

Essential Mathematics

2018 Subject Outline

Stage 2

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INTRODUCTION

SUBJECT DESCRIPTION

Essential Mathematics is a 10-credit subject or a 20-credit subject at Stage 1, and a 20-credit subject at Stage 2.

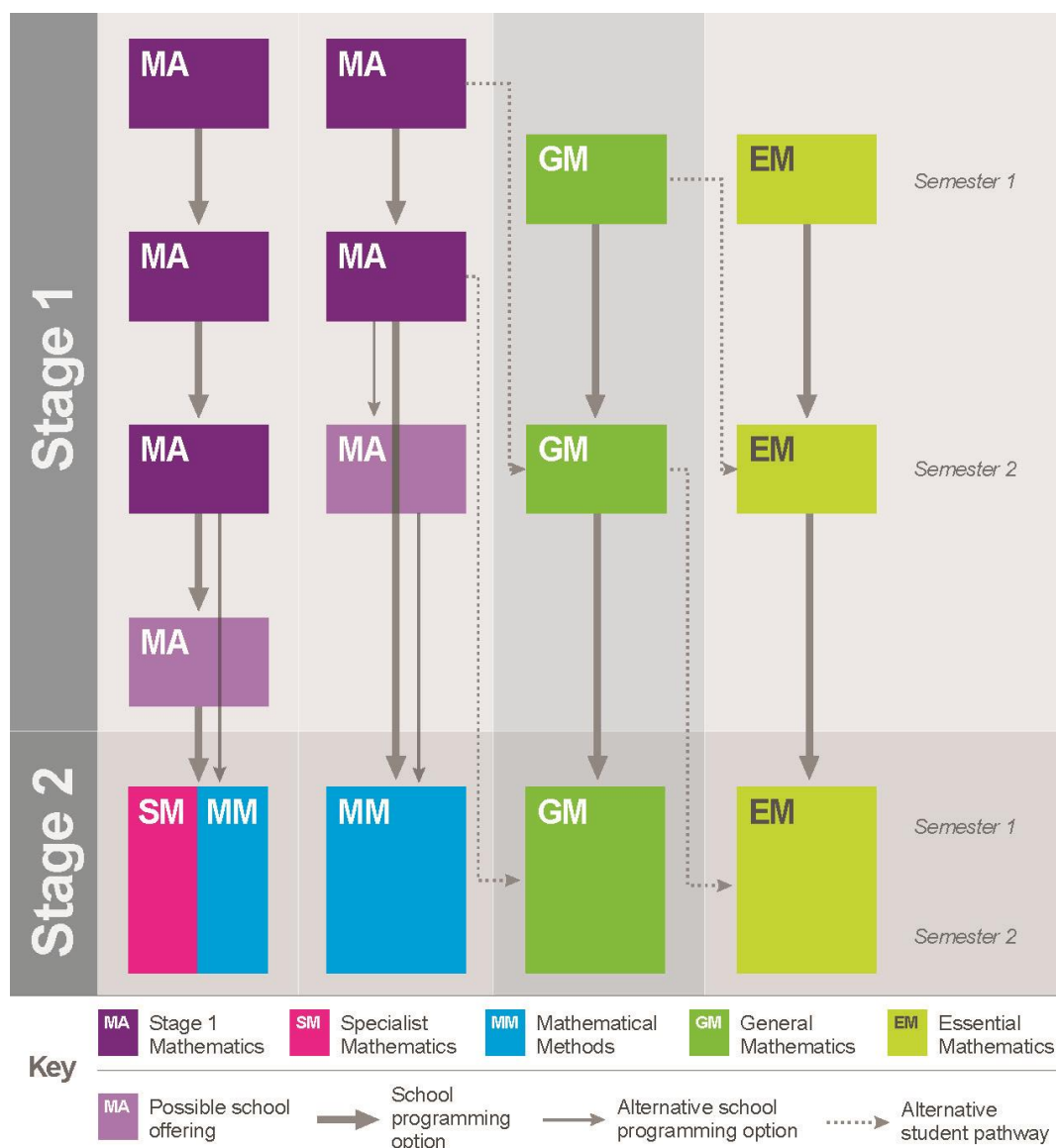
Essential Mathematics offers senior secondary students the opportunity to extend their mathematical skills in ways that apply to practical problem-solving in everyday and workplace contexts. Students apply their mathematics to diverse settings, including everyday calculations, financial management, business applications, measurement and geometry, and statistics in social contexts.

In Essential Mathematics there is an emphasis on developing students' computational skills and expanding their ability to apply their mathematical skills in flexible and resourceful ways.

This subject is intended for students planning to pursue a career in a range of trades or vocations.

MATHEMATICAL OPTIONS

The diagram below represents the possible mathematical options that students might study at Stage 1 and Stage 2.



Notes:

Although it is advantageous for students to study Australian Curriculum 10 and 10A in Year 10, the 10A curriculum per se is not a prerequisite for the study of Specialist Mathematics and Mathematical Methods. The essential aspects of 10A are included in the curriculum for Specialist Mathematics and Mathematical Methods.

Mathematical Methods can be studied as a single subject; however, Specialist Mathematics is designed to be studied together with Mathematical Methods.

CAPABILITIES

The capabilities connect student learning within and across subjects in a range of contexts. They include essential knowledge and skills that enable people to act in effective and successful ways.

The SACE identifies seven capabilities. They are:

- literacy
- numeracy
- information and communication technology (ICT) capability
- critical and creative thinking
- personal and social capability
- ethical understanding
- intercultural understanding.

Literacy

In this subject students develop their literacy capability by, for example:

- communicating mathematical reasoning and ideas for different purposes, using appropriate language and representations, such as symbols, equations, tables, and graphs
- interpreting and responding to appropriate mathematical language and representations
- analysing information and explaining mathematical results.

Mathematics provides a specialised language to describe and analyse phenomena. It provides a rich context for students to extend their ability to read, write, visualise, and talk about situations that involve investigating and solving problems.

Students apply and extend their literacy skills and strategies by using verbal, graphical, numerical, and symbolic forms of representing problems and displaying statistical information. Students learn to communicate their findings in different ways, using different systems of representation.

Numeracy

Being numerate is essential for participating in contemporary society. Students need to reason, calculate, and communicate to solve problems. Through the study of mathematics, they understand and use skills, concepts, and technologies in a range of contexts that can be applied to:

- using measurement in this physical world
- gathering, representing, interpreting, and analysing data
- using spatial sense and geometric reasoning
- investigating chance processes
- using number, number patterns, and relationships between numbers
- working with graphical, statistical and algebraic representations, and other mathematical models.

Information and communication technology (ICT) capability

In this subject students develop their information and communication technology capability by, for example:

- understanding the role of electronic technology when using mathematics
- making informed decisions about the use of electronic technology
- understanding the mathematics involved in computations carried out using technologies, so that reasonable interpretations can be made of the results.

Students extend their skills in using technology effectively and processing large amounts of quantitative information.

Students use ICT to extend their theoretical mathematical understanding and apply mathematical knowledge to a range of problems. They use software relevant for study and/or workplace contexts. This may include tools for statistical analysis, algorithm generation, data representation and manipulation, and complex calculation. They use digital tools to make connections between mathematical theory, practice, and application; for example, to use data, address problems, and operate systems in particular situations.

Critical and creative thinking

In this subject students develop critical and creative thinking by, for example:

- building confidence in applying knowledge and problem-solving skills in a range of mathematical contexts
- developing mathematical reasoning skills to think logically and make sense of the world
- understanding how to make and test projections from mathematical models
- interpreting results and drawing appropriate conclusions
- reflecting on the effectiveness of mathematical models, including the recognition of assumptions, strengths, and limitations
- using mathematics to solve practical problems and as a tool for learning
- making connections between concrete, pictorial, symbolic, verbal, written, and mental representations of mathematical ideas
- thinking abstractly, making and testing conjectures, and explaining processes.

Problem-solving in mathematics builds students' depth of conceptual understanding and supports development of critical and creative thinking. Learning through problem-solving helps students when they encounter new situations. They develop their creative and critical thinking capability by listening, discussing, conjecturing, and testing different strategies. They learn the importance of self-correction in building their conceptual understanding and mathematical skills.

Personal and social capability

In this subject students develop their personal and social capability by, for example:

- arriving at a sense of self as a capable and confident user of mathematics through expressing and presenting ideas in a variety of ways
- appreciating the usefulness of mathematical skills for life and career opportunities and achievements
- understanding the contribution of mathematics and mathematicians to society.

The elements of personal and social competence relevant to mathematics include the application of mathematical skills for informed decision-making, active citizenship, and effective self-management. Students build their personal and social competence in mathematics through setting and monitoring personal and academic goals, taking initiative, and building adaptability, communication, and teamwork.

Students use mathematics as a tool to solve problems they encounter in their personal and working lives. They acquire a repertoire of strategies and build the confidence needed to:

- meet the challenges and innovations of a changing world
- be the designers and innovators of the future, and leaders in their fields.

Ethical understanding

In this subject students develop their ethical understanding by, for example:

- gaining knowledge and understanding of ways in which mathematics can be used to support an argument or point of view
- examining critically ways in which the media present particular information and perspectives
- sharing their learning and valuing the skills of others
- considering the social consequences of making decisions based on mathematical results
- acknowledging and learning from errors rather than denying findings and/or evidence.

Areas of ethical understanding relevant to mathematics include issues associated with ethical decision-making and working collaboratively as part of students' mathematically related explorations. They develop ethical understanding in mathematics through considering social responsibility in ethical dilemmas that may arise when solving problems in personal, social, community, and/or workplace contexts.

Intercultural understanding

In this subject students develop their intercultural understanding by, for example:

- understanding mathematics as a body of knowledge that uses universal symbols that have their origins in many cultures
- understanding how mathematics assists individuals, groups, and societies to operate successfully across cultures in the global, knowledge-based economy.

Mathematics is a shared language that crosses borders and cultures, and is understood and used globally.

Students read about, represent, view, listen to, and discuss mathematical ideas. They become aware of the historical threads from different cultures that have led to the current bodies of mathematical knowledge. These opportunities allow students to create links between their own language and ideas and the formal language and symbols of mathematics.

ABORIGINAL AND TORRES STRAIT ISLANDER KNOWLEDGE, CULTURES, AND PERSPECTIVES

In partnership with Aboriginal and Torres Strait Islander communities, and schools and school sectors, the SACE Board of South Australia supports the development of high-quality learning and assessment design that respects the diverse knowledge, cultures, and perspectives of Indigenous Australians.

The SACE Board encourages teachers to include Aboriginal and Torres Strait Islander knowledge and perspectives in the design, delivery, and assessment of teaching and learning programs by:

- providing opportunities in SACE subjects for students to learn about Aboriginal and Torres Strait Islander histories, cultures, and contemporary experiences
- recognising and respecting the significant contribution of Aboriginal and Torres Strait Islander peoples to Australian society
- drawing students' attention to the value of Aboriginal and Torres Strait Islander knowledge and perspectives from the past and the present
- promoting the use of culturally appropriate protocols when engaging with and learning from Aboriginal and Torres Strait Islander peoples and communities.

SACE NUMERACY REQUIREMENT

Completion of 10 or 20 credits of Stage 1 Essential Mathematics with a C grade or better, or 20 credits of Stage 2 Essential Mathematics with a C– grade or better, will meet the numeracy requirement of the SACE.

LEARNING SCOPE AND REQUIREMENTS

LEARNING REQUIREMENTS

The learning requirements summarise the knowledge, skills, and understanding that students are expected to develop and demonstrate through learning in Stage 2 Essential Mathematics.

In this subject, students are expected to:

1. understand mathematical concepts and relationships
2. select and apply mathematical techniques and algorithms to analyse and solve problems, including forming and testing predictions
3. investigate and analyse mathematical information in a variety of contexts
4. interpret results, draw conclusions, and consider the reasonableness of solutions in context
5. make discerning use of electronic technology
6. communicate mathematically and present mathematical information in a variety of ways.

CONTENT

Stage 2 Essential Mathematics is a 20-credit subject.

In this subject students extend their mathematical skills in ways that apply to practical problem-solving in everyday and workplace contexts. A problem-based approach is integral to the development of mathematical skills and associated key ideas in this subject.

Stage 2 Essential Mathematics consists of the following six topics:

- Topic 1: Scales, plans, and models
- Topic 2: Measurement
- Topic 3: Business applications
- Topic 4: Statistics
- Topic 5: Investments and loans
- Topic 6: Open topic.

Students study five topics from the list of six topics above. All students must study Topics 2, 4, and 5.

Topics 1 to 5 consist of a number of subtopics. These are presented in the subject outline in two columns as a series of key questions and key concepts side-by-side with considerations for developing teaching and learning strategies.

Where a school chooses to undertake Topic 6: Open topic, the key questions and key concepts, considerations for developing teaching and learning strategies, and any subtopics, will need to be developed.

The key questions and key concepts cover the prescribed content for teaching, learning, and assessment in this subject. The considerations for developing teaching and learning strategies are provided as a guide only.

A problem-based approach is integral to the development of the computational models and associated key ideas in each topic. Through key questions teachers can develop the concepts and processes that relate to the mathematical models required to address the problems posed.

The considerations for developing teaching and learning strategies present suitable problems and guidelines for sequencing the development of ideas. They also give an indication of the depth of treatment and emphases required.

Although the external examination (see Assessment Type 3) will be based on the key questions and key concepts outlined in the three topics specified for examination, the considerations for developing teaching and learning strategies may provide useful contexts for examination questions.

Stage 2 Essential Mathematics prepares students with the mathematical knowledge, skills, and understanding needed for entry to a range of practical trades and vocations. In the considerations for developing teaching and learning strategies, the term 'trade' is used to suggest a context in a generic sense to cover a range of industry areas and occupations such as automotive, building and construction, electrical, hairdressing, hospitality, nursing and community services, plumbing, and retail.

Topic 1: Scales, plans, and models

Students extend their understanding of the properties of plane shapes and solids, and construct the nets of a range of three-dimensional shapes. They use scaled representations such as maps, plans, and three-dimensional models to determine full-scale measurements in practical contexts. Students develop practical skills in measuring and scaling down to create their own maps, scaled plans, or models. Comparison of lengths determined using a scale with those found by direct measurement allows students to consider the effect of errors.

Subtopic 1.1: Geometry

Key questions and key concepts

What are the properties of two-dimensional shapes?

- Number of vertices and edges

What are the properties of three-dimensional shapes?

- Number of faces, vertices, and edges

How can we recognise a three-dimensional solid from a two-dimensional representation?

- Nets

Considerations for developing teaching and learning strategies

Consideration of properties of two-dimensional shapes such as square, rectangle, rhombus, parallelogram, trapezium, circle, and triangle, includes the naming of polygons with a variety of number of sides, up to 12-sided figures.

Students identify these shapes in a range of everyday or trade contexts (e.g. different shapes in building structures such as windows, doors, and roofs).

Review the properties of three-dimensional shapes such as cube, sphere, prisms, pyramids, cylinder, and cone. Students identify these shapes in a range of everyday or trade contexts (e.g. prisms in food containers such as cereal boxes or powdered drink).

Students investigate the range of nets used to construct three-dimensional solids such as cubes, spheres, prisms, pyramids, cylinders, and cones. Students recognise the two-dimensional shapes that form the faces of the three-dimensional solids. Students name the three-dimensional shape from a net as well as draw a net for a given three-dimensional solid. Perspective diagrams allow students to extend their capacity to identify and represent three-dimensional solids.

Subtopic 1.2: Scale diagrams

Key questions and key concepts

How can scaled representations be constructed from data?

- Determining an appropriate scale
- Commonly used symbols and abbreviations
- Representing large-scale information in 2D

What information can be gained from scaled representations?

- Finding lengths, perimeters, and areas from scaled representations
- Solving problems using bearings

Considerations for developing teaching and learning strategies

Students take measurements to construct a scaled representation. These may take the form of a map of an area surveyed, such as the local park, constructing an orienteering course, a scaled plan of a site, or a diagram of an object to be constructed. Students use a clinometer or compass to measure angles, and a trundle wheel or large measuring tape to measure distances.

Discussion leads students to understand that the measurements they collect need to be displayed using a scale. Students present the collected measurements as a scale diagram using appropriate representations (e.g. scale in ratio, clear labelling, and indication of dimensions). Students construct scale diagrams by hand; however, where software packages are available these may be used to enhance students' understanding.

Students determine information from scaled representations such as lengths, perimeters, and areas. Students investigate a variety of situations in which problems could be posed, such as:

- finding the length of fencing needed for a farm paddock
- designing and costing a garden
- finding the distance between two locations on a road map
- finding a ship that is in trouble near the coast, when the same distress flare has been sighted from two different places along the coast.

Students consider the reasonableness of their answers in the context of the problem.

Key questions and key concepts

How accurate are measurements gained from scaled diagrams?

- Discussion of accuracy of measurements
- Effect of errors on calculations

Considerations for developing teaching and learning strategies

Discussion of the accuracy of measurements from a scaled representation assists in the understanding of limitations of some scale representations (e.g. a scale diagram will not allow for hills and valleys in the calculation of a distance between two towns on a map). Measurements of angles and their effect on the accuracy of measurements gained from scale diagrams should also be investigated (e.g. the effect of a small error in angle measurement is magnified by distance).

Scaled three-dimensional models may also be considered in this topic. Students determine information from plans and elevations for house constructions, or other three-dimensional objects.

Topic 2: Measurement

Students extend the concepts from Topic 5: Measurement in Stage 1 Essential Mathematics to include practical problems in two dimensions involving circles, polygons, and composite shapes, and in three dimensions involving cones, cylinders, pyramids, and spheres. Methods for estimating the size of irregular areas and volumes are investigated.

Through the study of Pythagoras' theorem and the trigonometry of right and non-right triangles, students solve for unknown sides and angles in triangle problems posed in everyday and workplace contexts. Students solve problems involving the calculation of volume, mass, and density posed in practical contexts.

Subtopic 2.1: Linear measure

Key questions and key concepts

Which metric units are appropriate for measuring linear distance in a given situation?

- For example, km, m, cm, mm
- Appropriate choice of units for linear measurement

Why convert units of measurement?

- Converting metric units of length
- Convert metric units of length to other units of length (e.g. metric measurements to imperial measurements)

When is it appropriate to use estimation?

How can you calculate the perimeter of familiar shapes?

- Circumference and perimeters of familiar shapes (triangles, squares, rectangles, polygons, circles, and arc lengths)
- Composite shapes

Considerations for developing teaching and learning strategies

Consideration of the units for measuring linear distances and their abbreviations, including very large and very small measurements, and review of the use of powers of 10 and scientific notation. Students choose appropriate units for one dimension. Specific trade examples could be covered, such as the use of millimetres as the standard measure for building plans.

Discussion of the rules for converting between metric units.

Familiarity of other length measurement systems (e.g. the imperial system, using inches, feet, and yards) may be necessary for students in certain trades. Some 'rule of thumb' conversions between other length units can be discussed and used (e.g. 1 metre is approximately equal to 3 feet).

Students estimate a variety of lengths, check their accuracy using an appropriate measuring device, and justify their choice of particular units. Where possible, the contexts should be based on every day and workplace examples, with a particular focus on trade scenarios (e.g. students pacing out distances for quote estimates and building an awareness of their level of accuracy). Discuss the different purposes of measurement and the level of accuracy required (e.g. determining the length of a fence, constructing a frame of wood for a chicken coop).

Students calculate the circumference of circles and arc lengths, and the perimeters of regular, non-regular, and composite shapes. They rearrange the formula to find the radius or diameter for circle and arc lengths. Consider notation on diagrams indicating equal lengths, and emphasise the appropriate conventions of constructing labelled diagrams. Calculations are carried out without electronic technology (where possible).

Key questions and key concepts

How can we find the lengths of missing sides when working with right-angled triangles?

- Pythagoras' theorem
- Sine, cosine, and tangent ratios
- Angle of elevation and angle of depression

How can we find the lengths of missing sides when working with non-right-angled triangles?

- Sine rule
- Cosine rule

How can unknown angles be found for right-angled and non-right-angled triangles?

Considerations for developing teaching and learning strategies

Right-angled triangles are commonly encountered in construction problems such as roof designs and trusses. Consider the use of Pythagoras' theorem, sine, cosine, and tangent ratios to provide students with tools to find the lengths of missing sides of right-angled triangles. Students use the concepts angle of elevation and angle of depression. They construct diagrams displaying information provided about angles of elevation and/or depression, and use these in solving problems.

The sine rule and cosine rule are introduced to allow for angles of non-right-angled triangles. Students use them to find the lengths of missing sides of non-right-angled triangles. These calculations require the use of electronic technology. Students are encouraged, when appropriate, to confirm their results from a scaled representation.

Students see how the formulae can be rearranged to find unknown angles in right-angled and non-right-angled triangles. Problems posed in practical contexts need not involve the ambiguous case of the sine rule.

Subtopic 2.2: Area measure

Key questions and key concepts

Which metric units are used for area and how can we convert between them?

- For example, km^2 , m^2 , cm^2 , mm^2
- Converting metric units of area

Considerations for developing teaching and learning strategies

Students discuss the most appropriate unit for measuring areas and their abbreviations.

Students choose appropriate units for the area being measured and carry out conversions between metric units of area where necessary to solve the problem. Students should be familiar with different measurements of area, such as square metres, square kilometres, hectares, and acres, and conversion of metric units of area to imperial measures of area.

Key questions and key concepts

How can we calculate areas?

- Regular shapes
- Composite shapes
- Irregular shapes. Use
 - ♦ Simpson's rule

$$A = \frac{1}{3}w(d_1 + 4d_2 + d_3)$$

- ♦ an approximation using simple mathematical shapes

Considerations for developing teaching and learning strategies

Contextual problems involving everyday and workplace scenarios will provide opportunities for students to apply formulae to solve various area calculations. The range of problems covered includes calculations of area for triangles, squares, rectangles, parallelograms, trapeziums, circles, and sectors, and composites of these shapes. Contexts such as determining the area of a floor to be covered in tiles, or the layout of a car park or playground, require students to find areas of regular and composite shapes.

Students use the following formulae to find the area of a:

- triangle $A = \frac{1}{2} \times \text{base} \times \text{height}$
- square $A = \text{length} \times \text{length}$
- rectangle $A = \text{base} \times \text{height}$
- parallelogram $A = \text{base} \times \text{perpendicular height}$
- trapezium $A = \left(\frac{a+b}{2}\right) \times \text{height}$
- circle $A = \pi r^2$
- sector of a circle $A = \left(\frac{\theta}{360}\right) \times \pi r^2$.

Where other area formulae are available (e.g. Heron's rule), their use is encouraged in order to provide variation and depth in class activities and in tasks for Assessment Type 2: Folio.

The area of irregular shapes such as kidney-shaped garden beds, fish ponds, golfing greens, or swimming pools can be calculated using Simpson's rule:

$$A = \frac{1}{3}w(L_0 + 4L_1 + 2L_2 + \dots + 4L_{n-1} + L_n),$$

where w is the distance between offsets and L_k is the length of the k th offset.

To use this method accurately L_0 and L_n must be the measurement of the strips at the ends of the irregular area, even if these lengths are of size zero. An alternative method that should be used, where appropriate, is the deconstruction of an irregular shape into regular shapes to estimate the area. Discussion of the accuracy of these methods in determining the areas of irregular shapes encourages students to consider the reasonableness of their answers, and the importance of accuracy to the original scenario.

Key questions and key concepts

How is surface area calculated?

- Cubes, rectangular- and triangular-based prisms, cylinders, pyramids, cones, and spheres
- Simple composites of these shapes

Considerations for developing teaching and learning strategies

Contextual problems involving everyday and workplace scenarios will provide opportunities for students to solve surface area problems. The range of contexts covered includes calculations of the amount of glass needed to cover a glass house, the amount of paint needed to cover a water tank. Students consider which parts of the shapes are important in the calculation (e.g. Can you paint the base of a rainwater tank?).

Students use formulae to find the surface area of the following solids:

- cubes
- rectangular-based prisms
- triangular-based prisms
- cylinders.

In Assessment Type 3: Examination, the formulae for the surface area of pyramids, cones, and spheres are provided where required.

Subtopic 2.3: Mass, volume, and capacity

Key questions and key concepts

How can we convert units of measurement used for mass?

- Converting metric units of mass

What is the relationship between volume and capacity and the relevant units?

How are the units of measurement used for volume related to measurements of capacity?

- Converting between volume and capacity (e.g. $1 \text{ cm}^3 = 1 \text{ mL}$ and $1 \text{ m}^3 = 1 \text{ kL}$)

How can we calculate the volume of solids?

- Volume of cubes, rectangular- and triangular-based prisms, cylinders, pyramids, cones, and spheres

How can we use density?

- Units of measurement for density (kg/m^3 and g/cm^3)
- Using density to determine the volume or mass of a specified material

Considerations for developing teaching and learning strategies

Students carry out conversions between tonnes, kilograms, grams, and milligrams, and select the correct units of mass for the problem posed. They discuss these measurements in various contexts, for example hospitality, nursing, and nutrition. Imperial measurements such as pounds and ounces could be considered.

Students review the relationship between volume and capacity in contexts and the appropriate metric units (kilolitre, litre, millilitre).

Students carry out a range of conversions between metric units of volume and capacity. Students convert cubic metres to litres and cubic centimetres to millilitres.

Students use formulae to find the volume and capacity of regular objects in a range of contextual problems such as the volume of a raised garden bed to determine the quantity of soil required and the volume of water in an aquarium for selection of an appropriate filter. Students choose appropriate units for the volume being measured.

Students use formulae to find the volume of the following solids:

- cubes
- rectangular-based prisms
- triangular-based prisms
- cylinders.

In Assessment Type 3: Examination, the formulae for the volume of pyramids, cones, and spheres are provided where required.

A practical approach is useful in the development of an understanding of the idea of density.

Compare solid objects with similar volume but different masses. Through experiment, students investigate the different densities of solids.

Problems considered should be posed in familiar contexts, for example, find the mass or volume of a specified material (e.g. garden soil, gravel, bark chips) to be transported, using its density. This would allow exploration of the number of loads that would need to be transported using a household trailer with a specified carrying capacity.

Topic 3: Business applications

In setting up and running a business there are several considerations: the location and spatial requirements of the premises; pricing policies and a mathematical analysis of their impact on the profitability of the business; the impact of taxation, depending on the business structure. Students investigate these physical and financial planning aspects of a small business.

Through break-even analysis a comparison can be made of the profit that can be obtained through changing fixed and variable costs or different sale prices for a particular product. Students investigate the effects of changing the initial parameters and consider the reasonableness of solutions.

In break-even problems, emphasis is placed on the use of graphing technology to facilitate solutions and provide students with opportunities to investigate 'What if ...' questions.

Subtopic 3.1: Planning a business premises

Key questions and key concepts

What factors influence a business in choosing a location for its business premises?

- Comparison of location and facilities
- Comparison of costs of premises

Considerations for developing teaching and learning strategies

A variety of retail businesses (e.g. hairdressing salon, delicatessen, real-estate firm, mechanic business, mobile dog wash) provide suitable discussion points about choice of location and facilities for a business.

The productivity of a business can depend on the location of its premises. Discussion focuses on the size of premises needed for a variety of business activities.

Consider the cost of the premises and its impact on the businesses' ability to make a profit. Carry out the cost calculations without the use of electronic technology. Provide costs in a variety of periods of time (e.g. weekly, fortnightly, monthly, quarterly, and annually).

Subtopic 3.2: Costing calculations

Key questions and key concepts

What terms may be used in describing the costing of goods to be sold?

- Manufacturer's cost, wholesaler's cost, retail cost, profit margin, discount, the goods and services tax (GST), input tax credits

How are pricing structures used to decide the price of a product?

- Trade discount based on payment terms, e.g. 7/10, 5.5/21, $n/30$
- Series discount of two or more percentage reductions, e.g. trade, cash, end of season, markdowns, end-of-line clearance
- GST
- Profit margin (mark-up)

What other factors may affect the viability of the business?

- Calculation of depreciation (straight-line and reducing balance depreciation)
- Construction of depreciation graphs
- Discussion of other insurance costs including WorkCover and public liability
- Input tax credits

Considerations for developing teaching and learning strategies

Students are introduced to the relevant terms associated with the selling of goods. Goods are produced by a manufacturer, sold to a wholesaler, and distributed to a retail business. The wholesaler then deals with a retail business. Costs are added at each stage of this process. Students could discuss when a manufacturer may sell direct to a retailer. Terms such as GST, input tax credits, profit margin, and discount are covered in relation to the retail sector.

Students calculate the pricing structure of buying and selling goods. These calculations include examples of trade discounts and series discounts. Students investigate the cost of the GST and how it affects the price of items between the manufacturer and the retailer. Examples are drawn from larger manufacturers and supply stores that are used by small business owners servicing the electronic, building, automotive, and plumbing sectors. Students determine the selling price of an item from a given profit margin.

Discussion of how businesses can use depreciation to minimise their taxation leads to consideration of what items can be depreciated, and the two methods that can be used. Calculation of the depreciation of an item using both methods allows decisions to be made about which option will better enable the business to minimise its taxation liability. Students make comparisons between the two methods using graphical methods. Initially, these graphs are constructed without the aid of electronic technology.

Students discuss insurance, another cost factor for most small businesses, and the types of insurance needed. In particular, explore WorkCover and public liability for a variety of businesses.

Investigate input tax credits/rebates and the manner in which a business can gain a rebate for previous GST payments on the items that they sell. Calculations covering the GST costs through the manufacturer, wholesaler, retailer/tradesperson, and customer chain allow students to investigate the return of GST through input tax credits.

Key questions and key concepts

What determines the break-even point?

- Calculation of fixed costs and variable costs
- Determination of break-even point graphically
- Calculation of break-even point using the marginal income

How viable is the business?

- Construction of profit and loss statements, including Cost of Goods Sold (COGS)
- Profit projections

Considerations for developing teaching and learning strategies

Students investigate the costs involved in the production of an item for sale. They identify these costs as fixed or variable. To investigate at what point a business will break even, determine the sale price of the item and carry out a break-even investigation both graphically and using the marginal income method.

Discussion of the reasonableness of the break-even point can lead to investigation of increasing or decreasing the sale price of the item or ways to reduce the fixed or variable costs. Students investigate business ideas, designing a product that can be sold to small retailers, and investigate viability through a break-even analysis.

Students understand that the profit and loss statement for a business provides an overview of the revenue and expenses incurred each financial year. Discussion covers how the figures in the statement are calculated from details of the income and costs for a business; the place of depreciation in a profit and loss statement; and why depreciation is an important factor in these calculations. Students construct a profit and loss statement from a list of expenses and revenue, including for businesses that earn their income from selling goods. This leads to questions such as: What constitutes a profit or loss?

Subtopic 3.3: Business structures and taxation

Key questions and key concepts

What are common business structures?

- Sole trader
- Partnership
- Company

How does the business structure affect the taxation liability of a business?

- Calculations comparing the taxation payable under sole trader or partnership structures, or different proportioning of ownership within the partnership

Considerations for developing teaching and learning strategies

Students understand that the legal structure of a business determines the taxation payable by the business.

Students understand that the business structure chosen can minimise the taxation liability for a business, depending on its level of taxable income. Consider a variety of income situations for the same business under both sole trader and partnership structures. Students recognise the importance of projecting future income levels and the way in which these projections can inform the setting up of the best business structure at both establishment and throughout the life of the business. For example, there may be a need to change a business structure from a sole trader to a partnership when the business grows too large to manage. Discussion of factors affecting taxation other than income tax (e.g. fringe benefits tax, Pay as You Go (PAYG), and primary producer) could cover concessions for businesses that have a turnover of less than \$2 million.

Note: The calculation of the taxation payable by a business with a company structure involves consideration of the personal taxation liability of directors as well as the company taxation liability on actual net profit, so this would be best covered in a discussion. No calculations are required.

Topic 4: Statistics

Students consider the collection of data through various methods of sampling. Emphasis is placed on the importance of eliminating bias and ensuring the validity and reliability of results used from the sample.

Two or more sets of data examining a single variable, from the same or similar populations, are compared using calculated statistics and graphical representations.

Students extend their skills introduced in Topic 4 in Stage 1 to analyse their data critically and use this analysis to form and support reasonable predictions.

Linear regression techniques are used to investigate the relationship between two variable characteristics. Students analyse data graphically and algebraically to determine the strength and nature of the relationship and use it, where appropriate, to make predictions.

Throughout this topic there is a focus on the use of electronic technology to facilitate the calculations of statistics and construction of graphs.

Subtopic 4.1: Sampling from populations

Key questions and key concepts

What is a sample and what is the purpose of sampling?

- Census
- Population
- Sample
- Survey

What are some methods of sampling?

- Simple random
- Stratified, including appropriate calculation
- Systematic
- Self-selected

What are the advantages and disadvantages of each sampling method?

Considerations for developing teaching and learning strategies

Students investigate the census through the Australian Bureau of Statistics (ABS) website (www.abs.gov.au). They develop an understanding of the purpose of the census in collecting data about the entire Australian population. The ABS's description of the 2011 census as the 'largest logistical peacetime operation ever undertaken in Australia' will form the basis of discussion of the costs and time involved in carrying out a census. Discussion of how data can be collected without the cost and time of surveying the entire population leads to a discussion of sampling. This in turn leads students to understand that sampling provides an estimate of the population values when a census is not used. Discussion of the size of a sample includes the reasonableness of the sample to reflect the views of the population.

Students explore a range of contexts where data is to be collected from an identified population via sampling, and the need for different methods of sampling to ensure that the data collected best represent the population. The problems posed relate to the students' interests and/or the community context. Students use the various methods of sampling to select a sample group from a variety of population scenarios.

Students discuss the advantages and disadvantages of each method of sampling. For example, in a self-selected sample, people or organisations choose to participate in a sample; the researcher does not approach them directly. This method of sampling may lead to a sample consisting of people with a particular point of view, leading to possible bias.

Students examine the four methods of determining samples. Discuss the validity of the results from each method of sampling for the described population. For example, a simple random sample of all employees of a business may not be appropriate if the question under consideration affects only one part of the business.

Key questions and key concepts

How can bias occur in sampling?

- Faults in the process of collecting data
- Errors in surveys:
 - ♦ sampling errors
 - ♦ measurement errors
 - ♦ coverage errors
 - ♦ non-response error

What influence does sample size have on the reliability of findings?

- Sample mean compared with population mean

Considerations for developing teaching and learning strategies

Discussion of the factors impacting on the collection of data for analysis and errors in the survey includes:

- survey questions that do not elicit the required information
- incorrect instructions given to those collecting data
- inaccuracies associated with using a sample to represent the population (sampling error)
- inaccuracies in measurement processes used to collect data (measurement error)
- inappropriate method of selecting sample (coverage error)
- inadequate sample size (coverage error)
- poor response rate (non-response error)

Students combine two samples and see what difference increasing the sample size makes to the sample mean. Using more data from the population to determine the sample mean leads to the understanding that the larger the sample size, the more closely it will reflect the population characteristics. Discuss the need to arrive at a balance between confidence in the results and the expense in cost and/or time.

Subtopic 4.2: Analysis and representation of sets of data

Key questions and key concepts

What do we do with the data now that we have collected it?

How do we compare two or more distributions?

- Calculation of measures of central tendency and spread

What is the effect of outliers on the distributions?

Which types of representation are most suitable for comparing two or more distributions?

- Stem-and-leaf plots
- Box-and-whisker diagrams

Considerations for developing teaching and learning strategies

Students discuss how the data they have collected can be analysed. For each problem, the focus is on having two sets of data from the same population, or from similar populations. Students analyse two sets of data for the testing of two products for a particular characteristic, or the size of a product being produced by two different machines.

The measures considered for comparing distributions include mean, median, range, interquartile range, and standard deviation. For smaller data sets the mean, median, range, and interquartile range can be calculated without the use of electronic technology. The use of technology for calculations of the standard deviation and for large data sets is recommended.

Emphasis is placed on the appropriateness of each measure as a representative of the particular set of data.

Students investigate the difference between resistant and non-resistant measures of central tendency and spread. Discussion of how outliers can distort the different measures of central tendency of a distribution is supported by carefully chosen examples. Students choose the measure of centre most appropriate for a given purpose and a given set of data. Investigate the identified outlier to determine if it is a 'real' piece of data or caused by an error in collection (e.g. faulty equipment, error in recording the value). Outliers should be excluded from the data set only if they can be shown to be invalid because of a data acquisition error or because the data is invalid in the context of the question.

Stem plots are useful for comparing smaller sets of data. Students select the size of stem and the treatment of data (truncation, rounding) that best shows the distribution. Discussion of the general shape and specific features of the plots is essential. Box plots are useful for larger sets of data and for comparing several distributions. Students can transfer box plots created by the calculator. Discussion of the general distribution and specific features of the plots is essential. The emphasis is on the interpretation of these representations and the comparison of two or more sets of data.

Subtopic 4.3: Linear correlation

Key questions and key concepts

Is there a linear relationship between two variables?

- Dependent and independent variable
- Patterns and features of scatter plots
- Description of association — direction, form, and strength
- Causality between variables

How can the degree of linear relationship between two variables be established?

- Pearson's correlation coefficient

When is it appropriate to draw a least squares regression line?

- Coefficient of determination (r^2)
- Least squares regression line ('line of best fit')

How may the least squares regression line be used?

Considerations for developing teaching and learning strategies

Students consider the relationship between two variables (bivariate data). Consider at least ten data pairs when constructing scatter plots. Initially, students produce the scatter plots without electronic technology, displaying approximate scales, axis labels, and approximate positioning of points. Where a strong relationship is evident, students indicate an approximate line of best fit by visual inspection and describe the direction, form, and strength of the relationship. Students understand that bivariate analysis allows the identification of a causal relationship between two variables (e.g. that one variable is a consequence of the other variable).

The scenarios chosen relate to workplace and everyday contexts, such as the amount of fertiliser used on a crop and its production of fruit, or the stopping distance for a vehicle at various speeds.

Students investigate the strength of the linear association by calculating Pearson's correlation coefficient (as indicated by r), but also realise that even a strong correlation does not imply causality.

Students understand that the square of r indicates the fraction, or percentage, of the variation in the values that is explained by least squares regression.

Students use electronic technology to calculate Pearson's correlation coefficient and the coefficient of determination to decide if the relationship is strong enough to warrant drawing a least squares regression line. If the strength of the relationship is sufficient, students determine the location of and draw the line of best fit, using electronic technology. As a guide, an $r^2 \geq 0.70$ is sufficiently large to proceed with, using a least squares regression line.

Students interpolate values and, where appropriate, extrapolate values, with an understanding of the validity of the results.

Key questions and key concepts

How do outliers affect the degree of linear relationship and the least squares regression line?

Considerations for developing teaching and learning strategies

Students note neither r nor the least squares regression line is resistant to outliers. Outliers are identified visually from the scatterplot. Removing them from the data can strengthen the correlation and improve the way the line of best fit predicts. However, it is necessary to consider carefully whether it is appropriate to do this. Any removal of outliers should be made only with reasonable justification.

Topic 5: Investments and loans

Students investigate a range of ways of investing and borrowing money. The simple and compound interest calculations from Topic 6: Investing in Stage 1 Essential Mathematics are extended by seeking the best return on a lump-sum investment. Students consider the effects of taxation and inflation on the investment return.

Annuity calculations are developed by considering that investing generally involves making regular deposits into an account, and borrowing requires regular repayments of a loan.

Emphasis is placed on the use of technology, particularly spreadsheets and financial graphical packages in a graphics calculator, to enhance students' opportunities to investigate investments and loans. The use of technology encourages students to ask and investigate 'What if ...'.

Subtopic 5.1: Lump-sum investments

Key questions and key concepts

How can you invest a lump sum of money?

- Simple interest investments
- Compound interest investments

What may impact on the earnings of the investment?

- Taxation of interest earned
- Inflation

Considerations for developing teaching and learning strategies

Consideration of earning money through investing a lump sum into an account should include both simple and compound interest calculations. As these calculations are covered in Stage 1, the focus is on rearranging the simple interest formula to find all of the variables. However, electronic technology is utilised to allow students to easily investigate problems requiring the range of variables to be found for compound interest problems. Graphical comparisons may assist students in seeing the manner in which the compounding of interest increases the growth of the accumulated savings.

Students learn interest rate terminology, including variable rates and fixed rates, and develop an understanding of the implications of the terminology to the investment.

Discussion and calculations of the impact of taxation on investment earnings and calculations of inflation provide students with an understanding of the factors that diminish the value of investment earning.

Subtopic 5.2: Annuity investments

Key questions and key concepts

What is an investment called when a regular payment is made into an account?

- Future-value annuity

What mathematics is used in calculating future-value annuities?

- Future value
- The regular deposit
- The number of periods
- The interest rate
- The interest earned by the annuity investment
- Assumptions made in long-term annuity calculations

Considerations for developing teaching and learning strategies

It is likely that students will need to save money to make a significant purchase in the future (e.g. a car or house). Introduce the idea of making a regular deposit into an account rather than investing a lump sum and waiting for it to build. Discussion of the likelihood that students will have access to a lump sum amount for investing leads students to understand that it is common to make a small regular investment as a method of building savings towards a significant purchase.

Students understand that the calculations to determine how much money a regular small investment could build up to over time require multiple applications of the simple or compound interest formula. The class constructs a spreadsheet that allows either of these formulae to be used to investigate the future value of a regular investment into a saving account.

The students are introduced to the variables that are used in the future-value annuity formula.

In Assessment Type 3: Examination, the number of compounding periods per year is equivalent to the number of payments per year for calculations of future-value annuities. However, where technology permits, different payment and compounding periods can be investigated in class and considered in tasks for Assessment Type 2: Folio.

Students use graphics calculators, spreadsheets, or other appropriate technology for their calculations.

Students investigate 'What if ...' questions with varying future values, payments, rates, and times, and consider the interest accrued after a given period.

Discuss the assumptions and limitations of these calculations.

Key questions and key concepts

What applications of future-value annuity savings plans are available? Discussion and calculations should cover:

- Long-term investments
- Superannuation

What may impact on the earnings of the future-value annuity?

- Taxation of interest earned
- Inflation

Considerations for developing teaching and learning strategies

Personal or business saving is an essential part of any investment strategy. Problems focus on scenarios such as the regular deposit of money towards a future savings goal or the investment in superannuation as a means of planning for retirement.

Calculations are related to 'What if ...' questions such as:

- What if the interest rate changes?
- What if the regular deposit amount changes?
- What if the term of the investment is extended or reduced?

Students investigate the impact of taxation on the investment earnings by calculating the tax liability. The effect of inflation on the value of investments is investigated, particularly when the investment is over a longer term. Inflation calculations involve determining the value of a savings goal, indexed for inflation.

Subtopic 5.3: Loan annuities

Key questions and key concepts

What is a present-value annuity?

What mathematics is used in calculating the cost of a loan?

- Present value
- The regular payment
- The number of periods
- The interest rate
- The interest paid
- Assumptions made in long-term annuity calculations

Considerations for developing teaching and learning strategies

It is likely that students will borrow money to purchase a car, property, or start a business. In this subtopic, students investigate the cost of a loan, and consider if it is better to take out a loan or to save the money required to purchase an item instead.

The students are introduced to variables that are used in a present-value annuity formula.

In Assessment Type 3: Examination, the number of compounding periods per year is equivalent to the number of payments per year for calculations of present-value annuities. However, where technology permits, different payment and compounding periods can be investigated in class and considered in tasks for Assessment Type 2: Folio.

Students use graphics calculators, spreadsheets, or other appropriate technology for their calculations. Students investigate 'What if ...' questions, including varying present values, payments, rates, and times.

Students use a loan simulator calculator from the internet to obtain results that they can compare with their calculated result. Examination of a loan using graphical methods highlights the high cost of interest in a loan, particularly in its early stages.

Key questions and key concepts

How can you determine the most appropriate loan option?

- Charges on loan accounts
- Comparison rates (no calculations required)

Considerations for developing teaching and learning strategies

Discussion of different loan terminology, including split loans and offset accounts, will familiarise students with the variety of options that people taking out a home loan can consider.

Students investigate strategies that can minimise the interest paid on a loan. The methods of interest minimisation that could be investigated include:

- Reducing the term
- Lump-sum payments
- Making larger repayments per period
- Making more frequent payments

Students investigate the various charges that can be levied on loan accounts. They gain an understanding that comparison rates take into account the fees and charges connected with the loan. They use comparison rates to determine the best loan option from two or more loans being investigated. Discussion focuses on the importance of factors other than the interest rate when choosing a loan. Students are not required to carry out comparison rate calculations.

Topic 6: Open topic

Schools may choose to develop a topic that is relevant to their own local context. When this option is undertaken, the open topic developed replaces either Topic 1: Scales, plans, and models or Topic 3: Business applications.

When developing an open topic, teachers should ensure that it:

- is introduced with an overview that provides a contextual framework, with an emphasis on application of the mathematics in the context
- includes an outline of the key questions and key concepts, with some consideration of the teaching and learning strategies that best relate to these questions and ideas
- is divided into subtopics, with key questions and key concepts, where appropriate
- enables students, together with the other topics for study, to develop the knowledge, skills, and understanding to meet the learning requirements of the subject
- emphasises the appropriate use of electronic technology in the teaching, learning, and assessment
- consists of content of a standard comparable to that of other topics outlined in the Stage 2 Essential Mathematics subject outline.

The open topic should relate to the needs and interests of the particular group of students for whom the topic is developed.

The topic should encourage a problem-based approach to mathematics, as this is integral to the development of the mathematical models and associated key concepts in each topic. Through the statement of key questions and key concepts, teachers can develop the concepts and processes that relate to the mathematical models required to address the problems posed. The teaching and learning strategies should give an indication of the depth of treatment and emphases required.

ASSESSMENT SCOPE AND REQUIREMENTS

All Stage 2 subjects have a school assessment component and an external assessment component.

EVIDENCE OF LEARNING

The following assessment types enable students to demonstrate their learning in Stage 2 Essential Mathematics:

School assessment (70%)

- Assessment Type 1: Skills and Applications Tasks (30%)
- Assessment Type 2: Folio (40%)

External assessment (30%)

- Assessment Type 3: Examination (30%)

Students provide evidence of their learning through eight assessments, including the external assessment component. Students undertake:

- four skills and applications tasks
- three folio tasks
- one examination.

ASSESSMENT DESIGN CRITERIA

The assessment design criteria are based on the learning requirements and are used by:

- teachers to clarify for students what they need to learn
- teachers and assessors to design opportunities for students to provide evidence of their learning at the highest possible level of achievement.

The assessment design criteria consist of specific features that:

- students should demonstrate in their learning
- teachers and assessors look for as evidence that students have met the learning requirements.

For this subject, the assessment design criteria are:

- concepts and techniques
- reasoning and communication.

The specific features of these criteria are described below.

The set of assessments as a whole gives students opportunities to demonstrate each of the specific features by the completion of study of the subject.

Concepts and Techniques

The specific features are as follows:

- CT1 Knowledge and understanding of concepts and relationships.
- CT2 Selection and application of mathematical techniques and algorithms to find solutions to problems in a variety of contexts.
- CT3 Application of mathematical models.
- CT4 Use of electronic technology to find solutions to mathematical problems.

Reasoning and Communication

The specific features are as follows:

- RC1 Interpretation of mathematical results.
- RC2 Drawing conclusions from mathematical results, with an understanding of their reasonableness and limitations.
- RC3 Use of appropriate mathematical notation, representations, and terminology.
- RC4 Communication of mathematical ideas and reasoning to develop logical arguments.
- RC5 Forming and testing of predictions*.

* In this subject the forming and testing of predictions (RC5) is not intended to include formal mathematical proof.

SCHOOL ASSESSMENT

Assessment Type 1: Skills and Applications Tasks (30%)

Students complete four skills and applications tasks, including at least one skills and applications task from each of the non-examined topics.

Skills and applications tasks are completed under the direct supervision of the teacher.

The equivalent of one skills and applications task must be undertaken without the use of either a calculator or notes.

In the remaining skills and applications tasks, electronic technology and up to one A4 sheet of handwritten notes (on one side only) may be used at the discretion of the teacher.

Students find solutions to mathematical problems that may:

- be routine, analytical, and/or interpretative
- be posed in a variety of familiar and new contexts
- require the discerning use of electronic technology.

In setting skills and applications tasks, teachers may provide students with information in written form or in the form of numerical data, diagrams, tables, or graphs. A task should require the student to demonstrate an understanding of relevant mathematical concepts and relationships.

Students select appropriate techniques or algorithms and relevant mathematical information and apply them to find solutions to routine, analytical, and/or interpretative problems. Some of these problems should be set in everyday and workplace contexts.

Students provide explanations, arguments, and use correct notation, terminology, and representation throughout the task.

Skills and applications tasks may provide opportunities to form and test predictions. Students must be given the opportunity to form and test predictions in at least one assessment task in the school assessment component.

For this assessment type, students provide evidence of their learning in relation to the following assessment design criteria:

- concepts and techniques
- reasoning and communication.

Assessment Type 2: Folio (40%)

Students complete three folio tasks.

Students, either individually or in a group, undertake planning; apply their numeracy skills to gather, represent, analyse, and interpret data; and propose or develop a solution to a mathematical problem based in an everyday or workplace context. The subject of the mathematical problem may be derived from one or more subtopics, although it can also relate to a whole topic or across topics.

A mathematical problem may be initiated by the teacher, or by a student or group of students. Teachers should give students clear advice and instructions on setting and solving the mathematical problem, and support students' progress in arriving at a mathematical solution. Where students initiate the mathematical problem, teachers should give detailed guidelines on developing a problem based on a context, theme, or topic, and give clear direction about the appropriateness of each student's choice.

If a mathematical problem is undertaken by a group, students explore the problem and gather data together to develop a model or solution individually. Each student must submit an individual model or solution.

A folio task may provide an opportunity to form and test predictions.

The folio tasks may take a variety of forms, but would usually include the following:

- an outline of the problem to be explored
- the method used to find a solution
- the application of the mathematics, including, for example:
 - generation or collection of relevant data and/or information, with a summary of the process of collection
 - mathematical calculations and results, using appropriate representations
 - discussion and interpretation of results, including consideration of the reasonableness and limitations of the results
- the results and conclusions in the context of the problem.

A bibliography and appendices, as appropriate, may be used.

The format of a folio task may be written or multimodal.

Each folio task, excluding bibliography and appendices if used, must be a maximum of eight A4 pages if written, or the equivalent in multimodal form. The maximum page limit is for single-sided A4 pages with minimum font size 10. Page reduction, such as two A4 pages reduced to fit on one A4 page, is not acceptable. Conclusions, interpretations and/or arguments that are required for the assessment must be presented in the folio task, and not in an appendix. Appendices are used only to support the folio task, and do not form part of the assessment decision.

For this assessment type, students provide evidence of their learning in relation to the following assessment design criteria:

- concepts and techniques
- reasoning and communication.

EXTERNAL ASSESSMENT

Assessment Type 3: Examination (30%)

Students undertake a 2-hour external examination in which they answer questions on the following three topics:

- Topic 2: Measurement
- Topic 4: Statistics
- Topic 5: Investments and loans.

The examination is based on the key questions and key concepts in Topics 2, 4, and 5. The considerations for developing teaching and learning strategies are provided as a guide only, although applications described under this heading may provide contexts for examination questions.

The examination consists of a range of problems, some focusing on knowledge, routine skills, and applications, and others focusing on analysis and interpretation. Students provide explanations and arguments, and use correct mathematical notation, terminology, and representation throughout the examination.

Students may take one unfolded A4 sheet (two sides) of handwritten notes into the examination room.

Students may use approved electronic technology during the external examination. However, students need to be discerning in their use of electronic technology to find solutions to questions/problems in examinations.

All specific features of the assessment design criteria for this subject may be assessed in the external examination.

PERFORMANCE STANDARDS

The performance standards describe five levels of achievement, A to E.

Each level of achievement describes the knowledge, skills, and understanding that teachers and assessors refer to in deciding how well students have demonstrated their learning, on the basis of the evidence provided.

During the teaching and learning program the teacher gives students feedback on their learning, with reference to the performance standards.

At the student's completion of study of each school assessment type, the teacher makes a decision about the quality of the student's learning by:

- referring to the performance standards
- assigning a grade between A+ and E– for the assessment type.

The student's school assessment and external assessment are combined for a final result, which is reported as a grade between A+ and E–.

Performance Standards for Stage 2 Essential Mathematics

	Concepts and Techniques	Reasoning and Communication
A	<p>Comprehensive knowledge and understanding of concepts and relationships.</p> <p>Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts.</p> <p>Successful development and application of mathematical models to find concise and accurate solutions.</p> <p>Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.</p>	<p>Comprehensive interpretation of mathematical results in the context of the problem.</p> <p>Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations.</p> <p>Proficient and accurate use of appropriate mathematical notation, representations, and terminology.</p> <p>Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments.</p> <p>Formation and testing of appropriate predictions, using sound mathematical evidence.</p>
B	<p>Some depth of knowledge and understanding of concepts and relationships.</p> <p>Mostly effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine and some complex problems in a variety of contexts.</p> <p>Attempted development and successful application of mathematical models to find mostly accurate solutions.</p> <p>Mostly appropriate and effective use of electronic technology to find mostly accurate solutions to routine and some complex problems.</p>	<p>Mostly appropriate interpretation of mathematical results in the context of the problem.</p> <p>Drawing mostly logical conclusions from mathematical results, with some depth of understanding of their reasonableness and limitations.</p> <p>Mostly accurate use of appropriate mathematical notation, representations, and terminology.</p> <p>Mostly effective communication of mathematical ideas and reasoning to develop mostly logical arguments.</p> <p>Formation and testing of mostly appropriate predictions, using some mathematical evidence.</p>
C	<p>Generally competent knowledge and understanding of concepts and relationships.</p> <p>Generally effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine problems in different contexts.</p> <p>Application of mathematical models to find generally accurate solutions.</p> <p>Generally appropriate and effective use of electronic technology to find mostly accurate solutions to routine problems.</p>	<p>Generally appropriate interpretation of mathematical results in the context of the problem.</p> <p>Drawing some logical conclusions from mathematical results, with some understanding of their reasonableness and limitations.</p> <p>Generally appropriate use of mathematical notation, representations, and terminology, with reasonable accuracy.</p> <p>Generally effective communication of mathematical ideas and reasoning to develop some logical arguments.</p> <p>Formation of an appropriate prediction and some attempt to test it using mathematical evidence.</p>

Concepts and Techniques		Reasoning and Communication
D	<p>Basic knowledge and some understanding of concepts and relationships.</p> <p>Some selection and application of mathematical techniques and algorithms to find some accurate solutions to routine problems in some contexts.</p> <p>Some application of mathematical models to find some accurate or partially accurate solutions.</p> <p>Some appropriate use of electronic technology to find some accurate solutions to routine problems.</p>	<p>Some interpretation of mathematical results.</p> <p>Drawing some conclusions from mathematical results, with some awareness of their reasonableness.</p> <p>Some appropriate use of mathematical notation, representations, and terminology, with some accuracy.</p> <p>Some communication of mathematical ideas, with attempted reasoning and/or arguments.</p> <p>Attempted formation of a prediction with limited attempt to test it using mathematical evidence.</p>
E	<p>Limited knowledge or understanding of concepts and relationships.</p> <p>Attempted selection and limited application of mathematical techniques or algorithms, with limited accuracy in solving routine problems.</p> <p>Attempted application of mathematical models, with limited accuracy.</p> <p>Attempted use of electronic technology, with limited accuracy in solving routine problems.</p>	<p>Limited interpretation of mathematical results.</p> <p>Limited understanding of the meaning of mathematical results, their reasonableness or limitations.</p> <p>Limited use of appropriate mathematical notation, representations, or terminology, with limited accuracy.</p> <p>Attempted communication of mathematical ideas, with limited reasoning.</p> <p>Limited attempt to form or test a prediction.</p>

ASSESSMENT INTEGRITY

The SACE Assuring Assessment Integrity Policy outlines the principles and processes that teachers and assessors follow to assure the integrity of student assessments. This policy is available on the SACE website (www.sace.sa.edu.au) as part of the SACE Policy Framework.

The SACE Board uses a range of quality assurance processes so that the grades awarded for student achievement, in both the school assessment and the external assessment, are applied consistently and fairly against the performance standards for a subject, and are comparable across all schools.

Information and guidelines on quality assurance in assessment at Stage 2 are available on the SACE website (www.sace.sa.edu.au)

SUPPORT MATERIALS

SUBJECT-SPECIFIC ADVICE

Online support materials are provided for each subject and updated regularly on the SACE website (www.sace.sa.edu.au). Examples of support materials are sample learning and assessment plans, annotated assessment tasks, annotated student responses, and recommended resource materials.

ADVICE ON ETHICAL STUDY AND RESEARCH

Advice for students and teachers on ethical study and research practices is available in the guidelines on the ethical conduct of research in the SACE on the SACE website (www.sace.sa.edu.au).