



Mathematics

Essential Learnings by the end of **Year 9**

Learning and assessment focus

Students build on their existing understandings of mathematical concepts and can relate mathematics to real-life and purely mathematical situations. Through engagement in familiar and unfamiliar, and simple and complex, mathematical investigations they understand that mathematics is a way of thinking, reasoning and working that is used to develop solutions to questions, problems and issues posed by themselves and others. They recognise the application of mathematics in a large number of fields that provide career opportunities.

Students use the essential processes of **Ways of working** to develop and demonstrate their **Knowledge and understanding**. They develop their ability to work mathematically and build on their prior understanding by individually and collaboratively planning and conducting mathematical investigations; by posing and solving mathematical questions, problems and issues; and by challenging the reasoning and perspectives of others. They reflect on their learning and transfer their thinking and reasoning to a range of real-life and purely mathematical situations.

Students select and use tools and technologies, including information and communication technologies (ICTs). They routinely demonstrate an autonomous and purposeful use of ICTs to inquire, create and communicate within mathematical contexts

Students demonstrate evidence of their learning over time in relation to the following assessable elements:

- knowledge and understanding
- thinking and reasoning
- communicating
- reflecting.

Ways of working

Students are able to:

- analyse situations to identify the key mathematical features and conditions, strategies and procedures that may be relevant in the generation of a solution
- pose and refine questions to confirm or alter thinking and develop hypotheses and predictions
- plan and conduct activities and investigations, using valid strategies and procedures to solve problems
- select and use mental and written computations, estimations, representations and technologies to generate solutions and to check for reasonableness of the solution
- use mathematical interpretations and conclusions to generalise reasoning and make inferences
- evaluate their own thinking and reasoning, considering their application of mathematical ideas, the efficiency of their procedures and opportunities to transfer results into new learning
- communicate thinking, and justify and evaluate reasoning and generalisations, using mathematical language, representations and technologies
- reflect and identify the contribution of mathematics to their own and other people's lives
- reflect on learning, apply new understandings and justify future applications.

Knowledge and understanding

Number

Number properties and operations and a range of strategies can be applied when working with integers and rational numbers.

- Rational numbers (integers, fractions and decimals) can be represented and described in different ways, including using scientific notation and index notation, for a variety of purposes
e.g. the distance to the Moon is approximately $400\,000\text{ km} = 4.00 \times 10^5 = 4.00\text{ E}5$; $\frac{7}{10} = 7 \times 10^{-1} = 0.7$.
- Rational numbers (integers, fractions and decimals) can be used to describe and solve problems involving rate, ratio, proportion and percentage
e.g. if the exchange rate for one Australian dollar is 0.7624 US dollars, find how many US dollars A\$550 buys.
- Rational numbers, and decimal approximations of irrational numbers including π , can be represented on the real number line.
- Decimal approximations of irrational numbers can be used in geometric contexts
e.g. when finding the area of a circle, represent π as 3.14.
- Estimates with upper and lower boundaries can be formed
e.g. when splitting a \$245 restaurant bill between 6 people, each share will be between \$40 and \$50.
- Problems can be interpreted and solved using rational and irrational numbers, including integers, simple powers and square roots, and conventions of the four operations to generate solutions using mental, written and technology-assisted strategies
e.g. 20 billion divided by 350 000; $(67.43 + 104.512 - 89.99) \div 241$.
- Financial decisions can be made based on the analysis of short- and long-term benefits and consequences of cash, credit and debit transactions
e.g. cost-benefit analysis of a variety of mobile phone plans.
- Financial transactions for the provision of goods and services may incur additional costs determined by government and organisations
e.g. Goods and Services Tax; transaction fees on everyday bank accounts.

Algebra

Variables, algebraic expressions and equations, relationships and functions can be described, represented and interpreted.

- Variables and constants are represented using words and symbols when writing expressions and equations
e.g. $V = \pi r^2 h$ where V is the volume of a cylinder in m^3 , r is the radius in m , and h is the height in m .
- Algebraic relationships can be modelled, interpreted and evaluated using integer, decimal and fraction values of variables
e.g. explore the relationship between area, width and length of a rectangle where the area equals 100 cm^2 .
- Inverse, associative, commutative and distributive properties can be used to manipulate and rearrange algebraic expressions that involve the four operations, reciprocals, whole-number powers and square roots
e.g. rearrange $p = 3q - 2$ to obtain $q = \frac{(p+2)}{3}$
- Linear and some non-linear equations related to real-life problems can be represented and solved using a variety of methods
e.g. find the time taken to travel 300 km at an average speed of 85 km/h ; determine the approximate dimensions of a rectangle with area 100 cm^2 , width w and length 3 cm greater than its width.
- Tables of values constructed for linear and simple non-linear functions can be graphed
e.g. tables of values for the relationship $vt = 6$, where v represents the average speed in km/h and t represents the time travelled in hours, are constructed and graphed.

Measurement

Units of measure, instruments, formulas and strategies can be used to estimate and calculate measurement and consider reasonable error.

- Instruments, technologies, strategies and formulas are used to estimate, compare and calculate measures and derived measures, including rate, area, duration and Australian time zone differences
e.g. average speed in km/h to determine time needed to complete a journey.
- Relationships exist between units of equivalent measure and are used to make conversions of units
e.g. use 4.5 hectares instead of $45\,000 \text{ m}^2$ to state the area of a parcel/block of land.
- Lengths and angles that cannot be measured directly can be investigated using scale, similarity or trigonometry
e.g. finding the height of a building using the angle of elevation and the distance to the base of the building; calculating distances from maps.
- Judgments can be made about acceptable error of measurement and error can be compounded by repetition and calculation
e.g. cutting three pieces of material to an accuracy of 3 mm from a single piece may give a total error of up to 9 mm ; when measuring the sides of a pentagon to find its perimeter, if each measurement has a 1 mm error the perimeter calculation may be incorrect by up to 5 mm .

Chance and data

Judgments can be based on theoretical or experimental probability. Data can be displayed in various ways and analysed to make inferences and generalisations.

- Data can be gathered from samples and surveys, experiments and simulations, published data and databases, and used to estimate probabilities of events and to respond to claims and questions
e.g. health statistics, such as the 1 in 10 chance of non-immunised people getting influenza in a given year, can be used to predict the number of people likely to suffer from influenza in a year.
- Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry
e.g. a grid for the scores when two six-sided dice are rolled; a tree diagram for the combination of results obtained by spinning a six-coloured spinner and tossing a coin.
- Data interpretation is simplified through the use of suitable representations and descriptive statistics
e.g. using two-way tables, histograms, stem and leaf plots and measures of location.
- Simple measures of spread and centre, distribution of responses, and the effect of bias and outliers on the measures of location are used to make inferences
e.g. the proportion of people who think the leader of a political party is doing a poor, satisfactory or good job in relation to age group can be used to make inferences about the popularity of the political party.

Space

Geometric conventions can be used to describe, represent, construct and manipulate a range of complex geometric shapes. Mapping conventions can be used to represent location, distance and orientation in maps and plans.

- Geometric conventions are used to describe a variety of 2D shapes and 3D objects, including curved surfaces, and compound and embedded shapes
e.g. using geometric terms, the diagonals of a rhombus bisect each other at right angles; use of geometric symbols to indicate parallel, perpendicular and congruent lines.
- 2D shapes and 3D objects and their cross-sections can be represented as sketches, drawings or electronic images, using specifications and conventions to identify and show geometric properties
e.g. draw various cross-sections of product packaging.
- 3D objects can be constructed from plans, cross-sections, nets, and isometric and perspective diagrams
e.g. construct a soccer ball from a net of its stitching pattern, involving a tessellation of pentagons and hexagons.
- Congruence, similarity, sequences of transformations, and symmetry are used to analyse geometric properties
e.g. compare geometric properties of triangles to determine congruence or similarity.
- Deductions about geometric properties can be supported by proofs related to angle properties associated with parallel, perpendicular and transverse lines and polygons
e.g. when two straight lines intersect, opposite angles are equal; the sum of the interior angles of a quadrilateral with 4 sides.
- Maps and plans using scale, coordinates, distance, bearing, angles, keys and annotations can be constructed and used to specify location and represent spatial relationships, as well as distance and orientation between locations
e.g. orienteering or bushwalking; shortest and alternative pathways around venues such as amusement parks.