considerable success in meeting the educational needs of these underserved populations not only in terms of access and equity, but also in helping them return to school and complete the education cycle, and especially in getting measurable learning outcomes.

I recommend the AEP and trust that the materials will be valuable in your endeavour to meet the educational needs of the refugee learners and other beneficiaries from the host communities.

Prof. George Openjuru
CHAIRPERSON
NCDC Governing Council

Acknowledgement
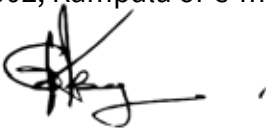
National Curriculum Development Centre (NCDC) would like to express its gratitude to all those who, in one way or another, contributed and worked tirelessly towards the development of this Accelerated Education Programme (AEP)syllabus.

Special thanks go to War Child Canada - Uganda for the financial support, their guidance in overseeing and taking timely decisions whenever necessary during the development and production of this AEP Mathematics Syllabus.

We also express our gratitude to NCDC Subject Specialists and panel members for their professional guidance and technical assistance.

Furthermore, NCDC recognises the work of the editors who worked with the writers through the development of this document.

NCDC takes responsibility for any shortcomings that might be identified in this syllabus and welcomes suggestions for addressing the inadequacies. Such comments and suggestions may be communicated to NCDC through: P.O. Box 7002, Kampala or e-mail; admin@ncdc.og.ug or website at; www.ncdc.og.ug

Dr Grace K. Baguma
DIRECTOR
NATIONAL CURRICULUM DEVELOPMENT CENTRE

Introduction

The UNESCO Education Strategy (2014 – 2021) advocates for a humanistic and holistic vision of education as a fundamental human right that is essential to personal and socio-economic development. UNESCO further recommends societies that are just, inclusive, peaceful and sustainable by 2030. Vision 2040 of Uganda aims to transform Uganda into a modern and prosperous country, while the National Development Plan III (NDPIII) recognises the existing weaknesses in education, including the low efficiency and variable quality at the Secondary level. Furthermore, NDPIII focuses on enhancement of human capital, development, strengthening mechanisms for quality, effective and efficient service delivery as well as improvement of quality and relevance of skills development.

The Sustainable Development Goal 4 advocates for inclusive and quality education. 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.

The above aspects are lacking and where they exist, it is at a minimum level in implementation of the curriculum.

In alignment with the above policies, 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 for Uganda, although highly regarded, has focused on the needs of a small academically oriented elite leaving out the needs of the majority of learners. 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 the following aims of secondary education in Uganda:

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-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 socio-economic 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 leadership 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.

Introduction to Accelerated Education Programme

Worldwide, substantial alternative schooling programmes are developed to meet the basic education needs of under-reached children. Of recent, it has been increasingly recognized that the goals of Education for All cannot be achieved unless more attention is paid to educating out-of-school children (UNESCO, Global Monitoring Report, 2008). Indeed, the UNESCO Global Monitoring Report 2010 'Reaching the Marginalized' focused on this issue. In a bid to help developing countries achieve the Millennium Development Goals, there should be initiatives to incorporate elements of accelerated learning to achieve SDG 4.

The Accelerated Education Programme (AEP) in Uganda is a form of curriculum option which combines the stronger features of earlier mainstreaming approaches into the new design to raise the success rates for refugee community learners. The AEP secondary school tier is a bigger stride to address the education gap within refugee communities not only in Uganda but also other neighbouring countries. Benchmarking the Primary AEP programmes, the Secondary Education Programme intends to infer the entire process of education and its cognitive, emotional, and social components.

The Accelerated Learning Programme at Secondary school level focuses on completing learning in a shorter period of time, of two years. The AEP is complementary both in providing an alternative route and in matching its curriculum to the 'official' curriculum, thus allowing learners to return to formal schooling at some stage. The programme intends to promote access to education in an accelerated timeframe for disadvantaged groups, out of school and over-age children, and youths who missed out or had their education interrupted due to poverty, violence, conflict, and crisis. The goal of this programme is to provide learners with competencies equivalent to those in the formal system in an accelerated timeframe, with learners either transitioning back into the mainstream education or exiting with some competencies required for work.

Ideally, teaching AEP calls for a methodology that is interactive and learner-centred, incorporating other aspects of multiple-intelligence learning.

Because teaching and learning are accelerated, and the curriculum content is compressed and condensed, the four 'P' elements are at the core of the accelerated learning cycle; processes, psychological, physiological, and physical. These core elements provide the physical and psychological space in which the learner can learn more effectively.

It is intentional to include alternative subjects in this programme e.g. life skills, peace education, environment, HIV and AIDS which are responsive to the context. Learners of AEP need alternative supporting knowledge and life skills to survive in the challenging world. It is equally important to note that this conception of accelerated learning requires an extremely well-resourced classroom and exceptionally well-trained teachers. The expanded learning time from the norm is because the teaching methodology is interactive and learner centred.

It is our hope that AEP will register considerable success in meeting the educational needs of these underserved populations, not only in terms of access and equity but also in being able to return to school and completion, and most importantly in getting measurable learning outcomes.

Background to Accelerated Education Programme

The review of AEP Curriculum was based on the situation within refugee camp in Adjumani. This hosts refugees from South Sudan where some of them had spent some time out of school. And others have never been in school.

The AEP curriculum came into existence as a catch-up programme The programme was based on the Uganda lower secondary curriculum whose cycle is four (4) years.

The Curriculum for the cycle of 4 years was compressed into **two levels**. Each level with a duration **one (1) year**.

The compression was possible because some content was removed and the other condensed.

AEP adopts accelerated learning techniques to support learners to achieve the Uganda Certificate of Education.

The Curriculum

This 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 Changes

The key change in the new curriculum is a move from a knowledge-based curriculum to a competency 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 inclusive and equitable quality education and promote lifelong learning opportunities for all.

The change can be summarised in the following diagrams.

The previous Knowledge-based Curriculum
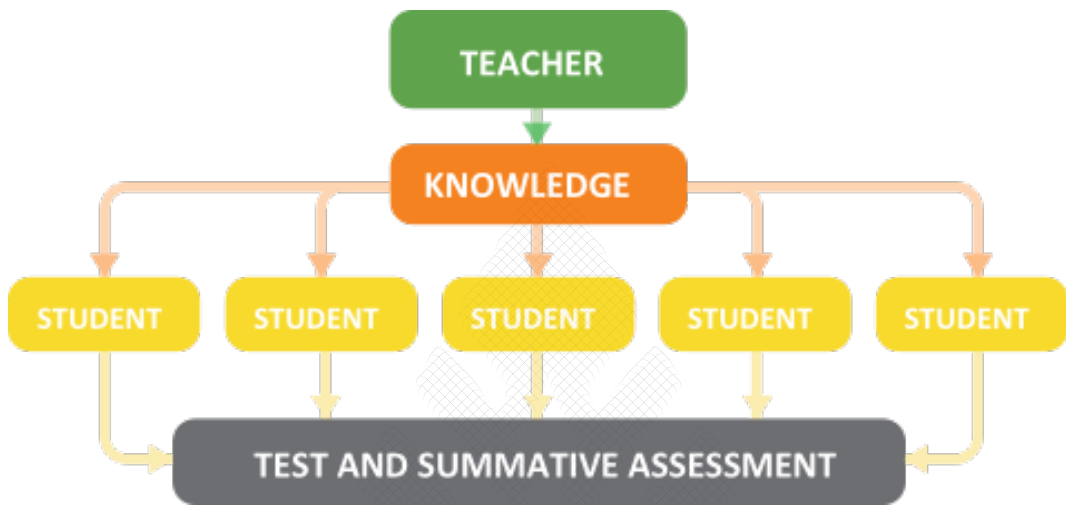
Knowledge-based teaching was based on transferring knowledge from the teacher to the students. The teacher had knowledge and transferred this knowledge to the students by lecturing, talking, asking them to read the text book or writing notes on the board for the students to copy and learn. Students acquired 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 do not reach university. The new curriculum will cater for this majority as well as those who later go on to University

The New Competency-based curriculum

ACTIVITY

STIMULUS MATERIAL, LEARNERS' EXPERIENCE, PROBLEM-SOLVING, INVESTIGATION, GROUP ACTIVITIES, EXPLORATION, EXPERIMENTS, FIELD WORK

DISCUSSION

LEARNER **TEACHER** **LEARNER** **TEACHER** **LEARNER**

FEEDBACK AND INTERACTION

FORMATIVE AND SUMMATIVE

In the new competency-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 becomes 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 and summative assessment; not just to give grades but to find out problems the learners may be having and help to solve them.

Key Learning Outcomes

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

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

1) **Self-assured individuals who:**
   a) Demonstrate self- motivation, self-management and self-esteem.
   b) Know their own preferences, strengths and limitations.
   c) Adjust their behaviour and language appropriately to different social situations.
   d) Relate well to a range of personality types.

2) **Responsible and patriotic citizens who:**
   a) Cherish the values promoted in the curriculum.
   b) Promote equity, the development of indigenous cultures and languages and appreciate other people's cultures.
   c) Apply environmental and health awareness when making decisions for themselves and their community.
   d) Are positive in their own identity as individuals and global citizens.
   e) Are motivated to contribute to the well-being of themselves, their community and the nation.

3) **Lifelong learners who:**
   a) Can plan, reflect and direct their own learning
   b) Actively seek lifelong learning opportunities for personal and professional development

4) **Positive contributors to society who:**
   a) Have acquired and can apply the Generic Skills
   b) Demonstrate knowledge and understanding of the emerging needs of society and the economy
   c) 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

This 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:

1) Respect for humanity and environment
2) Honesty; uphold and defend the truth at all times
3) Justice and fairness in dealing with others
4) Hard work for self-reliance
5) Integrity; moral uprightness and sound character
6) Creativity and innovativeness
7) Social Responsibility
8) Social Harmony
9) National Unity
10) 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 also known by several other names, including key skills, core skills, essential skills, key competencies, necessary skills, transferable skills and employability skills are versatile skills that have wide applicability across various jobs, education, and life situations, contributing to personal and professional success and societal well-being.

Changes in the modern workplace brought about by technology, management innovations, and increased competition in the global marketplace, have led to many concerns about the adequacy of workforce skills. In response to calls to reform education to better prepare young people for the future workforce, changes to the curriculum have emphasised the teaching of general skills (e.g. problem solving, creativity, critical thinking, communication, collaboration).

For this reason, generic skills lie at the heart of every subject. Apart from enabling learners to access and deepen learning across the curriculum, generic skills 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 at school, work and home. They need to be creative and innovative in their approach to learning and life. They must be able to communicate well in all forms, co-operate with others and also work independently. They must also be able to use functional mathematics and ICT effectively.

01 Critical thinking and problem-solving skills

a) Plan and carry out investigations
b) Sort and analyse information
c) Identify problems and ways forward
d) Predict outcomes and make reasonable decisions
e) Evaluate different solutions

03 Co-operation and self-directed learning

a) Work effectively in diverse teams
b) Interact effectively with others
c) Take responsibility for own learning
d) Work independently with persistence
e) Manage goals and time

02 Creativity and innovation

a) Use the imagination to explore possibilities
b) Work with others to generate ideas
c) Suggest and develop new solutions
d) Try out innovative alternatives
e) Look for patterns and make generalisations

04 Communication

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

05 Mathematical computation and ICT proficiency

a) Use numbers and measurements accurately
b) Interpret and interrogate mathematical data
c) Use mathematics to justify and support decisions
d) Use technology to create, manipulate and process information
e) Use technology to collaborate, communicate and refine one's 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 both levels, 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 Level 1 and then progress to thinking about the much more complex matters in Level 2.

Thus the progression is in the increasing complexity of the matters being thought about.
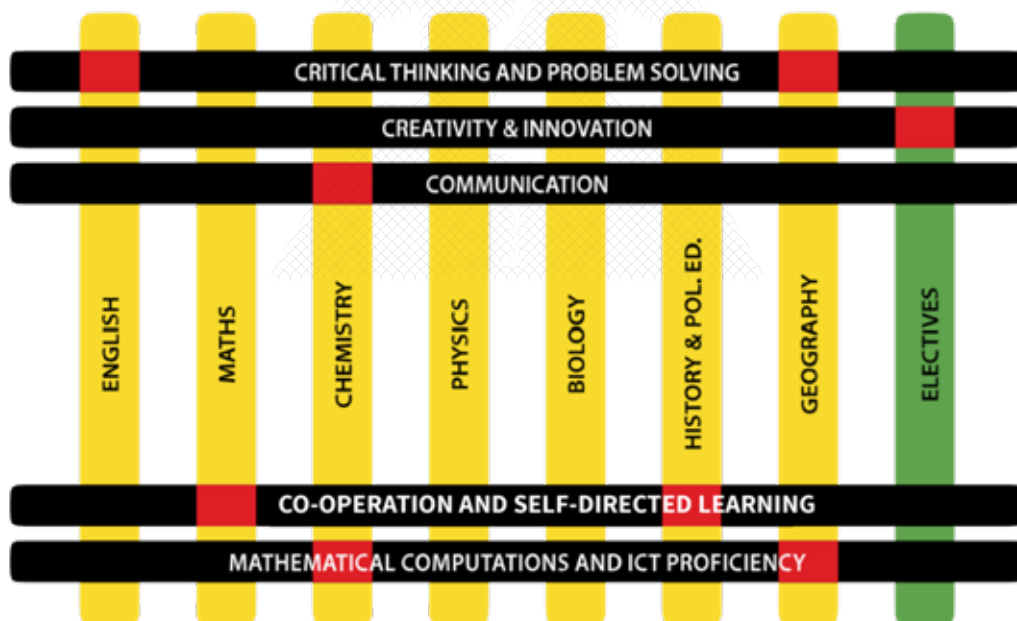
Cross-cutting Issues

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:

1) Environmental awareness
2) Health awareness
3) Life skills
4) Mixed abilities and involvement
5) Socio-economic challenges
6) 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)
1) Field works	Use of cameras to take photos and record videos
2) Presentations in class	Use presentation application
3) Key words and meanings	Use online dictionary or search online
4) Drawing/graphics	Use publishing software, Word processor
5) Role play, narrations	Use audio and video recordings
6) Demonstrations	Use audio and video recordings and simulations
7) Locating and putting marks on an area	Use digital/online mapping
8) Present findings in graphic and written format	Use desktop publishing software or word processor
9) Showing data charts	Use spreadsheet software
10) Group discussions	Mind-mapping software
11) Search for extra reading materials	Download files on internet or by sharing
12) Writing equations and formulas	Use equation editors
13) Carrying out academic research	Using the Internet and other academic applications like "Encarta", "Britannica" etc.
14) Sharing or learning with people across the world	Forming learning networks, formation of blogs, social media, emails etc

Integration of Special Needs Education (SNE)

In education system, learners of different abilities study together in the same class and in some developed countries, they are taught separately. In whatever case, the following methods are important when handling the SNE learners.

Category of impairments	SNE Teaching Methods
Blind learners: Learners who cannot see totally	• Through touching • Use of brails • Recorded / audio materials
Low vision learners: Learners who cannot see properly	• Use of large print materials • Use of bold teaching materials • Right placement of learners
Deaf learners: Learners who do not hear at all	• Use sign language • Total communication • Use of illustrations
Hard of hearing learners: Learners who fairly hear	• Total communication • Speak loudly • Right placement of learners • Use of illustrations • Being more practical
Dyslexic learners: Learners with reading difficulties	• Use less written content • Talk more than writing • Breaking tasks into simple steps • Repetition in teaching • Use of audio recordings
Time takers	• Give extra time • Use remedial classes
Hyper learners: Learners with attention deficit	• Use of timely breaks in teaching.
Gifted learners:	• Involve them in extra work • Use of suitable challenging tasks
Physically handicapped	• Use of head pointers • Training to use available limbs • Creating special sitting arrangements in class

The Mathematics Syllabus

Mathematics is a **compulsory** subject for Level 1 and 2

Time allocation

Mathematics	LEVEL 1	LEVEL 2
	3 Hours per Week	3 Hours per Week

Rationale

Mathematics forms a key element of every learner's education. The Mathematics programme of study emphasizes 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 whom 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 Four 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 is much more inclusive. 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 understanding 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 AEP syllabus is experiential and towards deeper understanding. The focus in Mathematics is on the development of understanding through mathematical enquiry and rational thought.

The AEP 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:
1) Be responsible for their own learning
2) Think for themselves and form their own ideas and opinions
3) Become critical thinkers, ready to face new challenges and situations for themselves

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

Topics

There are 32 topics for the two levels. They constitute 17 topics for Level 1 and 15 topics for Level 2 as shown in the Programme Planner.

Note: Content for Level 1 (year 1) is mostly drawn from Senior 1 and Senior 2, then Level 2 is Senior 3 and 4 of the Lower Secondary curriculum.

Programme Planner

Level 1	Theme	Topic	Duration (hours)
TERM 1	Numbers	1) Number Bases	6
	Numbers	2) Working with Integers	8
	Numbers	3) Fractions, Percentages and Decimals	8
	Numbers	4) Rectangular Cartesian Coordinates in 2-Dimensions	8
	Geometry and Measures	5) Geometric Construction Skills	6
TERM 2	Pattern and Algebra	6) Patterns and Sequences	4
	Geometry and Measures	7) Bearing	4
	Geometry and Measures	8) General Angle Properties of Geometric Figures	4
	Pattern and Algebra	9) Algebra	9
	Geometry and Measures	10) Business Arithmetic 1	4
	Geometry and Measures	11) Time and Time Tables	5
	Pattern and Algebra	12) Mapping and Relations	6

Level 1	Theme	Topic	Duration (hours)
TERM 3	Pattern and Algebra	13) Translation and Vector	6
	Data and Probability	14) Graphs	6
	Numbers	15) Numerical Concepts	10
	Data and Probability	16) Set Theory	7
	Pattern and Algebra	17) Equations of a Straight Line	7
		Total	**108**

Level 2	Term	Topic	Duration (hours)
TERM 1	Patterns and Algebra	1) Inequalities and Regions	6
	Data and Probability	2) Data Collection and Presentation	12
	Geometry and Measures	3) Similarities and Enlargement	6
	Geometry and Measures	4) Reflection and Rotation	6
	Data and Probability	5) Ratios and Proportions	6
TERM 2	Data and Probability	6) Matrices	6
	Geometry and Measures	7) Matrix Transformations	8
	Patterns and Algebra	8) Simultaneous Equations	4

Level 2	Term	Topic	Duration (hours)
	Patterns and Algebra	9) Quadratic Equations	8
	Geometry and Measures	10) Trigonometry	10
TERM 3	Geometry and Measures	11) Circle	8
	Geometry and Measures	12) Nets, Areas and Volumes of Solids (Mensuration)	7
	Geometry and Measures	13) Business Mathematics 2	6
	Data and Probability	14) Probability	7
	Geometry and Measures	15) Lines and Plane in Three Dimensional Geometrical Figures	8
		Total	**108**

References

Use the teaching and learning materials as recommended by the ministry of education and sports Uganda

Level 1: Senior 1 and Senior 2 materials

Level 2: Senior 3 and Senior 4 materials

DETAILED SYLLABUS
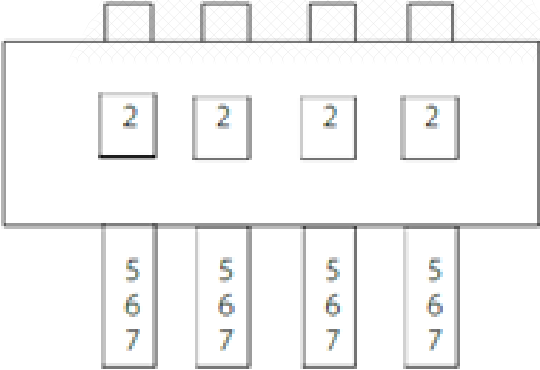# LEVEL 1
TERM 1
Topic 1: Number Bases

Duration: 6 Hours

Overview

In this topic, the learner will learn how to compute and appreciate the meaning of number bases and converting numbers in other bases other than base ten (decimal). You will learn the relationships amongst the various bases**.**

Competency: The learner uses decimal place value to develop understanding of numbers written in other bases.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) Identify numbers in any base using abacus. (k)	1) Identify situations in which you have ever used number bases in real life situation. 2) 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 3) Write numerical values of different bases (e.g.) base two uses 0,1 4) Make an abacus using local available materials to: a) identify place values in different bases b) state value of a digit	1) Observe learners in their groups trying to identify place values of various number bases using abacus and converting numbers from one base to

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
2) Convert numbers from one base to another. (u) 3) Manipulate numbers in different bases with respect to all the four operations. (u s) 4) Identify place value in different bases. (u)	c) manipulate numbers in different bases with respect to all four operations (addition, subtraction, multiplication and division) 5) Use a digit stop watch to demonstrate conversion of seconds to minutes. Imagine living in cartoon world where people have just eight digits rather than ten. What would their arithmetic be like? 6) Design counters in different number bases using strips threaded through card: 7) Prepare strips numbered 0 to 7, thread through a card so that a single number on each strip is displayed, use to make different numbers. Change the length of the strips to investigate different number bases (e.g., 2222 in base 8). **Hint:** a) Convert numbers 1 to 15 from base ten to base two	another. 2) Observe individual learners in their groups whether they are cooperative, whether they collaborate with their colleagues. 3) 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 $10020_{base\ p}$ =

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
	b) Place the numbers in four boxes provided according to the conversion above c) When a number appears in the box, record it as 1 and when it does not appear, then record it as 0. E.g., Guess number7. 7 does not appear in the first box but appears in other 3 boxes… so $7_{ten} = 0111_{two}$ The number of boxes depends on the largest number in base ten that one chooses to use.	$87_{base\,q}$? 4) Complete the addition/multiplication table for different number bases.

Hints to the Teacher

1) Carry out diagnostic assessment of the learners on number bases.
2) For any base beyond base twelve the numerals   used must be defined.
3) For better understanding of place values of various   bases, use abacus (involve learners in making their own abaci).
4) Let learners identify where number bases are used in real life situation.

Topic 2: Working with Integers

Duration: 8 Hours

Overview

In this topic, there is extension of numbers from millions to trillions. The learners should learn how to read and write numbers in words correctly and also learn different types of numbers and relationships amongst them.

Competency: The learner carries out calculations with positive and negative integers.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) Identify, read and write natural numbers as numerals and words in million, billion and trillion (u, s). 2) Differentiate between natural numbers and whole numbers/ integers. (u) 3) Identify even, odd, prime and composite numbers. (u) 4) Identify factors and multiples of numbers. 5) Work out divisibility tests of some numbers, (u s)	1) Write natural numbers of choice in words and vice versa. 2) Order numbers and locate them on a number line. 3) Use directed number in context e.g., temperature, height above and below sea level, floors in a building. 4) 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.	1) Observe learners as they discuss in groups how they can read and write natural numbers in words and differentiate between natural and whole numbers. 2) Observe the interaction of learners within their groups. 3) Nambi has four number cards: She can arrange the cards to form different numbers. For example, she can form the number 3407

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
6) Relate common factors with h.c.f and multiples with l.c.m. (u) 7) Identify directed numbers. (k) 8) Carry out mathematical operations on numbers using the rules of integers. (k) 9) Use bodmas rule to carry out the four mathematical operations on integers. (u) 10) Use directed numbers (limited to integers) in real life situations. (u, s)	Determine how to distinguish other multiples (e.g., 2 (even numbers), 5, 10). 5) Investigate the factors of numbers 1 to 30. 6) Which numbers have just two factors? Which numbers have an odd number of factors? 7) 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. 8) Determine the prime factorisation of any integer.	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? 4) How many hundreds are there in one million? 5) What are the prime factorisations of 942 and 357? Hence find the HCF of 942 and 357, and the LCM.

Hints to the Teacher

1) Attention must be taken in writing numbers given in figures and vice versa (commas must be used while writing in figures and avoid the use of the word (and) when writing in words.

2) For better understanding of concepts by learners, introduce different concepts one at time.

3) When dealing with mixed operations, the order of operations should be followed.

4) Let learners identify where integers are applied in real life.

Topic 3: Fractions, Percentages and Decimals

Duration: 8 Hours

Overview

This topic looks at numbers which are not whole but just parts of whole numbers. These parts can be fractions or decimals. There are relationships between whole numbers, fractions and decimals.

Competency: The learner understands and uses fractions, decimals and percentages.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) describe different types of fractions. (k) 2) convert improper fractions to mixed numbers and vice versa. (k, s) 3) add, subtract, divide and multiplies fractions. (u, s) 4) apply fractions to solve real life situations. (u, s) 5) add, subtract, divide and multiply decimals. (u, s) 6) convert fractions to decimals and vice versa. (u, s)	1) Draw a circle on a piece of paper and cut it out. 2) Fold the cut out and shade off different types of fractions including decimals. 3) Understand decimals as fractions with powers of ten as a denominator (tenths, hundredths, etc.), 4) Understand percentages as fractions with 100 as the denominator. 5) Play games matching fractions, percentage and decimals.	1) Let the learners explain to the group members how Moses would carry out the activity below. 2) 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. 3) 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?

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
7) identify and classify decimals into terminating, non -terminating and recurring decimals. (u) 8) convert recurring decimals into fractions (u, s). 9) convert fractions and decimals into percentages and vice versa. (u,s) 10) calculate a percentage in of a given quantity. (s) 11) work out real life situations involving percentages. (u, s, v/a)	6) Identify percentages in every day contexts. 7) Use a calculator to investigate fraction- decimal equivalence – which fractions produce terminating decimals and which fractions produce recurring decimals? 8) Develop strategies for converting decimals to fractions. 9) Solve problems that involve fractions, percentages and decimals.	4) How many 0.01s are there in: • 1 • 0.1 • 10 • 30 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.

Hint to the Teacher

1) Guide the learners to understand the meaning of a fractions.
2) Guide the learners to identify different types of fractions.
3) Guide the learner to relate percentages and decimals to fractions and vice versa.
4) Let learners identify where fractions, decimals and percentages are applied in real life.

# Topic 4: Rectangular Cartesian Coordinates in 2 Dimensions

Duration: 8 Hours

Overview

In this topic, the learner shall understand how to locate the position of a point, object, and place from a given starting point which may be called a point of origin.

Competency: The learner plots and interprets points in a range of contexts.

Learning Outcomes	Suggested Teaching and Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) draw and label the Cartesian plane. (k,s) 2) identify the x – and y – axis. (k) 3) read and plot points on the Cartesian plane. 4) complete shapes on a coordinate grid. (k, u, s) 5) choose and use appropriate scale for a bivariate data set. (u, s, v/a)	1) Create a rectangular cartesian plane using a piece of paper. 2) Draw shapes on a coordinate grid given the coordinates of one or more. 3) Collect data (e.g., height and head circumference) from your class and plot a scatter graph.	1) Observe learners as they try to do the activities below. Look out for their cooperation in the process of getting solutions for the given questions below, sharing of information. 2) 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?
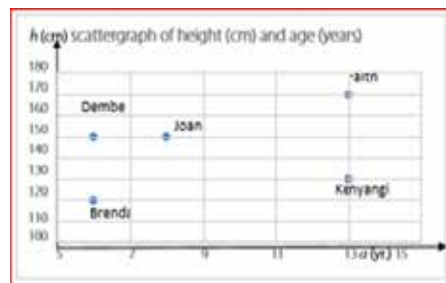
Learning Outcomes	Suggested Teaching and Learning Activities	Sample Assessment Strategies
		3) Two vertices of a square are at the points (2, 1) and (6, 3). What are the coordinates of the other two vertices of the square? There are three possible answers. Find all three Vertices

Hint to the Teacher

1. Guide the learners to understand the position of negative and positive numbers on the axes (Cartesian plane).
2. Emphasis should be put on choosing suitable scales.
3. Let learners identify where rectangular cartesian coordinates in 2 dimensions are applied in real life.
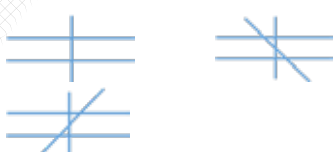
Topic 5: General Angle Properties of Geometric Figures
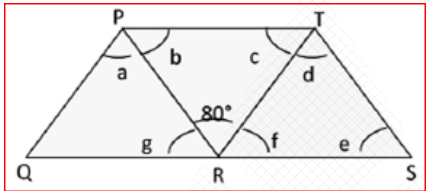
Duration: 4 Hours

Overview

In this topic the learner will draw, form and identify different angles. The learner will be able to understand how to use angle properties of polygons to solve problems in real situations. This is a hands-on topic, so the learner is encouraged to be practical.

Competency: The learner uses the angle properties of lines and shapes to solve problems.

Learning Outcomes	Suggested Teaching and Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) identify different angles. (k) 2) solve problems involving angles at a point on a straight line, angles on a transversal and parallel lines. (k, u, s)	1) Draw various angles and identify acute, obtuse and reflex angles. 2) Draw and label a pair of parallel lines and a line crossing them (transversal) Identify alternate, corresponding and supplementary angles on the diagram drawn above. 3) Add another transversal to determine the angle sum of a triangle. 4) Cut out three identical isosceles triangles from a scrap card. Arrange them to form a trapezium PQST.	1) Observe the learners as they carry out the following tasks: Expected diagrams 2) Through what angle do you turn in each of these cases? a) You are facing North and you turn: clockwise to face SE b) anti-clockwise to face SE c) You are facing NW and you turn to face SE

Learning Outcomes	Suggested Teaching and Learning Activities	Sample Assessment Strategies

3) know and use the angle sum of a triangle. (k, u)
 	
a. state and use angle properties of polygons when solving problems. (u, s)
	5) 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
	
	6) 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.
		3) How many sides does each regular polygon have, if the exterior angle is 720; 240; 60o; 450; 400?
		
		4) Three interior angles of a pentagon are 1100, 1000, and 1200 respectively. The fourth and the fifth angles are 3x0 and 2x0. Find their values.
		
		5) Observe their collaboration, respect for one another and attitude towards the task.

Hint to the Teacher

1) Encourage learners to acquire and use mathematical sets.

2) The schools should provide chalk and mathematical chalkboard instruments for demonstration.

3) Let learners identify where General angle properties of geometric figures are applied in real life.

Topic 6: Patterns and Sequence

Duration: 4 Hours

Overview

In this topic, the learn gets to understand how to determine the happening of the event based on the knowledge of the previous event. In this particular topic, the sequences and patterns are the numbers.

Competency: The learners explore number patterns and sequences.

Learning Outcomes	Suggested Teaching and Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) recognise and generate number patterns. (k, u) 2) explain how to generate a sequence. (u) 3) use number machines to generate	1) How many different ways can you continue the sequence that begins 2, 4… Explain how each sequence is generated. 2) 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. 3) 3, 6 and 9 are the 1st, 2nd and 3rd multiples of 3. d) Which position in the multiples of 3 is 93? e) Which position in the multiples of 3 is 3n?	1) 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.

Learning Outcomes	Suggested Teaching and Learning Activities	Sample Assessment Strategies
a sequence. (k, s) 4) describe a general rule when a pattern is given. (k, u, s) 5) determine terms in a sequence. (u, s)	4) Put the numbers 1, 2, 3, 4, 5… into this number machine to generate a sequence. - Write down the first five members of the sequence. - What is the formula for the nth term in the sequence? 5) 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. 6) Draw a double machine that could be used to generate the sequence 5, 8, 11, 14, 17….	2) Observe the following; collaboration, harmony amongst the members of the groups, willingness to do the activity. Write a formula for the nth term in a sequence starting: i) 1, 1, 1, 1, … ii) 1, 4, 9, 16, 25, …

Hints to the Teacher

1) Emphasis should also be put on number patterns.
2) Guide learners to develop number patterns.
3) Relate patterns to sequences.
4) Let learners identify where Patterns and Sequences are applied in real life.

Topic 7: Bearings

Duration: 4 Hours

Overview

The learner will not find challenges in this topic if he/she is well-grounded in the previous topics on Geometry which include; General Angle Properties of Geometric Figures. The learner will understand and describe the bearing of a point from a given point.

Competency: The learner uses compass points, bearings and scale drawings.

Learning Outcomes	Suggested Teaching and Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) know the compass points. (k) 2) describe the direction of a place from a given point using compass points. (u s) 3) describe the bearing of a place from a given point. (k s) 4) apply bearings in real life situations. (u s)	1) Match compass points with bearings. 2) Create a scale drawing of the classroom or school. 3) Alex is facing North. He turns clockwise to face West. What angle has he turned through? 4) 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	1) Let the learners in groups, discuss and explain how they will accomplish the following task: 2) 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. 3) Use a scale drawing to find: a) the distance AB

Learning Outcomes	Suggested Teaching and Learning Activities	Sample Assessment Strategies
5) choose and uses an appropriate scale to make an accurate drawing. (k u) 6) differentiate between a sketch and a scale drawing. (u, v)	of 310°. What is the bearing of the hospital from Henry's home? a) Make a scale drawing to find the distance and bearing of the hospital from Henry's home. b) Remember to state the scale you use on your drawing, and give your answer to a sensible degree of accuracy.	4) b) the bearing of B from A 5) 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.

Hint to the Teacher

1) Emphasise the difference between sketching and accurate drawing.
2) Emphasise practical work in bearings.
3) Let learners identify where are applied in real life.

Topic 8: Geometric Construction Skills

Duration: 6 Hours

Overview

Choosing suitable scales, measuring and drawing is prerequisite knowledge for this topic. The learner should be able to develop construction skills The topic is hands on.

Competency: The learner uses the angle properties of lines and shapes to solve problems.

Learning Outcomes	Suggested Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) Draw perpendicular and parallel lines. (k, s) 2) Construct parallel lines, perpendicular lines, angle bisectors and mediators. (u, s) 3) Ruse a pair of compasses and a ruler to construct special angles. (90^0, 60^0, 45^0) (u, s) 4) Describe a locus. (u) 5) Relate parallel lines, perpendicular bisector, angle bisector, straight line and a circle as a	1) Learners should identify perpendicular and parallel lines in the environment 2) 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	1) Observe learners as they select correct instruments to use. Observe their interaction, attitude towards what they are supposed to do. Do they differentiate drawing from constructing? 2) Let the learners explain or describe the procedure of constructing angles.

Learning Outcomes	Suggested Learning Activities	Sample Assessment Strategies
locus. (k, u) 6) Draw a polygon. (u) 7) Measure lengths and angles. (s) 8) Construct geometrical figures such as triangle, square, rectangle, rhombus, parallelogram. (u, s, v/a)	from two fixed points is a constant (ellipse) 3) Construct various polygons and geometric designs using geometric equipment	3) Let learners construct the following angles. 4) In your exercise book, construct the following angles by using a compass 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

Hint to the Teacher

1) Emphasize the difference between construction and drawing of angles and other shapes.
2) Emphasize the difference between sketching and accurate drawing in construction.
3) Emphasize practical work in construction.
4) Let learners identify where Geometric construction skills are applied in real life.
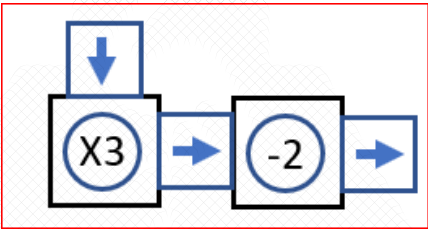
Topic 9: Algebra
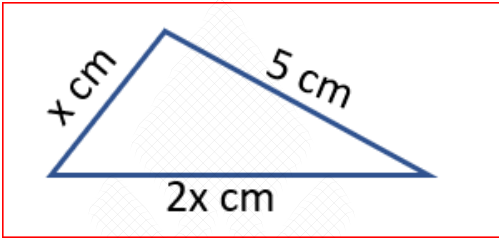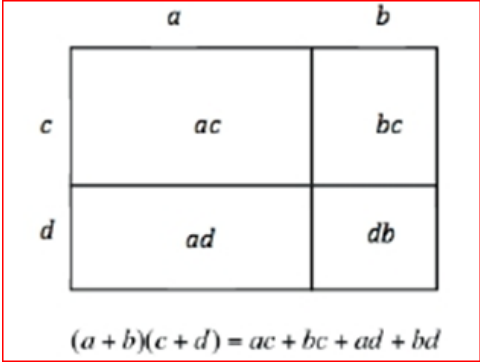
Duration: 9 Hours

Overview

In this topic, the learner will understand how to manipulate mathematical expressions involving unknowns.

Competency: The learner forms and uses simple algebraic expressions.

Learning Outcomes	Suggested Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) use letters to represent numbers. (u) 2) write statements in algebraic form. (u) 3) simplify algebraic expressions (to include algebraic fractions). (u, s) 4) evaluate algebraic expressions by substituting numerical values. (u, s)	1) Write an expression for each statement .use the variables to represent unknow numbers 2) Use number machines and write the equivalent algebraic expressions e.g. when x is put into this machine the output is 3x-2 3) 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?	1) As they discuss, observe participation in each group, presentations, methods used. 2) Find the missing input and output numbers in these double number machines:

Learning Outcomes	Suggested Learning Activities	Sample Assessment Strategies
5) manipulate simple algebraic equations in one variable and solve them. (u, s, v/a) 6) recognise equivalent quadratic expressions. (k u s) 7) expand algebraic expressions. (k s) 8) identify perfect squares. (u) 9) factorise quadratic expressions. (u s) 10) solve quadratic equations where the quadratic expression can be factorised. (k s)	4) In groups, draw a triangle and label as shown. 5) The perimeter of the triangle above is 26cm. Determine the lengths of the triangle. 6) The sum of two numbers is 10 and their product is 21. What are the numbers? 7) What is the connection with $2x(10-x) = 21$ and $x -10x+21=0$ and $(x-3)(x-7)=0$? 8) Investigate the relationship between multiplication and finding the area of a rectangle, and generalise to algebra $(a + b)(c + d) = ac + bc + ad + bd$	3) Solve the following equations: a) $3p - 2 = 8$ b) $2x + 1 = 3x - 2$ 4) 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

Learning Outcomes	Suggested Learning Activities	Sample Assessment Strategies
	9) 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 $$x^2 - a^2 = (x+a)(x-a)$$	to find Yusuf's original number.
	10) Substitute values of x in quadratic expressions and note the values when the expression is zero – link with the solutions of the quadratic equation.	
	11) Investigate when quadratic expressions can be factorised to establish $$x^2 + (p+q)x + pq = (x+p)(x+q)$$	

Hints to the Teacher

1) Use real life situations in order not to make algebra abstract.

2) Guide the learners to understand the difference between linear and non-linear expressions.

3) Let learners identify where Algebra is applied in real life.

Topic 10: Business Arithmetic 1

Duration: 4 Hours

Overview

The learner should understand the day today mathematics being used at home. This topic should draw experience from the learner's environment. Let it be practical.

Competency: The learner understands and applies Business arithmetic.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) describe and calculate profit, loss (*includes all expenses incurred*), commission, interest and discount. (u, s) 2) express profit or loss as percentage. (u) 3) solve simple interest problems. (k ,s, v/a)	1) In groups, let the learners discuss the cost of producing certain goods like pancakes, chapatis etc. and determine the selling price of the products. 2) They should use it to demonstrate how to make profit, loss and their percentages for the goods produced.	1) 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? 2) Are they creative and innovative? 3) In a school there are 100 students, each of whom is given 3 litres of milk per week. 4) If a half-litre pack costs UGX 1500, find the monthly milk bill (use 1 month = 4 weeks)

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
4) calculate compound interest using step by step method to a maximum of 3 years.	3) Describe how you can calculate, commission, interest, insurance and discount.	5) 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?

Hint to the Teacher

1) The formula for compound interest should not be introduced at this level 1.

2) Let learners identify where Business arithmetic 1 is applied in real life.

Topic 11: Time and Time Tables

Duration: 5 Hours

Overview

Time management is a skill and therefore, this topic will help the learner develop this skill by drawing her/his personal timetable.
Competency: The learner understands and uses time.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Activities
The learner should be able to: 1) identify and use units of time. (k, u, s). 2) use and interpret different representations of time (12- and 24-hour clock). (u, s) 3) apply the understanding of time in a range of relevant real-life contexts. (u, s v/a)	1) Look at the S1 school timetable. How much time do learners spend in school? 2) How much time is spent in lessons? What is the total time spent on each subject? 3) Use bus timetables to determine as much information as possible. 4) Plan a journey and draw up a detailed itinerary using the 24-hour clock. 5) 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	BUS STATION ARRIVE DEPART Soroti 20:30 Kumi 22:00 22:15 Mbale 23:30 24:00 Iganga 01:30 01:45 Jinja 02:05 02:55 Kampala 04:00 Look at the bus timetable. 1) Where does the bus start? 2) Where does it travel to? 3) How long does the whole journey take from start to finish? Give your answer in hours. 4) The bus travels for half the total journey time. Which

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Activities
4) read, interpret and draw timetable.	year? 6) 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? **Note**: Give learners some class projects in order to enable them to acquire skills about the topic.	should be the nearest station? 5) 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. 6) What is the latest time that Rona should leave her house? 7) Give the time on the 12-hour clock when the bus will arrive at Mbale. a) What is the total time the bus spends at the bus stations on its journey? Give your answer in hours and minutes. b) Musa wants to travel from Jinja to Kumi. Can he use this bus for his journey? Explain your answer.

Hint to the Teacher

1) This topic should be taught practically.

2) Emphasis should be put on duration of time when changing from AM to PM and vice versa.

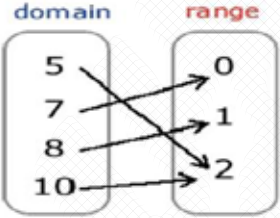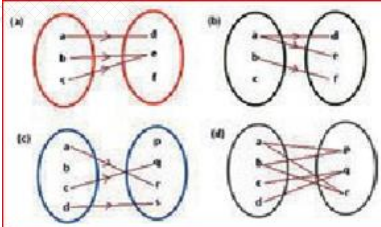3) Let learners identify where time and time tables are applied in real life.

Topic 12: Relations, Mapping, and Functions

Duration: 6 Hours

Overview

In this topic, the learner will understand how to determine a relationship between objects and develop logical skills in this topic.

Competency: The learner understands and uses arrow diagrams/mappings to represent relations and functions.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies

The learner should be able to:
 	
 1) use arrow diagrams /mappings to represent relations and functions. (k, u)
 	
 2) identify domain and range of a mapping. (k, u)
 	
 3) describe and distinguish between a function and non- function mappings. (u, s)
 	
 4) understand and use function notation. (k, u, s)
	
	 1) Investigate situations where one set can be related to another and draw the mapping diagrams.
	
	 2) In pairs, consider the functions $f(x) = 6x$ and $g(x) = x + 5$
	 c) What is $f(3)$ and $g(-1)$?
	   d) What is x if $g(x) = -11$?
		1) 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?
		
		 2) Do these mapping diagrams represent functions? Give
		
		   reasons for your answers.

Hint to the Teacher

1) Leave out composite function and inverse function.

2) Let learners identify where relations, mappings and functions are applied in real life.

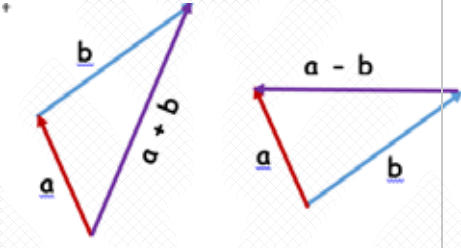# Topic 13: Translation and Vectors

Duration: 6 Hours

Overview

In this topic, the learner should be able to understand that translation and vectors are forms of transformations in given direction.

Competency: The learner understands the nature of vector, manipulates and represents them in order to define translation.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: a) describe translation as a transformation. (u) b) differentiate between scalars and vector quantities. (k, u) c) use vector notation. (k, s) d) represent vectors both single and combined geometrically. (u, s) e) apply vectors in real life situations. (u s)	1) lets learners move objects to the left, right, up and down in class or outside. task them to explain their observations at each stage. 2) Describe the translation of the purple polygon in the diagram below. 3) Distinguish scalars (magnitude only) and vectors (magnitude and direction),	In groups, let the learners discuss the following task: 1) What is the vector that translates T to U? 2) What is the vector that translates U to T? 3) Observe them as they discuss the task.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
f) describe position vector geometrically and as a column vector. (k, u) g) find out the vector of a directed line segment and its magnitude when position vectors of the end points are known. (u) h) find out the position vector of the mid-point of the line segment. (u)	4) 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. 5) Investigate how to 'undo' a translation; the effect of performing more than one translation – draw diagrams to illustrate findings. 6) 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? 7) Recall and review, what is the difference between a vector	4) Assess the learners on the core values and generic skills.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
	and scalar quantity? Give examples. 8) Identify parallel and equal vectors. 9) Use vector addition and subtraction. 10) 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.	

Hint to the Teacher

1) Teach the topic practically.
2) Let learners identify where Translation and Vectors are applied in real life.

Topic 14: Graphs

Duration: 6 Hours
Overview

The learner will be able to understand that graphs are forms of displaying information for easy analysis, interpretation of information and making decisions/conclusions based on what is displayed on the graphs.

Competency: The learner plots, interprets and uses graphs to solve problems.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) tabulate values from given relations (u). 2) choose and use appropriate scales (u). 3) plot and draw lines through given points (u s). 4) draw, read and interpret the graph	1) Provide learners with relations that they can use to generate values (e.g.) d=5/2t values (e.g.) d=5/2t <table><tr><td>BUS STATION</td><td>DISTANCE (KM)</td><td>ARRIVE</td><td>DEPART</td></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> 2) 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	1) 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. 2) Atim visited her friend. The distance/time graph shows her journey. a) How far did Atim walk to reach her

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
(e.g., Distance-Time graph, Speed-Time graph to estimate distance, speed and time) (u, s, v/a)	journey from Soroti to Kampala.	friend's house? 3) How long did Atim stay at the house? b) How long did it take Atim to walk back from her friend's house? c) Draw the speed-time graph for Atim's journey.

Hint to the Teacher

1) Emphasis should be put on use of suitable grid paper (squared paper).
2) Guide the learners on choosing the suitable scale to use.
3) Let learners identify where Graphs are applied in real life.
4) Emphasize graphs as a form of pattern.

Topic 15: Numerical Concepts

Duration: 10 Hours

Overview

In this topic, the learner would be able to understand how to write numbers in various forms for easy manipulation.

Competency: The learner manipulates indices, standard form and surds.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Activities
The learner should be able to: 1) estimate answer to calculations. (u, s) 2) write and differentiate numbers to a given number of significant figures, decimal places and place values. (u, s) 3) identify base number and index. (u) 4) express numbers in standard form. (k) 5) state and apply the laws of indices in calculations. (k	1) Take a long strip of paper and successively fold in half. Complete the table below. <table><tr><td>Number of Folds</td><td>Number of Parts</td><td>In Index For</td></tr><tr><td>0</td><td>1</td><td></td></tr><tr><td>1</td><td>2</td><td></td></tr><tr><td>2</td><td>4</td><td>4^2</td></tr><tr><td>3</td><td></td><td></td></tr></table> 2) Use a calculator to explore how indices work, establishing general rules for multiplying and dividing numbers written in index form: a ^{b} a ^{b} n ×n and n ÷n 3) Investigate how to 'undo' powers e.g. watch the video 'powers of ten' to introduce powers of ten and standard form. How many particles in	1) In groups, let the learners discuss the following task and observe them as they discuss the activity. 2) 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. b) How many millions are there in 3.4 trillion? Akumu said, • "5 = 5 × 3 = 15." • Burango said, "5 = 5 × 5 × 5 =

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Activities
u s) 6) use a calculator to find powers and roots. (k, u, s) 7) use surds to represent roots that cannot be represented exactly as decimals. (k, u) 8) manipulate and simplify expressions with surds. (u, s, v/a)	the universe? How far is it from the Earth to the moon? To the sun? 4) Investigate numbers that can't be written exactly on a calculator e.g., thirds, sevenths, pi. 5) Investigate the difference between significant figures, decimal places. 6) Rewrite a surd in its simplest form by ensuring the number underneath the root sign has no square numbers as factors. 7) Use the importance laws of surds, which can be derived from the laws of indices to help simplify surds.	225." Who was correct? Justify your answer. 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.

Hints to the Teacher

1) School should acquire standard mathematical tables.
2) Guide learners to use scientific calculators.
3) Let learners identify where Numerical concepts are applied in real life.
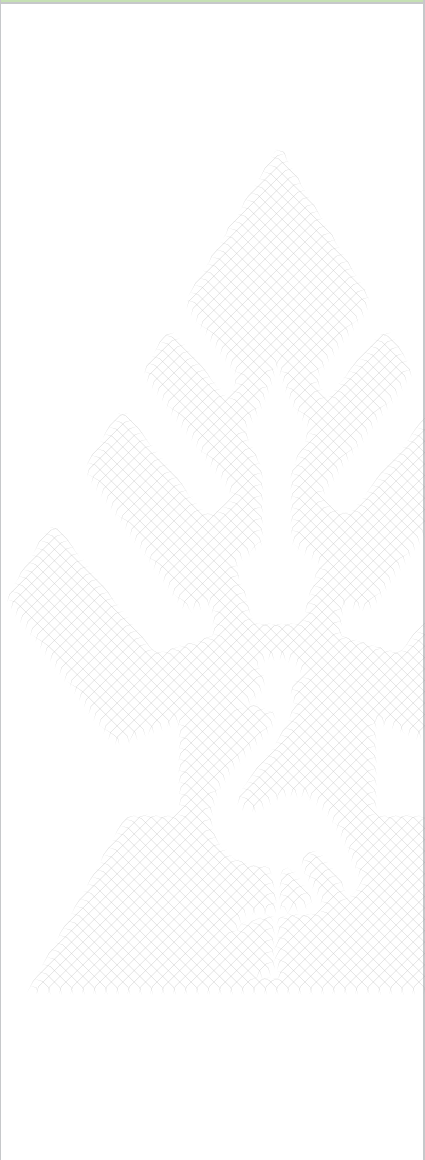
Topic 16: Set Theory

Duration: 7 Hours

Overview

The learner will be able to categorise items according to the given characters, rules or relationship.

Competency: The learner uses sets to solve real life situations.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) describe a set and identify elements of a set. (k, u) 2) identify different types of sets and their symbols (empty set, universal set, equal set, complement, disjoint set, intersection set union set, subset). (k)	i) 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 ε 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 $A \nsubseteq B$ A is a not a proper subset of B $A \not\subset B$ ii) Draw and interpret diagrams to illustrate relationships between sets, apply to practical contexts 	1) 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? 2) 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)' 3) 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

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
3) determine the number of elements in a set. (u, s) 4) represent and show different operations on sets by shading the different regions in a Venn diagram. (k, u, s) 5) apply sets to practical situations using two and three sets. (u, s, v/a)		not eat a meal. i) Represent this information in set notation ii) Represent the information on a Venn diagram. iii) How many guests ate both meat and chicken? iv) How many guests had meat? 4) 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?

Hint to the Teacher

1) Guide learners to write information from word problems into set language.
2) Guide the learners to begin with two Venn diagrams and continue to three Venn diagrams.
3) Let learners identify where set theory is applied in real life.

Topic 17: Equation of a Straight Line

Duration: 7 Hours

Overview

In this topic, the learner will explore the relationship between points and variables. Under some conditions, the variables or points are equal.

Competency: The learner understands and uses linear equations and their graphs.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) form linear equations with given points. (k, s) 2) draw the graph of a line given its equation. (u, s) 3) understand the relationship between a linear equation y=mx + c and its graph. (k, u) 4) determine the x and y intercepts of a given linear graph and a	1) Determine the equation for each set of points that form a straight line. 2) Investigate the properties of the equation of a straight-line y= mx+c, by plotting the graphs using different values of m and c 3) How do you get parallel lines? How do you make the line steeper? 4) Consider a ladder of length 10m. 5) Place the foot of the ladder at: i) 8m, ii)5m, iii) 2m from the wall and lean the ladder against the wall. 6) What happens to the angle between the ground and the ladder as the foot of the	1) 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? 2) Asabi is going to plot the graphs of these six equations: y=2x+1, y=3x, y=x+4

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
given linear equation. (u s) 5) determine the gradient of a straight line. (u, s) 6) state the gradient of a straight line when given the equation. (k, u) 7) apply the relationship of gradients of parallel and perpendicular lines to determine the equation of a straight line. (k, u, s)	ladder moves closer to the wall? 7) Relate the steepness of the ladder with the distance between the wall and the foot of the ladder. Explain this relationship. 8) Review how does the equation y=mx+c work? 9) Introduce gradient as a measure of steepness/rate of change 10) 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? 11) Investigate the least number of points that need to be plotted to draw a straight line.	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. 1. Sendi drew the graphs of 2x-3=y and y=7 on the same set of axes. What are the coordinates of intersection?

Hint to the Teacher

1) Emphasis should be put on use of suitable grid paper (squared paper)

2) Learners need to be aware that x is measured on the horizontal axis and y on the vertical axis

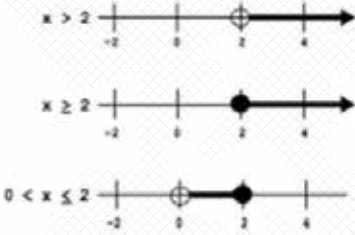3) Let learners identify where the equation of a straight line is applied in real life.

LEVEL 2
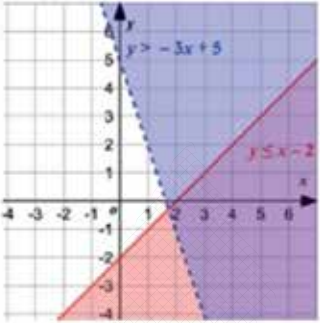
Topic 1: Inequalities and Regions

Duration: 6 Hours

Overview

In this topic, the learner will be able to differentiate equations from inequalities, manipulate inequalities, draw and show the required regions (feasible region).

Competency: The learner presents and solves problems involving inequalities.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) identify and use inequality symbols. (k, s) 2) illustrate inequalities on the number lines. (u, s) 3) solve linear inequalities in one unknown. (u, s)	1) Match inequalities on a number line with their algebraic representation 2) Solve linear inequalities and represent the solution on a number line. 3) Define regions on a coordinate graph using linear inequalities.	1) 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? 2) During the process of the description, are learners communicating effectively? Are

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
4) represent linear inequalities graphically. (k, u, s) 5) form simple linear inequalities for regions on a graph. (u, s)	 4) Play foxes and chickens – where chickens are positioned on a coordinate grid and inequalities are used as fences to protect the chickens from foxes.	they learning from one another? are they creative? 3) Solve the linear inequalities and represent the solutions on a number line 2x+7<x+10 2x+7<x+10 4) Use inequalities to define a square region that has (1, 1) at its centre.

Hint to the Teacher

1) Emphasis should be put on use of suitable grid paper (squared paper).

2) Guide learners on identification of wanted and unwanted regions.

3) Emphasis on when to use solid lines or dotted lines depending on the nature of the inequalities.

4) Let learners identify where inequalities and regions are applied in real life.
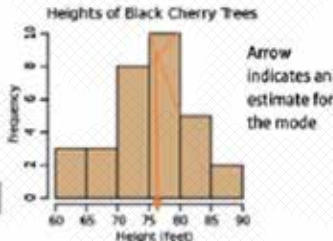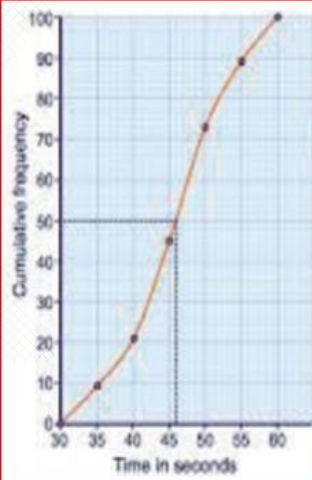
Topic 2: Data Collection and Presentation

Duration: 12 Hours

Overview

In this topic, the learner will develop the skills of collecting data, display it in various forms, interpret and analyse to make conclusions.

Competency: The learner collects and represents different sorts of data.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) understand the differences between the types of data. (k, u) 2) collect and represent simple data from local environment using tally chart, bar chart (bars do not touch), pie chart and line graph. (k, u, s, v/a) 3) understand mode, mean as a measure of location/tendency and knows how to find them and when to use them. (k, u, s) 4) understand range as a measure of dispersion /spread and how to find it. (k, u, s)	1) Class to get in height order – stand in a circle to illustrate the range (difference between tallest and shortest person). 2) Discuss representative/typical values – find the most popular height (mode), the middle height (median), what if we were all the same height? (The mean). 3) Compare the advantages and disadvantages of mean, median and mode in different contexts. 4) Explore the need for grouping data when there are many different values. Once grouped, exact statistics (mean, median, mode,	1) Observe the learners in their groups as they carry out the task below. During the process are learners communicating effectively? 2) Are they learning from one another? Are they creative and critical? 3) 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

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
5) draw and use frequency tables for ungrouped data. (u, s) 6) draw and use frequency tables for grouped data. (u, s) 7) estimate measures of location and dispersion for grouped data. (u, s) 8) calculate the mean using an assumed mean. (u, s) 9) draw a histogram with equal class intervals and use it to estimate the mode. (u, s) 10) draw a cumulative frequency curve (ogive) and uses it to estimate the median. (u, s, v/a)	range) cannot be determined. i) Compare estimates from grouped data with the actual values from the raw data. ii) Draw a histogram and estimate the mode Heights of Black Cherry Trees iii) Draw a cumulative frequency graph and estimate the median iv) Collect data for a purpose and apply techniques to draw conclusions.	choice. 4) 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

Hint to the Teacher

1) Emphasize the collection of data from the environment by learners.
2) Emphasis should be put on use of suitable grid paper (squared paper).
3) Emphasise use of appropriate scale.
4) Let learners identify where data collection and presentation is applied in real life.

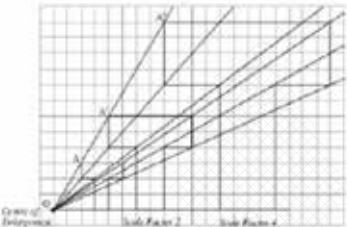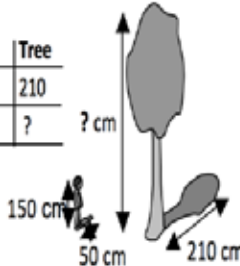# Topic 3: Similarities and Enlargement

Duration: 6 Hours

Overview

The learner will be able to understand that similarities and enlargement are forms of transformation.

Competency: The learner understands and applies relationships between lengths, areas and volumes of similar shapes and objects.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) identify similar figures. (u, s) 2) state and use the properties of similar figures. (k, u) 3) define enlargement. (k) 4) state the properties of enlargement to construct	1) Explore different similar shapes by matching proportion of their sides and angles (e.g.) 2) The photo below shows cubes and plastic balls. Consider the photo and answer the questions that follow. 3) True or false: the cubes are similar to each other. 4) True or false: the plastic balls are not similar to each other. 5) Explore enlarging shapes through different centres of	1) Observe the learners in their groups as they discuss the activity below. Find out the learners' attitude towards the group work, integrity, are they doing the work in harmony? 2) During the process of the description, are learners communicating effectively? Are they learning from one another? Are they creative and critical? 3) Let the learners give their group reports. **Activity:** Bayo and Sara want to find the height of a tree. They cannot climb the

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
objects and images. (k) 5) state the relationship between linear, area and volume scale factors. (u, s) 6) apply scale factors in real life situations. (u s) (Hint include map extracts)	enlargement with different scale factors. 6) What happens to the area of the shapes? a) Extend to 3D starting with cubes and cuboids b) Establish the relationship between the linear scale 2 factor (k) and the area scale factor (k) and the 3 volume scale factor (k)	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.

Hint to the Teacher

1) Teach similarity first before enlargement.
2) Teach ratios and proportions using a recipe, medicinal syrup etc. and the effects of misusing or correctly using ratios and proportions in real life.
3) Emphasis should be put on use of suitable grid paper (squared paper).
4) Guide the learners on how to choose the suitable scale to use.
5) Let learners identify where similarities and enlargement are applied in real life.

Topic 4: Reflection and Rotation

Duration: 6 Hours

Overview

The learner will be able to understand that reflection and rotation are forms of transformation.

Competency: The learner reflects and rotates shapes in a range of contexts.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies

The learner should be able to:
 	
1) Identify lines and planes of symmetry for different figures. (k)
 	
2) reflect shapes and objects. (u, s)
 	
3) apply reflection in the cartesian plane. (u, s)
	1) Write down numbers 0, 1, 2, 3, 4, 5, 6, 7, 8,9 on the paper. Place a mirror at each of the numbers above.
	
	  a) try to read the image of the numbers.
	
	  b) write down the images of these numbers.
	
	  c) comment on the image of 0 in comparison to the 'object' 0.
	
	2) The learner should cut shapes from scrap card and trace the different shapes on plain sheet of paper.
	
	a) Rotate the shapes about an identified centre of rotation through an angle.
	
	b) Trace out the images and let them discuss the characteristics of the object and image being rotated at
		1) 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.
		
		2) Let each group explain to the other groups how they have carried out the task.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
4) describe and state the order of rotational symmetry of plane figures. (k, u, s) 5) identifies the difference between clockwise and anti-clock wise rotation. (k, u) 6) states properties of rotation as a transformation include congruence. (k, u)	different centres and angles of rotation. c) Let the learners draw the different shapes with their images 3) Identify all the lines of symmetry in the letters of the alphabet written as capital letters, repeat for numbers 4) Use a mirror to reflect objects in a given line of symmetry 5) 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 6) 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.	3) 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) Find the equation of the line of reflection. 4) In pairs, let the learners discuss the following tasks. Observe them as they discuss. Assess the learners on the core values and generic skills. 5) 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

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
7) determines the centre and angle of rotation. (u, s) 8) applies properties of rotation in the Cartesian plane. (u, s, v/a)	7) Are there any capital letters of the alphabet that have rotational symmetry? 8) Cut shapes from scrap card, draw around the shape on a plain sheet of paper to create the object. 9) 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. 10) Investigate rotating different shapes on plain paper and a coordinate grid. 11) Given an object and image, construct the centre of rotation.	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.

Hint to the Teacher

1) Use congruence to explain reflection and rotation
2) Emphasis should be put on use of suitable grid paper (squared paper)
3) Guide the learners on how to choose suitable scale to be used.
4) Teach reflection before rotation.
5) Guide the learners to do the work practically.
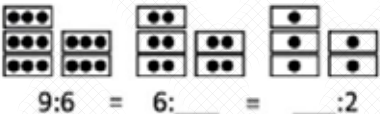6) Let learners identify where reflection and rotation are applied in real life.
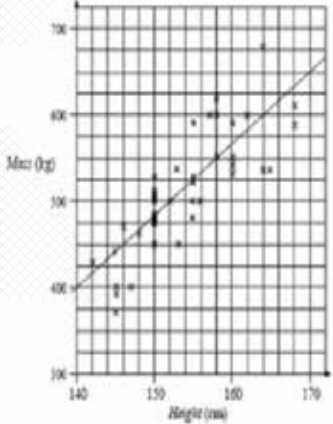
Topic 5: Ratios and Proportions

Duration: 6 Hours

Overview

In this topic the learner will be able to understand dividing in given ratios, sharing in the given proportions and differentiate the various proportions.

Competency: The learner understands ratio and proportion, and uses them in a range of contexts.

Learning Outcomes	Sample Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) understand and and apply equivalent ratios. (u, s) 2) understand and and apply direct and inverse proportional reasoning. (u, s)	1) 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. 2) 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	1) 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? 2) 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

Learning Outcomes	Sample Teaching & Learning Activities	Sample Assessment Strategies
3) understand and and apply ratio, proportion and scale. (k, u, s) a) draw and interpret the line of best fit when looking for a relationship in bivariate data on a scatter graph. (u, s)	direct proportion, $$y \propto x$$ 3) 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, $$y \propto \frac{1}{x}$$ 4) 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.	000 000 (one million shillings). She wants to buy and raise as many chicks as she can. How many should she buy? 3) 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.

Hint to the Teacher

1) Help learners to distinguish between ratios and proportions.
2) Let learners identify where ratios and proportions are applied in real life.

Topic 6: Matrices

Duration: 6 Hours

Overview

A matrix is a rectangular arrangement of numbers or letters. The learner will be able to understand that a matrix is one way of keeping information.

Competency: Learner understands and uses matrices.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) define a matrix and states its order. (k) 2) know when matrices can be added, subtracted or multiplied. (u, s) 3) find the determinant of a 2 × 2 matrix. (u, s) 4) find the inverse of a 2 × 2 matrix and understands why it may not be possible to	1) What is a matrix? 2) When can matrices be added together? $A = \begin{pmatrix} 2 & 0 & 1 \\ 3 & 0 & 0 \\ 5 & 1 & 1 \end{pmatrix}$ $B = \begin{pmatrix} 1 & 0 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 0 \end{pmatrix}$ $A+B = \begin{pmatrix} 2+1 & 0+0 & 1+1 \\ 3+1 & 0+2 & 0+1 \\ 5+1 & 1+1 & 1+0 \end{pmatrix} = \begin{pmatrix} 3 & 0 & 2 \\ 4 & 2 & 1 \\ 6 & 2 & 1 \end{pmatrix}$ 3) 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 ≠ BA 4) 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 d) What happens if det A = 0?	1) 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? 2) Use matrices to solve the simultaneous equations (a) $3x + 5y = 25$ $2x + 4y = 18$ (b) $7m + 3n - 46 = 0$ $30 - 3m = 5n + 40$

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
do so. (k, u, s) 5) apply knowledge of matrices in solving problems from real life situation. (u, s, v/a)	e) Use matrices to solve pairs of linear equations in two unknowns. f) Explore what happens when there are no solutions.	3) Use the matrix method to show that the following pairs of simultaneous equations have no unique solutions. Why does this happen? (a) $6x - 9y = 36$ $\quad 2x - 3y = 5$ (b) $3x - 7y = 45$ $\quad 9x - 21y = 135$

Hint to the Teacher

1) Guide the learners to identify and understand columns and rows in class.

2) Guide the learners to appreciate special matrices.

3) Let learners identify where matrices are applied in real life.

Topic 7: Matrix Transformations

Duration: 8 Hours

Overview

The learner will be able to understand that matrix transformation is a form of transformation in which the matrices are used.

Competency: The learner understands and uses matrices to transform shapes on a coordinate grid.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: a) derive 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) determine the matrix of transformation when the object and its image are given. (u, s) d) determine the a matrix that transforms the image back to	i) 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? ii) Plot the following five triangles on grid paper. T_1 (1, 1), (5, 1), (5, 3), T_2 (1, 1), (1, 5), (-1, 5) T_3 (-1, 1), (-5, 1), (-5, 3)	1) 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? 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'.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
the object. (u, s)) e) use the inverse matrix to find the object when the image is given. (u, s) f) Investigate the relationship between area scale factor and determinant of the transformation matrix. (u) g) determine a single matrix for successive transformations. (u, v/a)	T_4 (-1, -1), (-5, -1), (-5, -3) and T_5 (1, -3), (1, -5), (5, -3) iii) Describe a single transformation that maps: a) T_3 onto T_1. b) T_4 onto T_5 c) T1 onto T2 d) T4 onto T3 e) T1 onto T4 f) T_4 onto T_2, and determine the transformation matrix. iv) Determine the transformation matrix to 'undo' each transformation. What do you notice? v) Investigate combining transformations and the corresponding transformation matrices.	2) Describe the transformations defined by the matrices and Evaluate AB and BA. 3) Describe the transformation each represents. A shape P is subject to transformation AB to give image P_{AB}. The same shape P is subject to transformation BA to give image P_{BA}. 4) Describe the single transformation that will map P_{AB} to P_{BA}.

Hint to the Teacher

1) Guide the learners to discover some of the transformation matrices using a unit square.

2) Guide learners to always use transformation matrix as a pre- multiplier.

3) Emphasise that the matrix that transforms an image back to an object is the inverse of the matrix that transforms an object to an image.

4) Let learners identify where matrices of transformations are applied in real life.

Topic 8: Simultaneous Equations

Duration: 4 Hours

Overview

Simultaneous equations are equations which involve more than one variable or unknown that can be solved at the same time to give values which satisfy each of them.

Competency: Learners should understand, form, solve and use simultaneous equations in real life situation.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: 1) solve simultaneous equations using substitution method. (u, s) 2) solve simultaneous equations using elimination method. (u, s) 3) draw graphs of simultaneous equations and estimate the solution. (u, s)	i) 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? ii) How does the set of equations 3x+5y=32 and 6x+8y=59, relate to the problem above?	1) Observe the learners as they work on the tasks below. During the process, are learners: a) Communicating effectively? b) Are they learning from one another? c) Are they creative and critical? 2) Solve the following pairs of simultaneous equations using elimination method. a) $7x + 3y = 32$ $3x + 12y = 78$ b) $6y + 14 = 7x$ $5x - 12 = 4y$

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies

4) use matrices to solve simultaneous equations. (u, s, v/a)	iii) Explore different methods for solving simultaneous equations including substitution, elimination and use of matrices.
	
	iv) 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?
		3) Use substitution to solve the simultaneous equations:
		
		$3x + y = -2$
		
		$4x + 2y = 0$
		
		4) 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) $x+y=3$
		
		   $2y=6-2x$

Hint to the Teacher

1) Guide the learner to handle one method at a time (don't mix up methods).
2) Emphasis should be put on use of suitable grid paper (squared paper).
3) Guide the learners on how to choose the suitable scale to be used.
4) Let learners identify where simultaneous equations are applied in real life.

Topic 9: Quadratic Equations

Duration: 8 Hours

Overview

In this topic, the learner will differentiate between linear and quadratic equations. A quadratic equation is a second order polynomial equation in one variable.

Competency: Learner understands, solves and use quadratic equations in real life situation.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
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) b) form a quadratic equation given its roots. (u, s)	i) Create a table of values for the quadratic equations: $y=x^2$, $y=x^2-4$, $y=(x+1)^2$. ii) Describe the transformations that link these graphs. Find the solutions to the equation iii) $x^2=0$, $x^2=4$, $(x+1)^2=0$ 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	1) 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? 2) A room p metres long and (p- 3) metres wide, has an area of 40m². Obtain an equation in p. Find the value of p. 3) The roots of a quadratic equation are -2 and 3, write down at least three different equations

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies

c) 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)
	• 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.
	
	iv) Solve simultaneous equations involving a quadratic equation and a linear equation, and represent them graphically.
		that have these roots. Sketch their graphs.
		
		4) Try to solve $x2 - 3x + 4 = 0$ by:
		
		   a) factorising
		
		   b) completing the square
		
		   c) formula
		
		i) For each method, state briefly the difficulty encountered.
		
		ii) What do you conclude about the solution set of
		
		$x^2 - 3x + 4 = 0$
		
		iii) Draw the graph of $y=x^2 - 3x + 4$.
		
		What do you notice?

Hint to the Teacher

1. Emphasis should be put on use of suitable grid paper (squared paper)
2. Guide the learners on how to choose the suitable scale to be used.
3. Guide the learners to form linear equations from quadratic.
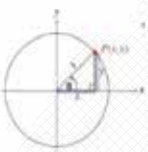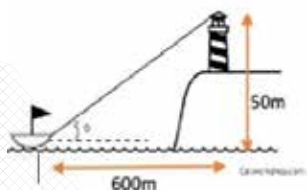4. Let learners identify where quadratic equations are applied in real life.
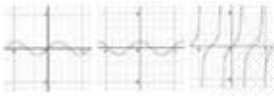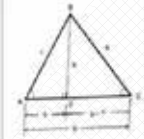
Topic 10: Trigonometry

Duration: Hours

Overview

The learner should be able to understand that trigonometry is the only geometry that deals with three sided figures.

Competency: The learner understands, justifies and applies the three basic trigonometry functions.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: a) derive sine, cosine and tangent functions from the unit circle. (k u s) b) read and use 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) find angles of elevation and depression. (k s)	i) 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 θ° Compute y÷x, plot y÷x against θ° include trigonometric functions. ii) Review, particularly the graphs of trigonometric	1) 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? 2) Find the angle of elevation θ, of the top of the lighthouse. 3) Find the height above the ground of a hot air balloon, whose angle elevation from the ground 1km away. 4) In pairs, let the learners discuss the following tasks. Observe them as they discuss. Assess the learners on the core values and generic skills.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
d) determine trigonometric ratios of angles greater than 90o. (u s) e) use the graphs of trigonometric functions to determine values of sine, cosine and tangent for any angle. (u s) f) apply sine and cosine rules to solve real life problems. (k u s)	functions and their relationship with the unit circle iii) 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. iv) Apply the sine and cosine rules. 	Solve $\sin\theta = 0.5, \qquad 0° \leq \theta \leq 720°$ $\cos\theta = \frac{\sqrt{2}}{2}, -360° \leq \theta \leq 360°$ $\tan\theta = -1, -180° \leq \theta \leq 540°$ 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 5) 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. 6) The distance between the other two ends is 4.7 metres. Find the angle between the two poles at the point of contact.

Hint to the Teacher

1. Guide the learners to identify the signs of the trigonometrical ratios using the unit circle.
2. This topic should be taught practically.
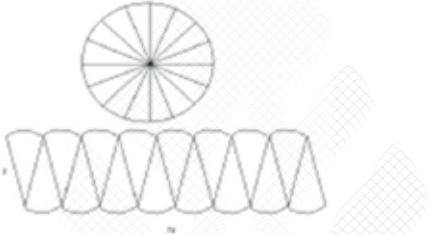3. Let learners identify where trigonometry is applied in real life.

Topic 11: Circle

Duration: 8 Hours

Overview

Learners should be able to understand, justify and apply the formulae for the area and circumference of a circle. They should also be able to understand and use circle properties to solve problems.

Competency: The learner understands, justifies and applies the formulae for the area, circumference and uses circle properties to solve problems.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
a) The learner should be able to: b) identify various parts of the Circle. (k) c) identify the line of a symmetry of the circle. d) state and use the formula for circumference and area enclosed by the circle (u).	i) 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? ii) Introduce the ratio of circumference to diameter as pi(π)	1) Observe the learners in their groups as they work out the activity below. Find out the learners' attitude towards the group work, integrity, are they doing the work in harmony?

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
e) identify arc, chord, sector and segment. (k) f) draw the tangent to the circle. (k) g) relate and compute angles subtended by an arc at the Centre and the circumference. (u, s) h) determine the angle properties of the circle. (u) i) determine and use the properties of a cyclic quadrilateral. (u, s) j) determine the length of the common	iii) How can you fit a circular cake on a rectangular plate? What are the least dimensions of the plate? iv) Apply the formulae for circumference and area enclosed by a circle in everyday contexts. Alternatively, 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 ½ ab sin C) v) 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.	2) During the process of the presentation, are learners communicating effectively? are they learning from one another? are they creative and critical? Let the learners hand in their group reports 3) The Wheels of a Bicycle have a diameter of 70cm. Taking π = 22/7, find the distance travelled by the

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
chord for two intersecting circles. (u, s) k) calculate the area of sectors and segments. (u, s, v/a)	 vi) 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. vii) Use the results above to derive and prove the properties of cyclic quadrilaterals. viii) Investigate the properties of tangents to a circle. ix) Find the length of the common chord when two circles intersect.	Bicycle when the Wheels turn through 300^0 4) (a) Given that A cm² is the area of a circle of a diameter d cm, show that $A = \pi d^2/4.$ (b) Use the formula in (a) to find the diameter of a circle of area 25cm²

Hint to the Teacher

1) Encourage learners to acquire and use mathematical sets.
2) Guide learners to discover the circle properties practically.
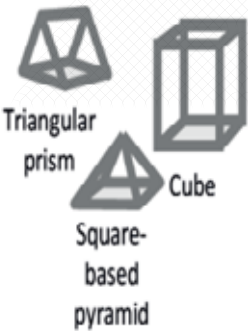3) Let learners identify where circles are applied in real life.

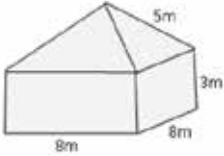# Topic 12: Nets, Areas and Volumes of Solids (Mensuration)

Duration: 7 Hours

Overview

The learner will be able to understand the nets of various solids and this will enable him/her to determine the surface areas and volumes of various solids.

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

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: a) identify common solids and their properties including faces, edges and vertices. (k) b) form nets of common solids. (u s) c) state units of measures. (k)	i) Provide learners with cardboard, packages and count the faces, edges and vertices. Dismantle to find the net. ii) •How many different nets of the following solids can they create? Triangular prism Cube Square-based pyramid • Cube • Cuboids • Square based pyramid	1) 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

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
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)	iii) 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? iv) How many different cuboids can be made from 24-unit cubes?	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.

Hint to the Teacher

1) Encourage learners to make nets of different 3-D shapes using locally available materials.

2) Let learners identify where mensuration is applied in real life.

Topic 13: Business Arithmetic 2

Duration: 6 Hours

Overview

The learner will understand the day-today usage of business mathematics in daily life. This topic should draw experience from the learner's environment. Like market places.

Competency: The learner understands and applies business mathematics when solving problems.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: a) Use a multiplier when calculating percentage change. (u, s) b) calculate compound interest using the formula. (u, s) c) understand and calculate depreciation and appreciation. (u, s)	i) Let the learners set up imaginary shops in the classroom. ii) Let the learners set the cost and selling prices. Learners can calculate the profit for each item sold. iii) When shopping which is the best saving: two for the price of one,	1) 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? 2) 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. 3) 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

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
d) understand and convert local or foreign currencies. (u, s) e) understand and calculate hire purchase. (u) f) describe and determine Mortgage of assets. (u s) g) calculate income tax given income tax bands. (u, v/a)	one third off, pay 20% tax and then have a discount of 50%, have a discount of 50% and then pay 20% tax? iv) 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?	curtains. 4) If a forex bureau buys Kenyan shilling at the rate of UGX 42 per Kenya shilling, find: 5) The amount in Uganda shillings paid out by the Bureau in exchange for K shillings 625. 6) The amount in Kenya shillings that can be exchanged for Uganda shillings 5460. 7) 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?

Hint to the Teacher

1) Guide the learners to use step –by –step approach to derive the compound interest formula.

2) Let learners visit nearby businesses like school canteen, nearby market to get real life experiences.

3) Let learners identify where business arithmetic 2 is applied in real life.
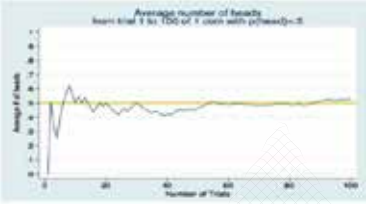
Topic 14: Probability
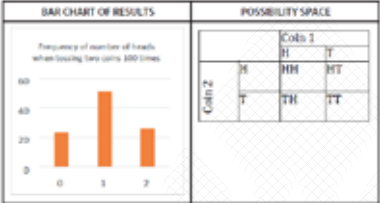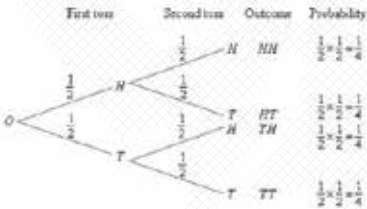
Duration: 7 Hours

Overview

This topic will help the learner to use the happenings of something in the past and present in predicting the happenings in future in order to bring out the relationship between the patterns and probability.

Competency: The learner applies his/her understanding of probability to predict events and solve a wide range of problems.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: understand the terms random, experiment, outcome, sample space, event and probability. (k, u) a) construct the probability space. (u, s) b) determine probabilities from experiments and real-life	i) Discuss the likelihood of different events and order them from impossible to certain. Introduce the probability scale from 0 to 1. impossible very unlikely unlikely even chance likely very likely certain 0 ¼ ½ ¾ 1 impossible even chance certain ii) 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, … iii) Plot a graph to show the proportion of heads after each throw.	1) Observe the learners as they work on the tasks below. 2) During the process, are learners communicating effectively? are they learning from one another? are they creative and critical? 3) 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. 4) What is the probability that she: a) gives more than UGX 200

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
data. (u, s) c) differentiate between theoretical and experimental probabilities. (k, u, s). d) identify and understand mutually exclusive and independent events. (k, u) e) use probability trees to determine the probabilities of mutually exclusive and independent events. (u, s)	 What do you notice as the number of tosses increases? iii) Distinguish experimental and theoretical probabilities iv) Play the horse race game (horses numbered 1 to 12, learners select a horse, two dice are thrown, their sum determines which horse moves) v) Use a possibility space to record the possible outcomes when two dice are thrown. vi) Toss a pair of coins 100 times and record the outcomes, compare the outcomes with the possibility space. Use the	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 5) A class has 30 girls and 40 boys. 6) 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 Teaching & Learning Activities	Sample Assessment Strategies
f) use Venn diagrams to determine probabilities. (u, s, v/a)	possibility space to determine the theoretical probabilities. vii) Use a tree diagram to determine the theoretical probabilities. viii) Apply probability in a variety of contexts including those that can be described using a Venn diagram.	7) 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?

Hint to the Teacher.

1) Teach probability concepts practically.
2) Let learners identify where probability is applied in real life.

Topic 15: Lines and Plane in Three Dimensional Geometrical Figures

Duration: 8 Hours

Overview

The learner will understand and make use of the characteristics of lines and planes in making 3-D Geometrical figures to solve societal problems

Competency: The learner understands and applies lines and planes in 3D to solve problems.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
The learner should be able to: a) apply Pythagoras theorem in 3D to calculate the distance between two points. (u, s) b) determine the angle between a line and a plane. (u,	i) 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. ii) 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.	1) Observe the learners in their groups as they discuss how to work out the activity below. Find out the learners' attitude towards the group work, integrity, are they doing the work in harmony? 2) During the process of the presentation, are learners communicating effectively? are they learning from one another? are they creative and critical? 3) Let the learners hand in their group work for marking.

Learning Outcomes	Suggested Teaching & Learning Activities	Sample Assessment Strategies
s) c) determine the angle between two planes. (u, s)	iii) 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? iv) What is the angle between the triangular faces and the square face? What is the angle between the triangular faces?	4) 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 60^0 to the horizontal. Calculate the height of the top of each stay and the length of a side of the square

Hint to the Teacher

1) Encourage learners to make nets and models of different 3-D shapes.
2) Emphasis should be put on use of right-angled triangle.
3) Let learners identify where three dimensional geometry is applied in real life.

Assessment

Assessing the New Expectations for Learning

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

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

It is not possible to assess values/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 values/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.

Knowledge	The retention of information.
Understanding	Putting knowledge into a framework of meaning –
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.

Each has its own implications for learning and assessment.

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.

The assessment of k,u,s,v/a is elaborated in the graphics below;

Knowledge	Understanding
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.	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.
Skills	**Values and Attitudes**
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.	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. Some skills, such as speaking or a physical education skill do not have a product so need to be observed.

Examinations

There will be examinations and tests set at the end of every level. 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 formative assessment to make some change to the teaching and learning process. 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:

i)   What needs to be learned next

ii) Whether an element of the syllabus needs to be taught again in a different way

iii) Changing teaching approaches if necessary

iv) Identifying learners who need more support, or who are making exceptional progress

v)   Enabling learners to understand what they have to do to improve

The final examination at the end of Cycle 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:

i)   The syllabus set out the learning outcomes

ii) The lessons seek to achieve these outcomes

iii) Assessment finds out whether or not the outcomes has been achieved

iv) 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:
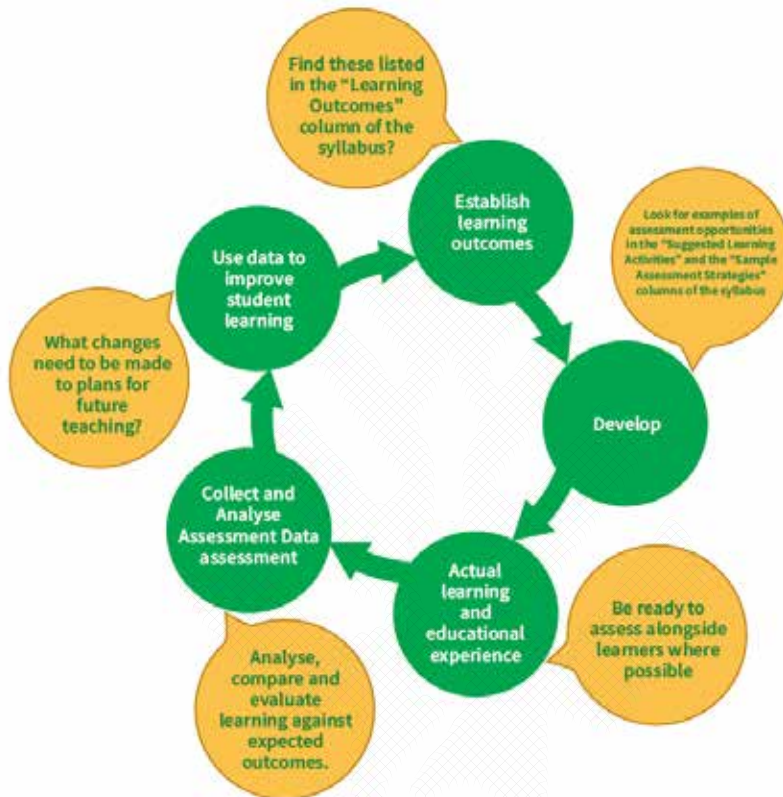
Formative assessment involves using all parts of the cycle

How to carryout formative assessments

In the AEP 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 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:

i) Observation – watching learners working (good for assessing skills and values)

ii) Conversation – asking questions , talking to learners, and learner to learner interactions (good for assessing knowledge and understanding)

iii) 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".
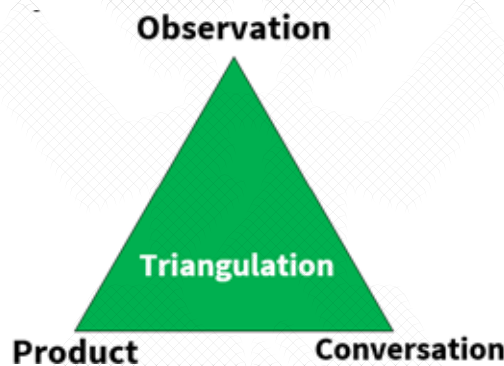
Triangulation of assessment opportunities.

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.

Generic Skills

The Generic Skills have been built into the syllabus 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 learners. 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 topic. 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:

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 Topic.

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 topic'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 topic assessments by subject in terms of the 3 descriptors. If numbers (1-3) are used as identifiers, then it will be possible to arrive at an overall number for a level by aggregating the identifiers for each topic.

Descriptor	Identifier
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-topic assessment for **five** learners.

	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	1	1	2	1	1	1	1	1	1	1

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 D & E. 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 1.

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

This summative teacher assessment will contribute 20% to the final grade of the School Leaving Certificate as elaborated in the Assessment Framework.

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 learners' 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.
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, understand, or be able to do within a particular aspect of a subject within a particular aspect of a subject.
Process Skill	A capability acquired by following the programme of study in a particular subject; enables a learner to apply the knowledge and understanding of the subject.
Sample Assessment Strategy	A strategy which gives a learner the opportunity to show the extent 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.

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