Year 7 to 10

Mathematics

September 2022

Scope and sequence

Revised to align with the Australian Curriculum V9.0 (2022)

V2.0

Government of South Australia
Department for Education

Mathematics: Year 7 to 10

Contents

Context statement

The Mathematics curriculum is organised around the interaction of three content strands and four proficiency strands. The content strands are number and algebra, measurement and geometry, and statistics and probability.

The Mathematics curriculum is taught through the proficiency strands of understanding, fluency, problem-solving and reasoning. They indicate the breadth of mathematical actions that teachers can emphasise. They describe how content is explored or developed.

Mathematics aims to instil in students an appreciation of the elegance and power of mathematical reasoning. Students are reasoning mathematically when they explain their thinking, when they deduce and justify strategies used and when they compare and contrast ideas and explain their choices.

Links between the various components of mathematics are made clear and taught as interconnected skills.

Students need to be supported to build a robust knowledge of adaptable and transferable mathematical concepts. They need to make connections between related concepts and become confident, creative users and communicators of mathematics.

The South Australian Mathematics Scope and Sequence R to 10:

- provides the achievement standards positioned with related strands; number and algebra, measurement and geometry, statistics and probability
- makes the relationship between achievement standards and content explicit through listing the achievement standards alongside the relevant content descriptors
- emphasises the progression of skills by highlighting the verbs to emphasise the development of skills across the curriculum
- supports clarity by breaking achievement standards into dot points
- provides the sequence of content and sequence of achievement
- includes content descriptors listed with their associated elaborations.

Achievement standards

Strand: Number

The Number strand develops ways of working with mental constructs that deal with correspondence, magnitude and order, for which operations and their properties can be defined. Numbers have wide ranging application and specific uses in counting, measuring and other means of quantifying situations and objects. Number systems are constructed to deal with different contexts and problems involving finite and infinite, discrete and continuous sets. Developing number sense and the ability to work effectively with numbers is critical to being an active and productive citizen who is successful at work and in future learning, who is financially literate, and who engages with the world and other individuals.

Year 7	Year 8	Year 9	Year 10 and Year 10A Mathematics Pathways
Skills By the end of Year 7, students: • represent natural numbers in expanded form and as products of prime factors, using exponent notation • solve problems involving ○ squares of numbers and ○ square roots of perfect square numbers • solve problems involving addition and subtraction of integers • use all 4 operations in calculations involving positive fractions and decimals • choose efficient calculation strategies • choose between equivalent representations of rational numbers and percentages to assist in calculations • use mathematical modelling to solve practical problems involving ○ rational numbers ○ percentages ○ ratios in financial ○ other applied contexts justifying choices of representation.	**Skills** By the end of Year 8, students: • recognise irrational numbers and terminating or recurring decimals • apply the exponent laws to calculations with numbers involving positive integer exponents • solve problems involving the 4 operations with integers and positive rational numbers • use mathematical modelling to solve practical problems involving ○ ratios ○ percentages ○ rates in measurement and financial contexts.	**Skills** By the end of Year 9, students: • recognise and use rational and irrational numbers to solve problems • extend and apply the exponent laws with positive integers to variables.	**Skills** By the end of Year 10, students: • recognise the effect of approximations of real numbers in repeated calculations.

Scope and sequence

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Describe the relationship between perfect square numbers and square roots, and **use** squares of numbers and square roots of perfect square numbers to **solve** problems • **investigate** squares of natural numbers from 1 to 20, and connect them to visual representations such as dots arranged in a square pattern • **use** the square and square root notation, and the distributive property and area diagrams to calculate the squares of two-digit numbers; for example, $43^2 = (40+3)^2$ $= 40^2 + 2 \times 40 \times 3 + 3^2$ $= 1600 + 240 + 9$ $= 1849$ • **determine** between which 2 consecutive natural numbers the square root of a given number lies; for example, 43 is between the square numbers 36 and 49 so $\sqrt{43}$ is between $\sqrt{36}$ and $\sqrt{49}$ and therefore between 6 and 7 • **generate** a list of perfect square numbers and describe any emerging patterns; for example, the last digit of perfect square numbers, or the difference between consecutive square numbers, and recognising the constant second difference • **use** the relationship between perfect square numbers and their square roots	**Recognise** irrational numbers in applied contexts, including square roots and π • **recognise** that the real number system includes irrational numbers which can be approximately located on the real number line; for example, the value of π lies somewhere between 3.141 and 3.142 that is, $3.141 < \pi < 3.142$ • **explore** the decimal representation of π as an irrational number that is neither terminating nor recurring • **use digital tools to** systematically explore contexts or situations that use irrational numbers, such as ◦ finding the length of the hypotenuse in a right-angled triangle with the other 2 sides having lengths of one metre or 2 metres and one metre; or ◦ given the area of a square, finding the length of the side where the result is irrational; or ◦ finding ratios involved with the side lengths of paper sizes A0, A1, A2, A3 and A4 • **investigate** the golden ratio in art and design, and historical approximations to π in different societies	**Recognise** that the real number system includes the rational numbers and the irrational numbers, and **solve** problems involving real numbers using digital tools • **investigate** the real number system by representing the relationships between irrationals, rationals, integers and natural numbers and discussing the difference between exact representations and approximate decimal representations of irrational numbers • **use** a real number line to indicate the solution interval for inequalities of the form $ax + b < c$; for example, $2x + 7 < 0$ or of the form $ax + b > c$; for example, $1.2x - 5.4 > 10.8$ • **use** positive and negative rational numbers to solve problems; for example, for financial planning such as budgeting • **solve** problems involving the substitution of real numbers into formulas, understanding that solutions can be represented in exact form or as a decimal approximation, such as calculating the area of a circle using the formula $A = \pi r^2$ and specifying the answer in terms of π as an exact real number; for example,	**Recognise** the effect of using approximations of real numbers in repeated calculations and **compare** the results when using exact representations • **compare** and **contrast** the effect of truncation or rounding on the final result of calculations when using approximations of real numbers rather than exact representations • **investigate** the impact of approximation on multiple calculations in contexts that involve the area of compound shapes involving circles, the surface area and volume of compound objects, and repeated calculations of simple interest where the solutions are not exact cents	Operations on numbers involving ractional exponents and surds • **explain** that $\sqrt{a} = a^{\frac{1}{2}} = a^{0.5}$ for $a \geq 0$, generalizing to $\sqrt[n]{a} = a^{\frac{1}{n}}$, and evaluating corresponding expressions; for example, ◦ $\sqrt{10} = 10^{0.5} \approx 3.162$, ◦ $2^5 = 32$ so $32^{\frac{1}{5}} = \sqrt[5]{32} = 2$ • **explain** that $a^{\frac{m}{n}} = \left(a^{\frac{1}{n}}\right)^m = \left(\sqrt[n]{a}\right)^m = \sqrt[n]{a^m} = (a^m)^{\frac{1}{n}}$ and evaluate corresponding expressions; for example, $8^{\frac{2}{3}} = \left(\sqrt[3]{8}\right)^2 = 2^2 = 4$ and $8^{\frac{2}{3}} = \sqrt[3]{8^2} = \sqrt[3]{64} = 4$ • **use** the $y^x$and $\sqrt[x]{y} = y^{\frac{1}{x}}$ functions of technology to evaluate expressions involving decimal exponents and surds approximately, for example, ◦ $10^{3.47} \approx 2951.21$ ◦ $\sqrt[3]{78} \approx 4.273$ ◦ $200^{0.7} \approx 40.8057$ • **show** that $\sqrt{a+b} \neq \sqrt{a} + \sqrt{b}$ and $\sqrt{a-b} \neq \sqrt{a} - \sqrt{b}$ for $a, b > 0$,

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
to determine the perimeter of a square tiled floor using square tiles; for example, an area of floor with 144 square tiles has a perimeter of 48 tile lengths		the circumference of a circle with diameter 5 units is 5π units, and the exact area is $\pi\left(\frac{5}{2}\right)^2 = \frac{25}{4}\pi$ square units which rounds to 19.63 square units, correct to 2 decimal places • **investigate** the position of rational and irrational numbers on the real number line, using geometric constructions to locate rational numbers and square roots on a number line; for example, $\sqrt{2}$ is located at the intersection of an arc and the number line, where the radius of the arc is the length of the diagonal of a one-unit square		for example, $\sqrt{16+9} = \sqrt{25} = 5$ but $\sqrt{16} + \sqrt{9} = 4 + 3 = 7$ and $\sqrt{16-9} = \sqrt{7} \approx 2.646$, but $\sqrt{16} - \sqrt{9} = 4 - 3 = 1$ • **calculate** with products and quotients of square roots, including simplifying square roots of natural numbers that have perfect square factors, for example, $\sqrt{96} = \sqrt{16 \times 6} = \sqrt{16} \times \sqrt{6} = 4\sqrt{6}$ and rationalizing expressions involving square roots, for example, $\sqrt{\frac{13}{5}} = \frac{\sqrt{13}}{\sqrt{5}} = \frac{\sqrt{13}}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{13} \times \sqrt{5}}{\sqrt{5} \times \sqrt{5}} = \frac{\sqrt{65}}{5}$ • **perform** the four arithmetic operations with surds of the form $a + b\sqrt{n}$ where n is a natural number, including rationalising the denominator of a quotient, for example, $\frac{(3+\sqrt{7})}{(3-\sqrt{7})} = \frac{(3+\sqrt{7})}{(3-\sqrt{7})} \times \frac{(3+\sqrt{7})}{(3+\sqrt{7})} = \frac{16+6\sqrt{7}}{2} = 8 + 3\sqrt{7}$

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Represent natural numbers as products of powers of prime numbers using exponent notation • **apply** knowledge of factors to strategies for expressing natural numbers as products of powers of prime factors, such as ○ repeated division by prime factors or ○ creating factor trees for example, $48 = 6 \times 8$ $= 2 \times 3 \times 2 \times 2 \times 2$ $= 3^1 \times 2^4$ $= 3 \times 2^4$ • **develop** familiarity with ○ the sequence 1, 2, 4, 8, 16, 32, 64, 128, 256, 512 and powers of 2 ○ the sequence 1, 3, 9, 27, 81, 243, 729 and powers of 3 and ○ the sequence 1, 5, 25, 125, 625 and powers of 5 • **solve** problems involving lowest common multiples and greatest common divisors (highest common factors) for pairs of natural numbers by comparing their prime factorisation	**Establish** and **apply** the exponent laws with positive integer exponents and the zero-exponent, using exponent notation with numbers • **recognise** the connection between exponent form and expanded form with the exponent laws of ○ product of powers rule ○ quotient of powers rule ○ power of a power rule ○ removing brackets ○ expressing in simplest form for example, $2^3 \times 2^2$ can be represented as $(2 \times 2 \times 2) \times (2 \times 2) = 2^5$ and connecting the result to the addition of exponents • **apply** the exponent laws of the ○ product of powers rule ○ quotient of powers rule ○ power of a power rule and ○ zero exponent individually and in combination;			

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Represent natural numbers in expanded notation using place value and powers of 10 • **investigate** exponent notation for powers of 10 such as “one hundred thousand” is $100\,000$ $= 10 \times 10 \times 10 \times 10 \times 10$ $= 10^5$ • **relate** the sequences $10,\ 100,\ 1000,$ $10\,000$ … and $10^1,\ 10^2,\ 10^3,\ 10^4$ … • **apply** and **explain** the connections between place value and expanded notations; for example, $7000 = 7 \times 10^3$ and $3750 = 3 \times 10^3 + 7 \times 10^2 + 5 \times 10^1$	for example, use exponents to determine the effect on the volume of a 2 centimetre cube when the cube is enlarged to a 6 centimetre cube, $\frac{6^3}{2^3}$ $= \frac{2^3 \times 3^3}{2^3}$ $= 3^3$, so the volume is increased by a factor of 27 • **use** digital tools to systematically explore the application of the exponent laws; observing that the bases need to be the same • **investigate** and **establish** the zero index law. Use examples such as $\frac{3^4}{3^4} = 1$, and $3^{4-4} = 3^0$ to illustrate the convention that for any non-zero natural number n, $n^0 = 1$			

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Find equivalent representations of rational numbers and **represent** rational numbers on a number line • **investigate** equivalence of fractions using common multiples and a fraction wall, diagrams or a number line to show that a fraction such as $\frac{2}{3}$ is equivalent to $\frac{4}{6}$ and $\frac{6}{9}$ and therefore $\frac{2}{3} < \frac{5}{6}$ • **express** a fraction in simplest form using common divisors • **apply** and **explain** the equivalence between fraction, decimal and percentage representations of rational numbers; for example, 16%, 0.16, $\frac{16}{100}$ and $\frac{4}{25}$, using manipulatives, number lines or diagrams • **represent** positive and negative fractions and mixed numerals on various intervals of the real number line, including intervals that are not symmetrical about zero				

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Round decimals to a given accuracy appropriate to the context and **use** appropriate rounding and estimation to **check** the reasonableness of solutions • **identify** the interval between a pair of consecutive integers that includes a given rational number • **choose** and **apply** conventions for rounding correct to a specified number of decimal places based upon the context • **check** that the accuracy of rounding is suitable for context and purpose, such as the amount of paint required and cost estimate for renovating a house; for example, ○ purchasing 2 litres of paint to paint the bedroom even though 1.89 litres is the exact answer or ○ estimating a renovation budget to the nearest $100	**Recognise** terminating and recurring decimals, **using** digital tools as appropriate • **identify** when a fraction has a terminating decimal expansion from the prime factorisation of its denominator; for example, $\frac{7}{24} = 0.291\dot{6}$ does not have a terminating decimal expansion, while $\frac{7}{25} = 0.28$ does • **identify** terminating, recurring and non-terminating decimals and choosing their appropriate representations such as $\frac{1}{3}$ is represented as $0.\overline{3}$			
Use the four operations with positive rational numbers including fractions, decimals and percentages using efficient calculation strategies • **solve** addition and subtraction problems involving fractions and decimals; for example, using rectangular arrays with dimensions equal to the denominators, algebra tiles, digital tools or informal jottings • **choose** an appropriate numerical representation for a problem so that	**Use** the four operations with integers and with rational numbers, choosing and using efficient strategies and digital tools where appropriate • **recognise** rational numbers are the set of all numbers that can be expressed as fractions • **use** patterns to assist in establishing the rules for the multiplication and division of integers • **recall**, **apply** and **explain** efficient strategies such as using			

Strand: Number				
Year 7	**Year 8**	**Year 9**	**Year 10**	**Year 10A Mathematics Pathways**
efficient computations can be made, such as 12.5%, $\frac{1}{8}$, 0.125 or $\frac{125}{1000}$ • **develop** efficient strategies with appropriate use of the ○ commutative and associative properties ○ place value ○ patterning ○ multiplication facts to solve multiplication and division problems involving fractions and decimals; for example, using the commutative property to calculate $\frac{2}{3}$ of $\frac{1}{2}$ giving $\frac{1}{2}$ of $\frac{2}{3} = \frac{1}{3}$ • **solve** multiplicative problems involving fractions and decimals using fraction walls, rectangular arrays, algebra tiles, calculators or informal jottings • **develop** efficient strategies with appropriate use of the commutative and associative properties, regrouping or partitioning to solve additive problems involving fractions and decimals • **calculate** solutions to solve problems using the representation that makes computations efficient such as ○ 12.5% of 96 is more efficiently calculated as $\frac{1}{8}$ of 96, ○ including contexts such as comparing land-use by calculating the total local municipal area set aside for parkland or	○ the commutative or associative property for regrouping ○ partitioning ○ place value ○ patterning ○ multiplication or division facts to solve problems involving positive and negative integers, fractions and decimals • **recognise** the effect of sign in the multiplication of integers; for example, $(^{-}1)^4 = 1$ and $(^{-}1)^5 = {}^{-}1$			

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
○ manufacturing and retail, the amount of protein in daily food intake across several days, or ○ increases/decreases in energy accounts each account cycle				
Compare, order and solve problems involving addition and subtraction of integers • **use** less-than and greater-than notation in expressions when comparing and ordering integers; for example, ○ negative 5 is less than positive 2 and can be represented as $(-5) < (+2)$; ○ negative 3 is greater than negative 6 and can be represented as $(-3) > (-6)$ • **discuss** language such as “addition”, “subtraction”, “magnitude”, “difference”, “sign” and synonyms of these terms • **order**, **add** and **subtract** integers using a number line				

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Recognise, represent and **solve** problems involving ratios • use diagrams, physical or virtual materials to represent ratios, recognising that ratios express the quantitative relationship between 2 or more groups; for example, using counters or coloured beads to show the ratios 1:4 and 1:1:2 • **use** fractions to solve ratio problems involving comparison of quantities and considering part-part and part-whole relations; for example, dividing a set into the ratio 1:2 by determining the number of parts as 3 • **share** quantities in a given ratio; for example, sharing an amount of money in a given ratio, such as sharing $20 in the ratio 2:3 • **apply** ratios to realistic and meaningful contexts; for example, mixing 500 millilitres of a liquid with a concentration of 1:4 means $\frac{1}{5}$ concentrate and $\frac{4}{5}$ water so, 0.2 of 500 millilitres is concentrate and 0.8 of 500 millilitres is water; interpreting results in context				

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Use mathematical modelling to solve practical problems involving rational numbers and percentages, including financial contexts; **formulate** problems, choosing representations and efficient calculation strategies, **use** digital tools as appropriate; **interpret** and **communicate** solutions in terms of the situation, justifying choices made about the representation • **model** additive situations involving positive and negative quantities; for example, ○ a lift travelling up and down floors in a high-rise apartment where the ground floor is interpreted as zero; ○ in geography when determining altitude above and below sea level • **recall** solving problems that require finding a familiar fraction, decimal or percentage of a quantity, include percentage discounts, choose efficient calculation strategies and use digital tools where appropriate • **model** contexts involving proportion, such as ○ the proportion of students attending the school disco ○ proportion of bottle cost to recycling refund	**Use** mathematical modelling to solve practical problems involving rational numbers and percentages, include financial contexts; **formulate** problems, choosing efficient calculation strategies and **use** digital tools where appropriate; **interpret** and **communicate** solutions in terms of the situation, reviewing the appropriateness of the model • **model** situations involving weather and environmental contexts including temperature or sea depths by applying operations to positive and negative rational numbers; for example, involving average temperature increases and decreases • **recall** knowledge of integers when modelling financial problems involving profit and loss, credits and debits, gains and losses • **model** situations that involve percentage increases or decreases and **explain** why it is an increase or decrease, such as ○ mark-ups ○ discounts ○ Goods and Services Tax ○ changes in populations ○ recycling rate			

Strand: Number

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
○ proportion of school site that is green space ○ 55% of Year 7 students attended the end of term function ○ 23% of the school population voted yes to a change of school uniform; interpreting and communicating answers in terms of the context of the situation • **model** financial problems involving ○ profit and loss ○ credits and debits ○ gains and losses; for example, holding a fundraising sausage sizzle and determining whether the event made a percentage profit or loss	• **model** situations involving personal income tax, interpreting tax tables to determine income tax at various levels of income, including overall percentage of income allocated to tax • **model** situations involving percentage increase or decrease such as ○ market trends ○ effects on population ○ effects on the environment over extended time periods			

Achievement standards

Strand: Algebra

The Algebra strand develops ways of using symbols and symbolic representations to think and reason about relationships in both mathematical and real-world contexts. It provides a means for manipulating mathematical objects, recognising patterns and structures, making connections, understanding properties of operations and the concept of equivalence, abstracting information, working with variables, solving equations and generalising number and operation facts and relationships. Algebra connects symbolic, graphic and numeric representations. It deals with situations of generality, communicating abstract ideas applied in areas such as science, health, finance, sports, engineering, and building and construction.

Year 7	Year 8	Year 9	Year 10 and Year 10A Mathematics Pathways
Skills By the end of Year 7, students: • use algebraic expressions to represent situations • describe the relationships between variables from authentic data • substitute values into formulas to determine unknown values • solve linear equations with natural number solutions • create tables of values related to algebraic expressions and formulas • describe the effect of variation.	**Skills** By the end of Year 8, students: • apply algebraic properties to rearrange, expand and factorise linear expressions • graph linear relations and solve linear equations with rational solutions and one-variable inequalities, graphically and algebraically • use mathematical modelling to solve problems using linear relations, interpreting and reviewing the model in context • make and test conjectures involving linear relations using digital tools.	**Skills** By the end of Year 9, students: • extend and apply the exponent laws with positive integers to variables • expand binomial products, and factorise monic quadratic expressions • find the ○ distance between 2 points on the Cartesian plane ○ gradient and midpoint of a line segment • use mathematical modelling to solve problems involving change in financial and other applied contexts, choosing to use linear and quadratic functions • graph quadratic functions and • solve monic quadratic equations with integer roots algebraically • describe the effects of variation of parameters on functions and relations, using digital tools, and make connections between their graphical and algebraic representations.	**Skills** By the end of Year 10, students: • use mathematical modelling to solve problems involving growth and decay in financial and other applied situations, applying linear, quadratic and exponential functions as appropriate, and solve related equations, numerically and graphically • make and test conjectures involving functions and relations using digital tools • solve problems involving simultaneous linear equations and linear inequalities in 2 variables graphically and justify solutions.

Scope and sequence

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Recognise and **use** variables to represent everyday formulas algebraically and **substitute** values into formulas to determine an unknown • **link** variables to attributes and measures being modelled when using formulas, such as ○ the area of a rectangle is equal to the length x width as $A = l \times w$ when finding the width of a rectangle with given area and length ○ using $p = 6g + b$ to describe a total of points expressed as goals (worth 6 points) and behinds (worth one point) • **interpret** and **use** formulas obtained from other sources; for example, maximum heart rates and target heart rates for moderate exercise • **substitute** numerical values for variables when using formulas and **calculate** the value of an unknown in practical situations; for example, ○ calculate weekly wage W given base wage b and overtime hours h at 1.5 times rate r, $W = b + 1.5 \times h \times r$, ○ use values for mass m and volume v to determine density d of a substance where $d = \frac{m}{v}$		**Apply** the exponent laws to numerical expressions with integer exponents and **extend** to variables • **recall** the index laws with variables ○ multiplying ○ dividing ○ raising a power to a power ○ power of a product ○ power of a quotient ○ power of zero • **investigate** the negative index law with numbers • **connect** with the meaning of reciprocals • **apply** negative index law with variables • **represent** decimals in exponential form; for example, 0.475 can be represented as $0.475 = \frac{4}{10} + \frac{7}{100} + \frac{5}{1000}$ $= 4 \times 10^{-1} + 7 \times 10^{-2} + 5 \times 10^{-3}$ and 0.00023 as 23×10^{-5} • **simplify** and **evaluate** numerical expressions, involving both positive and negative integer exponents, explaining why; for example, 5^{-3} $= \frac{1}{5^3}$ $= \left(\frac{1}{5}\right)^3$ $= \frac{1}{125}$	**Expand, factorise** and **simplify** expressions and **solve** equations algebraically, applying exponent laws involving products, quotients and powers of variables, and the distributive property • **recall** the process of factorisation, product of factors and highest common factor • **explain** the relationship between factorisation and expansion, including ○ common factors ○ the difference of two squares ○ perfect squares ○ sum and product ○ trial and error ○ four terms by grouping in pairs ○ the completed square form for quadratic expressions • **apply** knowledge of exponent laws to algebraic terms and use both positive and negative integral exponents to simplify algebraic expressions and solve equations algebraically	Simplification of combinations of linear expressions with rational coefficients and the solution of related equations • **simplify** sums and differences of linear expressions of the form $\frac{ax+b}{c}$ where a and b are integers, and c is a non-zero integer, for example, $\frac{6x-11}{2} - \frac{7x}{4} + \frac{9-5x}{3} = \frac{-5x-30}{12}$ • **solve** equations involving sums and differences of linear expressions with rational coefficients, for example $\frac{-2x}{3} + \frac{4}{9} = \frac{11}{5}(7x-1)$ $\Rightarrow -30x + 20 = 693x - 99$ $\Rightarrow x = \frac{119}{723}$, and verifying the solution

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
		and connecting terms of the sequence $125, 25, 5, 1, \frac{1}{5}, \frac{1}{25}, \frac{1}{125}$ ... to terms of the sequence $5^3, 5^2, 5^1, 5^0, 5^{-1}, 5^{-2}, 5^{-3}$ ... • **relate** the computation of numerical expressions involving exponents to the exponent laws and the definition of an exponent; for example, ○ $2^3 \div 2^5$ $= 2^{-2}$ $= \frac{1}{2^2}$ $= \frac{1}{4}$ ○ $(3 \times 5)^2$ $= 3^2 \times 5^2$ $= 9 \times 25$ $= 225$ • **recognise** exponents in algebraic expressions and corresponding conventions; for example, ○ for any non-zero natural number a, $a^0 = 1$ ○ $x^1 = x$ ○ $r^2 = r \times r$ ○ $h^3 = h \times h \times h$ ○ $y^4 = y \times y \times y \times y$, and ○ $\frac{1}{w} \times \frac{1}{w}$ $= \frac{1}{w^2}$ $= w^{-2}$		Investigate the concept of a polynomial and apply the factor and remainder theorems to solve problems • **explore** the polynomials and name each polynomial • **describe** terms of a polynomial • **explore** function notation • **expand** and simplify polynomials • **explore** division of polynomials and establish terms, dividend, divisor, quotient and remainder • **investigate** the relationship between algebraic long division and the factor and remainder theorems • **explore** solving polynomial equations, graphing polynomial equations and applications Apply understanding of polynomials to sketch a range of curves and describe the features of these curves from their equation • **investigate** the features of graphs of polynomials such as cubics and quartics using technology to include: ○ shape and the effect of leading coefficient ○ axes intercepts ○ the effect of repeated factors • **apply** the Null Factor Law and Remainder theorem to sketch the graph • **apply** this to higher degree polynomials • **explore** application problems

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
		• **relate** simplification of expressions from first principles and counting to the use of exponent laws; for example, ○ $(a^2)^3$ $= (a \times a) \times (a \times a) \times (a \times a)$ $= a \times a \times a \times a \times a \times a$ $= a^6$ ○ $b^2 \times b^3$ $= (b \times b) \times (b \times b \times b)$ $= b \times b \times b \times b \times b$ $= b^5$ ○ $\frac{y^4}{y^2}$ $= \frac{y \times y \times y \times y}{y \times y}$ $= \frac{y^2}{1}$ $=y^2$ ○ $(5a)^2$ $= (5 \times a) \times (5 \times a)$ $= 5 \times 5 \times a \times a$ $= 25 \times a^2$ $= 25a^2$ • **apply** the exponent laws to simplify expressions involving products, quotients, and powers of constants and variables; for example, $\frac{(2xy)^3}{xy^4}$ $= \frac{8x^3y^3}{xy^4}$ $= 8x^2y^{-1}$		

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
		• **relate** the prefixes for SI units from pico- (trillionth) to tera- (trillion) to the corresponding powers of 10; for example, one pico-gram = 10^{-12} grams and one terabyte = 10^{12} bytes		
Formulate algebraic expressions using constants, variables, operations and brackets • **establish** key words ○ variable ○ numeral ○ expression ○ equation ○ terms ○ like terms ○ coefficient ○ constant term • **generalise** arithmetic expressions to algebraic expressions involving constants, variables, operations and brackets; for example, ○ $7 + 7 + 7 = 3 \times 7$, ○ $x + x + x = 3 \times x$ noting that $3x$ includes implied multiplication and recognising the difference between $3x + 4$ and $3(x + 4)$ • **formulate** algebraic expressions that represent mathematical relationships; for example, translating from words to symbols, “think of a number” type of activities	**Create, expand, factorise, rearrange** and **simplify** linear expressions, applying the associative, commutative, identity, distributive and inverse properties • **rearrange** and **simplify** linear expressions involving variables with integer coefficients and constants; **use** manipulatives such as algebra tiles to support calculations; for example, using manipulatives to demonstrate that ○ $2x + 4 = 2(x + 2)$ ○ $3(a - b) = 3a - 3b$ ○ $5(m + 2n) + 3m - 4n$ $= 5m + 10n + 3m - 4n$ $= 8m + 6n$ • **demonstrate** the relationship between factorising and expanding linear expressions using manipulatives, such as algebra tiles or area models, and **describe** with mathematical language • **use** the distributive, associative, commutative, identity and inverse properties to expand and factorise algebraic expressions using strategies such as the area model	**Simplify** algebraic expressions, **expand** binomial products and **factorise** monic quadratic expressions • **expand** combinations of binomials such as ○ $(x + 7)(x + 8)$, ○ $(x + 7)(x - 8)$, ○ $(x - 7)(x + 8)$, ○ $(x - 7)(x - 8)$ to identify expansion and factorisation patterns related to $(x + a)(x + b)$ $= x^2 + (a + b)x + ab$, where a and b are integers • **use** manipulatives such as algebra tiles or area models to expand or factorise algebraic expressions with readily identifiable binomial factors; for example, ○ $(x + 1)(x + 3) = x^2 + 4x + 3$, ○ $(x - 5)^2 = x^2 - 10x + 25$ or ○ $(x - 3)^2 + 4$ $= x^2 - 6x + 9 + 4$ $= x^2 - 6x + 13$ • **recognise** the relationship between expansion and factorisation, and use digital tools to systematically explore the factorisation of $x^2 + mx + n$ where m and n are integers		Algebraic representations of quadratic functions of the form $f(x) = ax^2 + bx + c$ where a, b and c are non-zero integers, and their transformation to the form $f(x) = a(x + h)^2 + k$ where h and k are non-zero rational numbers, and the solution of related equations • **connect** the expanded and transformed representations of a quadratic function by completing the square, for example, $x^2 + 3x + 1 = \left(x + \frac{3}{2}\right)^2 - \frac{5}{4}$ and $2x^2 + 8x - 5 = 2(x + 2)^2 - 13$ • **derive** the quadratic formula and **apply** it to solve quadratic equations, using the discriminant to identify the number and nature of the roots of a quadratic equation, and verify solutions • **identify** what can be known about the graph of a quadratic function by considering its coefficients, the discriminant and symmetry to assist sketching by hand • **recognise** conjugate pairs of irrational roots of a quadratic equation and their location with respect to the axis of symmetry of the graph of the corresponding function

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
		• **consider** ○ product expansion ○ the difference of two squares ○ perfect squares ○ binomial expansion ○ $(a + b)(c + d + e)$		
Solve one-variable linear equations with natural number solutions; **verify** the solution by substitution • **recognise** that solving an equation is a process of determining a value that makes the equation true • **use** substitution to determine whether a given number is a solution to an equation or not • **solve** equations using concrete materials, the balance model, and backtracking, explaining the process • **solve** linear equations such as $3x + 7 = 19$ algebraically, and verify the solution by substitution • **perform** negative substitutions and calculate the result	**Graph** linear relations on the Cartesian plane using digital tools where appropriate; **solve** linear equations and one-variable inequalities using graphical and algebraic techniques; **verify** solutions by substitution • **recognise** that in a table of values, if the first difference between consecutive values of the dependent variable is constant, then it is a linear relation • **graph** linear functions and relations of the form ○ $x = a$ ○ $y = a$ ○ $x \leq a$ ○ $x > a$ ○ $y \leq a$ ○ $y > a$ on the Cartesian plane for known values of a • **complete** a table of values, plot the resulting points on the Cartesian plane and determine whether the relationship is linear • **graph** the linear relationship	**Find** the gradient of a line segment, the midpoint of the line interval and the distance between 2 distinct points on the Cartesian plane • **recognise** that the gradient of a line is calculated using the gradient of a line segment on that line and is independent of which 2 distinct points on the line are used for this calculation • **use** digital tools and transformations to illustrate that ○ parallel lines in the Cartesian plane have the same gradient ○ the relationship between the gradients of pairs of perpendicular lines is that their product is (−1) • **use** Pythagoras' theorem to establish the distance between 2 points in the Cartesian plane and apply this using horizontal and vertical distances and coordinates • **investigate** graphical and algebraic techniques for finding the midpoint and gradient of the line segment between 2 points • **use** dynamic graphing software and superimposed images; for example, ○ playground equipment	**Solve** linear inequalities and simultaneous linear equations in 2 variables; **interpret** solutions graphically and **communicate** solutions in terms of the situation • **investigate** ○ solution by graphing ○ solution by substitution ○ solution by elimination using technology • **describe** the form of simultaneous equations and determine whether it is appropriate to solve by substitution or elimination • **investigate** situations involving linear equations in context, such as ○ multiple quotes for a job ○ profit and loss • **solve** the equations graphically, giving solutions in everyday language, such as ○ "break-even point" or ○ "point to change providers" for the job • **describe** the solution of simultaneous equations within the context of the situation	**Solve** simultaneous equations using systematic guess-check-and-refine with digital technology • **recall** solution by graphing, substitution and elimination • **use** technology to solve simultaneous equations • **apply** this to problem solving with simultaneous equations and check your solution

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
	$ax + b = c$ for known values of a, b and c and identify from the graph where $ax + b < c$ or where $ax + b > c$ • **solve** linear equations of the form $ax + b = c$ and one-variable inequalities of the form ○ $ax + b < c$ or ○ $ax + b > c$ where $a > 0$ using inverse operations and digital tools, and check solutions by substitution • **solve** linear equations such as $3x + 7 = 6x - 9$, represent these graphically, and verify solutions by substitution	○ ramps ○ escalators to investigate gradients in context and their relationship to rule of a linear function, and interpret gradient as a constant rate of change in linear modelling contexts	• **recall** inequalities and number line representation • **investigate** the four operations with inequalities and establish rules • **graph** regions corresponding to inequalities in the Cartesian plane; for example, graphing $2x + 3y < 24$ and verifying using a test point such as $(0, 0)$ • **identify** all the combinations of trips to the movies, each costing \$12, and ice-skating sessions, each costing \$21, as the integer solutions for an entertainment budget of up to \$150 for the school holidays; expressing algebraically as $12m + 21s \leq 150$ • **test** when a circle of a specified radius has a corresponding area greater than a given value, or whether a point satisfies an inequality; for example, whether the point $(3, 5)$ satisfies $2y < x^2$	
Generate tables of values from visually growing patterns or the rule of a function; **describe** and **plot** these relationships on the Cartesian plane • **plot** points from a table of values generated using simple linear functions and recognise patterns, such as points that lie on a straight line • **discuss** and **use** variables to create a general rule and use the rule to determine the value of the dependent variable for any given value of the independent variable;		**Identify** and **graph** quadratic functions, **solve** quadratic equations graphically and numerically, and **solve** monic quadratic equations with integer roots algebraically, using graphing software and digital tools as appropriate • **recognise** that in a table of values, if the second difference between consecutive values of the dependent variable is constant, then it is a quadratic • **graph** quadratic functions using digital tools and compare what is the same and what is different between	**Recognise** the connection between algebraic and graphical representations of exponential relations and **solve** related exponential equations, using digital tools where appropriate • **recognise** that in a table of values, if the ratio between consecutive values of the dependent variable is constant, then it is an exponential relation • **investigate** the links between algebraic and graphical representations of exponential functions using graphing software	The graphs of $y = \sin(x)$ and $y = \cos(x)$ as functions of a real variable and the solution of related equations • **explore** the use of the unit circle and animations to show the periodic, symmetric, and complementary nature of the sine and cosine functions • **graph** the sine and cosine functions over different domains of a real variable, including negative values • **establish** relationships between Pythagoras' theorem, the unit circle, trigonometric ratios, and angles in half-

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
for example, plotting the value of the circumference of a circle for varying values of radius • **use** function machines to generate a table of ordered pairs using input and output values, plot the relationships on a Cartesian plane and describe the graph in terms of shape • **use** diagrams and manipulatives to form linear growth patterns, representing these patterns in tables and describe the relationship in terms of the way the pattern is growing and in the context of the situation		these different functions and their respective graphs; interpret features of the graphs such as ○ symmetry ○ turning point ○ maximum and minimum values ○ determining when values of the quadratic function lie within a given range • **solve** quadratic equations algebraically and compare these to graphical solutions • **use** graphs to determine the solutions of quadratic equations; recognise that the roots of a quadratic function correspond to the x-intercepts of its graph and that if the graph has no x-intercepts, then the corresponding equation has no real solutions • **relate** horizontal axis intercepts of the graph of a quadratic function to the factorised form of its rule using the null factor law; for example, the graph of the function $y = x^2 - 5x + 6$ can be represented as $y = (x - 2)(x - 3)$ with x-axis intercepts where either $(x - 2) = 0$ or $(x - 3) = 0$ • **recognise** that the equation $x^2 = a$, where $a > 0$, has 2 solutions, $x = \sqrt{a}$ and $x = -\sqrt{a}$; for example, ○ if $x^2 = 39$ then $x = \sqrt{39}$	• **use** digital tools with symbolic manipulation functionality to systematically explore exponential relations	square triangles and equilateral triangles • **approximate** values of the sine and cosine functions from a suitably scaled diagram of the unit circle, and solve equations of the form $\sin(x) = \frac{1}{\sqrt{2}}$ and $\cos(x) = -0.73$ over a specified interval graphically **Solve** simple exponential equations • **describe** exponential equations • **solve** exponential equations by equating indices when both sides have the same base • **use** technology to solve exponential equations if possible • **investigate** exponential equations derived from authentic mathematical models based on population growth • **solve** exponential equations using logarithm rules and applications

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
		$x = 6.245$ correct to 3 decimal places ○ $x = -\sqrt{39}$ $x = -6.245$ correct to 3 decimal places and representing these graphically		
Describe relationships between variables represented in graphs of functions from authentic data • **use** graphs to analyse ○ a building's electricity or gas usage over a period of time ○ the value of shares on a stock market ○ the temperature during a day interpreting and discussing the relationships they represent • **explore** properties of line graphs, such as ○ dependent and independent variables ○ increasing and decreasing graphs • **use** travel graphs to compare the distance travelled to and from school, interpreting and discussing features of travel graphs such as ○ the slope of lines ○ the meaning of horizontal line segments • **tell** the story behind what is being represented in graphs of functions; for example, graphs representing ○ pouring rates ○ distance versus time	**Use** mathematical modelling to solve applied problems involving linear relations, including financial contexts; **formulate** problems with linear functions, choosing a representation; **interpret** and communicate solutions in terms of the situation, reviewing the appropriateness of the model • **model** situations involving linear functions, including practical contexts such as ○ taxi fares involving flag fall fees ○ motion in a straight line at a constant speed ○ trade quotes involving call out fees ○ cooking that includes resting or cooling times ○ water leakage from water tanks interpreting the constant rate of change and initial value in context, and identifying when values of a model lie within a given range • **model** problems in practical situations and interpret solutions within the context of the problem, including giving attention to all units of measure and whether results are suitable; for example, once a water tank is empty no more water can flow from it	**Use** mathematical modelling to **solve** applied problems involving change including financial contexts; **formulate** problems, choosing to use either linear or quadratic functions; **interpret** solutions in terms of the situation; **evaluate** the model and report methods and findings • **model** practical contexts using linear functions such as ○ cooking times that include resting or cooling times ○ water leakage from water tanks using tables and graphs or digital tools and algebraically • **model** measurement situations and **determine** the perimeter and areas of rectangles where the length, l, of the rectangle is a linear function of its width, w; for example, ○ $l = w$ ○ $l = w + 5$ ○ $l = 3w$ ○ $l = 2w + 7$ • **model** practical contexts using simple quadratic functions, tables and graphs (hand drawn or using digital tools) and algebraically, interpreting features of	**Use** mathematical modelling to solve applied problems involving growth and decay, including financial contexts; **formulate** problems, choosing to apply linear, quadratic or exponential models; **interpret** solutions in terms of the situation; **evaluate** and **modify** models as necessary and report assumptions, methods and findings • **model** situations and **choose** between linear, quadratic and exponential models by representing relationships in a table of values and recognise that ○ linear functions have constant first differences ○ quadratic functions have constant second differences ○ exponential functions have a constant ratio between consecutive values of the dependent variable • **model** situations involving exponential growth and decay, and contrast this with linear growth or decay; for example, situations involving constant percentage change and constant ratio; **determine** doubling time and half-life and approximate intervals for which	The inverse relationship between exponential functions and logarithmic functions and the solution of related equations • **use** the definition of a logarithm and the exponent laws to establish the logarithm laws • **evaluate** 10^x for decimal values of x and relate this to a logarithm base 10 scale; **solve** exponential equations algebraically using base 10 logarithms; for example, $5\,000 \times 1.01^x = 10\,000$ $\Rightarrow x = \frac{\log_{10}(2)}{\log_{10}(1.01)} \approx 69.66,$ and **connect** to the graph of the corresponding function **Describe**, **interpret** and sketch parabolas, hyperbolas, circles and exponential functions and their transformations • **recall** the connection between algebraic and graphical representations of relations such as ○ parabolas ○ reciprocals ○ circles ○ exponentials • **apply** transformations, including translations, reflections in the axes and

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
	• **model** financial problems involving pay rates, use a table of values to represent the pay amounts and hours worked using an hourly rate of pay, and graph the relationship to make inferences	the graphs such as the turning point and intercepts in context; for example, ○ area ○ paths of projectiles ○ parabolic mirrors ○ satellite dishes • **model** and **solve** problems involving financial contexts using linear functions; for example, ○ combinations of purchases of different items when they have a set amount of money to spend ○ profit/loss situations ○ trade quotes involving call out fees • **model** situations involving change; for example, ○ change in daily temperature during the ski season ○ fluctuation of speed above and below the speed limit ○ acceleration and deceleration of a car coming to and moving off from a set of traffic lights	the values of the model lie within a given range • **model** situations that involve working with authentic information, data and interest rates to calculate compound interest and solve related problems	stretches to help graph parabolas, rectangular hyperbolas, circles and exponential functions
Manipulate formulas involving several variables using digital tools, and describe the effect of systematic variation in the values of the variables • **experiment** with different sets of tables of values from formulas; for example, using volume of a rectangular prism = length × width × height, and specifying a fixed width and equal length and varying the height	**Experiment** with linear functions and relations using digital tools, **make** and **test** conjectures and **generalise** emerging patterns • **use** graphing software to investigate the effect of systematically varying parameters of linear functions on the corresponding graphs, making and testing conjectures; for example,	**Experiment** with the effects of the variation of parameters on graphs of related functions, **use** digital tools, **make** connections between graphical and algebraic representations, and **generalise** emerging patterns • **investigate** transformations of the graph of $y = x$ to the graph of $y = ax + b$ by systematic variation of a and b and interpret the effects	**Experiment** with functions and relations using digital tools, **make** and **test** conjectures and **generalise** emerging patterns • **apply** the graphing zoom functionality of digital tools and systematically refine intervals to identify approximate location of points of intersection of the graphs of 2 functions, such as $x^2 = 2^x$ • **apply** a bisection algorithm to determine the approximate location of the horizontal axis intercepts of the	**Use** function notation to describe the relationship between dependent and independent variables in modelling contexts • **connect** y and $f(x)$ • **describe** $f(x)$ as "f of x" • **explore** composite functions • **explore** inverse functions • **use** function notation in modelling context

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
• **use** spreadsheets and the formula function to recognise the effect of changing parameters on the entries in cells • **analyse** distance travelled for different combinations of average speed and time of travel using a table of values and the distance formula	making a conjecture that if the co-efficient of x is negative, then the line will slope down from left to right • **use** graphing software to systematically contrast the graphs of ○ $y = 2x, -y = 2x, y = -2x$ and $-y = -2x$ with those of ○ $y < 2x, -y < 2x, y < -2x$ and $-y < -2x$ and those of ○ $y > 2x, -y > 2x, y > -2x$ and $-y > -2x$ making and testing conjectures about sign and direction of the inequality • **use** digital tools to investigate integer solutions to equations such as $2x + 3y = 48$	of these transformations using digital tools; for example, ○ $y = x \rightarrow y = 2x$ (vertical enlargement as $a > 1$) $\rightarrow y = 2x - 1$ (vertical translation) ○ $y = x \rightarrow y = \frac{1}{2}x$ (vertical compression as $a < 1$) $\rightarrow y = -\frac{1}{2}x$ (reflection in the horizontal axis) $\rightarrow y = -\frac{1}{2}x + 3$ (vertical translation) • **investigate** transformations of the parabola $y = x^2$ in the Cartesian plane using digital tools to determine the relationship between graphical and algebraic representations of quadratic functions, including the completed square form; for example, ○ $y = x^2 \rightarrow y = \frac{1}{3}x^2$ (vertical compression as $a < 1$) $\rightarrow y = \frac{1}{3}(x - 5)^2$ (horizontal translation) $\rightarrow y = \frac{1}{3}(x - 5)^2 + 7$ (vertical translation) ○ $y = x^2 \rightarrow y = 2x^2$ (vertical enlargement as $a > 1$) $\rightarrow y = -2x^2$ (reflection in the horizontal axis) $\rightarrow y = -2(x + 6)^2$ (horizontal translation) $\rightarrow y = -2(x + 6)^2 + 10$ (vertical translation)	graph of a quadratic function such as $f(x) = 2x^2 - 3x - 7$ • **apply** transformations to the graph of $x^2 + y^2 = 1$ • **identify** the coordinates of any points of intersection of the graph of a linear function with the graph of a quadratic function or a circle • **identify** intervals on the real number line over which a given quadratic function is positive or negative • **use** a table of values to determine when an exponential growth or decay function exceeds or falls below a given value, such as monitoring the trend in value of a share price in a context of exponential growth or decay	

Strand: Algebra

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
		• **experiment** with digital tools by applying transformations to the graphs of functions, such as ○ reciprocal $y = \frac{1}{x}$ ○ square root $y = \sqrt{x}$ ○ cube $y = x^3$ ○ exponential functions, $y = 2^x$, $y = \left(\frac{1}{2}\right)^x$, identifying patterns		

Achievement standards

Strand: Measurement

The Measurement strand develops ways of quantifying aspects of the human and physical world. Measures and units are defined and selected to be relevant and appropriate to the context. Measurement is used to answer questions, show results, demonstrate value, justify allocation of resources, evaluate performance, identify opportunities for improvement and manage results. Measurement underpins understanding, comparison and decision-making in many personal, societal, environmental, agricultural, industrial, health and economic contexts.

Year 7	Year 8	Year 9	Year 10 and Year 10A Mathematics Pathways
Skills By the end of Year 7, students: • apply knowledge of ○ angle relationships ○ the sum of angles in a triangle to solve problems, giving reasons • use formulas for ○ the areas of triangles and parallelograms ○ the volumes of rectangular and triangular prisms to solve problems • describe the relationships between the radius, diameter and circumference of a circle.	**Skills** By the end of Year 8, students: • use appropriate metric units when solving measurement problems involving the ○ perimeter and area of composite shapes ○ volume of right prisms • use Pythagoras' theorem to solve measurement problems involving unknown lengths of right-angle triangles • use formulas to solve problems involving the area and circumference of circles • solve problems of duration involving 12- and 24-hour cycles across multiple time zones • use 3 dimensions to locate and describe position.	**Skills** By the end of Year 9, students: • apply formulas to solve problems involving the surface area and volume of right prisms and cylinders • solve problems involving ratio, similarity and scale in two-dimensional situations • determine percentage errors in measurements • apply Pythagoras' theorem and use trigonometric ratios to solve problems involving right-angled triangles • use mathematical modelling to solve practical problems involving direct proportion, ratio and scale, evaluating the model and communicating their methods and findings • express small and large numbers in scientific notation.	**Skills** By the end of Year 10, students: • interpret and use logarithmic scales representing small or large quantities or change in applied contexts • solve measurement problems involving surface area and volume of composite objects • apply Pythagoras' theorem and trigonometry to solve practical problems involving right-angled triangles • identify the impact of measurement errors on the accuracy of results • use mathematical modelling to solve practical problems involving ○ proportion and scaling ○ evaluating and modifying models ○ reporting assumptions, methods and findings.

Scope and sequence

<table>
<tr><th colspan="5">Strand: Measurement</th></tr>
<tr><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th><th>Year 10A Mathematics Pathways</th></tr>
<tr><td colspan="5">Assumed students are now using and converting between metric units across the strands</td></tr>
<tr>
<td>Solve problems involving the area of triangles and parallelograms using established formulas and appropriate units
• use the formula for the area of a rectangle and the array structure to derive the formula for the area of a triangle and the area of a parallelogram, given their perpendicular heights;
for example,
establish that the area of a triangle is half the area of an appropriate rectangle by using the spatial relationship between rectangles and different types of triangles
• use dynamic geometry software to demonstrate how the sliding of the vertex of a triangle at a fixed altitude opposite a side leaves the area of the triangle unchanged
• use established formulas to solve practical problems involving the area of triangles, parallelograms and rectangles;
for example,
○ estimating the cost of materials needed to make shade sails based on a price per metre
○ determining different combinations of dimensions that lead to a given area</td>
<td>Solve problems involving the area and perimeter of irregular and composite shapes using appropriate units
• recall the area of triangles, squares, rectangles and parallelograms
• determine the area of composite shapes by composing or decomposing shapes
• use arrays and rectangles to approximate the area of irregular shapes in situations such as
○ a council needing to work out how much mosquito spray to use for a swamp area
○ a farmer needing to work out how much seed, fertilizer and herbicide are required to cover a paddock
• determine the perimeter and area of irregular shapes by sums of increasingly accurate covering measurements, such as line segments and grids;
for example,
using millimetres or square millimetres as opposed to centimetres or square centimetres</td>
<td>Solve problems involving the volume and surface area of right prisms and cylinders use appropriate units
• analyse nets of objects to generate short cuts and establish formulas for surface area
• determine the amount of material needed to make can-coolers for a class fundraising project and working out the most cost-efficient way to cut out the pieces
• find different prisms that have the same volume but different surface areas, making conjectures as to what type of prism would have the smallest or largest surface area</td>
<td>Solve problems involving the surface area and volume of composite objects using appropriate units
• determine the volumes and surface areas of composite solids, formed from a range of right prisms and cylinders, by considering the individual solids from which they are constructed
• estimate the surface area and volume of objects in practical contexts
• use mathematical modelling to provide solutions to problems involving surface area and volume;
for example,
ascertain the rainfall that can be saved from a roof top and the optimal shape and dimensions for rainwater storage based on where it will be located on a property
• determine whether to hire extra freezer space for the amount of ice cream required at a fundraising event for the school or community</td>
<td>The effect of increasingly small changes in the value of variables on the average rate of change and in relation to limiting values
• use the gradient of the line segment between two distinct points as a measure of rate of change to obtain numerical approximations to instantaneous speed and interpreting ‘tell me a story’ piecewise linear position-time graphs</td>
</tr>
</table>

Strand: Measurement

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Solve problems involving the volume of right prisms including rectangular and triangular prisms, using established formulas and appropriate units • **build** a rectangular prism out of unit cubes and show that the measure of volume is the same as would be found by multiplying the 3 edge lengths or by multiplying the area of the base by the height/length, establishing the formula $V = l \times b \times h$ • **develop** the connection between the area of the parallel cross-section (base), the height and volume of a rectangular or triangular prism to other prisms, establishing the formula $V = \ Area\ of\ cross\ section\ \times\ h$ • **connect** the area of the floor space and the number of floors of a high-rise building to calculate the volume of a building • **use** dynamic geometry software, spatial reasoning and prediction to derive the formula for the volume of prisms	**Solve** problems involving the volume and capacity of right prisms using appropriate units • **use** models to demonstrate the number of cubic centimetres in a cubic metre and relate this to capacities of millilitres and litres, recognising that one millilitre is equivalent to one cm^3 • **solve** problems involving volume and capacity; for example, optimal packaging and production • **choose** which measurements are useful to consider when solving practical problems in context; for example, when purchasing a new washing machine, ○ the dimensions are useful when determining whether it will fit in the available space in the laundry ○ its capacity is useful when considering the maximum washing load it can carry • **investigate**, **reason** and **find** solutions to measurement problems involving dimensions, rates, volume and capacity of objects; for example, given the dimensions of a pool and the rate of flow from a tap, determine how long it will take to fill the pool to its normal capacity			

Strand: Measurement

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Describe the relationship between π and the features of circles including the circumference, radius and diameter • **recognise** the features of circles and their relationships to one another; for example, ○ labelling the parts of a circle including centre, radius, diameter, circumference ○ using one of radius, diameter or circumference to determine the measure of the other 2 understanding that the diameter is twice the radius, or that the radius is the circumference divided by 2π • **compare** the circumference of circles in relation to their radius and diameter with materials and measuring, to establish measurement formulas; for example, using a compass to draw several circles, then using string to approximate the circumference, comparing the length of string to the diameter of the circle • **investigate** π as the constant in the proportional relationship between the circumference of a circle and its diameter, and historical approximations from different civilisations, including Egypt, Babylon, Greece, India and China	**Solve** problems involving the circumference and area of a circle using formulas and appropriate units • **recall** the irrational number π from the number strand • **deduce** that the area of a circle is between 2 radius squares and 4 radius squares, and using $3 \times \text{radius}^2$ as a rough estimate for the area of a circle • **investigate** the area of circles using a square grid or by rearranging a circle divided into smaller and smaller sectors or slices to resemble a close approximation of a rectangle • **apply** the formulas for the area and circumference of a circle to solve practical problems, and use one of the measures of radius, diameter, circumference or area to deduce the value of the other measures; for example, determining the length of material needed to edge a round table, given its dimensions as the area of the tabletop			

Strand: Measurement

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
	Solve problems involving duration, including using 12- and 24-hour time across multiple time zones • **use** digital tools to investigate time zones around the world and convert from one zone to another, such as time in Perth, Western Australia compared to Suva in Fiji or Toronto in Canada • **recognise** the challenges of planning regular virtual meeting times for a company that has both international staff and staff within different states and territories, and the impact daylight savings has due to multiple time zones, explaining the mathematical language used to communicate current time such as Coordinated Universal Time (UTC)+8, AEST, ACST and AWST • **plan** an international travel itinerary that covers destinations in different time zones across Asia	**Solve** problems involving very small and very large measurements, time scales and intervals expressed in scientific notation • **represent** very large and small real numbers in scientific notation, converting real numbers expressed in scientific notation into decimal form; for example, ○ the approximate geological age of the earth is 4.6×10^9 years ○ the mass of a sugar molecule is 5.68×10^{-21} grams • **use** knowledge of place value and apply exponent laws to operate with numbers expressed in scientific notation in applied contexts; for example, performing calculations involving extremely small numbers in scientific and other contexts • **examine** the degree of accuracy that different measurement instruments provided in a science laboratory, such as a measuring cylinder compared with a pipette and recording data values to the correct degree of accuracy using appropriate scientific notation	**Interpret** and **use** logarithmic scales in applied contexts involving small and large quantities and change • **understand** that the logarithmic scale is calibrated in terms of order of magnitude; for example, ○ doubling ○ powers of 10 • **identify** and **interpret** data representations (charts and graphs) that use logarithmic scales and **discuss** when it is appropriate to use this type of scale and when it is not appropriate; for example, ○ graphs representing percentage change ○ a wide range of values ○ exponential growth • **investigate** and **interpret** logarithmic scales used in real-world contexts; for example, ○ Richter, decibel and sensitivity scales or growth in investments ○ timescales ○ the spread of micro-organisms and disease and describe reasons for choosing to use a logarithmic scale rather than a linear scale	

Strand: Measurement

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Identify corresponding, alternate and co-interior relationships between angles formed when parallel lines are crossed by a transversal; **use** them to solve problems and explain reasons • **construct** a pair of parallel lines and a pair of perpendicular lines using their properties, a pair of compasses and a ruler, set squares or using dynamic geometry software • **use** dynamic geometry software to identify relationships between alternate, corresponding and co-interior angles for a pair of parallel lines cut by a transversal • **use** dynamic geometry software to demonstrate how angles and their properties are involved in the design and construction of ○ scissor lifts ○ folding umbrellas ○ toolboxes ○ cherry pickers • **use** geometric reasoning of angle properties to generalise the angle relationships of parallel lines and transversals, and related properties such as ○ the size of an exterior angle of a triangle is equal to the sum of the sizes of opposite and non-adjacent interior angles ○ the sum of the sizes of interior angles in a triangle in the plane is equal to the size of 2 right angles or 180°	**Recognise** and **use** rates to **solve** problems involving the comparison of 2 related quantities of different units of measure • **identify** examples of rates in the real world, including constant rates, rate of pay, cost per kilogram, recipes, simple interest and average rates • **apply** rates to solve problems involving the conversion between different units of measure; for example, ○ using a conversion rate to convert distances from miles into kilometres ○ using currency exchange rates to determine the price of items • **apply** rates to calculate solutions to problems in different contexts; for example, ○ required run rates in cricket ○ dilution of concentrated chemicals ○ comparing the petrol consumption rates of different vehicles • **use** taxation tables to calculate an individual's annual income tax			

Strand: Measurement

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Demonstrate that the interior angle sum of a triangle in the plane is 180° and **apply** this to determine the interior angle sum of other shapes and the size of unknown angles • **use** concrete materials to demonstrate that the sum of the interior angles of a triangle is 180°; for example, use paper triangles and tearing to demonstrate that the interior angles when combined form 180° • **use** decomposition and the angle sum of a triangle to generalise the interior angle sum of an n-sided polygon, as $180(n-2)=180n-360$	**Use** Pythagoras' theorem to **solve** problems involving the side lengths of right-angled triangles • **investigate** Pythagoras' theorem by using the sides of a right-angled triangle to form squares and use their area to establish the formula • **discuss** and compare different applications, demonstrations and proofs of Pythagoras' theorem, from Egypt and Mesopotamia, Greece, India and China with other historical and contemporary applications and proofs • **use** Pythagoras' theorem to determine unknown lengths of sides in right-angled triangles and find lengths of sides of right-angled triangles in practical applications • **recognise** the relationship between the squares of lengths of sides for different types of triangles: right-angled, acute or obtuse • **identify** Pythagorean triples, such as ○ $(3,4,5)$ ○ $(5,12,13)$ ○ $(7,24,25)$ ○ $(8,15,17)$	**Solve** spatial problems, applying angle properties, scale, similarity, Pythagoras' theorem and trigonometry in right-angled triangles • **recall** Pythagoras' theorem and Pythagorean triples • **investigate** the applications of Pythagoras' theorem in authentic problems, including applying Pythagoras' theorem and trigonometry to problems in surveying and design • **apply** the formula for calculation of distances between points on the Cartesian plane from their coordinates, emphasising the connection to vertical and horizontal displacements between the points • **understand** the relationship between the corresponding sides of similar right-angled triangles and establish the relationship between areas of similar figures and the ratio of corresponding sides, the scale factor • **use** images of proportional relationships to estimate actual measurements; for example, ○ taking a photograph of a person standing in front of a tree and using the image and scale to estimate the height of the tree ○ discussing the findings and ways to improve the estimates • **investigate** theorems and conjectures involving triangles; for example, ○ the triangle inequality and generalising links between the Pythagorean rule for right-angled	**Solve** practical problems applying Pythagoras' theorem and trigonometry of right-angled triangles, including problems involving direction and angles of elevation and depression • **recall** Pythagoras' theorem, its converse and Pythagorean triples • **apply** right-angled trigonometry to solve navigation problems involving bearings; for example, determining the bearing and estimating the distance of the final leg of an orienteering course • **apply** Pythagoras' theorem and trigonometry to problems in surveying and design, where three-dimensional problems are decomposed into two-dimensional problems; for example, investigating the dimensions of the smallest box needed to package an object of a particular length • **use** a clinometer to measure angles of inclination, and apply trigonometry, and proportional reasoning to determine the height of buildings in practical contexts • **apply** Pythagoras' theorem and trigonometry, and using dynamic geometric software, to design three-dimensional models of practical situations involving angles of elevation and depression; for example, modelling a crime scene	

Strand: Measurement

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
		triangles, and related inequalities for acute and obtuse triangles ○ determining the minimal sets of information for a triangle from which other measures can all be determined • **use** knowledge of similar triangles, Pythagoras' theorem, rates and algebra to design and construct a Biltmore stick used to measure the diameter and height of a tree, and calculate the density and dry mass to predict how much paper could be manufactured from the tree		
		Calculate and **interpret** absolute, relative and percentage errors in measurements, recognising that all measurements are estimates • **investigate** error as a percentage of the exact value; for example, comparing an estimation of the number of people expected to come to an event by subtracting the actual number that turned up to give an error, then converting this into a percentage error • **use** absolute value in a percentage error formula; considering when they would use the absolute value and when they would not, depending upon the context • **calculate** the percentage errors in expected budgets to actual expenditure • **estimate** the accuracy of measurements in practical contexts and give suitable lower and upper bounds for measurement values	**Identify** the impact of measurement errors on the accuracy of results in practical contexts • **describe** settings where measurement errors may impact research results and how measurement data impacted by error can result in biased findings • **analyse** instruments and methods for measuring in investigations and modelling activities • **determine** the impact that compounding errors have on financial calculations; for example, considering the effect of truncation on money amounts for large scale customer populations	

Strand: Measurement

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Assumes working in dollars and cents with money content across the strands post Year 3				
Use mathematical modelling to solve practical problems involving ratios; **formulate** problems, interpret and communicate solutions in terms of the situation, justifying choices made about the representation • **use** fractions to model and solve ratio problems involving comparison of quantities, and consider part-part and part-whole relations • **model** and **solve** practical problems involving ratios of length, capacity or mass, such as in ○ construction ○ design ○ food ○ textile production for example, ○ mixing concrete ○ the golden ratio in design ○ mixing a salad dressing • **model** the situation using manipulatives, diagrams and/or mathematical discussion; for example, mixing primary colours in a variety of ratios to investigate how new colours are created and the strength of those colours	**Use** mathematical modelling to solve practical problems involving ratios and rates, including financial contexts; **formulate** problems; **interpret** and **communicate** solutions in terms of the situation, reviewing the appropriateness of the model • **model** and **solve** problems related to situations such as ○ scales on maps and plans ○ the mixing of chemicals or ingredients ○ calculating magnification factors applying relevant ratios and proportions • **model** problems involving converting money amounts using different exchange rates and applying them when planning and budgeting for overseas travel • **model** situations involving financial contexts; for example, ○ income tax, using taxation rates on annual income ○ comparing different taxation brackets and rates of pay comparing the benefits of different phone plans using different call rates and associated fees to determine the best plan	**Use** mathematical modelling to **solve** practical problems involving direct proportion, rates, ratio and scale, including financial contexts; **formulate** the problems and interpret solutions in terms of the situation; **evaluate** the model and report methods and findings • **model** situations involving direct proportion such as ○ pro rata pay rates ○ exchange rates ○ multiple quotes for a job ○ conversion between scales or other appropriate science contexts; for example, Hooke's law and other science contexts involving wave lengths and frequencies • **mode**l situations that impact on image editing used in social media and how proportion may not be maintained and can result in distorted images • **model** situations involving compliance with building and construction standards in design and construction, such as ○ the rise and tread of staircases ○ vertical and horizontal components of escalators • **model** situations involving the application of rates in practical contexts;	**Use** mathematical modelling to solve practical problems involving proportion and scaling of objects; **formulate** problems and interpret solutions in terms of the situation; **evaluate** and modify models as necessary, and **report** assumptions, methods and findings • **use** plans and elevation drawings to investigate making changes to building designs, employing appropriate scales and converting to actual measurements within the context to make decisions about changes • **analyse** and **apply** scale and ratios in situations such as production prototypes and 3D printing; for example, using a 3D printer to produce scaled versions of actual objects • **estimate** the scale of an object, such as a toy car, by measuring a linear dimension and using a typical car dimension to work out the scale factor • **investigate** compliance with building codes and standards in design and construction, such as for escalators in shopping centres	

Strand: Measurement

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
		for example, ○ density ○ birth ○ flow ○ heartbeats		

Achievement standards

Strand: Space

The Space strand develops ways of visualising, representing and working with the location, direction, shape, placement, proximity and transformation of objects at macro, local and micro scales in natural and constructed worlds. It underpins the capacity to make pictures, diagrams, maps, projections, networks, models and graphics that enable the manipulation and analysis of shapes and objects through actions and the senses. This includes notions such as surface, region, boundary, curve, object, dimension, connectedness, symmetry, direction, congruence and similarity. These notions apply to art, design, architecture, planning, transportation, construction and manufacturing, physics, engineering, chemistry, biology and medicine.

Year 7	Year 8	Year 9	Year 10 and Year 10A Mathematics Pathways
Skills By the end of Year 7, students: • classify polygons according to their features • create an algorithm designed to sort and classify shapes • represent objects two-dimensionally in different ways • describe the usefulness of these representations • use coordinates to describe transformations of points in the plane.	**Skills** By the end of Year 8, students: • identify conditions for congruency and similarity in shapes • create and test algorithms designed to test for congruency and similarity • apply the properties of quadrilaterals to solve problems.	**Skills** By the end of Year 9, students: • apply the enlargement transformation to images of shapes and objects, and interpret results • design, use and test algorithms based on geometric constructions or theorems.	**Skills** By the end of Year 10, students: • use deductive reasoning, theorems and algorithms to solve spatial problems • interpret networks used to represent practical situations and describe connectedness.

Scope and sequence

Strand: Space

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Represent objects in 2 dimensions; **discuss** and **reason** about the advantages and disadvantages of different representations • **recall** ○ **connecting** objects to their nets ○ **building** objects from their nets using spatial and geometric reasoning • **deconstruct** packaging to identify shapes and nets • **use** different nets to construct prisms and determine which nets will make a cube, rectangular prism, triangular prism or pyramid • **use** aerial views of buildings and other three-dimensional structures to visualise the footprint made by the building or structure, identifying prisms that could approximate the structure • **use** isometric and square grid paper to draw views of front, back, side, top and bottom of objects	**Identify** the conditions for congruence and similarity of triangles and explain the conditions for other sets of common shapes to be congruent or similar, including those formed by transformations • **recall** corresponding, alternate and co-interior angles, and complementary, supplementary, adjacent and vertically opposite angles • **develop** an understanding of what it means for shapes to be congruent or similar • **use** the enlargement transformation and digital tools to develop sets of similar shapes • **investigate** sufficient conditions to establish that 2 triangles are congruent (SSS, SAS, ASA and RHS) • **apply** logical reasoning and tests for congruence and similarity, to problems and proofs involving plane shapes • **compare** angle and side measurements of shapes under transformation to answer questions such as ○ “What changes?” ○ “What stays the same?” • **establish** that 2 shapes are congruent if one lies exactly on top of the other after one or more transformations including translations, reflections and rotations, and recognising that the matching sides and the matching angles are equal • **solve** problems using the properties of congruent figures	**Recognise** the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles using properties of similarity • **understand** the terms “base”, “altitude”, “hypotenuse”, and “adjacent” and “opposite” sides to an angle, in a right-angled triangle, and identify these for a given right-angled triangle • **investigate** patterns to reason about nested similar triangles that are aligned on a coordinate plane, connecting ideas of parallel sides and identifying the constancy of ratios of corresponding sides for a given angle • **establish** an understanding that the sine of an angle can be considered as the length of the altitude of a right-angled triangle with a hypotenuse of length one unit and similarly the cosine as the length of the base of the same triangle, and relate this to enlargement and similar triangles • **relate** the tangent of an angle to the altitude and base of nested similar right-angled triangles, and connect the tangent of the angle at which the graph of a straight line meets the positive direction of the horizontal coordinate axis to the gradient of the straight line	**Apply** deductive reasoning to proofs involving shapes in the plane and use theorems to solve spatial problems • **distinguish** between a practical demonstration and a proof; for example, demonstrating that triangles are congruent by placing them on top of each other, as compared to using congruence tests to establish that triangles are congruent • **develop** proofs involving congruent triangles and angle properties, communicating the proof using a sequence of logically connected statements • **apply** an understanding of relationships to deduce properties of geometric figures; for example, the base angles of an isosceles triangle are equal • **investigate** proofs of geometric theorems and use them to solve spatial problems; for example, ○ applying logical reasoning and similarity to proofs ○ numerical exercises involving plane shapes; using visual proofs to justify solutions • **use** dynamic geometric software to investigate the shortest path that touches 3 sides of a rectangle, starting and finishing at the same point and prove that the path forms a parallelogram	Relationships between angles and various lines associated with circles (radii, diameters, chords, tangents) • **identify** relationships, angles between tangents and chords, angles subtended by a chord with respect to the centre of a circle, and with respect to a point on the circumference of a circle, including using dynamic geometric software • **explore** how deductive reasoning and diagrams are used in proving geometric theorems related to circles

Strand: Space

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Classify triangles, quadrilaterals and other polygons according to their side and angle properties; **identify** and **reason** about relationships • **use** digital tools or strips of paper with parallel sides to make triangles and quadrilaterals, and contrast the rigidity of triangles with the flexibility of quadrilaterals • **construct** triangles with 3 given side lengths and discuss the question, "Can any 3 lengths be used to form the sides of a triangle?" • **identify** and **communicate** about side and angle properties of ○ scalene ○ isosceles ○ equilateral ○ right-angled ○ acute ○ obtuse triangles using geometric conventions • **describe**, **compare** and **contrast** squares, rectangles, rhombuses, parallelograms, kites and trapeziums, explaining the relationships between these shapes	**Establish** properties of quadrilaterals using congruent triangles and angle properties, and solve related problems explaining reasoning • **establish** the properties of squares, rectangles, parallelograms, rhombuses, trapeziums and kites using geometric properties and proof, such as the sum of the exterior angles of a polygon is equal to a complete turn or 360° • **identify** properties of quadrilaterals related to side lengths, parallel sides, angles, diagonals and symmetry • **apply** the properties of triangles and quadrilaterals to construction designs such as ○ car jacks ○ scissor lifts ○ folding umbrellas ○ toolboxes ○ cherry pickers			

Strand: Space

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Describe transformations of a set of points using coordinates in the Cartesian plane, translations and reflections on an axis, and rotations about a given point • **use** digital tools to transform shapes in the Cartesian plane, describing and recording the transformations • **describe** patterns and investigate different ways to produce the same transformation, such as using 2 successive reflections to provide the same result as a translation • **experiment** with, create and re-create patterns using combinations of translations, reflections and rotations, using digital tools	**Describe** the position and location of objects in 3 dimensions in different ways, including using a three-dimensional coordinate system with the use of dynamic geometric software and other digital tools • **locate** aircraft/drones using latitude, longitude and altitude as a three-dimensional coordinate system • **construct** three-dimensional objects using 3D printers or designing software that uses a three-dimensional coordinate system • **compare** and **contrast** two-dimensional and three-dimensional coordinate systems by highlighting what is the same and what is different, including virtual maps versus street views • **use** dynamic geometry software to construct shapes and objects within the first quadrant of a three-dimensional coordinate system • **interpret** three-dimensional coordinate locations for objects in multi-storey car parks; **play** games based on three-dimensional coordinate systems such as three-dimensional Noughts and Crosses (Tic-Tac-Toe)		**Interpret** networks and network diagrams used to represent relationships in practical situations and describe connectedness • **recall** Euler's formula $F + V = E + 2$ to planar graphs, platonic solids and other polyhedra • **investigate** how networks and network diagrams can be used to model authentic situations, recognising what real world quantity is represented by the nodes (vertices), and what real world quantity is represented by the links between them (edges) • **investigate** the use of graphs to represent a network, analysing connectedness; for example, investigating the "The Seven Bridges of Königsberg" problem • **investigate** how polyhedra can be represented as a network using edges, vertices, interior and exterior faces; representing the number of edges, vertices and faces in a table and demonstrating how Euler's formula $F + V = E + 2$ applies • **investigate** how a social network, intranet, local area network (LAN), electrical wiring or wireless network of a home can be represented as a network diagram to specify relationships;	Establish the sine, cosine and area rules for any triangle and solve related problems • **explore** and establish the sine rule and cosine rule • **establish** the area of a non-right angled triangle • **solve** problems using the knowledge of sine, cosine and area rules • **apply** knowledge of sine, cosine and area rules to authentic problems such as those involving surveying and design

Strand: Space

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
		Apply the enlargement transformation to shapes and objects using dynamic geometry software as appropriate; **identify** and **explain** aspects that remain the same and those that change • **compare** the ratio of lengths of corresponding sides of similar triangles and angles • **use** the properties of similarity to solve problems involving enlargement • **investigate** and **generalise** patterns in length, angle, area and volume when side lengths of shapes and objects are enlarged or dilated by whole and rational numbers; for example, comparing an enlargement of a square and a cube of side length 2 units by a factor of 3 increases the area of the square, 2^2, to $(3 \times 2)^2 = 9 \times 2^2 = 9$ times the original area and the volume of the cube, 2^3, to $(3 \times 2)^3 = 27 \times 2^3 = 27$ times the volume	for example, • using network diagrams to investigate practical problems involving connections, power overload or the need for routers • **investigate** the use of networks to represent authentic situations; for example, ○ rail or air travel between or within London, Paris, Hong Kong ○ a food web representing a simple eco-system ○ metabolic networks and other chemical or biological structures	

Strand: Space

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Design and **create** algorithms involving a sequence of steps and decisions that will sort and classify sets of shapes according to their attributes, and **describe** how the algorithms work • **create** a classification scheme for ○ triangles based on sides and angles, using a flow chart using sequences and decisions ○ regular, irregular, concave or convex polygons that are sorted according to the number of sides • **create** a flow chart for quadrilaterals that shows the relationships between trapeziums, parallelograms, rhombuses, rectangles, squares and kites	**Design, create** and **test** algorithms involving a sequence of steps and decisions that identify congruency or similarity of shapes, and **describe** how the algorithm works • **list** the properties or criteria necessary to determine if shapes are similar or congruent • **use** the conditions for congruence of triangles and similarity of triangles to develop a sorting algorithm; for example, creating a flow chart • **evaluate** algorithms for accuracy in classifying and distinguishing between similar and congruent triangles	**Design, test** and **refine** algorithms involving a sequence of steps and decisions based on geometric constructions and theorems; **discuss** and **evaluate** refinements • **create** an algorithm using pseudocode or flow charts to apply the triangle inequality, or an algorithm to generate Pythagorean triples • **create** and **test** algorithms designed to construct or bisect angles, using pseudocode or flow charts • **develop** an algorithm for an animation of a geometric construction, or a visual proof, evaluating the algorithm using test cases	**Design, test** and **refine** solutions to spatial problems using algorithms and digital tools; **communicate** and **justify** solutions • **design** and **make** scale models of three-dimensional objects using digital tools; for example, ○ making components of a puzzle using a three-dimensional printer ○ planning and designing the puzzle using principles of tessellations • **apply** a computational thinking approach to solving problems involving networks; for example, ○ connectedness, coverage and weighted measures ○ taking different routes and choosing the most efficient route to take when travelling by car using virtual map software • **define** and decompose spatial problems, create and apply algorithms to generate solutions, evaluate and communicate solutions in terms of the problem; for example, designing a floor plan for a department store that limits congestion at key areas such as checkouts, changing rooms and popular sale items	

Achievement standards

Strand: Statistics

The Statistics strand develops ways of collecting, understanding, and describing data and its distribution. Statistics provides a story, or a means to support or question an argument, and enables exploratory data analysis that underpins decision-making and informed judgement. Statistical literacy requires an understanding of statistical information and processes, including an awareness of data and the ability to estimate, interpret, evaluate and communicate with respect to variation in the real world. Statistical literacy provides a basis for critical scrutiny of an argument, the accuracy of representations, and the validity and reliability of inferences and claims. The effective use of data requires acknowledging and expecting variation in the collection, analysis and interpretation of data arising for categorical and numerical variables. Statistics is used in business, government, research, sport, healthcare and media for critical and informed evaluation of issues, arguments and decision-making.

Year 7	Year 8	Year 9	Year 10 and Year 10A Mathematics Pathways
Skills By the end of Year 7, students: • plan and conduct statistical investigations involving discrete and continuous numerical data using appropriate displays • interpret data in terms of the shape of distribution and summary statistics, identifying possible outliers • decide which measure of central tendency is most suitable and explain their reasoning.	**Skills** By the end of Year 8, students: • conduct statistical investigations and explain the implications of obtaining data through sampling • analyse and describe the distribution of data • compare the variation in distributions of random samples of the same and different size from a given population with respect to ○ shape ○ measures of central tendency ○ range.	**Skills** By the end of Year 9, students: • compare and analyse the distributions of multiple numerical data sets, choose representations, describe features of these data sets using summary statistics and the shape of distributions, and consider the effect of outliers • explain how sampling techniques and representation can be used to support or question conclusions or to promote a point of view.	**Skills** By the end of Year 10, students: • plan and conduct statistical investigations involving bivariate data • represent the distribution of data involving 2 variables, using tables and scatter plots, and comment on possible association • analyse inferences and conclusions in the media, noting potential sources of bias • compare the distribution of continuous numerical data, using various displays, and discuss distributions in terms of centre, spread, shape and outliers.

Scope and sequence

Strand: Statistics

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Acquire data sets for discrete and continuous numerical variables and calculate the range, median, mean and mode; **make** and **justify** decisions about which measures of central tendency **provide** useful insights into the nature of the distribution of data • **understand** that summarising data by calculating measures of centre can help make sense of the data, commenting on skewness or symmetry of data and the use of mean and median as representative measures • **compare** the mean, median, mode and range of displays of data from a given context, and explain how outliers may affect summary statistics • **recognise** how different data sets can have the same measures of central tendency and experiment with how varying data affects these measures • **acquire** continuous numerical data by taking measurement samples during a science experiment, observation or field study, compare measures of central tendency and identify any anomalies in the distribution of data	**Investigate** techniques for data collection including census, sampling, experiment and observation, and **explain** the practicalities and implications of obtaining data through these techniques • **identify** situations where data can be collected by census and those where a sample is appropriate • **investigate** the practicalities and implications of obtaining data through sampling, using a variety of investigative processes; for example, investigating situations when ○ random sampling ○ non-random sampling is used to collect data and the implication of each sampling method • **discuss** how observations, experiments and sampling methods can be impacted by bias; for example, ○ recognise that a sampling bias occurs when certain members of a population are more likely to be selected in a sample than others, such as a survey conducted at a shopping centre; ○ recognise that environmental conditions may bias the results of scientific investigations if experiments are conducted at different times or under different conditions	**Analyse** reports of surveys in digital media and elsewhere for information on how data was obtained to estimate population means and medians • **investigate** and **evaluate** statistical reports in the media and other places by linking claims to displays, statistics and representative data • **investigate** a range of data and its sources; for example, ○ the age of residents in Australia, Cambodia and Tonga ○ the number of subjects studied at school in a year by 14-year-old students in Australia, Singapore, Japan, South Korea and Timor-Leste • **analyse** reports of public opinion surveys on environmental issues, such as ○ land clearing ○ wind farms ○ single use plastics; discussing methods of data collection and the reasonableness of any inferences made	**Analyse** claims, inferences and conclusions of statistical reports in the media, including ethical considerations and identification of potential sources of bias • **identify** potentially misleading data representations in the media such as graphs with broken axes and scales that do not start at zero or are nonlinear; recognising when data is not related to the claim, not representative of the population or is deliberately being used to mislead, or support a claim or biased point of view • **investigate** ○ the source and size of the sample from which the data was collected and decide whether the sample is appropriately representative of the population ○ population rates and discuss potential ethical considerations when presenting statistical data involving infection rates, and the number of cases per head of population • **use** secondary data to predict the number of people likely to be infected with a strain of flu or experience side effects with a certain medication, discussing the ethical considerations of reporting of such data to the wider public, considering validity claims and samples sizes	Measures of spread, their interpretation and usefulness with respect to different data distributions • **compare** the use of quantiles, percentiles, and cumulative frequency to analyse the distribution of data • **compare** measures of spread for different data distributions, such as mean or median absolute deviations with standard deviations, and explore the effect of outliers

Strand: Statistics

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
	• **use** digital tools such as ○ digital microscopes ○ simulations ○ digital measuring devices to observe, measure and record qualitative and quantitative data, discussing precision and the implications of error			
	Analyse and **report** on the distribution of data from primary and secondary sources using random and non-random sampling techniques to select and study samples • **investigate** different methods of sampling used to collect data, considering the source and size of samples • **compare** the sampling methods of simple random, systematic, stratified, quota, clustered or convenience, or judgement, and discuss the reliability of conclusions about the context that could be drawn • **define** and **distinguish** between probabilistic terms such as random, sample space, sample and sample distribution	**Analyse** how different sampling methods can affect the results of surveys and how choice of representation can be used to support a particular point of view • **investigate** and **analyse** different visualisations of data such as infographics found in the media and comment on the strengths, weaknesses and possible biases of particular examples • **discuss** the impact of decreased landline usage or an increased aversion to answering calls from unknown numbers on survey data	**Compare** data distributions for continuous numerical variables using appropriate data displays including boxplots; **discuss** the shapes of these distributions in terms of centre, spread, shape and outliers in the context of the data • **construct** and **interpret** box plots and use them to compare data sets, understanding that box plots are an efficient and common way of representing and summarising data and can facilitate comparisons between data sets • **compare** shapes of distributions using box plots, histograms, cumulative frequency graphs and dot plots, discussing symmetry, skew and modality • **use** digital tools to compare boxplots and histograms as displays of the same data in the light of the statistical questions being addressed and the effectiveness of the display in helping to answer the question • **find** the five-number summary (minimum and maximum values, median, and upper and lower quartiles) and using its graphical representation, the box plot, as tools for both	**Calculate** and **interpret** the mean and standard deviation of data and use these to compare data sets • **use** the standard deviation to describe the spread of a set of data • **use** the mean and standard deviation to compare numerical data sets

Strand: Statistics

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
			numerically and visually comparing the centre and spread of data sets with and without technology • **compare** the information that can be extracted and the stories that can be told about continuous and discrete numerical data sets that have been displayed in different ways, including histograms, dot plots, box plots and cumulative frequency graphs	
Create different types of numerical data displays including stem-and-leaf plots using software where appropriate; **describe** and **compare** the distribution of data, **comment** on the shape and spread including outliers and **determine** the range, median, mean and mode • **use** ordered stem-and-leaf plots to record and display numerical data collected in a class investigation, such as constructing a class plot of height in centimetres on a shared stem-and-leaf plot for which the stems 12, 13, 14, 15, 16 and 17 have been produced • **compare** variation in attributes by category using split stem-and-leaf plots or dot plots; interpreting the shape of the distribution using qualitative terms to describe symmetry or skewness, or “average” in terms of the mean, median and mode, and the amount of variation based on qualitative descriptions of the spread of the data • **connect** features of the data display; for example, ○ highest frequency ○ clusters	**Compare** variations in distributions and proportions obtained from random samples of the same size drawn from a population and **recognise** the effect of sample size on this variation • **recall** mean, median, mode and range • **compare** the proportion of students in favour of a proposal for a change in school uniform between different random samples of 50 students from the school population • **use** digital tools to simulate repeated sampling of the same population, such as heights or arm spans of students, recording and comparing means, median and range of data between samples • **use** relative frequencies from historical data to predict proportions and the likely number of outcomes in situations such as ○ weather forecasting ○ the countries of origin of visitors to tourist attractions	**Represent** the distribution of multiple data sets for numerical variables using comparative representations; **compare** data distributions with consideration of centre, spread and shape, and the effect of outliers on these measures • **describe** the shape of the distribution of data using terms such as “positive skew”, “negative skew” and “symmetric” and “bi-modal” • **use** stem-and-leaf plots to compare 2 like sets of data such as the heights of girls and the heights of boys in a class • **construct** grouped histograms that show trends in health issues such as ○ lung cancer ○ leukemia ○ stroke ○ diabetes and use the graph to justify, verify or invalidate claims	**Construct** scatterplots and **comment** on the association between the 2 numerical variables in terms of strength, direction and linearity • **discuss** the difference between association and cause and effect, and relate this to situations such as health, diversity of species and climate control • **use** statistical evidence to make, justify and critique claims about association between variables, such as in contexts of ○ climate change ○ migration ○ online shopping ○ social media • **informally use** a line of good fit by eye to discuss reliability of any predictions	**Use** information technologies to investigate bivariate numerical data sets. Where appropriate use a straight line to describe the relationship allowing for variation • **investigate** different techniques for finding a ‘line of best fit’, such as ‘by inspection’ or using linear regression using technology • **explore** interpolation and extrapolation and the trend of being reliable or not reliable

Strand: Statistics

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
○ gaps ○ symmetry ○ skewness to the mode, range and median, and the question in context; describing the shape of distributions using terms such as ○ "positive skew" ○ "negative skew" ○ "symmetric" ○ "bi-modal" and discuss the location of the median and mean on these distributions • **use** mean and median to compare data sets, identify possible outliers and explain how these may affect the comparison ○ **recognise** how different displays make specific information about data more evident, including proportions, and measures of mean, mode or median, spread and extreme values ○ **understand** that the median and the mean will be the same or similar for symmetric distributions but different for distributions that are skewed • **compare** the mean and median of data with and without extremes; for example, estimation of standard measures for length or mass, informally considering for a given set of data what might constitute an unexpected, unusual or extreme data value	• **investigate** the effect that adding or removing data from a data set has on measures of central tendency and spread	**Choose** appropriate forms of display or visualisation for a given type of data; **justify** selections and **interpret** displays for a given context • **compare** data displays using mean, median and range to describe and interpret numerical data sets in terms of centre and spread using histograms, dot plots, or stem-and-leaf plots • **choose** the type of representations based on the data type: categorical (nominal or ordinal) or numerical (discrete or continuous) • **use** different visualisations of data, including non-standard representations such as infographics, and discuss their purpose, intended audience; evaluating how well they communicate responses to statistical questions of interest • **compare** and **interpret** stacked bar charts, area charts and line graphs, discussing how they represent larger categories that can be subdivided into smaller categories and how information that can be obtained from these displays can be used for comparison	**Construct** two-way tables and **discuss** possible relationship between categorical variables • **use** two-way tables to investigate and compare the survey responses to questions involving five-point Likert scale against 2 different categories of respondents; for example, junior compared to senior students' responses to a survey question • **record** data in two-way tables and use percentages and proportions to identify patterns and associations in the data • **conduct** a litter survey around the school, considering the relationship between different categorical variables such as ○ the day of the week as canteen specials might lead to different types of litter ○ the weather due to hot days leading to more ice blocks and cold drinks being sold	

Strand: Statistics

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Plan and **conduct** statistical investigations involving discrete and continuous numerical variables; **analyse** and **interpret** distributions of data and **report** findings in terms of shape and summary statistics • **conduct** an investigation to ○ draw conclusions about whether teenagers have faster reaction times than adults ○ support claims that a modification of a Science, Technology, Engineering and Mathematics (STEM) related design has improved performance	**Plan** and **conduct** statistical investigations involving samples of a population; **use** ethical and fair methods to make inferences about the population and report findings, acknowledging uncertainty • **use** data such as electricity consumption to draw conclusions about the impacts of events, such as pandemics, on households or business • **identify** situations where the collection of data from a sample is necessary due to efficiency, cost or restricted time for collection of data, and sufficiently reliable for making inferences about a population	**Plan** and **conduct** statistical investigations involving the collection and analysis of different kinds of data; **report** findings and **discuss** the strength of evidence to support any conclusions • **plan** and **conduct** an investigation using questions together with analysis of secondary data set collected from online data bases such as the Australian Bureau of Statistics • **plan** and **conduct** an investigation relating to consumer spending habits; modelling market research on what teenagers are prepared to spend on technology compared to clothing with consideration of sample techniques and potential sources of bias	**Plan** and **conduct** statistical investigations of situations that involve bivariate data; **evaluate** and **report** findings with consideration of limitations of any inferences • **design** statistical investigations that collect bivariate data over time through observation, experiment or measurement; graphing, interpreting and analysing data; reporting within the context of the statistical investigation question • **investigate** anecdotal claims include those concerning climate, housing affordability and natural resources, with consideration of data validity and limitations of interpolation or extrapolation • **use** a statistical investigation to address the question, “Is there a relationship between vaccines and immunity from a virus”	

Achievement standards

Strand: Probability

The Probability strand develops ways of dealing with uncertainty and expectation, making predictions, and characterising the chance of events, or how likely events are to occur from both empirical and theoretical bases. It provides a means of considering, analysing and utilising the chance of events, and recognising random phenomena for which it is impossible to exactly determine the next observed outcome before it occurs. In contexts where chance plays a role, probability provides experimental and theoretical ways to quantify how likely it is that a particular event will occur or a proposition is the case. This enables students to understand contexts involving chance and to build mathematical models surrounding risk and decision-making in a range of areas of human endeavour. These include finance, science, business management, epidemiology, games of chance, computer science and artificial intelligence.

Year 7	Year 8	Year 9	Year 10 and Year 10A Mathematics Pathways
Skills By the end of Year 7, students: • list sample spaces for single step experiments • assign probabilities to outcomes • predict relative frequencies for related events • conduct repeated single-step chance experiments • run simulations using digital tools • give reasons for differences between predicted and observed results.	**Skills** By the end of Year 8, students: • represent the possible combinations of 2 events with tables and diagrams, and determine related probabilities to solve practical problems • conduct experiments and simulations using digital tools to determine related probabilities of compound events.	**Skills** By the end of Year 9, students: • determine sets of outcomes for compound events and represent these in various ways • assign probabilities to the outcomes of compound events • design and conduct experiments or simulations for combined events using digital tools.	**Skills** By the end of Year 10, students: • apply conditional probability to solve problems involving compound events • design and conduct simulations involving conditional probability, using digital tools.

Scope and sequence

Strand: Probability

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Identify the sample space for single-stage events; **assign** probabilities to the outcomes of these events and **predict** relative frequencies for related events • **discuss** the meaning of probability terminology; for example, ○ “probability” ○ “sample space” ○ “favourable outcome” ○ “trial” ○ “experiment” ○ “event” • **list** sample spaces for games involving throwing a coin or a die, spinners, or lucky dip • **assign** the probability for throwing a 6 on a die and use this to predict the number times a 6 will occur when a die is thrown multiple times	**Recognise** that complementary events have a combined probability of one; **use** this relationship to calculate probabilities in applied contexts • **recall** concept of probabilities, outcomes, sample spaces and events • **understand** that knowing the probability of an event allows the probability of its complement to be found, including for those events that are not equally likely, such as getting a specific novelty toy in a supermarket promotion • **use** the relationship that for a single event A, $Pr(A) + Pr(not\ A) = 1$; for example, if the probability that it rains on a particular day is 80%, the probability that it does not rain on that day is 20%, or the probability of not getting a 6 on a single roll of a fair dice is $1 - \frac{1}{6} = \frac{5}{6}$ • **use** the sum of probabilities to solve problems, such as the probability of starting a game by throwing a 5 or 6 on a die is $\frac{1}{3}$ and probability of not throwing a 5 or 6 is $\frac{2}{3}$	**List** all outcomes for compound events both with and without replacement, using lists, tree diagrams, tables or arrays; **assign** probabilities to outcomes • **discuss** two-step chance experiments, such as the game of Heads and tails, describing the different outcomes and their related probabilities • **use** systematic methods such as lists or arrays to record outcomes and assign probabilities, such as drawing the names of students from a bag to appoint 2 team leaders • **use** a tree diagram to represent a three-stage event and assign probabilities to these events; for example, selecting 3 cards from a deck, assigning the probability of drawing an ace, then a king, then a queen of the same suit, with and without replacing the cards after every draw • **assign** probabilities to compound events involving the random selection of people from a given population; for example, selecting 2 names at random from all of the students at a high school and assigning the probability that they are both in Year 9	**Use** the language of “if .... then”, “given”, “of”, “knowing that” to **describe** and **interpret** situations involving conditional probability • **use** two-way tables and Venn diagrams to understand conditional statements using the language of ○ “if … then …” ○ “given” ○ “of” ○ “knowing that” and identify common mistakes in interpreting such language • **use** arrays and tree diagrams to represent, interpret and compare probabilities of dependent and independent events	Counting principles, and factorial notation as a representation that provides efficient counting in multiplicative contexts, including calculations of probabilities • **apply** the multiplication principle to problems involving combinations including probabilities related to sampling with and without replacement, and represent these using tree diagrams • **understand** that a set with n elements has 2^n different subsets formed by considering each element for inclusion or not in combination, and that these can be systematically listed using a tree diagram or a table, for example, the set $\{a, b, c\}$ has $2^3 = 8$ subsets which are $\{\emptyset, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}$. • **use** the definition of $n!$ to represent and calculate in contexts that involve choices from a set for example, how many different combinations of 3 playing cards from a pack? How many of the suits are ignored? How many with and without replacement? • **perform** calculations on numbers expressed in factorial form, such as $\frac{n!}{r!}$ to evaluate the number of possible arrangements of n objects in a row, r of which are identical,

Strand: Probability

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
				for example, 5 objects, 3 of which are identical, can be arranged in a row in $\frac{5!}{3!} = \frac{5 \times 4 \times 3 \times 2 \times 1}{3 \times 2 \times 1} = 20$ different ways
	Determine all possible combinations for 2 events, using two-way tables, tree diagrams and Venn diagrams, and **use** these to **determine** probabilities of specific outcomes in practical situations • **describe** events using language of ○ "at least" ○ exclusive "or" (A or B but not both) ○ inclusive "or" (A or B or both) ○ "and" • **use** the relation $Pr(A \text{ and } B) + Pr(A \text{ and not } B) + Pr(\text{not } A \text{ and } B) + Pr(\text{not } A \text{ and not } B) = 1$ to calculate probabilities, including the special case of mutually exclusive events where $Pr(A \text{ and } B) = 0$ • **use** Venn diagrams or two-way tables to demonstrate the difference between events that are mutually exclusive, such as ○ whether a coin toss will land on a head or a tail or those that are not mutually exclusive, such as ○ people who have blonde hair and people who have blue eyes	**Calculate** relative frequencies from given or collected data to **estimate** probabilities of events involving "and", inclusive "or" and exclusive "or" • **understand** that relative frequencies from large data sets or long-run experiments can provide reliable measures of probability and can be used to make predictions of decisions • **use** Venn diagrams or two-way tables to estimate frequencies of events involving "and", "or" questions		

Strand: Probability

Year 7	Year 8	Year 9	Year 10	Year 10A Mathematics Pathways
Conduct repeated chance experiments and run simulations with a large number of trials using digital tools; **compare** predictions about outcomes with observed results, explaining the differences • **develop** an understanding of the law of large numbers through using experiments and simulations to conduct large numbers of trials for seemingly random events and discuss findings • **conduct** simulations using online simulation tools and compare the combined results of a large number of trials to predicted results	**Conduct** repeated chance experiments and simulations, using digital tools to determine probabilities for compound events, and **describe** results • **use** digital tools to conduct probability simulations involving compound events • **use** a random number generator and digital tools to simulate rolling 2 dice and **calculate** the difference between them, investigating what difference is likely to occur more often • **use** online simulation software to conduct probability simulations to determine in the long run if events are complementary	**Design** and **conduct** repeated chance experiments and simulations, using digital tools to compare probabilities of simple events to related compound events, and **describe** results • **use** digital tools to conduct probability simulations that demonstrate the relationship between the probability of compound events and the individual probabilities • **compare** experiments which differ only by being undertaken with replacement or without replacement • **conduct** two-step chance experiments using systematic methods to list outcomes of experiments and to list outcomes favourable to an event	**Design** and **conduct** repeated chance experiments and simulations using digital tools to model conditional probability and **interpret** results • **use** samples of different sizes with and without replacement from a population to identify when the difference in methods becomes negligible • **recognise** that an event can be dependent on another event and that this will affect the way its probability is calculated • **use** simulations to gather data on frequencies for situations involving chance that appear to be counter-intuitive, such as ○ the three-door problem ○ the birthday problem • **identify** situations in real-life where probability simulations are used for decision-making, such as ○ supply and demand of product ○ insurance risk ○ queueing • **use** simulation to predict the number of people likely to be infected with a strain of flu or virus	