

# **General Mathematics**

## **Upper Secondary Syllabus**



Papua New Guinea  
Department of Education

Issued free to schools by the Department of Education

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# Contents

Secretary's message .....	iv
Introduction .....	1
Rationale .....	3
Curriculum principles .....	4
Aims .....	7
Strands .....	8
Learning outcomes .....	10
Unit sequence and content .....	12
Grade 11 units .....	13
Grade 12 units .....	20
Assessment components, weightings and tasks .....	27
Assessment, examinations and certification.....	28

## Secretary's message

This General Mathematics syllabus is to be used by teachers to teach Upper Secondary students (Grades 11 and 12) throughout Papua New Guinea. This syllabus builds upon concepts, skills and attitudes learnt in Lower Secondary and provides a sound foundation for further learning.

The Upper Secondary General Mathematics Syllabus contributes to integral human development as it is based on the students' physical environments, societies and cultures. It links to the National Education Plan's vision, which is that secondary education enables students to achieve their individual potential to lead productive lives as members of the local, national and international community as they will undertake a broad range of subjects and work-related activities. The Education reform aims to provide useful everyday skills for the future citizens of Papua New Guinea as well as education for an increased number of students at the Upper Secondary level. The curriculum in all Upper Secondary learning areas, including Mathematics, has been developed to reflect these major aims of the Education reform.

Mathematics is a subject which is potentially a source of great fascination and enrichment. This syllabus should enable teachers and students to set realistic, achievable goals for themselves, which in turn should lead to the sense of satisfaction that stems from successful endeavour. Today's teachers of mathematics are encouraged to value diversity and variety, to acknowledge and allow for different modes of learning, to facilitate cooperation and effective collaboration and to incorporate an intelligent use of technology into their work with students. This syllabus should provide a firm basis for productive, worthwhile classroom activity in keeping with the outcomes of education in the 21st century.

Mathematics is an immense, multi-faceted field of knowledge with a rich history, a dynamic present and an exciting future. It impacts upon the daily life of people everywhere and helps them to understand the world in which they live and work. Mathematics has always been and continues to be a vital component of a soundly based general education.

I commend and approve this syllabus as the official curriculum for General Mathematics to be used in all schools with Grades 11 and 12 students throughout Papua New Guinea.



**DR JOSEPH PAGELIO**

Secretary for Education

# Introduction

This syllabus has been designed using learning outcomes that identify the knowledge, skills, attitudes and values that all students achieve or demonstrate by the end of Grade 12. It is linked to the national curriculum learning area Mathematics and builds on the knowledge and skills students have learnt since elementary grades. This General Mathematics syllabus offers a number of pathways to post-secondary study and the workforce. It has specialised and general applications in both areas.

<b>Lower Secondary Mathematics</b>	<b>Lower Secondary Mathematics</b>	<b>Upper Secondary General Mathematics</b>
<b>Strands</b>	<b>Units</b>	<b>Units</b>
Number and application Shape and space Measurement Chance and data Patterns and algebra	Mathematics in our Community Patterns of Change Working with Data Design in 2D and 3D Geometry Managing your Money Functions and Graphs Trigonometric Applications	Number and Application Managing Money 1 Statistics 1 Geometry Trigonometry Measurement Managing Money 2 Probability and Statistics 2 Algebra and Graphs Applying Geometry in Papua New Guinean Arts

General Mathematics requires students to be competent in English. Students need to be able to read, write and speak English for research, report writing and written presentations.

Assessment is an important component of teaching for learning and is integrated into the learning and teaching activities of General Mathematics. Continuous assessment in General Mathematics provides feedback to students and the teacher on students' progress towards achievement of the learning outcomes. It helps students improve their standards of achievement by knowing what they need to do well and where they need to improve. In General Mathematics, teachers gather evidence from students' work during the course of the term and use those continuous assessments to improve their teaching and students' learning.

Mathematics is the search for patterns and relationship. This search, using acquired knowledge and skills, leads to the development of concepts and generalisations, which can be applied in finding solutions to problems, improving our understanding of the world around us and meeting the specific needs of people. It is a way of thinking, characterised by processes such as exploring, manipulating, discovering, ordering, classifying, generalising, abstracting, estimating, calculating, predicting, describing, deducing, drawing and measuring. Mathematics is a powerful, precise and concise means of communication, used to represent, to interpret, to explain and to predict. It is accordingly a creative activity. It involves invention, intuition and discovery.

HIV and AIDS is one of the greatest problems facing Papua New Guinea and all curriculum areas contribute in the fight against this disease. In mathematics much use is made of statistics and all teachers are asked to ensure that HIV and AIDS is one of the contexts used as a data source for

statistical exercises. Similarly some students may be able to use simulation processes to model the growth of the epidemic. Mathematics is able to show students the exponential nature of the spread of AIDS and so help them better understand the scale of the problem.

Calculators and computer technology are becoming increasingly available in Papua New Guinea. Schools are encouraged to use efficiently any technology they have, and to enable students to become familiar with it so they can tackle problems that use real data and are difficult to solve.

General Mathematics emphasises the development of positive attitudes towards the student's involvement in mathematics. This development is encouraged through the use of relevant personal and work-related learning experiences. There is also a focus on developing mathematical knowledge and understanding through using investigative and explorative approaches to learning. These approaches also provide opportunities to work collaboratively and cooperatively in teams as well as individually.

General Mathematics involves the study of Financial Mathematics, Applied Geometry and Statistics. These are used to develop:

- knowledge and skills of computation, estimation and measurement
- simple algebraic manipulation
- a capacity to interpret and analyse information presented in a variety of forms
- the ability to make judgements based on evidence and reasoning
- a capacity to justify and communicate results in a variety of forms.

Mathematics is an integral part of the curriculum in that it assists learning across many learning areas. Integration with other subjects should be encouraged to enable students to see the connections between mathematical skills and their use in other learning areas. Mathematics learnt at Upper Secondary level provides students with knowledge and skills that are necessary in other learning areas or fields.

General Mathematics is to be timetabled for 240–250 minutes per week in Grades 11 and 12.

## Rationale

Mathematics aims to provide useful everyday skills for the future citizens of Papua New Guinea as well as education for an increased number of students at the Upper Secondary level. Individuals who can think mathematically are empowered to operate efficiently in our increasingly complex world. Learning mathematics enables a person to develop and improve his or her intellectual competency in logical reasoning, spatial visualisation, analysis and abstract thought. Being numerate enables people to better understand the vast amounts of quantitative information produced by modern society and to recognise when mathematical techniques are misused in order to produce misleading results.

The knowledge, skills and understanding associated with mathematics have always been important to society and everyday life and are increasingly important in the 21st century.

The mathematics learnt at Upper Secondary will assist Papua New Guinea advance in the scientific and technological world. Students acquire mathematical knowledge and skills that can be applied in modern technology and in many other fields such as scientific development, physical sciences and engineering, medicine and biological sciences, geography, economics, business and management studies, industry and commerce.

Whether it is in rural or urban, paid or self-employment, mathematics provides students with a precise logical methodology for problem solving in their everyday lives. Students need the ability to use mathematics to reason and communicate, to solve everyday problems and to conduct day-to-day activities such as trading, buying and selling, weighing, measuring and estimating. The mathematics learnt also provides students with a set of skills necessary for employment in the formal and informal sectors.

The reformed Upper Secondary Mathematics curriculum reflects the aims of the Education reform, which caters for students who will not go on to tertiary institutions and also provides adequate mathematical knowledge and skills to those going on to higher educational institutions or other pathways.

## Curriculum principles

The principles of the National Curriculum Statement influence what students learn and how teachers teach. These principles are related to our way of life, integral human development and learning and teaching.

### Cultural relevance

Cultural relevance focuses on the richness and diversity of Papua New Guinean cultures, language and numeracy skills. These cultures, languages and numeracy skills are examined within their own unique contexts and within historical, contemporary and future realities. As sophisticated, organised and self-sufficient, our traditional numeracy knowledge and skills can be enhanced by the use of modern mathematical concepts. General Mathematics, therefore, enables students to:

- demonstrate an understanding and appreciation of the traditional counting and measurement systems, and traditional patterns, values, customs and traditions of Papua New Guinea
- demonstrate recognition of the importance of mathematics as a universal language, which enhances the relationship between Papua New Guinea and the world around it.

### Maintenance of vernacular language

The Department of Education's *Language Policy in Secondary Schools* states that lessons will be conducted in English, but teachers can use opportunities to further develop the mathematical concepts in vernacular (or lingua franca) skills.

### Cultural diversity

Papua New Guinea has many languages and cultures. The diversity of our cultures is the source of knowledge, skills, attitudes and Melanesian values. As a multi-cultural society, we must protect, promote and respect our cultures and languages. We must make sure we promote and share our cultures while maintaining our Melanesian cultural heritage.

### Ethics, morals and values

Papua New Guinea strives to create a society in line with democratic, liberal traditions. Papua New Guinea should therefore recognise appropriate social relationships based on sound human and religious ethics, morals and values. The process of socialisation requires a belief in the ethics, morals and values of the Melanesian societies and a willingness to conserve and promote those aspects of our traditions that are consistent with integral human development.



## **Integral human development**

### **Facilitating integral human development**

Mathematics enables students to develop their potential so individuals can solve problems, contribute positively to building and maintaining our society, and promote and improve learning and living opportunities. Each individual must strive to become an integrated person and to work with others to create a better community.

### **Nation building and national unity**

Our constitution enables principles of nation building and national unity. In the study of Mathematics, students can understand and appreciate mathematical knowledge and skills so that they may become informed citizens capable of making sound decisions in the world of work and in their personal environment.

### **Sustainability**

Our environment is threatened by issues such as population growth, HIV and AIDS and misuse or abuse of resources through exploitation and commercialisation. Mathematical knowledge and skills enable students to understand the changing society, and maintain and sustain our resources so they can be used by future generations.

## **Catering for diversity**

### **Gender**

All Upper Secondary syllabuses are designed to cater for the educational needs and interests of both males and females in a non-violent, respectful environment.

### **Students with special needs**

Mathematics caters for the needs of all students, including both gifted and learning impaired students. Teachers need to adapt learning experiences and assessment tasks to cater for students with special needs. This syllabus promotes the principles of equity through providing a diverse range of learning experiences and fair assessment practices.

## **Teaching and learning**

### **Student-centred learning**

A student-centred approach means that learning and teaching strategies need to be flexible to cater for individual differences. Learning should be relevant and meaningful to the experiences and needs of students. A student-centred approach allows teachers to be more flexible in determining the most effective ways to help all students achieve the Mathematics learning outcomes.

### **Inclusive curriculum**

All students, being individuals, have the right to quality education. An inclusive curriculum uses content, language and teaching methods that take account of all students, regardless of gender, ability, geographic location, religious and cultural background, or socioeconomic status. Teachers have a responsibility to ensure that the curriculum they teach, and the classroom practices they use, give all students the opportunity to reach their full potential.

### **Relevance**

The Mathematics syllabus will provide students with real life and relevant learning experiences. Students who leave at the end of Grade 12 will not only be prepared to undertake further formal education, but will also need to be skilled to work in both the formal and informal sectors. All students need applied and academic skills and knowledge and need to know how to adapt new technologies and knowledge appropriately to their environment.

### **Lifelong learning**

The experiences that students have in Mathematics are critical in encouraging them to continue learning. The curriculum should build on what students already know. Therefore, learning about Mathematics will continue throughout life.

## Aims

The learning and teaching of General Mathematics aims to provide students with the following knowledge, skills, processes and attitudes.

### Knowledge and skills

General Mathematics aims to:

- provide students with mathematics knowledge to use in investigating, analysing, interpreting, modelling and describing problems in the real world
- enable students to apply mathematical knowledge and skills to become informed citizens capable of making sound decisions in their personal and work environment
- enable students to use mathematics as a means of communicating powerful, concise and unambiguous information
- enable students to acquire mathematical knowledge and skills that can be applied in modern technology and in many other fields
- provide students with mathematical knowledge and skills for their personal development and future career pathways.

### Processes

General Mathematics aims to enable students to:

- reason logically, communicate mathematically and learn cooperatively and independently
- develop appropriate process skills for the acquisition and application of mathematical concepts and skills
- produce imaginative and creative work arising from mathematical ideas.

### Attitudes

General Mathematics aims to enable students to:

- develop positive attitudes to mathematics
- appreciate the power, applicability and elegance of mathematics
- appreciate that mathematics provides a means of communication that is powerful, concise and unambiguous
- appreciate the usefulness and importance of mathematics in modern technology and in many other fields.

## Strands

The strands describe the dimensions of the subject. They are broad, organising structures that define ways of approaching learning in mathematics. They incorporate cross-curriculum learning and skills and are woven through the units within Mathematics.

The content of the Mathematics subject area is organised into five strands—‘Number and application’, ‘Geometry’, ‘Measurement’, ‘Statistics’, and ‘Algebra’. Each syllabus unit focuses on one or two of these strands. Students who complete the Upper Secondary Mathematics units will have achieved the learning outcomes in all of the strands.

The study of General Mathematics is described in the following strands:

### **Number and application**

This strand deals with new understandings and applications of the concept of real numbers. Understanding and using successive decimal expansions to specify real numbers through rational functions are important extensions of the concept of decimals. These ideas are central to the definition and evaluation of general exponentials and logarithms; and to the solution of equations as infinite decimals. Students’ concept of number, particularly decimals and how they are represented, stored and manipulated is influenced by the use of calculators resulting in a more sophisticated understanding of precision, error and estimation.

### **Geometry**

This strand deals with visual learning and conceptual understanding, and the development of skills appropriate to the study of dynamic situations. Algebraic and other mathematical concepts are explored, conjectured, examined and validated geometrically in solids and tessellations. Geometric constructions can be examined using calculators and appropriate mathematical instruments. Students extend their capacity to identify, understand and develop appropriate plans to construct the actual geometry from the scale drawings.

### **Measurement**

This strand deals with the theme of ‘measures’. Aspects of measurement are found in a variety of forms such as scales, rates, ratios, angles, dimensions, precisions, location and dispersion. Understanding and using scales, in surveying and map drawing, are important extensions of the concept of scales and dimensions. Students address matters of practical importance in the everyday world.

### **Statistics and probability**

The exploration and analysis of data is the focus of this strand. It includes identifying and collecting numerical data, displaying data using tables, graphs and constructing stem and leaf plots, and cumulative frequency distribution. The analysis uses averages and variances. It introduces probability concepts of outcomes, sample spaces, probability of events, independent and dependent events and the use of probability tree diagrams.

It also covers the recognition of trends in data and the application of these ideas to make interpretations of data drawn from the wealth of statistics produced by our society.

### **Algebra**

This strand deals with data-fitting and graphical and algebraic modelling, using functions to describe and analyse change. Examining the general behaviour of functions leads to understanding translation and dilation of the given function to the Y and X – axis. Algebraic and number relationships are explored, conjectured, examined and validated financially in models and projected budgets. Students fit real data and information with an appropriate mathematical description in order to conjecture and predict how various changes might affect a dynamic situation.

### **Financial Mathematics**

This strand introduces students to the basic mathematical principles that are used in managing money in business or for use by individuals. Students investigate ways of investing and borrowing and have practice in using mathematical calculations in diverse topics such as simple and compound interests, taxation, budgeting, loans interest, inflation, investments, consumer credits and investments, and algebraically manipulate financial formulas. This strand applies algebraic concepts to financial situations.

## Learning outcomes

The General Mathematics learning outcomes identify the knowledge, skills, attitudes and values that all students achieve or demonstrate at the end of Grade 12. The learning outcomes for General Mathematics are listed below.

Students can:

1. use knowledge of numbers and their relationships to investigate a range of different contexts
2. identify, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts
3. measure and use appropriate techniques and instruments to estimate and calculate physical quantities
4. interpret, describe and represent properties of relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions
5. demonstrate the application of statistical knowledge and probability to communicate, justify, predict and critically analyse findings and draw conclusions
6. describe and explain the interrelationships between mathematical concepts
7. apply mathematical procedures including technological resources to solve practical problems in familiar and new contexts
8. communicate mathematical processes and results
9. undertake mathematical tasks individually and/or cooperatively in planning, organising, and carrying out mathematical activities.

Learning outcomes mapped against units										
Learning outcomes	Units									
	11.1	11.2	11.3	11.4	11.5	12.1	12.2	12.3	12.4	12.5
1. Use knowledge of numbers and their relationships to investigate a range of different contexts		✓					✓			
2. Identify, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts					✓	✓		✓	✓	
3. Measure and use appropriate techniques and instruments to estimate and calculate physical quantities	✓			✓		✓				
4. Interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions				✓						✓
5. Demonstrate the application of statistical knowledge and probability to communicate, justify, predict and critically analyse findings and draw conclusions			✓					✓		
6. Describe and explain the interrelationships between mathematical concepts	✓				✓				✓	✓
7. Apply mathematical procedures including technological resources to solve practical problems in familiar and new contexts		✓				✓	✓			
8. Communicate mathematical processes and results	✓	✓	✓	✓	✓		✓	✓	✓	
9. Undertake mathematical tasks individually and/or cooperatively in planning, organising, and carrying out mathematical activities	✓	✓	✓	✓	✓		✓	✓	✓	

## Unit sequence and content

Grade 11 units	Grade 12 units
<p><b>11.1 Number and Application</b> <i>10 weeks</i></p> <ul style="list-style-type: none"> <li>• Basic numeracy</li> <li>• Units of measurement</li> <li>• Ratio and proportion</li> <li>• Basic algebra</li> </ul> <p><b>11.2 Managing Money 1</b> <i>8 weeks</i></p> <ul style="list-style-type: none"> <li>• Earnings and spending</li> <li>• Budgeting and loans</li> </ul> <p><b>11.3 Statistics</b> <i>6 weeks</i></p> <ul style="list-style-type: none"> <li>• Exploring data</li> <li>• Analysis of data</li> </ul> <p><b>11.4 Geometry</b> <i>8 weeks</i></p> <ul style="list-style-type: none"> <li>• Lines, angles, triangles and regular polygons</li> <li>• Geometric construction</li> <li>• Circles</li> </ul> <p><b>11.5 Trigonometry</b> <i>8 weeks</i></p> <ul style="list-style-type: none"> <li>• Trigonometry</li> <li>• Vectors</li> </ul>	<p><b>12.1 Measurement</b> <i>6 weeks</i></p> <ul style="list-style-type: none"> <li>• Scales and dimensions</li> <li>• Surveying</li> </ul> <p><b>12.2 Managing Money 2</b> <i>8 weeks</i></p> <ul style="list-style-type: none"> <li>• Interest and inflation</li> <li>• Consumer credit</li> <li>• Investments</li> <li>• Insurance</li> <li>• Using simple algebraic manipulation of financial formulae</li> </ul> <p><b>12.3 Probability and Statistics</b> <i>6 weeks</i></p> <ul style="list-style-type: none"> <li>• Probability</li> <li>• Correlation and regression</li> </ul> <p><b>12.4 Algebra and Graphs</b> <i>6 weeks</i></p> <ul style="list-style-type: none"> <li>• Equations</li> <li>• Graphs and functions</li> </ul> <p><b>12.5 Applying Geometry in Papua New Guinean Arts</b> <i>4 weeks</i></p> <ul style="list-style-type: none"> <li>• Tessellations and polyhedra</li> </ul>



## Grade 11 units

### 11.1 Number and Application

10 weeks

This unit focuses on the mathematics used every day in our communities to measure, compare and present information numerically. It emphasises the development of real numbers and their everyday usage in learning mathematics. The content develops from the 'Number' strand. Unit learning outcomes should be developed and assessed in the context of real problems.

#### Learning outcomes

Students can:

3. measure and use appropriate techniques and instruments to estimate and calculate physical quantities
6. describe and explain the interrelationships between mathematical concepts
8. communicate mathematical processes and results
9. undertake mathematical tasks individually and/or cooperatively in planning, organising, and carrying out mathematical activities.

#### Content

Students acquire knowledge and skills through the learning and teaching of this content.

##### **Basic numeracy**

###### *Real number*

- discuss the historical development of real numbers
- classify and relate symbols to all real numbers as
- plot real numbers on a real number line
- apply the properties of real numbers (Closure, Associative, Commutative and Distributive laws)

###### *Surds*

- apply properties of surds
- simplify and rationalise surds

###### *Recurring and non-recurring decimals*

- identify decimals as recurring and non-recurring
- convert recurring decimals to fractions

*Significant figures*

- state the number of significant figures in a given number
- rounding significant figures (s.f)

*Estimation and error*

- round individual figures to 1 significant figure
- state appropriate degree of accuracy; for example, to 1 d.p, 3 s.f depending on the measurement
- list types of error and calculate error, absolute and relative error from any physical quantity measurements.

*Standard Index form (SIF)*

- state numbers in the SIF (that is,  $a \times 10^n$ ) where  $1 \leq a < 10$ ,  $n \in \mathbb{Z}$
- convert ordinary numbers to SIF and vice versa

*Indices and logarithmic laws*

- apply the four Indices laws in given expressions including base numbers
- express index numbers in logarithmic form (such as  $y = a^x$  as  $x = \log_a y$ )
- state the logarithmic laws from the four index laws
- use calculator to do logarithms of base 10

*Calculator*

- identify appropriate functions and use in all strands

**Units of measurement**

*Metric and imperial measures*

- write metric measurements of length, mass and capacity
- convert metric measurements to imperial or vice versa using length and mass quantities

*Measuring devices and scales*

- use analogue and digital devices
- identify scale division in each device

**Ratio and proportion**

- apply scales on map with actual lengths on the ground
- solve problems on direct and inverse variation

**Basic algebra**

- factorise quadratic expressions
- simplify algebraic fractions
- solve and sketch quadratic equations
- solve simultaneous equations using elimination, substitution and graphical methods
- solve inequality and plot on number line or plane

## 11.2 Managing Money 1

8 weeks

This unit focuses on the mathematics that deals with money—spending money, earning money and lending money. There is a particular emphasis on the development of mathematical knowledge and application of mathematical skills in an applied context using the business environment. Students develop practical mathematical skills, such as calculating types of incomes, taxable income and drawing up budgets, and discuss types of loans. The content develops from the ‘Number and application’ mathematics strand.

### Learning outcomes

Students can:

1. use knowledge of numbers and their relationships to investigate a range of different contexts, which include financial aspects of personal, business and national issues
7. apply mathematical procedures including technological resources to solve practical problems in familiar and new contexts
8. communicate mathematical processes and results
9. undertake mathematical tasks individually and/or cooperatively in planning, organising and carrying out mathematical activities.

### Content

Students acquire knowledge and skills through the learning and teaching of this content.

#### Earnings and spending

- calculate salaries, wages, overtime, commission, piece work and rates as earning
- calculate taxable income, goods and services tax (VAT, GST), deductions, rebates, levies, superannuation
- use foreign exchange rates to perform simple calculations

#### Budgeting and loans

- record basic income or expenditure
- estimate monthly expenses
- estimate monthly income
- explain basic ideas of cash flow
- discuss types of loans and interest rates
- calculate interest on loans

## 11.3 Statistics

6 weeks

This unit focuses on everyday data and how it is collected, presented, analysed and interpreted. Representation of different forms of data enables students to create appropriate and effective data summaries and critically interpret common methods of presentations, such as frequency tables and graphs. People in many situations use statistical data in order to make informed decisions. The local environment is used as the context for most of the application problems. Skills are developed and assessed in the context of real problems. The content develops from the 'Statistics' strand.

### Learning outcomes

Students can:

5. demonstrate the application of statistical knowledge and probability to communicate, justify, predict and critically analyse findings and draw conclusions
8. communicate mathematical processes and results
9. undertake mathematical tasks individually and/or cooperatively in planning, organising, and carrying out mathematical activities.

### Content

Students acquire knowledge and skills through the learning and teaching of this content.

#### Exploring data

- construct stem and leaf plots
- plot frequency polygons and histograms
- tabulate and plot cumulative frequency distribution
- state whether the data is skewed to the left or right of the mean
- interpolate and extrapolate and/or calculate percentile, quartile and interquartile ranges

#### Analysis of data

- calculate range, interquartile range of any given data
- list and calculate the types of deviation as mean, variance and standard deviation

## 11.4 Geometry

8 weeks

This unit focuses on mathematics that deals with shapes and properties of planes and solid figures. Mathematical skills are developed and assessed mainly in an applied context and the local environment is used as the context for most of the application problems that students undertake. Students examine, for example, the application of traditional patterns and measurement and expand their shape classification skills. The content develops from the 'Space and shape', 'Measurement' and 'Number and application' strands.

### Learning outcomes

Students can:

3. measure and use appropriate techniques and instruments to estimate and calculate physical quantities
4. interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions
8. communicate mathematical processes and results
9. undertake mathematical tasks individually and/or cooperatively in planning, organising, and carrying out mathematical activities.

### Content

Students acquire knowledge and skills through the learning and teaching of this content.

#### Lines, angles, triangles and regular polygons

- find angle sum of interior and exterior angles of regular polygons
- apply geometrical properties to find similar and congruent triangles
- properties of a polygon
- use properties to identify special quadrilaterals
- define plane and calculate angles between a line and plane (solid trigonometry)
- calculate angles between two planes
- calculate the dimensions (length or width) of any given 3D

#### Geometric construction

- use protractor and compass to construct geometric angles and shapes
- draw similar triangles using scales
- apply geometrical properties to prove congruency in triangles
- construct scale diagrams of bearings

- identify and draw common 3D shapes such as spheres, cones, pyramids and cylinders
- discuss and identify planes in truncated solids in any 3D shapes

**Circles**

- discuss circle properties and calculate the angles
- draw and measure angles in a cyclic quadrilateral or polygons
- apply chord and tangent properties to find the length of chord, radius, tangent and angles

## 11.5 Trigonometry

8 weeks

This unit focuses on trigonometry and vectors used in a wide range of activities in modern and traditional society, such as mapping and navigation. Its content develops mainly from the 'Measurement' strand. It emphasises developing the skills for navigation routes and the skills of communicating mathematical information in the students' own locality. The core component of this unit will take 8 weeks. Teachers should use their local environment as the context for the application problems set for students.

### Learning outcomes

Students can:

2. identify, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts
6. describe and explain the interrelationships between mathematical concepts
8. communicate mathematical processes and results
9. undertake mathematical tasks individually and/or cooperatively in planning, organising, and carrying out mathematical activities.

### Content

Students acquire knowledge and skills through the learning and teaching of this content.

#### Trigonometry

- measure and calculate angles of elevation and depression
- solve application problems on right-angled triangles
- derive sine and cosine rule
- apply sine and cosine rule to solve practical problems
- discuss and measure conventional and compass bearing
- discuss, illustrate and interpret contour maps
- calculate average slope and distance of contour

#### Vectors

- vector notation and position vector
- use scalar multiplication to explain and apply parallel vectors

## Grade 12 units

### 12.1 Measurement

6 weeks

This unit focuses on mathematics that deals with scales and dimension. Mathematical skills are developed and assessed mainly in an applied context and the local environment is used as the context for the surveying activities that students undertake. The content develops from the 'Measurement' strand.

#### Learning outcomes

Students can:

2. identify, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts
3. measure and use appropriate techniques and instruments to estimate and calculate physical quantities
7. apply mathematical procedures including technological resources to solve practical problems in familiar and new contexts.

#### Content

Students acquire knowledge and skills through the learning and teaching of this content.

##### Scales and dimensions

###### *Area and scales*

- calculate actual area of the field given the ratios

###### *Perimeter and area of triangles*

- calculate area of a triangle using Pythagoras' theorem
- calculate area of a triangle using the sine ratio  
 $\text{Area} = \frac{1}{2} ab \sin C$
- calculate area of a triangle using Heron's formula  
that is,  $\text{Area} = \sqrt{S(S-a)(S-b)(S-c)}$  where  $S = \frac{1}{2}(a + b + c)$

###### *Perimeter and area of polygons*

- calculate area of polygon by identifying triangular shapes

###### *Volume and surface area*

- calculate the surface area and volumes of pyramids, spheres and truncated solids



## Surveying

### *Surveying on level ground without obstacles*

- determine pace length by measuring 100m using a tape measure or metre ruler, and trundle wheel
- estimate distances and area using pace length
- define survey lines, offset, and field book
- sketch a survey field using field book
- interpret and calculate areas and perimeter using sketch or scale diagram

### *Surveying around obstacles*

- describe offset method and triangulation
- apply the methods above to survey around obstacles

## 12.2 Managing Money 2

8 weeks

This unit focuses on the mathematics that deals with money—interest, inflation, loans and investment of money. There is a particular emphasis on developing mathematical knowledge and applying mathematical skills in business contexts. Students develop practical mathematical skills such as calculating compound interest, consumer credits and finding about types of investments. The content is drawn from the ‘Financial mathematics’ strands.

### Learning outcomes

Students can:

1. use knowledge of numbers and their relationships to investigate a range of different contexts (which include financial aspects of personal, business and national issues)
7. apply mathematical procedures including technological resources to solve practical problems in familiar and new contexts
8. communicate mathematical processes and results
9. undertake mathematical tasks individually and/or cooperatively in planning, organising, and carrying out mathematical activities.

### Content

Students acquire knowledge and skills through the learning and teaching of this content.

#### Interest and inflation

- calculate compound interest for various compounding periods
- discuss and calculate inflation, appreciation and depreciation

#### Consumer credit

- personal loans and credit cards
- calculate hire-purchase
- investigate flat rate interest loan
- construct and investigate a housing (mortgage) loan repayment schedule
- list and calculate types of service fees and charges

#### Investments

- types of investments; calculate their profit and investment value
  - real estate and stock markets
- calculate the dividend of chosen stocks
- calculate the dividend on the sale of chosen properties

**Insurance**

- types of insurances, policies and premium payments
- calculate returns over a given time
- use simple manipulation of financial formulas

## 12.3 Probability and Statistics

6 weeks

This unit focuses on everyday data and how it is analysed and interpreted. People in many situations use data and probability in order to make informed decisions. To help build ideas of random sampling, the basic concepts of probability are introduced. The local environment is the context for most application problems. Content develops from the 'Statistics' and 'Number' strands. Skills are developed and assessed in real and simulated contexts.

### Learning outcomes

Students can:

2. identify, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts
5. demonstrate the application of statistical knowledge and probability to communicate, justify, predict and critically analyse findings and draw conclusions
8. communicate mathematical processes and results
9. undertake mathematical tasks individually and/or cooperatively in planning, organising, and carrying out mathematical activities.

### Content

Students acquire knowledge and skills through the learning and teaching of this content.

#### Probability

- calculate simple probability of events
- classify and calculate events as independent and dependent
- investigate and calculate events as mutually and non-mutually exclusive

#### Correlation and regression

- plot scatter diagrams
- discuss and interpret linear and non-linear relationships
- calculate the regression and correlation coefficients
- write equation of the regression line
- interpret regression and correlation coefficient in the context of the problem

## 12.4 Algebra and Graphs

6 weeks

This unit focuses on interpreting linear, quadratic and curves, particularly hyperbola, exponential, logarithmic and inequality graphs. Applications on exponential and logarithmic functions are emphasised. Mathematical skills are developed and assessed in the context of real life problems as far as possible. The content develops mainly from the 'Algebra' and the 'Number' strands.

### Learning outcomes

Students can:

2. identify, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts
6. describe and explain the interrelationships between mathematical concepts
8. communicate mathematical processes and results
9. undertake mathematical tasks individually and/or cooperatively in planning, organising, and carrying out mathematical activities.

### Content

Students acquire knowledge and skills through the learning and teaching of this content.

#### Equations

- solve linear, quadratic exponential and inequality equations
- solve word problems involving linear and quadratic expressions

#### Graphs and functions

- solve simultaneous equations graphically
- graph inequalities and shade regions
- sketch graphs of hyperbolic, exponential, logarithmic functions
- derive equations of parabolic, hyperbolic and exponentials functions
- discuss and calculate asymptote in given hyperbola, exponential, logarithmic functions
- applications of exponential and logarithmic functions

## 12.5 Applying Geometry in Papua New Guinean Arts

4 weeks

This unit focuses on mathematics that deals with shapes and patterns. Mathematical skills are developed and assessed mainly in an applied context and the local environment is used as the context for all of the application problems that students undertake. Students examine, for example, the application of traditional patterns and measurement and expand their regular polygon properties. The content is drawn from the 'Number', 'Measurement' and 'Geometry' strands.

### Learning outcomes

Students can:

4. interpret, describe and represent properties of relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions
6. describe and explain the interrelationships between mathematical concepts.

### Content

Students acquire knowledge and skills through the learning and teaching of this content.

#### Tessellations and polyhedra

- identify prisms and pyramids
- construct nets of regular polygons and solids
- identify shapes formed by joining squares (polyominoes) and equilateral triangles (polyiamonds)
- use isometric graph paper to form tessellation patterns
- use traditional arts to identify the tessellation patterns

## Assessment components, weightings and tasks

The internal assessment mark for General Mathematics is to be based on the Grade 11–12 syllabus only. Final assessment should be based on a range and balance of assessment instruments.

### Suggested components, weightings and tasks for Grade 11

Component	Weighting	Tasks
Tests and examinations	40%	These may include multiple-choice items, short answers and extended responses
Research, investigation and communication	40%	These tasks can include elements within class, particularly in the presentation phase. Tasks may be undertaken over a period of time. The communication may be written or oral
Group work	20%	Should include group-based tasks, although it may incorporate individual elements in the reporting phase. The tasks can include written reports from group research, project, group presentations, multimedia presentations and meaningful participation
<b>Marks</b>	<b>300</b>	

### Components, weightings and tasks for Grade 12

Component	Weighting	Tasks
Tests and examinations	40%	These may include multiple-choice items, short answers and extended responses
Research, investigation and communication	40%	Tasks may include student research on aspects of a traditional activity. Tasks may be undertaken over a period of time. Reported through a written document
Group work	20%	Should include group-based tasks, although it may incorporate individual elements in the reporting phase. The tasks can include written reports from group research, seminars, group presentations, multimedia presentations and meaningful participation
<b>Marks</b>	<b>300</b>	

## Assessment, examinations and certification

Assessment and reporting practices described here are detailed further in the *National Assessment and Reporting Policy for Papua New Guinea* (2003) and in other support materials produced by the Department of Education.

### Assessment

The main purpose of assessment is to improve student learning.

Assessment needs to be *for* learning as well as *of* learning. It is used to evaluate and improve learning and teaching, report achievement and provide feedback to students on their progress.

Assessment measures students' achievement of learning outcomes as described in the syllabus. It is the ongoing process of identifying, gathering and interpreting information about students' achievement of the learning outcomes.

Teaching and learning using an outcomes approach requires teachers to plan their teaching and assess learner performance in relation to outcomes, using criteria derived from those outcomes. Assessment involves focusing less on whether a learner has 'passed' or 'failed' and more on what outcomes a learner has achieved and in which areas further support is required.

### Assessment in General Mathematics

A student's achievement in General Mathematics at the end of Grade 12 will be assessed against the learning outcomes. Assessment of student progress towards achieving these learning outcomes is cumulative throughout Grades 11 and 12.

It is important that teachers plan the learning and teaching sequence so that there is a balanced spread of assessment during the year. Some tasks, such as investigations or case studies, can be designed so that they are completed over a period of time rather than at the end of the unit. Other tasks can be done immediately the relevant section of the unit or topic has been covered.

### Assessment for Certification

A student's overall achievement in General Mathematics will be both internally and externally assessed. The mark awarded to each student for the national certificate will be a combination of the internal assessment mark provided by the school and the examination mark.

#### Internal assessment

Internal assessment provides a measure of a student's achievement based on a wider range of syllabus content and outcomes than may be covered by the external examination alone.



For General Mathematics the internal assessment marks will provide a summation of each student's achievements in Grades 11 and 12. The assessment tasks used to determine the internal assessment mark must comply with the components, weightings and types of tasks specified in the tables on page 28. A variety of tasks gives students the opportunity to demonstrate all the learning outcomes in different ways to improve the validity and reliability of the assessment.

All schools must meet the requirements for internal assessment as specified in the *Grade 12 Assessment, Examination and Certification Handbook*.

### **External examination**

The external examination provides a measure of student achievement of those aspects of the learning outcomes that can be reliably measured in an examination setting. Questions for the external examination in General Mathematics will be developed using the outcomes, knowledge and skills in the syllabus.

## **Recording**

All schools must meet the requirements for maintaining and submitting student records as specified in the *Grade 12 Assessment, Examination and Certification Handbook*.

## **Certification**

Candidates will be awarded the national certificate only if they meet all requirements for internal and external assessment. Eligibility rules for the award of certificates are specified in the *Grade 12 Assessment, Examination and Certification Handbook*.