Government of **Western Australia**
School Curriculum and Standards Authority

Western Australian Curriculum

Mathematics

Scope and sequence | Years 7–10

Revised curriculum | For familiarisation in 2025

Acknowledgement of Country

Kaya. The School Curriculum and Standards Authority (the Authority) acknowledges that our offices are on Whadjuk Noongar boodjar and that we deliver our services on the country of many traditional custodians and language groups throughout Western Australia. The Authority acknowledges the traditional custodians throughout Western Australia and their continuing connection to land, waters and community. We offer our respect to Elders past and present.

2024/53445[v11]

Contents

Overview

The current Western Australian Curriculum: Mathematics was adopted from the Australian Curriculum version 8.1.

The Western Australian Curriculum: Mathematics has been adapted from the current Western Australian Curriculum, the New South Wales Curriculum and Australian Curriculum version 9, and has been contextualised for the *Western Australian Curriculum and Assessment Outline*.

Guide to reading this document

The Scope and sequence shows the **mandated** curriculum for teaching, written as **content descriptions** across year levels so that a sequence of content can be viewed across the years of schooling from Pre-primary to Year 10. The **examples** illustrate the content and are **not mandated**. Teachers should use examples relevant to the context of their school and needs of their students.

This Scope and sequence shows the Years 7–10 Mathematics curriculum.

The document is organised by three Mathematics strands: Number and algebra; Measurement and geometry; and Probability and statistics.

The **Number and algebra** strand for **Years 7–10** includes: Understanding number; Calculating with number; Algebraic techniques; Linear and non-linear equations and inequalities; Linear and non-linear patterns and relationships; Financial mathematics; and Modelling with number and algebra.

The **Measurement and geometry** strand for **Years 7–10** includes: Two-dimensional space and structures; Three-dimensional space and structures; Non-spatial measurement; and Modelling with measurement and geometry.

The **Probability and statistics** strand for **Years 7–10** includes: Probability and statistics; and Modelling with probability and statistics.

The optional content in Years 9 and 10 is intended to build and extend students' year level knowledge according to areas of interest, understanding of content and preparation for subsequent study. Teachers may choose optional content according to the needs of the student/s.

The table below outlines the subject organisation for the Years 7–10 Mathematics curriculum.

Years 7–10

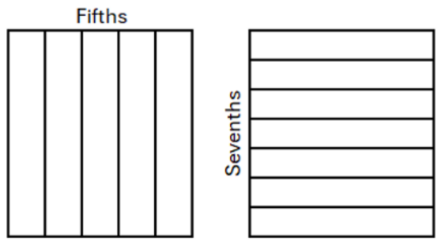
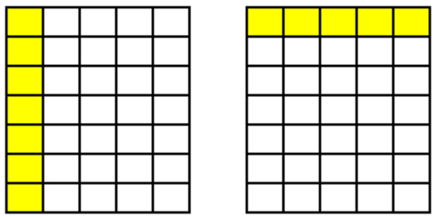
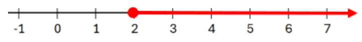
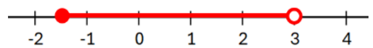
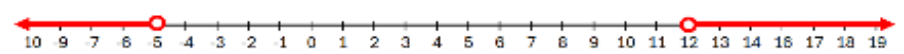
Number and algebra						
Understanding number	Calculating with number	Algebraic techniques	Linear and non-linear equations and inequalities	Linear and non-linear patterns and relationships	Financial mathematics	Modelling with number and algebra

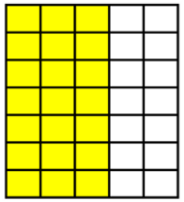
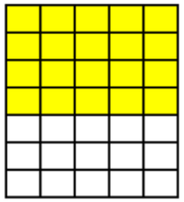
Measurement and geometry			
Two-dimensional space and structures	Three-dimensional space and structures	Non-spatial measurement	Modelling with measurement and geometry

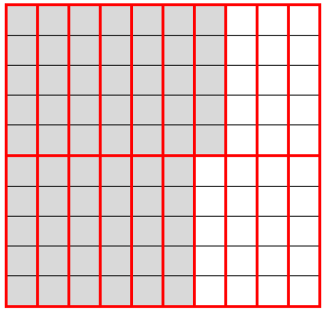
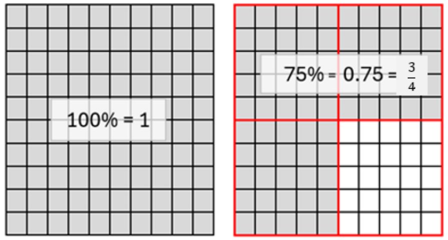
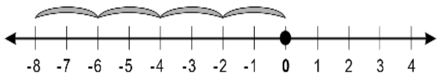
Probability and statistics	
Probability and statistics	Modelling with probability and statistics

Strand: Number and algebra

Sub-strand: Understanding number

Year 7	Year 8	Year 9	Year 10
Explore and represent equivalent fractions with related and unrelated denominators, visually and numerically For example:  $\frac{1}{5}=\frac{7}{35}$ $\frac{1}{7}=\frac{5}{35}$ 	Investigate, define, identify and use correct notation for rational and irrational numbers, including terminating, recurring and rounded decimals For example: • Investigating to explain that 3, 37% and $0.6666...$ ($0.\dot{6}$ or 0.67 rounded to 2dp) are rational numbers as they can be written as the fractions $\frac{3}{1}$, $\frac{37}{100}$ and $\frac{2}{3}$ • Investigating to explain that $\sqrt{2}$ and π are irrational numbers as they cannot be written as fractions with an integer numerator and denominator and that $\frac{22}{7}$ and 3.14 are approximations ($\approx$) for π • Investigating terminating, recurring and rounded decimals resulting from dividing 1 by 1, 2,	Investigate very large and very small numbers and move flexibly between their exact and approximated scientific notation For example: • Exploring contexts for very large numbers (population count, national debt, mass of celestial bodies, data storage) and very small numbers (nanoparticles, sizes of cells, microseconds, microtransactions, tolerances in engineering, winning times in Olympic events) and comparing these quantities or measurements to those in more familiar contexts • Exploring instruments used to measure very large and very small measures, such as the capacity of liquid in a scientific pipette being	Move flexibly between real number inequalities expressed as a worded statement, algebraically or on a number line For example: • Representing all measurements greater than or equal to two metres as an inequality and on a number line  • Representing a range of temperatures greater than or equal to $-1.5°$ and less than $3°$ as inequalities and on a number line  • Writing an inequality to match the following number line solution 

Year 7	Year 8	Year 9	Year 10
$\frac{3}{5} = \frac{21}{35}$  $\frac{4}{7} = \frac{20}{35}$  • Using the multiplicative relationships between equivalent fractions to justify that $\frac{2}{5} = \frac{6}{15}$ because if the parts are three times smaller, the number of parts needs to be three times greater • Using knowledge of equivalence to explore the truth of statements, such as $\frac{3}{4} > \frac{2}{3}$ or $\frac{3}{4} + \frac{1}{3} \neq \frac{4}{7}$ Explore and explain relationships between fractions, decimals and percentages For example: • Drawing diagrams to explain $65\% = 0.65 = \frac{65}{100} = \frac{13}{20}$	3, … to 15 comparing to dividing 10 by 1, 2, 3, … to 15, using correct notation Draw and label, or use a given number line, to locate, order and compare with equality and inequality symbols, rational and irrational numbers, including numbers written in index form, and percentages For example: • Locating $-1\frac{3}{4}, 3, -0.5, \sqrt{2}, 25\%,$ 2^1, 140% and $\frac{1}{3}$ on a number line. Writing the numbers in ascending order. Comparing numbers using $<, >, \leq, \geq$ or $=$ e.g. $\frac{1}{3} < \sqrt{2}$ • Justifying why the following statement is true $-4\frac{1}{20} > -4.1$	5.72×10^{-4} mL which is 0.000572 mL • Choosing to write the size of an atom given as 2.45×10^{-7} mm exactly as 0.000000245 mm, and the speed of light given as 299 792 458 ms as approximately 2.998×10^{8} ms for accuracy, efficiency or context Investigate, define, compare and order real numbers, with equality and inequality symbols, including those expressed in scientific notation For example: • Explaining that the real number system includes both rational and irrational numbers • Using efficient strategies to write the real numbers below in descending order and comparing the numbers using $<, >, \leq, \geq$ or $=$	

Year 7	Year 8	Year 9	Year 10
 • Explaining that as $100\% = 1$, 175% can be represented using a diagram, such as  $175\% = 1.75 = 1\frac{3}{4}$ • Investigating, comparing, generalising and validating calculator strategies to move between percentages, fractions and decimals	Explore to extend multiplicative thinking with positive integers to include multiplication and division of negative integers For example: • Exploring using patterning $3 \times 2 = 6$ $-3 \times 2 = -6$ $3 \times 1 = 3$ $-3 \times 1 = -3$ $3 \times 0 = 0$ $-3 \times 0 = 0$ $3 \times (-1) = -3$ $-3 \times (-1) = 3$ $3 \times (-2) = -6$ $-3 \times (-2) = 6$ • Representing 4×-2 as repeated addition on a number line  • Considering 4×-3 as $(-3) + (-3) + (-3) + (-3)$ and -4×-3 as $-[(-3) + (-3) + (-3) + (-3)]$ • Extending and exploring multiplication and division as inverse operations of each other, by constructing equivalent equations that include negative integers	$\sqrt{\pi}, -1\frac{1}{2}, 3.25 \times 10^{-1}, 2^0,$ $\sqrt[3]{-8.1}, 0.15, 1.4^0, 5.5 \times 10^{-2}, \sqrt{3}$ • Without calculating, justify why the following are true: $3.25 \times 10^{-1} > 5.5 \times 10^{-2}$ $\sqrt{\pi} < \pi$ $\sqrt{2} > \frac{1}{2}$ $\sqrt[3]{-64} > \sqrt[3]{-125}$ **Year 9 optional** Explore to develop a sequence of steps to flexibly move between recurring decimals and fractions	

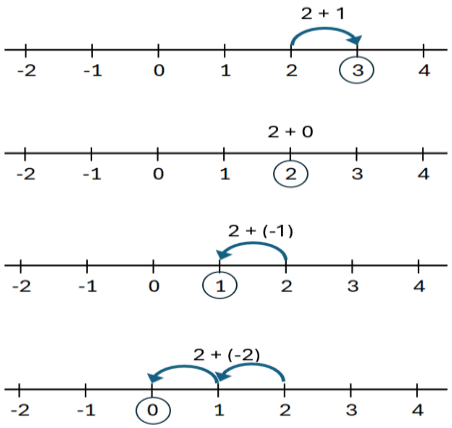
Year 7	Year 8	Year 9	Year 10
Draw and label, or use a given number line, to locate, order and compare with equality and inequality symbols, fractions, terminating decimals, percentages and integers For example: • Locating $\frac{2}{5}$, -2, -4, 95%, 0.75 and $2\frac{1}{4}$ on a number line and use this to assist in ordering and comparing numbers using inequalities $-4 < -2 < \frac{2}{5} < 0.75 < 95\% < 2\frac{1}{4}$ • Comparing $\frac{3}{5}$ and $\frac{6}{10}$ using equality and inequality symbols $\frac{3}{5} = \frac{6}{10}$ or $\frac{3}{5} \leq \frac{6}{10}$ or $\frac{3}{5} \geq \frac{6}{10}$ • Comparing $\frac{1}{4}$ and $-\frac{1}{3}$ using inequality symbols Explore to extend addition and subtraction of positive integers to include negative integers	$4 \times (-7) = -28$ $-28 \div 4 = -7$ $-28 \div -7 = 4$ • Investigating $(-5)^2$ and -5^2 $(-5)^3$ and -5^3 justifying that there are two numbers that can be squared to give a result of 25 and that $\sqrt[3]{-125} = -5$ Extend the use of associative, commutative and distributive laws, additive and multiplicative partitioning, inverse operations, order of operations, equality and inequality to validate a range of mental and written strategies involving the four operations on any rational number For example: • Selecting, using and communicating partitioning, commutativity, and order of operations to evaluate -74×4 $= 4 \times (-70) + 4 \times (-4)$		

For example:

- Using patterning to explore

$2+2=4$	$5-1=4$	$-3+2=-1$
$2+1=3$	$5-0=5$	$-3+1=-2$
$2+0=2$	$5-(-1)=6$	$-3+0=-3$
$2+(-1)=1$	$5-(-2)=7$	$-3+(-1)=-4$
$2+(-2)=0$	$5-(-3)=8$	$-3+(-2)=-5$
$2+(-3)=-1$	$5-(-4)=9$	$-3+(-3)=-6$

- Using number lines to explore



- Extending and exploring addition and subtraction as inverse operations of each other by constructing equivalent equations that include negative integers

  If $3+(-5)=-2$, then

  $-5+3=-2$

  $-2-3=-5$

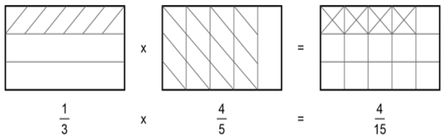
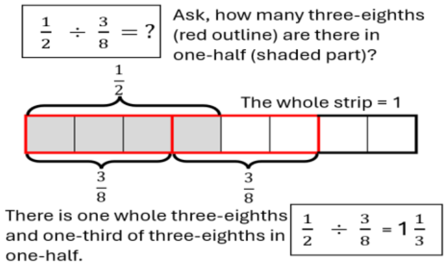
  $-2-(-5)=3$

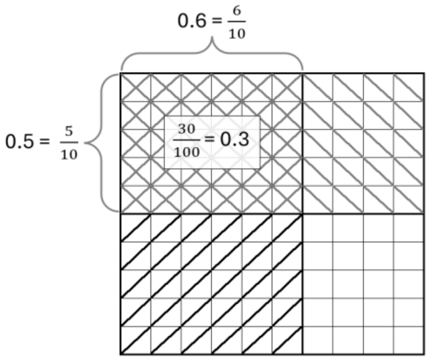
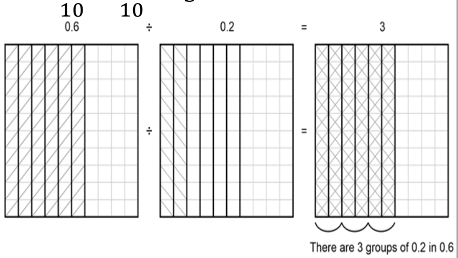
$$-63 \div 150$$
$$= \frac{-63}{150}$$
$$= \frac{3\times(-21)}{3\times 50}$$
$$= \frac{-21}{50}$$

$$-\frac{1}{2}+\frac{3}{5}\times\frac{1}{2}$$
$$= -\frac{1}{2}+\frac{3}{10}$$
$$= \frac{3}{10}-\frac{1}{2}$$

- Flexibly using associativity and inverse operations to create equivalent equations and use this to solve for unknown fractions or decimals in equations with one operation, such as

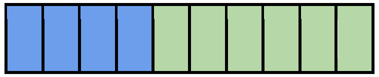
$$4\frac{1}{8} - ? = -2\frac{1}{4}$$
$$4\frac{1}{8} - (-2\frac{1}{4}) = ?$$
$$4\frac{1}{8} + 2\frac{1}{4} = ?$$
$$4+2+\frac{1}{8}+\frac{1}{4} = ?$$
$$? \times 3.5 = -16.1$$
$$? = -16.1 \div 3.5$$

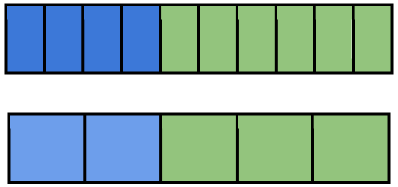
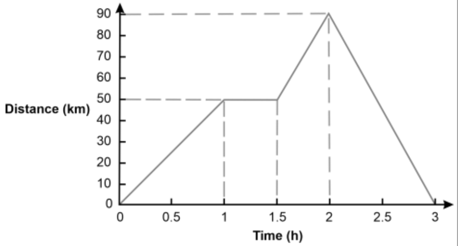
Year 7	Year 8	Year 9	Year 10
Explore and interpret multiplication and division of positive fractions, visually and numerically For example: • Representing $\frac{1}{3} \times \frac{4}{5}$  and using to explain $\frac{1}{3} \times \frac{4}{5} = \frac{4}{15}$  Explore and interpret multiplication and division of positive decimals, visually and numerically For example: • Representing 0.6×0.5 in a diagram and using to explain	• Without calculating, justify statements as true (T) or false (F) $9.6 + 8 \div 4 > 9.6 \div 8 + 4$ $9 \div (0.4 + 3) = (9 \div 0.4) + (9 \div 3)$		

Year 7	Year 8	Year 9	Year 10
and make connections to $\frac{6}{10} \times \frac{5}{10} = \frac{30}{100}$  The whole square = 1 • Representing $0.6 \div 0.2$ in a diagram and using the diagram to explain and make connections to $\frac{6}{10} \div \frac{2}{10} = 3$  Use place value understanding to explore rounding decimals to a specified number of decimal places			

For example: • Using place value to describe 3.64 as between 3.6 and 3.7, $\frac{4}{100}$ greater than 3.6 and $\frac{6}{100}$ smaller than 3.7 • When rounding to three decimal places 1.6248 rounds to 1.625 1.6273 rounds to 1.627 1.6235 rounds to 1.624 Extend the use of associative, commutative and distributive laws, additive and multiplicative partitioning, inverse operations, order of operations, equality and inequality to validate a range of mental and written strategies involving the four operations on whole numbers, positive fractions and decimals, and addition and subtraction of integers For example: • Exploring efficiency of strategic use of partitioning, commutativity and order of			

Year 7	Year 8	Year 9	Year 10
operations to assist calculation of $16 \times 75 = 4 \times 4 \times 3 \times 25$ $= 4 \times 25 \times 3 \times 4$ $4 \times 2\frac{3}{4} = (4 \times 2) + (4 \times \frac{3}{4})$ $-27 + 35 = -27 + (27 + 8)$ $15.3 - 4.8 = 15.3 + (-5) + 0.2$ • Extending the use of inverse operations to assist calculation for an unknown fraction or decimal in an equation with one operation, such as $\frac{5}{8} - ? = \frac{1}{4}$ $\frac{5}{8} - \frac{1}{4} = ?$ $? \times 3.5 = 16.1$ $? = 16.1 \div 3.5$ • Without calculating, justify statements as true (T) or false (F), such as $48 \times 2.5 = 12 \times 10$ $8 \div 1.8 \div 2 < 8 \div 2 \div 1.8$ $15 \times 6 < 15 \times 12 \div 2$ $-12 + 3 \geq -9 + (-3) + 3$ $\frac{3}{8} \times \frac{5}{8} > \frac{5}{8} \times \left(\frac{1}{5} + \frac{3}{5}\right)$			

Year 7	Year 8	Year 9	Year 10
Explore and explain the use of ratios and fractions to compare numbers and quantities. Make connections between equivalent fractions and between equivalent ratios For example: • The bar, or the whole, can be considered as 10 equal parts or 2 unequal parts made up of the 'blue part' and the 'green part'  Exploring ways to compare the sizes of ▪ the 'blue part' **and** the 'green part', such as $4:6$ or $2:3$, $6:4$ or $3:2$, $\frac{4}{6}$ or $\frac{2}{3}$, $\frac{6}{4}$ or $1\frac{1}{2}$ ▪ the 'blue part' **and** the 'whole', such as $4:10$ or $2:5$, $10:4$ or $5:2$, $\frac{4}{10}$ or $\frac{2}{5}$, $\frac{10}{4}$ or $\frac{5}{2}$ ▪ the 'green part' **to** the 'whole', such as $6:10$ or $\frac{6}{10}$ or $\frac{3}{5}$	Explore and apply proportional reasoning to find unknown numbers in equivalent ratios and fractions For example: • Giving reasons why n must be 2 if $\frac{n}{5} = \frac{6}{15}$ • Moving flexibly between ratios and fractions in order to calculate an unknown, such as $7:4 = a:6$ $\frac{7}{4} = \frac{a}{6}$ $4a = 42$ • Dividing a quantity in a given ratio, such as sharing $\$570$ in the ratio $2:1$ Identify, interpret, compare and use familiar rates, including those represented as graphs that show a quantity varying over time For example: • Identifying 30 kmh as a rate, interpreting as 30 km travelled in every one hour, reasoning that this is equivalent to 60 km travelled in two hours, 15 km in 30 mins or 0.5 km in one minute		

Year 7	Year 8	Year 9	Year 10
• Using diagrams to explain equivalent ratios and simplification of ratios,  such as $4:6 = 2:3$ (blue part to green part) or $4:10 = 2:5$ (blue part to whole) • Comparing measurements, such as 2 g **to** 0.8 kg $2:800$, $1:400$ or $\frac{1}{400}$	• Determining that purchasing cheese at $\$3.75/100$ grams is a better buy than purchasing the same product at $\$42$/kilogram • Given the following distance-time graph of a car travelling to visit a friend,  explaining the significance of the horizontal line segments and calculating the average speed of the trip in the first two hours		

Sub-strand: Calculating with number

Year 7	Year 8	Year 9	Year 10
Convert between fractions, decimals and percentages using flexible and efficient strategies For example: • Mentally converting, with jottings if needed, 12.5% to a fraction using thinking, such as 12.5% is half of 25% $(\frac{1}{4})$ and half of $\frac{1}{4}$ is $\frac{1}{8}$ and convert $\frac{3}{20}$ to a percentage using thinking, such as $\frac{3}{20}$ is equivalent to $\frac{15}{100}$ and is therefore 15% • Converting 37.5% to a fraction, communicating thinking using a sequence of equations, such as $\frac{37.5}{100} = \frac{375}{1000} = \frac{3}{8}$ • Converting $\frac{97}{22}$ to a decimal (2dp), using a calculator Determine percentages of quantities and express one quantity as a percentage of another using flexible and efficient strategies	Calculate percentage increases and decreases, using knowledge of fractions and decimals to improve efficiency For example: • Mentally, with jottings if needed, increasing 360 by 10% using thinking, such as $360 + 10\%$ of 360 $= 360 + \frac{1}{10} \times 360$ or by using strategies, such as 110% of 360 $= 1.1$ of 360 • Mentally, with jottings if needed, decreasing 360 by 25% using $360 - 25\%$ of 360 $= 360 - \frac{1}{4} \times 360$ or by using strategies, such as 75% of 360 $= \frac{3}{4}$ of 360		

Year 7	Year 8	Year 9	Year 10
For example: • Mentally calculating, with jottings if needed, 10% of 570, using the result to calculate 5% and 30% of 570 and finding 25% of 60 using thinking, such as $\frac{1}{4} \times 60$ is 15 • Determining the percentage that 0.48 is of 2, communicating thinking using a sequence of equations such as $\frac{0.48}{2} = \frac{48}{200} = \frac{24}{100} = 24\%$ • Using a calculator to find 17% of $\$9.20$	• Using a calculator to increase a population of 5560 by 107% using $5560 + 1.07$ of 5560 or 2.07 of 5560		
Add and subtract integers using flexible and efficient strategies For example: • Mentally calculating, with jottings if needed $-8 + 20$ using $20\ - 8$	Multiply and divide integers using flexible and efficient strategies For example: • Mentally calculating, with jottings if needed, $\frac{-35}{5}$ by using	Use flexible and efficient strategies for calculations involving the four operations with real numbers and express solutions in exact form or as an approximation	Use absolute and percentage error to compare the result of using approximate rather than exact real numbers on final calculations

Year 7	Year 8	Year 9	Year 10
$7 - 13$ using $7 - 7 - 6$ $3 - (-12)$ using $3 + 12$ $-6 + (-4)$ using $-6 - 4$ • Communicating thinking to the solution of $-35 + 48 - (-15) + (-11)$ using a sequence of equations, such as $= -35 + (35 + 13) + 15 - 11$ $= (-35 + 35) + 13 + 4$ $= 17$ • Using a calculator to evaluate $-54 + (-723) - 94 - (-6873)$ Add and subtract positive fractions with related and unrelated denominators using flexible and efficient strategies For example: • Mentally calculating, with jottings if needed, $1\frac{7}{8} + 2\frac{1}{4}$ using thinking, such as $3\frac{7}{8} + \frac{1}{4}$ which is $4\frac{1}{8}$ • Communicating thinking using a sequence of equations for $\frac{2}{7} + \frac{2}{3}$ and $2\frac{1}{3} - 1\frac{1}{2}$, simplifying answers where possible	thinking, such as $5 \times ? = -35$ or calculating $(2)(-6)(-45)$ using thinking, such as $2 \times (-45) \times (-6)$ which is the same as $-90 \times (-6)$ or 540 • Communicating thinking to $24 \times (-13)$ using a sequence of equations, such as $= 20 \times (-13) + 4 \times (-13)$ $= -260 + (-52)$ $= -260 - 52$ $= -260 - 50 - 2$ $= -312$ • Using a calculator to evaluate $-817 \div (-35)$ to 2 decimal places (2dp) Use flexible and efficient strategies for calculations involving the four operations with rational numbers, including those written in index form, using rounding, estimation or the context to check reasonableness of results For example: • Mentally, with jottings if needed, calculating	For example: • Determining the unknown side of a right-angled triangle, with a side length of 1 cm and a hypotenuse of 2 cm, as being exactly $\sqrt{3}$ cm and approximately as 1.73 cm • Recognising that solutions can be written exactly or as approximations, such as in a semi-circle with a radius of 6 units, the area can be written exactly as 18π square units and approximately as 56.55 square units (2dp) • Determining the average speed of light if the distance between the earth and the sun is 1.496×10^{11} metres and the time taken for light to travel from the earth to the sun is 4.987×10^{2} seconds, discussing differences between rounding decimal numbers before calculating and rounding the solution	For example: • Investigating the use of absolute error to determine percentage error $Percentage\ error = \frac{Absolute\ error}{Exact\ result} \times 100\%$ where absolute error is the positive difference between the approximate and exact results in situations, such as ▪ Calculating the surface area of cylinders using 3.14 instead of the exact value of π or by using π and then rounding the area of the base circles ▪ Applying Pythagoras' theorem or trigonometry to find a missing side in a right-angled triangle and using 1.41 instead of the exact value of $\sqrt{2}$ ▪ Applying the compound interest formula and using 2.67% interest per annum instead of $2\frac{2}{3}\%$

Year 7	Year 8	Year 9	Year 10
• Using a calculator to evaluate $6\frac{3}{7}+18\frac{5}{9}$ Multiply and divide positive fractions using flexible and efficient strategies For example: • Mentally calculating, with jottings, if needed, $5\frac{1}{2}\div\frac{1}{4}$ using thinking, such as there are 20 quarters in 5 and 2 quarters in $\frac{1}{2}$, so the answer is 22 and calculate $\frac{2}{3}\times 6\frac{1}{2}$ using thinking, such as $\frac{2}{3}\times 6$ is 4 and $\frac{2}{3}\times\frac{1}{2}$ is the same as $\frac{1}{2}\times\frac{2}{3}$ or $\frac{1}{3}$ so the answer is $4\frac{1}{3}$	$5-6^2\div(-4)$ $(2^4\times 10^2\div 4^2)^2$ $(-8^2)\div(2^3)$ • Communicating thinking using a sequence of equations for calculations, such as $-5.1+8.3-0.6$ $1\frac{1}{2}+5\frac{3}{5}$ and using rounding and properties of numbers to check reasonableness of results • Using a calculator to efficiently determine a solution to the hypotenuse of a right-angled triangle (e.g. $\sqrt{3.2^2+\ 7.85^2}$ cm) checking that the solution is reasonable, using an estimation of $\sqrt{3^2+8^2}$ and knowing that the hypotenuse is the longest side		

• Communicating thinking using a sequence of equations, for calculations, such as $\frac{2}{5} \times 2\frac{2}{3}$ $\frac{2}{7} \div \frac{2}{3}$ $\frac{1}{2} \times (\frac{2}{5} + \frac{3}{10})$ simplifying answers where possible • Using a calculator to evaluate $11\frac{2}{7} \div (2\frac{2}{3} \times \frac{1}{2})$ Multiply and divide positive decimals using flexible and efficient strategies For example: • Mentally calculating, with jottings, if needed, 0.25×1.2 by using thinking, such as $\frac{1}{4}$ of 1.2 which is 0.3 • Communicating thinking using a sequence of equations, for calculations, such as $6.4 \div 0.8$ $= 64 \div 8$ $= 8$			

Year 7	Year 8	Year 9	Year 10
7.8×9 $= 7.8 \times 10 - 7.8$ $= 78 - 7.8$ $= 70.2$ $0.36 \div 8$ $0.36 \div 2$ $0.18 \div 2$ $0.09 \div 2$ $= 0.045$ • Using a calculator to evaluate $27.4 \div 1.05$ Use appropriate rounding, estimation strategies and context to check reasonableness of solutions For example: • Recognising that $6\frac{3}{7} + 18\frac{5}{9}$ could be rounded to $6\frac{1}{2} + 18\frac{1}{2}$ and applying appropriate strategies to approximate ($\approx$) the solution, using this estimation as a tool to check if the solution derived from the actual values is reasonable			

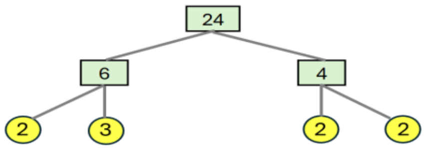
Year 7	Year 8	Year 9	Year 10
• Recognising that $695 \div 0.527$ could be rounded to $700 \div 0.5$ and that dividing a number by a number less than one, makes it bigger. Applying appropriate strategies to approximate the solution, using this estimation as a tool to check that the solution derived from the actual values is reasonable • Recognising that an interest of 4.95% of $\$500$ as being approximately 5% of $\$500$ and that multiplying by a number less than one makes the number smaller. Applying appropriate strategies to approximate the solution, using this estimation and the context as a tool to check that the solution derived from the actual values is reasonable			

Sub-strand: Algebraic techniques

Year 7	Year 8	Year 9	Year 10
Represent in expanded form, evaluate, and compare numbers expressed in index notation, including powers of 10 For example: • Identifying that 7^3 has a base of 7 and an index or power of 3, can be written as $7 \times 7 \times 7$ which can be evaluated as 343 • Recognising that $5^4 = 5 \times 5 \times 5 \times 5$ $= 625$ and that 625 is 25 times greater than 25 and 125 is 5 times fewer than 625 • Identifying and recognising patterns within powers of 10, such as 1000 is the same as $10 \times 10 \times 10$ which can be written as 10^3 which has a base of 10 and an index or power of 3 • Making connections between powers of 10 and place value, such as 4000 (4×10^3) is 100	Develop and apply the index laws for numbers in index form with positive-integer and zero indices For example: • Exploring expressions, such as $3^2 \times 3^4$ $= (3 \times 3) \times (3 \times 3 \times 3 \times 3)$ $= 3^6$ or 3^{2+4} and $3^5 \div 3^2$ $= \frac{3 \times 3 \times 3 \times 3 \times 3}{3 \times 3}$ $= 3^3$ or 3^{5-2} and $(3^3)^2$ $= 3^3 \times 3^3$ $= 3 \times 3 \times 3 \times 3 \times 3 \times 3$ $= 3^6$ or $3^{3 \times 2}$ and $(2 \times 3)^2$ $= (2 \times 3) \times (2 \times 3)$ $= 2^2 \times 3^2$ and	Extend and apply index laws with positive-integer indices and the zero index, to variable bases and simplify where appropriate For example: • Generalising numerical expressions, such as $2^2 \times 2^3 = 2^{2+3} = 2^5$ to $a^m \times a^n = a^{m+n}$ and hence simplifying $b^3 \times b^7 \times b$ or $3e^2 \times 5e^4$ $2^5 \div 2^3 = 2^{5-3} = 2^2$ to $a^m \div a^n = a^{m-n}$ and hence simplifying $\frac{h^8}{h^3}$ or $3ay^5 \div 6ay^3$ $(2^2)^3 = 2^{2 \times 3} = 2^6$ to $(a^m)^n = a^{mn}$ and hence simplifying $(7e^2)^3$ or $(2cd^2)^4$ $\left(\frac{2}{3}\right)^2 = \left(\frac{2^{1\times2}}{3^{1\times2}}\right) = \frac{2^2}{3^2}$ to $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$	Extend and apply index laws with positive-integer indices and variable bases, to include negative-integer indices For example: • Applying patterns, index notation and laws to establish $a^{-1} = \frac{1}{a}, a^{-2} = \frac{1}{a^2}, a^{-3} = \frac{1}{a^3}$ and $a^{-n} = \frac{1}{a^n}$ • Representing expressions involving negative-integer indices as expressions involving positive-integer indices and vice versa $x^{-3} = \frac{1}{x^3},\ 2x^{-1} = \frac{2}{x^1} = \frac{2}{x}$, $\frac{4}{x} = \frac{4}{x^1} = 4x^{-1}$, $\frac{1}{x^2} = x^{-2}$ • Justifying why these statements are true $\frac{9x^5}{3x^{-5}} = 3x^{10}$ $9x^{-7} \div 3x^5 \neq 3x^2$ $(3a^2)^2 \times a^3 \neq 6a^7$ $a^5 \times a^{-7} = \frac{1}{a^2}$

<table>
<tr><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th></tr>
<tr>
<td>times greater than 40 (4×10^1) and 1000 times less than four million (4×10^6)

Extend knowledge of factors to represent natural numbers as products of prime factors using index notation as appropriate

For example:
• Making connections between a series of equations and a tree diagram to express 24 as a product of primes

$24 = 6 \times 4$
$= 2 \times 3 \times 2 \times 2$
$= 3 \times 2 \times 2 \times 2$
We can write this in index form as 3×2^3
• Investigating the use of different pairs of initial factors, such as 8×3 or 2×12 when determining the prime factors of 24</td>
<td>$\left(\frac{2}{3}\right)^2$
$= \left(\frac{2}{3}\right) \times \left(\frac{2}{3}\right)$
$= \frac{2^2}{3^2}$
and using words to generalise each of these rules
• Exploring the meaning of the zero-index using examples, such as
$\frac{5^2}{5^2} = \frac{25}{25} = 1$
and
$\frac{5^2}{5^2} = 5^{2-2}$
$= 5^0$
$\therefore 5^0 = 1$
and by patterning in
$2^4, 2^3, 2^2, 2^1, 2^0$
• Applying the index laws to simplify and evaluate, mentally or with a calculator, depending on the complexity of the numbers, communicating thinking using a sequence of equations for expressions, such as</td>
<td>and hence simplifying
$\left(\frac{2b}{3e}\right)^3$ or $\left(\frac{5}{4x^2}\right)^2$
$2^3 \div 2^3 = 2^{3-3} = 2^0 = 1$
to $a^0 = 1$
and hence simplifying
$-5k^0 - 7$

Extend and apply index laws with numerical expressions of base 10 to include negative-integer indices. Develop the relationship between these negative indices and equivalent fractions and decimals

For example:
• Applying patterns, index notation and laws to negative integer numerical indices

Patterns
<table>
<tr><td>10^1</td><td>10^0</td><td>10^{-1}</td><td>10^{-2}</td><td>10^{-3}</td></tr>
<tr><td>10</td><td>1</td><td>$\frac{1}{10^1}$ or $\frac{1}{10}$</td><td>$\frac{1}{10^2}$ or $\frac{1}{100}$</td><td>$\frac{1}{10^3}$ or $\frac{1}{1000}$</td></tr>
<tr><td>10</td><td>1</td><td>0.1</td><td>0.01</td><td>0.001</td></tr>
</table></td>
<td>Substitute values into real-life linear, quadratic or simple exponential formulas to find unknowns using digital tools

For example:
• Using software and a real-life; for example, the height of a toy rocket launched from the ground being modelled by a quadratic given as $h = -16t^2 + 128$, to find unknown values of h and t
• Using spreadsheets to investigate $A = P(1 + i)^n$ for different values of unknowns

Year 10 optional
Simplify algebraic products and quotients involving indices with integer and fractional indices

Year 10 optional
Establish the connection between fractional indices and surds. Perform the four operations with surds and</td>
</tr>
</table>

Year 7	Year 8	Year 9	Year 10
Explore and explain connections between square numbers and square roots, cube numbers and cube roots, as products of repeated factors For example: • Deducing that if 9×9 is 9^2, or 81, then $\sqrt{81} = 9$ and if $6 \times 6 \times 6$ is 6^3 or 216, then $\sqrt[3]{216} = 6$ • Estimating the square root or cube root of a whole number, such as $\sqrt{34}$ by reasoning that it lies between $\sqrt{25}$ and $\sqrt{36}$ and is closer to $\sqrt{36}$ so could be estimated to be 5.8. Using a calculator to confirm a solution of 5.83 (2dp)	$(2^2)^3 \times 2 \times 2^3$ $((3^8 \div 3^6) \times 3^2) \div 3^0$ $\left(\frac{4}{3}\right)^2$	• Using index laws $10^2 \div 10^6$ $= \frac{10^2}{10^6}$ $= \frac{10 \times 10}{10 \times 10 \times 10 \times 10 \times 10 \times 10}$ $= \frac{1}{10^4}$ and making connections to $10^2 \div 10^6$ $= 10^{2-6}$ $= 10^{-4}$ $\therefore 10^{-4} = \frac{1}{10^4}$ or $1 \div 10\,000$ • Explaining when using scientific notation that $3.2 \times 10^{-4} = 3.2 \times \frac{1}{10\,000} = \frac{3.2}{10\,000}$ or 0.00032	rationalise the denominator if required **Year 10 optional** Interpret and use base-ten logarithmic scales on graphs of real-life contexts
Use real-world contexts or concrete materials to introduce the concept of a variable to represent a number using a letter. Create simple algebraic expressions and evaluate by substituting a given value for the variable/s	Extend and apply knowledge of additive and multiplicative partitioning, order of operations and the associative and commutative laws of numbers, to create or simplify algebraic expressions involving the four operations	Explore and apply the distributive law to expand and factorise algebraic expressions with a common algebraic factor, including collecting like terms where appropriate	Extend and apply knowledge of the expansion of binomial products to explore the factorisation of monic quadratics

Year 7	Year 8	Year 9	Year 10
For example: • Introducing a variable using unknown numbers of chocolates in two different sized bags where $m =$ number of chocolates in one small bag, $g =$ number of chocolates in one large bag, creating expressions, such as ▪ the number of chocolates in three large bags and one small bag as being $3 \times g + m = 3g + m$ ▪ the difference between the number of chocolates in the bags as being $g - m$ ▪ combining the number of chocolates in five large bags and two small bags and sharing them between four people as being $\frac{5g+2m}{4}$ and evaluating each expression if the numbers of chocolates in each bag is known	For example: • Simplifying the following algebraic expressions $-m + 2 - 5m - 8 + 2m$ $3p \times 2e \times (-5)$ $15x \div 3x$ $\frac{3p}{6}$ • Considering the accuracy of the following equations and explaining thinking $a \div 6b = a \div 2 \div 3b$ $-12h \times 10a = 3h \times (-8 \times 5a)$ $3a \times (-5b) \times 2g = 5a \times (-2b) \times 3g$ $m \div (-3) = 5m \div (-15)$ $20 \div (a + b) = (20 \div a) + (20 \div b)$ • Creating and comparing algebraic expressions to represent the total number of chocolates for a group of four people, each holding a bag that has the same unknown number of chocolates, if each person is given an extra three chocolates	For example: • Extending expansion and factorisation using the distributive law with numerical factors, to expansion and factorisation with algebraic factors $2b(m + 3c)$ $= 2b \times m + 2b \times 3c$ $= 2bm + 6bc$ and factorising using reverse thinking $2bm + 6bc$ $= 2b \times m + 2b \times 3c$ $= 2b(m + 3c)$, verifying factorisation using the distributive law • Expanding and simplifying expressions, such as $3b(2b - c + 1)$ $-2k(-3k + (-2))$ $-2b(b - 3) - 7b + 5$ $x(x + 2) - 6(x - 3)$ communicating thinking using a sequence of equations • Factorising expressions, such as $9mp - 3m + 6me$	For example: • Extending knowledge of expansion of $(x + 4)(x + 3)$ $\begin{array}{c\|c\|c} & x & +\ 3 \\ \hline x & x^2 & 3x \\ \hline +\ 4 & 4x & 12 \end{array}$ to make connections to factorising quadratics using knowledge of multiples and partitioning $x^2 + 7x + 12$ $= x^2 + 4x + 3x + 12$ $= x(x + 4) + 3(x + 4)$ $= (x + 4)(x + 3)$ • Factorising $x^2 + 12x + 20$ by making connections between expansion of binomial products and the area model and generalise to a factorising strategy involving factors of 20

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<tr><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th></tr>
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- Using concrete materials, such as algebra tiles to visually represent numbers as variables
- Using expressions of everyday formulas, such as carry-on bag size for an aeroplane flight being determined by the length + width + depth $(l + w + d)$ and using substitution to determine if a bag is of an appropriate size

Extend and apply the associative and commutative laws and properties of numbers to include variables

For example:

- Consider the accuracy of the following equations and explain thinking

$$\begin{array}{ll} m + 0 = m & 1 \times b = b \\ y \times 0 = y & g \times 3 = 3 \times g \\ x + x + x = 3x & \\ 5 + (m + 3) = (5 + m) + 3 & \\ 3p + 4 = 3(p + 4) & \\ e \div 3 = \frac{e}{3} & \end{array}$$

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Extend and apply knowledge of the distributive law with numbers to algebraically expand and factorise expressions with a common numerical factor

For example:

- Connecting the visual representation of 2×37 using an area model

$$\begin{array}{c|c|c|} & 30 \quad + & 7 \\ \hline 2 & 2 \times 30 = 60 & 2 \times 7 = 14 \\ \hline \end{array}$$

$= 60 + 14$

to $2(a + 7)$

$$\begin{array}{c|c|c|} & a \quad + & 7 \\ \hline 2 & 2 \times a = 2a & 2 \times 7 = 14 \\ \hline \end{array}$$

$= 2a + 14$,
factorising using reverse thinking
$2a + 14$
$= 2 \times a + 2 \times 7$
$= 2(a + 7)$
and verifying the factorisation using the distributive law

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$-2d^2 - 3d^3$

Explore and apply the distributive law to expand binomial products, collecting like terms where appropriate

For example:

- Connecting the visual representation of expansion with numbers, such as $24 \times 37 = (20 + 4)(30 + 7)$

$$\begin{array}{c|c|c|} & \multicolumn{2}{c}{30 + 7} \\ \hline 20 & 20 \times 30 & 20 \times 7 \\ \hline + \; 4 & 4 \times 30 & 4 \times 7 \\ \hline \end{array}$$

to
$(a + b)(c + d)$
$= ac + ad + bc + bd$

$$\begin{array}{c|c|c|} & c \quad + & d \\ \hline a & ac & ad \\ \hline + \; b & bc & bd \\ \hline \end{array}$$

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$$\begin{array}{c|c|c|} & x \quad + & \\ \hline x & x^2 & \\ \hline + & & 20 \\ \hline \end{array}$$

- Factorising quadratics, such as $x^2 - 14x + 24$, $x^2 - 3x - 28$ and $x^2 + 9x - 22$

Year 10 optional
Factorise monic and non-monic quadratic expressions using techniques, such as completing the square, perfect squares, difference of squares and grouping in pairs for four-term expressions

Year 10 optional
Explore efficient strategies to simplify expressions that involve addition, subtraction, multiplication or division of algebraic fractions with an algebraic expression in the numerator and/or denominator, including the use of factorisation

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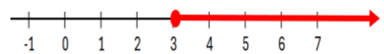
Year 7	Year 8	Year 9	Year 10
	• Expanding and simplifying expressions, such as $5\,(2g - h + 6)$ $-4\,(-3p + (-2))$ $-7b + 5(b - 3)$ communicating thinking using a sequence of equations • Factorising expressions, such as $-4 - 12k$ $2m - 6m^3 + 18 - 4de$	and using to expand and simplify $(x + 3)(x + 8)$ $\begin{array}{c\|c\|c} & x & +\ 8 \\ \hline x & x^2 & 8x \\ \hline +\ 3 & 3x & 24 \end{array}$ $= x^2 + 8x + 3x + 24$ $= x^2 + 11x + 24$ • Communicating thinking of expansion and simplification of equations, such as $(y - 4)^2$ $(c + 8)(c - 8)$ $(2y - 3p)(-y - 7p)$ $(b + 2)^2 - 5$ **Year 9 optional** Explore efficient strategies to simplify expressions that involve addition, subtraction, multiplication or division of algebraic fractions with an algebraic term in the numerator and a whole number denominator	

Sub-strand: Linear and non-linear equations and inequalities

Year 7	Year 8	Year 9	Year 10
Solve simple linear equations involving up to two operations and verify the solution by substitution For example: • Using a context, such as 'Three bags with equal numbers of chocolates were tipped into a container that already held five chocolates. There were 62 chocolates altogether. How many were in each bag?' • Exploring and comparing a variety of strategies, such as the balance model, backtracking or inspection to solve an equation, showing a sequence of steps to communicate thinking. Checking the solution by substitution using jottings or calculator for equations, such as $5m - 3 = 12$ $-3 + m = 11$ $e - 3 = -2$ $48 = 14 + 2p$	Solve linear equations involving up to three operations, including those with negative coefficients or requiring collection of like terms, and verify the solution by substitution For example: • Using a strategy, such as the balance model, backtracking or inspection to solve an equation, showing a sequence of steps to communicate thinking. Checking the solution by substitution using jottings or calculator for equations, such as $1 - 2p = -10$ $3 - 4h + 6h = 7$ $4.3 = \dfrac{5y - 1.2}{2}$ $\dfrac{8p}{3} = \dfrac{3}{5}$ • Communicating thinking to solve $3p - 5q = 5$ when $p = -4$	Solve linear equations involving brackets and/or a variable on each side of the equation, and verify the solution by substitution For example: • Using a strategy, such as the balance model, backtracking or inspection to solve an equation, showing a sequence of steps to communicate thinking and checking the solution by substitution using jottings or calculator for equations, such as $3(y - 5) = -6y$ $9 = 7(-4r - 1)$ $3d - 7 = 5d + 8$ $\dfrac{2 - e}{5} = -4$ $4\left(\dfrac{3}{4}c - 3\right) = 2c + 2$ • Communicating thinking to solve $5e + 2f = 7.5 - 3f$ when $e = 0$ or when $f = 0$	Solve one-variable linear inequalities involving brackets and/or a variable on each side. Represent the solution on a number line and verify the solution by substitution For example: • Using a strategy, such as the balance model, backtracking or inspection to solve an inequality, showing a sequence of steps to communicate thinking for inequations, such as $-2m - 1 \geq -3m + 2$, representing solutions as  and checking by substituting a value greater than 3, such as $m = 4$, to show that the inequality holds true $-2(4) - 1 \geq -3(4) + 2$ $-9 \geq -10$

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$\frac{e}{2} - 1 = 5$
$0.1v = 12$
$\frac{1}{4} + 2k = \frac{3}{8}$
Note: equations involving multiplication and division of negative integers are introduced in Year 8; however, equations, such as $6 - w = 5$ that can be solved by inspection in the Year 7 curriculum

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Determine and explain why there are two solutions to a quadratic equation of the form $x^2 = k$ if $k > 0$

For example:

- Reasoning that for $x^2 = 9$ there are 2 values of x that satisfy this quadratic equation given that 3^2 and $(-3)^2$ both equal 9
- Solving $b^2 + 7 = 71$ and verifying solutions
- Using knowledge of quadratic equations in situations involving Pythagoras' theorem, recognising that the solution must be positive because of the context

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Determine and explain why there are up to two solutions to a quadratic equation of the form $ax^2 = k$ and verify the possible solution/s by substitution

For example:

- Reasoning and appropriately communicating that for $x^2 = k$ there could be
  - two solutions $(k > 0)$
  - one solution $(k = 0)$
  - no real solutions $(k < 0)$
- Considering $2x^2 = 10$, explaining that x can be expressed in exact form as $x = \pm\sqrt{5}$ or as a decimal approximation of $x \approx \pm 2.24$ (2dp) and checking by substitution $2(\sqrt{5})^2$ and $2(-\sqrt{5})^2$ both equal 10

Year 9 optional
Solve linear equations that involve simple algebraic fractions with numerical denominators and verify the solution by substitution

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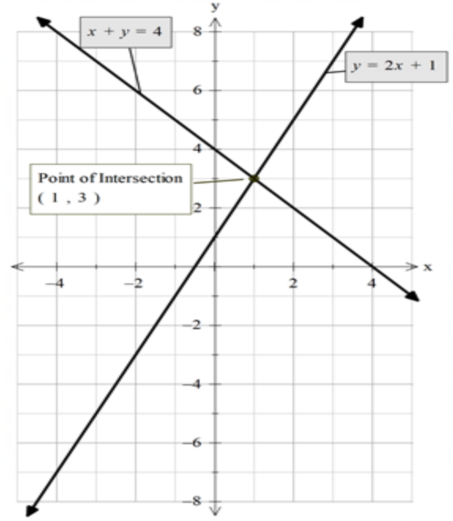
Determine the solution to linear simultaneous equations in the forms $y = mx + c$ or $ax + by = c$ graphically and verify the solution by substitution

For example:

- Graphing linear equations, such as $y = 2x + 1$ and $x + y = 4$ manually or digitally.



verifying that $(1, 3)$ is the point of intersection of the lines

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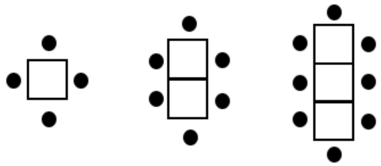
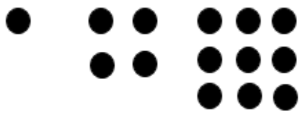
</table>

		Year 9 optional Solve quadratic equations in factorised form using the null factor theorem and verify the solution/s by substitution	Note: Consider graphs of parallel lines that will have no solution **Year 10 optional** Determine the solution to linear simultaneous equations in the forms $y = mx + c$ or $ax + by = c$ algebraically and verify the solution by substitution or using digital tools **Year 10 optional** Identify the region on the Cartesian plane defined by linear inequalities **Year 10 optional** Solve monic and non-monic quadratic equations graphically and algebraically, including the use of the quadratic formula, factorising techniques and digital tools and verify the solution/s by substitution **Year 10 optional** Use algebraic techniques to solve exponential equations that involve terms with related bases **Year 10 optional** Solve cubic equations in the form $ax^3 = k$ or in factored form, algebraically or using digital tools

Sub-strand: Linear and non-linear patterns and relationships

Year 7	Year 8	Year 9	Year 10
Explore, describe and represent concrete and real-world, linear and non-linear growing patterns using a table of values and a graph. Determine unknown values in the pattern For example: • Using diagrams or concrete materials, such as matchsticks and counters to continue growing patterns and represent as number sequences, in situations, such as chairs around connecting square tables  or growing dots 	Use a table of values to move flexibly between the equation of a line represented by $y = mx + c$ and its graph and make connections between the algebraic and graphical solution of the equation. Explore and explain similarities and differences between multiple lines on the same axes For example: • Using an equation, such as $y = 5x - 1$, generate a table of values, plot the coordinates on the Cartesian plane and create a line, recognising that there is an infinite number of ordered pairs in any given linear relationship. Connecting the graph of $y = 5x - 1$ to solving equations, such as $9 = 5x - 1$ and $1.5 = 5x - 1$, graphically and algebraically • Extracting a table of values from a linear graph and using the	Use the Cartesian plane to explore finding the distance, gradient and midpoint between two points For example: • Plotting and joining two points on a Cartesian plane to form a line segment. Investigating, explaining, and validating strategies, such as ▪ using vertical and horizontal units between points to form sides of a right-angled triangle and applying Pythagoras' theorem to determine the distance between the two points ▪ counting the vertical difference and horizontal difference between the points and dividing the vertical rise by the horizontal run to determine gradient (m). Connecting gradient to ratio, such as 3	Use a table of values to plot points and graph quadratic functions of the form $y = ax^2 + c$. Identify and relate key graphical and algebraic features and make connections to the graphical and algebraic solution/s of $ax^2 + c = k$. Use digital tools to explore the shapes, features and related solutions to more complex quadratic functions For example: • Making connections between graphical and algebraic representations of quadratics, such as ▪ the shape and concavity of the parabola and the value of the coefficient of x^2 ▪ the vertical intercept and the value of c ▪ the horizontal intercepts when they exist ▪ approximate solutions to examples, such as

<table>
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<td>

- using words to generalise rules
- meaningfully using variables to express rules as algebraic equations
- producing a table of values
- plotting points in the first quadrant on the Cartesian plane and describing the shape of the relationship

and using the sequence rule, table of values or graph to determine unknown values

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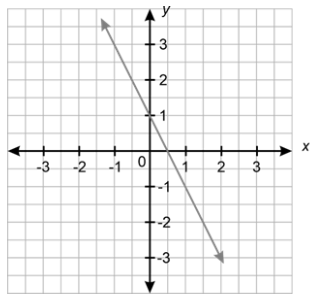
table to determine the equation of the line

For the following graph



a corresponding table of values can be produced

<table>
<tr><td>x</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td>y</td><td>3</td><td>1</td><td>-1</td><td>-3</td></tr>
</table>

The equation of the linear relationship can be determined as $y = -2x + 1$ by recognising the values of m and c as the constant difference between values of y (i.e. -2) and the value of y when $x = 0$ respectively

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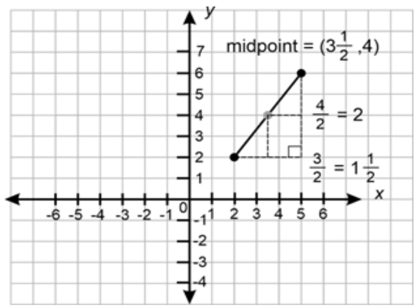
units to the right and 6 units up, is the same as 5 units to the right and 10 units up. Distinguishing between line segments with positive and negative gradients and those with the same gradient. Exploring gradients of horizontal and vertical line segments

- using the halfway points of the vertical and horizontal units to determine the midpoint.



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$-x^2 + 4 = 3.2$ using the graph of $y = -x^2 + 4$ and checking solutions using digital tools

- Using digital tools to graph easily factorised monic quadratics, such as $y = x^2 + 4x$ and $y = x^2 - 7x + 10$, exploring connections between the graphical and algebraic representations and approximating and checking solutions to related equations

Use a table of values to plot points and graph exponential functions of the form $y = a^x$ where $a > 0$. Identify and relate key graphical and algebraic features and use these to determine graphical solutions of related equations. Use digital tools to explore the shapes, features and related solutions to more complex exponential functions

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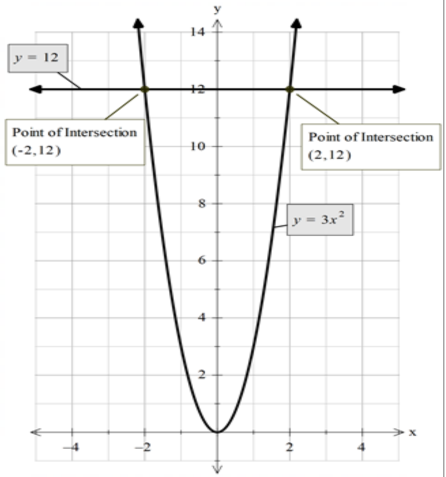
Year 7	Year 8	Year 9	Year 10
	• Investigate and describe similarities and differences between multiple lines, using terms, such as steepness, direction, parallel, non-parallel, pass through the same point, increasing and decreasing	Move flexibly between the equation of a line, represented by $y = mx + c$ and its graph using the gradient and y-intercept. Graph the equation of a line represented in $ax + by = c$ form For example: • Interpreting the coefficient of $x(m)$ in $y = mx + c$ form as the gradient/slope/rate of change and the constant (c) as the vertical intercept • Finding the equation of a line given the gradient (m) and the vertical intercept or by extracting the gradient and vertical intercept from a graph and using the equation to determine whether a given point lies on the line • Graphing an equation of a line using the gradient and vertical intercept in $y = mx + c$ form, verifying the accuracy of the drawn graph using another point	For example: • Making connections between graphical and algebraic representations of exponentials, such as ▪ the vertical intercept ▪ the direction of the graph given the nature of x ▪ the shape of the graph given the value of a ▪ the asymptote ▪ approximate solutions to examples, such as $2^x = 3$ and $y = 2^{2.5}$ using the graph of $y = 2^x$ and checking solutions using digital tools • Using digital tools to explore real life exponential growth and decay situations making connections between the algebraic and graphical forms

Year 7	Year 8	Year 9	Year 10
		• Graphing an equation of a line written in $ax + by = c$ form using the vertical and horizontal intercepts (i.e. when $x = 0$ and when $y = 0$), verifying the accuracy of the drawn graph using another point • Investigating to compare and contrast graphs and equations of horizontal, vertical and parallel lines **Year 9 optional** Develop and use the algebraic formulas for finding the distance, midpoint and gradient between two points **Year 9 optional** Rearrange formulae, including $ax + by = c$, to change the subject of the formula	
		Identify rates as direct proportion, represent algebraically and graphically and use both forms to predict unknown values and interpret in the context of the situation	Identify and distinguish between linear, quadratic and exponential functions represented by equations, tables of values and graphs

Year 7	Year 8	Year 9	Year 10
		For example: • Identifying that the relationship between the rate at which water drips from a tap into a bucket in each minute (d) and the amount of water in the bucket (w) in millilitres are directly proportional. Recognising that if there is 600 mL in the bucket after 40 minutes then this can be represented as $w = 15d$. Representing the equation graphically, recognising that $m = 15$ and that the y-intercept is $(0, 0)$, predicting unknown values and interpreting in context Use a table of values to plot points and graph quadratic functions of the form $y = ax^2$, describe key features and make connections to the algebraic solution/s of $ax^2 = k$	For example: • Recognising that in a table of values, if there is a constant difference between consecutive values of the dependent variable then the function is linear. If there is a constant second difference between consecutive values of the dependent variable then the function is quadratic and if the ratio between the consecutive values of the dependent variable is constant then the function is exponential • Investigating the links between algebraic and graphical representations of each function type using digital tools **Year 10 optional** Use gradient and/or point/s to graphically and algebraically determine equations of parallel and perpendicular lines

		For example: • Graphing $y = 3x^2$ manually or digitally, recognising that it is a parabola with an axis of symmetry at $x = 0$ and a turning point at $(0, 0)$ and using it to solve $3x^2 = 12$, verifying the solution algebraically, $3x^2 = 12$ $x^2 = 4$ $x = \pm 2$  and connecting to the graphical solutions of $(-2, 12)$ and $(2, 12)$	**Year 10 optional** Graph monic and non-monic quadratics of the form $y = ax^2 + bx + c$ or $y = a(x - p)^2 + q$ and their transformations, manually and using digital tools. Identify and connect key graphical and algebraic features and make connections to the algebraic solution/s **Year 10 optional** Explore and use strategies, including digital tools, to model the equation of a quadratic function from a table of values or graph **Year 10 optional** Explore, describe and interpret circles and rectangular hyperbolas where the asymptotes are parallel to the axes, and their transformations, using digital tools and make connections between the algebraic and graphical representations

Year 7	Year 8	Year 9	Year 10
		Year 9 optional Investigate indirect proportion, represent algebraically and graphically, use both forms to predict unknown values and interpret in the context of the situation	

Sub-strand: Financial mathematics

Year 7	Year 8	Year 9	Year 10
Identify the features of transactional statements and verify transactions. Explain reasons for checking and keeping financial records For example: • Identifying features of transactional statements (e.g. bank, subscriptions, canteen, transport, prepaid debit cards), including account information, statement period, transaction details (credits and debits), opening and closing balances, fees and interest earned (if appropriate) • Explaining the importance of checking and keeping receipts and invoices and tracking and verifying transactions for the purpose of budgeting and identifying suspicious transactions, such as 'Alice paid for a meal at a café electronically. She had bought a	Identify the advantages and disadvantages of various forms of payment for goods and services and determine penalties, such as interest charged and fees, inherent in these payments For example: • Considering payment forms, such as cash, EFTPOS, debit and credit payments, online payments, gift cards and transfers, including potential savings, costs and risks • Identifying and calculating surcharges and total amounts paid when using a debit card for purchases (0.75% transaction fee on top of the $\$25$ purchase) • Determining penalties for not adhering to the terms of credit, such as 'buy now, pay later' schemes, in situations, such as 'Bill made an $\$80$ purchase, paying four $\$20$ instalments. He	Explore, explain and perform calculations that relate to earning income. Identify the elements of an income statement/payslip, including employer superannuation contributions and income tax as a deduction from gross income For example: • Explaining that individuals earn an income in various ways, including salaries, wages (penalty rates), self-employment, commission or piecework • Determining the total wage earned for a casual employee on $\$23.50$ per hour who works fixed hours on the weekend and earns time and a half for all hours worked on a Saturday • Determining the exact commission on the sale of a $\$755$ painting given the commission rate of $4\frac{2}{3}\%$	Explore, explain and calculate income tax, including the use of tax tables For example: • Investigating differences in tax paid for incomes $\$10$ either side of one of the intervals in a current financial year tax bracket Apply repeated simple interest to develop the compound interest formula and solve problems that relate to saving and borrowing For example: • Using a loan of $\$5000$ over three years at 4% pa, show repeated yearly simple interest calculations and demonstrate connections to the compounded interest formula • Using the compound interest formula to calculate the exact interest earned for an

Year 7	Year 8	Year 9	Year 10
coffee for $\$5.50$ and a wrap for $\$12.75$. When she checked her bank statement on her bank app, she realised she had been charged $\$31$. Explain using calculations, how the error could have occurred and what Alice could do to address the mistake.’	was late to pay each monthly instalment which incurred a $\$10$ late fee each month. What percentage of the purchase price did Bill spend on late fees?’	• Explaining the features and calculations within payslips relating to pay period, payment details, deductions, tax paid, superannuation, gross and net pay, overtime and bonuses, year-to-date totals, employer information and payment method. Develop and use the simple interest formula to solve problems relating to saving and borrowing For example: • A car loan of $\$14\ 500$ is charged with 9.25% pa simple interest over a three-year period. How much interest will be charged for each month of the loan?	investment of $\$12\ 000$ at $3\frac{1}{3}\%$ over four years, compounded yearly • Comparing different finance options, such as ‘Is it better to borrow $\$2000$ from a store finance program that offers 8.55% pa simple interest over 18 months or from a bank that offers 7.2% pa, compounded yearly, over two years?’ **Year 10 optional** Use authenticated websites to investigate how changes to the principal, rate of return, voluntary contributions and time can affect superannuation balances or compare characteristics of insurance, such as young driver car insurance or holiday insurance and recognise that the cost is higher when the risk is higher

Year 7	Year 8	Year 9	Year 10
		Year 9 optional Use authenticated websites to explore and compare different savings account options based on their characteristics (interest rates, fees, withdrawal policy) or compare price, quality, terms and conditions of goods and services, such as phone plans and digital subscriptions	

Sub-strand: Modelling with number and algebra

Year 7	Year 8	Year 9	Year 10
In real-world situations involving whole numbers, positive fractions, decimals and percentages, addition and subtraction of integers, numbers in index form, linear equations with up to two operations, simple number patterns and/or transactional money statements I. analyse the situation, decide if an exact or approximate solution is required and determine assumptions and constraints II. represent the situation mathematically in order to reach a solution III. interpret and communicate findings in terms of the context and any assumptions or constraints For example: • Discussing assumptions, if any, choosing a representation, such	In real-world situations involving rational and irrational numbers, ratios, rates, percentage increases and decreases, numbers in index form, the distributive law, factorisation, linear equations with up to three operations, linear or simple quadratic relationships and/or penalties involved in different forms of goods and services payment I. analyse the situation, decide if an exact or approximate solution is required and determine assumptions and constraints II. represent the situation mathematically in order to reach a solution III. interpret and communicate findings in terms of the context and any assumptions or constraints	In real-world situations involving scientific notation, real numbers, linear equations with variables and/or brackets on either side of the equation, quadratic graphs and equations, direct proportion and/or simple interest, earning income or income statements I. analyse the situation, decide if an exact or approximate solution is required and determine assumptions and constraints II. represent the situation mathematically in order to reach a solution III. interpret and communicate findings in terms of the context and any assumptions or constraints For example: • Using company profit statistics in situations, such as	In real-world situations involving real numbers, absolute and percentage error, linear inequalities, simultaneous equations, real-world formulae, quadratic or exponential functions, taxation, and/or compound interest I. analyse the situation, decide if an exact or approximate solution is required and determine assumptions and constraints II. represent the situation mathematically in order to reach a solution III. interpret and communicate findings in terms of the context and any assumptions or constraints For example: • Using situations, such as ‘Jackson invests $\$12\ 500$ in an account, paying $3\frac{1}{3}\%$ compounded fortnightly for

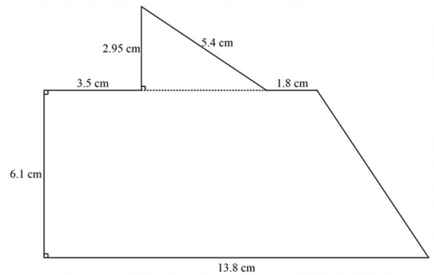
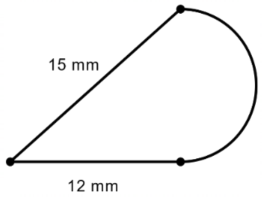
Year 7	Year 8	Year 9	Year 10
as a number line or numerical equation, and communicating a solution using correct mathematical notation and use of context, given a problem, such as 'In Nepal, the temperature overnight was $-12°$. It rose $23°$ to reach its daytime peak before falling $17°$ during the night. What was the final temperature?' • Discussing assumptions, their impact on solutions and communication of solutions in problem situations, such as 'A restaurant serves between 60 and 80 customers for lunch each day. Many customers order the scallop dish which requires around 0.15 kg of scallops per person. What weight of scallops should the chef order each week?' While an exact number of kilograms is required to place a weekly order, this is an estimate	For example: • Using a supermarket catalogue to create problems, such as 'Which is the better deal and by how much when buying two orange juices costing $\$4.15$ each – a discount of 30%, buying one and getting one for half price or three for $\$10$?' While it is clear an exact solution is required, it is necessary to discuss assumptions, such as only wanting to buy two juices, even if buying three could be cheaper per juice and rounding all calculations to the nearest 5c. Such assumptions would impact the representation, solution and communication of the solution • A childcare centre uses a ratio of one adult for every three children in the 2–3-year-old age group. If there are 26 children enrolled in the group, how many adults should be caring for the children?	'Moogle Millions' made a profit of approximately 4.15×10^7 dollars in 2025. In 2028, it is projected that they will make 100 times this amount. How much will 'Moogle Millions' make in 2028?' Discussing that as the original profit would have been rounded in its representation in scientific notation, it follows that the solution will also be rounded. Exploring assumptions, such as no market changes over the stated years, representing the solution using scientific notation and applying index laws ($4.15 \times 10^7 \times 10^2$), communicating the answer using scientific notation and the context • Using a newspaper bank advertisement on rates paid for investments over different time periods to investigate and compare the simple interest	$2\frac{1}{2}$ years. Compare the amount earned if the interest is calculated using 3.33% rather than its exact $3\frac{1}{3}\%$.' Discussing that an exact solution is required, with assumptions, such as there are 26 fortnights in a year. Choosing to represent the situation using the compound interest formula and communicating the comparison between rates using the exact difference, percentage difference and language of the problem • The cross-sectional shape of a tunnel can be represented by the quadratic equation $y = -0.75x^2 + 12$. Determine, using digital tools (i) the maximum height of the tunnel (ii) the maximum height a truck entering a tunnel could be, if its width is 4.8 m. Discussing assumptions, such as the x-axis is level ground and the tunnel is

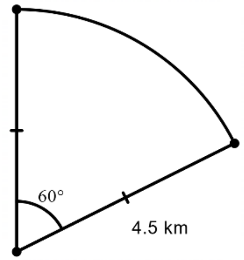
Year 7	Year 8	Year 9	Year 10
based on assumptions, such as number of days per week the restaurant is open, number of people choosing the dish, importance of minimising wastage and customer expectation the dish will be available. Considering the range of possible solutions based on different assumptions and, therefore when communicating a solution, the consequent need to describe and qualify the assumptions and constraints on which it is based • A formula for determining the maximum heart rate in beats per minute a person should reach when exercising can be calculated using: $220 - age$ (in years). At what age should the person be when the maximum heart rate is 187 beats per minute? Discussing assumptions, such as the	Discussing that an exact solution is required and that it needs to be assumed that the number of adults would need to be rounded up to ensure compliance. Representing the situation with equivalent ratios and communicating the solution using whole numbers and the context of the childcare • Using measurement knowledge to solve problems, such as 'the equal sides of a tile in the shape of an isosceles triangle are 2 cm longer than the shorter side. If the perimeter of the tile is 22.5 cm, determine the length of the shortest side.' Discussing assumptions, if any, choosing to represent the situation as an algebraic equation, communicating the solution in terms of the triangle and assumptions and constraints made	Suzie would earn if she invested $\$2500$ at the given rates for the time periods advertised • A fruit grower packs small and medium bags of oranges. The medium bags have two more oranges than the small. If the grower packs 500 oranges into 25 small bags and 30 medium bags, how many oranges are in each medium bag? Discussing assumptions, such as all 500 oranges are packed, choosing to represent the situation as an algebraic equation and communicating the solution in terms of the fruit growing context and assumptions and constraints made	one way, choosing to represent graphically using digital tools, interpreting the turning point of the graph as its maximum height and communicating the solution in terms of the tunnel and assumptions and constraints made • The growth of a bacteria changes according to the function $y = 800 \times 1.26^t$, where t is the time in hours after bacteria has been placed in a petri dish for experimental analysis. Using digital tools, determine when the number of bacteria will double? Discussing assumptions, such as the petri dish is closed so no further bacteria can enter, and the function remains consistent over time. Choosing to represent the function as an equation or graph to find an approximate answer, acknowledging the limitations of

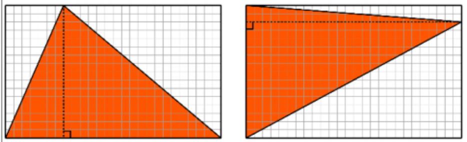
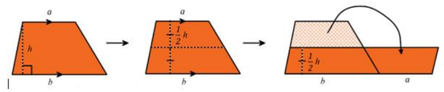
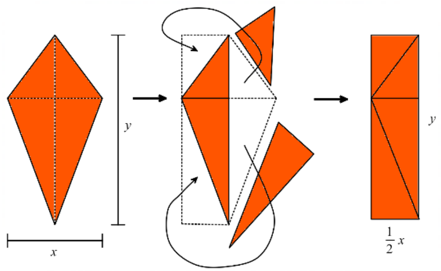
Year 7	Year 8	Year 9	Year 10
formula not being suitable to use for very young or very old people. Choosing to represent the situation graphically or by using a linear equation. Interpreting and communicating the solution in terms of the age and the initial assumptions			accuracy in the graph, and using digital tools to refine the solution. Communicating the appropriately rounded solution in the context of the problem, with assumptions and constraints made

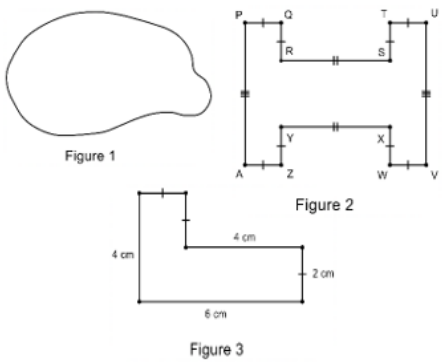
Strand: Measurement and geometry

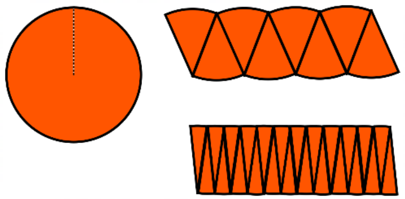
Sub-strand: Two-dimensional space and structures

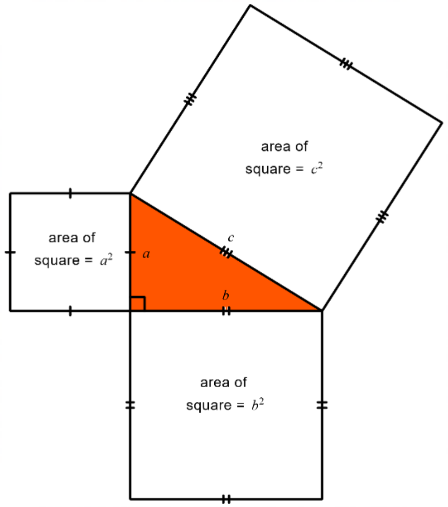
Year 7	Year 8	Year 9	Year 10
Establish and apply relationships between lengths of sides, perimeter and area for squares, rectangles and triangles. Generalise and apply formulas, using appropriate units For example: • Establishing relationships between lengths of sides and length of perimeters, of squares, rectangles and triangles, such as the perimeter of an equilateral triangle is three times longer than the length of one of its sides and the length of one side is $\frac{1}{3}$ of the length of the perimeter, generalising as $P = 3l$ where l is the number of length units and P is the number of length units in the perimeter of an equilateral triangle • Using grid paper or dynamic geometry software to demonstrate that for squares	Establish and apply relationships between lengths of sides, perpendicular lengths, lengths of diagonals, perimeter and area for parallelograms, trapeziums, rhombuses and kites. Generalise and apply formulas, using appropriate units For example: • Using properties of quadrilaterals to establish relationships between lengths of sides and perimeters, generalising as formulas in symbols, such as the perimeter of a rhombus is $P = 4l$ where l is the number of length units in the side and P is the number of length units in the perimeter • Using scissors or dynamic geometry software to strategically cut parallelograms, trapeziums, rhombuses and	Explore, explain and use efficient strategies to determine the perimeter and area of composite shapes involving triangles, quadrilaterals and/or circles, (including sectors), using appropriate units For example:  Figure 1 	Use Pythagoras' theorem and/or trigonometry to determine unknown sides and angles in right-angled triangles involving angles of elevation and depression For example: • Identifying, describing and defining angles of elevation and depression • Determining unknown sides and/or angles of elevation or depressions from given right-angled triangle diagrams by choosing an appropriate trigonometric ratio, applying and communicating solutions in appropriate units, through a sequence of equations • Sketching and labelling right-angled triangle diagrams and choosing and using

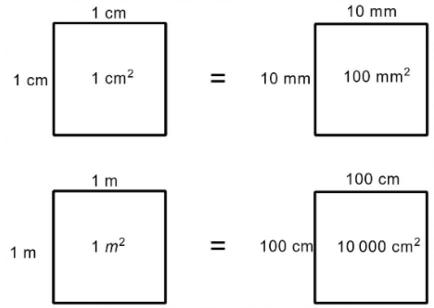
Year 7	Year 8	Year 9	Year 10
and rectangles, the number of length units in the length multiplied by the number of length units in the width, provides the number of square units of area, generalising this to $A = l^2$ and $A = l \times w$ respectively. Extending understanding to part-units by comparing areas determined using formula with diagrams showing whole and part-units of length and area • Using grid paper or dynamic geometry software to draw a rectangle, length 5 units and width 1 unit, determining its area and repeating for subsequent rectangles with a constant length of 5 units and widths increasing by 1 unit of length. Graphing the width compared to the area of the rectangles, connecting the graph to the constant increasing area in the sequence of drawn rectangles	kites, translating, reflecting or rotating the cut piece/s to form a rectangle and derive formulas for area, including ▪ generalising that the area of a parallelogram is equal to the length of one of the parallel sides multiplied by perpendicular distance between the parallel sides, leading to a formula, such as $Area\ parallelogram = b \times h$  Cutting the triangle from one end and moving it to fit on the other end  ▪ generalising that the area in a trapezium is the same as half the length of the perpendicular height multiplied by the total	Figure 2  Figure 3 • Exploring ways to determine perimeter using strategies appropriate to the shape, such as direct measurement, calculations of circumference and Pythagoras' theorem, knowledge of transformations or symmetrical parts. Applying addition of the length parts to determine an estimation, approximation or exact value of perimeter in appropriate length units • Exploring ways to determine area using strategies appropriate to the shape, such as decomposition into familiar	appropriate techniques to solve problems in situations, such as ▪ determining the angle of depression from the top of an 820 m hill to a bushfire 5.8 km away ▪ calculating the height of a flagpole erected on top of a Perth building given that at a distance of 300 m from the base of the building, the angles of elevation to the bottom and top of the flagpole are $37°$ and $39°$ respectively **Year 10 optional** Apply right-angled trigonometry to two dimensional situations involving navigational bearings **Year 10 optional** Explore to establish and use the sine, cosine and area rule to determine unknown sides and angles for any triangle

Year 7	Year 8	Year 9	Year 10
• Using grid paper to draw a rectangle around any triangle, comparing the area inside the triangle to that outside the triangle  Explaining how the area of the rectangle can be used to determine the area of a triangle and generalising to a formula in symbols, such as $Area\ triangle = \frac{1}{2} \times b \times h$ • Using diagrams and reasoning to determine whether it is possible or not to calculate the following and if so, determining ▪ the length of a rectangle, given that it has an area of 20 square centimetres ▪ the perimeter of a square, given that it has an area of 8100 square metres	length of the parallel sides, leading to a formula, such as $Area\ trapezium = \frac{1}{2}h \times (a + b)$  ▪ generalising that the area of a kite is the same as half the product of the diagonals, leading to a formula, such as $Area\ kite = \frac{1}{2} \times x \times y$  and discussing what is the same before and after each quadrilateral is cut and transformed • Drawing different parallelograms, trapeziums, rhombuses or kites each with an area of $15\ cm^2$	polygons and circles or parts thereof and applying formulas, superimposing a rectangle around a shape and subtracting the area of space within the rectangle but outside the shape, from the area of the rectangle, knowledge of transformations or symmetrical parts. Applying strategies to determine an estimation, approximation or exact value of area in appropriate square units and comparing strategies with others to determine and explain the most efficient and accurate method Use Pythagoras' theorem to determine the perimeter and area of shapes involving right-angled triangles, in both exact and decimal approximation form. Investigate and apply the converse of Pythagoras' theorem to establish whether a triangle is right-angled	**Year 10 optional** Use the unit circle and dynamic geometry software to explore and represent trigonometric functions graphically **Year 10 optional** Solve simple trigonometric equations graphically, algebraically or using the unit circle and verify solution/s by substitution

Year 7	Year 8	Year 9	Year 10
▪ the area of an isosceles triangle, given that the length of its base is 8 cm which is the same as the length of its perpendicular height ▪ the area of a rectangle of length 5 cm and width 3.4 mm. Explore and explain efficient strategies to determine the perimeter and area of irregular or composite shapes composed of squares and rectangles For example: Figure 1 Figure 2 Figure 3	• Investigating different ways of finding the area of a hexagon using the formulas of a rectangle, parallelogram, trapezium or triangle Identify, describe and explore the relationship between the radius, diameter and circumference of a circle and use this to establish and apply formulas to determine perimeter and area, using appropriate units For example: • Using concrete examples of circles to establish relationships between the lengths of the diameter and the circumference by measuring using string; creating and interpreting a graph of diameter and circumference and entering results into a spreadsheet to show that circumference ÷ diameter is approximately 3.1 (π). Generalising and applying relationships, such as the	For example: • Determining the height, area and perimeter of a right-angled triangle, with base length of 12 cm and hypotenuse 16 cm, in exact (height $= \sqrt{112}$ cm, $P = 28 + \sqrt{112}$ cm, $A = 6\sqrt{112}$ cm^2) or approximate units (height $= 10.583$ cm, $P = 38.583$ cm, $A = 63.498$ cm^2) • Exploring and using Pythagoras' theorem and geometric reasoning to determine the area of a rhombus with a side length of 8 cm and one diagonal of 15 cm or a regular hexagon with side length 5 cm • Using vertical and horizontal units between points plotted on a Cartesian plane and applying Pythagoras' theorem to determine the distance between the two points	

Year 7	Year 8	Year 9	Year 10
• Using rulers, grid paper, scissors, string, geometric reasoning or dynamic geometry software to investigate different ways of determining the perimeter and area of irregular and composite rectangular shapes as in Figures 1, 2 and 3 including exploring ▪ the minimum number of lengths requiring measurement in order to reason other lengths and hence calculate perimeter in Figure 2 ▪ different reasoning to find the length of unlabelled sides and hence calculate perimeter and area of Figure 3 ▪ ways of decomposing the shape by cutting or dividing all shapes into squares or rectangles to find area of the parts and hence total area or superimposing a rectangle around each shape determining the area of the	number of length units in the perimeter or circumference of a circle is approximately 3.1 (π) times greater than the number of length units in the diameter and the length of the radius is approximately $\frac{1}{6}$ of the circumference • Establishing the relationship between the number of length units in the radius and number of square units in the area of a circle by dissecting a cut out circle into many congruent sectors, arranging them to form an approximate parallelogram with a height of r and a base of πr and generalising the area of a parallelogram determined to $Area\ circle = \pi r^2$  • Determining the circumference of a circle given that its area is	• Justifying whether 5 cm, 12 cm and 13 cm is a Pythagorean triad (the lengths form the sides of a right-angle triangle) **Year 9 optional** Explore and apply Pythagoras' theorem and trigonometry to simple situations involving right-angled triangles in three-dimensional contexts projected to two-dimensions	

Year 7	Year 8	Year 9	Year 10
rectangle and using subtraction of the area of space within the rectangle but outside the shape, in order to estimate or determine exact area comparing strategies with others to determine and explain the most efficient and accurate method • Drawing different composite square and rectangular shapes that have equal areas but different perimeters and those that have equal perimeters but different areas, justifying using application of formula Explore and establish connections and conversions between units of area For example: • Using diagrams to represent and explain connections between numbers of different units of equal areas, such as	37 cm^2 and the area of a circle given that its circumference is 171 mm Investigate in order to establish, define and use Pythagoras' theorem to find the length of an unknown side in a right-angled triangle For example:  • Using grid paper or dynamic geometry software to draw a right-angled triangle, identifying the shorter sides and the hypotenuse, and exploring the relationship between the area of		

Year 7	Year 8	Year 9	Year 10
 Recognising that 1 m is 100 times bigger than 1 cm but 1 square metre is 10 000 times bigger than 1 square centimetre • Applying knowledge of place value and relative sizes of units to explain conversions between units of area, such as 0.72 cm^2 to mm^2 • Extending thinking to include 1 ha $=$ 10 000 m^2 and 1 km^2 $=$ 1 000 000 m^2 $=$ 100 ha	the squares on the two shorter sides to the area of the square on the hypotenuse. Testing, predicting and generalising the relationship to the formula $a^2 + b^2 = c^2$ • Applying Pythagoras' theorem to determine the length of the diagonal of a rectangle with width 7 cm and length 9 cm, in centimetre units, communicating the solution through a sequence of equations and demonstrating that the solution would be positive due to the context		
Explore, identify, define, name, label and apply the language, notation and conventions of geometry for points, lines, angles and polygons	Explore, identify, classify and establish properties of quadrilaterals, including the interior angle sum. Use this to determine unknown sides and angles in quadrilaterals and explain reasoning	Explore to identify and describe conditions for triangles to be congruent. Use this to determine unknown sides or angles in pairs of congruent triangles and explain reasoning	Explore to identify and describe conditions for triangles to be similar. Use this to determine unknown sides and angles in pairs of similar triangles and explain reasoning

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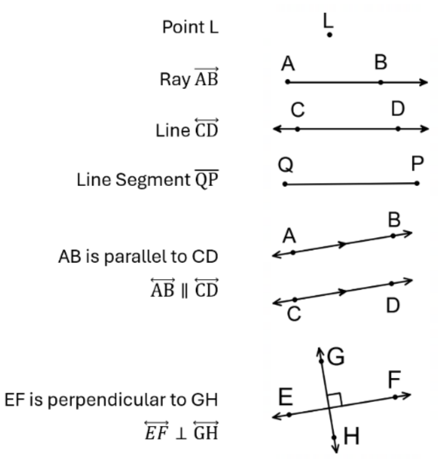
For example:

Using conventions, such as the use of capitals and appropriate symbols, to label, name and define points, rays, line segments, lines, parallel lines and perpendicular lines



Using conventions, such as capitals, Greek letters and appropriate symbols, to label, name and define acute or obtuse angles
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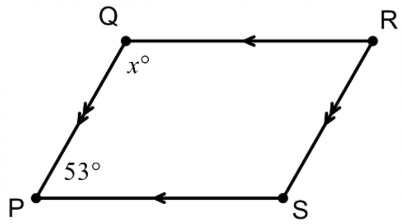
For example:

Creating a classification scheme for quadrilaterals based on sides, angles and diagonals, representing it as a sequence of decisions in a flow chart
Exploring strategies, such as cutting a quadrilateral into two triangles or marking the corners of a quadrilateral, ripping and placing the corners (angles) in a revolution, to generalise to the sum of the interior angles in any quadrilateral being 360°
Determining unknown angles in a quadrilateral, explaining reasons, such as finding the value of x given PQRS is a parallelogram


$\mathrm{QR} \parallel \mathrm{PS}$ (opposite sides of a parallelogram are parallel)

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For example:

Constructing manually or by using dynamic geometry software the following triangles with the given conditions

three sides of 5 cm, 6 cm and 4 cm
two sides of 7 cm, 5 cm and an included angle of 27°
one side of 5 cm and 2 angles, 32° and 54°
one right angle, a hypotenuse of 11 cm and one side of 4.5 cm
two sides of 5.5 cm and 4 cm and a non-included angle of 63°
three angles of $51^\circ, 24^\circ$ and 105°

comparing with others, reasoning and generalising which conditions confirm congruent triangles (SSS, SAS, RHS, AAS) and which do not
Identifying and justifying two triangles being congruent in words and symbols, communicating that $\Delta\mathrm{PQR} \cong$

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For example:

Constructing manually or by using dynamic geometry software, the following pairs of triangles with the given conditions

Triangle 1 with sides of 3 cm, 5 cm and 4.5 cm and Triangle 2 with sides of 6 cm, 10 cm and 9 cm
Triangle 1 with an angle of 35° and a side of 8 cm and Triangle 2 with an angle of 35° and a side of 4 cm
Triangle 1 with sides of 4 cm and 6 cm, with an included angle of 25° and Triangle 2 with sides of 6 cm and 9 cm, with an included angle of 25°
Triangle 1 with angles of 127° and 21° and Triangle 2 with angles of 32° and 21°
Triangle 1 with sides of 4 cm, 7.5 cm and 4.5 cm and Triangle 2 with sides of 3 cm, 15 cm and 9 cm

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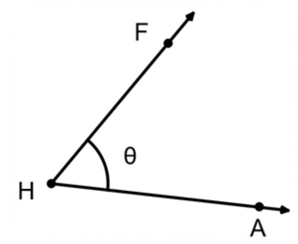
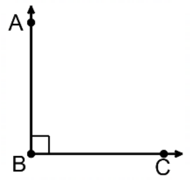
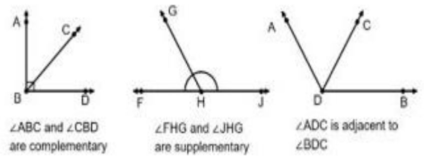
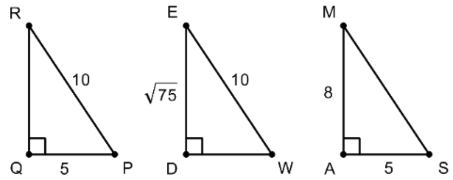
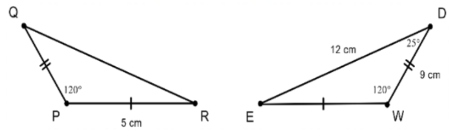
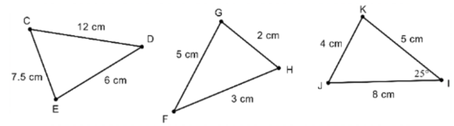
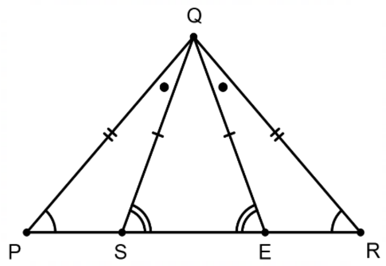
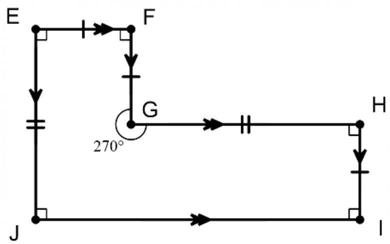
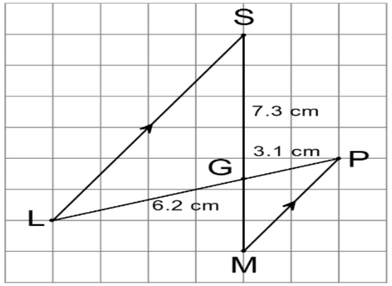
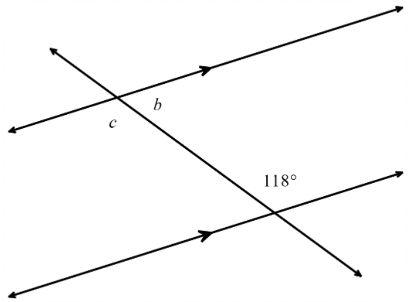
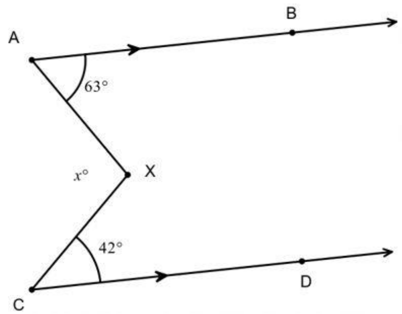
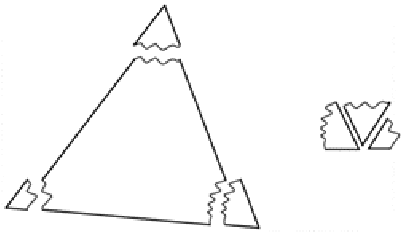
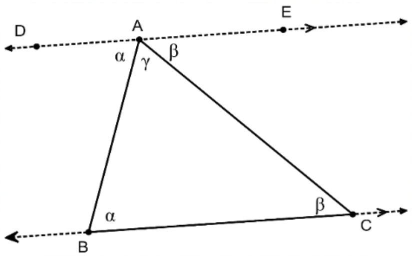
Year 7	Year 8	Year 9	Year 10
 as $\angle H$ or $\angle FHA$ or $\angle AHF$ or θ, right or perpendicular angles,  as $\angle ABC$ or $\angle BAC$ or $\angle B$, and angles at a point as complementary, supplementary and adjacent angles 	$x + 53° = 180°$ (co-interior angles are supplementary), $\therefore x = 127$ • Extend interior angle sum of triangles and quadrilaterals to include other polygons	ΔWDE because all three pairs of corresponding sides are equal to each other (SSS)  • Determining the test that confirms that two triangles are congruent, the congruency statement and unknown sides or angles, giving reasons, in situations, such as  The two sides and included angle of ΔPQR is equal to the two sides and included angle of ΔWDE, therefore $\Delta PQR \cong \Delta WDE$ (SAS) $\overline{QR} = 12$ cm as it corresponds to $\overline{DE}$ and $\angle Q = 25°$ as it corresponds to $\angle D$	▪ Triangle 1 with hypotenuse of 13 cm, a $90°$ angle and the shortest side being 10 cm and Triangle 2 with hypotenuse of 6.5 cm, a $90°$ angle and the shortest side being 5 cm Comparing with others to see if similar triangles have been produced, reasoning and generalising conditions to confirm similar triangles (SSS, SAS, RHS, AA) • Identifying and justifying two triangles being similar in words and symbols  Recognising $\Delta CDE \sim \Delta IJK$ because all three corresponding sides are in proportion (SSS) (scale $= \frac{2}{3}$) • Determining the test that confirms two triangles are similar, the similarity statement

Year 7	Year 8	Year 9	Year 10
Applying correct notation and labelling conventions to triangles and polygons to indicate equal angles, equal sides and parallel sides, such as in ΔPQR and ΔSQE  and in irregular, concave hexagon EFGHIJ  justifying that EFGHIJ is the same as HIJEFG but is not the same as EIJHGF			and finding unknown sides or angles, giving reasons, in situations, such as  Communicating in both words and symbols that $\angle SGL = \angle MGP$ because they are vertically opposite and $\angle GSL = \angle GMP$ as they are alternate angles, in parallel lines $\therefore$ $\Delta SGL \sim \Delta MGP$ because two angles of ΔSGL are equal to two angles of ΔMGP (AA) $\overline{GM} = 3.65$ cm as corresponding sides in similar triangles are in proportion

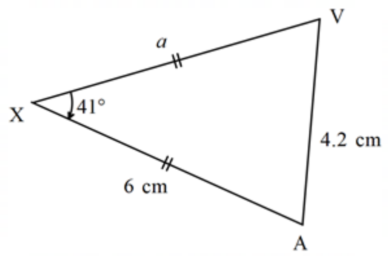
Year 7	Year 8	Year 9	Year 10
• Exploring geometric terminology and naming conventions used in dynamic geometry software Investigate, identify and describe corresponding, alternate and co-interior angles formed when two parallel lines are crossed by a transversal. Use relationships to find unknown angles and explain reasoning For example: • Using paper folding or dynamic geometry software to create a pair of parallel lines crossed by a transversal, identifying congruent and supplementary angles and labelling pairs of angles as corresponding, alternate and co-interior • Finding unknown angles within pairs of parallel lines explaining reasoning in situations, such as			**Year 10 optional** Explore geometric relationships and apply deductive reasoning and a sequence of logically connected statements, to produce proofs of similar triangles and angle/chord/radius/tangent properties in circles

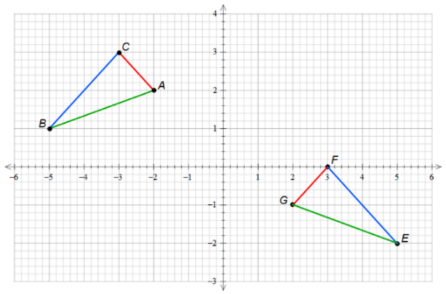
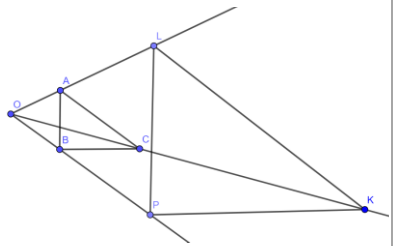
Year 7	Year 8	Year 9	Year 10
 $c = 118°$ (alternate to given angle) $b = 62°$ (co-interior with given angle) • Find the value of x in the diagram below and give reasons  Construct a line XY through X parallel to AB and CD $63° + \angle AXY = 180°$ (co-interior angles, $AB \parallel XY$) $\therefore \angle AXY = 117°$			

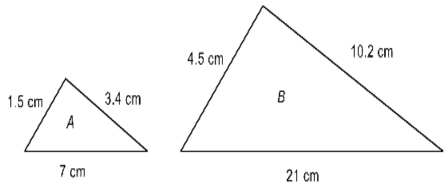
Year 7	Year 8	Year 9	Year 10
$42° + \angle \mathrm{CXY} = 180°$ (co-interior angles $\mathrm{CD} \parallel \mathrm{XY}$) $\therefore \angle \mathrm{CXY} = 138°$ $x + \angle \mathrm{AXY} + \angle \mathrm{CXY} = 360°$ (angles at a point) $x = 105$ comparing geometric reasoning with others, noting that there are alternative ways of determining and explaining the size of angles Demonstrate that the interior angle sum of a triangle is $180°$ For example: • Using a variety of paper triangles to mark corners, rip and place the corners (angles) in a straight line to generalise that the sum of the angles in $\Delta \mathrm{ABC}$ can be determined by $\angle \mathrm{A} + \angle \mathrm{B} + \angle \mathrm{C} = 180°$			

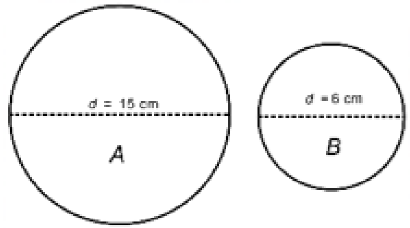
Year 7	Year 8	Year 9	Year 10
 • Using knowledge of alternate angles in parallel lines and supplementary angles to explain why the sum of the angles in a triangle is $180°$ using a sequence of logically connected statements  Explore to classify and name triangles according to their side and angle properties. Use the properties to find unknown angles in triangles and explain reasoning			

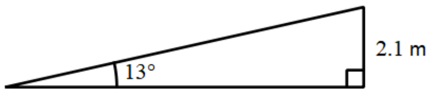
For example: • Creating a classification scheme for triangles based on sides and angles, representing it as a sequence of decisions in a flow chart • Using reasoning and/or construction to decide and explain whether the following triangles are possible or impossible, naming and labelling possible triangles and comparing the construction and naming with others ▪ a triangle with sides of 4 cm, 10 cm and 5 cm ▪ a triangle with all angles $60°$ ▪ A triangle with one side of 8 cm and a $90°$ angle ▪ a triangle with two equal sides of 7 cm and the included angle $45°$ ▪ a triangle with two equal angles of $95°$ • Determining unknown sides and angles in triangles, explaining and comparing reasons with others			

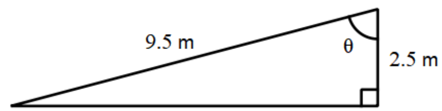
Year 7	Year 8	Year 9	Year 10
 $a = 6$ cm (equal sides in an isosceles triangle) $\angle \mathrm{XAV}$ and $\angle \mathrm{XVA} = 69.5°$ (equal base angles of an isosceles triangle)			

Year 7	Year 8	Year 9	Year 10
Plot coordinates on the Cartesian plane and explore, visualise, predict and determine image coordinates after translation or reflection across the axes, or rotation about the origin For example: • Plotting the following points $\mathrm{D}(-1,6), \mathrm{E}(3,-2), \mathrm{F}(2,4)$ onto a paper or dynamic geometry software Cartesian plane. Using counters for coordinates, paper folding and tracing, digitally moving points and/or reasoning and visualisation to determine the image coordinates $(\mathrm{D}', \mathrm{E}', \mathrm{F}')$ after a transformation, such as ▪ 2 units left and 3 units down ▪ a reflection across the x axis ▪ a rotation of $180°$ anticlockwise about the origin ▪ a rotation of $90°$ clockwise about the origin • Generalising the effect of the transformation on the	Recognise and identify equal corresponding sides and equal corresponding angles of congruent figures. Explore, visualise, predict and determine the translation, reflection, rotation, or combination of these transformations, to match one congruent figure to another For example:  • Identifying and expressing in both words and symbols that between the figure and its image, corresponding sides are the same length, corresponding angles are the same size, the triangles are the same shape and size and are therefore congruent ($\Delta\mathrm{ABC} \cong \Delta\mathrm{GEF}$)	Construct similar figures by enlargement and reduction and use this to establish, explain and apply properties of similar figures For example: • Constructing similar figures using techniques, such as dynamic geometry software, grids, compasses and centres of enlargement or reduction. Design, test and refine a sequence of steps for producing similar figures  • Comparing what is the same and what is different between the original figure and its image, noting that they are the same shape but not necessarily size. Measuring to generalise the	Investigate, explore and determine the effect on the perimeter and area of shapes when they are enlarged or reduced by a scale factor For example: • Determining the perimeter and area of figures, such as triangles, quadrilaterals, circles and composite figures that have been drawn using grid paper, a compass or dynamic geometry software. Making a prediction as to what the perimeter and area of their similar figures would be when side lengths or diameters have been doubled, tripled or halved. Testing this prediction by constructing the scaled figures manually or by using dynamic geometry software to determine the new perimeter and area. Using results to explain and make generalisations as to the effect on perimeter ($\times k$) and area ($\times k^2$) when a figure has been

Year 7	Year 8	Year 9	Year 10
coordinate (e.g. in a reflection in the x-axis, the y part of the coordinate changes sign from a positive to a negative and vice versa) and investigating whether there are different ways of translating, reflecting or rotating the points that produce the same transformation	• Using cardboard triangles, paper folding and tracing, dynamic geometry software and/or reasoning, to predict, visualise and investigate different combinations and patterns of transformations that exactly match the figure of $\Delta\mathrm{ABC}$ to its image $\Delta\mathrm{GEF}$. Investigating to determine whether a sequence of transformations is commutative or not • Investigating, exploring and creating designs in textile patterns involving the translation, reflection and rotation of congruent figures using dynamic geometry software or A3 paper and shape templates	properties of similar figures to ▪ corresponding angles are the same size ▪ corresponding sides are in proportion $(\frac{\overline{\mathrm{AB}}}{\overline{\mathrm{LP}}} = \frac{\overline{\mathrm{AC}}}{\overline{\mathrm{LK}}} = \frac{\overline{\mathrm{BC}}}{\overline{\mathrm{PK}}})$ and recognising that this proportion is the scale or scale factor and writing a similarity statement between pairs of similar figures, such as $\Delta\mathrm{ABC} \sim \Delta\mathrm{LPK}$ • Determining the scale factor between similar figures using corresponding lengths in situations, such as  $\frac{4.5}{1.5} = \frac{10.2}{3.4} = \frac{21}{7} =$ scale factor of 3 and	scaled with a given scale factor (k) • Determining the scale factor when a semi-circle with an area of $42.47\ \mathrm{cm}^2$ is enlarged to have an area of $679.59\ \mathrm{cm}^2$

Year 7	Year 8	Year 9	Year 10
		 $\frac{6}{15}$ = scale factor of $\frac{2}{5}$ recognising that an original figure will be enlarged if the scale factor is greater than one but will be reduced if the scale factor is greater than zero but less than one Use similarity to investigate and explain the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles. Choose and use a trigonometric ratio to determine the length of an unknown side or the size of an unknown angle For example: • Identifying and labelling the hypotenuse, adjacent and opposite sides with respect to a	

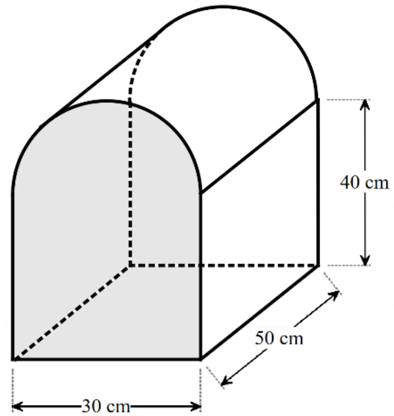
Year 7	Year 8	Year 9	Year 10
		given angle in a right-angled triangle in any orientation • Verifying the constancy of each trigonometric ratio for a given angle by creating a series of similar triangles, measuring corresponding side lengths and identifying and determining the constancy of the different ratios between sides using the trigonometric notation of $\sin\theta$, $\cos\theta$, $\tan\theta$ • Choosing and using a trigonometric ratio to determine the length of a wheelchair ramp in the following situation 	

		- Choosing and using a trigonometric ratio to determine the size of the missing angle θ  Apply the properties of similarity to determine scales, lengths and angles of real-life figures from scale drawings, maps, plans and photographs For example: - Exploring and interpreting maps, plans and scale drawings, recognising that between the scale drawing and actual figure, angles are equal, and sides are in proportion - Determining the scale used between a floor plan and actual house, the width of a bookcase using the scale or ratio on its construction plan and the actual radius of a cell, given a scale and its biological drawing	

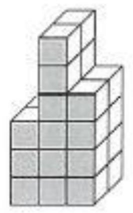
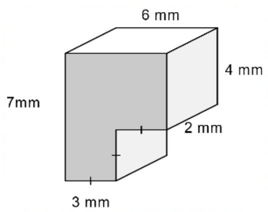
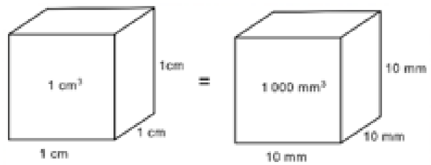
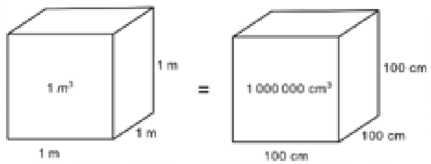
Year 7	Year 8	Year 9	Year 10
		• Exploring scale by mapping a 30 000 hectare bushfire onto a map • Exploring scale in photographs, such as taking a picture of a person standing next to a tree, using their height and the tree's height in the image and the actual height of the person to determine a scale factor and hence estimating the actual height of the tree, discussing and finding ways to improve the estimate **Year 9 optional** Explore the relationship between sine and cosine ratios and the unit circle, determine their approximate values for angles from 0° to 360°, and identify pairs of angles that share the same ratio value **Year 9 optional** Apply deductive reasoning and use a sequence of logically connected statements to produce proofs of congruent triangles	

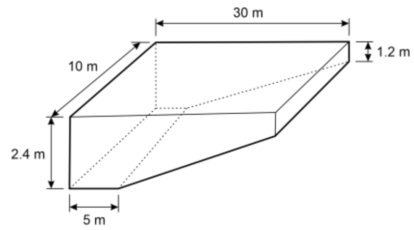
Sub-strand: Three-dimensional space and structures

Year 7	Year 8	Year 9	Year 10
Move flexibly between building and drawing rectangular and composite rectangular prisms from different views For example: • Building rectangular prisms or composite rectangular prisms using at most 12 cubes, visualising and drawing manually, the front, top, side and isometric views. Using dynamic geometry software and the three-dimensional coordinate system to draw representations of rectangular and composite rectangular prisms • Using provided isometric or perspective drawings of rectangular and composite rectangular prisms to build the prism from blocks • Exploring the views of rectangular and composite	Explore in order to visualise and draw cross-sections of different solids and use this to identify prisms For example: • Using concrete materials, such as a block of cheese, round cake, chocolate moulded into a triangular prism, ice-cream cone, chocolate ball, or playdough square-based pyramid to visualise, predict, draw then cut different cross-sections, identifying that any cross-section taken parallel to the base in a right prism, is always congruent • Exploring how many different polygons can be formed from the cut faces of a cube		

Year 7	Year 8	Year 9	Year 10
rectangular buildings depicted in map software, highlighting what is the same and what is different between each view			
Establish and apply relationships between the number of identical layers of cubic units, the number of cubic units in each identical layer and volume for rectangular prisms and composite rectangular prisms. Generalise and apply formula, using appropriate units For example: • Using layers of interlocking blocks or dynamic geometry software to reinforce volume is measured in cubic units and that the volume of a rectangular prism is determined by the number of cubic units in any outer layer, multiplied by the number of identical layers in the prism, generalising to $V = l^3$ or $V = l \times w \times h$ for cubes and rectangular prisms respectively. Extending understanding to	Establish and apply relationships between the area of a uniform cross-section, the length perpendicular to that uniform cross-section and the volume of right prisms. Generalise, apply formulas and use this to connect to capacity if required, using appropriate units For example: • Recognising that right prisms have uniform cross-sections that match the base of the prism and that the volume is determined by calculating the area of the cross-sectional base, multiplying it by the number of units of height, in relation to that base, generalising to $V = base\ area \times height$ and using it to determine the volume in cubic units,	Establish, explain and apply formulas to determine the volume, capacity and surface area of cylinders, using appropriate units For example: • Recognising that a cylinder has uniform cross-sections of a circle and multiplying the area of this circle by the height; generalising to $Volume\ cylinder = \pi r^2 \times h$ to determine the volume in cubic units, converting to capacity units if required • Decomposing a cylinder into a sketched net or visualising its net, as comprising two equal circles and a rectangle, showing the addition of the area of the faces to generalise to a formula $SA\ cylinder = 2\pi r^2 + 2\pi rh$ and	Use efficient strategies and apply formulas to determine the volume, capacity and surface area of composite solids, using appropriate units For example:  • Exploring the orientation of the object to identify the base end and the height. Use strategies to calculate the volume, such as

Year 7	Year 8	Year 9	Year 10
part-units by comparing volumes determined using formula with diagrams showing whole and part-units of length and volume • Using blocks, grid paper or dynamic geometry software to construct a rectangular prism with a length of 5 units, a width of 1 unit and a depth of 1 unit, determining its volume and repeating for subsequent rectangular prisms, with a constant length of 5 units, a constant width of 1 unit and increasing units of depth. Graphing the depth compared to the volume of the prism, connecting the graph to the constant increasing volume in the sequence of prisms and using the graph to determine relationships between the quantities, including finding the depth of the prism if the volume is 18.5 cm^3 • Determining the unknown depth of a rectangular prism	converting to capacity units if required • Using knowledge of volume of prism formulas and capacity conversions to find ▪ the capacity of a 16 cm tall trapezoidal prism that has trapezoidal sides with parallel lengths of 17.2 cm and 12.3 cm and a perpendicular height of 11.5 cm ▪ the side length of a cube with capacity 32 L (using $\sqrt[3]{32}$) ▪ possible dimensions of a triangular prism that holds 40 cm^3 Explore and establish connections and conversions between units of volume and between units of volume and capacity For example: • Using models and diagrams of cubes or rectangular prisms to represent and explain	applying to determine the surface area in square units • Investigating and designing the net of the largest possible cylindrical closed container on an A3 sheet of cardboard by considering which attribute best determines 'largest', applying formulas, calculations and conversions before constructing, comparing and ordering cylinders with others Explore and explain efficient strategies to determine the surface area of right prisms using appropriate units For example: • Using strategies, such as unfolding a cardboard prism, visualising or drawing the net or different two-dimensional views of the prism, recognising congruent faces and showing related area calculations of the different faces, in a sequence of steps, adding to determine the surface area in square units	dividing the base end into familiar shapes to determine the area of the cross-sectional base and multiplying by the height or dividing the composite solid into familiar prisms, applying appropriate formulas and adding to find total volume. Using the volume to determine capacity and comparing strategies with others, deciding which approach is the most efficient • Visualising or drawing the net or different two-dimensional views of a composite object, recognising congruent faces and showing area calculations of the different faces in a sequence of steps, adding to determine the surface area in square unit Investigate, calculate and identify the impact of errors on the accuracy and outcome of results in measurement situations

Year 7	Year 8	Year 9	Year 10
given it has a length of 23.4 cm, a width of 13.75 cm and a volume of 4872.81 cm^3 using formula • Using composite rectangular prisms made of blocks or depicted as isometric or oblique drawings to visualise, determine and compare methods for finding volume   	connections between numbers of different units of equal volume, such as   recognising that 1 mm is 10 times smaller than 1 cm but 1 cubic mm is 1000 times smaller than 1 cubic cm • Applying knowledge of place value and relative sizes of units to explain conversions between units of volume, such as 0.25 m^3 to cm^3 • Using materials, such as a milk carton, a medicine syringe or graduated beakers to show that 1 cm$^3 =$ 1 mL, 1000 cm$^3 =$ 1 L, and extending thinking to	• Determining the depth of a rectangular prism, given that it has a surface area of 726 cm^2, length of 15 cm and width of 5 cm • Determining the surface area of a cube given that its volume is 15.625 m^3 Use dynamic geometry software to explore and construct familiar objects in three-dimensions using transformations of two-dimensional figures For example: • Using dynamic geometry software to show transformations of two-dimensional figures in the plane through a third dimension to create prisms and cylinders, such as constructing a right cylinder by rotating a rectangle around a line in the plane of the rectangle or rotating a triangle around an axis to create a cone.	For example: • Determining the length of a wooden beam leaning against a wall, using a clinometer or large protractor to measure an angle of elevation and applying trigonometry and/or Pythagoras' theorem. Comparing calculated and actual measurements of the wooden beam and discussing accuracy of results in terms of absolute and percentage error, the measuring instruments, the size of the measurement unit used and human error • Determining the planned height of an access ramp being built from a carpark to the entrance of a Leisure Centre, given that the plan is for it to be 3.5 m long, on an inclination of $12°$. Discussing any implications of the miscalculation or error of $1°$ on the access ramp build

Year 7	Year 8	Year 9	Year 10
	$1\ \text{m}^3 = 1000$ L or 1 kL, $1000\ \text{m}^3 = 1$ megalitre (ML) and $1\ 000\ 000\ \text{m}^3 = 1$ gigalitre (GL) • Choosing an object with a known volume in cubic centimetres, immersing it in water to show the millilitres it displaces, and connecting to conversion between units, such as $95\ \text{cm}^3$ is the same as 95 mL • Using knowledge of conversions, place value and relative sizes of units to assist in explaining the capacity in millilitres of a $0.73\ \text{m}^3$ storage container	Describing different views of the object, altering the dimensions and highlighting what is the same and what is different about the original object and its alteration • Drawing a two-dimensional shape and describing how to transform images of the shape to represent a three-dimensional object, using at least two different transformations, such as translating, rotating, reflecting a square to form a cube	• Investigating the effect on capacity of the following fibreglass swimming pool if the 2.4 m height was accidentally read as 2.6 m, determining percentage error and discussing the impact of the misreading  Investigate in order to determine the effect on surface area and volume when objects are enlarged or reduced by a scale factor For example: • Constructing similar objects with a given scale using dynamic geometry software, cardboard, grid or isometric paper and discussing what is the same and what is different about the object and its enlarged/reduced image. Calculating and

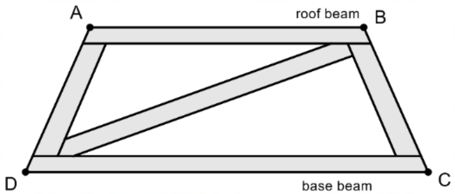
Year 7	Year 8	Year 9	Year 10
			comparing the surface area and volume of the object and its image. Determining that the surface area of the object is enlarged or reduced by the square of the scale factor ($\times k^2$) and that the volume of the object is enlarged or reduced by the cube of the scale factor ($\times k^3$) • Determining the scale factor when a rectangular prism with a volume of 44.8 cm^3 is enlarged to have a volume of 1209.6 cm^3 • Exploring the impact of changes in scale on the surface area and volume in situations involving 3D printing or production prototypes **Year 10 optional** Explore, explain and apply efficient strategies and formulas to determine the surface area and volume of right pyramids, right cones, spheres and related composite solids

Sub-strand: Non-spatial measurement

Year 7	Year 8	Year 9	Year 10
Explore and interpret representations of time zones within Australia using 12- and 24-hour time and determine the local time at different locations considering different times of the year For example: • Using maps, number lines or digital tools to interpret and explore the language and thinking used in determining and communicating current times across Australia (AEST, ACST, AWST and DST) • Determining current times in Sydney during Daylight Saving Time (DST) if it is 2245 hours in Perth or a quarter past 3 in the afternoon in the NT or 7.35 pm in Tasmania	Explore and interpret representations of national and international time zones using 12- and 24-hour time, and determine duration of events across multiple time zones For example: • Using maps, number lines or digital tools interpret and explore the language and thinking used in determining International time zones and comparing times in Beijing, China to Suva, Fiji and Toronto, Canada • Recognising the challenges of planning regular 3-hour virtual meeting times for a company that has staff in both Vancouver, Canada and Western Australia and determining suitable starting and ending times for these meetings, including consideration of Coordinated Universal Time (UTC)		

Sub-strand: Modelling with measurement and geometry

Year 7	Year 8	Year 9	Year 10
In real-world situations involving perimeter and area of squares, rectangles, triangles and rectangular composite shapes, parallel lines, properties of triangles, transformations of points, views of rectangular prisms and rectangular composite objects, volume, and/or Australian time zones I. analyse the situation, decide if an exact or approximate solution is required and determine assumptions and constraints II. represent the situation mathematically in order to reach a solution III. interpret and communicate findings in terms of the context and any assumptions or constraints For example: • 'Maya is a Year 7 student who lives in Albany and wants to	In real-world situations involving perimeter and area of quadrilaterals and circles, properties of quadrilaterals, transformations of figures, Pythagoras' theorem, congruency, cross-sections, volume or capacity of prisms and/or international time zones I. analyse the situation, decide if an exact or approximate solution is required and determine assumptions and constraints II. represent the situation mathematically in order to reach a solution III. interpret and communicate findings in terms of the context and any assumptions or constraints For example: • 'Barri has designed a disposable sugar sachet, the shape of a triangular prism. The length of	In real-world situations involving the perimeter and area of composite shapes and right-angled triangles, enlargement and reduction of similar figures, finding unknown side lengths and angles using trigonometric ratios, scale in similar figures and/or volume, capacity and surface area of right prisms and cylinders I. analyse the situation, decide if an exact or approximate solution is required and determine assumptions and constraints II. represent the situation mathematically in order to reach a solution III. interpret and communicate findings in terms of the context and any assumptions or constraints	In real-world situations involving Pythagoras' theorem, trigonometry and angles of elevation and depression in right-angled triangles, volume, capacity and surface area of composite objects, the impact of errors in measurement and/or the effect of enlargement and reduction on perimeter, area and volume of similar figures and objects I. analyse the situation, decide if an exact or approximate solution is required and determine assumptions and constraints II. represent the situation mathematically in order to reach a solution III. interpret and communicate findings in terms of the context and any assumptions or constraints

Year 7	Year 8	Year 9	Year 10
telephone her grandmother who lives in Adelaide. Maya would like to call her grandmother after school and also knows her grandmother goes to bed at 7.30 pm. Determine a suitable time range in which Maya could ring her grandmother.' Realising that an approximate range of times is required, that Maya would need to ring her grandmother after school finishes at approximately 4 pm in Albany and before 7 pm in Adelaide, to allow time for the conversation. Maya would also need to consider if it is daylight saving time or not. Choosing to represent the situation using a number line, communicating the solution as an appropriate local time range for Maya and checking against the initial assumptions	the prism is 52 mm, and the end face has a base length of 0.9 cm and perpendicular height of 8 mm. Barri is asked to redesign the sachet to have a volume of 2 cm^3 by altering just one dimension. Determine the new dimensions of the sugar sachet.' Assuming that an exact solution would be required given the degree of accuracy of the measurements and the size of the object. Choosing to represent the situation as an oblique sketch and with the formula for volume of a triangular prism. Showing calculations using the same units and solving equations to determine new dimensions. Communicating the solution with the chosen units and explaining that the solution could differ, depending on the dimension chosen to alter	For example: • 'A building firm is constructing a roof beam with an 11.4 m base beam parallel to a 7.6 m roof beam and 1.5 m apart. The firm wants to insert a truss to connect from one top corner to the diagonal bottom corner to ensure that the beam is rigid. What is the total length of roof beam needed to build the whole roof beam?'  Deciding that an exact answer to the nearest millimetre is required for building purposes and that the truss is straight. Choosing to use properties of an isosceles trapezium, Pythagoras' theorem to determine the length of the truss and the length of the equal, non-parallel sides and perimeter	For example: • 'A drone is hovering at a height of 455 m. The angles of depression from the drone to a boat in trouble are at first 9° and then 14°. How far has the troubled boat travelled between the two observations?' Making assumptions, such as the sea is relatively flat, the drone's height is constant and that it does not change position. Using representations, such as a diagram, choosing a trigonometric function, such as tangent and determining the difference between the horizontal distance from the drone at 9° to 14°. Communicating the solution in terms of the drone and the boat and with reference to the assumptions • 'A construction firm needs to build a bespoke hollow cylindrical 1.25 m cement pipe

Year 7	Year 8	Year 9	Year 10
• 'Charlie is planning to knit a floor rug. She already has 5 m of braiding that she will use to go around the outside edge of the rug. She wants to know if she should knit a square or a rectangular rug to maximise the floor space that the rug will cover. What shape and dimensions should Charlie choose?' Deciding that an accurate answer is required, that the perimeter length needs to be less than 5 m to allow the braid ends to be connected, so a small reduction in the length of braid should be determined, and that the room dimensions and visual appeal of the rug will be constraining factors. Representing the situation using square and rectangle diagrams, choosing the attribute of area to determine the largest floor space and reasoning using		of a trapezium to determine the total length of beam. Communicating the solution in the context of the roof beam and to the nearest millimetre	with an outer diameter of 32.5 cm and a pipe thickness of 6.5 cm. Determine the volume of cement required to make the pipe and the maximum capacity of the pipe at any given time.' Making assumptions, such as an exact volume and capacity is required and that the thickness of the pipe is uniform with the pipe cross-section congruent throughout the length of the pipe. Choosing to use consistent, appropriate units, such as metres. Selecting efficient strategies and appropriate formulas to determine the volume of the pipe in cubic metres, rounding up appropriately to ensure enough cement. Determining the volume of the hollow pipe and converting to capacity in litres. Communicating the solution to the total volume of the pipe in cubic metres and the

Year 7	Year 8	Year 9	Year 10
patterning, to find possible dimensions that satisfy the braid length (perimeter) of 4.92 m (assuming 8 cm to connect the braid). Determining the area of each possibility in square units. Identifying and communicating that the square of side length 1.23 m provides the maximum possible area of 1.51 m^2 that it satisfies the constraint of 4.92 m and would be a suitable, visually appealing shape			capacity of the pipe in litres, making reference to the assumptions made

Strand: Probability and statistics

Sub-strand: Probability and statistics

<table>
<tr><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th></tr>
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<td>
Construct sample spaces for single-stage chance experiments, assign probabilities to the outcomes and predict frequencies for different numbers of trials
For example:

Discussing probability terminology, such as probability, favourable outcome, event, trial, sample space, experiment.
Producing a sample space for a standard 6-sided dice
S = {1, 2, 3, 4, 5, 6} and determining the probability of rolling a 4 using
$\mathrm{P(event)} = \frac{\text{number of favourable outcomes}}{\text{total number of outcomes}}$
So $\mathrm{P}(4) = \frac{1}{6},\ 0.17, 16.67\%$ or a one in six chance.
In 100 trials, it would be expected that the number of

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Construct sample spaces, such as lists, simple tree diagrams, tables or arrays to show all possible outcomes for two events. Assign probabilities to outcomes and events including those involving ‘and’, ‘not’, ‘at least’, exclusive ‘or’ and inclusive ‘or’
For example:

Constructing sample spaces to show all outcomes for a couple having a two-child family, such as
S = {GG, GB, BB, BG}
or
<table>
<tr><td></td><td></td><td colspan="2">Second child</td></tr>
<tr><td></td><td></td><td>Boy</td><td>Girl</td></tr>
<tr><td rowspan="2">First child</td><td>Boy</td><td>B,B</td><td>B,G</td></tr>
<tr><td>Girl</td><td>G,B</td><td>G,G</td></tr>
</table>
or

</td>
<td>
Construct sample spaces to show outcomes for two-stage chance experiments both with and without replacement. Assign probabilities to outcomes and make informal connections to independent and dependent events
For example:

The digits 1, 2, 3, 4 and 5 are written on ping pong balls and placed in a bag. Two balls are drawn consecutively, without replacement to make a two-digit number. Choosing from a list, an array or a tree diagram to show all possible outcomes and use this to find the probability that the number formed is even.
Repeating with replacement.
Noting that the events of drawing one ball after another, with replacement are independent as

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Choose and construct appropriate sample spaces to show outcomes for two- and three-stage chance experiments both with and without replacement. Assign probabilities to events involving conditional statements, such as ‘if ... then’, ‘given’, ‘of’, ‘knowing that’
For example:

Recognising and interpreting the notation and language of conditional probability, such as from a dice roll and a coin toss, determining
$\mathrm{P(3 \text{ and a Tail} | \text{the dice roll was a prime number})}$
i.e. the probability of flipping a 3 and a Tail, given that the dice roll was a prime number.
Choosing from a list, array or tree diagram to show all

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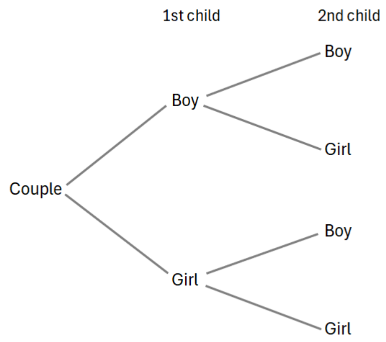
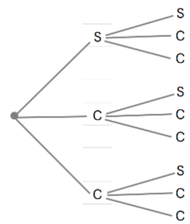
<tr><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th></tr>
<tr>
<td>times 4 would occur would be approximately $\frac{1}{6} \times 100 = 16.66$ which would be rounded to 17
Assigning probabilities to events involving coins, dice, spinners, cards, lucky dips etc.</td>
<td>

and using to assign probabilities to events, such as
P(a boy first and a girl second)
P(boy first or a girl second)
P(at least one girl)
P(not having any boys)
Creating a sample space to show all outcomes for rolling two standard dice
<table>
<tr><th>Dice 2 / Dice 1</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td>1</td><td>1,1</td><td>1,2</td><td>1,3</td><td>1,4</td><td>1,5</td><td>1,6</td></tr>
<tr><td>2</td><td>2,1</td><td>2,2</td><td>2,3</td><td>2,4</td><td>2,5</td><td>2,6</td></tr>
<tr><td>3</td><td>3,1</td><td>3,2</td><td>3,3</td><td>3,4</td><td>3,5</td><td>3,6</td></tr>
<tr><td>4</td><td>4,1</td><td>4,2</td><td>4,3</td><td>4,4</td><td>4,5</td><td>4,6</td></tr>
<tr><td>5</td><td>5,1</td><td>5,2</td><td>5,3</td><td>5,4</td><td>5,5</td><td>5,6</td></tr>
<tr><td>6</td><td>6,1</td><td>6,2</td><td>6,3</td><td>6,4</td><td>6,5</td><td>6,6</td></tr>
</table></td>
<td>the outcome of the first event does not impact the outcome of the second event
Choosing to construct a tree diagram sample space to represent a box of three chocolates, containing one strawberry and two caramel chocolates, with two chocolates being randomly selected, one after the other. Determining the probability of selecting two caramels in each of the following scenarios
With replacement
The three chocolates have coloured wrappers to indicate the flavour. A chocolate is randomly chosen, the flavour noted, and the chocolate replaced (independent events)

</td>
<td>outcomes and assign a probability
Choose and represent a suitable sample space, such as an array, for rolling two, 8-sided dice to assist in determining the probability of a sum of 14, given that both dice show an even number. Use knowledge and reasoning of conditional events to restrict the sample space and assign conditional probabilities
Choosing to represent the sample space of drawing three marbles from a bag containing 2 red, 1 green and 2 blue marbles, one after the other without replacement, in a tree diagram. Determining the probability of events, such as ‘drawing a blue marble third, given the first was red’ and ‘drawing a green marble first, knowing that the second was blue’</td>
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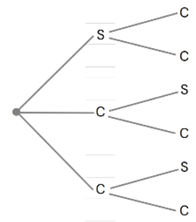
Year 7	Year 8	Year 9	Year 10
	and using to assign probabilities to events, such as P(rolling a 1 first) P(rolling at least one 5) P(not rolling a double) P(rolling a 4 first and a 4 second) P(sum of 6) Recognise that complementary events have a combined probability of one and use this relationship to calculate probabilities For example: • Exploring the language of complementary events, such as rolling a 3 on a dice and not rolling a 3 on a dice. Verifying that as the probability of rolling a 3 on a dice is $\frac{1}{6}$ and the probability of not rolling a 3 on a dice is $\frac{5}{6}$, then the sum of the event and its complement is 1 • Using complementary events to assign the probability of not choosing a red 3 from a standard pack of cards by	P(caramel, caramel) $= \frac{4}{9}$ Without replacement Three unwrapped chocolates, needing to be eaten to identify flavours (dependent events)  P(caramel, caramel) $= \frac{2}{6} = \frac{1}{3}$ **Year 9 optional** Identify independent and dependent two-stage chance events using $P(A \text{ and } B) = P(A) \times P(B)$ and sample spaces, such as tree diagrams to determine the probability of independent events	**Year 10 optional** Use weighted tree diagrams and/or formulas to assign probabilities to two- and three-stage chance events including situations involving conditional probability

Year 7	Year 8	Year 9	Year 10
	P(not choosing a red 3) $= 1 -$ P(choosing a red 3) $= 1 - \frac{2}{52}$ $= \frac{50}{52}$ or $\frac{25}{26}$ or 96.2% or 0.962 or a 25 in 26 chance • Using complementary events to assign a probability to rolling at most a 9 from a 10-sided dice roll by identifying that P(at most a 9) and P(10) are complementary events. Using $1 - \frac{1}{10}$ to determine the expected probability		
Conduct repeated single-stage chance experiments and simulations to produce datasets, including through the use of digital tools, for an increasingly large number of trials. Discuss and describe variation and estimated probabilities for outcomes and compare to predictions and theoretical probability, where appropriate	Conduct repeated chance experiments and simulations for two events to produce datasets, including through the use of digital tools, for a large number of trials. Discuss, explain and compare variation and estimated probabilities for simple and compound events For example: • Conducting a simulation to determine the estimated	Conduct repeated two-stage chance experiments and simulations, both with and without replacement, to produce datasets, including through the use of digital tools. Discuss, compare and interpret variation and estimated probabilities for compound events For example: • Conducting an experiment to find the estimated probability of	Conduct repeated chance experiments and simulations to model conditional probability and produce datasets using digital tools. Discuss, compare and analyse variation and estimated probabilities for conditional events

For example: • Conducting an experiment to find the estimated probability of a drawing pin falling point up or point down when tossed. Completing 20 trials, determining relative frequencies (fraction of those that landed point up or point down), comparing with others, describing variation in results and estimating probabilities of each outcome. Repeating over a large number of trials, comparing to others again and using the data to estimate the probability that a pin will land point down when tossed. Comparing this to former estimates of probabilities and discussing the law of large numbers • Conducting a simulation to determine the chance of randomly choosing a person who supports the Dockers from a family comprising three Eagles supporters, two Dockers	probability of not getting two tails when tossing two coins. Predicting the probability before using a virtual coin toss or random number generator with 1 representing 'heads' and 2 representing 'tails', to flip two coins for a large number of trials. Comparing results with others, and with predicted and theoretical probability results, discussing and explaining any variation and making connections to complementary events. Conducting an experiment to find the estimated probability of a difference of 6 between the sum of the numbers shown on two white dice and the number shown on a green dice. Completing an actual or virtual dice experiment to produce a large set of data, representing results in a column graph and using to estimate the probability of the difference being 6. Comparing the shape of the graph in terms of clusters, gaps,	choosing two hazelnut chocolates one after the other from a box containing seven strawberry, 11 hazelnut and two caramel chocolates for the following scenarios With replacement The chocolates have coloured wrappers to indicate the flavour. A chocolate is randomly chosen, the flavour noted, the chocolate replaced, and a second chocolate is chosen, and flavour noted Without replacement The chocolates are unwrapped, needing to be eaten to identify flavours (not replaced), choosing and using an appropriate tool, such as a 1–20 random number generator (1–7 strawberry, 8–18 hazelnut and 19–20 caramel) to simulate and generate large datasets for both scenarios. Using the datasets to estimate the probability of drawing a hazelnut followed by another hazelnut in each case, comparing and	For example: • Conducting an experiment to find the estimated probability of drawing a red marble third, given the first was green when drawing three marbles consecutively, without replacement, from a bag containing 19 red, 8 blue marbles and 13 green marbles. Choosing and using an appropriate tool, such as a 1–40 random number generator to simulate the situation. Producing a large number of trials to estimate the probability of drawing a red marble third, given the first was green. Comparing results with others, recognising the effect of 'without replacement', conditional events and chance variation on the datasets produced and the estimated probability. Comparing and analysing differences between the initial prediction and the estimated probability.

Year 7	Year 8	Year 9	Year 10
supporters and one Geelong supporter. Predicting the expected probability before using a random number generator from 1–6, with 1, 2, 3 representing the Eagles supporters, 4 and 5 representing the Dockers supporters and 6 representing the Geelong supporter, over 20 trials. Determining the relative frequency that a Docker supporter is chosen, comparing results with others, describing variation and estimating the probability. Repeating over an increasingly large number of trials. Comparing results of estimated probability to theoretical probability and discussing variation. • Conducting an experiment to predict the unknown distribution of red, green, and blue counters in a bag of 12. Randomly choosing a counter,	outliers and symmetry with others and noting variation. Explaining and justifying conclusions made regarding the probability of a difference of 6 between the sum of the numbers shown on two white dice and the number shown on a green dice	explaining differences in the estimated probabilities of drawing two hazelnuts between scenarios. Discussing and interpreting the effects of with/without replacement and chance variation on the datasets and the conclusions drawn. For students engaging in Year 9 optional, extending and connecting to the probability formula for independent events	For students engaging in Year 10 optional, extending and connecting to the probability formula for conditional events • Conducting a simulation of an amusement arcade game where the prizes are three toys with the chances of winning a toy dinosaur being 20%, a fluffy dice 50% and a stuffed toy 30%. Making predictions of the average number of played games required, to win at least one of each of all three prizes. Choosing and using an appropriate tool, such as a virtual spinner or a random 1–10 number generator to simulate the situation and to produce a large dataset. Using data to estimate the average number of games played to collect at least one of each of all three prizes. Comparing results with others, describing and explaining variation of

Year 7	Year 8	Year 9	Year 10
noting its colour, replacing and recording the frequencies of red, green, and blue, over 50 trials. Determining the relative frequencies for each colour, noting that they add to one. Comparing results with others, describing variation and predicting colour distribution. Repeating over many trials, and again comparing to others, calculating appropriate averages, predicting colour distribution, then confirming the actual number of each colour in the bag. Describing comparisons of predicted and actual colour distribution. Relating to the theoretical probability and discussing variation in the experimental probability as the number of trials increases (law of large numbers)			results. Discussing, comparing and analysing differences in in the average number of games needed to win at least one of each of all three prizes, in situations where it was given that the first prize drawn was ▪ a stuffed toy ▪ a toy dinosaur ▪ a fluffy dice • Conducting simulations to produce datasets for situations involving chance, such as the 'birthday problem' or 'three door problem'

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<td>
Explore and determine the mean, mode, median and range for sets of data and justify, using the context, which measure best reflects the dataset

For example:

Using concrete materials, such as a small collection of

beakers of different amounts of water
‘fake’ $100 notes allocated to students ($\$500, \$200, \$500, \$1400, \$600, \$0$)

to physically show the mode and the range, re-ordering to demonstrate the median and redistributing evenly between each data point to show the mean (generalising to a numerical calculation of the mean). Discussing which measure of average best reflects each physical context
Given the mean number of pets in seven households is 4.25, working backwards to

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Analyse data represented in stem and leaf plots, column graphs and frequency tables to determine the mean, mode/s, median and range. Describe the effect of any outliers on the statistical measures

For example:

Using information recorded in a table, on the number of cups of coffee consumed by people in an office on a given day
<table>
<tr><td>Number of cups</td><td>0</td><td>1</td><td>2</td><td>3</td><td>9</td></tr>
<tr><td>Frequency</td><td>12</td><td>27</td><td>16</td><td>5</td><td>1</td></tr>
</table>
Determining the mean, mode, median and range of the data with and without the outlier, manually or with digital tools. Comparing and describing differences in the two sets of statistical measures (with and without outlier), recognising the impact of the outlier on mean and range and understanding why it is often more appropriate

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Analyse data with multiple variables represented in tables, describe using statistical measures and relative frequencies to make inferences

For example:

Describing data in tables involving variables, such as the states of Australia, their population, land size and median house price. Determining proportions, such as the percentage of Australians who live in NSW or the fraction of land size that WA is of Australia and statistical measures, such as the average median house price. Discussing possible inferences that could be made from the data

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<td>
Analyse bivariate data represented in a two-way table, using proportions and comment on possible association between categorical variables

For example:

Forty people in the suburb of Gosnells were randomly surveyed about dog adoption from the local dog shelter to produce data to guide an adoption advertising campaign. The data was represented in a two-way table
<table>
<tr><th colspan="5">Living near a dog shelter and dog adoption</th></tr>
<tr><td></td><td></td><td>Live ≤ 5km from shelter</td><td>Live >5 km from shelter</td><td>Total</td></tr>
<tr><td rowspan="3">Dog adoption</td><td>Have adopted a dog</td><td>15</td><td>4</td><td>19</td></tr>
<tr><td>Have not adopted a dog</td><td>16</td><td>5</td><td>21</td></tr>
<tr><td>Total</td><td>31</td><td>9</td><td>40</td></tr>
</table>
Determining proportions, such as $\frac{15}{31}$ of the population that live within 5 km of the dog shelter have adopted a dog, which is similar to $\frac{4}{9}$ of the

</td>
</tr>
</table>

Year 7	Year 8	Year 9	Year 10
produce and explain seven reasonable data points • Using data sources, such as primary, discrete data collected from chance experiments, or secondary, continuous data, such as the maximum temperature/rainfall in the class town or city for each month of the year, to determine mean, mode, median and range using written jottings or digital tools depending on the complexity of the data. Explaining and justifying which is the most reflective of the dataset	to use the mode or median to describe data when an outlier is included in the calculations		population that live further than 5 km from the dog shelter and have adopted a dog. Commenting that proximity to a dog shelter does not appear to have an association with dog adoption. Discussing how the information could be used to guide the dog adoption advertising campaign

<table>
<tr><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th></tr>
<tr>
<td>Represent primary categorical and numerical data in a Venn diagram, calculate related relative frequencies and interpret results

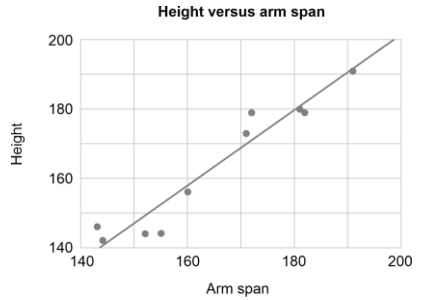
For example:
• Collecting data from a Year 7 Maths class on different options for an end of term activity, such as those who prefer to go to a movie, those who prefer ten-pin bowling, those who are happy with any option and those who like none of the options. Representing the results in a Venn diagram and determining the proportion (relative frequency) of students who choose the movies and not ten-pin bowling (e.g. $\frac{4}{5}$). Analysing results, such as most of our class would like to go to a movie because the film playing at that time is very popular. Acknowledging that the data would vary if recorded on a different day or from a different</td>
<td>Use secondary data represented in two-way tables and Venn diagrams to describe events, including those that are mutually exclusive. Estimate related probabilities and make predictions as appropriate

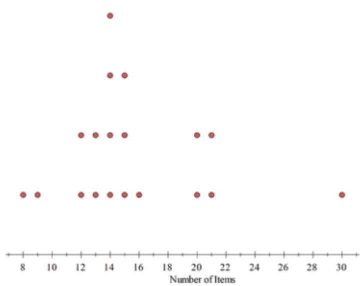
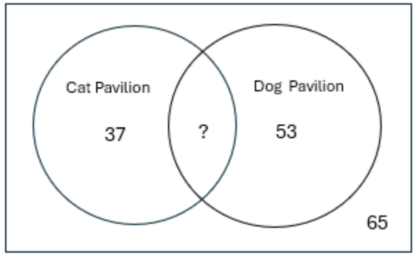
For example:
• Using data represented in completed or partially completed two-way tables, such as information concerning jackets ordered by members of a Netball club and whether the jacket had a hood or a name printed on the jacket
<table>
<tr><th></th><th></th><th>Name printed</th><th>No name printed</th><th>Total</th></tr>
<tr><td>Hood</td><td>Hood</td><td>68</td><td>112</td><td></td></tr>
<tr><td></td><td>No hood</td><td></td><td>26</td><td></td></tr>
<tr><td></td><td>Total</td><td>82</td><td></td><td></td></tr>
</table>
Determining and describing the jackets of 14 students as having a name printed but not having a hood, 68 students as having a hood and a name printed and 194 students having a hood, or a name printed</td>
<td>Explore, choose and create graphical or visual representations and justify choice with regards to context, purpose, data type and intended audience

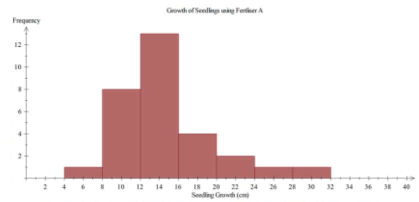
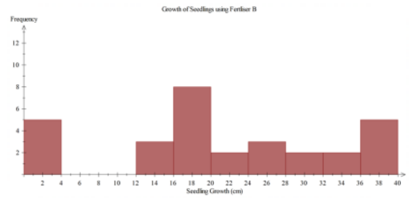
For example:
• Using digital tools, a variety of data types and data size, explore and create standard and non-standard representations, such as histograms, line graphs, Venn diagrams, two-way tables, stem and leaf plots, stacked bar charts, pie charts, infographics or 3D graphs
• Discussing determining factors involved in choosing an appropriate representation, such as where the representation will be displayed, whether the data is categorical, numerical, continuous or discrete, the message the representation will be intending to convey, who will be viewing the representation and what level of detail or</td>
<td>Represent secondary data in two-way tables or Venn diagrams and assign probabilities to outcomes involving conditional statements

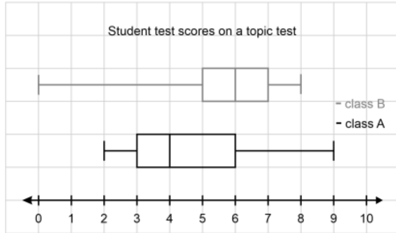
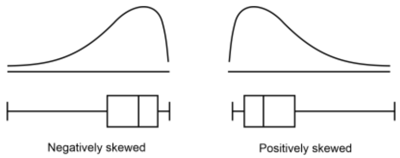
For example:
• Choosing from a Venn diagram or two-way table to represent information, such as 200 people were asked about which social media platform they used. 115 use ‘Quickgram’ only, 13 used ‘Z’ only and 45 use neither. Determine the probability that a person chosen at random uses ‘Z’ given that they also use ‘Quickgram’
Note: situations involving mutually exclusive events should also be included

Represent the relationship between bivariate data in a scatter plot and draw a trend line by eye if appropriate. Use the graph and context to describe any association in terms of strength, direction,</td>
</tr>
</table>

Year 7	Year 8	Year 9	Year 10
Year 7 class, impacting conclusions. Discussing whether it would be valid to use the data from this Maths class to make decisions for the whole population of Year 7 students Represent collected data in a stem and leaf plot, describe the shape and spread including outliers, and compare to dot plots or column graphs. Use the data to estimate probabilities of specific outcomes For example: • Collecting data, such as the number of items of stationery in pencil cases, with one half of the class representing results in a stem and leaf plot and the other in a dot plot, manually or by using digital tools. Stem and Leaf plot displaying number of items of stationery in pencil cases	Determining related probabilities, such as a student being chosen at random who does not have a name printed on their jacket. Identifying and describing that the outcomes of having a hood and having a name printed are not mutually exclusive as they can occur at the same time. Using the data to predict that in a future group of 300 members of the Netball club $\frac{112}{220} \times 300 = 152.72$, or approximately half the members, would order a jacket with a hood but no name, acknowledging that future prediction will be affected by chance variation, such as fashion trends • Using data represented in a completed or partially complete Venn diagram concerning a sample of 180 people at the Perth Royal Show being asked by the organisers to complete a questionnaire as to whether they	complexity in the representation is appropriate for the audience • Using topics of interest involving sports statistics, environmental data over time, social media ‘likes’ etc., selecting and creating an appropriate display based on the dataset and the determining factors Interpret and compare multiple datasets represented in back-to-back stem and leaf plots and histograms with consideration of shape, spread and centre For example: • Given a back-to-back stem and leaf plot of pulse rates before and after exercise to show heart beats per minute	linearity and outliers. Make predictions and recognise and explain any limitations of the model For example: • Representing data of the arm span and height of a group of students, manually or with digital tools, depending on the amount or complexity of the data, in a scatter plot  • Describing the data as having a strong, positive, linear relationship between arm span and height, with arm span increasing as height increases and with no outliers

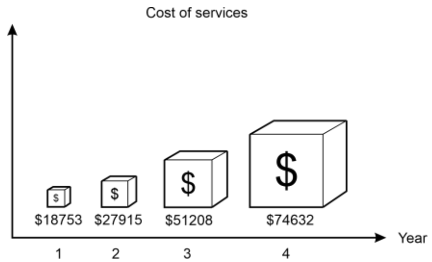
Year 7	Year 8	Year 9	Year 10
0 | 8 9 1 | 2 2 3 3 4 4 4 4 5 5 5 6 2 | 0 0 1 1 3 | 0 Dot plot displaying number of items of stationery in pencil cases  Each half of the class to comment on the shape of the data from their distribution. Identifying clustering of most items between 12–16, non-symmetry, a spread in items of 22 (30–8), gaps between 9–12 and 16–20 and an outlier of 30, recognising that 30 items could be the result of an error or that one	had visited the Cat pavilion only, the Dog pavilion only, both or neither.  Reasoning that the number of people who had visited both pavilions was 25. Determining related probabilities of a person being chosen at random for a follow up survey, who had visited at least one of the pavilions. Recognising that visiting the cat pavilion and the dog pavilion are not mutually exclusive events as both events could occur at once. Understanding that for mutually exclusive events, such as buying a Royal Show entrance ticket online or buying it at the gate, a Venn diagram depicting how	pulse rate before | | after 9 8 8 8 | 6 | 6 6 4 1 1 0 | 7 | 8 8 6 2 | 8 | 6 7 8 8 6 0 | 9 | 0 2 2 4 5 8 9 9 4 | 10 | 0 4 4 0 | 11 | 8 | 12 | 4 4 | 13 | | 14 | 6 Describing the shape of 'before' and 'after' as both being non-symmetrical and positively skewed. Comparing the gaps (a significant gap between 124 and the outlier of 146 in the 'after' pulses), clusters (tighter clustering around the middle values in the 'after' pulses) and range (significantly higher in the 'after' pulses due to the outlier). Determining the mean, mode and median of 'before' and 'after', recognising that the 'after' pulses have more than one mode and calculating the differences	• Using the trend line to make predictions between known data values, such as predicting the height of a student with an arm span of 165 cm (interpolation) and beyond known data values, such as predicting the arm span of a student who is 210 cm tall (extrapolation), discussing the validity of each prediction and explaining the predictions limitations in terms of chance variation

Year 7	Year 8	Year 9	Year 10
person has a lot of stationery items. Comparing displays and recognising that a stem and leaf plot provides detailed information about individual data points and the dot plot (or column/bar graph) provides a clear picture of the mode, shape, spread and outliers of the distribution. Determining the probability that a person chosen at random from the class would be someone from the 'cluster', that is, has 12–16 items of stationery in their pencil case	visitors purchased tickets would appear as two non-interconnecting circles. Determining that approximately 26% of visitors to the Royal Show do not go to either pavilion and using this to inform possible action for future Royal Shows, acknowledging that future predictions will be affected by chance variation, such as weather Investigate and explain techniques for data collection, including census, survey, experiment and observation and explain the practicalities and implications of obtaining data through these techniques For example: • Defining and identifying data collection techniques and explaining the practicalities and implications of each in situations, such as ▪ Australian Bureau of Statistics, five-yearly surveys ▪ polling voters ▪ testing a new medicine	between datasets of mean and median. Generalising to 'after' pulse rates have higher central tendencies, a wider spread and tighter clustering compared to the 'before' pulse rates • Describing comparative histograms displaying the growth of seedlings after different fertilisers are applied in terms of shape and spread   • Describing the shape, spread and centre of the Australian Bureau of Statistics Population clock pyramid, in terms of the age	Represent and analyse boxplots. Explain differences between multiple boxplot datasets in terms of shape, spread and centre. Compare or match the shapes of boxplots to distributions depicting the same data For example: • Using a five-number summary calculated from a dataset to assist in producing a boxplot manually or with digital tools depending on the size and complexity of the data, and conversely, using a given boxplot to extract a five-number summary. Analysing the distribution in terms of shape (symmetry, skewness and clustering), spread (range and IQR) and centre (median) • Representing multiple datasets, such as test results for Class A and Class B, manually or with digital tools, on the same scale and

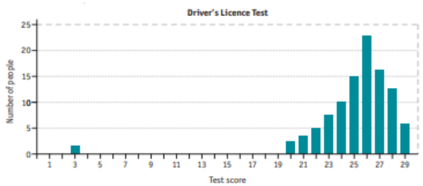
Year 7	Year 8	Year 9	Year 10
	▪ studying animal behaviour Explore, analyse and compare variation between results from same size random samples drawn from the same population. Identify and explain how chance variation impacts on data validity, reliability and conclusions drawn For example: • Defining sample, random sample and population in the context of producing a dataset of the heights of a sample of five students, randomly chosen from the Year 8 school population using a random number generator. Determining mean, mode, median, range and proportions (e.g. fraction or percentage of students between 150 and 155 cm tall) manually or with digital tools from this sample. Repeating for different samples of five students, comparing and analysing variation between the samples,	structure of males and females in Australia over time Describe different sampling methods and analyse how the different methods can affect the results of surveys. Identify and explain how chance variation impacts on the data validity, reliability and conclusions drawn from surveys For example: • Exploring and explaining systematic, stratified, clustered, convenience or capture/recapture sampling methods and deciding which method would be most representative of a total population (e.g. stratified sampling would be most suitable when surveying employee satisfaction across different departments) • Conducting a survey of fellow students to decide a suitable frozen yoghurt to be included in the school canteen menu.	comparing differences between the shape, spread and centre of the distributions  • Analysing a negatively skewed distribution where the mean is smaller than the median and comparing it with a positively skewed distribution where the mean is larger than the median  • Describing the shape of boxplots and matching the distributions to histograms and dot plots

Year 7	Year 8	Year 9	Year 10
	including the effect of outliers. Repeating the process with samples of 15 students, recognising the effect of the increased sample size on variation. Commenting on the impact of the sample size and the validity and reliability of the datasets as indicators of the height of the total population of Year 8 students	Assigning different sampling methods to groups of students to each produce two different samples. Each group analysing their samples separately to determine and compare findings, discussing chance variation. Comparing results between groups and discussing factors that could explain differences. Suggesting and explaining which of the sampling methods produces a valid and reliable dataset on which a prediction of the total population for this scenario can be made • Explaining how the number of people with type A blood could be estimated, justifying choices of sampling size and method with consideration to ensuring the collection of valid and reliable data	**Year 10 optional** Produce, organise and represent accurate and valid data in a cumulative frequency graph and use this to analyse quartiles and percentiles **Year 10 optional** Determine the mean and standard deviation of a dataset. Investigate, analyse and interpret the effect of individual data values, including outliers, on the standard deviation

Year 7	Year 8	Year 9	Year 10
		Year 9 optional Produce and organise accurate and valid, ungrouped continuous data to construct histograms and frequency polygons. Determine summary statistics and analyse the distribution in terms of centre, shape and spread	

Critically analyse statistical statements made in the media and other real-life situations, that relate to the averages of mean, mode and median. Investigate the impact of chance variation on the dataset from which the averages were determined
 	
For example:
• Critically commenting on the terminology and meaning of the averages quoted and the impact of chance variation in data, on statements made in the media, such as
  ▪ the average Australian family has 2.1 children
  ▪ the Fever netball team
	Critically analyse visual representations and tables in the media and other real-life situations to identify misleading or inaccurate features and interpretations. Recognise the impact of the validity and reliability of the data used
	
	For example:
	• Using the following graphical display showing the cost of services for a day-care business, to describe misleading features.
	
		Critically analyse statistics in the media and other real-life situations relating to data samples, including the effect of chance variation on sample analyses
		
		For example:
		• Critically commenting on whether a statistical sample is produced from valid and reliable data by considering factors, such as sample size, random variation, measurement or recording error or inconsistencies or biases in where, when and how the data sample was collected. Recognising that uncertainty in sampling produces uncertainty of conclusions. Commenting in situations, such as
			Critically analyse the claims, inferences and conclusions of statistical reports in the media and other real-life situations and identify potential sources of bias
			
			For example:
			• Critically analysing the source, sampling method, validity and reliability of the dataset, accuracy and appropriateness of statistical measures and representations, interpretation and extrapolation of results, including conclusions regarding association, and overall implications and recommendations outlined, to

Year 7	Year 8	Year 9	Year 10
scored 42 goals in a game on three occasions in the season. This was more times than any other score ▪ half of Australia's population earn less than $\$75\ 000$ per year and the average wage is $\$98\ 000$ per year ▪ a popular confectionary company stating that the typical price of a 150 g chocolate bar is $\$2.25$	Recognising the title and axes labels do not provide clarity as to the purpose of the graph, there is a distorted or non-existent scale, selective data of only four years, no acknowledgement of the source presenting the display, thus the data that the graph is depicting may not be valid and reliable. There is an inappropriate use of size for each of the 'blocks', creating the impression that the fourth year had at least four times the cost of services than the second. The graph is a biased representation and influences the audience into thinking that the cost of services has increased more than it actually has • The results of people completing the written Learner Driver's Licence test in a town in WA for one month were represented in a column graph for the State Licensing report. The report	▪ a newsagent in a small country town advertises that they have had two, million-dollar winners in the past week, so buy the winning ticket from them ▪ a major national supermarket conducted a survey about brand preferences using an online form. They received 65 responses ▪ researchers want to estimate the population of fish in a dam using the capture-recapture method. They capture and tag 100 fish, release them back into the dam and after a month, capture another 100 fish, finding that 10 of them are tagged. They estimate the population of fish in the dam to be 1000 ▪ a pharmaceutical company conducts a paid clinical trial with 30 volunteers to test the	identify possible bias in reports involving ▪ the effectiveness of a new exercise regimen in a magazine ▪ climate change trends and the impact on a local ecosystem reported in the community newspaper ▪ a post on social media concerning crime rates in your local area ▪ satisfaction ratings and reports in social media concerning restaurants or other places to visit

Year 7	Year 8	Year 9	Year 10
	stated: ‘there was great variation in results however, the average score was 25.3 and most people scored above the pass mark of 26.’  Critically looking at the validity of including the outlier in the comments and calculations, the mean being the chosen ‘average’ and the accuracy of the calculations	efficacy of a new drug for headaches	

Sub-strand: Modelling with probability and statistics

Year 7	Year 8	Year 9	Year 10
In real-world situations that involve assigning a probability to single-stage chance experiments or simulations, statistical measures, stem and leaf plots, dot plots, column graphs and/or Venn diagrams I. analyse the situation, pose questions as required, determine assumptions and constraints II. determine appropriate production of a valid and reliable dataset, statistical measures, data representations and analyses, including examination of distributions, to effectively investigate the situation III. interpret, draw inferences and communicate findings in terms of the context, assumptions, constraints, chance variation and knowledge or insights gained	In real-world situations that involve two-stage chance experiments or simulations, complementary events, data collection methods, same sized random sampling and/or analysis of graphs, tables and data I. analyse the situation, pose questions as required, determine assumptions and constraints II. determine appropriate production of a valid and reliable dataset, statistical measures, data representations and analyses, including examination of distributions, to effectively investigate the situation III. interpret, draw inferences and communicate findings in terms of the context, assumptions, constraints, chance variation and knowledge or insights gained	In real-world situations involving two-stage chance experiments or simulations both with or without replacement, different sampling methods, choosing and creating graphical representations and/or analysis of tables and comparative graphs I. analyse the situation, pose questions as required, determine assumptions and constraints II. determine appropriate production of a valid and reliable dataset, statistical measures, data representations and analyses, including examination of distributions, to effectively investigate the situation III. interpret, draw inferences and communicate findings in terms of the context, assumptions, constraints, chance variation and knowledge or insights gained	In real-world situations involving two- and three-stage chance experiments both with and without replacement, conditional probability or statements, boxplots, bivariate data and/or two-way tables I. analyse the situation, pose questions as required, determine assumptions and constraints II. determine appropriate production of a valid and reliable dataset, statistical measures, data representations and analyses, including examination of distributions, to effectively investigate the situation III. interpret, draw inferences and communicate findings, in terms of the context, assumptions, constraints, chance variation and knowledge or insights gained

Year 7	Year 8	Year 9	Year 10
For example: • 'What are the chances that the next song on a shuffled playlist is 3.5 minutes long?' Analysing the situation by considering the number of songs on a playlist, where to find the length of a song on the playlist and the time units used to show the length of a song. Posing questions, such as 'How long is a song?' Determining experimental constraints, such as choosing a sample of class members' playlists to represent the group and only using the first 20 songs played. Discussing how data from the sample could be collated and recorded to ensure validity and reliability, including rounding appropriately to the nearest 0.1 minute. Representing the data as a stem and leaf plot, determining the relative	For example: • 'Who has the best chance of winning in a game of throwing two, different coloured, 10-sided dice where Player One wins if the sum of the dice is 9, 10, 11 or 12, Player Two wins if the sum is 13, 14, 15 or 16 and Player Three wins for all other sums of dice?' Analysing the situation by considering the sums of dice Player Three could win with. Posing questions, such as 'What are all the possible sums when two 10-sided dice are rolled? and 'What is the probability of each sum occurring?'. Making assumptions, such as the dice are fair and that the game is based on a single roll of the dice. Deciding to represent the problem by producing an array or by conducting a simulation over a large number of trials. Using representation, data or complementary events to	For example: • 'What are the chances of Kevin randomly choosing two consecutive days in April of this year to holiday?' Analysing the situation by recognising that days cannot be repeated and that the last day of April cannot be included as the first of the consecutive days. Posing questions, such as 'How many days in April?' and 'What are the possible consecutive dates?' Producing a large set of data using a random calendar date or sequence generator, representing the results in a table and using to estimate the probability of randomly choosing two consecutive April dates. Interpreting and communicating the result, recognising and acknowledging the impact of chance variation. • Oliver is planning his holidays for next year. He wants to spend	For example: Using the modelling process to investigate topics, such as • analysing the number of kicks made by two Western Australian football teams in the previous football season, comparing to the number of games won and providing advice to coaching staff for the upcoming season • A report in a health magazine stated that 'The average adolescent has a resting heart rate of approximately 80 beats per minute which is reduced depending on the number of hours of exercise they did per week'. Investigate the validity of this statement **Year 10 optional** Using the modelling process to design and conduct a chance experiment, simulation or statistics experiment on a topic of interest

Year 7	Year 8	Year 9	Year 10
frequencies for lengths (i.e. fraction of songs that were 3.2 minutes long) and the mean, mode, median and range. Analysing the shape and distribution of the data commenting on variation. Interpreting the results and drawing inferences to predict the probability of the next song being 3.5 minutes long. Communicating findings in terms of the playlist, qualifying that variation would exist due to reasons, such as the order songs were shuffled, the chosen class members and the type of music they prefer and commenting on whether and why the dataset would be reflective of a broader population of songs	determine the chance of each player winning and hence the winner. Communicating the results in the context of the game and with a consideration to variation • 'The health department has noticed an increase in back problems of 13–15-year-old adolescents. The recommended weight of backpacks for this age group is 8 kg or less. Investigate if this backpack weight is typical for adolescents in this age group.' Analysing the situation by considering an appropriate sample size of backpacks to be weighed, the units of weight to be used, and what is meant by 'typical'. Posing questions, such as 'How much does a backpack weigh?' From the analysis, determining constraints, a sample of backpacks from Year 8 students should be weighed rather than	a week in Esperance for one holiday and a week in Geraldton for another holiday. Oliver wants to determine the best months to holiday according to the weather. Analysing the situation by determining the important aspects of weather. Posing questions, such as 'What is the maximum temperature in each month for each of the places in the last 10 years?' Making assumptions, such as his employer allows him to take holidays in two separate weeks. Producing valid and reliable data from a source, such as the Bureau of Meteorology. Choosing and using appropriate comparative representations depending on the data collected. Analysing and interpreting the representations, communicating when Oliver should travel to these destinations in reference to the initial qualifications	

Year 7	Year 8	Year 9	Year 10
	the population of Year 8 students and that the backpacks should be weighed to the nearest half kilogram. Making assumptions, such as the measuring scale is accurate and that the weight reflects what students carry on a daily basis. Randomly choosing a student sample using a random number generator, weighing their backpacks and recording the results in a frequency table. Determining the mean, mode, median and range, representing in an appropriate graph and commenting on variation and the effect of outliers. Repeating the task with a different same sized sample to consider variation. Communicating the findings in terms of the average weights of the sample backpacks compared to the recommended weight and commenting if and why this		

Year 7	Year 8	Year 9	Year 10
	result would be reflective of the broader population		