DEPARTMENT OF EDUCATION

NATIONAL CURRICULUM
STATEMENT GRADES 10-12
(GENERAL)

MATHEMATICAL LITERACY

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National Curriculum Statement
Grades 10-12
(General)

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HOW TO USE THIS BOOK

This document is a policy document divided into four chapters. It is important for the reader to read and integrate information from the different sections in the document. The content of each chapter is described below.

Chapter 1 - Introducing the National Curriculum Statement

This chapter describes the principles and the design features of the National Curriculum Statement Grades 10 – 12 (General). It provides an introduction to the curriculum for the reader.

Chapter 2 - Introducing the Subject

This chapter describes the definition, purpose, scope, career links and Learning Outcomes of the subject. It provides an orientation to the Subject Statement.

Chapter 3 - Learning Outcomes, Assessment Standards, Content and Contexts

This chapter contains the Assessment Standards for each Learning Outcome, as well as content and contexts for the subject. The Assessment Standards are arranged to assist the reader to see the intended progression from Grade 10 to Grade12. The Assessment Standards are consequently laid out in double-page spreads. At the end of the chapter is the proposed content and contexts to teach, learn and attain Assessment Standards.

Chapter 4 – Assessment

This chapter deals with the generic approach to assessment being suggested by the National Curriculum Statement. At the end of the chapter is a table of subject-specific competence descriptions. Codes, scales and competence descriptions are provided for each grade. The competence descriptions are arranged to demonstrate progression from Grade 10 to Grade 12.

Symbols

The following symbols are used to identify Learning Outcomes, Assessment Standards, grades, codes, scales, competence description, and content and contexts.

 = Learning Outcome

 = Assessment Standard

 = Grade

 = Code

 = Scale

 = Competence Description

 = Content and Contexts

CONTENTS

ACRONYMS

2D/2-D	Two Dimensions (or two dimensional)
3D/3-D	Three Dimensions (or three dimensional)
AIDS	Acquired Immune Deficiency Syndrome
CASS	Continuous Assessment
DO	Developmental Outcome
FET	Further Education and Training
GET	General Education and Training
HIV	Human Immunodeficiency Virus
IKS	Indigenous Knowledge Systems
NCS	National Curriculum Statement
NQF	National Qualifications Framework
OBE	Outcomes-Based Education
SAQA	South African Qualifications Authority
TB	Tuberculosis

CHAPTER 1

INTRODUCING THE NATIONAL CURRICULUM STATEMENT

The adoption of the Constitution of the Republic of South Africa (Act 108 of 1996) provided a basis for curriculum transformation and development in South Africa. The Preamble states that the aims of the Constitution are to:

- heal the divisions of the past and establish a society based on democratic values, social justice and fundamental human rights;
- improve the quality of life of all citizens and free the potential of each person;
- lay the foundations for a democratic and open society in which government is based on the will of the people and every citizen is equally protected by law; and
- build a united and democratic South Africa able to take its rightful place as a sovereign state in the family of nations.

The Constitution further states that 'everyone has the right … to further education which the State, through reasonable measures, must make progressively available and accessible'.

The National Curriculum Statement Grades 10 – 12 (General) lays a foundation for the achievement of these goals by stipulating Learning Outcomes and Assessment Standards, and by spelling out the key principles and values that underpin the curriculum.

PRINCIPLES

The National Curriculum Statement Grades 10 – 12 (General) is based on the following principles:

- social transformation;
- outcomes-based education;
- high knowledge and high skills;
- integration and applied competence;
- progression;
- articulation and portability;
- human rights, inclusivity, environmental and social justice;
- valuing indigenous knowledge systems; and
- credibility, quality and efficiency.

Social transformation

The Constitution of the Republic of South Africa forms the basis for social transformation in our post-apartheid society. The imperative to transform South African society by making use of various transformative tools stems from a need to address the legacy of apartheid in all areas of human activity and in education in particular. Social transformation in education is aimed at ensuring that the educational imbalances of the past are redressed, and that equal educational opportunities are provided for all sections of our population. If social transformation is to be achieved, all South Africans have to be educationally affirmed through the recognition of their potential and the removal of artificial barriers to the attainment of qualifications.

Outcomes-based education

Outcomes-based education (OBE) forms the foundation for the curriculum in South Africa. It strives to enable all learners to reach their maximum learning potential by setting the Learning Outcomes to be achieved by the end of the education process. OBE encourages a learner-centred and activity-based approach to education. The National Curriculum Statement builds its Learning Outcomes for Grades 10 – 12 on the Critical and Developmental Outcomes that were inspired by the Constitution and developed through a democratic process.

The Critical Outcomes require learners 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; and
- 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 learners 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 social contexts;
- explore education and career opportunities; and
- develop entrepreneurial opportunities.

High knowledge and high skills

The National Curriculum Statement Grades 10 – 12 (General) aims to develop a high level of knowledge and skills in learners. It sets up high expectations of what all South African learners can achieve. Social justice requires the empowerment of those sections of the population previously disempowered by the lack of knowledge and skills. The National Curriculum Statement specifies the minimum standards of knowledge and skills to be achieved at each grade and sets high, achievable standards in all subjects.

Integration and applied competence

Integration is achieved within and across subjects and fields of learning. The integration of knowledge and skills across subjects and terrains of practice is crucial for achieving applied competence as defined in the National Qualifications Framework. Applied competence aims at integrating three discrete competences – namely, practical, foundational and reflective competences. In adopting integration and applied competence, the National Curriculum Statement Grades 10 – 12 (General) seeks to promote an integrated learning of theory, practice and reflection.

Progression

Progression refers to the process of developing more advanced and complex knowledge and skills. The Subject Statements show progression from one grade to another. Each Learning Outcome is followed by an explicit statement of what level of performance is expected for the outcome. Assessment Standards are arranged in a format that shows an increased level of expected performance per grade. The content and context of each grade will also show progression from simple to complex.

Articulation and portability

Articulation refers to the relationship between qualifications in different National Qualifications Framework levels or bands in ways that promote access from one qualification to another. This is especially important for qualifications falling within the same learning pathway. Given that the Further Education and Training band is nested between the General Education and Training and the Higher Education bands, it is vital that the Further Education and Training Certificate (General) articulates with the General Education and Training Certificate and with qualifications in similar learning pathways of Higher Education. In order to achieve this articulation, the development of each Subject Statement included a close scrutiny of the exit level expectations in the General Education and Training Learning Areas, and of the learning assumed to be in place at the entrance levels of cognate disciplines in Higher Education.

Portability refers to the extent to which parts of a qualification (subjects or unit standards) are transferable to another qualification in a different learning pathway of the same National Qualifications Framework band. For purposes of enhancing the portability of subjects obtained in Grades 10 – 12, various mechanisms have been explored, for example, regarding a subject as a 20-credit unit standard. Subjects contained in the National Curriculum Statement Grades 10 – 12 (General) compare with appropriate unit standards registered on the National Qualifications Framework.

Human rights, inclusivity, environmental and social justice

The National Curriculum Statement Grades 10 – 12 (General) seeks to promote human rights, inclusitivity, environmental and social justice. All newly-developed Subject Statements are infused with the principles and practices of social and environmental justice and human rights as defined in the Constitution of the Republic of South Africa. In particular, the National Curriculum Statement Grades 10 – 12 (General) is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors.

The National Curriculum Statement Grades 10 – 12 (General) adopts an inclusive approach by specifying minimum requirements for all learners. It acknowledges that all learners should be able to develop to their full potential provided they receive the necessary support. The intellectual, social, emotional, spiritual and physical needs of learners will be addressed through the design and development of appropriate Learning Programmes and through the use of appropriate assessment instruments.

Valuing indigenous knowledge systems

In the 1960s, the theory of multiple-intelligences forced educationists to recognise that there were many ways of processing information to make sense of the world, and that, if one were to define intelligence anew, one would have to take these different approaches into account. Up until then the Western world had only valued logical, mathematical and specific linguistic abilities, and rated people as 'intelligent' only if they were adept in these ways. Now people recognise the wide diversity of knowledge systems through which people make sense of and attach meaning to the world in which they live. Indigenous knowledge systems in the South African context refer to a body of knowledge embedded in African philosophical thinking and social practices that have evolved over thousands of years. The National Curriculum Statement Grades 10 – 12 (General) has infused indigenous knowledge systems into the Subject Statements. It acknowledges the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution. As many different perspectives as possible have been included to assist problem solving in all fields.

Credibility, quality and efficiency

The National Curriculum Statement Grades 10 – 12 (General) aims to achieve credibility through pursuing a transformational agenda and through providing an education that is comparable in quality, breadth and depth to those of other countries. Quality assurance is to be regulated by the requirements of the South African Qualifications Authority Act (Act 58 of 1995), the Education and Training Quality Assurance Regulations, and the General and Further Education and Training Quality Assurance Act (Act 58 of 2001).

THE KIND OF LEARNER THAT IS ENVISAGED

Of vital importance to our development as people are the values that give meaning to our personal spiritual and intellectual journeys. *The Manifesto on Values, Education and Democracy* (Department of Education, 2001:9-10) states the following about education and values:

> *Values and morality give meaning to our individual and social relationships. They are the common currencies that help make life more meaningful than might otherwise have been. An education system does not exist to simply serve a market, important as that may be for economic growth and material prosperity. Its primary purpose must be to enrich the individual and, by extension, the broader society.*

The kind of learner that is envisaged is one who will be imbued with the values and act in the interests of a society based on respect for democracy, equality, human dignity and social justice as promoted in the Constitution.

The learner emerging from the Further Education and Training band must also demonstrate achievement of the Critical and Developmental Outcomes listed earlier in this document. Subjects in the Fundamental Learning Component collectively promote the achievement of the Critical and Developmental Outcomes, while specific subjects in the Core and Elective Components individually promote the achievement of particular Critical and Developmental Outcomes.

In addition to the above, learners emerging from the Further Education and Training band must:

- have access to, and succeed in, lifelong education and training of good quality;
- demonstrate an ability to think logically and analytically, as well as holistically and laterally; and
- be able to transfer skills from familiar to unfamiliar situations.

THE KIND OF TEACHER THAT IS ENVISAGED

All teachers and other educators are key contributors to the transformation of education in South Africa. The National Curriculum Statement Grades 10 – 12 (General) visualises teachers who are qualified, competent, dedicated and caring. They will be able to fulfil the various roles outlined in the Norms and Standards for Educators. These include being mediators of learning, interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors, and subject specialists.

STRUCTURE AND DESIGN FEATURES

Structure of the National Curriculum Statement

The National Curriculum Statement Grades 10 – 12 (General) consists of an Overview Document, the Qualifications and Assessment Policy Framework, and the Subject Statements.

The subjects in the National Curriculum Statement Grades 10 – 12 (General) are categorised into Learning Fields.

What is a Learning Field?

A Learning Field is a category that serves as a home for cognate subjects, and that facilitates the formulation of rules of combination for the Further Education and Training Certificate (General). The demarcations of the Learning Fields for Grades 10 – 12 took cognisance of articulation with the General Education and Training and Higher Education bands, as well as with classification schemes in other countries.

Although the development of the National Curriculum Statement Grades 10 – 12 (General) has taken the twelve National Qualifications Framework organising fields as its point of departure, it should be emphasised that those organising fields are not necessarily Learning Fields or 'knowledge' fields, but rather are linked to occupational categories.

The following subject groupings were demarcated into Learning Fields to help with learner subject combinations:

- Languages (Fundamentals);
- Arts and Culture;
- Business, Commerce, Management and Service Studies;
- Manufacturing, Engineering and Technology;
- Human and Social Sciences and Languages; and
- Physical, Mathematical, Computer, Life and Agricultural Sciences.

What is a subject?

Historically, a subject has been defined as a specific body of academic knowledge. This understanding of a subject laid emphasis on knowledge at the expense of skills, values and attitudes. Subjects were viewed by some as static and unchanging, with rigid boundaries. Very often, subjects mainly emphasised Western contributions to knowledge.

In an outcomes-based curriculum like the National Curriculum Statement Grades 10 – 12 (General), subject boundaries are blurred. Knowledge integrates theory, skills and values. Subjects are viewed as dynamic, always responding to new and diverse knowledge, including knowledge that traditionally has been excluded from the formal curriculum.

A subject in an outcomes-based curriculum is broadly defined by Learning Outcomes, and not only by its body of content. In the South African context, the Learning Outcomes should, by design, lead to the achievement of the Critical and Developmental Outcomes. Learning Outcomes are defined in broad terms and are flexible, making allowances for the inclusion of local inputs.

What is a Learning Outcome?

A Learning Outcome is a statement of an intended result of learning and teaching. It describes knowledge, skills and values that learners should acquire by the end of the Further Education and Training band.

What is an Assessment Standard?

Assessment Standards are criteria that collectively describe what a learner should know and be able to demonstrate at a specific grade. They embody the knowledge, skills and values required to achieve the Learning Outcomes. Assessment Standards within each Learning Outcome collectively show how conceptual progression occurs from grade to grade.

Contents of Subject Statements

Each Subject Statement consists of four chapters and a glossary:

- *Chapter 1, Introducing the National Curriculum Statement:* This generic chapter introduces the National Curriculum Statement Grades 10 – 12 (General).
- *Chapter 2, Introducing the Subject:* This chapter introduces the key features of the subject. It consists of a definition of the subject, its purpose, scope, educational and career links, and Learning Outcomes.
- *Chapter 3, Learning Outcomes, Assessment Standards, Content and Contexts:* This chapter contains Learning Outcomes with their associated Assessment Standards, as well as content and contexts for attaining the Assessment Standards.
- *Chapter 4, Assessment:* This chapter outlines principles for assessment and makes suggestions for recording and reporting on assessment. It also lists subject-specific competence descriptions.
- *Glossary:* Where appropriate, a list of selected general and subject-specific terms are briefly defined.

LEARNING PROGRAMME GUIDELINES

A Learning Programme specifies the scope of learning and assessment for the three grades in the Further Education and Training band. It is the plan that ensures that learners achieve the Learning Outcomes as prescribed by the Assessment Standards for a particular grade. The Learning Programme Guidelines assist teachers and other Learning Programme developers to plan and design quality learning, teaching and assessment programmes.

CHAPTER 2

MATHEMATICAL LITERACY

DEFINITION

Mathematical Literacy provides learners with an awareness and understanding of the role that mathematics plays in the modern world. Mathematical Literacy is a subject driven by life-related applications of mathematics. It enables learners to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyse everyday situations and to solve problems.

PURPOSE

South Africa has come from a past in which poor quality or lack of education resulted in very low levels of literacy and numeracy in our adult population. International studies have shown that South African learners fare very poorly in mathematical literacy tests when compared to counterparts in other developed and developing countries. Learners who could not do well mathematically in General Education and Training usually stopped studying Mathematics, thus contributing to a perpetuation of high levels of innumeracy.

The inclusion of Mathematical Literacy as a fundamental subject in the Further Education and Training curriculum will ensure that our citizens of the future are highly numerate consumers of mathematics. In the teaching and learning of Mathematical Literacy, learners will be provided with opportunities to engage with real-life problems in different contexts, and so to consolidate and extend basic mathematical skills. Thus, Mathematical Literacy will result in the ability to understand mathematical terminology and to make sense of numerical and spatial information communicated in tables, graphs, diagrams and texts. Furthermore, Mathematical Literacy will develop the use of basic mathematical skills in critically analysing situations and creatively solving everyday problems.

In everyday life a person is continually faced with mathematical demands which the adolescent and adult should be in a position to handle with confidence. These demands frequently relate to financial issues such as hire-purchase, mortgage bonds, and investments. There are others, however, such as the ability to read a map, follow timetables, estimate and calculate areas and volumes, and understand house plans and sewing patterns. Situations, such as in cooking and the use of medicine, requiring the efficient use of ratio and proportion are encountered on a daily basis. Here, mathematical literacy is required by a self-managing person.

The workplace requires the use of fundamental numerical and spatial skills in order to efficiently meet the demands of the job. To benefit from specialised training for the workplace, a flexible understanding of mathematical principles is often necessary. This numeracy must enable the person to, for example, deal with work-related formulae, read statistical charts, deal with schedules and understand instructions involving numerical components. Such numeracy will enable the person to be a contributing worker.

To be a participating citizen in a developing democracy, it is essential that the adolescent and adult have acquired a critical stance with regard to mathematical arguments presented in the media and other platforms. The concerned citizen needs to be aware that statistics can often be used to support opposing arguments, for example, for or against the use of an ecologically sensitive stretch of land for mining purposes. In the information age, the power of numbers and mathematical ways of thinking often shape policy. Unless citizens appreciate this, they will not be in a position to use their vote appropriately.

The Further Education and Training subject, Mathematical Literacy, should enable the learner to become a self-managing person, a contributing worker and a participating citizen in a developing democracy. Mathematical Literacy will ensure a broadening of the education of the learner which is suited to the modern world.

Mathematical Literacy contributes to the attainment of the Critical and Developmental Outcomes in that it enables learners to:

- use mathematical process skills to identify, pose and solve problems creatively and critically;
- work collaboratively in teams and groups to enhance mathematical understanding;
- organise, interpret and manage authentic activities in substantial mathematical ways that demonstrate responsibility and sensitivity to personal and broader societal concerns;
- collect, analyse and organise quantitative data to evaluate and critique conclusions;
- communicate appropriately by using descriptions in words, graphs, symbols, tables and diagrams;
- use mathematical literacy in a critical and effective manner to ensure that science and technology are applied responsibly to the environment and to the health of others;
- demonstrate that a knowledge of mathematics assists in understanding the interrelatedness of systems and how they affect each other;
- be prepared to use a variety of individual and co-operative strategies in learning mathematics;
- engage responsibly with quantitative arguments relating to local, national and global issues;
- be sensitive to the aesthetic value of mathematics;
- explore the importance of mathematical literacy for career opportunities;
- realise that mathematical literacy contributes to entrepreneurial success.

SCOPE

All learners in the Further Education and Training band increasingly become involved in issues related to their lives which involve mathematics, *inter alia*, in working towards being able to:

- use numbers with understanding to solve real-life problems in different contexts including the social, personal and financial;
- use mathematically-acquired skills to perform with understanding financially-related calculations involving personal, provincial and national budgets;
- model relevant situations using suitable functions and graphical representation to solve related problems;

- describe, represent and analyse shape and space in two dimensions and three dimensions using geometrical skills;
- engage critically with the handling of data (statistics and chance), especially in the manner in which these are encountered in the media and in presenting arguments;
- use computational tools competently (a scientific calculator is taken as the minimum).

EDUCATIONAL AND CAREER LINKS

The learning achieved in Mathematics in the General Education and Training band provides a base from which to proceed to the demands of Mathematical Literacy in the Further Education and Training band. The essentials of numeracy are taken further by working in contexts which become increasingly relevant. The engagement with space and shape becomes more practical. The methods and uses of statistics and chance are dealt with in greater depth. Learners have to deal with more complex financial issues which directly affect their lives.

The Learning Outcomes of Mathematical Literacy are designed to enable learners passing through the Further Education and Training band to handle with confidence the mathematics that affects their lives and so be appropriately educated for the modern world. They will be able to proceed with learnerships in career pathways that require Mathematical Literacy at the relevant National Qualifications Framework (NQF) levels.

Students proceeding to Higher Education institutions will have acquired a mathematical literacy that will enable them to deal effectively with mathematically-related requirements in disciplines such as the social and life sciences. Mathematical Literacy should not be taken by those learners who intend to study disciplines which are mathematically based, such as the natural sciences or engineering.

LEARNING OUTCOMES

Learning Outcome 1: Number and Operations In Context

The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.

The focus of this Learning Outcome is on the investigation and solution of problems that require a sound understanding of numbers and their use in calculations, especially in financial contexts, ranging from personal to international issues. Applications in increasingly complex contexts provide opportunities to extend and consolidate calculation skills. Learners should develop sound estimation and mental calculation skills and a facility in using equivalent forms to simplify calculations. Proper conceptual understanding will be required to enable learners to use calculators appropriately and effectively.

Learning Outcome 2: Functional Relationships

The learner is able to recognise, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts.

Functional relationships pervade our society. This Learning Outcome is designed to give learners opportunities to investigate and make sense of such relationships where they arise in the context of other subjects, work or life-related situations. Learners will reflect on relationships between variables and use various means to determine values for variables when solving problems. Rate of change is emphasised as a useful way to describe the behaviour of functions. Context-free algebraic manipulations are not expected. Algebraic manipulation skills should rather be developed as needed in solving problems.

Learning Outcome 3: Space, Shape and Measurement

The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.

This Learning Outcome focuses on the development of spatial understanding and geometric skills through engagement with suitable contexts. This includes visualisation and knowledge of transformations. A variety of contexts should be employed to represent spatial aspects through diagrams and models, and to analyse shapes geometrically in order to solve problems and investigate situations. Numerous applications are available in design, art, geography and other fields. Such applications develop measurement and modelling skills as well as appreciation for aesthetic form.

Learning Outcome 4: Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

This Learning Outcome focuses on the role of learners as consumers of interpretations of data. Contexts should be taken from the way data is handled in the media and used to investigate situations. Learners should have the opportunity to reflect on the meaning of different graphical representations in a way that will enable them to access unfamiliar types in future. Critical awareness of how data can be manipulated to prove opposing views should be developed. Opportunities for learner-driven investigations by gathering and analysing data should be provided. These investigations must allow learners to experience data-handling skills as useful. Where possible, learners should have the opportunity to use spreadsheets and other computer tools.

CHAPTER 3

LEARNING OUTCOMES, ASSESSMENT STANDARDS, CONTENT AND CONTEXTS

In the Learning Outcomes that follow, the bulleted items are the Assessment Standards. The alphabetical points that follow (e.g. a, b, c) introduce the sub-skills, knowledge and attitudes of which each Assessment Standard is constituted.

Grade 10

Learning Outcome 1

Number and Operations in Context

The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.

Assessment Standards

We know this when the learner is able to:

10.1.1 Solve problems in various contexts, including financial contexts, by estimating and calculating accurately using mental, written and calculator methods where appropriate, inclusive of:

- working with simple formulae (*e.g.* $A = P(1+i)^n$);
- using the relationships between arithmetical operations (including the commutative, distributive and associative laws) to simplify calculations where possible;
- working with positive exponents and roots.

(The range of problem types includes percentage, ratio, rate and proportion (direct and inverse), simple and compound growth, calculations with very small and very large numbers in decimal and scientific notation.)

For example:

* *explore compound growth in various situations numerically and work with the compound interest formula;*

Grade 11

Assessment Standards

We know this when the learner is able to:

11.1.1 In a variety of contexts, find ways to explore and analyse situations that are numerically based, by:

- estimating efficiently;
- working with complex formulae by hand and with a scientific calculator, for example:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- showing awareness of the significance of digits when rounding;
- checking statements and results by doing relevant calculations;
- working with positive exponents and roots;
- involving ratio and proportion in cases where more than two quantities are involved.

For example:

* *estimate the length of a side if the volume of a cube is 10 cubic units,*
* *do calculations to compare different currencies,*

Grade 12

Assessment Standards

We know this when the learner is able to:

12.1.1 Correctly apply problem-solving and calculation skills to situations and problems dealt with.

For example:

* *work with issues involving proportional representation in voting.*

Grade 10

Learning Outcome 1 Continued

Number and Operations in Context

The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.

Assessment Standards

We know this when the learner is able to:

* *find a percentage by which a quantity was increased;*
* *calculate the number of person hours needed for a job if the number of workers is increased;*
* *calculate proportional payments for work done by groups of people;*
* *calculate the amount of money allocated to education by the budget if it is 8,4% of R36,04 billion;*
* *criticise numerically-based arguments.*

10.1.2 Relate calculated answers correctly and appropriately to the problem situation by:

- interpreting fractional parts of answers in terms of the context;
- reworking a problem if the first answer is not sensible, or if the initial conditions change;
- interpreting calculated answers logically in relation to the problem and communicating processes and results.

10.1.3 Apply mathematical knowledge and skills to plan personal finances (so as to enable effective participation in the economy), inclusive of:

- income and expenditure;
- simple interest problems and compound interest situations capitalised annually, half-yearly, quarterly and monthly, including calculation of either rate, principal amount or time when other variables are given or known.

Grade 11

Assessment Standards

We know this when the learner is able to:

* *check a claim that costs of phone calls have risen by 8% by doing relevant calculations,*
* *check the effect of rounding on effective repayments on a loan or account (one of the payments will have to be adjusted to reach the total amount to be repaid).*

11.1.2 Relate calculated answers correctly and appropriately to the problem situation by:
- interpreting fractional parts of answers in terms of the context;
- reworking a problem if the first answer is not sensible or if the initial conditions change;
- interpreting calculated answers logically in relation to the problem, and communicating processes and results.

11.1.3 Investigate opportunities for entrepreneurship and determine profit and sustainability by analysing contributing variables, inclusive of:
- specifying and calculating the value of income and expenditure items;
- determining optimal selling prices;
- estimating and checking profit margins.

Grade 12

Assessment Standards

We know this when the learner is able to:

12.1.2 Relate calculated answers correctly and appropriately to the problem situation by:
- interpreting fractional parts of answers in terms of the context;
- reworking a problem if the first answer is not sensible or if the initial conditions change;
- interpreting calculated answers logically in relation to the problem and communicating processes and results.

12.1.3 Analyse and critically interpret a wide variety of financial situations mathematically, inclusive of:
- personal and business finances;
- the effects of taxation, inflation and changing interest rates on personal credit, investment and growth options;
- financial and other indicators;
- the effects of currency fluctuations;
- critical engagement with debates about socially responsible trade.

Grade 10

Learning Outcome 1 Continued

Number and Operations in Context

The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.

Assessment Standards

We know this when the learner is able to:

For example:

* *identify variable expenses and calculate new values to adapt a budget to deal with increased bond repayments due to rising interest rates,*
* *adapt a budget to accommodate a change in the price of petrol,*
* *calculate the value of the fraction of a bond repayment that goes towards repaying interest or capital,*
* *calculate the real cost of a loan of R10 000 for 5 years at 5% capitalised monthly and half yearly.*

Grade 11

Assessment Standards

We know this when the learner is able to:

For example:

* *calculate the effect of increased prices of imported vehicle parts on the profit margin of a motor car manufacturer or a small vehicle service workshop,*
* *investigate the effect of increasing the number of employees on the profit margin of a small company,*
* *investigate the effect of a sales discount on the profit margin.*

Grade 12

Assessment Standards

We know this when the learner is able to:

For example:

* *calculate the effect of a fixed interest rate against probable variations in interest rates when buying a house or when choosing an investment,*
* *calculate the net effect of different interest offerings and bank charges when saving schemes are considered,*
* *calculate and compare the projected yields of different retirement options,*
* *interpret changes in indices such as the consumer price index or the business confidence index,*
* *compare different credit options,*
* *calculate the effect of defaulting payments over a period of time,*
* *consider different currencies for investment purposes,*
* *calculate values in simplified situations in order to discuss the effect of import/export control, levies and rebates, linking the discussion to the way mathematics can be used to argue opposing points of view.*

Grade 10

Learning Outcome 2

Functional Relationships

The learner is able to recognise, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts.

Assessment Standards

We know this when the learner is able to:

10.2.1 Work with numerical data and formulae in a variety of real-life situations, in order to establish relationships between variables by:

- finding the dependent variable;
- finding the independent variable;
- describing the rate of change.

(Types of relationships to be dealt with include linear, inverse proportion and compound growth in simple situations.)

For example:

* *critique information about functional relationships in media articles such as telephone costs before and after rate changes,*
* *calculate relationships in speed, distance and time.*

Grade 11

Assessment Standards

We know this when the learner is able to:

11.2.1 Work with numerical data and formulae in a variety of real-life situations, in order to establish relationships between variables by:

- finding break-even points;
- finding optimal ranges.

(Types of relationships to be dealt with include two simultaneous linear functions in two unknowns, inverse proportion, compound growth [only positive integer exponents] and quadratic functions.)

For example:

* *interpret and critique quotations for two similar packages given by cell phone providers or car hire companies,*
* *use rate of change to offset impressions created by magnification of scales on the axes of graphs.*

Grade 12

Assessment Standards

We know this when the learner is able to:

12.2.1 Work with numerical data and formulae in a variety of real-life situations, in order to:

- solve design and planning problems;

  For example:

  * *find optimal values for two discrete variables, subject to two or more linear constraints.*

- investigate situations of compound change.

  For example:

  * *investigate the rate of depletion of natural resources,*
  * *investigate the spread of HIV/AIDS and other epidemics,*
  * *critique articles and reports in the media that are based on graphs or tables.*

Grade 10

Learning Outcome 2 Continued

Functional Relationships

The learner is able to recognise, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts.

Assessment Standards

We know this when the learner is able to:

10.2.2 Draw graphs in a variety of real-life situations by:

- point-by-point plotting of data;
- working with formulae to establish points to plot;
- using graphing software where available.

For example, draw graphs of:

* *mass against time when on diet,*
* *surface area against side length of a cube,*
* *volume against surface area,*
* *lengths of a spring against mass added,*
* *amount of savings against the investment period.*

10.2.3 Critically interpret tables and graphs that relate to a variety of real-life situations by:

- finding values of variables at certain points;
- describing overall trends;
- identifying maximum and minimum points;
- describing trends in terms of rates of change.

For example, interpret graphs that:

* *compare the incidence of AIDS over time,*
* *indicate trends in road fatalities,*
* *show the expected changes in the mass of a baby with age.*

Grade 11

Assessment Standards

We know this when the learner is able to:

11.2.2 Draw graphs as required by the situations and problems being investigated.

For example:

* *compare costs of cell phone packages for different call intervals by drawing graphs of cost against time.*

11.2.3 Critically interpret tables and graphs depicting relationships between two variables in a variety of real-life and simulated situations by:

- estimating input and output values;
- using numerical arguments to verify relationships.

For example:

* *do spot calculations of the rate of change of population growth in different countries by taking readings from supplied graphs to check figures quoted and to verify estimations of future growth.*

Grade 12

Assessment Standards

We know this when the learner is able to:

12.2.2 Draw graphs as required by the situations and problems being investigated.

For example:

* *draw graphs of number of AIDS-related deaths and deaths caused by malaria over time, on the same system of axes to describe the extent of the AIDS epidemic.*

12.2.3 Critically interpret tables and graphs in the media, inclusive of:

- graphs with negative values on the axes (dependant variable in particular);
- more than one graph on a system of axes.

For example:

* *interpret graphs of temperature against time of day during winter over a number of years to investigate claims of global warming,*
* *compare graphs of indices such as the consumer price index and business confidence index to graphs of percentage change in those indices over a particular time interval.*

Grade 10

Learning Outcome 3

Space, Shape and Measurement

The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.

Assessment Standards

We know this when the learner is able to:

10.3.1 Solve problems in 2-dimensional and 3-dimensional contexts by:

- estimating, measuring and calculating (*e.g. by the use of the Theorem of Pythagoras*) values which involve:
  - lengths and distances,
  - perimeters and areas of common polygons and circles,
  - volumes of right prisms,
  - angle sizes (0˚-360˚);
- checking values for solutions against the contexts in terms of suitability and degree of accuracy.

10.3.2 Convert units of measurement within the metric system.

For example:

- *convert km to m, mm^3 to litres, km^2 to m^2, cm^3 to m^3.*

Grade 11

Assessment Standards

We know this when the learner is able to:

11.3.1 Solve problems in 2-dimensional and 3-dimensional contexts by:
- estimating, measuring and calculating *(e.g. regular shapes, irregular shapes and natural objects)* values which involve:
  * lengths and distances,
  * perimeters and areas of polygons,
  * volumes of right prisms and right circular cylinders,
  * surface areas of right prisms and right circular cylinders,
  * angle sizes (0˚-360˚);
- making adjustments to calculated values to accommodate measurement errors and inaccuracies due to rounding.

11.3.2 Convert units of measurement between different scales and systems.

For example:
* *convert km to m, mm^3 to litres, miles to km, kg to lb,*
* *work with international times*

Grade 12

Assessment Standards

We know this when the learner is able to:

12.3.1 Solve problems in 2-dimensional and 3-dimensional contexts by:
- estimating, measuring and calculating (*e.g. regular shapes, irregular shapes and natural objects*) values which involve:
  * lengths and distances,
  * perimeters and areas of polygons,
  * volumes of right prisms, right circular cylinders, cones and spheres,
  * surface areas of right prisms, right circular cylinders, cones and spheres,
  * angle sizes (0˚-360˚);
- making adjustments to calculated values to accommodate measurement errors and inaccuracies due to rounding.

12.3.2 Convert units of measurement between different scales and systems as required in dealing with problems.

For example:
* *the dimensions of an imported washing machine are given in inches and must be converted accurately to centimetres for installation purposes,*
* *a recipe that is written with imperial measures must be rewritten with accurate metric measures,*
* *measures of temperature must be converted between Fahrenheit and Celsius (conversion ratios and formulae given).*

Grade 10

Learning Outcome 3 Continued

Space, Shape and Measurement

The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.

Assessment Standards

We know this when the learner is able to:

10.3.3 Draw and interpret scale drawings of plans to represent and identify views.

For example:

* *draw and interpret top, front and side views or elevations on a plan.*

10.3.4 Solve real-life problems in 2-dimensional and 3-dimensional situations by the use of geometric diagrams to represent relationships between objects.

For example:

* *draw floor plans and use symbols to indicate areas and positions taken up by furniture in different arrangements.*

Grade 11

Assessment Standards

We know this when the learner is able to:

11.3.3 Use and interpret scale drawings of plans to:
- represent and identify views, estimate and calculate values according to scale.

For example:
* *study a plan of the school building and identify locations or calculate available real area for extensions.*

11.3.4 Use grids, including the Cartesian plane and compass directions, in order to:
- determine locations;
- describe relative positions.

For example:
* *local maps,*
* *seat location in cinemas and stadiums,*
* *room numbers in multi-levelled buildings.*

11.3.5 Use basic trigonometric ratios (sine, cosine and tangent) and geometric arguments to interpret situations and solve problems about heights, distances and position.

Grade 12

Assessment Standards

We know this when the learner is able to:

12.3.3 Use and interpret scale drawings of plans to:
- represent and identify views, estimate and calculate values according to scale, and build models.

For example:
* *build a scale model of a school building, based on the plan of the building.*

12.3.4 Use grids, including the Cartesian plane and compass directions, in order to:
- determine locations;
- describe relative positions.

For example:
* *understand the use of latitude and longitude in global positioning systems.*

12.3.5 Use basic trigonometric ratios (sine, cosine and tangent) and geometric arguments to interpret situations and solve problems about heights, distances, and position including the application of area, sine and cosine rules.

Grade 10

Learning Outcome 3 Continued

Space, Shape and Measurement

The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.

Assessment Standards

We know this when the learner is able to:

10.3.6 Recognise, visualise, describe and compare properties of geometrical plane figures in natural and cultural forms.

For example:

* *use the concepts of tessellation and symmetry in describing tilings, Zulu beadwork and other artefacts.*

Grade 11

Assessment Standards

We know this when the learner is able to:

11.3.6 Recognise, visualise, describe and compare properties of geometrical plane figures and solids in natural and cultural forms.

For example:

* *use the concepts of rotation, symmetry and reflection in describing decorative Ndebele and Sotho mural designs.*

Grade 12

Assessment Standards

We know this when the learner is able to:

12.3.6 Recognise, visualise, describe and compare properties of geometrical plane figures and solids in natural and cultural forms.

For example:

* *use the concepts of proportion and symmetry in describing local artefacts, art and architecture.*

Grade 10

Learning Outcome 4

Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

Assessment Standards

We know this when the learner is able to:

10.4.1 Investigate situations in own life by:

- formulating questions on issues such as those related to:
  - social, environmental and political factors,
  - people's opinions,
  - human rights and inclusivity;
- collecting or finding data by appropriate methods (e.g. interviews, questionnaires, the use of data bases) suited to the purpose of drawing conclusions to the questions.

  For example, investigate:
  - *substance abuse in the school,*
  - *water conservation,*
  - *prevalence of flu during winter,*
  - *approaches to discipline in the school.*

Grade 11

Assessment Standards

We know this when the learner is able to:

11.4.1 Investigate a problem on issues such as those related to:

- social, environmental and political factors;
- people's opinions;
- human rights and inclusivity by:
  - using appropriate statistical methods;
  - selecting a representative sample from a population with due sensitivity to issues relating to bias;
  - comparing data from different sources and samples.

For example:

- *conduct a survey in own school about home languages and comparing that with related data from other sources,*
- *identify possible sources of bias in gathering the data,*
- *investigate the increase in absenteeism at school (e.g. investigate the correlation between living conditions – squatter camps, houses – and absenteeism),*
- *investigate the correlation between distance from school and absenteeism.*

Grade 12

Assessment Standards

We know this when the learner is able to:

12.4.1 Investigate a problem on issues such as those related to:

- social, environmental and political factors;
- people's opinions;
- human rights and inclusivity by:
  - using appropriate statistical methods;
  - selecting a representative sample from a population with due sensitivity to issues relating to bias;
  - comparing data from different sources and samples.

For example:

- *challenge learners to compare claims about preferred TV programmes among teenagers with data from schools in their area,*
- *compare preferences across grades or gender.*

Grade 10

Learning Outcome 4 Continued

Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

Assessment Standards

We know this when the learner is able to:

10.4.2 Select, justify and use a variety of methods to summarise and display data in statistical charts and graphs inclusive of:

- tallies;
- tables;
- pie charts;
- histograms (first grouping the data);
- single bar and compound bar graphs;
- line and broken-line graphs.

For example:

* *pie charts to show the relative proportions of learners who have flu,*
* *compound bar graphs to show the abuse of different substances in the respective Further Education and Training grades.*

Grade 11

Assessment Standards

We know this when the learner is able to:

11.4.2 Appropriately choose and interpret the use of methods to summarise and display data in statistical charts and graphs inclusive of:

- tallies;
- tables;
- pie charts;
- single and compound bar graphs;
- line and broken-line graphs;
- ogives of cumulative frequencies.

For example:

* *interpret the meaning of points on a broken-line graph of house prices in 2002 – does it make sense to assign a monetary value to a point halfway between January and February?*

Grade 12

Assessment Standards

We know this when the learner is able to:

12.4.2 Appropriately choose and interpret the use of methods to summarise and display data in statistical charts and graphs including the use of scatter-plots and intuitively-placed lines of best fit to:

- represent the association between variables (regression analysis not included);
- describe trends (*e.g. a positive linear association*).

For example:

* *Does a positive correlation between age and height necessarily mean that height is dependent on age?*
* *Does a positive correlation between mathematics marks and music marks necessarily mean that facility in mathematics is dependent on musical aptitude?*
* *Does a positive correlation between pollution levels and TB infections necessarily mean that pollution causes TB?*

Grade 10

Learning Outcome 4 Continued

Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

Assessment Standards

We know this when the learner is able to:

10.4.3 Calculate and use appropriate measures of central tendency and spread to make comparisons and draw conclusions, inclusive of the:

- mean;
- median;
- mode;
- range.

For example:

* *investigate the cost of a trolley of groceries at three different shops in the area and report the findings by means of mean, median, mode and range.*

10.4.4 Critically interpret a single set of data and representations thereof (with awareness of sources of error) in order to draw conclusions on questions investigated and to make predictions.

For example:

* *interpret data from the media on the number of stolen and recovered vehicles after a certain tracking device has been installed.*

Grade 11

Assessment Standards

We know this when the learner is able to:

11.4.3 Calculate, interpret and compare two sets of data using measures of central tendency and spread, inclusive of the:

- mean;
- median;
- mode;
- range;
- variance (interpretation only);
- standard deviation (interpretation only);
- quartiles.

For example:

* *conduct a survey in own school about home languages and compare that with related data from other sources,*
* *identify possible sources of bias in gathering the data,*
* *use concepts of average, mode or median to interpret the data.*

11.4.4 Critically interpret two sets of data and representations thereof (with awareness of sources of error and bias) in order to draw conclusions on problems investigated and make predictions.

For example:

* *compare data from two providers of tracking devices and draw conclusions about success rates.*

Grade 12

Assessment Standards

We know this when the learner is able to:

12.4.3 Compare different sets of data by calculating and using measures of central tendency and spread, including:

- mean;
- median;
- mode;
- variance (interpretation only);
- standard deviation (interpretation only);
- quartiles;
- percentiles.

For example:

* *compare the increase in the cost of a trolley of groceries to the increase in the consumer price food index, and report the findings in terms of variance and standard deviation of specific items,*
* *compare academic results in own school to those in the province in terms of quartiles and percentiles.*

12.4.4 Represent and critically analyse data, statistics and probability values in order to draw conclusions on problems investigated and to predict trends.

For example:

* *compare data about stolen vehicles from providers of tracking devices with data provided by official sources like SAPS, and draw conclusions about the trend in vehicle thefts (types of cars most at risk, areas most at risk).*

Grade 10

Learning Outcome 4 Continued

Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

Assessment Standards

We know this when the learner is able to:

10.4.5 Work with probability concepts to:

- compare the relative frequency of an outcome with the probability of an outcome (*establishing that it takes very many trials before the relative frequency approaches the value of the probability of an outcome, e.g. to get a 6 when rolling a die*);
- express probability values in terms of fractions, ratios and percentages.

10.4.6 Effectively communicate conclusions and predictions (using appropriate terminology such as trend, increase, decrease, constant, impossible, likely, fifty-fifty chance), that can be made from the analysis and representation of data on learner-driven issues.

Grade 11

Assessment Standards

We know this when the learner is able to:

11.4.5 Make and/or test predictions of compound outcomes in the context of games and real-life situations by:

- designing simple contingency tables to estimate basic probabilities;
- drawing tree diagrams.

For example:

* *draw a tree diagram to investigate the probability of getting three 'heads' when tossing three coins.*

11.4.6 Manipulate data in different ways to justify opposing conclusions.

Grade 12

Assessment Standards

We know this when the learner is able to:

12.4.5 Critically engage with the use of probability values in making predictions of outcomes in the context of games and real-life situations.

For example:

* *Investigate claims that the probability of winning a game of chance (e.g. a slot machine) improves if it has not produced a winner for some time.*

12.4.6 Critically evaluate statistically-based arguments, describe the use and misuse of statistics in society, and make well-justified recommendations.

CONTENT AND CONTEXTS FOR THE ATTAINMENT OF ASSESSMENT STANDARDS

In this section, content and contexts are provided to support the attainment of the Assessment Standards. The content indicated needs to be dealt with in such a way as to assist the learner to progress towards the achievement of the Learning Outcomes. Content must serve the Learning Outcomes and not be an end in itself. The contexts suggested will enable the content to be embedded in situations which are meaningful to the learner and so assist learning and teaching. The teacher and other educators should be aware of and use local contexts, not necessarily indicated here, which could be more suited to the experiences of the learner. Content and context, when aligned to the attainment of the Assessment Standards, provide a framework for the development of Learning Programmes. The Learning Programme Guidelines give more detail in this respect.

For Mathematical Literacy, the Assessment Standards do indicate progression from grade to grade. However, this progression is not markedly evident in some of the Assessment Standards. The complexity of the situation to be addressed in context, through using the mathematical knowledge and ways of thought available to the learner, is where the extent of the progression needs to be ensured. This is illustrated by the examples given with the Assessment Standards.

Learning Outcome 1: Number and Operations in Context

The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.

The learner will be involved in life-related problem situations such as those involving finance and quantities. In order to solve such problems, the learner will have to estimate efficiently and calculate accurately while making use of the following concepts and content as well as that from other Learning Outcomes.

Grade 10

- Fractions, decimals, percentages.
- Positive exponents and roots.
- The associative, commutative and distributive laws.
- Rate.
- Ratio.
- Direct proportion.
- Inverse proportion.
- Simple formulae.
- Simple and compound growth.
- Scientific notation.

Grade 11

- Content involved in Grade 10 work but applied to more complex situations.
- Square roots and cube roots.
- Ratio and proportion.
- Complex formulae.
- Cost price and selling price.
- Profit margins.

Grade 12

- Content of Grade 10 and Grade 11 but applied to more complex situations.
- Taxation.
- Currency fluctuations.
- Financial and other indices.

Learning Outcome 2: Functional Relationships

The learner is able to recognise, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts.

The learner will be involved in situations that involve relationships between variables depicted graphically, numerically and in tables. These situations can be dealt with through making use of the following content and concepts. Some of the content and concepts more directly related to the other Learning Outcomes will also have to be used.

Grade 10

- Tables of values.
- Formulae depicting relationships between variables.
- Cartesian co-ordinate system.
- Linear functions.
- Inverse proportion.
- Compound growth.
- Graphs depicting the relationship between variables.
- Maximum and minimum points.
- Rates of change (speed, distance, time).

Grade 11

- The content of Grade 10 but applied to more complex situations.
- Simple quadratic functions.
- Solution to linear, quadratic and simple exponential equations.
- Solution to two simultaneous linear equations.

Grade 12

- The content of Grade 10 and Grade 11 but applied to more complex situations.
- Simple linear programming (design and planning problems).
- Graphs showing the fluctuations of indices over time.

Learning Outcome 3: Space, Shape and Measurement

The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.

Contexts that the learner will deal with here involve space, shape and time. In order to deal with real-life situations in such contexts, the learner will make use of the following and other content and concepts.

Grade 10

- Measurement of length, distance, volume, area, perimeter.
- Measurement of time (international time zones).
- Polygons commonly encountered (triangles, squares, rectangles that are not squares, parallelograms, trapesiums, regular hexagons).
- Circles.
- Angles (0˚-360˚).
- Theorem of Pythagoras.
- Conversion of units within the metric system.
- Scale drawings.
- Floor plans.
- Views.
- Basic transformation geometry, symmetry and tessellations.

Grade 11

- Grade 10 content but applied to more complex situations.
- Measurement in 3D (angles included, 0˚-360˚).
- Surface area and volumes of right prisms and right circular cylinders.
- Conversion of measurements between different scales and systems.
- Compass directions.
- Properties of plane figures and solids in natural and cultural forms.
- Location and position on grids.
- Trigonometric ratios: sin x, cos x, tan x.

Grade 12

- Content of Grade 10 and Grade 11 but applied to more complex situations.
- Surface areas and volumes of right pyramids and right circular cones and spheres.
- Scale models.
- Sine rule, cosine rule, area rule.

Learning Outcome 4: Data Handling

The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions.

The learner will investigate and interpret situations which can be dealt with using statistical techniques. The following and other content and concepts will assist the learner to do so.

Grade 10

- Construction of questionnaires.
- Populations.
- Selection of a sample.
- Tables recording data.
- Tally and frequency tables.
- Single and compound bar graphs.
- Pie charts.
- Histograms.
- Line and broken-line graphs.
- Mean, median, mode.
- Range.
- Relative frequency.
- Probability.

Grade 11

- The content of Grade 10 but applied to more complex situations.
- Selection of samples and bias.
- Cumulative frequencies.
- Ogives (cumulative frequency graphs).
- Variance (interpretation only).
- Standard deviation (interpretation only).
- Quartiles.
- Compound events.
- Contingency tables.
- Tree diagrams.

Grade 12

- The content of Grade 10 and Grade 11 but applied to more complex situations.
- Bivariate data.
- Scatter plots.
- Intuitively-placed lines of best fit.
- Percentiles.

Contexts

Contexts are central to the development of Mathematical Literacy in learners. Mathematical Literacy, by its very nature, requires that the subject be rooted in the lives of the learners. It is through engaging learners in situations of a mathematical nature experienced in their lives that the teacher will bring home to learners the usefulness and importance of mathematical ways of thought in solving problems in such situations. To this end it is very important for the teacher to incorporate local and topical issues into the Learning Programmes that they design. The practices of the local community, the home environment and local industry provide a wealth of relevant contexts to explore. The media frequently provide resources that will assist in making what is currently happening locally, nationally and internationally available to the Mathematical Literacy classroom. The approach that needs to be adopted in developing Mathematical Literacy is to engage with contexts rather than applying Mathematics already learned to the context. Research done internationally and in South Africa confirms this approach for young people as well as for adults.

A wealth of contexts can be used to attain the Assessment Standards for Mathematical Literacy in the manner described above. The examples provided in support of many of the Assessment Standards are illustrations of some of these contexts. The possibilities of using such contexts in investigations, projects, assignments and assessment show that Mathematical Literacy is an ideal subject for attaining the authentic education and assessment which is at the core of outcomes-based education. Contexts which have been highlighted are those related to the principles of the National Curriculum Statement, that is, issues which arise in human rights, inclusivity, health (HIV/AIDS) and indigenous knowledge systems.

Being literate in Mathematics is an essential requirement for the development of the responsible citizen, the contributing worker and the self-managing person. Being mathematically literate implies an awareness of the manner in which Mathematics is used to format society and enables astuteness in the user of the products of Mathematics such as hire-purchase agreements and mathematical arguments in the media – hence the inclusion of Mathematical Literacy as a Fundamental requirement in the Further Education and Training curriculum.

Many local and international studies have shown the existence of a set of attitudes – described as 'mathsphobia' – in school-going learners and in the population at large. It is the responsibility of the teacher, in implementing this curriculum, to endeavour to win learners to Mathematics. Real-life contexts which lend themselves to mathematical ways of thought are ideal for doing this.

The teacher needs to be sensitive to the manner in which gendered attitudes towards Mathematics play themselves out in the classroom, particularly so in co-educational schools. Stereotyping needs to be guarded against in this respect, where Mathematics is often seen as a male preserve leading to arrogance and domination by the boys in the class. The interests of all need to be taken into account in providing access to mathematical ways of thought so essential to Mathematical Literacy.

Another aspect of providing access and affirmation for learners of Mathematics is to look at examples of Mathematics in the variety of cultures and societal practices that exist in our country. Mathematics is embedded in many cultural artefacts which we experience in our daily lives: the murals of the Ndebele, the rhythm in the drums of the Venda, the beadwork of the Zulu and Vedic art, to name but a few. Architecture, games and music are rich fields to explore through the lenses of Mathematics. Ethnomathematics provides a wealth of more recently developed materials, sensitive to the sacredness of culture, for use in the classroom. The flexibility allowed by the curriculum also promotes the incorporation of local practices as starting points for or applications of the Mathematics to be investigated.

Ethnomathematics also stresses that Mathematics originated in cultures other than the Greek and that it continued to be developed in sophistication by many societies other than the European. Projects in the history of Mathematics can be used to explore this.

CHAPTER 4

ASSESSMENT

INTRODUCTION

Assessment is a critical element of the National Curriculum Statement Grades 10 – 12 (General). It is a process of collecting and interpreting evidence in order to determine the learner's progress in learning and to make a judgement about a learner's performance. Evidence can be collected at different times and places, and with the use of various methods, instruments, modes and media.

To ensure that assessment results can be accessed and used for various purposes at a future date, the results have to be recorded. There are various approaches to recording learners' performances. Some of these are explored in this chapter. Others are dealt with in a more subject-specific manner in the Learning Programme Guidelines.

Many stakeholders have an interest in how learners perform in Grades 10 – 12. These include the learners themselves, parents, guardians, sponsors, provincial departments of education, the Department of Education, the Ministry of Education, employers, and higher education and training institutions. In order to facilitate access to learners' overall performances and to inferences on learners' competences, assessment results have to be reported. There are many ways of reporting. The Learning Programme Guidelines and the Assessment Guidelines discuss ways of recording and reporting on school-based and external assessment as well as giving guidance on assessment issues specific to the subject.

WHY ASSESS

Before a teacher assesses learners, it is crucial that the purposes of the assessment be clear and unambiguous. Understanding the purposes of assessment ensures that an appropriate match exists between the purposes and the methods of assessment. This, in turn, will help to ensure that decisions and conclusions based on the assessment are fair and appropriate for the particular purpose or purposes.

There are many reasons why learners' performance is assessed. These include monitoring progress and providing feedback, diagnosing or remediating barriers to learning, selection, guidance, supporting learning, certification and promotion.

In this curriculum, learning and assessment are very closely linked. Assessment helps learners to gauge the value of their learning. It gives them information about their own progress and enables them to take control of and to make decisions about their learning. In this sense, assessment provides information about whether teaching and learning is succeeding in getting closer to the specified Learning Outcomes. When assessment indicates lack of progress, teaching and learning plans should be changed accordingly.

TYPES OF ASSESSMENT

This section discusses the following types of assessment:

- baseline assessment;
- diagnostic assessment;
- formative assessment; and
- summative assessment.

Baseline assessment

Baseline assessment is important at the start of a grade, but can occur at the beginning of any learning cycle. It is used to establish what learners already know and can do. It helps in the planning of activities and in Learning Programme development. The recording of baseline assessment is usually informal.

Diagnostic assessment

Any assessment can be used for diagnostic purposes – that is, to discover the cause or causes of a learning barrier. Diagnostic assessment assists in deciding on support strategies or identifying the need for professional help or remediation. It acts as a checkpoint to help redefine the Learning Programme goals, or to discover what learning has not taken place so as to put intervention strategies in place.

Formative assessment

Any form of assessment that is used to give feedback to the learner is fulfilling a formative purpose. Formative assessment is a crucial element of teaching and learning. It monitors and supports the learning process. All stakeholders use this type of assessment to acquire information on the progress of learners. Constructive feedback is a vital component of assessment for formative purposes.

Summative assessment

When assessment is used to record a judgement of the competence or performance of the learner, it serves a summative purpose. Summative assessment gives a picture of a learner's competence or progress at any specific moment. It can occur at the end of a single learning activity, a unit, cycle, term, semester or year of learning. Summative assessment should be planned and a variety of assessment instruments and strategies should be used to enable learners to demonstrate competence.

WHAT SHOULD ASSESSMENT BE AND DO?

Assessment should:

- be understood by the learner and by the broader public;
- be clearly focused;
- be integrated with teaching and learning;
- be based on the pre-set criteria of the Assessment Standards;
- allow for expanded opportunities for learners;
- be learner-paced and fair; and
- be flexible;
- use a variety of instruments;
- use a variety of methods.

HOW TO ASSESS

Teachers' assessment of learners' performances must have a great degree of reliability. This means that teachers' judgements of learners' competences should be generalisable across different times, assessment items and markers. The judgements made through assessment should also show a great degree of validity; that is, they should be made on the aspects of learning that were assessed.

Because each assessment cannot be totally valid or reliable by itself, decisions on learner progress must be based on more than one assessment. This is the principle behind continuous assessment (CASS). Continuous assessment is a strategy that bases decisions about learning on a range of different assessment activities and events that happen at different times throughout the learning process. It involves assessment activities that are spread throughout the year, using various kinds of assessment instruments and methods such as tests, examinations, projects and assignments. Oral, written and performance assessments are included. The different pieces of evidence that learners produce as part of the continuous assessment process can be included in a portfolio. Different subjects have different requirements for what should be included in the portfolio. The Learning Programme Guidelines discuss these requirements further.

Continuous assessment is both classroom-based and school-based, and focuses on the ongoing manner in which assessment is integrated into the process of teaching and learning. Teachers get to know their learners through their day-to-day teaching, questioning, observation, and through interacting with the learners and watching them interact with one another.

Continuous assessment should be applied both to sections of the curriculum that are best assessed through written tests and assignments and those that are best assessed through other methods, such as by performance, using practical or spoken evidence of learning.

METHODS OF ASSESSMENT

Self-assessment

All Learning Outcomes and Assessment Standards are transparent. Learners know what is expected of them. Learners can, therefore, play an important part, through self-assessment, in 'pre-assessing' work before the teacher does the final assessment. Reflection on one's own learning is a vital component of learning.

Peer assessment

Peer assessment, using a checklist or rubric, helps both the learners whose work is being assessed and the learners who are doing the assessment. The sharing of the criteria for assessment empowers learners to evaluate their own and others' performances.

Group assessment

The ability to work effectively in groups is one of the Critical Outcomes. Assessing group work involves looking for evidence that the group of learners co-operate, assist one another, divide work, and combine individual contributions into a single composite assessable product. Group assessment looks at process as well as product. It involves assessing social skills, time management, resource management and group dynamics, as well as the output of the group.

METHODS OF COLLECTING ASSESSMENT EVIDENCE

There are various methods of collecting evidence. Some of these are discussed below.

Observation-based assessment

Observation-based assessment methods tend to be less structured and allow the development of a record of different kinds of evidence for different learners at different times. This kind of assessment is often based on tasks that require learners to interact with one another in pursuit of a common solution or product. Observation has to be intentional and should be conducted with the help of an appropriate observation instrument.

Test-based assessment

Test-based assessment is more structured, and enables teachers to gather the same evidence for all learners in

the same way and at the same time. This kind of assessment creates evidence of learning that is verified by a specific score. If used correctly, tests and examinations are an important part of the curriculum because they give good evidence of what has been learned.

Task-based assessment

Task-based or performance assessment methods aim to show whether learners can apply the skills and knowledge they have learned in unfamiliar contexts or in contexts outside of the classroom. Performance assessment also covers the practical components of subjects by determining how learners put theory into practice. The criteria, standards or rules by which the task will be assessed are described in rubrics or task checklists, and help the teacher to use professional judgement to assess each learner's performance.

RECORDING AND REPORTING

Recording and reporting involves the capturing of data collected during assessment so that it can be logically analysed and published in an accurate and understandable way.

Methods of recording

There are different methods of recording. It is often difficult to separate methods of recording from methods of evaluating learners' performances.

The following are examples of different types of recording instruments:

- rating scales;
- task lists or checklists; and
- rubrics.

Each is discussed below.

Rating scales

Rating scales are any marking system where a symbol (such as A or B) or a mark (such as 5/10 or 50%) is defined in detail to link the coded score to a description of the competences that are required to achieve that score. The detail is more important than the coded score in the process of teaching and learning, as it gives learners a much clearer idea of what has been achieved and where and why their learning has fallen short of the target. Traditional marking tended to use rating scales without the descriptive details, making it difficult to have a sense of the learners' strengths and weaknesses in terms of intended outcomes. A six-point scale of achievement is used in the National Curriculum Statement Grades 10 – 12 (General).

Task lists or checklists

Task lists or checklists consist of discrete statements describing the expected performance in a particular task. When a particular statement (criterion) on the checklist can be observed as having been satisfied by a learner during a performance, the statement is ticked off. All the statements that have been ticked off on the list (as criteria that have been met) describe the learner's performance. These checklists are very useful in peer or group assessment activities.

Rubrics

Rubrics are a combination of rating codes and descriptions of standards. They consist of a hierarchy of standards with benchmarks that describe the range of acceptable performance in each code band. Rubrics require teachers to know exactly what is required by the outcome. Rubrics can be holistic, giving a global picture of the standard required, or analytic, giving a clear picture of the distinct features that make up the criteria, or can combine both. The Learning Programme Guidelines give examples of subject-specific rubrics.

To design a rubric, a teacher has to decide the following:

- Which outcomes are being targeted?
- Which Assessment Standards are targeted by the task?
- What kind of evidence should be collected?
- What are the different parts of the performance that will be assessed?
- What different assessment instruments best suit each part of the task (such as the process and the product)?
- What knowledge should be evident?
- What skills should be applied or actions taken?
- What opportunities for expressing personal opinions, values or attitudes arise in the task and which of these should be assessed and how?
- Should one rubric target all the Learning Outcomes and Assessment Standards of the task or does the task need several rubrics?
- How many rubrics are, in fact, needed for the task?

It is crucial that a teacher shares the rubric or rubrics for the task with the learners before they do the required task. The rubric clarifies what both the learning and the performance should focus on. It becomes a powerful tool for self-assessment.

Reporting performance and achievement

Reporting performance and achievement informs all those involved with or interested in the learner's progress. Once the evidence has been collected and interpreted, teachers need to record a learner's achievements. Sufficient summative assessments need to be made so that a report can make a statement about the standard achieved by the learner.

The National Curriculum Statement Grades 10 – 12 (General) adopts a six-point scale of achievement. The scale is shown in Table 4.1.

Table 4.1 Scale of achievement for the National Curriculum Statement Grades 10 – 12 (General)

Rating Code	Description of Competence	Marks (%)
6	Outstanding	80-100
5	Meritorious	60-79
4	Satisfactory	50-59
3	Adequate	40-49
2	Partial	30-39
1	Inadequate	0-29

SUBJECT COMPETENCE DESCRIPTIONS

To assist with benchmarking the achievement of Learning Outcomes in Grades 10 – 12, subject competences have been described to distinguish the grade expectations of what learners must know and be able to achieve. Six levels of competence have been described for each subject for each grade. These descriptions will assist teachers to assess learners and place them in the correct rating. The descriptions summarise the Learning Outcomes and the Assessment Standards, and give the distinguishing features that fix the achievement for a particular rating. The various achievement levels and their corresponding percentage bands are as shown in Table 4.1.

In line with the principles and practice of outcomes-based assessment, all assessment – both school-based and external – should primarily be criterion-referenced. Marks could be used in evaluating specific assessment tasks, but the tasks should be assessed against rubrics instead of simply ticking correct answers and awarding marks in terms of the number of ticks. The statements of competence for a subject describe the minimum skills, knowledge, attitudes and values that a learner should demonstrate for achievement on each level of the rating scale.

When teachers/assessors prepare an assessment task or question, they must ensure that the task or question addresses an aspect of a particular outcome. The relevant Assessment Standard or Standards must be used when creating the rubric for assessing the task or question. The descriptions clearly indicate the minimum level of attainment for each category on the rating scale.

The competence descriptions for this subject appear at the end of this chapter.

PROMOTION

Promotion at Grade 10 and Grade 11 level will be based on internal assessment only, but must be based on the same conditions as those for the Further Education and Training Certificate. The requirements, conditions, and rules of combination and condonation are spelled out in the *Qualifications and Assessment Policy Framework for the Grades 10 – 12 (General).*

WHAT REPORT CARDS SHOULD LOOK LIKE

There are many ways to structure a report card, but the simpler the report card the better, provided that all important information is included. Report cards should include information about a learner's overall progress, including the following:

- the learning achievement against outcomes;
- the learner's strengths;
- the support needed or provided where relevant;
- constructive feedback commenting on the performance in relation to the learner's previous performance and the requirements of the subject; and
- the learner's developmental progress in learning how to learn.

In addition, report cards should include the following:

- name of school;
- name of learner;
- learner's grade;
- year and term;
- space for signature of parent or guardian;
- signature of teacher and of principal;
- date;
- dates of closing and re-opening of school;
- school stamp; and
- school attendance profile of learner.

ASSESSMENT OF LEARNERS WHO EXPERIENCE BARRIERS TO LEARNING

The assessment of learners who experience any barriers to learning will be conducted in accordance with the recommended alternative and/or adaptive methods as stipulated in the *Qualifications and Assessment Policy Framework for Grades 10 – 12 (General)* as it relates to learners who experience barriers to learning. *Refer to White Paper 6 on Special Needs Education: Building an Inclusive Education and Training System.*

COMPETENCE DESCRIPTIONS FOR MATHEMATICAL LITERACY

Grade 10

Code	Scale	Competence Descriptions
6	**80%-100% Outstanding**	**By the end of Grade 10 the learner with outstanding achievement can:** ■ analyse everyday contexts to derive a range of problem statements that can be solved mathematically; ■ analyse and critically interpret information in mathematically-based representations such as graphs, tables and diagrams; ■ evaluate the logic in arguments presented in relation to everyday contexts; ■ formulate a range of questions during investigations and organise own investigations in innovative ways, integrating knowledge and skills across the Learning Outcomes in creative ways; ■ solve problems in context efficiently and accurately and be able to interpret formulas logically and justify answers and methods; ■ communicate mathematical reasoning, problem-solving processes, conclusions and predictions clearly and logically.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with outstanding achievement can:

- integrate knowledge and skills across the Learning Outcomes to solve problems and analyse situations creatively;
- evaluate the logic in arguments presented in relation to everyday contexts;
- analyse and critically interpret information in mathematically-based representations such as graphs, tables and diagrams and be able to interpret formulas and statistical measures logically;
- derive a range of problem statements that can be solved mathematically and justify answers and methods;
- investigate opportunities for entrepreneurship mathematically, working creatively with an extended range of factors;
- formulate a range of questions and organise own investigations in innovative ways;
- use mathematical terminology to communicate reasoning, problem-solving processes, conclusions and predictions clearly and logically.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with outstanding achievement can:

- critically analyse and compare aspects of real-life situations to derive a range of problem statements that can be solved mathematically;
- demonstrate solid understanding of concepts (mathematical, statistical and geometrical) in application to everyday contexts;
- communicate mathematical reasoning, problem-solving processes, conclusions and predictions clearly and with logic and derive formulae or rules from generalised methods and apply them with accuracy;
- investigate opportunities for entrepreneurship mathematically, analysing and comparing an extended range of factors and options;
- critique opinions and statements based on data collection, presentation and analysis.

Grade 10

Code	Scale
5	60%-79% Meritorious

Competence Descriptions

By the end of Grade 10 the learner with meritorious achievement can:

- analyse everyday contexts to derive simple problem statements that can be solved mathematically and devise logical ways to solve these problems where formulae are not available;
- analyse and critically interpret information in mathematically-based representations such as graphs, tables and diagrams and draw conclusions and make predictions on the basis of mathematical arguments;
- formulate a range of questions and plan and organise own investigations logically;
- present arguments which reflect a critical awareness of the use of mathematical ways of thought as related to everyday contexts.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with meritorious achievement can:

- analyse everyday contexts to derive simple problem statements that can be solved mathematically and devise logical ways to solve such problems where formulae are not available;
- analyse and critically interpret information in mathematically-based representations such as graphs, tables and diagrams;
- investigate opportunities for entrepreneurship mathematically, comparing an extended range of factors;
- formulate a range of questions and plan and organise own investigations, draw conclusions and make predictions on the basis of mathematical and statistical arguments;
- reflect a critical awareness of the use of mathematical ways of thought as related to everyday contexts.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with meritorious achievement can:

- solve any presented problem or set of related problems with competence, applying skills and knowledge attained across the Learning Outcomes and grades;
- demonstrate understanding of mathematical concepts (numerical, algebraic and geometrical) and apply them with confidence in everyday contexts;
- analyse and compare mathematically-based options in a variety of situations and present logical arguments to substantiate decisions;
- investigate opportunities for entrepreneurship mathematically, comparing an extended range of factors;
- draw conclusions and make predictions on the basis of mathematical arguments;
- apply knowledge of technological tools to solve complex problems.

Grade 10

Code	Scale
4	50%-59% Satisfactory

Competence Descriptions

By the end of Grade 10 the learner with satisfactory achievement can:

- interpret and analyse given problem statements and solve multi-step problems in a logical sequence;
- analyse and critically interpret information in mathematically-based representations such as graphs, tables and diagrams;
- select and apply appropriate formulae and interpret and justify answers and methods in relation to the problem statements;
- formulate questions and organise own activities systematically and logically;
- retain knowledge of symbols, definitions, representations, facts and information and communicate clearly using commonly understandable mathematical terminology.

Grade 11

Competence Descriptions

By the end of Grade 10 the learner with satisfactory achievement can:

- interpret and analyse problem statements and solve multi-step problems in a logical sequence;
- select and apply appropriate formulae to problem solving and interpret and justify answers and methods in relation to the problem;
- work with data and statistics to investigate and compare situations and make predictions taking into account an extended range of contributing factors;
- mathematically investigate opportunities for entrepreneurship and organise own activities systematically and logically during investigations;
- analyse and critically interpret information in mathematically-based representations such as graphs, tables and diagrams and communicate clearly using commonly understandable mathematical terminology.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with satisfactory achievement can:

- investigate problem situations (numerical, algebraic and geometrical) and choose appropriate methods to find solutions;
- correctly apply problem-solving and calculation skills and reflect on processes followed;
- communicate solutions of complex problems in clear and appropriate ways with awareness of sources of error and acceptable error margins;
- organise own investigations systematically and logically and select appropriate methods to display information in order to convey arguments;
- critically evaluate mathematically-based arguments and make recommendations.

Grade 10

Code	Scale
3	40%-49% Adequate

Competence Descriptions

By the end of Grade 10 the learner with adequate achievement can:

- interpret and analyse problem statements presented by the educator and set up a logical sequence to solve multi-step problems by estimating and measuring accurately and calculating with given algorithms and formulae;
- interpret information in mathematically-based representations such as graphs, tables and diagrams and interpret answers in relation to the problem;
- communicate clearly using commonly understandable mathematical terminology and retain knowledge of the symbols, definitions, representations, facts and information described in the Learning Outcomes;
- follow the instructions in formulating questions and organising activities during investigations.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with adequate achievement can:

- interpret and analyse given problem statements and solve multi-step problems by estimating and measuring accurately and calculating with given algorithms and formulae in a logical sequence;
- interpret answers in relation to the problem and communicate clearly using commonly understandable mathematical terminology;
- investigate opportunities for entrepreneurship mathematically, guided by the teacher, taking into account a logical range of factors, formulating questions and organising activities systematically and logically;
- work with data and statistics to compare situations and make predictions taking into account a logical range of contributing factors;
- interpret information in mathematically-based representations such as graphs, tables and diagrams.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with adequate achievement can:

- investigate and pose questions in a variety of problem situations and choose appropriate methods to find solutions;
- communicate reasoning and solutions logically in appropriate ways;
- organise own investigations systematically and logically and make appropriate inferences and recommendations based on analysis of data;
- analyse and critically interpret mathematically-based representations and statements in everyday contexts.

Grade 10

Code	Scale
2	30%-39% Partial

Competence Descriptions

By the end of Grade 10 the learner with partial achievement can:

- partially interpret given problem statements but solve multi-step contextual problems in an un-integrated way;
- estimate and measure accurately and make few errors when using given algorithms and formulae;
- partially interpret and justify answers in relation to the problem;
- partially interpret information in mathematically-based representations such as graphs, tables and diagrams;
- attempt to pose questions and organise activities during investigations;
- retain knowledge of a range of simple symbols, definitions, facts and information and attempt to communicate thinking processes in mathematical language.

Grade 11

Competence Descriptions

By the end of Grade 10 the learner with partial achievement can:

- interpret given problem statements with assistance from the educator, but solve multi-step contextual problems in an un-integrated way;
- estimate and measure accurately and make few errors when calculating with given algorithms and formulae but needs to follow instructions to investigate opportunities for entrepreneurship mathematically and to organise activities during investigations;
- work with data and statistics in a limited way to compare situations and make predictions but is only partially able to interpret information in mathematically-based representations such as graphs, tables and diagrams.
- interpret and justify answers in relation to the problem but only with clear instructions;
- retain knowledge of symbols, definitions, facts and information but can formulate arguments in a limited way only to communicate effectively.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with partial achievement can:

- apply mathematical skills (numerical, algebraic and geometrical) to solve problems in everyday context in a rote manner;
- communicate solutions to problems but in a haphazard way and is limited in selecting appropriate ways to gather, organise and analyse data to investigate situations;
- represent data graphically but struggles to make logical inferences.

Grade 10

Code	Scale
1	0%-29% Inadequate

Competence Descriptions

By the end of Grade 10 the learner with inadequate achievement can:

- interpret given problem statements but with difficulty;
- find mathematical ways to work with simple contextual problems with difficulty but confuses terminology, definitions, and specific facts;
- estimate and measure but makes some errors in measurement, estimation and calculation with algorithms and formulae;
- organise activities for an investigation but with guidance at every step and struggles to interpret and justify answers in relation to the problem posed;
- interpret mathematically (numerically and geometrically) based representations such as graphs, tables and diagrams in very simple cases.

Grade 11

Competence Descriptions

By the end of Grade 11 the learner with inadequate achievement can:

- explore and analyse situations that are numerically or geometrically based but with difficulty;
- investigate opportunities for entrepreneurship mathematically but needs constant guidance to organise activities during an investigation and does not interpret and justify answers in relation to the problem posed;
- make estimation and measurement errors and calculation errors with algorithms and formulae, confuse terminology, definitions, and specific facts, and struggle to find relationships between variables;
- interpret mathematically-based representations such as graphs, tables and diagrams with difficulty and makes badly-substantiated comparisons and predictions when working with data and statistics.

Grade 12

Competence Descriptions

By the end of Grade 12 the learner with inadequate achievement can:

- apply mathematical skills (numerical, algebraic and geometrical) to solve problems in simple everyday context but struggles to do so;
- make estimation and calculation errors and lacks ability to critically evaluate opinions and arguments based on presentations of data;
- work with given algorithms and formulae in a rote manner.

GLOSSARY

association – a general term to describe the relationship between two variables. Two variables in bivariate data are *associated* or **dependent** if the pattern of frequencies of their bivariate values cannot be explained only by the frequencies of the univariate values. In contrast, two variables are *not associated* or **independent**, if the frequencies of bivariate values can be determined simply from the frequencies of the values of each variable.

associative law/property – the property of an operation which allows for the operation to be carried out by grouping the terms differently (e.g. for addition of real numbers: $(a + b) + c = a + (b + c)$ and for multiplication $(a \times b) \times c = a \times (b \times c)$).

bar graph/diagram – a diagram that uses horizontal or vertical bars to represent the **frequency** of classes (or groups or labels) in data consisting of observations of a categorical variable. The height or length of each bar is proportional to the frequency of the corresponding class, but the thickness of a bar has no meaning. The bars are not required to touch each other, and may be separated. A bar graph is *not* a **histogram**.

bias – a distortion of the data in a set due to irregularities in the collection of the data; an unjustified tendency to favour a particular point of view.

bivariate data – two dimensions (of each object under observation) that are recorded as a pair of variables (usually to investigate or describe an **association** or correlation or relationship between the variables). Numerical bivariate data are often presented visually as a **scatter plot** on a Cartesian plane where one variable (e.g. height) is read on the vertical axis and another variable (e.g. mass) is read on the horizontal axis.

break-even point – the value of the independent variable at which the costs associated with various (two) pricing structures for a commodity become equal; the point at which expenditure and income are equal.

business confidence index – an index used to gauge the commercial world's confidence in the South African business situation.

Cartesian plane – the system whereby position in a plane is determined with reference to two axes (number lines) which are at right angles to each other and intersecting at the origin (the 0s on the number lines); any point on the plane is fixed by an ordered pair of real numbers (co-ordinates) which are the numbers the point refers to on the axes.

circumference – the (measure of) the perimeter of a circle.

commutative law/property – the property of an operation which allows for the order of the values operated with to be interchanged (e.g. for the addition of real numbers $a + b = b + a$ and for multiplication $a \times b = b \times a$).

compass direction – the direction indicated with reference to the globe of the earth as north, south, east or west; the direction in degrees from the northerly direction in an anticlockwise sense.

compound event – an **event** consisting of **compound outcomes**, from a compound experiment. We say the compound event has *occurred* at one particular repetition of the experiment when *any one* of its compound outcomes is observed.

compound growth – the accelerated effect in the manner in which a quantity increases (or decreases) due to the factor causing the increase (or decrease) also acting on the increase (or decrease) in the amount itself (e.g. the growth in the amount invested when interest is calculated on interest, as in **compound interest**).

compound interest – the calculation of the new amount A when the original amount (the principal), P, of money is subjected to interest being calculated on interest at the end of a period according to the following formula $A = P(1+i)^n$.

compound outcome – any **outcome** of a compound experiment; generally composed by a sequenced list of the outcome of each of the constituent simple experiments (e.g. throwing a head on spinning a coin and then a six and then a four on successive rolls of a die (H; 6; 4)).

conjecture – a tentative solution or generalisation inferred from collected data.

constraint – limiting condition (usually translated into a linear inequality) in a linear programming problem.

contingency table – classification of a population or group in a two-way table of qualitative (categorical) elements. The rows of the table denote the categories of the first variable and the columns denote the categories of the second variable.

continuous variable – a variable which ranges through all the real numbers on the interval applicable to it.

cumulative frequency – for data that has been ordered (from minimum to maximum values) the successive values can be assigned frequencies. The cumulative frequency for a value x is the *total count* of all the data values that are less than or equal in value to x.

data – items of information that have been observed and recorded; can be categorical (e.g. gender), numerical (e.g. age), **univariate**, **bivariate** or **multivariate,** and are often arranged in a list or table.

dependent variable – the element of the range of a function which depends on the corresponding value(s) of the domain (e.g. in $y = f(x) = \pi x^2$ the area of a circle (y) depends of the radius, x. x is the **independent variable** and y the dependent variable).

direct proportion – two variables, x and y, which are related by the equation $y = kx$, are said to be in direct proportion.

discrete variables – variables for which the values do not take on all the real numbers within the range over which they vary; a discrete variable is often associated with a count and so takes the values of the counting

numbers (e.g. 0, 1, 2, 3 …).

event – any subset of all the possible outcomes of an experiment. An event *occurs* at a particular experimental **trial** if *any one* of its constituent outcomes is the outcome observed for that trial.

exchange rate – the price of a unit of the currency of one country in terms of the currency of another.

experiment – a repeatable activity or process for which each repetition gives rise to exactly one outcome drawn from the sample space (statistical experiment); gives rise to **univariate data** on the outcome of each **trial** (e.g. the observed face of a die) (simple experiment). The number of trials observed is the sample size n.

extrapolate – to estimate an unknown quantity by projecting from the basis of what is already known, but *outside* the limits of the known data (in contrast see **interpolate).**

feasible region – the set of all points that satisfy the constraints of a linear programming problem.

frequency – a count of the number of times a particular outcome or event was observed in data with a sample size n.

frequency polygon – a polygon formed by joining the mid-points of the top of the columns of a **histogram.**

frequency table – a table reporting the groups into which data values were organised, and the **frequency** of each group.

function – a relationship between two sets of variables such that each element of the one set (the domain) is associated with a unique element of the second set (the range).

functional relationship – a relationship between variables which is a function.

global positioning system – a system using satellite and electronic technology, whereby a particular location on the earth's surface is determined in terms of its **latitude** and **longitude.**

grid – a pattern of lines usually drawn at right angles to each other to form rectangles.

grouped data – data arising from organising n observed values into a smaller number of disjoint groups of values, and counting the frequency of each group; often presented as a **frequency table** or visually as a **histogram.**

hire-purchase – the system whereby goods are bought by putting down a deposit and then periodically paying off the balance of the purchase price plus interest. Simple interest usually applies while insurance costs are commonly also included.

histogram – a visual representation used for grouped data for a numerical variable which has been divided into class intervals. The histogram consists of *adjacent* rectangles, each standing on a class interval. The area of each rectangle is proportional to the frequency of observations falling in a class interval. Class intervals are often plotted on the horizontal axis so that all have the same width, while the rectangles are vertical. Frequency density is read on the vertical axis. A **bar graph** is *not* a histogram.

independent events – the idea that two events do not connect with each other in any observable pattern, and hence that neither event can give any useful information about the other event (in contrast see **associated)**. Numerical variables that are said to be correlated are *not* independent.

independent variable – as used in dealing with functions, the value that determines the value of the **dependent variable** (e.g. in $y = f(x) = \pi x^2$ the area of a circle (y) depends on the radius, x; x is the independent variable and y the dependent variable).

index – mathematically, in the form 2^5 the 5 is referred to as the index; commercially, a variable which indicates the changes in a particular item of interest, such as the consumer price index or the **business confidence index.** Such indices are usually given a value of 100 when initially established.

inflation rate – a quantitative measure which indicates the rate at which the price of consumer goods are increasing over time.

interpolate – to estimate an unknown quantity within the limits of what is already known (in contrast see **extrapolate**).

inverse proportion – two variables, x and y, which are related to each other by the equation $y = k/x$ are said to be in inverse proportion.

latitude – the number of degrees that a location is north or south of the equator.

line of best fit – a line plotted on a **scatter plot** of data (using a least-squares method) which is 'closest to most points' of the plot.

longitude – the number of degrees that a location is east or west of a line passing through the poles and Greenwich in Britain.

median – a value that splits the sample data of a numerical variable into two parts of equal size, one part consisting of all values less than the median and one part with all values greater than the median; most easily established if the data values are arranged in increasing or decreasing order.

mode – the most frequently occurring observation in a set of data.

mortgage bond – a loan from a bank, usually for the purchase of property. The loan is subject to the payment of **compound interest** and is paid off in regular instalments which include interest and capital.

multivariate data – two or more dimensions (of each object under observation) are recorded as an ordered string of variables (often to investigate or describe any **association** or **correlation** or **relationship** between some of the variables). The data is often arranged in a rectangular format of rows and columns, where a specific column is reserved for each variable, and a row is allocated to each object that is observed (e.g. 5 rows of data, one row for the 5 variables height, mass, age, eye-colour, and gender observed for each person, and 5 columns each with n entries). Categorical variables are summarised by **frequency** counts. Numerical multivariate data are often presented two variables at a time, with a **scatter plot** for each pair.

nominal interest rate – the quoted interest rate per annum. If interest is compounded more often than once a year, the **effective rate** is greater than the nominal rate (e.g. 12% p.a. compounded monthly is equivalent to 12,68% p.a.; the nominal interest rate (i) is 0,12 and the effective interest rate is 0,1268).

ogive – a cumulative frequency curve with cumulative frequency plotted on the vertical axis against increasing values of the observed variate on the horizontal axis.

outcome – the result of an experiment (in statistics) (e.g. the outcome of an experiment in which a dice is rolled can be any one of the natural numbers 1 through 6).

percentiles – values of ranked data separated into one hundred groups of equal size, especially when sample size n is very large.

polygon – a figure in a plane formed by some number of straight sides.

probability – for equally likely outcomes, the number of favourable outcomes divided by the total number of possible outcomes of an experiment.

qualitative data – information or data arising from observations which are *not* numerical; can be categorical.

quantitative data – data with values that are numerical; can be discrete (counted) or continuous (measured).

quartiles – three values which split the ordered sample values into four groups of equal size. The second quartile is the **median**.

reflection – a transformation.

relative frequency – (of a particular **outcome** in a statistical experiment) the number of occurrences of a particular outcome divided by the number of **trials.**

right circular cone – a cone that has its vertex directly above the centre of the circular base.

right cylinder – a solid that has one axis of symmetry through the centre of the circular base and a uniform, circular cross-section.

right prism – a prism whose lateral sides are perpendicular to its base.

right pyramid – a pyramid that has its vertex directly above the centre of its base.

rotation – a transformation under which a point or shape is rotated (turned) around a fixed point

sample – in statistics, a group of data chosen from all the possible data.

scatter plot – a graph using a pair of *x*-*y* axes to represent bivariate data, each bivariate element being plotted at a position that represents its pair of values; often accompanied by a line of best fit for the data.

significant figures – the number of digits in a number, starting from the first non-zero digit and including final zeros (e.g. 0,0012340 has 5 significant figures).

standard deviation – a measure of the spread of statistical data given by the square root of the variance of the data.

symmetry – usually refers to bilateral symmetry, or the property which a plane figure has of one section of the figure being the reflection of the other in a line of symmetry.

tesseleation – a covering of the plane with shapes, often polygons and in a repetitive manner.

translation – a transformation whereby a figure is reproduced at a different location by sliding it from the original location.

tree diagrams – a diagram in which the possible outcomes of trials involving one or more events are indicated by line segments.

trial – each repetition of a statistical **experiment.**

univariate data – one-dimensional data; any quantity or attribute whose value varies from one observation to another gives rise to univariate data, which may be qualitative or quantitative.

variance – a measure of the spread of data in a sample or population involving the squares of the deviations of data values from the mean.

NATIONAL CURRICULUM STATEMENT GRADES 10-12 (GENERAL) POLICY

MATHEMATICAL LITERACY

DEPARTMENT OF EDUCATION

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