

BRAIN*tastic!* Maths Skills

Correlation with the
Victorian Essential Learning Standards

Discipline-based Learning Strand

Mathematics

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Level 1

Learning focus

As students work towards the achievement of Level 1 standards in Mathematics, they manipulate and play with objects to develop links between the simulated environment, their experiences, everyday language and mathematical activity.

In *Number*, students manipulate and group objects to develop basic understanding of the concepts of number and numerals. They group objects into sets (collections) and form simple correspondences (relations) between two sets; for example, in sharing apples among children. They learn to count a number of objects (up to 2-digit numbers) and relate the number counted to the use of numerals. They describe and place objects in order such as first, second and third. They model addition by putting groups of objects together and counting the combined set and they model subtraction by moving apart groups of objects.

In *Space*, students manipulate and investigate the properties of basic two- and three-dimensional shapes. They use the properties of point, line, edge and surface to identify everyday objects and pictures. They recognise inside and outside. They participate in activities in which they follow simple verbal instructions to locate items.

In *Measurement, chance and data*, students learn to compare common objects using terms such as *longer*, *heavier* and *fuller*.

When *Working mathematically*, students undertake activities to develop skills in making correspondences. They create and explore number patterns using numerals, counters or other objects on screen. They take risks by making and exploring conjectures relating to patterns, shapes and measurements (for example, 'the next shape in a sequence will be..').

Standards

Number

At Level 1, students form small sets of objects (up to 2-digit numbers). They count the size of small sets. They use one-to-one correspondence to identify when two sets are equal in size and when one set is larger than another. They form collections of sets of equal size. They use ordinal numbers to describe the position of elements in a set from first to tenth. They use materials to model addition and subtraction by the aggregation (grouping together) and disaggregation (moving apart) of objects. They add and subtract by counting forward and backward with 2-digit numbers.

Space

At Level 1, students use and recognise points, lines and curves. They identify basic two-dimensional shapes such as circles and squares and three-dimensional solids and objects such as boxes. They sort geometric objects according to simple descriptions. They place and orientate shapes according to simple descriptions such as *next to, beside, in front of, behind, over* and *under*.

They follow simple instructions to move and place shapes and objects in familiar situations in relation to what they can see.

Measurement, chance and data

At Level 1, students compare length, area, capacity and mass of familiar objects using descriptive terms such as *longer, taller, larger, holds more* and *heavier*. They make comparative measurements between different objects.

They recognise the continuity of time and the natural cycles such as day/night and the seasons. They recognise the correct sequence of days of the week. They compare activities that take different amounts of time to complete.

Working mathematically

At Level 1, students use diagrams and visual resources to investigate mathematical and real life situations. They explore patterns in number and space.

They test simple conjectures such as 'nine is four more than five'. They make estimates and predictions, and check their work with respect to computations and constructions in *Number, Space, and Measurement, chance and data* as a result of the feature of second attempts at questions.

Level 2

Learning focus

As students work towards the achievement of Level 2 standards in Mathematics, they begin to use mathematical symbols and language in a variety of mathematical explorations.

In *Number*, students learn to use virtual base 10 models (units, longs, flats and cubes) and arrays to identify, order and model the counting numbers up to 1000. They identify number patterns. They use models and arrays to support the development of skip counting. They recognise patterns created by skip counting (for example, when counting by fours, the pattern of the ones digits is 4, 8, 2, 6, 0, 4, 8). Students perform simple addition (count on) and subtraction (count back) using numbers up to 3-digits. They use equal groups of objects and rectangular arrays to model multiplication and equal sharing for division. Students divide geometric objects including arrays and regular shapes into equal parts to develop the concept of a simple fraction as part of a whole. They have opportunity to form different totals using dollars and cents, and carry out simple calculations such as change from small amounts.

In *Space*, students participate in activities which focus on identification of key features of shapes and solids. They learn to name familiar two- and three- dimensional shapes. They visualise and describe the effect of transformations (for example turns). They use mirrors and folding to investigate symmetry of shapes and pictures. Students learn to follow directions, informal maps, diagrams and routes to locations.

In *Measurement, chance and data*, students learn to use uniform (for example, same-sized squares) informal measurement units. They recognise time units (second, minute, hour, day, week, and month) and investigate basic time patterns and cycles. They learn to tell the time using analogue and digital clocks.

Students respond to questions dealing with data collection. They use pictographs and bar graphs in responding to questions.

When *Working mathematically*, students learn to use a combination of everyday language and mathematical statements and symbols to describe sets of numbers, shapes, objects and patterns. They interpret the data of daily activities and familiar events in pictures, diagrams and maps.

Students test the truth of conjectures by attempting to find examples or counter-examples. They develop and consolidate their understanding of the commutative and associative properties for addition and multiplication.

Standards

Number

At Level 2, students model the place value of the natural numbers up to 3-digits. They order numbers and count by 1s, 10s and 100s. Students identify multiples of 2, 4 and 5. They form patterns and sets of numbers based on simple criteria such as odd and even numbers. They carry out simple money calculations. They identify simple fractions such as one half, one third and one quarter in terms of equal sized parts of a whole object, such as a quarter of a pizza, and subsets such as half of a set of 20 coloured pencils. They add and subtract one- and two-digit numbers by counting on and counting back. They mentally compute simple addition and subtraction calculations involving two- or three-digit natural numbers. They describe and calculate simple multiplication as repeated addition, such as $3 \times 5 = 5 + 5 + 5$; and division as sharing, such as 8 shared between 4. They have opportunity to use commutative and associative properties of addition and multiplication in mental computation (for example, $3 + 4 = 4 + 3$ and $3 + 4 + 5$ can be done as $7 + 5$ or $3 + 9$).

Space

At Level 2, students recognise lines, surfaces and planes, corners and boundaries; familiar two-dimensional shapes including rectangles, rhombuses and hexagons, and three dimensional shapes and objects including pyramids, cones, and cylinders. They arrange a collection of geometric shapes, such as a set of attribute blocks, into subsets according to simple criteria, and recognise when one set of shapes is a subset of another set of shapes. They recognise symmetry, asymmetry, and congruence in these shapes and objects. They apply simple transformations to shapes (turn). They specify location as a relative position, including left and right, and interpret simple diagrams and maps involving a small number of points, objects or locations.

Measurement, chance and data

At Level 2, students make, describe and compare measurements of length, area, volume, mass and time using informal and formal units. They judge relative capacity of familiar objects and containers by eye and make informal comparisons of weight. They describe temperature using qualitative terms (for example, *cold*, *warm*, *hot*). Students use formal units such as hour and minute for time, litre for capacity and the standard units of metres, kilograms and seconds.

Students recognise the key elements of the calendar and place in sequence days, weeks and months. They describe common and familiar time patterns and such as the time, duration and day of events and tell the time using a digital or an analogue clock.

Students collect simple categorical and numerical data (count of frequency) and present and use this data in pictographs and simple bar graphs.

Working mathematically

At Level 2, students make and test simple conjectures by finding examples and counter examples and informally decide whether a conjecture is likely to be true.

Level 3

Learning focus

As students work towards the achievement of Level 3 standards in Mathematics, they recognise and explore patterns in numbers and shapes. They increasingly use mathematical terms and symbols to describe computations, measurements and characteristics of objects.

In *Number*, students explore place value and order of numbers to tens of thousands. They skip count to create number patterns. They use onscreen resources to develop concepts of decimals to hundredths. They develop concepts of equivalent fractions and compare fraction sizes. They apply number skills to everyday contexts such as shopping. They extend addition and subtraction computations to three digit numbers. They learn to multiply and divide by 2-digit numbers and some decimals.

In *Space*, students sort lines, shapes and solids according to key features. They explore nets of three-dimensional shapes by counting edges, faces and vertices. They investigate simple transformations (reflections, slides and turns) in designs. They explore the concept of angle as turn. They use grid references (for example, A5 on a street directory) to specify location and compass bearings to describe directions. They use maps to locate places.

In *Measurement, chance and data*, students measure the attributes of everyday objects and events using formal (for example, metres and centimetres) and informal units (for example, pencil lengths). Students tell the time using analogue and digital clocks. Students use simple frequency graphs. They use simple two-way tables to sort non-numerical data.

In *Structure*, students use structured questions to develop ideas about multiplication by replication and division by sharing. They recognise the possibility of remainders when dividing. They investigate the distributive property to develop methods of multiplication and division by whole numbers. They learn to use and describe simple algorithms for computations. They use simple rules to generate number patterns (for example, 'the next term in the sequence is two more than the previous term'). They create and complete number sentences using whole numbers, decimals and fractions.

When *Working mathematically*, students use mathematical symbols (for example, division and inequality, the words *and*, *or* and *not*). Students develop and test ideas (conjectures) across the content of mathematical experience.

Students learn to recognise practical applications of mathematics in daily life, including shopping and travel. They identify the mathematical nature of problems for investigation. They choose and use learned facts, procedures and strategies to find solutions.

Standards

Number

At Level 3, students use place value (as the idea that 'ten of these is one of those') to determine the size and order of whole numbers to tens of thousands, and decimals to hundredths. They round numbers up and down to the nearest unit, ten, hundred, or thousand. They develop fraction notation and compare simple common fractions such as $\frac{3}{4} > \frac{2}{3}$. They skip count forwards and backwards, from various starting points using multiples of 2, 3, 4, 5, 10 and 100.

They estimate the results of computations and recognise. They compute with numbers up to 30 using all four operations.

They explore:

- whole number problems of addition and subtraction involving numbers up to four digits.
- multiplication by single digits (using recall of multiplication tables) and multiples and powers of ten (for example, 5×100 , 5×70).
- division by a single-digit divisor (based on inverse relations in multiplication tables).

They devise and use algorithms for the addition and subtraction of numbers to two decimal places, including situations involving money.

Space

At Level 3, students recognise and describe the directions of lines as vertical, horizontal or diagonal. They recognise angles are the result of rotation of lines with a common end-point. They recognise and describe polygons. They recognise and name common three-dimensional shapes such as spheres, prisms and pyramids. They identify edges, vertices and faces. They use two-dimensional nets, cross-sections and simple projections to represent simple three-dimensional shapes. They follow instructions to identify shapes and patterns in tangram-like puzzles. They locate and identify places on maps and diagrams. They use travel directions and describe positions using simple compass directions (for example, N for North) and grid references on a street directory.

Measurement, chance and data

At Level 3, students estimate and measure length, area, volume, capacity, mass and time. They recognise and use different units of measurement including informal (for example, paces), formal (for example, centimetres) and standard metric measures (for example, metre) in appropriate contexts. They read linear scales (for example, tape measures) and circular scales (for example, bathroom scales) in measurement contexts. They read digital time displays and analogue clock times. They recognise different types of data: non-numerical (categories), separate numbers (discrete), or points on an unbroken number line (continuous). They interpret column or bar graphs.

Structure

At Level 3, students recognise that the sharing of a collection into equal-sized parts (division) frequently leaves a remainder. They investigate sequences of decimal numbers generated using multiplication or division by 10. They understand the meaning of the '=' in mathematical statements (for example, to indicate either the result of a computation or equivalence). They use number properties in combination to facilitate computations (for example, $7 + 10 + 13 = 10 + 7 + 13 = 10 + 20$). They multiply using the distributive property of multiplication over addition (for example, $13 \times 5 = (10 + 3) \times 5 = 10 \times 5 + 3 \times 5$). They use lists, tables and grids to show the possible combinations of two attributes. They recognise samples as subsets of the population under consideration (for example, pets owned by class members as a subset of pets owned by all children). They solve number sentences with missing numbers.

Working mathematically

At Level 3, students apply number skills to everyday contexts such as shopping and travel. They recognise the mathematical structure of problems and use appropriate strategies (for example, recognition of sameness, difference and repetition) to find solutions.

Students test the truth of mathematical statements and generalisations. For example, in:

- computations (whether products will be odd or even, the patterns of remainders from division)
- number patterns (the patterns of ones digits of multiples, terminating or repeating decimals resulting from division)
- Shape properties
- Transformations (the effect of reflections and turns on a shape).
- Measurement (the relationship between size and capacity of a container).

Level 4

Learning focus

As students work towards the achievement of Level 4 standards in Mathematics, they use correct mathematical terms, symbols and notations. They use mathematical procedures to construct and test conjectures or hypotheses.

In *Number*, students extend their understanding of whole numbers, fractions and decimals. They use patterns and arrays to develop understanding of multiples (including lowest common multiple), factors (including highest common factor), and prime numbers. They recognise and use simple powers (for example, $2^3 = 8$).

Students investigate and use equivalent forms of common fractions. They order fractions and decimals. They explore ideas of ratio (as a comparison) and percentage (comparing to 100). They explore decimals, ratios and percentages as equivalent forms of fractions (for example, $1/2 = 0.5 = 50\% = 1:2$). They explore decimals, ratios and percentages as equivalent forms of fractions (for example, $3/4$ metre = 75cm).

Students select and use mental and written methods (algorithms) to add, subtract, multiply and divide whole numbers. For division they recognise remainders as common fractions or decimals. They use mental and written methods to add and subtract decimals. They develop in their understanding of multiplication and division of decimals and simple common fractions.

In *Space*, students identify and sort shapes by properties such as parallel and perpendicular lines (for example, quadrilaterals). They use the ideas of angle, size and scale to describe the features of shapes and solids. They identify symmetry by reflection or rotation. They identify two-dimensional drawings and nets as representations of solids (for example, prisms, pyramids, cylinders and cones). They identify and describe relative and absolute location on grids and maps.

In *Measurement, chance and data*, students estimate and measure lengths (including perimeter), area (including surface area), volumes, capacity and time (including duration) in metric units. They determine and use the level of accuracy required for the purpose of the measurement. They develop simple procedures to determine the perimeter and area of simple shapes (for example, counting squares in a grid to determine area).

Students estimate and describe the chance of random events using words, percentages and fractions or decimals between 0 and 1. They estimate probability through simulations of chance events (for example, randomly selecting a marble from a bag).

Students recognise different data types such as categorical and numerical, discrete and continuous. They use grouped and ungrouped data presented as simple frequency tables and histograms. They calculate and interpret measures of centre (mean, median and mode) and spread (range) for ungrouped data.

In *Structure*, students use tables to test the validity of statements involving the quantifiers *none*, *some* and *all*. Students create number sequences by computing the next term from the previous term or terms. They select and use algorithms involving words, diagrams and mathematical symbols (for example, for testing the divisibility of a number).

Students create number sequences by computing the next term from the previous term or terms (recursion). They develop function rules for the terms in sequences based on their position in the sequence.

Students recognise that the 'identity' for each operation has no effect: the number 0 for addition and subtraction, and 1 for multiplication and division.

When *Working mathematically*, students select and test conjectures and generalisations about numbers and mathematical structure. For example:

- in *Space*, the properties of shapes
- in *Measurement, chance and data*, the probability of outcomes in games of chance

Students identify and investigate real life and practical applications of mathematics. They solve mathematical problems using a range of strategies (for example, find a pattern, work backwards). They solve new problems based on familiar problem structures.

Standards

Number

At Level 4, students comprehend the size and order of small numbers (to thousandths) and large numbers (to millions). They model integers (positive and negative whole numbers and zero), common fractions and decimals. They create sets of number multiples to find the lowest common multiple of the numbers.

Students identify square and prime numbers. They create factor sets and identify the highest common factor of two or more numbers. They recognise and calculate simple powers of whole numbers (for example, $2^3 = 8$).

Students use decimals, ratios and percentages to find equivalent representations of common fractions (for example, $\frac{3}{4} = \frac{9}{12} = 0.75 = 75\% = 3:4 = 6:8$). They use mental and written algorithms for the addition, subtraction, multiplication and division of natural numbers (positive whole numbers). They add, subtract, and multiply fractions and decimals and apply these operations in practical contexts, including the use of money.

Space

At Level 4, students classify and sort shapes and solids (for example, prisms, pyramids, cylinders and cones) using the properties of lines (orientation and size), angles (less than, equal to, or greater than 90°), and surfaces. They create two-dimensional representations of three-dimensional shapes and objects. They identify shapes and nets of solids. They describe the features of shapes that remain the same (for example, angles) or change (for example, side length) when a shape is enlarged or reduced. They apply a range of transformations to shapes.

Students describe relative and absolute location of objects in maps. They use compass directions, coordinates and distance, and conventional symbols that describe routes between places shown on maps.

Measurement, chance and data

Level 4, students use metric units to estimate and measure length, perimeter, area, surface area, mass, volume, capacity, time and temperature. They measure angles in degrees. They measure as accurately as needed for the purpose of the activity. They convert between metric units of length, capacity and time (for example, L–mL, sec–min).

Students describe and calculate probabilities using fractions and decimals between 0 and 1. They calculate probabilities for chance outcomes. They simulate chance events (for example, the chance that a family has three girls in a row).

Students distinguish between categorical and numerical data and classify numerical data as discrete (from counting) or continuous (from measurement). They respond to questions using appropriate displays (for example, a pie chart for eye colour data and a histogram for grouped data of student heights). They calculate and interpret measures of centrality (mean, median, and mode) and data spread (range).

Structure

At Level 4 students form and specify sets of numbers and objects according to given criteria and conditions (for example, 6, 12, 18, 24 are the even numbers less than 30 that are also multiples of three and the properties of different types of quadrilaterals).

Students construct and use rules for sequences based on the previous term, recursion (for example, the next term is three times the last term plus two), and by formula (for example, a term is three times its position in the sequence plus two).

Students establish equivalence relationships between mathematical expressions using properties such as the distributive property for multiplication over addition (for example, $3 \times 26 = 3 \times (20 + 6)$).

Students recognise that addition and subtraction, and multiplication and division are inverse operations. They solve equations by trial and error through the use of second attempts at questions.

Working mathematically

At Level 4, students recognise and investigate the use of mathematics in real situations (for example, determination of test results as a percentage).

Students select and test conjectures. They understand a single counter-example is sufficient to invalidate a conjecture.

Students use the mathematical structure of problems to choose and interpret solutions. They have opportunity to solve new problems based on familiar problem structures. They select, devise and interpret appropriate solutions. Students engage in investigations involving mathematical modelling.

Level 5

Learning focus

As students work towards the achievement of Level 5 standards in Mathematics, they use mathematics to explore and describe the physical world.

In *Number*, students investigate and explore whole numbers and fractions as squares, square roots and other simple powers.

Students compare quantities using ratios, and form equal ratios using proportion. They use ratios of number pairs to understand constant rate of change. They use numerical means to solve proportion problems and percentage problems as proportion relative to 100.

Students use visual information and patterns to understand binary numbers and to convert between binary and decimal notation.

In *Space*, students select shapes and regular polygons according to given specifications. They explore the properties of angles formed by intersecting straight lines. They use ideas of congruency and similarity to create and describe designs. They identify nets for common three-dimensional shapes that construct corresponding geometric objects. They identify and use two-dimensional perspective drawings of three-dimensional objects.

Students interpret and use a range of familiar and common maps of locations, using plans and grids. They explore the patterns formed by following procedures involving simple transformations or movements around grids.

In *Measurement, chance and data*, students use metric units to estimate and measure length, perimeter, area, surface area, mass, volume, capacity, angle in shapes and solids, time, and temperature. They convert metric units into smaller or larger units as required. They judge the accuracy of their estimates by measurement. They use mensuration formulas (for example, for area and perimeter of circles, area and perimeter of triangles and parallelograms, and the surface area and volume of prisms and cylinders). They solve problems involving simple rates (per unit time or area).

They calculate theoretical probabilities. Students use samples in order to make inferences and predictions about a population or future event. They make use of a variety of data presentations. They calculate and interpret summary statistics (mean, median, mode and range).

In *Structure*, students make use of number properties (commutative, associative and distributive) and know where they do not apply.

Students use the opposite of any integer for addition, and the inverse of any rational number for multiplication (reciprocal) to rearrange formulas and simple algebraic expressions and to solve equations. They use linear and other simple functions of a single variable, to explore number patterns and provide models for practical situations. They represent functions by tables of values, ordered pairs, graphs and rules applied over a given domain. They solve equations with a sequence of inverse operations.

When *Working mathematically*, students generalise from multiple examples and informally justify those generalisations. They use linear and other simple mathematical models to explore practical situations. They make and test predictions from these models.

Standards

Number

At Level 5, students identify complete factor sets for natural numbers. They select equivalent fractions for a fraction given in simplest form (for example, $\frac{2}{3} = \frac{4}{6} = \frac{6}{9} = \dots$). They know the decimal equivalents for the unit fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{8}$, $\frac{1}{9}$ and find equivalent representations of fractions as decimals, ratios and percentages.

Students use knowledge of perfect squares when calculating squares and square roots of numbers (for example, $20^2 = 400$ and $30^2 = 900$ so $\sqrt{700}$ is between 20 and 30). They evaluate natural numbers given in simple base-exponent form (for example, $5^3 = 125$). They calculate squares and cubes of small numbers. They calculate squares and square roots of rational numbers that are perfect squares (for example, $\sqrt{0.81} = 0.9$).

Students express natural numbers base 10 in binary form, (for example, $42_{10} = 101010_2$). Students understand ratio as both set : set comparison (for example, number of boys : number of girls) and subset : set comparison (for example, number of girls : number of students), and find integer proportions of these, including percentages (for example, the ratio number of girls : the number of boys is $2:3 = 4:6 = 40\% : 60\%$).

Students have opportunity to develop efficient mental and/or written methods for arithmetic computation involving rational numbers, including division of integers by two-digit divisors.

Space

At Level 5, students use constructions of two-dimensional and simple three-dimensional shapes that specify length, angle and adjacency. They use the properties of parallel lines to

calculate angles that are supplementary, corresponding, allied (co-interior) and alternate. They describe and apply the angle properties of regular and irregular polygons, in particular, triangles and quadrilaterals. They use two-dimensional nets that construct a simple three-dimensional object such as a prism or a platonic solid. They recognise congruence of shapes and solids. They use single-point perspective to make a two dimensional representation of a simple three-dimensional object.

Students use coordinates to identify position in the plane. They use lines, grids and bearings to specify location and direction on plans and maps.

Measurement, chance and data

At Level 5, students measure length, perimeter, area, surface area, mass, volume, capacity, angle, time and temperature using suitable units for these measurements in context. They interpret and use measurement formulas for the area and perimeter of circles, triangles and parallelograms and simple composite shapes. They calculate the surface area and volume of prisms and cylinders.

Students estimate the accuracy of measurements and give suitable lower and upper bounds for measurement values.

Students calculate theoretical probabilities by dividing the number of possible successful outcomes by the total number of possible outcomes.

Students use displays of discrete and continuous data (grouped and ungrouped), including those with larger data sets. They use representations of data in a variety of graphical forms including Venn diagrams, Carroll diagrams, stem and leaf plots, column graphs, bar charts and histograms. They calculate summary statistics for measures of centre (mean, median, mode) and spread (range, and mean absolute difference), and make simple inferences based on this data.

Structure

At Level 5, students use Venn diagrams to show the relationships of intersection, union, inclusion (subset) and complement between the sets. They test the validity of statements formed by the use of the connectives *and*, *or*, *not*, and the quantifiers *none*, *some* and *all*. They apply these to the specification of sets defined in terms of one or two attributes.

Students apply the commutative, associative, and distributive properties in mental and written computation (for example, 24×60 can be calculated as $20 \times 60 + 4 \times 60$ or as $12 \times 12 \times 10$).

Students recognise and apply simple geometric transformations of the plane such as translation, reflection and rotation and combinations of the above, including their inverses.

They identify element and inverse of rational numbers for the operations of addition and multiplication (for example, $1/2 + -1/2 = 0$ and $2/3 \times 3/2 = 1$).

Students use inverses to rearrange simple mensuration formulas, and to find equivalent algebraic expressions (for example, if $P = 2L + 2W$, then $W = P/2 - L$. If $A = \pi r^2$ then $r = \sqrt{A/\pi}$ for $r > 0$).

They solve simple equations (for example, $5x + 7 = 23$, $1.4x - 1.6 = 8.3$, and $4x^2 - 3 = 13$) using tables, graphs and inverse operations. They recognise and use inequality symbols.

Students represent a function by a table of values, a graph, and by a rule. They describe and specify the independent variable of a function and its domain, and the dependent variable and its range. They construct tables of values and graphs for linear functions. They use linear and other functions such as $f(x) = 2x - 4$, $xy = 24$, $y = 2^x$ and $y = x^2 - 3$ that model various situations.

Working mathematically

At Level 5, students formulate conjectures and follow simple mathematical deductions (for example, if the side length of a cube is doubled, then the surface area increases by a factor of four, and the volume increases by a factor of eight).

Students use variables in general mathematical statements. They substitute numbers for variables (for example, in equations, identities and formulas).

Students explain and calculate geometric propositions (for example, by varying the location of key points and/or lines in a construction).

Students develop generalisations by abstracting the features from situations and expressing these in words and symbols. They analyse the reasonableness of suggested solutions, according to given criteria.

Level 6

Learning focus

In *Number*, students investigate familiar and unfamiliar situations and contexts involving the use of all types of real numbers. They use irrational numbers such as common surds in calculations in exact form. They apply mental, or written forms of computation as appropriate, using estimation to validate their answers. They compute using large or small numbers expressed in scientific notation. They apply the concepts of rounding to either a given number of decimal places or significant figures.

In *Space*, students investigate the properties of angles formed when lines (including parallel lines) intersect. They learn how space is enclosed in two and three dimensions, and systematically investigate the properties of boundaries and regions on surfaces with shapes such as polygons and circles, prisms and polyhedra (including the platonic solids). They learn to use the concepts of congruency and similarity to compare the size and shape of polygons. They investigate the properties of similar triangles.

Students investigate the relationship between position, length and angle using the Pythagorean relationship and trigonometry of right-angled triangles. They explore simple combinations of rotations, translations and reflections as transformations of geometric shapes in the plane. They investigate the paths (loci) formed by points, lines and shapes. Students use maps to investigate location and distances between places.

In *Measurement, chance and data*, students measure and estimate perimeter, area, surface area, mass, volume, capacity, angle, and the rates of speed. They use and convert units to suit the purpose of measurements. They use formulas (including trigonometry) to calculate perimeters, areas, angles in shapes, and the surface areas and volumes of solids. They use degrees, when applicable, for units of measurement of angles.

Students apply probability concepts to aspects of chance in life-like situations. They represent event spaces that show the nature of events and their probabilities, and use these representations to assist in the computation of the probabilities of independent and dependent events.

In *Structure*, students apply algebraic properties (for example, associative, commutative, identity and distributive) to expressions, formulas and equations.

Students work with functions (for example, linear, quadratic and exponential) and their graphs. They solve simultaneous linear equations using algebraic, numerical and graphical approaches.

When *Working mathematically*, students develop generalisations by abstracting the features from situations, expressing these in words and symbols. They test propositions, and use formal mathematical arguments to test their truth, modifying them as required.

Standards

Number

At Level 6, students comprehend the set of real numbers containing natural, integer, rational and irrational numbers. They represent rational numbers in both fractional and decimal (terminating and infinite recurring) forms (for example, $14/25 = 1.16$, $0.47 = 47/99$).

Students carry out arithmetic computations involving natural numbers, integers and finite decimals using mental and/or written algorithms (one- or two-digit divisors in the case of division). They perform computations involving very large or very small numbers in scientific notation (for example, $0.0045 \times 0.000028 = 4.5 \times 10^{-3} \times 2.8 \times 10^{-5} = 1.26 \times 10^{-7}$).

They carry out exact arithmetic computations involving fractions and irrational numbers such as square roots and multiples. They make appropriate estimates of the results of calculations involving rational and irrational numbers, and the decimal approximations for them. They carry out computations to a required accuracy in terms of decimal places and/or significant figures.

Space

At Level 6, students recognise and describe boundaries, surfaces and interiors of common plane and three-dimensional shapes, including cylinders, spheres, cones, prisms and polyhedra. They recognise the features of circles (centre, radius, diameter, chord, arc, semi-circle, circumference, segment, sector and tangent) and use associated angle properties.

Students explore the properties of spheres.

Students use the conditions for shapes to be congruent or similar.

Measurement, chance and data

At Level 6, students estimate and measure length, area, surface area, mass, volume, capacity and angle. They select and use appropriate units, converting between units as required. They calculate constant rates such as average speed. They interpret and use mensuration formulas for calculating the perimeter, surface area and volume of familiar

two- and three-dimensional shapes and simple composites of these shapes. Students use Pythagoras' theorem to obtain lengths of sides, angles and the area of right-angled triangles.

Students calculate summary statistics for centrality (mode, median and mean), spread and association (by-eye estimation of the line of best fit from a scatter plot).

Structure

At Level 6, students apply the algebraic properties (associative, commutative, identity, inverse and distributive) to computation with number, to rearrange formulas, rearrange and simplify algebraic expressions involving real variables. They verify the equivalence or otherwise of algebraic expressions (linear, square, cube).

Students identify and represent linear and quadratic functions in graphs (all four quadrants of the Cartesian coordinate system) with consideration of independent and dependent variables, domain and range.

They recognise and explain the roles of the relevant constants in the relationships $f(x) = ax + c$, with reference to gradient and y axis intercept, $f(x) = a(x + b)^2 + c$ and $f(x) = ca^x$.

They solve equations of the form $f(x) = k$, where k is a real constant (for example, $x(x + 5) = 100$) and simultaneous linear equations in two variables (for example, $\{2x - 3y = -4$ and $5x + 6y = 27\}$ using algebraic, and numerical methods (systematic guess, check and refine or bisection).

Working mathematically

At Level 6, students formulate and test conjectures, generalisations and arguments in natural language and symbolic form (for example, 'if m^2 is even then m is even, and if m^2 is odd then m is odd'). Students choose and use mathematical models and procedures to investigate and solve problems set in a wide range of practical and theoretical contexts (for example, measurement formulas for the volumes of various three dimensional objects).