



education

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NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

MATHEMATICAL LITERACY

NQF Level 4

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MATHEMATICAL LITERACY – LEVEL 4

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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 students 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.

Students 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 and other areas of responsibility

Patterns and relationships

Identify patterns and relationships between varying quantities in the workplace and other areas of responsibility

Finance

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

Space; shape and orientation

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

Information communicated through numbers, graphs and tables

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

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 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 externally for level 4. 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
1. Numbers	20%
2. Patterns and Relationships	20%
3. Finance	20%
4. Space, Shape and Orientation	20%
5. 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 4 the student 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:

7.1.1 Subject Outcome 1: Uses numbers correctly when working with problems in the workplace and other areas of responsibility.

Learning Outcomes:

- Use numbers to count; order and estimate.
- Use positive and negative numbers as directional indicators.
- 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 student – it is anticipated that these will include: $\frac{1}{2}$; $\frac{1}{4}$; $\frac{3}{4}$; $\frac{1}{3}$; $\frac{2}{3}$; $\frac{1}{10}$; $\frac{1}{100}$

- Find decimal equivalents of any fraction using a calculator.
- Convert between decimal fractions and percentages.
- Write time using conventions of am/pm, 24 hour clock, analogue and digital.
- Convert between different time notations.

7.1.2 Subject Outcome 2: Perform calculations correctly to solve problems in the workplace and other areas of responsibility.

Learning Outcomes:

- Perform calculations correctly by means of paper, mental and/or calculator methods.
- Round numbers (rounds up, down and off) according to the requirements of the context.
- Apply addition and multiplication properties (distributive and associative) to simplify calculations where possible and/or useful.
- Estimate to anticipate answers and evaluate the result of a calculation and/or measurement.
- Estimate unknowns as necessary to solve problems.
- Use the following functions on a basic calculator: addition; subtraction; multiplication and division; percentage; memory; and 'clear' and 'clear all' keys.
- 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 and other areas of responsibility.

Learning Outcomes:

- Measuring instruments are selected and used to make direct measurements of: length; weight; volume/capacity; temperature; and time intervals to levels of precision appropriate to the context.
- 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, trundle wheels and vernier scales, 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.

- Read meters and dials on instruments, tools and machines.
- Set prescribed dial settings on instruments, tools and machines.
- 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, e.g., rectangle; triangle; circle and other shapes that can be decomposed into rectangles, triangles and circles;

- volume, e.g., rectangular prisms; cylinders and other objects that can be decomposed into rectangular prisms, and cylinders;
- time, e.g., elapsed time; calculations involving time zones;
- distance, using scale and direction; and
- other dimensions appropriate to the context/ qualification using formulae supplied.
- Calculate indirect measurements from information available.
- Perform conversions using known relationships between:
 - mm – cm – m – km;
 - ml – l;
 - g – kg – tonne;
 - sec – min – hours – days.
- Use conversion tables (supplied) to perform conversions appropriate to the context/qualification.
- 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; and
 - other rates appropriate to the context/ qualification.
- Determine rates from given values/relationships.

7.2 Topic 2: Patterns and Relationships

7.2.1 Subject Outcome 1: Identify and extend patterns for different relationships in the workplace and other areas of responsibility.

Learning Outcomes:

- 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; and*
 - *Long- and short-term trend patterns e.g. sales vs. month of the year; exchange rates vs. time; and population growth patterns*
- 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.
- Interpolates and extrapolates to estimate and predict values based on trends evident in situations.
- Describe patterns in words (spoken and written) and through algebraic descriptions of them (formulae)
- Describe trends in words that include:
 - Increasing and/or decreasing;
 - Critical values;
 - Maximum and minimum values; and
 - Discreet and/or continuous.
- 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 Outcomes:

- Identify and select information including:
 - Dependent variables for given independent variables;
 - Independent variables for given dependent variables;
 - Critical points including zeros; and
 - Intervals over which the relationship values increase and/or decrease from the following representations of relationships: tables; graphs; formulae and equations.
- 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.
- Determine formulae and/or equations to describe relationships where these exist, including constant relationships; linear relationships; and inverse proportion relationships.

7.2.3 Subject Outcome 3: Translate between different representations of relationships found in the workplace and other areas of responsibility.

Learning Outcomes:

- 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.
- 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

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 and finances within other areas of responsibility.

Learning Outcomes:

- Identify, record and manage sources of income related to workplace based job description.
Range: Sources of income include sales, services, rental, donations, grants, interest and other investment income.
- Account for how/where income is kept (bank account; cash). Sources of income are categorised as fixed/variable.
- Maintain records of income according to requirements of workplace (e.g. receipts; petty cash vouchers; invoices, statements, etc.).
- List and manage expenses related to workplace based job description.
Range: Expenses include salary; wages; commission; running expenses; raw materials; stock; products; investments; savings; taxes (UIF/PAYE/SDL/VAT).
- Understand the importance of saving for future/occasional expenses. Expenses are categorized as fixed and variable.
- Maintain records of expenses according to requirements of workplace (e.g. receipts; petty cash vouchers; invoices, statements, etc.).
- Develop and maintain income/expenditure statements.
- Develop budgets based on previous income/expenditure statements.
- Develop budgets for new projects and/or activities (e.g. new product/service).
- Explain variations between budgeted and actual income and expenditure.
- Understand and explain that there are factors that impact on budgets such as inflation and exchange rates in the context of international purchases and expenses.
Range: Determine deductions including UIF/PAYE/SDL/VAT and bargaining council fees

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 Outcomes:

- 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
- 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
- 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.
- Consider the benefits of buying in bulk vs. buying individually. Evaluate and choose with justification the best solution to a problem.

7.4 Topic 4: Space, shape and orientation:

7.4.1 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 Outcomes:

- Calculate the following with appropriate conversions and rounding (see Numbers):
 - area, e.g. rectangle; triangle; circle and other shapes that can be decomposed into rectangles, triangles and circles.
 - volume, e.g. rectangular prisms; cylinders and other objects that can be decomposed into rectangular prisms, and cylinders.
 - Time, e.g. elapsed time; calculations involving time zones.
 - Distance, e.g. using scale and direction.

7.4.2 Subject Outcome 2: Read, interpret and use representations to make sense of and solve problems in the workplace and other areas of responsibility.

Learning Outcomes:

- 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
 - Relative position of objects using compass direction
- Use plans (e.g. house, building and development plans) to determine dimensions, positions and quantities of materials needed.
- Use diagrams (e.g. assembly diagrams such as those found in manuals and brochures) to identify parts and objects and follow instructions.

- Sequence activities to complete a task in the most cost and/or time effective manner (e.g. make a dress; build a building; move contents of a house/office) using plans and/or diagrams.

7.4.3 Subject Outcome 3: Make physical and diagrammatic representations to investigate problems and/or illustrate solutions in the workplace and other areas of responsibility.

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 Outcomes:

- Make 2-D and/or 3-D scale models of 3-D objects to investigate packing problems (e.g. arranging furniture in a room, arranging items in a box).
- Make 3-D scale models of objects from 2-D plans (e.g. make a model of a building from its plan; make a model of a product from its diagram).
- Make rough sketches of objects and/or areas in order to make scale drawings (e.g. rough maps and plans).
- Make maps, plans and diagrams to scale from rough sketches and/or objects.
- Make route maps to illustrate proposed trips.
- Make flow diagrams to illustrate a proposed sequence of activities.

7.5 Topic 5: Information communicated through numbers, graphs and tables

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 students 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 the workplace and other areas of responsibility.

Note: The 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*

Collecting and comparing prices from a range of shops for a possible purchase is as much an information activity as conducting a census.

Learning Outcomes:

- Develop sets of questions for collecting information, being aware that the way in which the questions are posed will influence the responses given.
- Compile and use an information collection tool (e.g. survey; questionnaire; tally list) to collect information.
- Select appropriate samples from the population for collecting data, in awareness of the impact that sample choice has on the information gained.
- Organise information using tables and/or grouping as appropriate, being aware of the impact that the group size used to group the data has.
- Summarise information using the following measures: mean, median and mode of both ungrouped and grouped information as appropriate; quartiles (approximate only); percentiles (approximate only) showing sensitivity to the role of outliers and awareness of how the choice of summary statistic will impact on the answer to the question.
- Represent information using: tables, pie charts, bar graphs, line and broken line graphs, and box and whisker plots as appropriate to the information collected, aware of how the choice of representation impacts on the impression it creates.
- Use summarised and/or represented information to develop and substantiate answers to the questions that led to the collection of the information.
- 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 the workplace and other areas of responsibility.

Learning Outcomes:

- Read and select information from tables and graphs in order to answer questions.
- Identify trends from the information presented in graphs and tables and make predictions through interpolation and/or extrapolation as appropriate.
- Correctly interpret the meaning of the following statistics in text:
 - Mean; median; and mode (both grouped and ungrouped data)
 - Quartiles and percentiles.
- Critique the choice of representation and/or statistic(s) in terms of their impact on the impression created and conclusion(s) drawn.

Note: Students 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 and the 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.*
- 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 ...”)

Range: 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 Outcomes:

- Differentiate between random and non-random events.
- Differentiate between independent and dependent events.
- 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).
- Explain the implications of expressions of likelihood found in text.

8 RESOURCE NEEDS FOR THE TEACHING OF MATHEMATICAL LITERACY LEVEL 4

8.1 Physical resources

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

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 student.