Mathematics Sample Program: Year 9



Authorised and published by the Victorian Curriculum and Assessment Authority  
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Melbourne VIC 3000

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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 9 is an example of how the Mathematics curriculum could be organised into a teaching and learning program. It is based on 3 hours teaching time per week.

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

|  |  |  |
| --- | --- | --- |
| **Week\*** | **Semester 1** | **Semester 2** |
| 1 | *9.1.1: Number and financial mathematics*  Strand: Number and Algebra  Sub-strand: Money and financial mathematics  Sub-strand: Patterns and algebra | *9.2.1: Applications of trigonometry*  Strand: Measurement and Geometry  Sub-strand: Pythagoras and trigonometry |
| 2 |
| 3 | *9.1.2: Pythagoras’ Theorem*  Strand: Measurement and Geometry  Sub-strand: Pythagoras and trigonometry |
| 4 | *9.2.2: Linear equations*  Strand: Number and Algebra  Sub-strand: Linear and non-linear relationships |
| 5 |
| 6 | *9.1.3: Algebra techniques*  Strand: Number and Algebra  Sub-strand: Patterns and algebra | *9.2.3: Indices and scientific notation*  Strand: Number and Algebra  Sub-strand: Real numbers  Sub-strand: Patterns and algebra  Strand: Measurement and Geometry  Sub-strand: Using units of measurement |
| 7 |
| 8 | *9.1.4: Linear relations and coordinate geometry*  Strand: Number and Algebra  Sub-strand: Patterns and algebra |
| 9 | *9.2.4: Shapes, prisms and cylinders*  Strand: Measurement and Geometry  Sub-strand: Using units of measurement |
| 10 |
| 11 | *9.1.5: Rate, ratio and proportion*  Strand: Number and Algebra  Sub-strand: Real numbers |
| 12 | *9.2.5: Statistics*  Strand: Statistics and Probability  Sub-strand: Data representation and interpretation  Strand: Number and Algebra  Sub-strand: Patterns and algebra |
| 13 | *9.1.6: Probability*  Strand: Statistics and Probability  Sub-strand: Chance  Strand: Number and algebra  Sub-strand: Patterns and algebra |
| 14 |
| 15 | *9.2.6: Further algebra*  Strand: Number and Algebra  Sub-strand: Patterns and algebra |
| 16 | *9.1.7: Similarity and trigonometric ratios*  Strand: Measurement and Geometry  Sub-strand: Geometric reasoning  Sub-strand: Pythagoras and trigonometry |
| 17 | *9.2.7: Graphs of non-linear relations*  Strand: Number and AlgebraSub-strand: Linear and non-linear relationships |
| 18 |

\* Based on 3 hours teaching time per week

Content descriptions coverage within each topic

|  |  |
| --- | --- |
| **Level 9 content descriptions** | **Topic/s** |
| **Strand: Number and algebra** | |
| **Sub-strand: Money and financial mathematics** | |
| Solve problems involving simple interest [(VCMNA304)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA304) | 9.1.1 |
| **Sub-strand: Patterns and algebra** | |
| Extend and apply the index laws to variables, using positive integer indices and the zero index [(VCMNA305)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA305) | 9.2.3 |
| Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate [(VCMNA306)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA306) | 9.1.3  9.2.6 |
| Apply set structures to solve real-world problems [(VCMNA307)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA307) | 9.1.1  9.1.6  9.2.3  9.2.4  9.2.5 |
| **Sub-strand: Real numbers** | |
| Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems [(VCMNA301)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA301) | 9.1.5 |
| Apply index laws to numerical expressions with integer indices [(VCMNA302)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA302) | 9.2.3 |
| Express numbers in scientific notation [(VCMNA303)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA303) | 9.2.3 |
| **Sub-strand: Linear and non-linear relationships** | |
| Find the distance between two points located on a Cartesian plane using a range of strategies, including graphing software [(VCMNA308)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA308) | 9.1.4 |
| Find the mid-point and gradient of a line segment (interval) on the Cartesian plane using a range of strategies, including graphing software [(VCMNA309)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA309) | 9.1.4 |
| Sketch linear graphs using the coordinates of two points and solve linear equations [(VCMNA310)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA310) | 9.1.4  9.2.2 |
| Graph simple non-linear relations with and without the use of digital technologies and solve simple related equations [(VCMNA311)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA311) | 9.2.7 |
| **Strand: Measurement and geometry** | |
| **Sub-strand: Pythagoras and trigonometry** | |
| Investigate Pythagoras’ Theorem and its application to solving simple problems involving right-angled triangles [(VCMMG318)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG318) | 9.1.2 |
| Use similarity to investigate the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles [(VCMMG319)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG319) | 9.1.7 |
| Apply trigonometry to solve right-angled triangle problems [(VCMMG320)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG320) | 9.2.1 |
| **Sub-strand: Geometric reasoning** | |
| Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar [(VCMMG316)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG316) | 9.1.7 |
| Solve problems using ratio and scale factors in similar figures [(VCMMG317)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG317) | 9.1.7 |
| **Sub-strand: Using units of measurement** | |
| Investigate very small and very large time scales and intervals [(VCMMG315)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG315) | 9.2.3 |
| Calculate the areas of composite shapes [(VCMMG312)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG312) | 9.2.4 |
| Calculate the surface area and volume of cylinders and solve related problems [(VCMMG313)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG313) | 9.2.4 |
| Solve problems involving the surface area and volume of right prisms [(VCMMG314)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG314) | 9.2.4 |
| **Strand: Statistics and probability** | |
| **Sub-strand: Chance** | |
| List all outcomes for two-step chance experiments, both with and without replacement using tree diagrams or arrays. Assign probabilities to outcomes and determine probabilities for events [(VCMSP321)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP321) | 9.1.6 |
| Calculate relative frequencies from given or collected data to estimate probabilities of events involving ‘and’ or ‘or’ [(VCMSP322)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP322) | 9.1.6 |
| Investigate reports of surveys in digital media and elsewhere for information on how data were obtained to estimate population means and medians [(VCMSP323)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP323) | 9.1.6 |
| **Sub-strand: Data representation and interpretation** | |
| Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly from secondary sources [(VCMSP324)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP324) | 9.2.5 |
| Construct back-to-back stem-and-leaf plots and histograms and describe data, using terms including ‘skewed’, ‘symmetric’ and ‘bi-modal’ [(VCMSP325)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP325) | 9.2.5 |
| Compare data displays using mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread [(VCMSP326)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP326) | 9.2.5 |

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

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| Level 8 | Level 9 | Level 10 |
| **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. | **Number and algebra**  Students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, with and without the use of digital technology. Students substitute into formulas, find unknown values, manipulate linear algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital technology. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. |
| **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’ theorem and trigonometry to solve problems involving angles and lengths in right-angled triangles. | **Measurement and geometry**  Students solve and explain surface area and volume problems relating to composite solids. They use parallel and perpendicular lines, angle and triangle properties, similarity, trigonometry and congruence to solve practical problems and develop proofs involving lengths, angles and areas in plane shapes. They use digital technology to construct and manipulate geometric shapes and objects, and explore symmetry and pattern in two dimensions. |

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| Level 8 | Level 9 | Level 10 |
| **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. | **Statistics and probability**  Students compare univariate data sets by referring to summary statistics and the shape of their displays. They describe bivariate data where the independent variable is time and use scatter-plots generated by digital technology to investigate relationships between two continuous variables. Students evaluate the use of statistics in the media. They list outcomes for multi-step chance experiments involving independent and dependent events, and assign probabilities for these experiments. |

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 9 Semester 1



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| Topic 9.1.1: Number and financial mathematics | | |
| Strand:  Number and Algebra | Sub-strands:  Money and financial mathematics  Patterns and algebra | Recommended teaching time:  2 weeks (approximately 6 hours) |

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| **Mapping to F–10 curriculum in Victoria** | | |
| **Content descriptions** | | |
| * Solve problems involving simple interest [(VCMNA304)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA304). * Apply set structures to solve real-world problems [(VCMNA307)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA307) | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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. | Students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, with and without the use of digital technology. Students substitute into formulas, find unknown values, manipulate linear algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital technology. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. |

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| **Activities** | **Proficiencies** |
| Simple interest:   * review of percentages * using percentages * application of simple interest formula * reverse use of simple interest formula. * **Algorithms and coding**: * explore [error detection](http://csunplugged.org/error-detection/) formulas and check digits used to validate numbers on [UPC bar codes](http://www.cimt.org.uk/resources/res1/barcode.htm), [ISBN](https://en.wikipedia.org/wiki/International_Standard_Book_Number), [credit cards](https://education.ti.com/en-au/australiancurriculumnspired/aus-nz/detail?id=05E3E4D8079440E68FAF6D7725742028&t=E80CC10576A84C9285EAD0753B130F0D) and the like. The NCTM [Check that digit](http://illuminations.nctm.org/Lesson.aspx?id=2383) activity introduces the concept, including modular arithmetic. * Develop and implement a program, utilising appropriate set structures, that enables input of the number on a credit card, ISBN or UPC, and uses the appropriate formula to check the validity of the number. * Number computation techniques integrated in the coverage of simple interest: * four operations, positive integer powers, square roots * prime factors * common fractions as recurring or terminating decimals * four operations with positive and negative integers * strategies for mental calculation and estimation * sensible and efficient calculator use. | * **Understanding** through applying computational techniques learnt in earlier years to calculations involving simple interest. * **Fluency** through carrying out number computations accurately and efficiently. * **Problem solving** through applying the simple interest formula flexibly to solve practical problems, including some reverse cases. * **Reasoning** through estimating and appraising the reasonableness of answers. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Use technology to create tables for consecutive sums of money for a fixed percentage increase. This could be done for different ranges in the amount of money, and for different values of percentage increase.   Level 10  Students who are working at this level could:   * Compare the effect of real simple interest and compund interest rates offered for a given principal value, over a period of several years. Write a program that uses a loop structure to recursively calculate compound interest. |

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| **Assessment ideas** |
| Students complete an assignment based on financial calculations, such as GST, percentage discounts and practical applications of simple interest, for example hire-purchase contracts. This may include the use of spreadsheets to carry out a sequence of related calculations and explore the effect of changing a variable, such as the interest rate or term of a loan. Also looking at real contracts, for example, a contract when buying a car. |

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| **Resources** |
| AMSI  [Simple interest](http://www.amsi.org.au/ESA_middle_years/Year9/Year9_md/Year9_1c.html)  [Consumer arithmetic](http://www.amsi.org.au/teacher_modules/consumer_arithmetic.html)  CS Unplugged  [Error detection](http://csunplugged.org/error-detection/)  NCTM Illuminations  [Check that digit](http://illuminations.nctm.org/Lesson.aspx?id=2383)  [Grid and percent it](http://illuminations.nctm.org/Lesson.aspx?id=960)  FUSE: Discover resources aligned to the Victorian Curriculum  [Solve problems involving simple interest](http://fuse.education.vic.gov.au/VCAA/VCMNA304)  [Apply set structures to solve real-world problems](http://fuse.education.vic.gov.au/VCAA/VCMNA307) |

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| **Notes** |
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| Topic 9.1.2: Pythagoras’ Theorem | | |
| Strand:  Measurement and Geometry | Sub-strand:  Pythagoras and trigonometry | Recommended teaching time:  3 weeks (approximately 9 hours) |

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| **Mapping to F–10 curriculum in Victoria** | | |
| **Content descriptions** | | |
| * Investigate Pythagoras’ Theorem and its application to solving simple problems involving right angled triangles [(VCMMG318)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG318). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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’ theorem** and trigonometry **to solve problems** **involving** angles and **lengths in right-angled triangles.** | Students solve and explain surface area and volume problems relating to composite solids. They use parallel and perpendicular lines, angle and triangle properties, similarity, trigonometry and congruence to solve practical problems and develop proofs involving lengths, angles and areas in plane shapes. They use digital technology to construct and manipulate geometric shapes and objects, and explore symmetry and pattern in two dimensions. |

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| **Activities** | **Proficiencies** |
| * Identifying the hypotenuse for any orientation of a right-angled triangle. * Establishing and proving the theorem by various means. * Solving problems that involve finding the length of the hypotenuse. * The converse theorem and solving problems involving finding the length of one of the sides of a triangle. * Pythagorean triples (triads) (primitive and non-primitive). * Given the lengths of the three sides, determining whether the largest angle of a triangle is equal to, greater than or less than 90°. * Irrational numbers and the Pythagorean spiral. | * **Understanding** through making connections between various ways of proving Pythagoras’ theorem. * **Fluency** through selecting and correctly applying the theorem or its converse to solve simple problems involving right angled triangles. * **Problem solving** through modelling and investigating problem situations involving right-angled triangles. * **Reasoning** through determining whether the largest angle of a triangle is equal to, greater than or less than 90°, given the lengths of the three sides. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Use square counting and dissection with graph paper to compare the areas of squares on the sides of right angles triangles and the relationship between them.   Level 10  Students who are working at this level could:   * Use dynamic geometry software to explore the relationship between the sides of a triangle and the area of the square on that side when the reference angle is acute or obtuse. |

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| **Assessment ideas** |
| Students:   * carry out an investigation into patterns in Pythagorean triples and ways of generating triples (See the University of Surrey resource: [Methods of generating Pythagorean triples](http://www.maths.surrey.ac.uk/hosted-sites/R.Knott/Pythag/pythag.html#moretriples) * create a Pythagorean spiral to find the lengths of successive irrational number,, and find the position of these numbers on a suitably scaled number line. |

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| **Resources** |
| AMSI  [Pythagoras’ theorem](http://www.amsi.org.au/teacher_modules/pythagoras_theorem.html)  DET  [Trigonometric ratios and Pythagorean theorem: Level 9 eBookbox](https://fuse.education.vic.gov.au/Search/Results?AssociatedPackageId=&QueryText=pythagoras+interactive&SearchScope=All)  NCTM Illuminations  [Proof without words: Pythagorean theorem](http://illuminations.nctm.org/Activity.aspx?id=4211)  FUSE: Discover resources aligned to the Victorian Curriculum  [Investigate Pythagoras’ Theorem and its application to solving simple problems involving right angled triangles](http://fuse.education.vic.gov.au/VCAA/VCMMG318) |

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| Topic 9.1.3: Algebra techniques | | |
| 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** | | |
| * Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate [(VCMNA306)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA306). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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. | Students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, with and without the use of digital technology. Students substitute into formulas, find unknown values, manipulate linear algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital technology. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. |

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| **Activities** | **Proficiencies** |
| * Review of the distributive law and expansion of linear algebraic expressions. * Review of factorisation of simple algebraic expressions by identifying numerical factors. * Review of simplification of linear algebraic expressions using four operations. * Application of the distributive law to expand simple non-linear expressions. * Factorisation of simple algebraic expressions by identifying numerical and symbolic factors. * Establish the connection between expansion and factorisation of expressions. * Algebraic simplification of simple non-linear expressions. | * **Understanding** through connecting factorisation and expansion as inverse processes. * **Fluency** through identifying like terms and common factors. * **Problem solving** through applying existing knowledge of factorising, expanding and simplifying to more complex expressions. * **Reasoning** through generalising the use of the distributive law from numerical calculations to algebraic expressions |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Use the rectangular grid method to multiply numbers such as 234 × 7 as (200 + 30 + 4) × 7 or 58 × 49 as  (50 + 8) × (40 + 9) then extend the same method to expressions such as 7 × (*a* + 3) and (*a* + 8) × (*b* + 9)   Level 10  Students who are working at this level could:   * Use the table functionality of a computer algebra system to explore patterns related to the expansion and factorisation of monic quadratic expressions such as expanding (*x* + *a*) (x + 6) for *a* from -10 to 10, or factorising (*x*2 + *b x* – 36) for *b* from -20 to 20 |

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| **Assessment ideas** |
| Students carry out an item response analysis of a collection of multiple-choice items involving algebraic simplification, factorisation and expansion. They explain the error the leads to one of the distractors for each item. |

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| **Resources** |
| AMSI  [Special expansions and algebraic fractions](http://www.amsi.org.au/teacher_modules/special_expansions_algbrc_fracs.html)  NCTM Illuminations  [Modelling algebraic expressions](http://illuminations.nctm.org/Activity.aspx?id=3482)  NLVM  (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download)  [Algebra tiles](http://nlvm.usu.edu/en/nav/frames_asid_189_g_4_t_2.html?open=activities&from=category_g_4_t_2.html)  FUSE: Discover resources aligned to the Victorian Curriculum  [Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate](http://fuse.education.vic.gov.au/VCAA/VCMNA306) |

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| Topic 9.1.4: Linear relations and coordinate geometry | | |
| Strand:  Number and Algebra | Sub-strand:  Patters and algebra | Recommended teaching time:  3 weeks (approximately 9 hours) |

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| **Mapping to F–10 curriculum in Victoria** | | |
| **Content descriptions** | | |
| * Find the distance between two points located on a Cartesian plane using a range of strategies, including graphing software [(VCMNA308)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA308). * Find the midpoint and gradient of a line segment (interval) on the Cartesian plane using a range of strategies, including graphing software [(VCMNA309)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA309). * Sketch linear graphs using the coordinates of two points (and solve linear equations) [(VCMNA310)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA310). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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. | Students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, with and without the use of digital technology. Students substitute into formulas, find unknown values, manipulate linear algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital technology. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. |

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| **Activities** | **Proficiencies** |
| * Review of the Cartesian plane and Cartesian coordinates in four quadrants. * Finding the distance between two points on the Cartesian plane, using a range of strategies, including graphing software and Pythagoras’ theorem. * Finding the midpoint and gradient of the line joining two points on the Cartesian plane, using a range of strategies, including graphing software. * Review: completing a table of values from rules of functional relationships and from growing patterns. * Review: plotting the points from table of values and determining whether or not the relationship is linear, using various methods, including digital technologies such as spreadsheets and graphing software. * Sketching linear graphs using the coordinate of two points; generating a table of values from other points on the line to determine the rule from the resultant pattern of values. | * **Understanding** through making connections between different representations of a linear relationship: as pattern, rules, tables and graphs. * **Fluency** through accurately identifying and plotting Cartesian coordinates and given two points, finding the distance and gradient between the points. * **Problem solving** through interpreting linear relationships that are represented in various ways. * **Reasoning** through justifying the rule of a linear relation that is represented as a graph |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Use graph paper to determine the equation of the straight line passing through two given points, the distance between the two points and the coordinates of the midpoint of the line segment joining the two points.   Level 10  Students who are working at this level could:   * Use technology to construct animations which show the effect of the parameters *a* and *b* in developing families of graphs of linear functions; and to show the representation of the linear equation *a x* + *b* = *c* as the intersection of the graphs of *y = ax + b and y = c* |

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| **Assessment ideas** |
| Students use suitable digital technology to superimpose lines passing through two points on interesting photographs or maps. They find the gradients and equations of the lines and determine the length of the line segments and the coordinates of the midpoints of the line segments, using various means, including dynamic geometry or graphing software. |

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| **Resources** |
| AMSI  [Coordinate geometry](http://www.amsi.org.au/ESA_middle_years/Year9/Year9_md/Year9_1d.html#intro)  NCTM Illuminations  [Equations of attack](http://illuminations.nctm.org/Lesson.aspx?id=2858)  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_4_t_2.html?from=category_g_4_t_2.html)  FUSE: Discover resources aligned to the Victorian Curriculum  [Find the distance between two points located on a Cartesian plane using a range of strategies, including graphing software](http://fuse.education.vic.gov.au/VCAA/VCMNA308)  [Find the midpoint and gradient of a line segment (interval) on the Cartesian plane using a range of strategies, including graphing software](http://fuse.education.vic.gov.au/VCAA/VCMNA309)  [Sketch linear graphs using the coordinates of two points (and solve linear equations)](http://fuse.education.vic.gov.au/VCAA/VCMNA310) |

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| Topic 9.1.5: Rate, ratio and proportion | | |
| Strand:  Number and Algebra | Sub-strand:  Real 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 direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems [(VCMNA301)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA301). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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. | Students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, with and without the use of digital technology. Students substitute into formulas, find unknown values, manipulate linear algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital technology. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. |

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| **Activities** | **Proficiencies** |
| * Review of ratio as a comparison of two quantities (see Topic 8.2.7). * ‘Comparing ratio’ problems. * Graphs showing ratios, such as the graph showing ratio of sides of similar rectangles. * Review of rates, as a measure of how one quantity changes for every unit of another quantity (see Topic 8.2.7) * Practical problems involving time rates and other rates, such as the run rate (runs per over) in the game of cricket and fuel consumption (litres per 100 km) of motor cars. * The relationship between constant rates and linear graphs that pass through the origin, with gradient as the ratio rise:run. * The concept of direct proportion and identifying direct proportion in practical contexts. * Proportional increase and decrease. * Scale factors. * The connection between rate, ratio, proportion and linear equations and graphs. | * **Understanding** through making connections between rate, ratio, proportion and features of corresponding linear graphs. * **Fluency** through choosing appropriate procedures to solve ratio and rate problems. * **Problem solving** through modelling practical direct-proportional problems in a number of ways, including the use of linear graphs. * **Reasoning** through applying proportional reasoning to a range of practical problems. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Construct line graphs for simple rate situations and use these to solve rate problems graphically.   Level 10  Students who are working at this level could:   * Model contexts involving rectilinear motion based on intervals with different constant speeds using piecewise line segment graphs. |

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| **Assessment ideas** |
| Students investigate practical problems involving direct proportion and relate them to concepts of ratio, rate and gradient of corresponding graphs. Possible examples to investigate include:   * supermarkets give per 100 gram unit values * gradients in hills * computer screen percentage view.   An investigation of the Golden ratio is a possible extension to the task. |

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| **Resources** |
| AMSI  [Rates and Ratios](http://www.amsi.org.au/teacher_modules/rates_and_ratio.html#Rates)  [Proportion](http://www.amsi.org.au/teacher_modules/proportion.html)  NCTM Illuminations  [Pedal power](http://illuminations.nctm.org/Lesson.aspx?id=1922)  [What’s your rate?](http://illuminations.nctm.org/Lesson.aspx?id=1660)  [Varying motion](http://illuminations.nctm.org/Lesson.aspx?id=2955)  NLVM  (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download)  [Golden rectangle](http://nlvm.usu.edu/en/nav/frames_asid_133_g_4_t_1.html?open=instructions&from=category_g_4_t_1.html)  FUSE: Discover resources aligned to the Victorian Curriculum  [Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems](http://fuse.education.vic.gov.au/VCAA/VCMNA301) [(VCMNA301)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA301). |

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| Topic 9.1.6: Probability | | |
| 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** | | |
| * List all outcomes for two-step chance experiments, both with and without replacement using tree diagrams or arrays. Assign probabilities to outcomes and determine probabilities for events [(VCMSP321)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP321). * Calculate relative frequencies from given or collected data to estimate probabilities of events involving 'and' or 'or' [(VCMSP322)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP322). * Investigate reports of surveys in digital media and elsewhere for information on how data were obtained to estimate population means and medians [(VCMSP323)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP323). * Apply set structures to solve real-world problems [(VCMNA307)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA307) | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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. T**hey calculate relative frequencies to estimate probabilities. Students list outcomes for two-step experiments and assign probabilities for those outcomes and related events.** | Students compare univariate data sets by referring to summary statistics and the shape of their displays. They describe bivariate data where the independent variable is time and use scatter-plots generated by digital technology to investigate relationships between two continuous variables. Students evaluate the use of statistics in the media. They list outcomes for multi-step chance experiments involving independent and dependent events, and assign probabilities for these experiments. |

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| **Activities** | **Proficiencies** |
| * Assign probabilities from models, such as the probability of a ‘fair’ coin landing ‘tails’ is one-half. * Conduct two step chance experiments, such as throwing two dice. Simulate two step chance experiments with large numbers of trials, using suitable functionalities of digital technology, such as a spreadsheet or program. Understanding that these technologies generate pseudo-random numbers based on an algorithm. * Systematically record possible outcomes of a sample space and list favourable outcomes of an event, using organised lists, tables, arrays, tree diagrams and the like. * Compare related experiments conducted with and without replacement, such as drawing two jelly-beans from a bag containing 4 red and 6 green jelly-beans, with and without replacement. Simulate these experiments, with a large number of trials, using suitable functionalities of digital technology, such as a spreadsheet. * Calculate relative frequencies of events involving ‘and’, ‘or’ questions, using Venn diagrams and two-way tables. * Estimate probabilities of ‘and’, ‘or’ events from data, using relative frequencies. * **Algorithms and coding**: using the inbuilt pseudo-random number generator, develop an algorithm and implement a program that simulates random sampling by selecting a random set from a universal set, which is the population for the context. For a set of many random samples, observe variation between samples. * Investigate a range of survey data obtained and how estimates of the population mean and median were obtained. | * **Understanding** through comparing and contrasting probabilities for related two-step chance experiments conducted with and without replacement. * **Fluency** through describing and calculating probabilities for two-step chance experiments. * **Problem solving** through using chance experiments and relative frequencies to investigate and estimate the probabilities of events. * **Reasoning** through interpreting information displayed in various ways, including two-way tables and Venn diagrams. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Physically simulate the sampling of objects of a given kind from a finite population with and without replacement and estimate related probabilities.   Level 10  Students who are working at this level could:   * Investigate questions such as the length of run for a given outcome before the first occurrence of another ouctome, or the length of run of repeated occurrence of a given outcome in a large sequence of trials. |

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| **Assessment ideas** |
| Students make and defend a prediction of the probability of a two-step chance event. They then conduct an experiment or simulation with a large number of trials and compare the experimental results with their predictions. Finally, they reconcile any differences (this may involve determining theoretical probabilities where appropriate). |

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| **Resources** |
| AMSI  [Chance](http://www.amsi.org.au/teacher_modules/Chance_year_9.html)  NCTM Illuminations  [Explorations with chance](http://illuminations.nctm.org/Lesson.aspx?id=1145)  [What’s your rate?](http://illuminations.nctm.org/Lesson.aspx?id=1660)  NLVM  (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download)  [Stick or switch](http://nlvm.usu.edu/en/nav/frames_asid_117_g_4_t_5.html?from=category_g_4_t_5.html)  [Coin tossing](http://nlvm.usu.edu/en/nav/frames_asid_305_g_4_t_5.html?from=category_g_4_t_5.html)  FUSE: Discover resources aligned to the Victorian Curriculum  [Investigate reports of surveys in digital media and elsewhere for information on how data were obtained to estimate population means and medians](http://fuse.education.vic.gov.au/VCAA/VCMSP323)  [Apply set structures to solve real-world problems](http://fuse.education.vic.gov.au/VCAA/VCMNA307) |

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| Topic 9.1.7: Similarity and trigonometric ratios | | |
| Strand:  Measurement and Geometry | Sub-strand:  Geometric reasoning  Pythagoras and trigonometry | Recommended teaching time:  3 weeks (approximately 9 hours) |

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| **Mapping to F–10 curriculum in Victoria** | | |
| **Content descriptions** | | |
| * Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar [(VCMMG316)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG316). * Solve problems using ratio and scale factors in similar figures [(VCMMG317)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG317). * Use similarity to investigate the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles [(VCMMG319)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG319). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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’ theorem and trigonometry to solve problems involving angles and lengths in right-angled triangles. | Students solve and explain surface area and volume problems relating to composite solids. They use parallel and perpendicular lines, angle and triangle properties, similarity, trigonometry and congruence to solve practical problems and develop proofs involving lengths, angles and areas in plane shapes. They use digital technology to construct and manipulate geometric shapes and objects, and explore symmetry and pattern in two dimensions. |

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| **Activities** | **Proficiencies** |
| * The enlargement transformation. * Scale factors and properties of enlargements. * Similar figures and conditions for triangles to be similar: AAA, SSS, SAS and RHS tests. * Using dynamic functionality of technology to explore congruence and similarity. * Using similarity and ratio to solve problems involving enlargement, such as scale diagrams. * The relationship between areas of similar figures and the ratio of corresponding sides (scale factor). * Similarity of right-angled triangles. * The three basic trigonometric ratios. * Solving simple right-angled triangle problems by comparison to a similar triangle in the unit circle, and making links to the trigonometric ratios. | * **Understanding** through recognising relationships between geometric properties of shapes. * **Fluency** through describing enlargements and calculating scale factors. * **Problem solving** through using formal congruence tests to establish whether two triangles are congruent. * **Reasoning** through discovering new properties by deduction, and providing and justifying informal arguments. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Use physical instruments and drawing software to create enlarged or reduced images, with attention to scaling.   Level 10  Students who are working at this level could:   * Use similarity to represent fractions of different denominators, and fractions of surds, on a common number line. |

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| **Assessment ideas** |
| Students complete a task based on congruence and similarity that contain a variety of contexts and problems of varying complexity. For example, students use similar triangles to find the length of an inaccessible distance, such as the height of a tree, by measuring the lengths of the shadows cast by the tree and by a 1 metre ruler. They use congruence to find a distance without measurement in the footbridge problem. |

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| **Resources** |
| AMSI  [Similarity](http://www.amsi.org.au/ESA_middle_years/Year9/Year9_md/Year9_2b.html)  [Scale drawings and similarity](http://www.amsi.org.au/teacher_modules/Scale_drawings_and_similarity.html)  NCTM Illuminations  [In your shadow](http://illuminations.nctm.org/Lesson.aspx?id=1672)  NLVM  (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download)  [Transformations - Dilation](http://nlvm.usu.edu/en/nav/frames_asid_296_g_4_t_3.html)  FUSE: Discover resources aligned to the Victorian Curriculum  [Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar](http://fuse.education.vic.gov.au/VCAA/VCMMG316)  [Solve problems using ratio and scale factors in similar figures](http://fuse.education.vic.gov.au/VCAA/VCMMG317)  [Use similarity to investigate the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles](http://fuse.education.vic.gov.au/VCAA/VCMMG319) |

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Year 9 Semester 2



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| Topic 9.2.1: Applications of trigonometry | | |
| Strand:  Measurement and Geometry | Sub-strand:  Pythagoras and trigonometry | Recommended teaching time:  3 weeks (approximately 9 hours) |

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| **Mapping to F–10 curriculum in Victoria** | | |
| **Content descriptions** | | |
| * Apply trigonometry to solve right-angled triangle problems ([VCMMG320](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG320)). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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’ theorem and **trigonometry to solve problems involving angles and lengths in right-angled triangles.** | Students solve and explain surface area and volume problems relating to composite solids. They use parallel and perpendicular lines, angle and triangle properties, similarity, trigonometry and congruence to solve practical problems and develop proofs involving lengths, angles and areas in plane shapes. They use digital technology to construct and manipulate geometric shapes and objects, and explore symmetry and pattern in two dimensions. |

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| **Activities** | **Proficiencies** |
| * The three basic trigonometric ratios. * Values of trigonometric ratios. * Exact values of trigonometric ratios for sin (30°), cos (60°) and tan (45°). * Finding side lengths when the angles are known. * Finding angle when two side lengths are known. * Applications, including angles of elevation and depression. | * **Understanding** through applying their knowledge of trigonometric ratios flexibly to a variety of contexts and making connections with other content, such as Pythagoras’ theorem. * **Fluency** through choosing appropriate trigonometric ratios and procedures to solve problems involving right-angled triangles * **Problem solving** through investigating problem situations that can be modelled with right-angled triangles and formulating solutions. * **Reasoning** through communicating and justifying their solution method in problem situations modelled with right-angles triangles. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Use technology to generate families of similar right angle triangles and confirm the constant value of the ratio of sides for the pairs of sides corresponding to sine, cosine and tangent of the reference angle.   Level 10  Students who are working at this level could:   * Use a unit circle with a 10 cm = 1 unit scale to determine values of the three ratios correct to 2 decimal paces for angles from  0 to 360 degrees and solve simple related equation approximately. |

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| **Assessment ideas** |
| Students predict the heights of inaccessible objects (such as tall trees and buildings). They use clinometers (or clinometer app on a smartphone) to measure angles of elevation at a known distance from the foot of the object and calculate the height of the object. Finally, they calculate the percentage difference between their estimated and calculated heights. |

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| **Resources** |
| AMSI  [Trigonometry](http://www.amsi.org.au/ESA_middle_years/Year9/Year9_md/Year9main.html)  [Introductory trigonometry](http://www.amsi.org.au/teacher_modules/Introductory_trigonometry.html)  DET  [Trigonometric ratios and Pythagorean theorem eBox](https://fuse.education.vic.gov.au/Search/Results?AssociatedPackageId=&QueryText=trigonometry+ebox&SearchScope=All)  NLVM  (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download)  [Right triangle solver](http://nlvm.usu.edu/en/nav/frames_asid_335_g_4_t_3.html?from=category_g_4_t_3.html)  FUSE: Discover resources aligned to the Victorian Curriculum  [Apply trigonometry to solve right-angled triangle problems](http://fuse.education.vic.gov.au/VCAA/VCMMG320) |

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| Topic 9.2.2: Linear equations | | |
| Strand:  Numbers and Algebra | Sub-strand:  Linear and non-linear relationships | Recommended teaching time:  2 weeks (approximately 4 hours) |

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| **Mapping to F–10 curriculum in Victoria** | | |
| **Content descriptions** | | |
| * Sketch linear graphs using the coordinates of two points and solve linear equations ([VCMNA310](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA310)). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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.** | Students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, with and without the use of digital technology. Students substitute into formulas, find unknown values, manipulate linear algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital technology. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. |

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| **Activities** | **Proficiencies** |
| * Determining linear rules for real world situations (such as taxi fares, hire costs, sales costs and revenue earned from sales). * Graphs of linear rules for real world situations, with and without technology. * Substitution into linear equations. * Break-even analysis of simple situations (such as comparison of charges for two equipment hire companies with different pricing schemes or break-even for setting up a hot-dog stand at the school fete). * Solving simple linear equations by inverse operations and graphically. * Problems that lead to more complicated linear equations. Solving the multi-step linear equations by inverse operations and interpreting the result to answer the question posed in each problem. | * **Understanding** through connecting linear rules with corresponding graphs and tables of values and describing the rules in words and algebraically. * **Fluency** through systematically using inverse operations to solve linear equations. * **Problem solving** through investigating problem situations that can be modelled with linear functions and carrying out break-even analysis. * **Reasoning** through justifying strategies and conclusions reached with respect to situations modelled with linear functions. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Use technology to plot a set of points from a table of values generated by a linear function on the same graph as the continuous straight line through these points, and relate these to the gradient and intercepts of the graph of the linear function.   Level 10  Students who are working at this level could:   * Use technolgy to explore the location of the point of interesection of the graphs of two linear functions with rerspect to their gradients and vertical axis intercept, including the condition for the two lines to be perpendicular at the point of intersection. |

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| **Assessment ideas** |
| Students carry out a break-even analysis for a practical situation that involves linear relationships. For example, students explore the cost and potential revenue for setting up and operating a food stall at a school function. They analyse graphs of cost and revenue for different scenarios (e.g. selling hot dogs or pies). |

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| **Resources** |
| AMSI  [Formulas](http://www.amsi.org.au/teacher_modules/Formulas.html)  NCTM Illuminations  [Exploring linear data](http://illuminations.nctm.org/Lesson.aspx?id=1189)  [Walk the plank](http://illuminations.nctm.org/Lesson.aspx?id=2347)  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_4_t_2.html)  [Grapher](http://nlvm.usu.edu/en/nav/frames_asid_109_g_4_t_2.html)  FUSE: Discover resources aligned to the Victorian Curriculum  [Sketch linear graphs using the coordinates of two points and solve linear equations (VCMNA310).](http://fuse.education.vic.gov.au/VCAA/VCMNA310) |

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| Topic 9.2.3: Indices and scientific notation | | |
| Strand:  Number and Algebra | Sub-strands:  Real numbers  Patterns and algebra | Recommended teaching time:  3 weeks (approximately 9 hours) |
| Strand:  Measurement and Geometry | Sub-strand:  Using units of measurement |

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| **Mapping to F–10 curriculum in Victoria** | | |
| **Content descriptions** | | |
| * Apply index laws to numerical expressions with integer indices ([VCMNA302](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA302)). * Express numbers in scientific notation ([VCMNA303](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA303)). * Extend and apply the index laws to variables, using positive integer indices and the zero index ([VCMNA305](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA305)). * Apply set structures to solve real-world problems ([VCMNA307](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA307)) * Investigate very small and very large time scales and intervals ([VCMMG315](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG315)). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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. | Students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, with and without the use of digital technology. Students substitute into formulas, find unknown values, manipulate linear algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital technology. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. |
| 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’ theorem and trigonometry to solve problems involving angles and lengths in right-angled triangles. | Students solve and explain surface area and volume problems relating to composite solids. They use parallel and perpendicular lines, angle and triangle properties, similarity, trigonometry and congruence to solve practical problems and develop proofs involving lengths, angles and areas in plane shapes. They use digital technology to construct and manipulate geometric shapes and objects, and explore symmetry and pattern in two dimensions. |

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| **Activities** | **Proficiencies** |
| * Index notation. * Index laws. * Zero index law. * Negative integer indices. * Simplifying and evaluating numerical expressions, involving both positive and negative integer indices. * **Algorithms and coding**: * Compare place value for base-10 integers and [binary numbers](http://csunplugged.org/binary-numbers/) ( and ). Explore the conversion from decimal (base-10) to binary numbers, noting the ‘carrying’ between the place-value columns. * Develop an algorithm and write a program, utilising appropriate set structures, to convert a set of decimal integers to [binary](https://education.ti.com/en-au/australiancurriculumnspired/aus-nz/detail?id=ABAEFC0D6557497D96174432B79642B3&t=E80CC10576A84C9285EAD0753B130F0D). * Explore the connection between [ASCII codes](https://en.wikipedia.org/wiki/ASCII) and binary numbers. * Introduction to scientific notation. * Operations with numbers using scientific notation. * Metric prefixes in scientific notation. * Very large and very small numbers in time and space measurement. | * **Understanding** through making connections between index laws and operations with very large and very small numbers expressed in scientific notation. * **Fluency** through applying the index laws flexibly to solve problems. * **Problem solving** through modelling very large distances in celestial measurement using scientific notation. * **Reasoning** through evaluating the reasonableness of answers by estimating and interpreting the order of magnitude of a calculation. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Construct scales using scientific notation to indicate order of magnitude in a range of contexts, such as income, geological time, astronomical distances.   Level 10  Students who are working at this level could:   * Investigate computatons involving formulas with several very large and/or very small quantities, where scientific notation is used to determine the order of magnitude of the final result. |

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| **Assessment ideas** |
| Students complete a task in which they simplify and evaluate numerical expressions, using both positive and negative integer indices and carry out operations in scientific notation with numbers relating to celestial measurements. |

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| **Resources** |
| AMSI  [Indices](http://www.amsi.org.au/ESA_middle_years/Year9/Year9_md/Year9_1a.html)  [Scientific notation](http://www.amsi.org.au/ESA_middle_years/Year9/Year9_md/Year9_1b.html)  [Very large and very small numbers](http://www.amsi.org.au/ESA_middle_years/Year9/Year9_md/Year9_1e.html)  NCTM Illuminations  [Exploring linear data](http://illuminations.nctm.org/Lesson.aspx?id=1189)  [Walk the plank](http://illuminations.nctm.org/Lesson.aspx?id=2347)  CS Unplugged  [Binary numbers](http://csunplugged.org/binary-numbers/)  FUSE: Discover resources aligned to the Victorian Curriculum  [Apply index laws to numerical expressions with integer indices](http://fuse.education.vic.gov.au/VCAA/VCMNA302)  [Express numbers in scientific notation](http://fuse.education.vic.gov.au/VCAA/VCMNA303)  [Extend and apply the index laws to variables, using positive integer indices and the zero index](http://fuse.education.vic.gov.au/VCAA/VCMNA305)  [Apply set structures to solve real-world problems](http://fuse.education.vic.gov.au/VCAA/VCMNA307)  [Investigate very small and very large time scales and intervals](http://fuse.education.vic.gov.au/VCAA/VCMMG315) |

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| Topic 9.2.4: Shapes, prisms and cylinders | | |
| 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** | | |
| * Calculate the areas of composite shapes [(VCMMG312)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG312). * Calculate the surface area and volume of cylinders and solve related problems [(VCMMG313)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG313). * Solve problems involving the surface area and volume of right prisms [(VCMMG314)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG314) * Apply set structures to solve real-world problems [(VCMNA307)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA307) | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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’ theorem and trigonometry to solve problems involving angles and lengths in right-angled triangles. | Students solve and explain surface area and volume problems relating to composite solids. They use parallel and perpendicular lines, angle and triangle properties, similarity, trigonometry and congruence to solve practical problems and develop proofs involving lengths, angles and areas in plane shapes. They use digital technology to construct and manipulate geometric shapes and objects, and explore symmetry and pattern in two dimensions. |

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| **Activities** | **Proficiencies** |
| * Review area of rectangles, triangles, parallelograms, trapeziums, kites and rhombuses, including some ‘reverse’ cases (see Topic 8.1.4). * Review area of a circle. * Solve area problems for composite shapes using combinations of area formulas. * Review naming of prisms. * Explore nets of prisms and cylinders and develop rules for finding the surface area of prisms and cylinders * Solve surface area problems for cylinders and prisms. * Generalise the rule for finding the volume of right cylinders and prisms and solve volume problems. * **Algorithms and coding**: develop a program that makes use of appropriate set structures to calculate the volumes of cylinders from a set of radii and a corresponding set of heights. Modify the program so that, depending on user input, it will alternatively calculate surface area, perhaps using a structure such as ‘If then else’ to decide whether to apply or . Modify further, so depending on user input, the program uses the sets of measurements to calculate volumes of cylinders, surface areas of cylinders or volumes of cones. | * **Understanding** through making connections between area, surface area and volume and recognising similarities and differences between surface area and volume formulas for different 3D objects. * **Fluency** through selecting and applying area and volume formulas appropriately and efficiently. * **Problem solving** through formulating and solving application problems involving area, surface area and volume. * **Reasoning** through explaining the solution method used in application problems involving 2D shapes and 3D objects. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Use dissection methods in conjunction with graph paper and square counting to measure the areas of various triangles and quadrilaterals.   Level 10  Students who are working at this level could:   * Investigate the relationship between side length, perimeter and area of regular polygons, and surface area and volume of related polyhedra. |

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| **Assessment ideas** |
| Students solve practical problems involving surface area and volume of prisms and cylinders and connect volume to capacity. For example, students investigate possible surface areas of cans and tetrahedral containers with a capacity of 1 litre (1000 cm3). |

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| **Resources** |
| AMSI  [Surface area and volume of prisms and cylinders:](http://www.amsi.org.au/ESA_middle_years/Year9/Year9_md/Year9_2a.html)  [Area, volume and surface area](http://www.amsi.org.au/teacher_modules/area_volume_surface_area.html)  NCTM Illuminations  [Fishing for the best prism](http://illuminations.nctm.org/Lesson.aspx?id=2911)  [Cubed cans](http://illuminations.nctm.org/Lesson.aspx?id=2904)  NLVM  (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download)  [Space blocks](http://nlvm.usu.edu/en/nav/frames_asid_195_g_4_t_3.html)  FUSE: Discover resources aligned to the Victorian Curriculum  [Calculate the areas of composite shapes](http://fuse.education.vic.gov.au/VCAA/VCMMG312)  [Calculate the surface area and volume of cylinders and solve related problems](http://fuse.education.vic.gov.au/VCAA/VCMMG313)  [Solve problems involving the surface area and volume of right prisms](http://fuse.education.vic.gov.au/VCAA/VCMMG314)  [Apply set structures to solve real-world problems](http://fuse.education.vic.gov.au/VCAA/VCMNA307) |

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| Topic 9.2.5: Statistics | | |
| 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** | | |
| * Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly from secondary sources [(VCMSP324)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP324). * Construct back-to-back stem-and-leaf plots and histograms and describe data, using terms including ‘skewed’, ‘symmetric’ and ‘bi modal’ [(VCMSP325)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP325). * Compare data displays using mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread [(VCMSP326)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMSP326) * Apply set structures to solve real-world problems [(VCMNA307)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA307) | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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. | Students compare univariate data sets by referring to summary statistics and the shape of their displays. They describe bivariate data where the independent variable is time and use scatter-plots generated by digital technology to investigate relationships between two continuous variables. Students evaluate the use of statistics in the media. They list outcomes for multi-step chance experiments involving independent and dependent events, and assign probabilities for these experiments. |

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| **Activities** | **Proficiencies** |
| * Techniques for collecting data: census, survey, observational and experimental. * Review types of data and statistical variables (see [Topic 8.1.5](file:///K:/AAA%20-%20Executive/Executive%20Assistant/Australian%20Curriculum/2014/Mathematics%20Curriculum/Sample%20Program%20Year%209%20and%2010.docx#_Topic_8.1.5_Collecting_1)). * Data investigation using the ‘statistical data investigation process’ (See AMSI’s [Data investigation and interpretation](http://www.amsi.org.au/teacher_modules/Data_Investigation-year_9.html)). * Displaying and comparing data using histograms and stem-and-leaf plots (including ‘back-to-back’ stem-and-leaf plots). * Describing the shape of the distribution of data using terms such as ‘positive skew’, ‘negative skew’ and 'symmetric' and 'bi-modal'. * Comparing means, medians and ranges of two sets of numerical data which have been displayed using histograms, dot plots, or stem-and-leaf plots. * **Algorithms and coding**: * Spreadsheets have an inbuilt command to sort a set of data in ascending or descending order. Explore how various [sorting algorithms](http://csunplugged.org/sorting-algorithms/) work. * Develop and implement a program with the following attributes. For any set of integers in random order, use a loop structure to compare each value of the set with the one immediately after it. Swap their positions if the first value is greater than the second. Observe the effect of one pass of the program. (Students should observe that the largest number in the set is now at the end). * Manually apply the program to the partly-sorted set and observe the effect of subsequent passes of the program. For any set of *n* integers, conjecture the number of passes that will guarantee that the entire set in sorted in ascending order. (Students should realise that *n* – 1 passes will guarantee this because in the second pass the second-largest number is placed second-last, and so on). * Modify the program to automatically repeat *n* – 1 passes. Improve the program so that it stops when the set is sorted, even if it is in less than *n* – 1 passes. * Statistical investigation using secondary data, such as the ABS census at school activities: [Are males better drivers?](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSMa06+ARE+MALES+BETTER+DRIVERS) or [Participation in sport](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/MAT05+Participation+in+Sport). | * **Understanding** through recognising different types of data and statistical variables, and appropriate representations of different data types. * **Fluency** through calculating appropriate summary statistics and creating appropriate displays of data. * **Problem solving** through applying the ‘statistical data investigation process’ to plan and conduct an investigation and interpret the results. * **Reasoning** through interpreting and evaluating the results of statistical investigations and making inferences about a population from sample data. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Identify when various given data distributions are symmetric, positively skewed or negatively skewed and interpret this in context   Level 10  Students who are working at this level could:   * Analyse summary statistics from text excerpts of a given type of article from different news sources to see if the source can be identified (eg from which newspaper sample text for an editorial article is likely to have come from) |

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| **Assessment ideas** |
| Students carry out a statistical investigation using a random sample of data obtained from a secondary source. For example, the ABS census at school activities: [Are males better drivers?](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/CaSMa06+ARE+MALES+BETTER+DRIVERS) or [Participation in sport](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/MAT05+Participation+in+Sport). |

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| **Resources** |
| ABS  [Year 9 Resources](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/Year+9+Resources#math)  AMSI  [Comparing data](http://www.amsi.org.au/ESA_middle_years/Year9/Year9_md/Year9_3a.html)  [Data representation and interpretation](http://www.amsi.org.au/teacher_modules/Data_Investigation-year_9.html)  CS Unplugged  [Sorting algorithms](http://csunplugged.org/sorting-algorithms/)  FUSE: Discover resources aligned to the Victorian Curriculum  [Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly from secondary sources](http://fuse.education.vic.gov.au/VCAA/VCMSP324)  [Compare data displays using mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread](http://fuse.education.vic.gov.au/VCAA/VCMSP326)  [Apply set structures to solve real-world problems](http://fuse.education.vic.gov.au/VCAA/VCMNA307) |

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| Topic 9.2.6: Further algebra | | |
| 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** | | |
| * Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate [(VCMNA306)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA306). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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. | Students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, with and without the use of digital technology. Students substitute into formulas, find unknown values, manipulate linear algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital technology. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. |

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| **Activities** | **Proficiencies** |
| * Application of the distributive law to expand algebraic expressions, including pairs of binomials. * Generalisation of numerical models, such as 2 x 2 number expansion, to explain and visualise algebraic expansion. * Area models (such as algebra tiles) to visualise the distributive law. * Difference of squares and the identities for the square of a sum and the square of a difference. * The relationship between factorisation and expansion, including visualising this with area models. * Factorising using common factors, perfect squares and difference of squares. * Identifying linear factors for simple monic quadratic trinomials. * Quadratic equations in factorised form and the null factor law and substitution to test the answer. * Solving quadratic equations involving difference of squares. * Solving quadratic equations involving simple monic quadratic trinomials. | * **Understanding** through connecting and generalising the distributive law and factorisation in arithmetic processes to symbolic expressions. * **Fluency** through applying the distributive law to binomial expressions and expanding and factorising quadratic expressions. * **Problem solving** through modelling expansion and factorisation of quadratic expressions with algebra tiles and other area models. * **Reasoning** through explaining the relationship between expansion and factorisation and identifying algebraic factors in algebraic expressions. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Explore the relationship between the distributive property for multiplication over addition and the structure of different algorithms for by hand multiplication.   Level 10  Students who are working at this level could:   * Use a computer algebra system to identify the values of the constant term which for a given coefficent of x lead to no, one or two roots for the quadratic equated to zero. |

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| **Assessment ideas** |
| Students respond to a set of problems requiring them to expand and factorise quadratic expressions and to represent some of these expressions using area models. Algebraic reasoning could be assessed by gathering data that indicate the degree to which the student makes generalisations and expresses the generalisations using appropriate language and symbols. |

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| **Resources** |
| AMSI  [Special expansions and algebraic fractions](http://www.amsi.org.au/teacher_modules/special_expansions_algbrc_fracs.html)  [Factorisation](http://www.amsi.org.au/teacher_modules/Factorisation.html)  [Quadratic equations](http://www.amsi.org.au/teacher_modules/Quadratic_Equations.html)  NCTM Illuminations  [Difference of squares](http://illuminations.nctm.org/Lesson.aspx?id=1581)  NLVM  (Note: Some web browsers may not support the NLVM Java plug-in. An off-line NLVM app is available for download)  [Algebra tiles](http://nlvm.usu.edu/en/nav/frames_asid_189_g_4_t_2.html)  FUSE: Discover resources aligned to the Victorian Curriculum  [Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate](http://fuse.education.vic.gov.au/VCAA/VCMNA306) |

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| **Notes** |
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| Topic 9.2.7: Graphs of non-linear relations | | |
| 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** | | |
| * Graph simple non-linear relations with and without the use of digital technologies and solve simple related equations [(VCMNA311)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA311). | | |
| **Achievement standard (excerpt in bold)** | | |
| Level 8 | Level 9 | Level 10 |
| 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.** | Students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, with and without the use of digital technology. Students substitute into formulas, find unknown values, manipulate linear algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital technology. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. |

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| **Activities** | **Proficiencies** |
| * The graph of the parabola . * Using technology to explore families of graphs, including simple transformations of : graphs of the form , . * Graphs of  that can be expressed in the form , where *p* and *q* are integers. Use technology to explore patterns to assist with finding the values of *p* and *q*. * The connection between linear factors, solutions to the equation  and the *x*-axis intercepts of the graph of . * Graphs of the form and , as a translation of  and as a special case of . * Using technology to explore graphs of the form ; the coordinates of the vertex and the axis of symmetry. | * **Understanding** through connecting the *x*-axis intercepts of a graph to the related linear factors and the related equation. * **Fluency** through plotting points accurately and sketching graphs from equations and labelling key features. * **Problem solving** through recognising that every quadratic graph is a transformation of , and using this knowledge as an aid for sketching parabolas from their equations. * **Reasoning** through explaining how different equivalent forms of an equation highlight different features of the corresponding graph. |

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| **Considering different levels of student ability** |
| Level 8  Students who are working at this level could:   * Explore the relationship between simple quadratic sequences defined by tables of values with a constant second difference and the corresponding parabolic graphs.   Level 10  Students who are working at this level could:   * Use graphical guess – check and refine method to identify a sequence of nested intervals containing a solution for equations of the form: quadratic = constant, quadratic = linear and quadratic = quadratic. |

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| **Assessment ideas** |
| Students carry out an investigation where they explore possible equations of real world objects that can be modelled with a quadratic function, such as the arch of a bridge and the curve formed by a chain hanging between two posts. |

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| **Resources** |
| AMSI  [Quadratic equations](http://www.amsi.org.au/teacher_modules/Quadratic_Equations.html)  [The quadratic function](http://www.amsi.org.au/teacher_modules/Quadratic_Function.html)  NCTM Illuminations  [Hanging chains](http://illuminations.nctm.org/Lesson.aspx?id=2105)  CIMT  [Quadratic functions](http://www.cimt.org.uk/projects/mepres/step-up/sect2/index.htm)  FUSE: Discover resources aligned to the Victorian Curriculum  [Graph simple non-linear relations with and without the use of digital technologies and solve simple related equations](http://fuse.education.vic.gov.au/VCAA/VCMNA311) |

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