education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

MATHEMATICS

NQF Level 4

September 2007

MATHEMATICS – LEVEL 4

CONTENTS

INTRODUCTION

A. What is Mathematics?

Reader's Digest Oxford Complete Wordfinder defines Mathematics as "the abstract science of number, quantity and space studied in its own right".

Mathematics enables creative and logical reasoning about problems in the physical and social world and in the context of Mathematics itself. Through mathematical problem solving, students can understand the world and use that understanding in their daily lives.

Knowledge in the mathematical sciences is constructed through the establishment of descriptive, numerical and symbolic relationships. The Mathematics Subject Outcomes and Assessment Standards are designed to allow all Further Education and Training (FET) (Vocational) students to develop into citizens who confidently deal with mathematics as and when it impinges on their daily lives, their community and the world in general. Mathematics in the Further Education and Training band also provides a platform to link with Higher Education.

B. Why is Mathematics important as a Fundamental?

The Mathematics programme (NQF Level 2 – 4) empowers students to:

- Communicate appropriately using descriptions in words, graphs, symbols, tables and diagrams.
- Use mathematical process skills to identify, pose and solve problems creatively and critically.
- Organise, interpret and manage authentic activities in substantial mathematical ways that demonstrate responsibility and sensitivity to personal and broader societal concerns.
- Work collaboratively in teams and groups to enhance mathematical understanding.
- Collect, analyse and organise quantitative data to evaluate and comment on conclusions.
- Engage responsibly with quantitative arguments relating to local, national and global issues.

C. The link between Mathematics Learning Outcomes and the Critical and Developmental Outcomes

The Mathematics Learning Outcomes provide a platform for students to achieve the seven Critical Outcomes and five Developmental Outcomes.

The Critical Outcomes require students to be able to:

- Identify and solve problems and make decisions using critical and creative thinking.
- Work effectively with others as members of a team, group, organisation and community.
- Organise and manage themselves and their activities responsibly and effectively.
- Collect, analyse, organise and critically evaluate information.
- Communicate effectively using visual, symbolic and/or language skills in various modes.
- Use science and technology effectively and critically showing responsibility towards the environment and the health of others.
- Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

The Developmental Outcomes require students to be able to:

- Reflect on and explore a variety of strategies to learn more effectively.
- Participate as responsible citizens in the life of local, national and global communities.
- Be culturally and aesthetically sensitive across a range of societal contexts.
- Develop entrepreneurial opportunities.

D. Factors that contribute to achieving Mathematics Learning Outcomes

Students in the Further Education and Training band who are interested in the subject or who intend to follow a career path requiring Mathematics will, while ensuring that they are mathematically literate, work towards being able to:

- Completely use mathematical process skills, such as making conjectures, proving assertions and modelling situations.
- Calculate confidently and competently with and without calculators and use rational and irrational numbers with understanding.
- Competently produce useful equivalents for algebraic expressions and use such equivalents appropriately and with confidence.
- Use Mathematics to critically investigate and monitor the financial aspects of personal and community life and political decisions.
- Work with a wide range of patterns and transformations (translations, rotations, reflections) of functions and solve related problems.
- Describe, represent and analyse shape and space in two and three dimensions using various approaches in geometry (synthetic, analytic, transformational) and trigonometry in an interrelated or connected manner.
- Collect and use data to establish basic statistical and probability models, solve related problems and critically consider representations provided or conclusions reached.
- Use and understand the principles of differential calculus to determine the rate of change of a range of simple, non-linear functions and solve simple optimisation problems.
- Solve problems involving sequences and series in real-life and mathematical situations.
- Use and understand basic principles of integration to calculate volume and area.
- Use and understand other sets of numbers, such as complex numbers, to solve non-real equations particularly with reference to electrical problems.
- Solve non-routine, unseen problems using mathematical principles and processes.
- Investigate historical aspects of the development and use of mathematics in various cultures.
- Use available technology (the minimum being a scientific calculator) in calculations and in the development of models.

These mathematical skills and process abilities will, where possible, be embedded in contexts that relate to HIV/AIDS, human rights, indigenous knowledge systems and political, economic, environmental and inclusivity issues.

1 DURATION AND TUITION TIME

This is a one year instructional programme comprising 200 teaching and learning hours. The subject may be offered on a part-time basis provided all of the assessment requirements set out hereunder are adhered to.

Students with special education needs (LSEN) must be catered for in a way that eliminates barriers to learning.

2 SUBJECT LEVEL OUTCOMES

- Analyse and represent a wide range of algebraic and trigonometric functions and solve related problems.
- Interpret data to establish statistical models to solve related problems
- Analyse properties of shape in 2-dimensional and 3-dimensional space with justification.
- Manipulate mathematical statements involving complex numbers.
- Use differentiation formulas and techniques to solve practical problems.
- Apply mathematical knowledge and skills to plan personal finance and investigate opportunities for entrepreneurs.

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (25 percent)

All internal assessments must be finalised by an assessor with at least a certificate of competence.

3.1.1 Theoretical Component

The theoretical component will form 25 percent of the internal assessment.

Assessment of this component should take the form of tests and assignments. One test and one assignment per month are recommended.

3.1.2 Practical Component

The practical component will form 75 percent of the internl assessment.

The practical component in Mathematics includes all exercises and applications, tests and assignments done by the student. All practical components must be indicated in a Portfolio of Evidence (PoE). One test and one assignment are recommended per month.

- **Some examples of practical assessments include, but are not limited to:**

  A. Practical exercise work and applications to contextual problems.
  B. Presentations (lectures, demonstrations, group discussions and activities, practical work, observation, role play, self activity, judging and evaluation)
  C. Use of aids
  D. Exhibitions
  E. Visits
  F. Research

- **Evidence in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the student's Portfolio of Evidence (PoE). The tools and instruments constructed and used for the purpose of conducting such assessments must be clear from evidence contained in the PoE.

3.1.3 Processing of internal assessment mark for the year

A year mark out of 100 is calculated by adding the marks of the theoretical component and the practical component of the internal continuous assessment.

3.1.4 Moderation of internal assessment mark

Internal assessment is subjected to both internal and external moderation procedures as contained in the *National Examinations Policy for Further Education and Training College Programmes*.

3.2 External assessment (75 percent)

A national examination is conducted annually in October or November each year by means of two papers set externally and marked and moderated internally. For level 4 there will be two three hour examination papers. The one will focus on algebra, statistics and complex numbers, and the other on geometry, trigonometry, calculus and financial mathematics.

Details in respect of external assessment are contained in *Assessment Guidelines: Mathematics Level 4*.

4 WEIGHTED VALUES OF THE TOPICS

Paper 1

TOPICS	WEIGHTED VALUE
1. Functions and algebra	40% (20% + 20%)
2. Data handling and statistics.	40% (20% + 20%)
3. Complex numbers	20%
TOTAL	**100**

Paper 2

TOPICS/THEMES	WEIGHTED VALUE
4. Geometry	30% (15% + 15%)
5. Trigonometry	40% (20% + 20%)
6. Calculus	20%
7. Financial Mathematics	10%
TOTAL	**100**

5 CALCULATION OF FINAL MARK

Continuous assessment: Student's mark/100 x 25/1 = a mark out of 25 (a)
Examination mark: Student's mark/100 x 75/1= a mark out of 75 (b)
Final mark: (a) + (b) = a mark out of 100

All marks are systematically processed and accurately recorded to be available as hard copy evidence for, amongst others, purposes of moderation and verification.

6 PASS REQUIREMENTS

The student must obtain minimum of 30 percent to pass the subject. A pass will be condoned at 25% if it is the only subject preventing the student from going to level 5.

7 SUBJECT AND LEARNING OUTCOMES

On completion of Mathematics Level 4, the student should have covered the following topics:

Topic 1: Functions and algebra
Topic 2: Data handling and probability
Topic 3: Space, shape and measurement
Topic 4: Complex numbers
Topic 5: Derivatives and integrals
Topic 6: Financial mathematics

7.1 Topic 1: Functions and Algebra

7.1.1 Subject Outcome 1: Work with a wide range of functions and patterns and solve problems.

Learning Outcomes

Students should be able to:

- Formulate the inverses of the functions and sketch the following graph.

  $y = ax + q$

  $y = ax^2$

  $y = a^x; a \rangle 0$

7.1.2 Subject Outcome 2: Factorise third degree polynomials.

Learning Outcomes

Students should be able to:

- Factorise third degree polynomials including examples that require factor theorem.

7.1.3 Subject Outcome 3: Investigate and use instantaneous rate of change of a variable when interpreting models of situations.

Learning Outcomes:

Students should be able to:

- Find the derivatives of the following functions using first principles:

  $f(x) = b$

  $f(x) = x$

  $f(x) = x^2$

  $f(x) = x^3$

  $f(x) = \frac{1}{x}$

7.1.4 Subject Outcomes 4: Use rules of differentiation.

Learning Outcomes

Students should be able to:

- Use the constant, sum, difference, product, quotient and chain rules correctly.
- Use notation appropriately.

7.1.5 Subject Outcomes 5: Determine the equations of tangent to the curve.

Learning Outcome

Students should be able to:

- Find equations of the tangents.

7.1.6 Subject Outcomes 6: Sketch graphs of cubic functions.

Learning Outcomes

Students should be able to:

- Sketch the graph of cubic and other suitable polynomial functions.
- Solve practical problems involving optimisation and rates of change.
- Solve problems based on linear programming.

7.2 Topic 2: Data Handling and probability

7.2.1 Subject Outcome 1: Collect and work with data using various techniques to establish statistical models for specific purposes.

Learning Outcomes

Students should be able to:

- Handle issues that can be dealt with; statistical methods are identified correctly.
- Collect record and organise data and resolutions are made to maximize efficiency.
- Represent data graphically and numerically with consistency

7.2.2 Subject Outcome 2: Use experiments, simulations and probability distribution to set and explore probability models.

Learning Outcomes

Students should be able to:

- Make predictions based on validated experimental or theoretical probabilities.
- Interpret results of the experiments correctly in terms of real context.
- Communicate clearly the outcomes of the experiments

7.2.3 Subject Outcome 3: Construct and interpret probability and statistical models.

Learning Outcomes

Students should be able to:

- Define assumptions made in data collection.
- Use tables, diagrams, chart and graphs appropriately in the analysis and representation of data, statistics and probability distributions.
- Predict, conclude and make judgement on the basis of valid arguments and supporting data, statistics and probability models.

7.3 Topic 3: Space, Shape and Measurement

7.3.1 Subject Outcome 1: Measure, estimate and calculate physical quantities.

Learning Outcomes

Students should be able to:

- Read scales on the measuring instrument correctly.
- Select and use the appropriate formula.
- Use symbols and Systeme Internationale (SI) units as appropriate to the situation.

7.3.2 Subject Outcome 2: Explore, analyse and critique, describe and represent, interpret and justify geometrical relationships.

Learning Outcomes

Students should be able to:

- State and prove major theorems on circles.
- Find equation of a circle, equation of a tangent to a circle at a given point on the circle using co-ordinate geometry.
- Apply compound angle identities to solve problems based on two and three dimensions.

7.4 Topic 4: Complex Numbers

7.4.1 Subject Outcome 1: Use complex numbers and systems to make sense of and solve non-trivial problems.

Learning Outcomes

Students should be able to:

- Solve identical complex numbers.
- Interpret and use modulus notation with complex numbers.
- Represent complex numbers using various methods like polar and algebraic forms.

7.4.2 Subject Outcome 2: Carry out operations on complex numbers in non-trivial cases.

Learning Outcomes

Students should be able to:

- Do all four operations on complex numbers in both rectangular and polar form; and conversion of rectangular and polar form.

7.5 Topic 5: Derivatives and integrals

7.5.1 Subject Outcome 1: Use radian measure in working with trigonometric functions.

Learning Outcomes

Students should be able to:

- Express angles correctly in terms of radians.
- Solve equation correctly and give solutions in radians.

7.5.2 Subject Outcome 2: Analyse and represent mathematical and contextual situations using integral and curve sketching.

Learning Outcomes

Students should be able to:

- Find anti-derivatives and integrals by using rules and simplifications correctly.

7.5.3 Subject Outcome 3: Determine anti-derivatives and area under curves using integration rules.

Learning Outcomes

Students should be able to:

- Determine areas under a curve by splitting two or more intervals when the graph crosses the x-axis.

7.6 Topic 6: Financial mathematics

7.6.1 Subject Outcomes 1: Use mathematics to plan and control financial instruments.

Learning Outcomes

Students should be able to:

- Organise personal and business finances.
- Understand taxation, inflation interest rate and predicate the impact of it.

8 RESOURCE NEEDS FOR THE TEACHING OF MATHEMATICS - LEVEL 4

8.1 Physical resources

- Soft cover spring file for portfolios
- Scientific calculators
- Graph paper
- Textbook or workbook
- Computer 3½ floppy disk or memory stick
- Computer and printing facilities
- Geometric sets
- Chalk and chalkboards
- Paper
- Overhead projectors
- Models of solids like sphere, cone, hemisphere, pyramids, prisms, and cylinder.

8.2 Human resources

The Mathematics lecturer should have NQF Level 5 Mathematics or equivalent qualification with a teaching qualification, to teach level 4 Mathematics

8.3 Other resources

- Paper
- Graph paper
- Chalk
- Workbooks