



NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

MATHEMATICAL LITERACY **NQF Level 3**

September 2007

MATHEMATICAL LITERACY – LEVEL 3

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INTRODUCTION

A. What is Mathematical Literacy?

Mathematical literacy is an attribute of individuals who are prepared and able to participate effectively in the modern world – a world characterised by numbers and numerically based arguments and data represented (and misrepresented) in a large variety of ways. The subject Mathematical Literacy develops this attribute in individuals – an attribute that involves managing situations and solving problems in everyday life, work, societal and lifelong learning contexts by engaging with mathematical concepts (numbers and measurements; patterns and relationships; finances; space, shape and orientation; and data and likelihood) presented in a wide range of different ways.

B. Why is Mathematical Literacy important as a Fundamental?

In order to be more effective self-managing individuals, contributing workers, life-long learners and critical citizens in the modern world, people need to be able to engage with numbers and numerically based arguments and data represented (and misrepresented) in a large variety of ways that confront them on a day-to-day basis. Mathematical Literacy develops the knowledge, skills, values and attitudes that enable people to do so.

C. The link between Mathematical Literacy Learning Outcomes and the Critical and Developmental Outcomes

Mathematical Literacy aims to encourage students to:

- Develop logical thought processes.
- Develop analytical ability.
- Approach problem solving in a systematic manner.
- Identify and solve problems.
- Evaluate information critically.
- Be accurate.
- Work with numbers with confidence.
- Interpret financial information and manage personal finances in a meaningful manner.

D. Factors that contribute to achieving Mathematical Literacy Learning Outcomes

- Interest in working with numbers and experience in and exposure to working with numbers.
- Experience working with a calculator, working in an orderly manner, analytically, critically and evaluatively.
- Accuracy when analysing, calculating and recording.

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.

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

2 SUBJECT AND LEARNING FOCUS

Numbers

Calculate and measure using numbers in the workplace

Patterns and Relationships

Identify patterns and relationships between varying quantities in the workplace

Finance

Deal with finances in personal and/or familiar contexts, as well as finances associated with workplace based job descriptions, in a responsible manner

Space; Shape and Orientation

Read, interpret, make and use representations of the physical world appropriate to the workplace

Information communicated through numbers, graphs and tables

Use information communicated through numbers, tables and graphs in order to make sense of, and make predictions about, the workplace

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (25%)

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

3.1.1 Processing of internal assessment mark for the year

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

3.1.2 Moderation of internal assessment mark

Internal assessment is subjected to internal and external moderation procedures as set out 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 by means of papers set externally and marked and moderated internally for level 3. The examination will be structured as follows:

	Knowing 30%	Applying routine procedures in familiar contexts 30%	Applying multi-step procedures in a variety of contexts 20%	Reasoning and reflecting 20%
Numbers 20%	Paper 1 (150 marks) Paper 1 is intended to be a basic knowing and routine applications paper		Paper 2 (150 marks) Paper 2 is intended to be an applications and reasoning and reflecting paper	
Patterns and relationships 20%				
Finances 20%				
Space, Shape and Orientation 20%				
Information communicated ... 20%				

4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
Numbers	20%
Patterns and Relationships	20%
Finance	20%
Space, Shape and Orientation	20%
Information communicated through numbers, graphs and tables	20%
TOTAL	100

5 CALCULATION OF FINAL MARK

Continuous assessment: Student's mark out of $100 \div 4 =$ a mark out of 25 (a)

Examination mark: Student's mark out of $300 \div 4 =$ 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 at least 30% – 39% to achieve a pass in the subject.

7 SUBJECT AND LEARNING OUTCOMES

On completion of Mathematical Literacy Level 3 the learner should have achieved the following topics:

- Topic 1: Numbers
Topic 2: Patterns and relationships
Topic 3: Finance
Topic 4: Space, shape and orientation
Topic 5: Information communicated through numbers, graphs and tables

7.1 Topic 1: Numbers: Calculate and measure using numbers in the workplace

7.1.1 Subject Outcome 1: Uses numbers correctly when working with problems in the workplace

Learning Outcome: Use numbers to count; order and estimate

Learning Outcome: Use positive and negative numbers as directional indicators

Learning Outcome: Use fractions; decimals and percentages as measures of parts of a whole

Range: The fractions used in problems should be limited to those fractions that arise naturally in the context of the learner – it is anticipated that these will include: $\frac{1}{2}$; $\frac{1}{4}$; $\frac{3}{4}$; $\frac{1}{3}$; $\frac{2}{3}$; $\frac{1}{10}$; $\frac{1}{100}$

Learning Outcome: Find decimal equivalents of any fraction using a calculator

Learning Outcome: Convert between decimal fractions and percentages

Learning Outcome: Write time using conventions of:

- am/pm
- 24 hour clock
- analogue and digital

Learning Outcome: Convert between different time notations

7.1.2 Subject Outcome 2: Perform calculations correctly to solve problems in the workplace

Learning Outcome: Perform calculations correctly by means of paper, mental and/or calculator methods

Learning Outcome: Round numbers (rounds up, down and off) according to the requirements of the context

Learning Outcome: Apply addition and multiplication properties (distributive and associative) to simplify calculations where possible and/or useful

Learning Outcome: Estimate to anticipate answers and evaluate the result of a calculation and/or measurement

Learning Outcome: Estimate unknowns as necessary to solve problems

Learning Outcome: Use the following functions on a basic calculator:

- addition; subtraction; multiplication and division;
- percentage;
- memory; and
- “clear” and “clear all” keys

Learning Outcome: Solve problems that involve ratio/proportion (linear and inverse) and/or rate and/or percentage

7.1.3 Subject Outcome 3: Identify and use appropriate measuring tools and techniques to solve problems in the workplace

Learning Outcome: Estimate anticipated measurements where possible based on a sense/"feel" for different dimensions (i.e. have a "feel" of dimensions in relation to common objects)

Range: Instruments include:

- *Ruler and measuring tape;*
- *Scale;*
- *Measuring jugs, cups, measuring cylinders, burettes and pipettes as appropriate);*
- *Thermometer;*
- *Watch and/or stopwatch; and*
- *Other measuring instruments appropriate to the context/qualification*

Learning Outcome: Read meters and dials on instruments, tools and machines

Learning Outcome: Set prescribed dial settings on instruments, tools and machines

Learning Outcome: Calculate and report the solution with a number of decimal places and in units appropriate to the problem, the following measurements using formulae as necessary:

- Area: rectangle; triangle; circle and other shapes that can be decomposed into rectangles, triangles and circles
- Volume: rectangular prisms; cylinders and other objects that can be decomposed into rectangular prisms, and cylinders
- Time: elapsed time; calculations involving time zones
- Distance (using scale) and direction
- Other dimensions appropriate to the context/ qualification using formulae supplied

Learning Outcome: Calculate indirect measurements from information available

Learning Outcome: Perform conversions using known relationships between:

- mm – cm – m – km;
- ml – l;
- g – kg – tonne;
- sec – min – hours – days

Learning Outcome: Use conversion tables (supplied) to perform conversions appropriate to the context/qualification

Learning Outcome: Calculate values using rates including:

- conversion rates e.g.: grams to kilograms;
- consumption rates e.g.: kilometers per litre;
- distance, time, speed rates e.g.: kilometers per hour;
- cost rates e.g.: rand per kilogram;
- mixing rates e.g.: milliliters of tint per milliliters of peroxide
- Other rates appropriate to the context/ qualification

Learning Outcome: Determine rates from given values/relationships

7.2 Topic 2: Patterns and Relationships: Identify patterns and relationships between varying quantities in the workplace

7.2.1 Subject Outcome 1: Identify and extend patterns for different relationships in the workplace

Learning Outcome: Investigate and extend numerical and geometric patterns and trends in data

Range: Patterns include:

- *Constant difference patterns (arithmetic progressions) e.g. the cost of a number of items*
- *Constant ratio patterns (geometric progressions) e.g. fixed deposit bank account with a fixed interest rate*
- *Patterns associated with inverse and direct proportion relationships*
- *Situations in which there is no mathematical relationship between the independent and dependent variable but in which a trend can be identified e.g. height vs. age for children*

Learning Outcome: Use both the relationship between consecutive terms and the relationship between the term's position and its value to find missing/additional terms in a pattern

Learning Outcome: Interpolate and extrapolate to estimate and predict values based on trends evident in situations

Learning Outcome: Describe patterns in words (spoken and written) and through algebraic descriptions of them (formulae)

Learning Outcome: Describe trends in words that include;

- Increasing and/or decreasing;
- Critical values;
- Maximum and minimum values; and
- Discreet and/or continuous

Learning Outcome: Generate numerical and geometric patterns from descriptions given in words (instructions) and formulae.

7.2.2 Subject Outcome 2: Identify and use information from different representations of relationships of patterns and relationships to solve problems in the workplace

Learning Outcome: Identify and select information including:

- dependent variables for given independent variables;
- independent variables for given dependent variables
- critical points including zeros
- intervals over which the relationship values increase and/or decrease

from the following representations of relationships:

- tables:
- graphs
- formulae and equations

Learning Outcome: Use formulae supplied to:

- determine dependent variables for given independent variables
 - determine independent variables for given dependent variables
- by performing appropriate operations including:
- basic arithmetic operations
 - calculations with exponents, square and cube roots
 - solving equations

Learning Outcome: Determine formulae and/or equations to describe relationships where these exist, including:

- constant relationships
- linear relationships
- inverse proportion relationships

7.2.3 Subject Outcome 3: Translate between different representations of relationship found in the workplace

Learning Outcome: Translate between representations of relationships as follows:

- complete a table of values by reading values from the graph
- complete a table of values for formulae and/or descriptions of relationships
- plot a graph from the values in a table of values
- match formulae/equations to graphs and/or tables of values of the relationship based on features and/or trends

Learning Outcome: Choose and develop a representation that most effectively communicates and/or illustrates a result/finding from among:

- tables
- graphs
- formulae and equations

7.3 Topic 3: Finance: Deal with finances in personal and/or familiar contexts, as well as finances associated with workplace based job descriptions, in a responsible manner

7.3.1 Subject Outcome 1: Manage finances with confidence in personal and/or familiar context as well as finances associated with workplace based job descriptions

Learning Outcome: Identify, record and manage sources of income related to workplace based job description

Range: Sources of income include:

- sales/services
- rental
- donations/grants

Learning Outcome: Account for how/where income is kept (bank account; cash). Categorise sources of income as fixed/variable

Learning Outcome: Maintain records of income according to requirements of workplace (e.g. receipts; petty cash vouchers; invoices)

Learning Outcome: List and manage expenses related to workplace based job description

Range: Expenses include:

- salary/ wages/ commission
- running expenses
- raw materials/ stock/ products
- investment/ savings

Learning Outcome: Understand the importance of saving for future /occasional expenses. Expenses are categorized as fixed and variable.

Learning Outcome: Maintain records of expenses according to requirements of workplace (e.g. receipts; petty cash vouchers; invoices)

Learning Outcome: Develop and maintain income/ expenditure statements

Learning Outcome: Develop budgets based on previous income/ expenditure statements

Learning Outcome: Develop budgets for new projects and/or activities (e.g. new product/ service)

Learning Outcome: Explain variations between budgeted and actual income/ expenditure

7.3.2 Subject Outcome 2: Read, interpret and act on financial information presented in documents in a personal, workplace based and familiar context

Range: Documents include: pay slip; cheque; receipt; bank statement; accounts; cell phone rate tables; catalogues/price lists; transport rate tables; advertisements; service charges (e.g. water, electricity and sewerage)

Learning Outcome: Identify balance on a statement and distinguish between credit and debit. Identify the following:

- income/credit and/or expenses/debit
- balance
- beneficiaries/recipients
- payments due
- date/time period
- rates/times
- costs
- payment options

Learning Outcome: For example can analyse which transactions contribute most significantly to bank charges on a bank statement. Documents include:

- cheques
- withdrawal/deposit slips
- other documents related to personal finance (e.g. account application forms)
- receipts/petty cash vouchers

- invoices/statements

Learning Outcome: Make and justify decisions taken to solve problems using information from financial documents.

Range: For example the time of day for making a phone call is influenced by the different rates at different times of day. Make decisions that are affordable; cost and/or time efficient.

Learning Outcome: Consider the benefits of buying in bulk vs. buying individually are

7.4 Topic 4: Space, Shape and Orientation: Read, interpret, make and use representations of the physical world appropriate to the workplace

7.4.1 Subject Outcome 1: Use and apply the vocabulary of space, shape and orientation appropriately.

Note: It is assumed that the knowledge listed in the Assessment Criteria will be taught in an integrated way with the other Space; Shape and Orientation Outcomes. The vocabulary listed should be assessed in context of problems and not as dictionary definitions.

Learning Outcome: Know and use correctly the vocabulary of space, shape and orientation.

Range: Vocabulary should include the following:

Space: block; rectangular prism; pyramid; cone; cylinder; sphere; cube; prism; base

Shape: rectangle; square; triangle; circle;

Attributes: length; breadth; height; side; perimeter; diagonal; area; angle; centre; radius; diameter; circumference; volume; perpendicular; parallel; scale; column; row; co-ordinates/grid reference; weight (mass)

Representation: grid; map; plan; scale drawing; diagram

Time: 24 hour /12 hour clocks and conventions

7.4.2 Subject Outcome 2: Perform space, shape and orientation calculations correctly to solve problems in workplace based contexts

Note: Space; shape and orientation provide a context for the attainment of the Subject Outcomes, Assessment Standards and Learning Outcomes of the calculations and measurement theme.

Learning Outcome: Calculate the following with appropriate conversions and rounding (see Numbers)

- Area: rectangle; triangle; circle and other shapes that can be decomposed into rectangles, triangles and circles
- Volume: rectangular prisms; cylinders and other objects that can be decomposed into rectangular prisms, and cylinders
- Time: elapsed time; calculations involving time zones
- Distance (using scale) and direction

7.4.3 Subject Outcome 3: Read, interpret and use representations to make sense of and solve problems in workplace based contexts.

Learning Outcome: Use maps (e.g. road map and, route maps for busses and trains etc) to determine:

- Location
- Distance between two or more positions using the scale of the map
- Routes to get from one position to another

Learning Outcome: Use plans (e.g. layout and house plans) to determine:

- Dimensions
- Positions
- Quantities of materials needed

Learning Outcome: Use diagrams (e.g. assembly diagrams such as those found in manuals and brochures) to:

- Identify parts and objects
- Follow instructions

Learning Outcome: Plan trips choosing the shortest and/or fastest and/or most appropriate routes for a given mode of transport using maps

Learning Outcome: Sequence activities to complete a task (e.g. make a dress; build a building; move contents of a house/office) using plans and/or diagrams

7.4.4 Subject Outcome 4: Make physical and diagrammatic representations to investigate problems and/or illustrate solutions in workplace based contexts

Note: In terms of investigation, physical representations – models – are made for two distinct reasons:

- 3D-scale models made from 2D-diagrams/plans can help with the visualisation of the object – e.g. when designing buildings etc.
- scale models (including maps and diagrams) can help us to investigate problems and develop solutions (e.g. how best to pack a container; how best to arrange furniture in a room; how to design space to accommodate particular furniture).

Modelling – the use of models to investigate problems – is an important skill and attribute of mathematically literate persons.

Learning Outcome: Make 2-D and/or 3-D scale models of 3-D objects to investigate packing problems (e.g. arranging furniture in a room)

Learning Outcome: Make 3-D scale models of objects from 2-D plans (e.g. make a model of a house from its plan; make a model of a product from its plan)

Learning Outcome: Make rough sketches of objects and/or areas in order to make scale drawings (e.g. rough maps and plans)

Learning Outcome: Make maps, plans and diagrams to scale from rough sketches and or objects

Learning Outcome: Make route maps to illustrate proposed trips

Learning Outcome: Make flow diagrams to illustrate a proposed sequence of activities

7.5 Topic 5: Information communicated through numbers, graphs and tables: Use information communicated through numbers, tables and graphs in order to make sense of, and make predictions about, the workplace

Note: The philosophy that underlies this theme is to develop in individuals the ability to critically engage with the information (communicated through numbers/graphs and tables) they face so that they can be more effective self-managing individuals, contributing workers, life-long learners and critical citizens.

In order to understand how information (communicated through numbers/graphs and tables) is generated, individuals should have some experience with collecting, organising and interpreting information. However, it is not anticipated that students in their daily lives will regularly be involved in this process and so the Subject Outcomes and Assessment Standards give greater focus to interpreting information than to gathering and/or generating it.

To develop a healthy cynicism toward arguments based on information (communicated through numbers/graphs and tables) students should be aware that information can be represented and interpreted (and misrepresented) in different ways.

7.5.1 Subject Outcome 1: Collect and organise information in order to answer questions in workplace based contexts.

Note: Learners should recognise that information gained is influenced by all of the following:

- the method of information collection;
- the sample used;
- the method(s) used to summarise the information; and
- the choice of representation

Students should realise that collecting and comparing prices from a range of shops for a possible purchase is as much an information activity as conducting a census.

Learning Outcome: Develop sets of questions for collecting information, being aware that the way in which the questions are posed will influence the responses given.

Learning Outcome: Compile and use an information collection tool (e.g. survey; questionnaire; tally list)

Learning Outcome: Select appropriate samples from the population for collecting data, in awareness of the impact that sample choice has on the information gained

Learning Outcome: Organise information using tables and/or grouping as appropriate, being aware of the impact that the data group size has.

Learning Outcome: Summarise information by calculating the mean, median and mode of both ungrouped and grouped information as appropriate, being aware of how the choice of summary statistic will impact on the answer to the question

Learning Outcome: Represent information using: tables, pie charts, bar graphs, line and broken line graphs as appropriate to the information collected, in awareness of the manner in which the choice of representation impacts on the impression it creates

Learning Outcome: Use summarised and/or represented information to develop and substantiate answers to the questions that led to the information collection

Learning Outcome: Use summarised and/or represented information to show that different interpretations are possible

7.5.2 Subject Outcome 2: Critically interpret information presented (and misrepresented) in various forms in workplace contexts.

Learning Outcome: Read and select information from tables and graphs in order to answer questions.

Learning Outcome: Identify trends from the information presented in graphs and tables

Learning Outcome: Correctly interpret, with reference to both ungrouped and grouped information as appropriate, the meaning of the following statistics:

- Mean
- Median
- Mode

Learning Outcome: Critique the choice of representation and/or statistic(s) in terms of their impact on the impression created and conclusion(s) drawn

Note: Learners should know that:

- *Pie charts reveal relationships between different characteristics of the information but do not reveal the population/sample size*
- *Bar graphs reveal the population/sample size but do not show the relationship as effectively;*
- *The choice of scale on the axes, and/or the point at which the axes cross, etc. impact on the impression created by the graph*
- *Tables will often have more information than graphs but the trends/patterns are less easy to observe*

Learning Outcome: Ask questions about the information collection, organisation, summary and representation processes to reveal sources of error/ bias/ misinterpretation

Range: Questions should include:

- *Which statistic was used in text that uses the word 'average'*
- *The range of the information*
- *What was done with outliers in the information*
- *The size of the sample*
- *How representative the sample is*
- *How the information was grouped*
- *The method of information collection*
- *The neutrality of the information collection process*
- *Whether the information collected was fact or opinion*

7.5.3 Subject Outcome 3: Interpret the implications of expressions of likelihood in personal and workplace-based contexts.

Note: By 'expressions of likelihood' is meant what is known as chance or more formally, probability.

Expressions of likelihood are used (correctly and incorrectly) in daily conversation and in text to predict what may happen (e.g.: "the likelihood of Bafana Bafana winning the cup is ..."; "the likelihood of winning the LOTTO is ..."; "the probability of throwing an even number when a die is rolled is ...")

Students should interpret such statements of likelihood with awareness:

- *that the likelihood (probability) scale goes from 0 (the event will not happen) to 1 or 100% (the event will definitely happen);*
- *of the difference between random events (rolling die; spinning a spinner) and non-random events such as the weather and/or the performance of a sports team which are based on history*
- *that some things can be predicted while others cannot – we can predict that $\frac{1}{2}$ of a very large number of coin tosses will give a head, however, we cannot predict what will happen when we toss the next coin*

Learning Outcome: Differentiate between random and non-random events

Learning Outcome: Differentiate between independent and dependent events

Learning Outcome: Differentiate between expressions of likelihood based on evidence (theoretical/ empirical, likelihood/ probability) and expressions of likelihood based on the properties of the situation (theoretical likelihood/probability)

Learning Outcome: Explain the implications of expressions of likelihood found in text

8 RESOURCE NEEDS FOR THE TEACHING OF MATHEMATICAL LITERACY LEVEL 3

8.1 Physical resources

- Black board / white board
- Overhead projector
- Desks and tables for learners

8.2 Media

- Daily newspapers
- Magazines

8.3 Human resources

Lecturers/ facilitator should have:

- Minimum of Grade 12 Mathematics, preferably more
- Diploma / degree in education
- Training in OBE
- Declared competence as an assessor and/or moderator
- Interest and understanding of the field in which presenting Mathematical Literacy e.g. hair care; agriculture; business management.
- Enthusiasm for Mathematical Literacy

8.4 Equipment

- Basic calculators;
- Rulers and measuring tapes; measuring jugs; scales; compass; stopwatch and/or clock;
- Scissors; graph paper; glue and string; elastic bands; paper clips;
- National, regional and local road maps; (world map for tourism);
- Timetables for trains, buses, aeroplane, etc;
- Tournament logs and results; recipe books; banking brochures;
- Municipal tariff tables; municipal utility account statements;
- Nutritional panels from food packages; sales brochures offering different options;
- Articles and advertisements from the media that are supported by graphs and tables; advertisements from the media that refer to percentage and interest rate;
- Text books;
- Files for portfolio of each learner.