Mathematics Sample Program: Year 8



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Abbreviations

ABS Australian Bureau of Statistics

AMSI Australian Mathematical Sciences Institute

CIMT Centre for Innovation in Mathematical Teaching

DET Department of Education and Training

ESA Educational Services Australia

NCTM National Council Teachers of Mathematics

NLVM National Library of Virtual Manipulatives

MAV Mathematical Association of Victoria

Hyperlinks

At the time of publication the URLs (website addresses) cited were checked for accuracy and appropriateness of content. However, due to the transient nature of material placed on the web, their continuing accuracy cannot be verified. Teachers are strongly advised to prepare their own indexes of sites that are suitable and applicable to the courses they teach, and to check these addresses prior to allowing student access.

Overview

This Mathematics Sample Program: Year 8 is an example of how the Mathematics curriculum could be organised into a teaching and learning program.

This sample program provides comprehensive coverage of content descriptions from the three strands of the mathematics curriculum and is sequenced to develop knowledge and skills; however, there are many other ways that the curriculum content can be arranged to suit the learning needs of students.

Topics, suggested time allocations and sequencing

|  |  |  |
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| **Week\*** | **Semester 1** | **Semester 2** |
| 1 | *8.1.1: Positive and negative integers*Strand: Number and AlgebraSub-strand: Number and place value | *8.2.1: Linear and non-linear functions and graphs*Strand: Number and AlgebraSub-strand: Linear and non-linear relationshipsSub-strand: Patterns and algebra |
| 2 |
| 3 |
| 4 | *8.1.2: The Cartesian plane*Strand: Number and AlgebraSub-strand: Linear and non-linear relationships | *8.2.2: Real numbers and indices*Strand: Number and AlgebraSub-strand: Real numbersSub-strand: Number and place value |
| 5 |
| 6 | *8.1.3: Properties of plane shapes*Strand: Measurement and GeometrySub-strand: Geometric reasoning |
| 7 | *8.2.3: Angles, polygons and solids*Strand: Measurement and GeometrySub-strand: Geometric reasoning |
| 8 |
| 9 | *8.1.4: Measurement: time and shapes*Strand: Measurement and GeometrySub-strand: Using units of measurementStrand: Number and AlgebraSub-strand: Patterns and algebra | *8.2.4: Linear equations*Strand: Number and AlgebraSub-strand: Patterns and algebra |
| 10 |
| 11 | *8.2.5: Volume and surface area*Strand: Measurement and GeometrySub-strand: Using units of measurementStrand: Number and AlgebraSub-strand: Patterns and algebra |
| 12 | *8.1.5: Collecting and displaying data*Strand: Statistics and ProbabilitySub-strand: Data representation and interpretationStrand: Number and AlgebraSub-strand: Patterns and algebra |
| 13 | *8.2.6: Probability and simulation*Strand: Statistics and ProbabilitySub-strand: ChanceStrand: Number and AlgebraSub-strand: Patterns and algebra |
| 14 |
| 15 | *8.1.6: Money and percentages*Strand: Number and AlgebraSub-strand: Money and financial mathematicsSub-strand: Real numbersSub-strand: Patterns and algebra |
| 16 | *8.2.7: Ratio and rates*Strand: Number and AlgebraSub-strand: Real numbers |
| 17 | *8.1.7: Algebra: expressions*Strand: Number and AlgebraSub-strand: Patterns and algebra |
| 18 |

\* Based on 3 hours teaching time per week

Content descriptions coverage within each topic

|  |  |
| --- | --- |
| **Level 8 content descriptions** | **Topic/s** |
| **Strand: Number and Algebra** |
| **Sub-strand: Number and place value** |
| Carry out the four operations with rational numbers and integers, using efficient mental and written strategies and appropriate digital technologies and make estimates for these computations [(VCMNA273)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA273) | 8.1.1 |
| Use index notation with numbers to establish the index laws with positive integral indices and the zero index [(VCMNA272)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA272) | 8.2.2 |
| **Sub-strand: Linear and non-linear relationships** |
| Plot linear relationships on the Cartesian plane with and without the use of digital technologies [(VCMNA283)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA283) | 8.1.28.2.1 |
| Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution [(VCMNA284)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA284) | 8.2.4 |
| Plot graphs of non-linear real life data with and without the use of digital technologies, and interpret and analyse these graphs [(VCMNA285)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA285) | 8.2.1 |
| **Sub-strand: Money and financial mathematics** |
| Solve problems involving profit and loss, with and without digital technologies [(VCMNA278)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA278) | 8.1.6 |
| **Sub-strand: Real numbers** |
| Solve problems involving the use of percentages, including percentage increases and decreases and percentage error, with and without digital technologies [(VCMNA276)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA276) | 8.1.6 |
| Investigate terminating and recurring decimals [(VCMNA274)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA274) | 8.2.2 |
| Investigate the concept of irrational numbers, including π [(VCMNA275)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA275) | 8.2.2 |
| Solve a range of problems involving rates and ratios, including distance-time problems for travel at a constant speed, with and without digital technologies [(VCMNA277)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA277) | 8.2.7 |
| **Sub-strand: Patterns and algebra** |
| Extend and apply the distributive law to the expansion of algebraic expressions [(VCMNA279)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA279) | 8.1.7 |
| Factorise algebraic expressions by identifying numerical factors [(VCMNA280)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA280) | 8.1.7 |
| Simplify algebraic expressions involving the four operations [(VCMNA281)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA281) | 8.1.7 |
| Use algorithms and related testing procedures to identify and correct errors [(VCMNA282)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA282) | 8.1.48.1.58.2.18.2.58.2.6 |
| **Strand: Measurement and Geometry** |
| **Sub-strand: Geometric reasoning** |
| Define congruence of plane shapes using transformations and use transformations of congruent shapes to produce regular patterns in the plane including tessellations with and without the use of digital technology [(VCMMG291)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG291) | 8.1.3 |
| Develop the conditions for congruence of triangles [(VCMMG292)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG292) | 8.1.3 |
| Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related numerical problems using reasoning [(VCMMG293)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG293) | 8.1.38.2.3 |
| **Sub-strand: Using units of measurement** |
| Solve problems involving duration, including 12 and 24-hour time within a single time zone ([VCMMG290)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG290) | 8.1.4 |
| Choose appropriate units of measurement for area and volume and convert from one unit to another [(VCMMG286)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG286) | 8.1.4 |
| Find perimeters and areas of parallelograms, trapeziums, rhombuses and kites [(VCMMG287)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG287) | 8.1.4 |
| Investigate the relationship between features of circles such as circumference, area, radius and diameter. Use formulas to solve problems involving determining radius, diameter, circumference and area from each other [(VCMMG288)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG288) | 8.1.4 |
| Develop the formulas for volumes of rectangular and triangular prisms and prisms in general. Use formulas to solve problems involving volume [(VCMMG289)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG289) | 8.2.5 |
| **Strand: Statistics and Probability** |
| **Sub-strand: Data representation and interpretation** |
| Distinguish between a population and a sample and investigate techniques for collecting data, including census, sampling and observation [(VCMSP297)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP297) | 8.1.5 |
| Explore the practicalities and implications of obtaining data through sampling using a variety of investigative processes [(VCMSP298)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP298) | 8.1.5 |
| Explore the variation of means and proportions of random samples drawn from the same population [VCMSP298)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP298) | 8.1.5 |
| Investigate the effect of individual data values including outliers, on the range, mean and median [(VCMSP300)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP300) | 8.1.5 |
| **Sub-strand: Chance** |
| Identify complementary events and use the sum of probabilities to solve problems [(VCMSP294)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP294) | 8.2.6 |
| Describe events using language of ‘at least’, exclusive ‘or’ (A or B but not both), inclusive ‘or’ (A or B or both) and ‘and’ [(VCMSP295)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP295) | 8.2.6 |
| Represent events in two-way tables and Venn diagrams and solve related problems [(VCMSP296)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP296) | 8.2.6 |

Achievement standards (for three levels to support planning for a continuum of learning)

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| **Level 7**  | **Level 8** | **Level 9** |
| **Number and algebra**Students solve problems involving the order, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving all four operations with fractions, decimals, percentages and their equivalences, and express fractions in their simplest form. Students compare the cost of items to make financial decisions, with and without the use of digital technology. They make simple estimates to judge the reasonableness of results. Students use variables to represent arbitrary numbers and connect the laws and properties of number to algebra and substitute numbers into algebraic expressions. They assign ordered pairs to given points on the Cartesian plane and interpret and analyse graphs of relations from real data. Students develop simple linear models for situations, make predictions based on these models, solve related equations and check their solutions. | **Number and algebra**Students use efficient mental and written strategies to make estimates and carry out the four operations with integers, and apply the index laws to whole numbers. They identify and describe rational and irrational numbers in context. Students estimate answers and solve everyday problems involving profit and loss rates, ratios and percentages, with and without the use of digital technology. They simplify a variety of algebraic expressions and connect expansion and factorisation of linear expressions. Students solve linear equations and graph linear relationships on the Cartesian plane. | **Number and algebra**Students apply the index laws using integer indices to variables and numbers, express numbers in scientific notation, solve problems involving very small and very large numbers, and check the order of magnitude of calculations. They solve problems involving simple interest. Students use the distributive law to expand algebraic expressions, including binomial expressions, and simplify a range of algebraic expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment using a range of strategies including the use of digital technology. Students sketch and draw linear and non-linear relations, solve simple related equations and explain the relationship between the graphical and symbolic forms, with and without the use of digital technology. |
| **Measurement and geometry**Students use formulas for the area and perimeter of rectangles. They classify triangles and quadrilaterals and represent transformations of these shapes on the Cartesian plane, with and without the use of digital technology. Students name the types of angles formed by a transversal crossing parallel lines and solve simple numerical problems involving these lines and angles. They describe different views of three-dimensional objects, and use models, sketches and digital technology to represent these views. Students calculate volumes of rectangular prisms. | **Measurement and geometry**Students convert between units of measurement for area and for volume. They find the perimeter and area of parallelograms, rhombuses and kites. Students name the features of circles, calculate circumference and area, and solve problems relating to the volume of prisms. They make sense of time duration in real applications, including the use of 24-hour time. Students identify conditions for the congruence of triangles and deduce the properties of quadrilaterals. They use tools, including digital technology, to construct congruent shapes. | **Measurement and geometry**Students solve measurement problems involving perimeter and area of composite shapes, surface area and volume of rectangular prisms and cylinders, with and without the use of digital technology. They relate three-dimensional objects to two-dimensional representations. Students explain similarity of triangles, interpret ratios and scale factors in similar figures, and apply Pythagoras's theorem and trigonometry to solve problems involving angles and lengths in right-angled triangles. |

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| **Level 7**  | **Level 8** | **Level 9** |
| **Statistics and probability**Students identify issues involving the collection of discrete and continuous data from primary and secondary sources. They construct stem-and-leaf plots and dot-plots. Students identify or calculate mean, mode, median and range for data sets, using digital technology for larger data sets. They describe the relationship between the median and mean in data displays. Students determine the sample space for simple experiments with equally likely outcomes, and assign probabilities outcomes. | **Statistics and probability**Students explain issues related to the collection of sample data and discuss the effect of outliers on means and medians of the data. They use various approaches, including the use of digital technology, to generate simple random samples from a population. Students model situations with Venn diagrams and two-way tables and explain the use of 'not', 'and' and 'or'. Students choose appropriate language to describe events and experiments. They determine complementary events and calculate the sum of probabilities. | **Statistics and probability**Students compare techniques for collecting data from primary and secondary sources, and identify questions and issues involving different data types. They construct histograms and back-to-back stem-and-leaf plots with and without the use of digital technology. Students identify mean and median in skewed, symmetric and bi-modal displays and use these to describe and interpret the distribution of the data. They calculate relative frequencies to estimate probabilities. Students list outcomes for two-step experiments and assign probabilities for those outcomes and related events. |

Learning in Mathematics

The proficiencies of Understanding, Fluency, Problem Solving and Reasoning are fundamental to learning mathematics and working mathematically, and are applied across all three strands Number and Algebra, Measurement and Geometry, and Statistics and Probability.

Understanding refers to students building a robust knowledge of adaptable and transferable mathematical concepts and structures. Students make connections between related concepts and progressively apply the familiar to develop new ideas. They develop an understanding of the relationship between the ‘why’ and the ‘how’ of mathematics. Students build understanding when they:

* connect related ideas
* represent concepts in different ways
* identify commonalities and differences between aspects of content
* describe their thinking mathematically
* interpret mathematical information.

Fluency describes students developing skills in choosing appropriate procedures, carrying out procedures flexibly, accurately, efficiently and appropriately, and recalling factual knowledge and concepts readily. Students are fluent when they:

* make reasonable estimates
* calculate answers efficiently
* recognise robust ways of answering questions
* choose appropriate methods and approximations
* recall definitions and regularly use facts,
* can manipulate expressions and equations to find solutions.

Problem solving is the ability of students to make choices, interpret, formulate, model and investigate problem situations, select and use technological functions and communicate solutions effectively. Students pose and solve problems when they:

* use mathematics to represent unfamiliar or meaningful situations
* design investigations and plan their approaches
* apply their existing strategies to seek solutions
* verify that their answers are reasonable.

Reasoning refers to students developing an increasingly sophisticated capacity for logical, statistical and probabilistic thinking and actions, such as conjecturing, hypothesising, analysing, proving, evaluating, explaining, inferring, justifying, refuting, abstracting and generalising. Students are reasoning mathematically when they:

* explain their thinking
* deduce and justify strategies used and conclusions reached
* adapt the known to the unknown
* transfer learning from one context to another
* prove that something is true or false
* make inferences about data or the likelihood of events
* compare and contrast related ideas and explain their choices.

Year 8 Semester 1



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| Topic 8.1.1: Positive and negative integers  |
| Strand: Number and Algebra | Sub-strand: Number and place value | Recommended teaching time: 3 weeks (approximately 9 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Carry out the four operations with rational numbers and integers, using efficient mental and written strategies and appropriate digital technologies and make estimates for these computations [(VCMNA273)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA273)
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students solve problems involving the order, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving all four operations with fractions, decimals, percentages and their equivalences, and express fractions in their simplest form. Students compare the cost of items to make financial decisions, with and without the use of digital technology. They make simple estimates to judge the reasonableness of results. Students use variables to represent arbitrary numbers and connect the laws and properties of number to algebra and substitute numbers into algebraic expressions. They assign ordered pairs to given points on the Cartesian plane and interpret and analyse graphs of relations from real data. Students develop simple linear models for situations, make predictions based on these models, solve related equations and check their solutions. | **Students use efficient mental and written strategies to make estimates and carry out the four operations with integers**, and apply the index laws to whole numbers. They identify and describe rational and irrational numbers in context. Students estimate answers and solve everyday problems involving profit and loss rates, ratios and percentages, with and without the use of digital technology. They simplify a variety of algebraic expressions and connect expansion and factorisation of linear expressions. Students solve linear equations and graph linear relationships on the Cartesian plane. | Students apply the index laws using integer indices to variables and numbers, express numbers in scientific notation, solve problems involving very small and very large numbers, and check the order of magnitude of calculations. They solve problems involving simple interest. Students use the distributive law to expand algebraic expressions, including binomial expressions, and simplify a range of algebraic expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment using a range of strategies including the use of digital technology. Students sketch and draw linear and non-linear relations, solve simple related equations and explain the relationship between the graphical and symbolic forms, with and without the use of digital technology. |

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| **Activities** | **Proficiencies** |
| * Comparing and ordering negative integers and quantities involving negative numbers.
* Representing integers on a number line.
* Counting forwards and backwards by fixed amounts.
* Addition and subtraction of integers, using the number line to develop strategies.
* Applying addition and subtraction of positive and negative integers in context (e.g. [temperature change](http://map.mathshell.org/materials/download.php?fileid=1304)), change in elevation above/below sea level, change in debt level, change in location in a multi-storey building with an underground car park ([Zip, zilch, zero](http://illuminations.nctm.org/LessonDetail.aspx?id=L819) game).
* Using patterns to assist in finding rules for the multiplication and division of integers.
* Multiplication and division of positive and negative integers.
* Order of operations with positive and negative integers.
* Substituting of negative as well as positive values in formulas.
* Equivalent expressions involving operations with negative coefficients.
 | * **Understanding** through representing operations on integers in different ways, and connecting addition and subtraction of integers to authentic contexts.
* **Fluency** through selecting appropriate strategies to carry out operations on integers, and applying them flexibly.
* **Problem solving** through identifying patterns to assist in multiplication and division of integers and modelling addition and subtraction of integers.
* **Reasoning** through interpreting and explaining models and patterns to assist with operations on integers.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Use red and black counters and manipulations of these to model integers and integer arithmetic

Level 9Students who are working at this level could:* Investigate the ordered pair and vector representation of integers and their arithmetic (e.g. [The Integers](http://amsi.org.au/teacher_modules/Integer.html#Appendix:_Construction_of_the_Integers) )
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| **Assessment ideas** |
| * Students carry out an investigation involving integers in context (e.g. [temperature change](http://map.mathshell.org/materials/download.php?fileid=1304) PDF).
* Assessments of procedural fluency can include questions such as: ‘in the number , what does the (−) sign represent?’; ‘in the expression , what does the middle (−) sign represent?’; ‘tell a story that matches the expression ’.
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| **Resources** |
| AMSI[The Integers](http://amsi.org.au/teacher_modules/Integer.html) NCTM Illuminations[Zip, zilch, zero](http://illuminations.nctm.org/LessonDetail.aspx?id=L819)NLVM (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [Circle zero](http://nlvm.usu.edu/en/nav/frames_asid_122_g_3_t_1.html?open=instructions&from=category_g_3_t_1.html)[Colour chip](http://nlvm.usu.edu/en/nav/frames_asid_162_g_3_t_1.html?from=category_g_3_t_1.html) [Diffy](http://nlvm.usu.edu/en/nav/frames_asid_326_g_3_t_1.html?from=category_g_3_t_1.html)FUSE: Discover resources aligned to the Victorian Curriculum[Carry out the four operations with rational numbers and integers, using efficient mental and written strategies and appropriate digital technologies and make estimates for these computations](http://fuse.education.vic.gov.au/VCAA/VCMNA273)  |

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| **Notes** |
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| Topic 8.1.2: The Cartesian plane |
| Strand: Number and Algebra | Sub-strand: Linear and non-linear relationships | Recommended teaching time: 2 weeks (approximately 6 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Plot linear relationships on the Cartesian plane with and without the use of digital technologies [(VCMNA283)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA283).
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students solve problems involving the order, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving all four operations with fractions, decimals, percentages and their equivalences, and express fractions in their simplest form. Students compare the cost of items to make financial decisions, with and without the use of digital technology. They make simple estimates to judge the reasonableness of results. Students use variables to represent arbitrary numbers and connect the laws and properties of number to algebra and substitute numbers into algebraic expressions. They assign ordered pairs to given points on the Cartesian plane and interpret and analyse graphs of relations from real data. Students develop simple linear models for situations, make predictions based on these models, solve related equations and check their solutions. | Students use efficient mental and written strategies to make estimates and carry out the four operations with integers, and apply the index laws to whole numbers. They identify and describe rational and irrational numbers in context. Students estimate answers and solve everyday problems involving profit and loss rates, ratios and percentages, with and without the use of digital technology. They simplify a variety of algebraic expressions and connect expansion and factorisation of linear expressions. **Students** solve linear equations and **graph linear relationships on the Cartesian plane.** | Students apply the index laws using integer indices to variables and numbers, express numbers in scientific notation, solve problems involving very small and very large numbers, and check the order of magnitude of calculations. They solve problems involving simple interest. Students use the distributive law to expand algebraic expressions, including binomial expressions, and simplify a range of algebraic expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment using a range of strategies including the use of digital technology. Students sketch and draw linear and non-linear relations, solve simple related equations and explain the relationship between the graphical and symbolic forms, with and without the use of digital technology. |

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| **Activities** | **Proficiencies** |
| * Cartesian coordinates in four quadrants.
* Using coordinates in four quadrants to specify points.
* Formulating rules for linear growing patterns (e.g. [Chairs](http://illuminations.nctm.org/ActivityDetail.aspx?ID=144), [garden beds](http://mathematicscentre.com/taskcentre/147gardn.htm)) and write tables of coordinates from the rules.
* Introducing variables, e.g. through rule for growing pattern and simple formulas such taxi-fare charges.
* Obtaining number pairs for two related variables and plotting the relation on simple scaled axes.
* Using spreadsheets or other technology to generate tables/lists of coordinates from rules, and generate a plot.
* Scale and proportion related to enlargements or reductions of shapes in the Cartesian plane, scale plans and maps.
* Calculating and estimating distances from scale plans and maps.
* Using Information on a map or scale plan to obtain actual distances, checking reasonableness of answers.
 | * **Understanding** through interpreting information on maps and plans.
* **Fluency** through obtaining actual distances from maps and scale drawings and accurately plotting points from a table of coordinates.
* **Problem solving** through applying the ‘draw a diagram’ strategy to formulate and solve authentic problems, and communicate the result effectively.
* **Reasoning** through evaluating the reasonableness of answers related to actual distances calculated from maps and scale drawings.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Use coordinates and match-the-dot activities to draw various objects, shapes and images across all four quadrants in the Cartesian plane

Level 9Students who are working at this level could:* Investigate the exact construction of complete graphs by regular polygons and their diagonals with coordinates on the circumference of a circle centred at the original in the Cartesian plane (e.g. [Polygon vertex calculator](http://www.mathopenref.com/coordpolycalc.html) )
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| **Assessment ideas** |
| Students:* formulate rules for linear growing patterns (e.g. [chairs](http://illuminations.nctm.org/ActivityDetail.aspx?ID=144), [garden beds](http://mathematicscentre.com/taskcentre/147gardn.htm)) in terms of a variable, generate a table of coordinates from the rules and plot the coordinates on the Cartesian plane.
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| **Resources** |
| AMSI [Plotting linear relationships](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_1a.html#teacon-2)NCTM Illuminations [Chairs](http://illuminations.nctm.org/ActivityDetail.aspx?ID=144)NLVM (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [Point plotter](http://nlvm.usu.edu/en/nav/frames_asid_331_g_3_t_2.html?from=category_g_3_t_2.html)[Function machine](http://nlvm.usu.edu/en/nav/frames_asid_191_g_3_t_2.html?from=category_g_3_t_2.html)FUSE: Discover resouces aligned to the Victorian Curriculum[Plot linear relationships on the Cartesian plane with and without the use of digital technologies](http://fuse.education.vic.gov.au/VCAA/VCMNA283) |

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| Topic 8.1.3: Properties of plane shapes |
| Strand: Measurement and Geometry | Sub-strand: Geometric reasoning | Recommended teaching time: 3 weeks (approximately 9 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Define congruence of plane shapes using transformations and use transformations of congruent shapes to produce regular patterns in the plane including tessellations with and without the use of digital technology [(VCMMG291)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG291)
* Develop the conditions for congruence of triangles [(VCMMG292)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG292).
* Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related numerical problems using reasoning [(VCMMG293)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG293).
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| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students use formulas for the area and perimeter of rectangles. They classify triangles and quadrilaterals and represent transformations of these shapes on the Cartesian plane, with and without the use of digital technology. Students name the types of angles formed by a transversal crossing parallel lines and solve simple numerical problems involving these lines and angles. They describe different views of three-dimensional objects, and use models, sketches and digital technology to represent these views. Students calculate volumes of rectangular prisms. | Students convert between units of measurement for area and for volume. They find the perimeter and area of parallelograms, rhombuses and kites. Students name the features of circles, calculate circumference and area, and solve problems relating to the volume of prisms. They make sense of time duration in real applications, including the use of 24-hour time. **Students identify conditions for the congruence of triangles and deduce the properties of quadrilaterals. They use tools, including digital technology, to construct congruent shapes.** | Students solve measurement problems involving perimeter and area of composite shapes, surface area and volume of rectangular prisms and cylinders, with and without the use of digital technology. They relate three-dimensional objects to two-dimensional representations. Students explain similarity of triangles, interpret ratios and scale factors in similar figures, and apply Pythagoras's theorem and trigonometry to solve problems involving angles and lengths in right-angled triangles. |

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| **Activities** | **Proficiencies** |
| * Review of classification and hierarchy of triangles by angle and side properties.
* Establishing the properties of squares, rectangles, parallelograms, rhombuses, trapeziums and kites and classifying quadrilaterals by their properties.
* Hierarchy of quadrilaterals and the relationship between properties (e.g. every rhombus and rectangle is a parallelogram).
* Using dynamic geometry software, such as GeoGebra, to explore properties of trapeziums, kites and parallelograms, and investigate special cases (e.g. can a trapezium have 3 equal sides? Can a trapezium be a parallelogram? Can a kite be a concave polygon? Can a kite be a rhombus?)
* Transformations of the plane: translation, reflection, rotation (e.g. AMSI’s [Transformations of the plane](http://www.amsi.org.au/ESA_middle_years/Year7/Year7_md/Year7_2d.html))
* Understanding the properties that determine congruence of triangles and recognising which transformations create congruent figures.
* Establishing that two figures are congruent if one shape lies exactly on top of the other after one or more transformations (translation, reflection, rotation), and recognising that the matching sides and the matching angles are equal.
* Investigating the minimal conditions needed for the unique construction of triangles, leading to the establishment of the conditions for congruence (SSS, SAS, ASA and RHS).
* Constructing triangles using the conditions for congruence (e.g. AMSI’s [Congruence](http://www.amsi.org.au/teacher_modules/Congruence.html) module 14, Ex. 1–4).
* Solving problems using the properties of congruent figures (e.g. AMSI’s [Congruence](http://www.amsi.org.au/teacher_modules/Congruence.html) Ex. 5–14).
* Creating tessellations of congruent shapes using dynamic geometry software, or other technologies.
 | * **Understanding** through recognising how geometric properties are related and how some properties are dependent on others.
* **Fluency** through choosing and accurately applying conditions for congruency.
* **Problem solving** through using knowledge of transformations and conditions for congruence to solve problems related to congruent figures, and justifying the method of solution.
* **Reasoning** through the ability to demonstrate if-then deductive thinking (e.g. by considering minimal defining properties, *if* it is a rhombus *then* it is a parallelogram and a kite).
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Use software to identify congruent shapes by interactive transformations (e.g. [Try It Yourself: Congruent Shapes](http://www.learner.org/courses/teachingmath/grades3_5/session_02/section_02_b.html) )

Level 9Students who are working at this level could:* Explore which geometric properties are conserved or not under different types of map projections from a sphere onto the plane (e.g. [Map Projection Transitions](https://www.jasondavies.com/maps/transition/) )
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| **Assessment ideas** |
| Students:* carry out an investigation using dynamic geometry software, such as GeoGebra, and they report their findings. For example, they explore properties of trapeziums, kites and parallelograms, and investigate special cases (e.g. can a trapezium have 3 equal sides? Can a kite be a rhombus?).
* use conditions for congruence to solve a series of short problems related to congruent figures, such as those in AMSI’s [Congruence](http://www.amsi.org.au/teacher_modules/Congruence.html).
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| **Resources** |
| AMSI [Geometric reasoning – congruence](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_2b.html)[Congruence](http://www.amsi.org.au/teacher_modules/Congruence.html)[Transformations of the plane](http://www.amsi.org.au/ESA_middle_years/Year7/Year7_md/Year7_2d.html)NCTM Illuminations[Tessellation creator](http://illuminations.nctm.org/Activity.aspx?id=3533)NLVM(Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [Congruent triangles](http://nlvm.usu.edu/en/nav/frames_asid_165_g_3_t_3.html?open=instructions&from=category_g_3_t_3.html)[Transformations - composite](http://nlvm.usu.edu/en/nav/frames_asid_294_g_3_t_3.html?open=activities&from=category_g_3_t_3.html)FUSE: Discover resources aligned to the Victorian Curriculum[Define congruence of plane shapes using transformations and use transformations of congruent shapes to produce regular patterns in the plane including tessellations with and without the use of digital technology](http://fuse.education.vic.gov.au/VCAA/VCMMG291) [Develop the conditions for congruence of triangles](http://fuse.education.vic.gov.au/VCAA/VCMMG292) [Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related numerical problems using reasoning](http://fuse.education.vic.gov.au/VCAA/VCMMG293)  |

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| Topic 8.1.4: Measurement: time and shapes |
| Strand: Measurement and Geometry | Sub-strand: Using units of measurement | Recommended teaching time: 3 weeks (approximately 9 hours) |
| Strand: Number and algebra | Sub-strand: Patterns and algebra |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Solve problems involving duration, including 12 and 24-hour time within a single time zone ([VCMMG290)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG290).
* Choose appropriate units of measurement for area and volume and convert from one unit to another [(VCMMG286)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG286).
* Find perimeters and areas of parallelograms, trapeziums, rhombuses and kites [(VCMMG287)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG287).
* Investigate the relationship between features of circles such as circumference, area, radius and diameter. Use formulas to solve problems involving determining radius, diameter, circumference and area from each other [(VCMMG288)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG288).
* Use algorithms and related testing procedures to identify and correct errors [(VCMNA282)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA282)
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students use formulas for the area and perimeter of rectangles. They classify triangles and quadrilaterals and represent transformations of these shapes on the Cartesian plane, with and without the use of digital technology. Students name the types of angles formed by a transversal crossing parallel lines and solve simple numerical problems involving these lines and angles. They describe different views of three-dimensional objects, and use models, sketches and digital technology to represent these views. Students calculate volumes of rectangular prisms. | **Students convert between units of measurement for area and for volume. They find the perimeter and area of parallelograms, rhombuses and kites. Students name the features of circles, calculate circumference and area**, and solve problems relating to the volume of prisms. **They make sense of time duration in real applications, including the use of 24-hour time.** Students identify conditions for the congruence of triangles and deduce the properties of quadrilaterals. They use tools, including digital technology, to construct congruent shapes. | Students solve measurement problems involving perimeter and area of composite shapes, surface area and volume of rectangular prisms and cylinders, with and without the use of digital technology. They relate three-dimensional objects to two-dimensional representations. Students explain similarity of triangles, interpret ratios and scale factors in similar figures, and apply Pythagoras's theorem and trigonometry to solve problems involving angles and lengths in right-angled triangles. |

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| **Activities** | **Proficiencies** |
| * Estimating and calculating duration of events and checking the reasonableness of answers.
* Use of and interpretation of clocks, calendars, timetables, schedules and timelines.
* Identifying regions in Australia and countries in Asia that are in the same time zone.
* Choosing appropriate units of area, recognising that the conversion factors for area units are the squares of those for the corresponding linear units.
* Establishing formulas for areas of parallelograms and trapeziums using decomposition and rearrangement (cut-out shapes) to relate base (or ‘average base’ for trapezium) and height to area.
* Establishing the ‘half the product of diagonals’ formula for the area of kites, including rhombuses.
* Using formulas to solve area problems for parallelograms, trapeziums, kites and rhombuses, including some ‘reverse’ cases.
* Defining parts of a circle: diameter, radius circumference, arc, chord, sector and segment.
* Investigate the circumference and area of circles with materials, by measuring common circular objects and using dynamic geometry software measuring tools, to establish a relationship with the radius and diameter.
* Introduce pi as a constant *π*  that cannot be expressed exactly as a finite or infinite recurring decimal.
* Applying circumference and area formulas to solve problems involving circumference and area of circles, including composite shapes and some ‘reverse’ cases.
* Algorithms and coding:
* Developing a program to calculate the circumferences of circles from a list of radii. Modifying the program so that it will alternatively calculate radii from a list of circumferences, perhaps using a structure such as ‘If then else’ to decide whether to apply or .
* Validating the program and identifying the source of error if a test fails. Dealing with invalid inputs, such as a negative radius or circumference.
 | * **Understanding** through recognising and connecting other area formulas, including area of circle, to the formula of a rectangle.
* **Fluency** through choosing efficient methods of calculating duration of events and by choosing and applying appropriate formulas to solve area and circumference problems.
* **Problem solving** through using knowledge of formulas to solve unfamiliar area and circumference problems and evaluating the reasonableness of answers.
* **Reasoning** through rearranging formulas and applying their knowledge to solve ‘reverse’ cases, and explain their thinking.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Investigate historical approximations to pi for quick and easy calculations of circumference and area of circles

Level 9Students who are working at this level could:* Use an informal limit approach based on the subdivision of a circle into triangular segments of a regular polygon to

form estimates for pi, and derive the area of a circle formula (e.g. [Area of a Circle by Cutting into Sectors](https://www.mathsisfun.com/geometry/circle-area-by-sectors.html) ) |

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| **Assessment ideas** |
| Students:* solve duration of event problems involving clocks (including 24-hour time), timetables, calendars and timelines
* carry out an investigation involving areas and circumference. For example, the cost of paving and fencing a semi-circular driveway and adjoining picnic area of different shapes
* solve a set of application problems related to area and circumference, including composite shapes and some ‘reverse’ cases.
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| **Resources** |
| AMSI [Circles](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_2c.html%22%20%5Co%20%22more%20on%20congruence)[Time](http://www.amsi.org.au/teacher_modules/time.html)NCTM Illuminations[Area tool](http://illuminations.nctm.org/Activity.aspx?id=3567)[Area formulas](http://illuminations.nctm.org/unit.aspx?id=6046)[Circle tool](http://illuminations.nctm.org/ActivityDetail.aspx?ID=116)NLVM (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [Congruent triangles](http://nlvm.usu.edu/en/nav/frames_asid_165_g_3_t_3.html?open=instructions&from=category_g_3_t_3.html)[Transformations - composite](http://nlvm.usu.edu/en/nav/frames_asid_294_g_3_t_3.html?open=activities&from=category_g_3_t_3.html)FUSE: Discover resources aligned to the Victorian Curriculum[Solve problems involving duration, including 12 and 24-hour time within a single time zone](http://fuse.education.vic.gov.au/VCAA/VCMMG290) [Choose appropriate units of measurement for area and volume and convert from one unit to another](http://fuse.education.vic.gov.au/VCAA/VCMMG286) [Find perimeters and areas of parallelograms, trapeziums, rhombuses and kites](http://fuse.education.vic.gov.au/VCAA/VCMMG287) [Investigate the relationship between features of circles such as circumference, area, radius and diameter. Use formulas to solve problems involving determining radius, diameter, circumference and area from each other](http://fuse.education.vic.gov.au/VCAA/VCMMG288)  |

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| Topic 8.1.5: Collecting and displaying data |
| Strand: Statistics and Probability | Sub-strand: Data representation and interpretation | Recommended teaching time: 3 weeks (approximately 9 hours) |
| Strand: Number and algebra | Sub-strand: Patterns and algebra |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Distinguish between a population and a sample and investigate techniques for collecting data, including census, sampling and observation [(VCMSP297)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP297).
* Explore the practicalities and implications of obtaining data through sampling using a variety of investigative processes [(VCMSP298)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP298).
* Explore the variation of means and proportions of random samples drawn from the same population [VCMSP298)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP298).
* Investigate the effect of individual data values including outliers, on the range, mean and median [(VCMSP300)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP300).
* Use algorithms and related testing procedures to identify and correct errors [(VCMNA282)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA282)
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students identify issues involving the collection of discrete and continuous data from primary and secondary sources. They construct stem-and-leaf plots and dot-plots. Students identify or calculate mean, mode, median and range for data sets, using digital technology for larger data sets. They describe the relationship between the median and mean in data displays. Students determine the sample space for simple experiments with equally likely outcomes, and assign probabilities outcomes. | **Students explain issues related to the collection of sample data and discuss the effect of outliers on means and medians of the data. They use various approaches, including the use of digital technology, to generate simple random samples from a population.** Students model situations with Venn diagrams and two-way tables and explain the use of 'not', 'and' and 'or'. Students choose appropriate language to describe events and experiments. They determine complementary events and calculate the sum of probabilities. | Students compare techniques for collecting data from primary and secondary sources, and identify questions and issues involving different data types. They construct histograms and back-to-back stem-and-leaf plots with and without the use of digital technology. Students identify mean and median in skewed, symmetric and bi-modal displays and use these to describe and interpret the distribution of the data. They calculate relative frequencies to estimate probabilities. Students list outcomes for two-step experiments and assign probabilities for those outcomes and related events. |

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| **Activities** | **Proficiencies** |
| * Types of data: categorical and numerical data that can be discrete (from counting) or continuous (from measuring) (see, for example, the [ABS modules on types of data](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSQ%2B3B%2BNUMERICAL%2BDATA%3A%2BWHAT%27S%2BTHE%2BDIFFERENCE%2BBETWEEN%2BDISCRETE%2BAND%2BCONTINUOUS)).
* Statistical enquiry cycle: posing and answering questions; gathering, sorting, and displaying categorical and numerical data; communicating findings based on the data.
* Methods of data collection and issues associated with these methods, including size and randomness of samples to obtain representative data through sampling from a larger population.
* Sample data and variability in sampling for categorical and numerical variables. For example:
* Students investigate the proportion of people in the population who can curl the sides of their tongues by surveying samples of 20 people. Sample variability is explored by comparing the sample proportions for data collected by different class members.
* Students use the Census at School [Random Sampler](http://www.cas.abs.gov.au/cgi-local/cassampler.pl) tool to obtain random samples, which can be downloaded as a spreadsheet. Students calculate mean of, say, arm-span for their sample, and analyse variations in sample means and proportions by comparing results with other class members.
* Making sense of data by calculating summary statistics and displaying the data graphically, with the aid of digital technologies.
* **Algorithms and coding**:
* Developing a program to draw random samples from a larger set, being the population for the context. Observe the variation from sample to sample.
* Validating the program and identifying the source of error if a test fails. Dealing with invalid inputs, such as a sample size which is too large.
* Investigating the different snapshots of data given by different representations.
* Comparison of mean and median for different data sets, including the effect of outliers.
 | * **Understanding** through recognising that different data representations provide different snapshots of the data and influence audience interpretation.
* **Fluency** through calculating and creating appropriate summary statistics and data displays for categorical and numerical data.
* **Problem solving** through using the statistical enquiry cycle to investigate a characteristic of a population from samples.
* **Reasoning** through evaluating the representativeness of samples and making inferences about a population from sample data.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Explore the effect on the mean and median of a set of data by adding new data elements including outliers.

Level 9Students who are working at this level could:* Use technology to produce many samples of a given size from a population and explore the variation in proportions for a given property
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| **Assessment ideas** |
| Students use the statistical enquiry cycle to investigate characteristics of a population from samples, and analyse sample variability. For example, students use the Census at School [Random Sampler](http://www.cas.abs.gov.au/cgi-local/cassampler.pl) tool to obtain random samples, which can be downloaded as a spreadsheet. Students calculate means and proportions of, say, arm-span and eye colour for their sample. They make inferences about the population from the sample data, and analyse variations in sample means and proportions by comparing results with other class members. |

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| **Resources** |
| ABS[Census at School](http://www.abs.gov.au/censusatschool) AMSI [Sampling from a population](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_3a.html)[Data investigation and interpretation](http://www.amsi.org.au/teacher_modules/Data_Investigation_and_interpretation8.html)NCTM Illuminations [Advanced data grapher: numerical data](http://illuminations.nctm.org/ActivityDetail.aspx?ID=220)[Data grapher: categorical data](http://illuminations.nctm.org/ActivityDetail.aspx?ID=204)[Mean and median](http://illuminations.nctm.org/ActivityDetail.aspx?ID=160)FUSE: Discover resources aligned to the Victorian Curriculum[Distinguish between a population and a sample and investigate techniques for collecting data, including census, sampling and observation](http://fuse.education.vic.gov.au/VCAA/VCMSP297) [Investigate the effect of individual data values including outliers, on the range, mean and median](http://fuse.education.vic.gov.au/VCAA/VCMSP300)  |

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| Topic 8.1.6: Money and percentages |
| Strand: Number and Algebra | Sub-strands: Money and financial mathematicsReal numbers | Recommended teaching time: 2 weeks (approximately 6 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Solve problems involving profit and loss, with and without digital technologies [(VCMNA278)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA278).
* Solve problems involving the use of percentages, including percentage increases and decreases and percentage error, with and without digital technologies [(VCMNA276)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA276).
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students solve problems involving the order, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving all four operations with fractions, decimals, percentages and their equivalences, and express fractions in their simplest form. Students compare the cost of items to make financial decisions, with and without the use of digital technology. They make simple estimates to judge the reasonableness of results. Students use variables to represent arbitrary numbers and connect the laws and properties of number to algebra and substitute numbers into algebraic expressions. They assign ordered pairs to given points on the Cartesian plane and interpret and analyse graphs of relations from real data. Students develop simple linear models for situations, make predictions based on these models, solve related equations and check their solutions. | Students use efficient mental and written strategies to make estimates and carry out the four operations with integers, and apply the index laws to whole numbers. They identify and describe rational and irrational numbers in context. **Students estimate answers and solve everyday problems involving profit and loss rates, ratios and percentages, with and without the use of digital technology.** They simplify a variety of algebraic expressions and connect expansion and factorisation of linear expressions. Students solve linear equations and graph linear relationships on the Cartesian plane. | Students apply the index laws using integer indices to variables and numbers, express numbers in scientific notation, solve problems involving very small and very large numbers, and check the order of magnitude of calculations. They solve problems involving simple interest. Students use the distributive law to expand algebraic expressions, including binomial expressions, and simplify a range of algebraic expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment using a range of strategies including the use of digital technology. Students sketch and draw linear and non-linear relations, solve simple related equations and explain the relationship between the graphical and symbolic forms, with and without the use of digital technology. |

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| **Activities** | **Proficiencies** |
| * Expressing one quantity as a percentage of another.
* Using the unitary method to find a percentage of a quantity.
* Using the unitary method in reverse to find the whole from a percentage of the whole (e.g. Jan paid a deposit of $2400 on a new car, which was 8% of the purchase price of the car. What was the total price of the car?)
* Calculating percentage increase and decrease.
* Using percentages to solve problems, including those involving mark-ups, discounts, GST and population increases and decreases.
* Expressing profit and loss as a percentage of cost or selling price, comparing the difference.
* Investigating the methods used in retail stores to express discounts.
 | * **Understanding** through recognising similarities and differences in the various strategies used to compute financial and percentage problems.
* **Fluency** through selecting and applying efficient procedures to carry out financial and percentage calculations mentally, by hand and aided by technology.
* **Problem solving** through applying existing knowledge to solve unfamiliar financial and percentage problems.
* **Reasoning** through estimating answers and assessing and justifying their reasonableness.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Use straight line graphs as simple percentage calculators

Level 9Students who are working at this level could:* Investigate percentage change trend graphs in different contexts
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| **Assessment ideas** |
| Students solve a set of realistic problems that relate to financial mathematics and percentages. Some questions could ask students to explain why they think their answer makes sense, thereby awarding credit for reasons and justification.  |

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| **Resources** |
| AMSI [Percentages](http://www.amsi.org.au/teacher_modules/Percentages.html) NCTM Illuminations[Hay bale farmer](http://illuminations.nctm.org/LessonDetail.aspx?id=L783)NLVM (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [Percent grids](http://nlvm.usu.edu/en/nav/frames_asid_333_g_3_t_1.html?from=category_g_3_t_1.html)FUSE: Discover resources aligned to the Victorian Curriculum[Solve problems involving profit and loss, with and without digital technologies](http://fuse.education.vic.gov.au/VCAA/VCMNA278) [Solve problems involving the use of percentages, including percentage increases and decreases and percentage error, with and without digital technologies](http://fuse.education.vic.gov.au/VCAA/VCMNA276)  |

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| Topic 8.1.7: Algebra: expressions |
| Strand: Number and Algebra | Sub-strand: Patterns and algebra | Recommended teaching time: 2 weeks (approximately 6 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Extend and apply the distributive law to the expansion of algebraic expressions [(VCMNA279)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA279).
* Factorise algebraic expressions by identifying numerical factors [(VCMNA280)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA280).
* Simplify algebraic expressions involving the four operations [(VCMNA281)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA281).
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students solve problems involving the order, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving all four operations with fractions, decimals, percentages and their equivalences, and express fractions in their simplest form. Students compare the cost of items to make financial decisions, with and without the use of digital technology. They make simple estimates to judge the reasonableness of results. Students use variables to represent arbitrary numbers and connect the laws and properties of number to algebra and substitute numbers into algebraic expressions. They assign ordered pairs to given points on the Cartesian plane and interpret and analyse graphs of relations from real data. Students develop simple linear models for situations, make predictions based on these models, solve related equations and check their solutions. | Students use efficient mental and written strategies to make estimates and carry out the four operations with integers, and apply the index laws to whole numbers. They identify and describe rational and irrational numbers in context. Students estimate answers and solve everyday problems involving profit and loss rates, ratios and percentages, with and without the use of digital technology. **They simplify a variety of algebraic expressions and connect expansion and factorisation of linear expressions.** Students solve linear equations and graph linear relationships on the Cartesian plane. | Students apply the index laws using integer indices to variables and numbers, express numbers in scientific notation, solve problems involving very small and very large numbers, and check the order of magnitude of calculations. They solve problems involving simple interest. Students use the distributive law to expand algebraic expressions, including binomial expressions, and simplify a range of algebraic expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment using a range of strategies including the use of digital technology. Students sketch and draw linear and non-linear relations, solve simple related equations and explain the relationship between the graphical and symbolic forms, with and without the use of digital technology. |

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| **Activities** | **Proficiencies** |
| * Modelling algebraic expressions with area tiles, such as the interactive NCTM’s [Algebra tiles](http://illuminations.nctm.org/ActivityDetail.aspx?ID=216), includes modelling substitution, expansion, factorisation and simplification.
* Substituting values in algebraic expressions.
* Applying the distributive law to the expansion of algebraic expressions using strategies such as the area model.
* Recognising the relationship between factorising and expanding.
* Identifying the (HCF) highest common factor of numeric and algebraic expressions and using a range of strategies to factorise algebraic expressions.
* Understanding that the laws used with numbers can also be used with algebra.
* Simplifying algebraic expressions by collecting like terms, including cases requiring the expanding brackets prior to collecting like terms.
 | * **Understanding** through connecting expansion and factorisation, and recognising commutativity of multiplication in identifying like terms (e.g. recognising 2xy = 2yx).
* **Fluency** through using the distributive law to expand brackets, identifying HCF to factorise expressions and collecting like terms to simplify expressions.
* **Problem solving** through modelling algebraic expressions and related manipulations of expressions using area tiles.
* **Reasoning** through generalising laws used with numbers to algebraic expressions.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Use area tiles to represent simple linear expressions geometrically by rectangles

Level 9Students who are working at this level could:* Simplify multivariable linear expressions
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| **Assessment ideas** |
| Students complete a set of algebraic expression problems, which may include expansion, factorisation and simplification using a range of strategies, including modelling with area tiles.  |

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| **Resources** |
| AMSI[Algebraic expressions](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_1e.html#teaprop-4)NCTM Illuminations[Algebra tiles](http://illuminations.nctm.org/Activity.aspx?id=3482)NLVM [Algebra tiles](http://nlvm.usu.edu/en/nav/frames_asid_189_g_3_t_2.html?open=activities&from=category_g_3_t_2.html)FUSE: Discover resources aligned to the Victorian Curriculum[Extend and apply the distributive law to the expansion of algebraic expressions](http://fuse.education.vic.gov.au/VCAA/VCMNA279) [Factorise algebraic expressions by identifying numerical factors](http://fuse.education.vic.gov.au/VCAA/VCMNA280) [Simplify algebraic expressions involving the four operations](http://fuse.education.vic.gov.au/VCAA/VCMNA281)  |

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| **Notes** |
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Year 8 Semester 2



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| Topic 8.2.1: Linear and non-linear functions and graphs |
| Strand: Number and Algebra | Sub-strands: Linear and non-linear relationshipsPatterns and algebra | Recommended teaching time: 3 weeks (approximately 9 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Plot linear relationships on the Cartesian plane with and without the use of digital technologies [(VCMNA283)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA283)
* Plot graphs of non-linear real life data with and without the use of digital technologies, and interpret and analyse these graphs [(VCMNA285)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA285)
* Use algorithms and related testing procedures to identify and correct errors [(VCMNA282)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA282)
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students solve problems involving the order, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving all four operations with fractions, decimals, percentages and their equivalences, and express fractions in their simplest form. Students compare the cost of items to make financial decisions, with and without the use of digital technology. They make simple estimates to judge the reasonableness of results. Students use variables to represent arbitrary numbers and connect the laws and properties of number to algebra and substitute numbers into algebraic expressions. They assign ordered pairs to given points on the Cartesian plane and interpret and analyse graphs of relations from real data. Students develop simple linear models for situations, make predictions based on these models, solve related equations and check their solutions. | Students use efficient mental and written strategies to make estimates and carry out the four operations with integers, and apply the index laws to whole numbers. They identify and describe rational and irrational numbers in context. Students estimate answers and solve everyday problems involving profit and loss rates, ratios and percentages, with and without the use of digital technology. They simplify a variety of algebraic expressions and connect expansion and factorisation of linear expressions. **Students** solve linear equations and **graph linear relationships on the Cartesian plane.** | Students apply the index laws using integer indices to variables and numbers, express numbers in scientific notation, solve problems involving very small and very large numbers, and check the order of magnitude of calculations. They solve problems involving simple interest. Students use the distributive law to expand algebraic expressions, including binomial expressions, and simplify a range of algebraic expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment using a range of strategies including the use of digital technology. Students sketch and draw linear and non-linear relations, solve simple related equations and explain the relationship between the graphical and symbolic forms, with and without the use of digital technology. |

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| **Activities** | **Proficiencies** |
| * Defining variables and exploring functional relationships between the variables related to simple formulas such as distance-time and growing patterns.
* Completing a table of values from rules of functional relationships.
* Plotting the points from table of values and determining whether the functional relationship is linear or non-linear, using various methods, including digital technologies such as spreadsheets and graphing software.
* Algorithms and coding activities could include:
* Using a loop structures to develop algorithms to generate recursive non-linear patterns, such as the [number of handshakes](http://illuminations.nctm.org/LessonDetail.aspx?ID=L630) or the number of moves in the [Tower of Hanoi](https://www.mathsisfun.com/games/towerofhanoi.html) puzzle.
* Validating these algorithms and programs, and identifying the source if a test fails.
* Modifying programs to deal with, for example, invalid inputs, and avoid program errors or invalid output.
* Drawing a line on the plane defined by two points; generating a table of values from other points on the line to determine the rule from the resultant pattern of values.
* Investigating the gradient of a line on the plane and the effect of changing the ratio of the *x* and *y* values.
* Investigating the *x* and *y* intercepts of a line on the plane.
* Investigating special cases: the gradients and rules of horizontal and vertical lines.
* Generalising the rule of a straight line.
 | * **Understanding** through representing functional relationships in different ways: as pattern, rules, tables and graphs.
* **Fluency** through generating tables of values from rules, plotting points resultant coordinates and determining gradients and other features.
* **Problem solving** through deducing rules of linear relationships (equation of a line) from tables of values and graph properties such as gradient and coordinates of points.
* **Reasoning** through generalising the equation of a straight line and through making connections between different representations of functional relationships.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Plot graphs of linear functions with integer coefficients on 1 cm square grid graph paper and determine the gradient and vertical axis intercept from the graph

Level 9Students who are working at this level could:* Determine the gradient, intercepts and rules of a range of linear modelling functions with decimal coefficients
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| **Assessment ideas** |
| Students carry out an investigation of a linear or non-linear relationship arising from a context such as relationships from: * growing patterns
* real-world situations (e.g. litres of fuel remaining if a car is using fuel at a constant rate during a long journey)
* formulas and proportional situations (e.g. relationship between radius and circumference or area of circles).

Students create different representations and communicate findings.  |

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| **Resources** |
| AMSI[Plotting linear relationships and examples of linear relations](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_1a.html)NCTM Illuminations[Number of handshakes](http://illuminations.nctm.org/LessonDetail.aspx?ID=L630) [Tower of Hanoi](http://illuminations.nctm.org/ActivityDetail.aspx?id=40)NLVM (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [Line plotter](http://nlvm.usu.edu/en/nav/frames_asid_332_g_3_t_2.html?from=category_g_3_t_2.html)FUSE: Discover resources aligned to the Victorian Curriculum[Plot linear relationships on the Cartesian plane with and without the use of digital technologies](http://fuse.education.vic.gov.au/VCAA/VCMNA283)  |

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| Topic 8.2.2: Real numbers and indices |
| Strand: Number and Algebra | Sub-strands: Number and place valueReal number | Recommended teaching time: 3 weeks (approximately 9 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Use index notation with numbers to establish the index laws with positive integral indices and the zero index [(VCMNA272)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA272).
* Investigate terminating and recurring decimals [(VCMNA274)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA274).
* Investigate the concept of irrational numbers, including π [(VCMNA275)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA275).
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students solve problems involving the order, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving all four operations with fractions, decimals, percentages and their equivalences, and express fractions in their simplest form. Students compare the cost of items to make financial decisions, with and without the use of digital technology. They make simple estimates to judge the reasonableness of results. Students use variables to represent arbitrary numbers and connect the laws and properties of number to algebra and substitute numbers into algebraic expressions. They assign ordered pairs to given points on the Cartesian plane and interpret and analyse graphs of relations from real data. Students develop simple linear models for situations, make predictions based on these models, solve related equations and check their solutions. | **Students** use efficient mental and written strategies to make estimates and carry out the four operations with integers, and **apply the index laws to whole numbers. They identify and describe rational and irrational numbers in context.** Students estimate answers and solve everyday problems involving profit and loss rates, ratios and percentages, with and without the use of digital technology. They simplify a variety of algebraic expressions and connect expansion and factorisation of linear expressions. Students solve linear equations and graph linear relationships on the Cartesian plane. | Students apply the index laws using integer indices to variables and numbers, express numbers in scientific notation, solve problems involving very small and very large numbers, and check the order of magnitude of calculations. They solve problems involving simple interest. Students use the distributive law to expand algebraic expressions, including binomial expressions, and simplify a range of algebraic expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment using a range of strategies including the use of digital technology. Students sketch and draw linear and non-linear relations, solve simple related equations and explain the relationship between the graphical and symbolic forms, with and without the use of digital technology. |

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| **Activities** | **Proficiencies** |
| * Reviewing operations with decimal fractions, including rounding of decimals to a specified degree of accuracy.
* Investigating and recognising terminating and recurring decimals through division (examples in AMSI’s [investigating terminating and recurring decimals](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_1b.html)).
* Understanding the hierarchy of the real number system, including irrational numbers.
* Exploring the value of π (e.g. [Computing Pi](http://illuminations.nctm.org/ActivityDetail.aspx?ID=161))
* Investigating irrational numbers including π (examples in AMSI’s [investigating terminating and recurring decimals](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_1b.html)).
* Evaluating numbers expressed as powers of positive integers.
* Establishing and applying the index laws with positive indices and the zero index.
* Modelling with indices (e.g. population growth and radioactive decay, [Tower of Hanoi](https://www.mathsisfun.com/games/towerofhanoi.html)).
 | * **Understanding** through recognising terminating and recurring decimals and representing exponential expressions in different ways.
* **Fluency** through evaluating numbers expressed as powers of non-negative indices and applying index laws in straight-forward cases.
* **Problem solving** through investigating an application of exponents and communicating the results.
* **Reasoning** through making generalisations from specific cases to establish the index laws.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* List fraction equivalences for each stage in the decimal expansion of fractions with simple infinite recurring decimals, for example: 0.1, 0.11, 0.111 …

Level 9Students who are working at this level could:* Investigate the distribution of digits in the decimal expansion of *π* (e.g. [Pi Digits](http://mathworld.wolfram.com/PiDigits.html) )
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| **Assessment ideas** |
| Students:* carry out an investigation involving modelling with exponents, such as population growth or radioactive decay and communicate results and conclusions.
* solve sets of problems on applications of terminating and recurring decimals, and index laws.
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| **Resources** |
| AMSI[Investigating terminating and recurring decimals](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_1b.html)[Investigating irrational numbers including π](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_1c.html)[Negatives and the index laws in algebra](http://www.amsi.org.au/teacher_modules/Negative_and_the_Index_Laws.html)NCTM Illuminations [Computing π](http://illuminations.nctm.org/ActivityDetail.aspx?ID=161)[Tower of Hanoi](http://illuminations.nctm.org/ActivityDetail.aspx?ID=40)NLVM(Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [Block patterns](http://nlvm.usu.edu/en/nav/frames_asid_328_g_3_t_2.html?open=activities&from=category_g_3_t_2.html)FUSE: Discover resources aligned to the Victorian Curriculum[Use index notation with numbers to establish the index laws with positive integral indices and the zero index](http://fuse.education.vic.gov.au/VCAA/VCMNA272) [Investigate terminating and recurring decimals](http://fuse.education.vic.gov.au/VCAA/VCMNA274)  |

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| Topic 8.2.3: Angles, polygons and solids |
| Strand: Measurement and Geometry | Sub-strand: Geometric reasoning | Recommended teaching time: 2 weeks (approximately 6 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related numerical problems using reasoning [(VCMMG293)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG293).
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students use formulas for the area and perimeter of rectangles. They classify triangles and quadrilaterals and represent transformations of these shapes on the Cartesian plane, with and without the use of digital technology. Students name the types of angles formed by a transversal crossing parallel lines and solve simple numerical problems involving these lines and angles. They describe different views of three-dimensional objects, and use models, sketches and digital technology to represent these views. Students calculate volumes of rectangular prisms. | Students convert between units of measurement for area and for volume. They find the perimeter and area of parallelograms, rhombuses and kites. Students name the features of circles, calculate circumference and area, and solve problems relating to the volume of prisms. They make sense of time duration in real applications, including the use of 24-hour time. **Students identify conditions for the congruence of triangles and deduce the properties of quadrilaterals. They use tools, including digital technology, to construct congruent shapes.** | Students solve measurement problems involving perimeter and area of composite shapes, surface area and volume of rectangular prisms and cylinders, with and without the use of digital technology. They relate three-dimensional objects to two-dimensional representations. Students explain similarity of triangles, interpret ratios and scale factors in similar figures, and apply Pythagoras's theorem and trigonometry to solve problems involving angles and lengths in right-angled triangles. |

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| **Activities** | **Proficiencies** |
| * Drawing and analysing regular and irregular polygons.
* Identifying properties related to side lengths, parallel sides, angles, diagonals and symmetry.
* Establishing the sum of interior angles of polygons.
* Constructing and analysing nets of polyhedra, cylinders and cones.
* Using correct geometrical language in descriptions (e.g. closed cylinder, right cone).
* Describing the effects of transformations (translations, rotations and reflections).
* Presenting and following a short geometrical chain of reasoning, e.g. verifying that a shape is a kite, analysing angle properties of polygons using constituent triangles.
* Geometrical constructions (with ruler and compasses): bisecting line segment and angle; using appropriate language to describe procedures.
* Using dynamic geometry or other computer software to produce geometrical designs.
 | * **Understanding** through connecting related geometrical ideas.
* **Fluency** through accurately carrying out calculations involving angles associated with polygons.
* **Problem solving** through applying knowledge of angle properties to solve unfamiliar problems.
* **Reasoning** through presenting a short chain of geometric reasoning to explain solutions.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Use dynamic geometry software to calculate the interior angle sums for polygons

Level 9Students who are working at this level could:* Investigate and carry out compass and straight edge constructions for regular polygons, and compare these with dynamic geometry constructions
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| **Assessment ideas** |
| Students:* construct nets of polyhedra and other solids, and describe the solids using appropriate language: faces, edges and vertices. They investigate relationships between numbers of faces, edges and vertices.
* solve sets of problems involving polygons and parallel lines, using angle relations and giving a chain of reasoning to explain solutions.
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| **Resources** |
| AMSI[Construction](http://www.amsi.org.au/teacher_modules/Construction.html)[Introduction to measurement](http://www.amsi.org.au/teacher_modules/introduction_to_measurement.html)[Transformations of the plane](http://www.amsi.org.au/ESA_middle_years/Year7/Year7_md/Year7_2d.html)[Geometric drawing including simple solids](http://www.amsi.org.au/ESA_middle_years/Year7/Year7_md/Year7_2b.html)NCTM Illuminations[Geometric solids](http://illuminations.nctm.org/ActivityDetail.aspx?ID=70)[Cube nets](http://illuminations.nctm.org/ActivityDetail.aspx?ID=84)[Tessellation creator](http://illuminations.nctm.org/ActivityDetail.aspx?ID=202)NLVM(Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [Platonic solids](http://nlvm.usu.edu/en/nav/frames_asid_128_g_3_t_3.html?open=instructions&from=category_g_3_t_3.html)FUSE: Discover resources aligned with the Victorian Curriculum[Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related numerical problems using reasoning](http://fuse.education.vic.gov.au/VCAA/VCMMG293)  |

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| Topic 8.2.4: Linear equations |
| Strand: Number and Algebra | Sub-strand: Linear and non-linear relationships | Recommended teaching time: 2 weeks (approximately 6 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution [(VCMNA284)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA284).
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students solve problems involving the order, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving all four operations with fractions, decimals, percentages and their equivalences, and express fractions in their simplest form. Students compare the cost of items to make financial decisions, with and without the use of digital technology. They make simple estimates to judge the reasonableness of results. Students use variables to represent arbitrary numbers and connect the laws and properties of number to algebra and substitute numbers into algebraic expressions. They assign ordered pairs to given points on the Cartesian plane and interpret and analyse graphs of relations from real data. Students develop simple linear models for situations, make predictions based on these models, solve related equations and check their solutions. | Students use efficient mental and written strategies to make estimates and carry out the four operations with integers, and apply the index laws to whole numbers. They identify and describe rational and irrational numbers in context. Students estimate answers and solve everyday problems involving profit and loss rates, ratios and percentages, with and without the use of digital technology. **They simplify a variety of algebraic expressions and connect expansion and factorisation of linear expressions. Students solve linear equations** and graph linear relationships on the Cartesian plane. | Students apply the index laws using integer indices to variables and numbers, express numbers in scientific notation, solve problems involving very small and very large numbers, and check the order of magnitude of calculations. They solve problems involving simple interest. Students use the distributive law to expand algebraic expressions, including binomial expressions, and simplify a range of algebraic expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment using a range of strategies including the use of digital technology. Students sketch and draw linear and non-linear relations, solve simple related equations and explain the relationship between the graphical and symbolic forms, with and without the use of digital technology. |

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| **Activities** | **Proficiencies** |
| * Identifying similarities and differences between expressions, equations and identities.
* Using a balance concept to solve one step equations, and relating the balance and backtracking concepts; checking the answer by substitution.
* Using a balance concept to solve equations involving more than one step, and relating the balance and backtracking concepts for multi-step solutions; checking the answer by substitution.
* Simplifying and solving equations where the variable appears more than once; checking the answer by substitution.
* Proving identities.
* Solving worded problems that lead to linear equations.
* Finding all possible solutions to Diophantine equations (e.g. find all possible solutions to the equation  if *a* and *b* are positive integers, and how will you know when you have found all solutions? See AMSI [Linear equations: Times module 26.)](http://amsi.org.au/teacher_modules/pdfs/Linear_equations.pdf)
 | * **Understanding** through connecting the backtracking and balance approaches to solving equations, and verifying answers by substitution.
* **Fluency** through finding solutions to straight-forward linear equations using the ‘balance’ concept.
* **Problem solving** through formulating appropriate equations from worded problems.
* **Reasoning** through finding the set of possible solutions to simple Diophantine equations, and justifying that all possible solutions have been found.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Use the scale balance model to solve simple linear equations (e.g. [Model Algebra](http://www.mathplayground.com/AlgebraEquations.html) )

Level 9Students who are working at this level could:* Use tables to solve linear Diophantine equations, plot corresponding graphs and investigate a general method
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| **Assessment ideas** |
| Students respond to a set of problems which lead to linear equations (such as those in the [AMSI linear equations module](http://amsi.org.au/teacher_modules/Linear_equations.html)). They solve the equation and interpret the answer in words. For example: ‘I bought a TV and PVR. The price of the TV is times the price of the PVR. The sum of the price of both items is $750 more than the price of two PVRs. What is the price of the TV?’  |

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| **Resources** |
| AMSI[Linear equations](http://amsi.org.au/teacher_modules/Linear_equations.html)DEECD [Linear and non-linear functions: Level 8 eBookbox](https://fuse.education.vic.gov.au/pages/View.aspx?id=9d4e443d-f04b-4bf3-a779-be6792653f45&Source=%252fpages%252fView.aspx%253fpin%253dF497FD)NLVM (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [Algebra balance scales](http://nlvm.usu.edu/en/nav/frames_asid_201_g_3_t_2.html?open=instructions&from=category_g_3_t_2.html)[Algebra balance scales - negatives](http://nlvm.usu.edu/en/nav/frames_asid_324_g_3_t_2.html)FUSE: Discover resources aligned to the Victorian Curriculum[Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution](http://fuse.education.vic.gov.au/VCAA/VCMNA284)  |

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| Topic 8.2.5: Volume and surface area |
| Strand: Measurement and Geometry | Sub-strand: Using units of measurement | Recommended teaching time: 2 weeks (approximately 6 hours) |
| Strand: Number and algebra | Sub-strand: Patterns and algebra |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Develop the formulas for volumes of rectangular and triangular prisms and prisms in general. Use formulas to solve problems involving volume [(VCMMG289)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG289)
* Use algorithms and related testing procedures to identify and correct errors [(VCMNA282)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA282)
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students use formulas for the area and perimeter of rectangles. They classify triangles and quadrilaterals and represent transformations of these shapes on the Cartesian plane, with and without the use of digital technology. Students name the types of angles formed by a transversal crossing parallel lines and solve simple numerical problems involving these lines and angles. They describe different views of three-dimensional objects, and use models, sketches and digital technology to represent these views. Students calculate volumes of rectangular prisms. | Students convert between units of measurement for area and for volume. They find the perimeter and area of parallelograms, rhombuses and kites. **Students** name the features of circles, calculate circumference and area, and **solve problems relating to the volume of prisms.** They make sense of time duration in real applications, including the use of 24-hour time. Students identify conditions for the congruence of triangles and deduce the properties of quadrilaterals. They use tools, including digital technology, to construct congruent shapes. | Students solve measurement problems involving perimeter and area of composite shapes, surface area and volume of rectangular prisms and cylinders, with and without the use of digital technology. They relate three-dimensional objects to two-dimensional representations. Students explain similarity of triangles, interpret ratios and scale factors in similar figures, and apply Pythagoras's theorem and trigonometry to solve problems involving angles and lengths in right-angled triangles. |

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| **Activities** | **Proficiencies** |
| * Developing and using rules to calculate volume and surface areas of rectangular prisms, including some ‘reverse cases’ (e.g. finding area of cross-section from volume and height).
* Calculating volumes of shapes based on rectangular prisms.
* Developing and using rules to calculate volume of triangular prisms.
* Investigating the relationship between volumes of rectangular and triangular prisms.
* Understanding and using cubic units when interpreting and finding volumes of cubes and rectangular prisms.
* Investigating volumes of right prisms in general, when the area of cross-section and height are known.
* Devising ways of measuring very large and very small quantities (e.g. volume of water (litres) in a fish tank where sides are measured in cm; volume of water drop).
* Reading and writing sentences involving the use of numbers and units to express areas and volumes.
* Algorithms and coding:
* Modifying the program described in Topic 8.1.4 to calculate the volume of a square-base prism from a list of side lengths and a list of corresponding heights. Modify the program further so that it will alternatively calculate the surface area, perhaps using a structure such as ‘If then else’ to decide whether to apply the volume or surface area formula.
* Validating the program and identifying the source of error if a test fails. Dealing with invalid inputs, such as a negative length or height.
 | * **Understanding** through connecting cubic units to units of area and length.
* **Fluency** through accurately applying rules to calculate volumes of rectangular and triangular prisms.
* **Problem solving** through generalising volume concepts to solve problems of prisms of known cross-sectional area.
* **Reasoning** through comparing and contrasting volumes and surface areas of rectangular prisms.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Calculate the volumes of various boxes and rectangular prism containers by measuring dimensions and applying the volume formula sections (e.g. [Volume Worksheets](http://www.mathworksheets4kids.com/volume.html) )

Level 9Students who are working at this level could:* Investigate formulas for the volume of right prisms with regular polygon end sections (e.g. [Volume Worksheets](http://www.mathworksheets4kids.com/volume.html) )
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| **Assessment ideas** |
| Students:* carry out an investigation where they build rectangular prisms of fixed volume and compare dimensions and surface areas, using, for example, 64 multilink or wooden cubes. They record their findings systematically and report on their observations.
* solve sets of problems involving volume of rectangular and triangular prisms, including some ‘reverse’ cases.
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| **Resources** |
| AMSI[Volume of prisms](http://www.amsi.org.au/ESA_middle_years/Year8/Year8_md/Year8_2a.html)NCTM Illuminations[Hay bale farmer](http://illuminations.nctm.org/LessonDetail.aspx?id=L783) [Cubes](http://illuminations.nctm.org/ActivityDetail.aspx?id=6)NLVM(Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download) [How high](http://nlvm.usu.edu/en/nav/frames_asid_275_g_3_t_4.html?from=category_g_3_t_4.html)?FUSE: Discover resources aligned to the Victorian Curriculum[Develop the formulas for volumes of rectangular and triangular prisms and prisms in general. Use formulas to solve problems involving volume](http://fuse.education.vic.gov.au/VCAA/VCMMG289)  |

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| **Notes** |
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| Topic 8.2.6: Probability and simulation |
| Strand: Statistics and Probability | Sub-strand: Chance | Recommended teaching time: 3 weeks (approximately 9 hours) |
| Strand: Number and algebra | Sub-strand: Patterns and algebra |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Identify complementary events and use the sum of probabilities to solve problems [(VCMSP294)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP294).
* Describe events using language of ‘at least’, exclusive ‘or’ (A or B but not both), inclusive ‘or’ (A or B or both) and ‘and’ [(VCMSP295)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP295).
* Represent events in two-way tables and Venn diagrams and solve related problems [(VCMSP296)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP296)
* Use algorithms and related testing procedures to identify and correct errors [(VCMNA282)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA282)
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students identify issues involving the collection of discrete and continuous data from primary and secondary sources. They construct stem-and-leaf plots and dot-plots. Students identify or calculate mean, mode, median and range for data sets, using digital technology for larger data sets. They describe the relationship between the median and mean in data displays. Students determine the sample space for simple experiments with equally likely outcomes, and assign probabilities outcomes. | Students explain issues related to the collection of sample data and discuss the effect of outliers on means and medians of the data. They **use various approaches, including the use of digital technology, to generate simple random samples from a population.** **Students model situations with Venn diagrams and two-way tables and explain the use of 'not', 'and' and 'or'. Students choose appropriate language to describe events and experiments. They determine complementary events and calculate the sum of probabilities.** | Students compare techniques for collecting data from primary and secondary sources, and identify questions and issues involving different data types. They construct histograms and back-to-back stem-and-leaf plots with and without the use of digital technology. Students identify mean and median in skewed, symmetric and bi-modal displays and use these to describe and interpret the distribution of the data. They calculate relative frequencies to estimate probabilities. Students list outcomes for two-step experiments and assign probabilities for those outcomes and related events. |

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| **Activities** | **Proficiencies** |
| * Review of introductory probability; identifying the complement of familiar events.
* Understanding that probabilities range between 0 to 1 and that calculating the probability of an event allows the probability of its complement to be found.
* Relative probability and theoretical probability involving dice, spinners, cards and coins.
* Using long-run relative frequency to estimate probability: practical exercise involving repeated trials of simple experiment; application to other cases (e.g., published data).
* Using a random device to simulate a real-world situation (e.g. [birth month paradox](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSQ%2B9C%2BBIRTH%2BMONTH%2BPARADOX%2BIWB), [Stick or switch?](http://illuminations.nctm.org/LessonDetail.aspx?id=L377)); repeated trials and probability estimates based on simulation.
* Predicting estimated proportion/probability based on samples.
* Posing 'and', 'or' and 'not' probability questions about objects or people.
* Using Venn diagrams and two-way tables to calculate probabilities for events, satisfying 'and', 'or' and 'not' conditions.
* Understanding that representing data in Venn diagrams or two-way tables facilitates the calculation of probabilities.
* Collecting data to answer the questions using Venn diagrams or two-way tables.
* Activities involving multiple simulations (e.g. from different groups within a class). Discussion of computer simulations.
* Algorithms and coding:
* Develop an algorithm that uses the inbuilt pseudo-random number generator of a device or spreadsheet to simulate events such as the flipping two coin or the sum of the outcomes from rolling two dice.
* Validating the algorithm and identifying the source of error if a test fails.
 | * **Understanding** through demonstrating an appreciation that the outcome of an individual chance process is uncertain, but the long-run outcome is highly predictable.
* **Fluency** through using Venn diagrams and two-way tables to represent chance data.
* **Problem solving** through using the key steps of simulation to collect data and find estimated probabilities.
* **Reasoning** through interpreting data from Venn diagrams, two-way tables and simulation results.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Investigate probabilities from experiments conducted with biased objects , e.g. a biased coin or die

Level 9Students who are working at this level could:* Investigate length of runs for a particular event in experiments or games
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| **Assessment ideas** |
| Students:* plan and carry out a probability simulation of an authentic situation (e.g. [Stick or switch?](http://illuminations.nctm.org/LessonDetail.aspx?id=L377), [birth month paradox](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSQ%2B9C%2BBIRTH%2BMONTH%2BPARADOX%2BIWB)), including a statement of the problem, assumptions made, the random device used, what a single trial consists of and the number of trials carried out. They display the data sensibly and draw appropriate conclusions.
* respond to sets of problems requiring them to represent and interpret data in Venn diagrams and two-way tables.
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| **Resources** |
| AMSI[Chance](http://www.amsi.org.au/teacher_modules/Chance_year_8.html)NCTM Illuminations[Stick or switch?](http://illuminations.nctm.org/LessonDetail.aspx?id=L377)[Adjustable spinner](http://illuminations.nctm.org/ActivityDetail.aspx?ID=79)NZ Maths[Probability units of work](http://www.nzmaths.co.nz/probability-units-work) FUSE: Discover resources aligned to the Victorian Curriculum[Identify complementary events and use the sum of probabilities to solve problems](http://fuse.education.vic.gov.au/VCAA/VCMSP294) [Describe events using language of ‘at least’, exclusive ‘or’ (A or B but not both), inclusive ‘or’ (A or B or both) and ‘and’](http://fuse.education.vic.gov.au/VCAA/VCMSP295) [Represent events in two-way tables and Venn diagrams and solve related problems](http://fuse.education.vic.gov.au/VCAA/VCMSP296)  |

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| Topic 8.2.7: Ratios and rates |
| Strand: Number and Algebra | Sub-strand: Real numbers | Recommended teaching time: 3 weeks (approximately 9 hours) |

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| **Mapping to F–10 curriculum in Victoria** |
| **Content descriptions** |
| * Solve a range of problems involving rates and ratios, including distance-time problems for travel at a constant speed, with and without digital technologies [(VCMNA277)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA277)
 |
| **Achievement standard (excerpt in bold)** |
| Level 7 | Level 8 | Level 9 |
| Students solve problems involving the order, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving all four operations with fractions, decimals, percentages and their equivalences, and express fractions in their simplest form. Students compare the cost of items to make financial decisions, with and without the use of digital technology. They make simple estimates to judge the reasonableness of results. Students use variables to represent arbitrary numbers and connect the laws and properties of number to algebra and substitute numbers into algebraic expressions. They assign ordered pairs to given points on the Cartesian plane and interpret and analyse graphs of relations from real data. Students develop simple linear models for situations, make predictions based on these models, solve related equations and check their solutions. | Students use efficient mental and written strategies to make estimates and carry out the four operations with integers, and apply the index laws to whole numbers. They identify and describe rational and irrational numbers in context. **Students estimate answers and solve everyday problems involving** profit and loss rates, **ratios and percentages, with and without the use of digital technology.** They simplify a variety of algebraic expressions and connect expansion and factorisation of linear expressions. Students solve linear equations and graph linear relationships on the Cartesian plane. | Students apply the index laws using integer indices to variables and numbers, express numbers in scientific notation, solve problems involving very small and very large numbers, and check the order of magnitude of calculations. They solve problems involving simple interest. Students use the distributive law to expand algebraic expressions, including binomial expressions, and simplify a range of algebraic expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment using a range of strategies including the use of digital technology. Students sketch and draw linear and non-linear relations, solve simple related equations and explain the relationship between the graphical and symbolic forms, with and without the use of digital technology. |

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| **Activities** | **Proficiencies** |
| * Understanding that rate and ratio problems can be solved using fractions or percentages and choosing the most efficient form to solve a particular problem.
* Applying ratios (e.g. sharing in a given ratio).
* Using multipliers for proportional increase and decrease; scale factors.
* Reading, interpreting and writing sentences involving symbols for ratios and rates.
* Calculations (e.g. costs) involving areas and rates (e.g. advertising rates for a local newspaper).
* Simple time rates:
* simple derived units; average speed in kilometres per hour (km/h), metres per second (m/s)
* calculations involving time, distance and speed
* calculations involving quantities such as water flow rate and capacity.
* Checking reasonableness and completeness of results; communicating results.
* Investigative project and/or extended problem solving activity (e.g. budget for interior decoration of house or design and costing of garden; scheduling journey, calculating population growth rates in Australia and Asia and explaining their difference).
 | * **Understanding** through making connections between ratio, rates, fractions and percentages.
* **Fluency** through selecting and using appropriate procedures to solve problems involving rate and ratio.
* **Problem solving** through planning an investigation involving a practical application of ratio and rates, and communicating the results.
* **Reasoning** through interpreting and writing sentences involving symbols for ratios and rates.
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| **Considering different levels of student ability** |
| Level 7Students who are working at this level could:* Compare distances travelled at different average speeds over the same time interval

Level 9Students who are working at this level could:* Investigate travel problems involving time, distance travelled and average speed, where the average speed takes different values over sections of the journey, including rest stops (e.g. train control graphs)
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| **Assessment ideas** |
| Students:* plan and carry out an investigative project and/or extended problem solving activity (e.g. budget for interior decoration of house or design and costing of garden; scheduling journey, calculating population growth rates in Australia and Asia and explaining their difference).
* select the most efficient form of expression to solve sets of ratio and rates problems.
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| **Resources** |
| AMSI[Rates and ratios](http://www.amsi.org.au/teacher_modules/rates_and_ratio.html)NCTM Illuminations[Scale factor](http://illuminations.nctm.org/ActivityDetail.aspx?ID=176)[Constant cost per minute](http://www.nctm.org/standards/content.aspx?id=25092)NRICH Maths[Ratio and proportion challenges](http://nrich.maths.org/public/search.php?search=ratio+and+proportion+challenges)FUSE: Discover resources aligned to the Victorian Curriculum[Solve a range of problems involving rates and ratios, including distance-time problems for travel at a constant speed, with and without digital technologies](http://fuse.education.vic.gov.au/VCAA/VCMNA277)  |
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