9 Continuum of learning in Mathematics K–10

ⓘ for your information

Stage outcomes and stage statements illustrate the continuum of learning in the *Mathematics K–10 Syllabus.*

9.1 Stage outcomes

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The continuum of learning K–10 Mathematics table is an overview of the substrands and outcomes in each of the content strands.

The concepts in each of these strands are developed across the Stages to show how understanding in the early years needs to precede understanding in later years. In this way, the continuum of learning table provides an overview of the sequence of learning for particular concepts in mathematics and links content typically taught in primary mathematics classrooms with content that is typically taught in secondary mathematics classrooms. It illustrates assumptions about prior learning and indicates pathways for further learning.

In this syllabus, it is generally the case that content is not repeated. This is intentional and is not meant to suggest that review and consolidation are not necessary. When programming, it will be necessary for teachers to determine the level of achievement of outcomes in previous Stages before planning new teaching and learning experiences. Students may be at different Stages for different strands of the continuum of learning. For example, a student may be working on Stage 4 content in Number and Algebra but be working on Stage 3 content in the Measurement and Geometry strand.

It is not intended that the continuum of learning table be used as a checklist of teaching ideas. Rather, a variety of learning experiences need to be planned and presented to students to maximise opportunities for achievement of outcomes. Students need appropriate time to explore, experiment and engage with the underpinning concepts and principles of what they are to learn.

EARLY STAGE 1				GE 4	STAGE 5.1	STAGE 5.2	STAGE 5.3
Communicating MAe-1WM describes mathematical situations using everyday language, actions, materials and informal recordings	*Communicating* MA1-1WM describes mathematical situations and methods using everyday and some mathematical language, actions, materials, diagrams and symbols	*Communicating* MA2-1WM uses appropriate terminology to describe, and symbols to represent, mathematical ideas	*Communicating* MA3-1WM describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions	*Communicating* MA4-1WM communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols	*Communicating* MA5.1-1WM uses appropriate terminology, diagrams and symbols in mathematical contexts	*Communicating* MA5.2-1WM selects appropriate notations and conventions to communicate mathematical ideas and solutions	*Communicating* MA5.3-1WM uses and interprets formal definitions and generalisations when explaining solutions and/or conjectures
Problem Solving MAe-2WM uses objects, actions, technology and/or trial and error to explore mathematical problems	*Problem Solving* MA1-2WM uses objects, diagrams and technology to explore mathematical problems	*Problem Solving* MA2-2WM selects and uses appropriate mental or written strategies, or technology, to solve problems	*Problem Solving* MA3-2WM selects and applies appropriate problem-solving strategies, including technological applications, in undertaking investigations	*Problem Solving* MA4-2WM applies appropriate mathematical techniques to solve problems	*Problem Solving* MA5.1-2WM selects and uses appropriate strategies to solve problems	*Problem Solving* MA5.2-2WM interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems	*Problem Solving* MA5.3-2WM generalises mathematical ideas and techniques to analyse and solve problems efficiently
Reasoning MAe-3WM uses concrete materials and/or pictorial representations to support conclusions	*Reasoning* MA1-3WM supports conclusions by explaining or demonstrating how answers were obtained	*Reasoning* MA2-3WM checks the accuracy of a statement and explains the reasoning used	*Reasoning* MA3-3WM gives a valid reason for supporting one possible solution over another	*Reasoning* MA4-3WM recognises and explains mathematical relationships using reasoning	*Reasoning* MA5.1-3WM provides reasoning to support conclusions which are appropriate to the context	*Reasoning* MA5.2-3WM constructs arguments to prove and justify results	*Reasoning* MA5.3-3WM uses deductive reasoning in presenting arguments and formal proofs

Continuum of learning in Mathematics K–10 *Number and Algebra*

EARLY STAGE 1	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5.1	STAGE 5.2	STAGE 5.3
Whole Numbers MAe-4NA counts to 30, and orders, reads and represents numbers in the range 0 to 20	*Whole Numbers* MA1-4NA counts, orders, reads and represents two- and three-digit numbers	*Whole Numbers* MA2-4NA orders, reads and represents numbers of up to five digits	*Whole Numbers* MA3-4NA orders, reads and represents numbers of any size				
Addition and Subtraction MAe-5NA combines, separates and compares collections of objects, describes using everyday language and records using informal methods	*Addition and Subtraction* MA1-5NA uses a range of mental strategies and informal recording methods for addition and subtraction involving one- and two-digit numbers	*Addition and Subtraction* MA2-5NA uses mental and written strategies for addition and subtraction involving two-, three- and four-digit numbers	*Addition and Subtraction* MA3-5NA selects and applies appropriate strategies for addition and subtraction with counting numbers of any size	*Computation with Integers* MA4-4NA compares, orders and calculates with integers, applying a range of strategies to aid computation			
Multiplication and Division MAe-6NA groups, shares and counts collections of objects, describes using everyday language and records using informal methods	*Multiplication and Division* MA1-6NA uses a range of mental strategies and concrete materials for multiplication and division	*Multiplication and Division* MA2-6NA uses mental and informal written strategies for multiplication and division	*Multiplication and Division* MA3-6NA selects and applies appropriate strategies for multiplication and division, and applies the order of operations to calculations involving more than one operation				
Fractions and Decimals MAe-7NA describes two equal parts as halves	*Fractions and Decimals* MA1-7NA represents and models halves, quarters and eighths	*Fractions and Decimals* MA2-7NA represents, models and compares commonly used fractions and decimals	*Fractions and Decimals* MA3-7NA compares, orders and calculates with decimals, simple fractions and simple percentages	*Fractions, Decimals and Percentages* MA4-5NA operates with fractions, decimals and percentages			
				Financial Mathematics MA4-6NA solves financial problems involving purchasing goods	*Financial Mathematics* MA5.1-4NA solves financial problems involving earning, spending and investing money	*Financial Mathematics* MA5.2-4NA solves financial problems involving compound interest	
				Proportion MA4-7NA operates with ratios and rates, and explores their graphical representation		*Proportion* MA5.2-5NA recognises direct and indirect proportion, and solves problems involving direct proportion	*Proportion* MA5.3-4NA draws, interprets and analyses graphs of physical phenomena
Patterns and Algebra MAe-8NA recognises, describes and continues repeating patterns and number patterns that increase or decrease	*Patterns and Algebra* MA1-8NA creates, represents and continues a variety of patterns, and builds and completes number relationships	*Patterns and Algebra* MA2-8NA generates number patterns and completes simple number sentences by calculating missing values	*Patterns and Algebra* MA3-8NA analyses and creates geometric and number patterns, and constructs and completes number sentences involving the four operations	*Algebraic Techniques* MA4-8NA generalises number properties to operate with algebraic expressions		*Algebraic Techniques* MA5.2-6NA simplifies algebraic fractions, and expands and factorises quadratic expressions	*Algebraic Techniques* MA5.3-5NA selects and applies appropriate algebraic techniques to operate with algebraic expressions
				Indices MA4-9NA operates with positive-integer and zero indices of numerical bases	*Indices* MA5.1-5NA operates with algebraic expressions involving positive-integer and zero indices, and establishes the meaning of negative indices for numerical bases	*Indices* MA5.2-7NA applies index laws to operate with algebraic expressions involving integer indices	*Surds and Indices* MA5.3-6NA performs operations with surds and indices
				Equations MA4-10NA uses algebraic techniques to solve simple linear equations		*Equations* MA5.2-8NA solves linear and simple quadratic equations, linear inequalities and linear simultaneous equations, using analytical and graphical techniques	*Equations* MA5.3-7NA solves complex linear, quadratic and simultaneous equations, and rearranges literal equations
				Linear Relationships MA4-11NA creates and displays number patterns; graphs and analyses linear relationships; and performs transformations on the Cartesian plane	*Linear Relationships* MA5.1-6NA determines the midpoint, gradient and length of an interval, and graphs linear relationships	*Linear Relationships* MA5.2-9NA uses the gradient-intercept form to interpret and graph linear relationships	*Linear Relationships* MA5.3-8NA uses formulas to find midpoint, gradient and distance, and applies standard forms of the equation of a straight line
					Non-linear Relationships MA5.1-7NA graphs simple non-linear relationships	*Non-linear Relationships* MA5.2-10NA connects algebraic and graphical representations of simple non-linear relationships	*Non-linear Relationships* MA5.3-9NA sketches and interprets a variety of non-linear relationships
							Polynomials MA5.3-10NA recognises, describes and sketches polynomials, and applies the factor and remainder theorems to solve problems
							Logarithms MA5.3-11NA uses the definition of a logarithm to establish and apply the laws of logarithms
							Functions and Other Graphs MA5.3-12NA uses function notation to describe and sketch functions

Continuum of learning in Mathematics K–10   **Measurement and Geometry**

EARLY STAGE 1	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5.1	STAGE 5.2	STAGE 5.3
Length MAe-9MG describes and compares lengths and distances using everyday language	*Length* MA1-9MG estimates, measures, compares and records lengths and distances using informal units, metres and centimetres	*Length* MA2-9MG estimates, measures, compares and records lengths, distances and perimeters in metres, centimetres and millimetres	*Length* MA3-9MG selects and uses the appropriate unit and device to measure lengths, distances and perimeters, and converts between units of length	*Length* MA4-12MG calculates the perimeter of plane shapes and the circumference of circles			
Area MAe-10MG describes and compares areas using everyday language	*Area* MA1-10MG estimates, measures, compares and records areas using informal units	*Area* MA2-10MG estimates, measures, compares and records areas using square centimetres and square metres	*Area* MA3-10MG selects and uses the appropriate unit to calculate areas, including the areas of squares, rectangles and triangles	*Area* MA4-13MG uses formulas to calculate the area of quadrilaterals and circles, and converts between units of area	*Area and Surface Area* MA5.1-8MG calculates the area of composite shapes, and the surface area of rectangular and triangular prisms	*Area and Surface Area* MA5.2-11MG calculates the surface area of right prisms, cylinders and related composite solids	*Area and Surface Area* MA5.3-13MG applies formulas to find the surface area of right pyramids, right cones, spheres and related composite solids
Volume and Capacity MAe-11MG describes and compares the capacities of containers and the volumes of objects or substances using everyday language	*Volume and Capacity* MA1-11MG estimates, measures, compares and records capacities and volumes using informal units	*Volume and Capacity* MA2-11MG estimates, measures, compares and records capacities and volumes using litres, millilitres and cubic centimetres	*Volume and Capacity* MA3-11MG selects and uses the appropriate unit to estimate, measure and calculate volumes and capacities, and converts between units of capacity	*Volume* MA4-14MG uses formulas to calculate the volume of prisms and cylinders, and converts between units of volume		*Volume* MA5.2-12MG applies formulas to calculate the volume of composite solids composed of right prisms and cylinders	*Volume* MA5.3-14MG applies formulas to find the volume of right pyramids, right cones, spheres and related composite solids
Mass MAe-12MG describes and compares masses of objects using everyday language	*Mass* MA1-12MG estimates, measures, compares and records masses of objects using informal units	*Mass* MA2-12MG estimates, measures, compares and records masses of objects using kilograms and grams	*Mass* MA3-12MG selects and uses the appropriate unit and device to measure masses of objects, and converts between units of mass				
Time MAe-13MG sequences events, using everyday language to describe the durations of activities, and reads hour time on clocks	*Time* MA1-13MG describes, compares and orders durations of events, and reads half- and quarter-hour time	*Time* MA2-13MG reads and records time in one-minute intervals and converts between hours, minutes and seconds	*Time* MA3-13MG uses twenty-four hour time and am and pm notation in real-life situations, and constructs timelines	*Time* MA4-15MG performs calculations of time that involve mixed units, and interprets time zones	*Numbers of Any Magnitude* MA5.1-9MG interprets very small and very large units of measurement, uses scientific notation, and rounds to significant figures		
				Right-Angled Triangles (Pythagoras) MA4-16MG applies Pythagoras' theorem to calculate side lengths in right-angled triangles, and solves related problems	*Right-Angled Triangles (Trigonometry)* MA5.1-10MG applies trigonometry, given diagrams, to solve problems, including problems involving angles of elevation and depression	*Right-Angled Triangles (Trigonometry)* MA5.2-13MG applies trigonometry to solve problems, including problems involving bearings	*Trigonometry and Pythagoras' Theorem* MA5.3-15MG applies Pythagoras' theorem, trigonometric relationships, the sine rule, the cosine rule and the area rule, to solve problems, including problems involving three dimensions
Three-Dimensional Space MAe-14MG manipulates, sorts and represents three-dimensional objects and describes them using everyday language	*Three-Dimensional Space* MA1-14MG sorts, describes, represents and recognises three-dimensional objects	*Three-Dimensional space* MA2-14MG makes, compares, sketches and names three-dimensional objects, and describes their features	*Three-Dimensional Space* MA3-14MG identifies three-dimensional objects on the basis of their properties, and visualises, sketches and constructs them given drawings of different views				
Two-Dimensional Space MAe-15MG manipulates, sorts and describes representations of two-dimensional shapes using everyday language	*Two-Dimensional Space* MA1-15MG manipulates, sorts, represents, describes and explores two-dimensional shapes	*Two-Dimensional Space* MA2-15MG manipulates, classifies and sketches two-dimensional shapes, including quadrilaterals, and describes their features	*Two-Dimensional Space* MA3-15MG manipulates, classifies and draws two-dimensional shapes, including triangles, and describes their properties	*Properties of Geometrical Figures* MA4-17MG classifies, describes and uses the properties of triangles and quadrilaterals, and determines congruent triangles to find unknown side lengths and angles	*Properties of Geometrical Figures* MA5.1-11MG describes and applies the properties of similar figures and scale drawings	*Properties of Geometrical Figures* MA5.2-14MG calculates the angle sum of any polygon and uses minimum conditions to prove triangles are congruent	*Properties of Geometrical Figures* MA5.3-16MG proves triangles are similar, and uses formal geometric reasoning to establish properties of triangles and quadrilaterals
		Angles MA2-16MG identifies, compares and describes angles	*Angles* MA3-16MG classifies, measures and constructs angles	*Angle Relationships* MA4-18MG identifies and uses angle relationships, including those related to transversals on sets of parallel lines			
Position MAe-16MG describes position and gives and follows simple directions using everyday language	*Position* MA1-16MG represents and describes the position of objects in everyday situations and on maps	*Position* MA2-17MG uses simple maps and grids to represent position and follow routes, including directions using a compass	*Position* MA3-17MG locates and describes position on maps using a grid reference system				
							Circle Geometry MA5.3-17MG applies deductive reasoning to prove circle theorems and to solve related problems

Continuum of learning in Mathematics K–10   **Statistics and Probability**

EARLY STAGE 1	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5.1	STAGE 5.2	STAGE 5.3
				Data Collection and Representation MA4-19SP collects, represents and interprets single sets of data, using appropriate statistical displays			
Data MAe-17SP represents data and interprets data displays made from objects and pictures	***Data*** MA1-17SP gathers and organises data, represents data in column and picture graphs, and interprets the results	***Data*** MA2-18SP selects appropriate data collection methods and constructs, compares and interprets data displays	***Data*** MA3-18SP uses appropriate data collection methods, constructs and interprets data displays, and analyses sets of data	***Single Variable Data Analysis*** MA4-20SP analyses single sets of data using measures of location and range	***Single Variable Data Analysis*** MA5.1-12SP uses statistical displays to compare sets of data, and evaluates statistical claims made in the media	***Single Variable Data Analysis*** MA5.2-15SP uses quartiles and box plots to compare sets of data, and evaluates sources of data	***Single Variable Data Analysis*** MA5.3-18SP uses standard deviation to analyse data
						Bivariate Data Analysis MA5.2-16SP investigates relationships between two statistical variables, including their relationship over time	***Bivariate Data Analysis*** MA5.3-19SP investigates the relationship between numerical variables using lines of best fit, and explores how data is used to inform decision making processes
	Chance MA1-18SP recognises and describes the elements of chance in everyday events	***Chance*** MA2-19SP describes and compares chance events in social and experimental contexts	***Chance*** MA3-19SP orders the likelihood of simple events using fractions	***Probability*** MA4-21SP represents probabilities of simple and compound events	***Probability*** MA5.1-13SP calculates relative frequencies to estimate probabilities of simple and compound events	***Probability*** MA5.2-17SP describes and calculates probabilities in multi-step chance experiments	

9.2   Stage Statements

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The stage statements include the Australian curriculum achievement standards and summarise the knowledge, understanding, skills, values and attitudes developed by students as a result of achieving the outcomes for each stage of learning.

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Early Stage 1
Students ask questions and use known facts to explore mathematical problems and develop fluency with mathematical ideas. They use everyday language, concrete materials and informal recordings to demonstrate understanding and link mathematical ideas.

Students count to 30 and represent numbers to 20 with objects, pictures, numerals and words. They read and use ordinal numbers to at least 'tenth' place. Students use concrete materials to model addition and subtraction, multiplication and division. They use the language of money and recognise the coins and notes of the Australian monetary system. Students divide objects into two equal parts and describe them as halves. They recognise, describe and continue patterns that increase or decrease.

Students identify length, area, volume, capacity and mass, and compare and arrange objects according to these attributes. They manipulate, sort and represent three-dimensional objects and describe them using everyday language. Students manipulate, sort and describe representations of two-dimensional shapes, identifying circles, squares, triangles and rectangles. They connect events and the days of the week and explain the order and duration of events, telling the time on the hour. Students give and follow simple directions and describe position using appropriate language.

Students answer simple questions to collect information. They use objects and pictures to create a data display and interpret data.

Stage 1
Students ask questions and use known facts, objects, diagrams and technology to explore mathematical problems and develop mathematical fluency. They link mathematical ideas and use appropriate language and diagrams to explain strategies used.

Students count, order, read and write two- and three-digit numbers and use a range of mental strategies and recording methods. They use mental strategies and concrete materials to add, subtract, multiply and divide, and solve problems. Students model and describe objects and collections divided into halves, quarters and eighths. They associate collections of Australian coins with their value and use place value to partition numbers. Students describe and continue a variety of number patterns and build number relationships. They relate addition and subtraction facts to at least 20.

Students estimate, measure, compare and record using informal units for length, area, volume and capacity and mass. They recognise the need for formal units of length and use the metre and centimetre to measure length and distance. They use a calendar to identify the date and name and order the months and the seasons of the year. Students use informal units to compare and order the duration of events and tell the time on the half- and quarter-hour. They identify, describe, sort and model particular three-dimensional objects and two-dimensional shapes. Students represent and describe the position of objects and interpret simple maps.

Students collect, organise, display and interpret data using column and picture graphs. They recognise and describe the element of chance in everyday events.

Stage 2

Students ask questions and use efficient mental and written strategies with increasing fluency to solve problems. They use technology to investigate mathematical concepts and check their solutions. Students use appropriate terminology to describe and link mathematical ideas, check statements for accuracy and explain their reasoning.

Students count, order, read and record numbers up to five-digits. They use informal and formal mental and written strategies to solve addition and subtraction problems. Students use mental strategies to recall multiplication facts up to 10 × 10 and related division facts. They use informal written strategies for multiplication and division of two-digit numbers by one-digit numbers. Students represent, model and compare commonly used fractions and decimals, and they model, compare, represent, add and subtract decimals to two decimal places. Students perform simple calculations with money and solve simple purchasing problems. They record, describe and complete number patterns and relate multiplication and division facts.

Students estimate, measure, compare, convert and record length, area, volume, capacity and mass using formal units. They read and record time in hours and minutes, convert between units of time and solve simple problems involving the duration of time. Students name, describe and sketch particular three-dimensional objects and two-dimensional shapes. They compare angles using informal means and classify angles according to their size. Students use coordinates to describe position, and compass points to give and follow directions.

Students collect and organise data, and create and interpret tables and graphs. They list probabilities of everyday events, and describe and compare chance events in social and experimental contexts.

Stage 3

Students ask questions and undertake investigations, selecting appropriate technological applications and problem-solving strategies to demonstrate fluency in mathematical techniques. They use mathematical terminology and some conventions, and they give valid reasons when comparing and selecting from possible solutions, making connections with existing knowledge and understanding.

Students select and apply appropriate mental, written or calculator strategies for the four operations and check the reasonableness of answers using estimation. They solve problems and apply the order of operations to number sentences where required. Students identify factors and multiples and recognise the properties of prime, composite, square and triangular numbers. They connect fractions, decimals and percentages as different representations of the same value. Students compare, order and perform calculations with simple fractions, decimals and percentages and apply the four operations to money in real-life situations. Students record, describe and continue geometric and number patterns and they find unknown quantities in number sentences. They locate an ordered pair in any one of the four quadrants on the Cartesian plane.

Students select and use the appropriate unit to estimate, measure and calculate length, area, volume, capacity and mass. They make connections between capacity and volume, and solve problems involving length and area. Students use 24-hour time in real-life situations, construct timelines and convert between units. They construct and classify three-dimensional objects and two-dimensional shapes and compare and describe their properties. Students describe, classify, measure and construct angles and combinations of transformations. They use a grid reference system to locate landmarks and make simple calculations using scale.

Students use appropriate data collection methods to interpret and analyse sets of data and construct a range of data displays. They assign probabilities as fractions, decimals or percentages in simple chance experiments.

Stage 4

Students use mathematical terminology, algebraic notation, diagrams, text and tables to communicate mathematical ideas, and link concepts and processes within and between mathematical contexts. They apply their mathematical skills and understanding in analysing real-life situations and in systematically exploring and solving problems using technology where appropriate. In solving particular problems, they compare the strengths and weaknesses of different strategies and solutions.

Students develop a range of mental strategies to enhance their computational skills. They operate competently with directed numbers, fractions, percentages, mixed numerals and decimals and apply these in a range of practical contexts, including problems related to GST, discounts and profit and loss. They are familiar with the concepts of ratio and rates, and apply these when solving problems. They investigate divisibility tests and use index notation for numbers with positive integral indices and explore prime factorisation, squares and related square roots.

Extending and generalising number patterns leads students into an understanding of the use of pronumerals and the language of algebra. Students simplify algebraic expressions, substitute into algebraic expressions and formulas, and expand and factorise algebraic expressions. They solve simple linear equations and apply equations to solve word problems. They develop tables of values from linear relationships and illustrate these relationships on the Cartesian plane with and without the use of ICT technology.

Students calculate the area and perimeter of a variety of polygons, circles, and simple composite figures, and solve related problems. They calculate the volume and capacity of right prisms and cylinders and solve related problems. Pythagoras' theorem is used to calculate side lengths in right-angled triangles and solve problems in two-dimensions. They describe the limit of accuracy of their measures, calculate time duration, and apply their understanding of Australian and world time zones to solve problems.

Their knowledge of the properties of two- and three-dimensional geometrical figures, angles, parallel lines, perpendicular lines, congruent figures enables them to apply logical reasoning to solve numerical exercises involving unknown lengths and angles in figures.

Students construct, interpret and compare data displays including dot plots, stem-and-leaf plots, and frequency tables and histograms. In analysing data, they consider both categorical and numerical (discrete and continuous) variables, sampling versus census, possible misrepresentation of data, and calculate the mean, mode, median and range. Students represent events using Venn diagrams and two-way tables, and calculate the probability of simple and complementary events in single-step chance experiments.

Stage 5.1

Students explain and verify mathematical relationships, select and use appropriate strategies to solve problems and link mathematical ideas to existing knowledge and understanding. They use mathematical language and notation to explain mathematical ideas, and interpret tables, diagrams and text in mathematical situations.

Students apply their knowledge of percentages, fractions and decimals to problems involving financial contexts related to earning and spending money, and simple and compound interest. They simplify and evaluate arithmetic expressions using index laws for positive and zero indices, round numbers to a specified number of significant figures and express numbers in scientific notation. Students apply the index laws to simplify algebraic expressions. They determine the midpoint, length and gradient of intervals on the Cartesian plane and draw graphs of linear and simple non-linear relationships.

Skills in measurement are further developed to include finding the areas of composite shapes and the surface areas of rectangular and triangular prisms. Students apply right-angled triangle trigonometry to practical situations including those involving angles of elevation and depression. They apply the properties of similar figures to find side lengths in problems related to similar figures.

Their statistical skills are extended to include considering shape and skewness, comparing data and their displays, and evaluating the reliability of statistical claims. Students also determine the relative

frequencies of events in chance experiments and calculate probabilities from information displayed Venn diagrams and two-way tables.

Stage 5.2

Students use mathematical arguments to reach and justify conclusions. When communicating mathematical ideas, they use appropriate mathematical language and algebraic, statistical and other notations and conventions in written, oral or graphical form. Students use suitable problem-solving strategies which include selecting and organising key information and they extend their inquiries by identifying and working on related problems.

Students apply their knowledge of percentages, fractions and decimals to problems involving conversion of rates, direct proportion and consumer situations related to compound interest and depreciation.

Students apply the index laws with integer indices to simplify expressions. They operate with algebraic fractions, expand binomial products and factorise monic quadratic expressions. They solve linear equations and monic quadratic equations, linear inequalities and linear simultaneous equations. On the Cartesian plane they draw and interpret graphs of straight lines and simple parabolas, circles, and exponentials. Formulas are used to calculate distance, gradient and midpoint on the Cartesian plane. Students determine the equations of straight lines and use the properties of parallel and perpendicular lines on the Cartesian plane.

Students extend their skills in measurement to solve problems involving of the area of complex composite figures, the volume of composite solids, and the surface area of cylinders and composite solids. Students use trigonometric ratios to solve problems in which angles can be measured to the nearest second, and problems involving bearings and. In geometry, they use deductive reasoning in numerical and non-numerical problems drawing on their knowledge of the properties of congruent triangles, the angle properties of polygons and the properties of quadrilaterals.

Statistical skills are extended to include the construction of box-and-whisker plots and calculation of interquartile range to analyse and compare data sets using appropriate data displays. Students investigate bivariate data sets and use scatter plots to describe relationships between variables. They evaluate the sources of data in statistical reports. In probability, students record and determine probabilities of events in multi-step chance experiments and examine conditional language.

Stage 5.3

Students use deductive reasoning in problem solving and in presenting arguments and formal proofs. They interpret and apply formal definitions and generalisations and connect and apply mathematical ideas within and across substrands.

Students operate with irrational numbers and extend their knowledge of the number system to include all real numbers. They use algebra to analyse and describe physical phenomena and rates of change. Algebraic skills are extended to expanding the special binomial products and factorising non-monic quadratic expressions using a variety of techniques. Students solve complex linear equations, non-monic quadratic equations and simultaneous equations. They change the subject of literal equations. They generate, describe and graph equations of straight lines, parabolas, cubics, hyperbolas, circles and exponential functions.

Students solve problems involving the surface areas and volumes of pyramids, cones and spheres and related composite solids. They explore similarity relationships for area and volume. They determine exact trigonometric ratios for 30°, 45° and 60°, extend trigonometric ratios to obtuse angles and sketch sine and cosine curves for angular values from 0° to 360°. Students apply the sine and cosine rules for finding unknown angles and/or sides in non-right-angled triangles. They use Pythagoras theorem and trigonometry to solve problems in three dimensions.

Their knowledge of a wide range of geometrical facts and relationships is used to prove general statements in geometry, extending the concepts of similarity and congruence to more generalised applications. Students prove known properties of triangles, quadrilaterals and circles.

Students use standard deviation to analyse data, and extrapolate and interpolate from bivariate data using lines of best fit. They investigate statistical reports for information on the planning and implementation.