



**education**

Department:  
Education  
REPUBLIC OF SOUTH AFRICA

# **NATIONAL CERTIFICATES (VOCATIONAL)**

## **ASSESSMENT GUIDELINES**

### **MATHEMATICS**

### **NQF Level 3**

September 2007



# MATHEMATICS – LEVEL 3

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## SECTION A: PURPOSE OF THE SUBJECT ASSESSMENT GUIDELINES

This document provides the lecturer with guidelines to develop and implement a coherent, integrated assessment system for Mathematics in the National Certificates (Vocational). It must be read with the *National Policy Regarding Further Education and Training Programmes: Approval of the Documents, Policy for the National Certificates (Vocational) Qualifications at Levels 2 to 4 on the National Qualifications Framework (NQF)*. This assessment guideline will be used for National Qualifications Framework Levels 2-4.

This document explains the requirements for the internal and external subject assessment. The lecturer must use this document with the *Subject Guidelines: Mathematics Level 3* to prepare for and deliver Mathematics. Lecturers should use a variety of resources and apply a range of assessment skills in the setting, marking and recording of assessment tasks.

## SECTION B: ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

### 1 ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

Assessment in the National Certificates (Vocational) is underpinned by the objectives of the National Qualifications Framework (NQF). These objectives are to:

- Create an integrated national framework for learning achievements.
- Facilitate access to and progression within education, training and career paths.
- Enhance the quality of education and training.
- Redress unfair discrimination and past imbalances and thereby accelerate employment opportunities.
- Contribute to the holistic development of the student by addressing:
  - social adjustment and responsibility;
  - moral accountability and ethical work orientation;
  - economic participation; and
  - nation-building.

The principles that drive these objectives are:

- **Integration**

To adopt a unified approach to education and training that will strengthen the human resources development capacity of the nation.

- **Relevance**

To be dynamic and responsive to national development needs.

- **Credibility**

To demonstrate national and international value and recognition of qualification and acquired competencies and skills.

- **Coherence**

To work within a consistent framework of principles and certification.

- **Flexibility**

To allow for creativity and resourcefulness when achieving Learning Outcomes, to cater for different learning styles and use a range of assessment methods, instruments and techniques.

- **Participation**

To enable stakeholders to participate in setting standards and co-ordinating the achievement of the qualification.

- **Access**

To address barriers to learning at each level to facilitate students' progress.

- **Progression**

To ensure that the qualification framework permits individuals to move through the levels of the national qualification via different, appropriate combinations of the components of the delivery system.

- **Portability**

To enable students to transfer credits of qualifications from one learning institution and/or employer to another.

- **Articulation**

To allow for vertical and horizontal mobility in the education system when accredited pre-requisites have been successfully completed.

- **Recognition of Prior Learning**

To grant credits for a unit of learning following an assessment or if a student possesses the capabilities specified in the outcomes statement.

- **Validity of assessments**

To ensure assessment covers a broad range of knowledge, skills, values and attitudes (SKVAs) needed to demonstrate applied competency. This is achieved through:

- clearly stating the outcome to be assessed;
- selecting the appropriate or suitable evidence;
- matching the evidence with a compatible or appropriate method of assessment; and
- selecting and constructing an instrument(s) of assessment.

Topics should be assessed individually and then cumulatively with other topics. There should be a final summative internal assessment prior to the external assessment.

- **Reliability**

To assure that assessment practices are consistent so that the same result or judgment is arrived at if the assessment is replicated in the same context. This demands consistency in the interpretation of evidence; therefore, careful monitoring of assessment is vital.

- Cumulative and summative assessments must be weighted more than single topic tests for the internal mark.
- There should be at least one standardised or norm test in each trimester.
- All standardised or norm tests must be moderated by a subject specialist.

- **Fairness and transparency**

To verify that no assessment process or method(s) hinders or unfairly advantages any student. The following could constitute unfairness in assessment:

- Inequality of opportunities, resources or teaching and learning approaches
- Bias based on ethnicity, race, gender, age, disability or social class
- Lack of clarity regarding Learning Outcome being assessed
- Comparison of students' work with other students, based on learning styles and language

Assessment in Mathematics must take into consideration that the process or method carries more weight than the final answer.

- **Practicability and cost-effectiveness**

To integrate assessment practices within an outcomes-based education and training system and strive for cost and time-effective assessment.

## 2 ASSESSMENT FRAMEWORK FOR VOCATIONAL QUALIFICATIONS

The assessment structure for the National Certificates (Vocational) qualification is as follows:

### 2.1 Internal continuous assessment (ICASS)

Knowledge, skills values, and attitudes (SKVAs) are assessed throughout the year using assessment instruments such as projects, tests, assignments, investigations, role-play and case studies. The internal continuous assessment (ICASS) practical component is undertaken in a real workplace, a workshop or a

“Structured Environment”. This component is moderated internally and externally quality assured by Umalusi. All internal continuous assessment (ICASS) evidence is kept in a Portfolio of Evidence (PoE) and must be readily available for monitoring, moderation and verification purposes.

## **2.2 External summative assessment (ESASS)**

The external summative assessment is either a single or a set of written papers set to the requirements of the Subject Learning Outcomes. The Department of Education administers the theoretical component according to relevant assessment policies.

External summative assessments will be conducted annually between October and December, with provision made for supplementary sittings.

## **3 MODERATION OF ASSESSMENT**

### **3.1 Internal moderation**

Assessment must be moderated according to the internal moderation policy of the Further Education and Training (FET) college. Internal college moderation is a continuous process. The moderator’s involvement starts with the planning of assessment methods and instruments and follows with continuous collaboration with and support to the assessors. Internal moderation creates common understanding of Assessment Standards and maintains these across vocational programmes.

### **3.2 External moderation**

External moderation is conducted by the Department of Education, Umalusi and, where relevant, an Education and Training Quality Assurance (ETQA) body according to South African Qualifications Authority (SAQA) and Umalusi standards and requirements.

The external moderator:

- monitors and evaluates the standard of all summative assessments;
- maintains standards by exercising appropriate influence and control over assessors;
- ensures proper procedures are followed;
- ensures summative integrated assessments are correctly administered;
- observes a minimum sample of ten (10) to twenty-five (25) percent of summative assessments;
- gives written feedback to the relevant quality assurer; and
- moderates in case of a dispute between an assessor and a student.

Policy on inclusive education requires that assessment procedures for students who experience barriers to learning be customised and supported to enable these students to achieve their maximum potential.

## **4 PERIOD OF VALIDITY OF INTERNAL CONTINUOUS ASSESSMENT (ICASS)**

The period of validity of the internal continuous assessment mark is determined by the *National Policy on the Conduct, Administration and Management of the Assessment of the National Certificates (Vocational)*.

The internal continuous assessment (ICASS) must be re-submitted with each examination enrolment for which it constitutes a component.

## **5 ASSESSOR REQUIREMENTS**

Assessors must be subject specialists and should ideally be declared competent against the standards set by the ETDP SETA. If the lecturer conducting the assessments has not been declared a competent assessor, an assessor who has been declared competent may be appointed to oversee the assessment process to ensure the quality and integrity of assessments.

## **6 TYPES OF ASSESSMENT**

Assessment benefits the student and the lecturer. It informs students about their progress and helps lecturers make informed decisions at different stages of the learning process. Depending on the intended purpose, different types of assessment can be used.

### 6.1 Baseline assessment

At the beginning of a level or learning experience, baseline assessment establishes the knowledge, skills, values and attitudes (SKVAs) that students bring to the classroom. This knowledge assists lecturers to plan learning programmes and learning activities.

### 6.2 Diagnostic assessment

This assessment diagnoses the nature and causes of learning barriers experienced by specific students. It is followed by guidance, appropriate support and intervention strategies. This type of assessment is useful to make referrals for students requiring specialist help.

### 6.3 Formative assessment

This assessment monitors and supports teaching and learning. It determines student strengths and weaknesses and provides feedback on progress. It determines if a student is ready for summative assessment.

### 6.4 Summative assessment

This type of assessment gives an overall picture of student progress at a given time. It determines whether the student is sufficiently competent to progress to the next level.

## 7 PLANNING ASSESSMENT

An assessment plan should cover three main processes:

### 7.1 Collecting evidence

The assessment plan indicates which Subject Outcomes and Assessment Standards will be assessed, what assessment method or activity will be used and when this assessment will be conducted.

### 7.2 Recording

Recording refers to the assessment instruments or tools with which the assessment will be captured or recorded. Therefore, appropriate assessment instruments must be developed or adapted.

### 7.3 Reporting

All the evidence is put together in a report to deliver a decision for the subject.

## 8 METHODS OF ASSESSMENT

Methods of assessment refer to who carries out the assessment and includes lecturer assessment, self-assessment, peer assessment and group assessment.

<b>LECTURER ASSESSMENT</b>	The lecturer assesses students' performance against given criteria in different contexts, such as individual work, group work, etc.
<b>SELF-ASSESSMENT</b>	Students assess their own performance against given criteria in different contexts, such as individual work, group work, etc.
<b>PEER ASSESSMENT</b>	Students assess another student's or group of students' performance against given criteria in different contexts, such as individual work, group work, etc.
<b>GROUP ASSESSMENT</b>	Students assess the individual performance of other students within a group or the overall performance of a group of students against given criteria.

## 9 INSTRUMENTS AND TOOLS FOR COLLECTING EVIDENCE

All evidence collected for assessment purposes is kept or recorded in the student's Portfolio of Evidence (PoE).

The following table summarises a variety of methods and instruments for collecting evidence. A method and instrument is chosen to give students ample opportunity to demonstrate that the Subject Outcome has been attained. This will only be possible if the chosen methods and instruments are appropriate for the target group and the Specific Outcome being assessed.

	METHODS FOR COLLECTING EVIDENCE		
	Observation-based (Less structured)	Task-based (Structured)	Test-based (More structured)
<b>Assessment instruments</b>	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Class questions</li> <li>• Lecturer, student, parent discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Investigations or research</li> <li>• Case studies</li> <li>• Practical exercises</li> <li>• Demonstrations</li> <li>• Role-play</li> <li>• Interviews</li> </ul>	<ul style="list-style-type: none"> <li>• Examinations</li> <li>• Class tests</li> <li>• Practical examinations</li> <li>• Oral tests</li> <li>• Open-book tests</li> </ul>
<b>Assessment tools</b>	<ul style="list-style-type: none"> <li>• Observation sheets</li> <li>• Lecturer's notes</li> <li>• Comments</li> </ul>	<ul style="list-style-type: none"> <li>• Checklists</li> <li>• Rating scales</li> <li>• Rubrics</li> </ul>	<ul style="list-style-type: none"> <li>• Marks (e.g. %)</li> <li>• Rating scales (1-7)</li> </ul>
<b>Evidence</b>	<ul style="list-style-type: none"> <li>• Focus on individual students</li> <li>• Subjective evidence based on lecturer observations and impressions</li> </ul>	<p><b>Open middle:</b> Students produce the same evidence but in different ways.</p> <p><b>Open end:</b> Students use same process to achieve different results.</p>	Students answer the same questions in the same way, within the same time.

## 10 TOOLS FOR ASSESSING STUDENT PERFORMANCE

**Rating scales** are marking systems where a symbol (such as 1 to 7) or a mark (such as 5/10 or 50%) is defined in detail. The detail is as important as the coded score. Traditional marking, assessment and evaluation mostly used rating scales without details such as what was right or wrong, weak or strong, etc.

**Task lists** and **checklists** show the student what needs to be done. They consist of short statements describing the expected performance in a particular task. The statements on the checklist can be ticked off when the student has adequately achieved the criterion. Checklists and task lists are useful in peer or group assessment activities.

**Rubrics** provide a hierarchy (graded levels) of criteria with benchmarks that describe the minimum level of acceptable performance or achievement for each criterion. Use of rubrics provide a different way of assessing that cannot be compared to tests. Each criterion described in the rubric must be assessed separately. Mainly two types of rubrics, namely holistic and analytical, are used.

## 11 SELECTING AND/OR DESIGNING RECORDING AND REPORTING SYSTEMS

The selection or design of recording and reporting systems depends on the purpose of recording and reporting student achievement. **Why** particular information is recorded and **how** it is recorded determine which instrument will be used.

Computer-based systems, for example spreadsheets, are cost and time effective. The recording system should be user-friendly and information should be easily accessed and retrieved.

## 12 COMPETENCE DESCRIPTIONS

All assessment should award marks to evaluate specific assessment tasks. However, marks should be awarded against rubrics and not simply be a total of ticks for right answers. Rubrics should explain the competence level descriptors for the skills, knowledge, values and attitudes (SKVAs) that a student must demonstrate to achieve each level of the rating scale.

When lecturers or assessors prepare an assessment task or question, they must ensure that the task or question addresses an aspect of a Subject Outcome. The relevant Assessment Standard must be used to create the rubric to assess the task or question. The descriptions must clearly indicate the minimum level of attainment for each category on the rating scale.



### 13 STRATEGIES FOR COLLECTING EVIDENCE

A number of different assessment instruments may be used to collect and record evidence. Examples of instruments that can be (adapted and) used in the classroom include:

#### 13.1 Record sheets

The lecturer observes students working in a group. These observations are recorded in a summary table at the end of each project. The lecturer can design a record sheet to observe students' interactive and problem-solving skills, attitudes towards group work and involvement in a group activity.

#### 13.2 Checklists

Checklists should have clear categories to ensure that the objectives are effectively met. The categories should describe how the activities are evaluated and against what criteria they are evaluated. Space for comments is essential.

## SECTION C: ASSESSMENT IN MATHEMATICS

### 1 SCHEDULE OF ASSESSMENT

At NQF levels 2, 3 and 4, lecturers will conduct assessments as well as develop a schedule of formal assessments that will be undertaken in the year. All three levels also have an external examination that accounts for 75 percent of the total mark. The marks allocated to assessment tasks completed during the year, kept or recorded in a Portfolio of Evidence (PoE) account for the other 25 percent.

The Portfolio of Evidence (PoE) and the external assessment include practical and written components. The practical assessment in Mathematics, must, where necessary, be subjected to external moderation by Umalusi or an appropriate Education and Training Quality Assurance (ETQA) body, appointed by the Umalusi Council in terms of Section 28(2) of the *General and Further Education and Training Quality Assurance Act, 2001 (Act No. 58 of 2001)*.

### 14 RECORDING AND REPORTING

Mathematics is assessed according to seven levels of competence. The level descriptions are explained in the following table.

#### ***Scale of achievement for the Fundamental component***

RATING CODE	RATING	MARKS (%)
7	Outstanding	80 – 100
6	Meritorious	70 – 79
5	Substantial	60 – 69
4	Adequate	50 – 59
3	Moderate	40 – 49
2	Elementary	30 – 39
1	Not achieved	0 – 29

The programme of assessment should be recorded in the Lecturer's Portfolio of Assessment for each subject. The following should at least be included in the Lecturer's Assessment Portfolio:

- A contents page
- The formal schedule of assessment
- The requirements for each assessment task
- The tools used for each assessment task
- Recording instrument(s) for each assessment task
- A mark sheet and report for each assessment task

The college must standardise these documents.

The student's Portfolio of Evidence (PoE) must at least include:

- A contents page
- The assessment tasks according to the assessment schedule
- The assessment tools or instruments for the task
- A record of the marks (and comments) achieved for each task

Where a task cannot be contained as evidence in the Portfolio of Evidence (PoE), its exact location must be recorded and it must be readily available for moderation purposes.

The following internal assessment units guide the assessment of Mathematics:

<b>NUMBER OF UNITS</b>	<b>ASSESSMENT</b>	<b>COVERAGE</b>
3	Formal written tests	One or more completed topics
1	Internal written examination	All completed topics
4	Practical assessment	The related Subject Outcomes, for example: <ol style="list-style-type: none"><li>1. Analysis demographics of the community to test applicability of a new product.</li><li>2. Work out a personal budget and find out where savings can best be invested.</li><li>3. Construct at least three models of solids and calculate their total surface area and volume.</li><li>4. Choose the national flag of a country or a favourite sports flag and discuss all the axes of symmetry, reflection and transformation that can be demonstrated in the flag</li></ol>

**ASSESSMENT OF MATHEMATICS**  
**LEVEL 3**

### 3 INTERNAL ASSESSMENT OF OUTCOMES IN MATHEMATICS - LEVEL 3

#### 3.1 Topics for Mathematics

##### Topic 1: Complex numbers

SUBJECT OUTCOME	
<b>1.1 Represent complex numbers in a form appropriate to the context.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Complex numbers are represented in a form appropriate to context. <i>RANGE: Standard, polar and Argand diagrams.</i>	<ul style="list-style-type: none"> <li>• Represent complex numbers in standard and polar form.</li> <li>• Construct Argand diagrams.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>	

SUBJECT OUTCOME	
<b>1.2 Perform operations on complex numbers.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Operations are performed on complex numbers. <i>RANGE: addition, subtraction, multiplication, division and raising to a power</i>	<ul style="list-style-type: none"> <li>• Perform addition, subtraction, multiplication and division on complex numbers in standard and polar form.</li> <li>• Use De Moivre's theorem to raise complex numbers to powers.</li> <li>• Execute algorithms correctly and appropriately to do calculations.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>• Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>	

SUBJECT OUTCOME	
<b>1.3 Solve problems using complex numbers.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Problems are solved using complex numbers. <i>RANGE: To include non-real solution of equations.</i>	<ul style="list-style-type: none"> <li>• Represent complex numbers in a form appropriate to the context.</li> <li>• Perform operations of various forms of complex numbers consistently.</li> <li>• Use complex numbers to solve problems which cannot be solved using the real number system.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> <li>• Project of application to their field</li> </ul>	

**Topic 2: Functions**

SUBJECT OUTCOME	
<b>2.1 Use a variety of techniques to sketch and interpret information from graphs of functions.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
<p>A variety of techniques are used to sketch and interpret information from graphs of functions <i>RANGE: Point by point plotting. Characteristic identification such as domain, range, axis of symmetry and turning point. Differential calculus is used.</i></p>	<ul style="list-style-type: none"> <li>Work with several types of functions including:  <math>y = \sin(kx); y = \cos(kx); y = \tan(kx); y = \sin(x + p); y = \cos(x + p);</math>  <math>y = \tan(x + p); y = a(x + p)^2; y = a(x + p)^2 + q; y = ax^2 + bx + c, y = \frac{a}{(x + p)} + q;</math>  <math>y = ab^{x+p} + q, (b &gt; 0); y = ax^3 + bx^2 + cx + d</math></li> <li>NB. The cubic function should only be done once differential calculus has been done.</li> <li>Generate graphs (including those stated above) by means of point by point plotting, supported by available technology.</li> <li>Generalize the effects of the parameters <math>k, p, a</math> and <math>q</math> on the graphs of the above mentioned functions.</li> <li>Identify and use the following characteristics to sketch graphs of the above mentioned functions: domain and range, intercepts with axes, turning points minima and maxima, asymptotes, shape and symmetry, periodicity and amplitude, average gradient or rate of change, and intervals on which the function increases or decreases.</li> <li>Understand and be able to describe the discrete and continuous nature of graphs.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOMES	
<b>2.2 Manipulate and simplify algebraic expressions.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
<ul style="list-style-type: none"> <li>A variety of techniques are used to sketch and interpret information from graphs of functions <i>RANGE: Point by point plotting. Characteristic identification such as domain, range, axis of symmetry and turning point. Differential calculus is used.</i></li> <li>Algebraic Expressions are manipulated and simplified.</li> </ul>	<ul style="list-style-type: none"> <li>Manipulate algebraic expressions by completing the square.</li> <li>Simplify algebraic fractions with binomial denominators.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOMES	
<b>2.3 Solve algebraic equations and inequalities</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
<p>Algebraic Equations and inequalities are solved <i>RANGE: Factorizing, completing the square, quadratic formula, simultaneous equations and graphical solutions</i></p>	<ul style="list-style-type: none"> <li>Solve quadratic equations by factorization, completion of the square and by using the quadratic formula.</li> <li>Solve quadratic inequalities in one variable and be able to graph the solution.</li> <li>Solve simultaneous equations in two unknowns algebraically and graphically; where the one equation is linear and the other equation is quadratic.</li> </ul>

<b>ASSESSMENT TASKS OR ACTIVITIES</b>
<ul style="list-style-type: none"> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>

<b>SUBJECT OUTCOMES</b>	
<b>2.4 Use Mathematical models to investigate problems that arise in a real-life context.</b>	
<b>ASSESSMENT STANDARD</b>	<b>LEARNING OUTCOME</b>
<ul style="list-style-type: none"> <li>• Conjectures are made, demonstrated and the validity is proved.</li> <li>• Mathematical generalizations of situations are expressed and justified.</li> <li>• Various representations are used to interpolate and extrapolate.</li> <li>• Situations are described by interpreting a graph and focusing on trends and pertinent features.</li> <li>• Graphs are drawn from descriptions of situations which focus on trends and pertinent features</li> <li>• Generalizations are expressed in symbolic form appropriate to the situation.</li> <li>• Conjectures are supported with acceptable arguments and generalizations by coherent reasons.</li> <li>• The average gradient between two points on a curve are investigated numerically and an intuitive understanding of gradient developed</li> </ul>	<ul style="list-style-type: none"> <li>• Make, demonstrate and prove the validity of conjectures.</li> <li>• Express mathematical generalizations of situations and justify them.</li> <li>• Use various representations to interpolate and extrapolate.</li> <li>• Describe a situation by interpreting a graph especially focussing on trends and pertinent features.</li> <li>• Draw graphs from descriptions of situations which focus on trends and pertinent features.</li> <li>• Express generalizations in symbolic form appropriate to the situation.</li> <li>• Support conjectures with acceptable arguments. Claims where generalizations are not possible must be supported by coherent reasons.</li> <li>• Investigate the average gradient between two points on a curve numerically to develop an intuitive understanding of the concept of the gradient of a curve at a point.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>	

<b>SUBJECT OUTCOMES</b>	
<b>2.5 Use Mathematical models to investigate linear programming problems.</b>	
<b>ASSESSMENT STANDARD</b>	<b>LEARNING OUTCOME</b>
<p>Mathematical models are used to investigate problems that arise in the real-life context.</p> <p>RANGE: To include linear programming problems, creation of equations from situations and the sketching of curves from equations</p>	<ul style="list-style-type: none"> <li>• Optimize a function in two variables, subject to one or more linear constraints by creating a feasible region and conducting a boundary search.</li> <li>• Solve a system of linear equations in order to find the vertices of a feasible region.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>	

SUBJECT OUTCOME	
<b>2.6 Determine limits of functions through an intuitive understanding of limits.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Limits of functions are determined through an intuitive understanding of limits.	<ul style="list-style-type: none"> <li>Determine limits of functions intuitively.</li> <li>Distinguish between the value of a function at a particular point and the limit of that function at that point.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOME	
<b>2.7 Determine the derivative from first principles.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
The derivative is determined by first principles. <i>RANGE: The derivatives must be understood in terms of the gradient of a curve and instantaneous rate of change.</i>	<ul style="list-style-type: none"> <li>Interrelate in a meaningful way, graphical, numerical and symbolic representations of the process of determining the derivative in an intuitive way.</li> <li>Apply first principles correctly.</li> <li>Do the necessary algebraic manipulations accurately.</li> <li>Use notation appropriately.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOME	
<b>2.8 Find derivatives using the rules for differentiation.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Derivatives are found using the rules. <i>RANGE: First and second derivatives are found using constant, sum, difference, product, quotient and chain rules.</i>	<ul style="list-style-type: none"> <li>Use correctly the constant, sum, difference, product, quotient and chain rules for differentiation.</li> <li>Use notation appropriately.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOME	
<b>2.9 Use derivatives to solve problems of both Mathematical and real-life situations.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Derivatives are used to solve problems of both Mathematical and real life situations. <i>RANGE: Sketch curves, solve rate of change problems and find equations of tangents to graphs.</i>	<ul style="list-style-type: none"> <li>• Differentiate correctly.</li> <li>• Find the tangent to the graph at a point correctly.</li> <li>• Solve maxima and minima problems about real-life situations.</li> <li>• Draw graphs, including those of cubic functions, using differentiation, maxima and minima, and interpret graphs.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>	

### Topic 3: Space, shape and orientation

SUBJECT OUTCOME	
<b>3.1 Use and learn formula for area and volume</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Formula for area and volume are used and learnt. <i>RANGE: Right pyramids, right cones, spheres and combinations of these are included</i>	Determine and calculate the surface area and volume of right pyramids, right cones, spheres and combinations of these geometric objects.
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>• Practical tasks in groups with actual objects.</li> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>	

SUBJECT OUTCOME	
<b>3.2 Investigate necessary and sufficient conditions for similarity of polygons.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Necessary and sufficient conditions for similarity of polygons are investigated. <i>RANGE: Midpoint theorem, equilateral triangles, triangles in the same proportion and the Pythagorean theorem by similar triangles are included.</i>	<ul style="list-style-type: none"> <li>• Carry out an investigation to prove the Mid-point theorem.</li> <li>• Carry out investigations and prove that equilateral triangles are similar.</li> <li>• Carry out investigations and prove that triangles with sides in proportion are similar.</li> <li>• Carry out investigations and prove Pythagoras' Theorem using similar triangles.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>• Investigations</li> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>	



SUBJECT OUTCOME	
<b>3.3 Use the Cartesian co-ordinate system to derive and apply equations.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
The Cartesian co-ordinate system is used to derive and apply equations. <i>RANGE: To include lines through two given points, lines through one point and parallel or perpendicular to another line, and the inclination of lines.</i>	<ul style="list-style-type: none"> <li>Use the Cartesian co-ordinate system to derive the equation of a line through two given points.</li> <li>Use the Cartesian co-ordinate system to derive the equation of a line parallel or perpendicular to another line.</li> <li>Use the Cartesian co-ordinate system to derive and use the inclination of a line.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOME	
<b>3.4 Investigate, generalize and apply the effect of transformations on the co-ordinates</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
The effect on the coordinates is investigated, generalized and applied. <i>RANGE: rotation about <math>0^\circ, 90^\circ</math> and <math>180^\circ</math> and enlargement through the origin by a constant <math>k</math> are to be included.</i>	<ul style="list-style-type: none"> <li>Investigate, generalize and apply the effect on the co-ordinates of the point <math>(x; y)</math> after rotation about the origin through an angle of <math>90^\circ</math> or <math>180^\circ</math>.</li> <li>Investigate, generalize and apply the effect on the vertices <math>(x_1; y_1), (x_2; y_2) \dots (x_n; y_n)</math> of a polygon after enlargement through the origin by a constant factor <math>k</math>.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Investigations</li> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOME	
<b>3.5 Derive and use special angles in calculations.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Special angles are derived and their values used in calculations. <i>RANGE: <math>30^\circ, 45^\circ</math>, and <math>60^\circ</math>.</i>	<ul style="list-style-type: none"> <li>Find values of the trigonometric functions of <math>30^\circ, 45^\circ</math> and <math>60^\circ</math> using the definitions of trigonometric functions and leaving the answers in surd form.</li> <li>Use these special angles in calculations.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOME	
<b>3.6 Derive and use quotient and squares trigonometric identities.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Quotient and squares identities are derived and used.	<ul style="list-style-type: none"> <li>Simplify expressions using these trigonometric identities.</li> <li>Prove more complicated identities using these identities.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOME	
<b>3.7 Derive and use reduction formula to simplify trigonometric expressions.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Reduction formula are derived and used to simplify trigonometric expressions and solve trigonometric equations. <i>RANGE: Includes general solutions.</i>	<ul style="list-style-type: none"> <li>Derive reduction formula for the six trigonometric equations for: <math>(0^\circ \pm \theta)</math>, <math>(90^\circ \pm \theta)</math>, <math>(180^\circ \pm \theta)</math>, <math>(270^\circ \pm \theta)</math>, and <math>(360^\circ \pm \theta)</math>.</li> <li>Determine the general solution of trigonometric equations.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

SUBJECT OUTCOME	
<b>3.8 Establish and use the area, sine and cosine rule to solve real life problems.</b>	
ASSESSMENT STANDARD	LEARNING OUTCOME
Area, sine, and cosine rule are established and used to solve real-life problems.	<ul style="list-style-type: none"> <li>Construct geometric and trigonometric models.</li> <li>Solve problems in 2- and 3- dimensions using the area, sine and cosine rules.</li> <li>Perform an investigative project on the history of Geometry and Trigonometry in different cultures through history.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Investigations</li> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

**Topic 4: Statistical and probability models**

<b>SUBJECT OUTCOME</b>	
<b>4.1 Calculate and represent measures of central tendency and dispersion in univariate numerical data</b>	
<b>ASSESSMENT STANDARD</b>	<b>LEARNING OUTCOME</b>
Measures of central tendency and dispersion in univariate numerical data are calculated and represented. <i>RANGE: Five number summary, box and whisker diagrams, ogives, calculating variance and standard deviation, and representing results graphically.</i>	Calculate and represent measures of central tendency and dispersion in the following 4 ways: <ul style="list-style-type: none"> <li>• five number summary including maximum, minimum and quartiles,</li> <li>• box and whisker diagrams,</li> <li>• ogives,</li> <li>• calculation and graphical representation using histograms and frequency polygons of the variance and standard deviation manually (for small sets of data) and using available technology like a computer (for large sets of data).</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Research Project</li> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>4.2 Pose questions, collect and organize data</b>	
<b>ASSESSMENT STANDARD</b>	<b>LEARNING OUTCOME</b>
Questions are posed and data is collected and organized. <i>RANGE: Appropriate situations, identification of variables, efficient collection and organization of data and adequate population sizes are used.</i>	<ul style="list-style-type: none"> <li>• Identify situations or issues that can be dealt with through statistical methods.</li> <li>• Use appropriate and efficient methods to collect, record and organize data.</li> <li>• Establish data samples of adequate size and which are representative of the population.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Research Project and Demonstration</li> <li>• Practical Exercises</li> <li>• Assignments</li> <li>• Test</li> <li>• Examination</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>4.3 Analyse and interpret data using various techniques.</b>	
<b>ASSESSMENT STANDARD</b>	<b>LEARNING OUTCOME</b>
Data is analyzed and interpreted using various techniques. <i>RANGE:</i> <ul style="list-style-type: none"> <li>graphical representation and numerical summaries,</li> <li>different aspects are calculated from the same data,</li> <li>verbal explanations and interpretations are justified by data and used to answer questions, and</li> <li>new questions arise from the modeling of data discussed.</li> </ul>	<ul style="list-style-type: none"> <li>Make graphical representations and numerical summaries which are consistent with the data, and clear and appropriate to the situation and target audience.</li> <li>Take a position on an issue by comparing different representations of data.</li> <li>Do calculations and use statistics in a way that is appropriate to the problem that is posed.</li> <li>Justify and apply statistics to answer questions about problems.</li> <li>Discuss new questions that arise from the modelling of data.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Research Project and demonstration</li> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

#### Topic 5: Financial Mathematics

<b>SUBJECT OUTCOME</b>	
<b>5.1 Apply mathematical knowledge and skills to plan personal finances and investigate opportunities for entrepreneurship</b>	
<b>ASSESSMENT STANDARD</b>	<b>LEARNING OUTCOME</b>
<ul style="list-style-type: none"> <li>Income and Expenditure sheets and budgets are completed for personal and social club finances.</li> <li>Simple and compound interests are used to make sense of and define a variety of situations.</li> </ul>	<ul style="list-style-type: none"> <li>Complete Income and Expenditure sheets and budgets for personal and social club finances.</li> <li>Simple and compound interests are used to make sense of and define a variety of situations.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Projects</li> <li>Practical Exercises</li> <li>Assignments</li> <li>Test</li> <li>Examination</li> </ul>	

#### 4 SPECIFICATIONS FOR EXTERNAL ASSESSMENT IN MATHEMATICS - LEVEL 3

A national examination is conducted annually in October or November each year by means of two three hour examination papers set externally and marked and moderated externally. The content covered in each is described in *Subject Guidelines Mathematics Level 3*. The level 3 papers will be structured as follows:

<b>LEVEL 3</b>	<b>KNOWLEDGE AND COMPREHENSION</b>	<b>APPLICATION</b>	<b>ANALYSIS, SYNTHESIS AND EVALUATION</b>
	25%	50%	25%

Details in respect of relative weightings of the topics are contained in *Subject Guidelines Mathematics Level 3*.