The Australian Curriculum

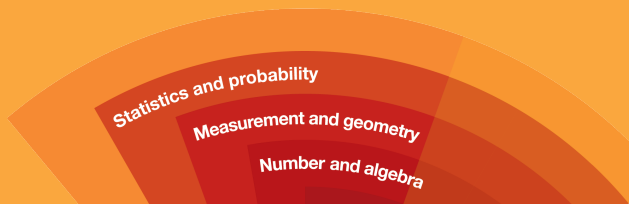
Learning areas	Mathematics
Year levels	Foundation Year, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 10A
Curriculum version	Version 1.2
Dated	Tuesday, 8 March 2011

acara AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

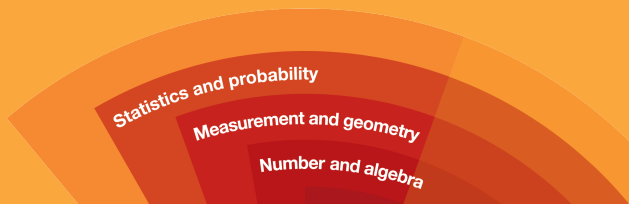
The Australian Curriculum
Mathematics

acara AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

Mathematics



Rationale and Aims



Rationale

Learning mathematics creates opportunities for and enriches the lives of all Australians. The Australian Curriculum: Mathematics provides students with essential mathematical skills and knowledge in **Number and Algebra**, **Measurement and Geometry**, and **Statistics and Probability**. It develops the numeracy capabilities that all students need in their personal, work and civic life, and provides the fundamentals on which mathematical specialties and professional applications of mathematics are built.

Mathematics has its own value and beauty and the Australian Curriculum: Mathematics aims to instil in students an appreciation of the elegance and power of mathematical reasoning. Mathematical ideas have evolved across all cultures over thousands of years, and are constantly developing. Digital technologies are facilitating this expansion of ideas and providing access to new tools for continuing mathematical exploration and invention. The curriculum focuses on developing increasingly sophisticated and refined mathematical understanding, fluency, logical reasoning, analytical thought and problem-solving skills. These capabilities enable students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

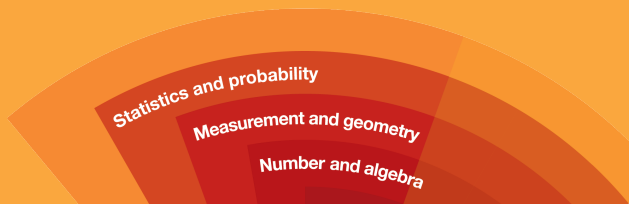
The Australian Curriculum: Mathematics ensures that the links between the various components of mathematics, as well as the relationship between mathematics and other disciplines, are made clear. Mathematics is composed of multiple but interrelated and interdependent concepts and systems which students apply beyond the mathematics classroom. In science, for example, understanding sources of error and their impact on the confidence of conclusions is vital, as is the use of mathematical models in other disciplines. In geography, interpretation of data underpins the study of human populations and their physical environments; in history, students need to be able to imagine timelines and time frames to reconcile related events; and in English, deriving quantitative and spatial information is an important aspect of making meaning of texts.

The curriculum anticipates that schools will ensure all students benefit from access to the power of mathematical reasoning and learn to apply their mathematical understanding creatively and efficiently. The mathematics curriculum provides students with carefully paced, in-depth study of critical skills and concepts. It encourages teachers to help students become self-motivated, confident learners through inquiry and active participation in challenging and engaging experiences.

Aims

The Australian Curriculum: Mathematics aims to ensure that students:

- are confident, creative users and communicators of mathematics, able to investigate, represent and interpret situations in their personal and work lives and as active citizens
- develop an increasingly sophisticated understanding of mathematical concepts and fluency with processes, and are able to pose and solve problems and reason in **Number and Algebra, Measurement and Geometry, and Statistics and Probability**
- recognise connections between the areas of mathematics and other disciplines and appreciate mathematics as an accessible and enjoyable discipline to study.



Content structure

The Australian Curriculum: Mathematics is organised around the interaction of three content strands and four proficiency strands.

The content strands are *Number and Algebra*, *Measurement and Geometry*, and *Statistics and Probability*. They describe what is to be taught and learnt.

The proficiency strands are *Understanding*, *Fluency*, *Problem Solving*, and *Reasoning*. They describe how content is explored or developed, that is, the thinking and doing of mathematics. They provide the language to build in the developmental aspects of the learning of mathematics and have been incorporated into the content descriptions of the three content strands described above. This approach has been adopted to ensure students' proficiency in mathematical skills develops throughout the curriculum and becomes increasingly sophisticated over the years of schooling.

Content strands

Number and Algebra

Number and Algebra are developed together, as each enriches the study of the other. Students apply number sense and strategies for counting and representing numbers. They explore the magnitude and properties of numbers. They apply a range of strategies for computation and understand the connections between operations. They recognise patterns and understand the concepts of variable and function. They build on their understanding of the number system to describe relationships and formulate generalisations. They recognise equivalence and solve equations and inequalities. They apply their number and algebra skills to conduct investigations, solve problems and communicate their reasoning.

Measurement and Geometry

Measurement and Geometry are presented together to emphasise their relationship to each other, enhancing their practical relevance. Students develop an increasingly sophisticated understanding of size, shape, relative position and movement of two-dimensional figures in the plane and three-dimensional objects in space. They investigate properties and apply their understanding of them to define, compare and construct figures and objects. They learn to develop geometric arguments. They make meaningful measurements of quantities, choosing appropriate metric units of measurement. They build an understanding of the connections between units and calculate derived measures such as area, speed and density.

Statistics and Probability

Statistics and Probability initially develop in parallel and the curriculum then progressively builds the links between them. Students recognise and analyse data and draw inferences. They represent, summarise and interpret data and undertake purposeful investigations involving the collection and interpretation of data. They assess likelihood and assign probabilities using experimental and theoretical approaches. They develop an increasingly sophisticated ability to critically evaluate chance and data concepts and make reasoned judgments and decisions, as well as building skills to critically evaluate statistical information and develop intuitions about data.

Proficiency strands

The proficiency strands describe the actions in which students can engage when learning and using the content. While not all proficiency strands apply to every content description, they indicate the breadth of mathematical actions that teachers can emphasise.

Understanding

Students build a robust knowledge of adaptable and transferable mathematical concepts. They 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, when they represent concepts in different ways, when they identify commonalities and differences between aspects of content, when they describe their thinking mathematically and when they interpret mathematical information.

Fluency

Students develop 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 calculate answers efficiently, when they recognise robust ways of answering questions, when they choose appropriate methods and approximations, when they recall definitions and regularly use facts, and when they can manipulate expressions and equations to find solutions.

Problem Solving

Students develop the ability to make choices, interpret, formulate, model and investigate problem situations, and communicate solutions effectively. Students formulate and solve problems when they use mathematics to represent unfamiliar or meaningful situations, when they design investigations and plan their approaches, when they apply their existing strategies to seek solutions, and when they verify that their answers are reasonable.

Reasoning

Students develop an increasingly sophisticated capacity for logical thought and actions, such as analysing, proving, evaluating, explaining, inferring, justifying and generalising. Students are reasoning mathematically when they explain their thinking, when they deduce and justify strategies used and conclusions reached, when they adapt the known to the unknown, when they transfer learning from one context to another, when they prove that something is true or false and when they compare and contrast related ideas and explain their choices.

Content descriptions

The mathematics curriculum includes content descriptions at each year level. These describe the knowledge, concepts, skills and processes that teachers are expected to teach and students are expected to learn. However, they do not prescribe approaches to teaching. The content descriptions are intended to ensure that learning is appropriately ordered and that unnecessary repetition is avoided. However, a concept or skill introduced at one year level may be revisited, strengthened and extended at later year levels as needed.

Sub-strands

Content descriptions are grouped into sub-strands to illustrate the clarity and sequence of development of concepts through and across the year levels. They support the ability to see the connections across strands and the sequential development of concepts from Foundation to Year 10.

Number and Algebra	Measurement and Geometry	Statistics and Probability

Number and place value (F-8)	*Using units of measurement* *(F-10)*	*Chance (1-10)*
Fractions and decimals (1-6)	*Shape (F-7)*	*Data representation and interpretation (F-10)*
Real numbers (7-10)	*Geometric reasoning (3-10)*	
Money and financial mathematics (1-10)	*Location and transformation* *(F-7)*	
Patterns and algebra (F-10)	*Pythagoras and trigonometry (9-10)*	
Linear and non-linear relationships (8-10)		

Year level descriptions

Year level descriptions emphasise the importance of working mathematically within the content. They provide an overview of the relationship between the proficiencies (*Understanding, Fluency, Problem Solving* and *Reasoning*) and the content for each year level.

Content elaborations

Content elaborations are provided for Foundation to Year 10 to illustrate and exemplify content and assist teachers to develop a common understanding of the content descriptions. They are not intended to be comprehensive content points that all students need to be taught.

Glossary

A glossary is provided to support the common understanding of key terms in the content descriptions.

This support document contains additional information to support the glossary.

Mathematics across Foundation to Year 12

Although the curriculum is described year by year, this document provides advice across four year groupings on the nature of learners and the relevant curriculum:

- Foundation – Year 2: typically students from 5 to 8 years of age
- Years 3–6: typically students from 8 to 12 years of age
- Years 7–10: typically students from 12 to 15 years of age
- Senior secondary years: typically students from 15 to 18 years of age.

Foundation – Year 2

The early years (5–8 years of age) lay the foundation for learning mathematics. Students at this level can access powerful mathematical ideas relevant to their current lives and learn the language of mathematics, which is vital to future progression.

Children have the opportunity to access mathematical ideas by developing a sense of number, order, sequence and pattern; by understanding quantities and their representations; by learning about attributes of objects and collections, position, movement and direction, and by developing an awareness of the collection, presentation and variation of data and a capacity to make predictions about chance events.

Understanding and experiencing these concepts in the early years provides a foundation for algebraic, statistical and multiplicative thinking, that will develop in subsequent years. These foundations also enable children to pose basic mathematical questions about their world, to identify simple strategies to investigate solutions, and to strengthen their reasoning to solve personally meaningful problems.

Years 3–6

These years emphasise the importance of students studying coherent, meaningful and purposeful mathematics that is relevant to their lives. Students still require active experiences that allow them to construct key mathematical ideas, but also gradually move to using models, pictures and symbols to represent these ideas.

The curriculum develops key understandings by extending the number, measurement, geometric and statistical learning from the early years; by building foundations for future studies through an emphasis on patterns that lead to generalisations; by describing relationships from data collected and represented; by making predictions; and by introducing topics that represent a key challenge in these years, such as fractions and decimals.

In these years of schooling, it is particularly important for students to develop a deep understanding of whole numbers to build reasoning in fractions and decimals and to develop a conceptual understanding of place value. These concepts allow students to develop proportional reasoning and flexibility with number through mental computation skills, and to extend their number sense and statistical fluency.

Years 7–10

These years of school mark a shift in mathematics learning to more abstract ideas. Through key activities such as the exploration, recognition and application of patterns, the capacity for abstract thought can be developed and the ways of thinking associated with abstract ideas can be illustrated.

The foundations built in previous years prepare students for this change. Previously established mathematical ideas can be drawn upon in unfamiliar sequences and combinations to solve non-routine problems and to consequently develop more complex mathematical ideas. However, students of this age also need an understanding of the connections between mathematical concepts and their application in their world as a motivation to learn. This means using contexts directly related to topics of relevance and interest to this age group.

During these years, students need to be able to represent numbers in a variety of ways; to develop an understanding of the benefits of algebra, through building algebraic models and applications and the various applications of geometry; to estimate and select appropriate units of measure; to explore ways of working with data to allow a variety of representations; and to make predictions about events based on their observations.

The intent of the curriculum is to encourage the development of important ideas in more depth, and to promote the interconnectedness of mathematical concepts. An obvious concern is the preparation of students intending to continue studying mathematics in the senior secondary years. Teachers will, in implementing the curriculum, extend the more mathematically able students by using appropriate challenges and extensions within available topics. A deeper understanding of mathematics in the curriculum enhances a student's potential to use this knowledge to solve non-routine problems, both at this level of study and at later stages.

The 10A content is optional and is intended for students who require more content to enrich their mathematical study whilst completing the common Year 10 content. It is NOT anticipated that all students will attempt the 10A content, but doing so would be advantageous for students intending to pursue Mathematical Methods (Course C) or Specialist Mathematics (Course D) in the senior secondary years. A selection of topics from the 10A curriculum can be completed according to the needs of the students.

It is anticipated that all students will study the Australian Curriculum: Mathematics up to the end of Year 10. From Year 10, the curriculum should provide pathway options suitable for students of differing abilities and interests, and with a range of future career and study plans.

Senior secondary years

Four mathematics courses have been designed for the senior secondary years. They have been designed to allow flexibility for students, taking into account a range of future pathways and the reality that some students reassess their choice of mathematics program part way through the senior secondary years.

The elements of the content strands from Foundation to Year 10 are evident in the senior secondary curriculum, but are not used as the major organisers. The proficiency strands of Understanding, Fluency, Reasoning and Problem Solving are integrated into the content descriptions as in the Foundation to Year 10 curriculum.

Achievement Standards

Across Foundation to Year 10, achievement standards indicate the quality of learning that students should typically demonstrate by a particular point in their schooling. Achievement standards comprise a written description and student work samples.

An achievement standard describes the quality of learning (the extent of knowledge, the depth of understanding, and the sophistication of skills) that would indicate the student is well placed to commence the learning required at the next level of achievement.

The sequence of achievement standards across Foundation to Year 10 describes progress in the learning area. This sequence provides teachers with a framework of growth and development in the learning area.

Student work samples play a key role in communicating expectations described in the achievement standards. Each work sample includes the relevant assessment task, the student's response, and annotations identifying the quality of learning evident in the student's response in relation to relevant parts of the achievement standard.

Together, the description of the achievement standard and the accompanying set of annotated work samples help teachers to make judgments about whether students have achieved the standard.

Diversity of Learners

The Australian Curriculum has been developed to ensure that curriculum content and achievement standards establish high expectations for all students. Every student is entitled to enriching learning experiences across all areas of the curriculum. Students in Australian classrooms have multiple, diverse and changing needs that are shaped by individual learning histories and abilities as well as cultural language backgrounds and socio-economic factors.

Special education needs

The objectives of the Australian Curriculum are the same for all students. The curriculum offers flexibility for teachers to tailor their teaching in ways that provide rigorous, relevant and engaging learning and assessment opportunities for students with special education needs.

Most students with special education needs can engage with the curriculum provided the necessary adjustments are made to the complexity of the curriculum content and to the means through which students demonstrate their knowledge, skills and understanding.

For some learners, making adjustments to instructional processes and to assessment strategies enables students to achieve educational standards commensurate with their peers.

For other students, teachers will need to make appropriate adjustments to the complexity of the curriculum content, focusing instruction on content different to that taught to others in their age group. It follows that adjustments will also need to be made to how the student's progress is monitored, assessed and reported.

For a small percentage of students, the Foundation to Year 10 curriculum content and achievement standards may not be appropriate nor meaningful, even with adjustments. Most of these students have a significant intellectual disability. During 2011, ACARA will develop additional curriculum content and achievement standards for this group of students in order to provide an Australian Curriculum that is inclusive of every learner.

Further advice and guidance are available about how to use each learning area and the curriculum generally for these students.

English as an additional language or dialect

Many students in Australian schools are learners of English as an additional language or dialect (EAL/D). Learners of EAL/D are students whose first language is a language other than Standard Australian English and who require additional support to assist them to develop English language proficiency. While many EAL/D learners do well in school, there is a significant group of these learners who leave school without achieving their potential.

EAL/D students come from diverse backgrounds and may include:

- overseas- and Australian-born children whose first language is a language other than English
- Aboriginal and Torres Strait Islander students whose first language is an Indigenous language, including traditional languages, creoles and related varieties, or Aboriginal English.

EAL/D learners enter Australian schools at different ages and at different stages of English language learning and have various educational backgrounds in their first languages. For some, school is the only place they use English.

The aims of the Australian Curriculum: Mathematics are ultimately the same for all students. However, EAL/D learners are simultaneously learning a new language and the knowledge, understanding and skills of the mathematics curriculum through that new language. They require additional time and support, along with informed teaching that explicitly addresses their language needs, and assessments that take into account their developing language proficiency.

A national EAL/D document is being produced that will support the Australian Curriculum. It will provide a description of how language proficiency develops, and will be a valuable reference for all teachers. It will allow mathematics teachers to identify the language levels of the EAL/D learners in their classrooms and to address their specific learning requirements when teaching, ensuring equity of access to the mathematics learning area for all.

General capabilities

The skills, behaviours and attributes that students need to succeed in life and work in the twenty-first century have been identified in the Australian Curriculum as general capabilities. There are seven general capabilities:

- literacy
- numeracy
- competence in information and communication technology (ICT)
- critical and creative thinking
- ethical behaviour
- personal and social competence
- intercultural understanding.

Over the course of their schooling, students develop and use these general capabilities within and across learning areas and in their lives outside school. General capabilities and learning areas have a reciprocal relationship. Learning areas provide opportunities for students to develop and use general capabilities. Similarly, wherever general capabilities are made explicit in learning areas, they can enrich and deepen learning. In the Australian Curriculum: Mathematics, each of the seven general capabilities is embedded (where appropriate) in the content descriptions or elaborations. There are further opportunities to develop the general capabilities through appropriate teaching activities.

Literacy

Students become literate as they develop the skills to learn and communicate confidently at school and to become effective individuals, community members, workers and citizens. These skills include listening, reading and viewing, writing, speaking and creating print, visual and digital materials accurately and purposefully within and across all learning areas.

Literacy is an important aspect of mathematics. Students need to understand written problems and instructions; ellipsis (for example, ‘convert your age to days, then hours, minutes and finally seconds’); synonyms (for example, ‘subtract’, ‘take away’, ‘minus’); imperatives (for example, ‘circle the correct answer’); the passive voice (for example, ‘if 7 is taken from 10…’); nominalisations (for example, ‘product’, ‘quotient’); technical terminology (for example, ‘digits’, ‘lowest common denominator’), including the use of common words with a specific meaning in a mathematical context (for example ‘find the value of x’ requires more than searching, it implies problem solving), and metaphorical language used to express mathematics concepts and processes.

Numeracy

Students become numerate as they develop the capacity to recognise and understand the role of mathematics in the world around them and the confidence, willingness and ability to apply mathematics to their lives in ways that are constructive and meaningful.

Mathematics makes a special contribution to the development of numeracy in a manner that is more explicit and foregrounded than is the case in other learning areas. It is important that the mathematics curriculum provides the opportunity to apply mathematical understanding and skills in context, both in other learning areas

and in real world contexts. A particularly important context for the application of Number and Algebra is financial mathematics. In Measurement and Geometry, there is an opportunity to apply understanding to design. The twenty-first century world is information driven, and through Statistics and Probability students can interpret data and make informed judgments about events involving chance.

Information and communication technology (ICT) competence

Students develop ICT competence as they learn to use ICT effectively and appropriately when investigating, creating and communicating ideas and information at school, at home, at work and in their communities. ICT competence allows students to solve problems and readily perform previously onerous tasks. Calculators of all types, from the simple four-operations versions to more complex graphical and CAS calculators, can be used to make calculations, draw graphs and interpret data in ways that have previously not been possible. Digital technologies, such as spreadsheets, dynamic geometry software and computer algebra software, can engage students and promote understanding of key concepts. However, there will be occasions where teachers will ask students to undertake tasks without using technology.

Critical and creative thinking

Students develop critical and creative thinking as they learn to generate and evaluate knowledge, ideas and possibilities, and use them when seeking new pathways or solutions. In the context of schooling, critical and creative thinking are integral to activities that require reason, logic, imagination and divergence.

Critical and creative thinking is key to the development of mathematical understanding. Critical thinking is used in the proficiency strands of Reasoning and Problem Solving. Engaging students in reasoning and thinking about solutions to problems, and the strategies needed to find these solutions, are core parts of the mathematics curriculum. For example, students are encouraged to be critical thinkers in justifying their choice of a particular calculation strategy or in identifying the questions that need to be answered when undertaking a statistical investigation.

Creative thinking is essential to mathematical problem solving. The mathematics curriculum encourages students to look for alternative ways to approach problems. For example, identifying when a problem is similar to a previous one or drawing diagrams or simplifying a problem to control some variables, are strategies students will develop to find solutions.

Ethical behaviour

Students develop ethical behaviour as they learn to understand and act in accordance with ethical principles. This includes understanding the role of ethical principles, values and virtues in human life; acting with moral integrity; acting with regard for others, and having a desire and capacity to work for the common good.

There are opportunities in the mathematics curriculum to develop and apply ethical behaviour in a range of contexts; for example, in the selection and interpretation of data and statistics for different purposes.

Personal and social competence

Students develop personal and social competence as they learn to understand and manage themselves, their relationships, lives, work and learning more effectively. This involves recognising and regulating their emotions, developing concern and understanding of others, establishing positive relationships, making responsible decisions, working effectively in teams and handling challenging situations constructively.

The elements of personal and social competence relevant to mathematics include the application of mathematical skills for personal purposes, such as the use of timetables, budgeting and personal problem solving, which are all important skills in self-management.

Students' capacities to work in teams in undertaking explorations and investigations are another important part of learning to be mathematicians.

Intercultural understanding

Students develop intercultural understanding as they learn to understand themselves in relation to others. This involves students valuing their own cultures and beliefs and those of others, and engaging with people of diverse cultures in ways that recognise commonalities and differences, create connections and cultivate respect between people.

Intercultural understanding can be enhanced if students are exposed to a range of cultural traditions in mathematics. For example, through examining Aboriginal and Torres Strait Islander people's perceptions of time and weather patterns, the networks embedded in family relationships and the algebraic concepts inherent in storytelling students' broader cultural knowledge is enriched. It is also important for mathematics classes to explore the influences of many cultures in the development of mathematical thinking.

Cross-curriculum priorities

There are three cross curriculum priorities in the Australian Curriculum:

- Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia's engagement with Asia
- Sustainability.

The cross curriculum priorities are embedded in the curriculum and will have a strong but varying presence depending on their relevance to each of the learning areas.

Aboriginal and Torres Strait Islander histories and cultures

Aboriginal and Torres Strait Islander communities are strong, rich and diverse. Aboriginal and Torres Strait Islander Identity is central to this priority and is intrinsically linked to living, learning Aboriginal and Torres Strait Islander communities, deep knowledge traditions and holistic world view.

A conceptual framework based on Aboriginal and Torres Strait Islander Peoples' unique sense of Identity has been developed as a structural tool for the embedding of Aboriginal and Torres Strait Islander histories and cultures within the Australian curriculum. This sense of Identity is approached through the interconnected aspects of Country/Place, People and Culture. Embracing these elements enhances all areas of the curriculum.

The Aboriginal and Torres Strait Islander priority provides opportunities for all learners to deepen their knowledge of Australia by engaging with the world's oldest continuous living cultures. This knowledge and understanding will enrich their ability to participate positively in the ongoing development of Australia.

The Australian Curriculum: mathematics values Aboriginal and Torres Strait Islander histories and cultures. It provides opportunities for students to appreciate that Aboriginal and Torres Strait Islander societies have sophisticated applications of mathematical concepts.

Students will explore connections between representations of number and pattern and how they relate to aspects of Aboriginal and Torres Strait Islander cultures. They will investigate time, place, relationships and measurement concepts in Aboriginal and Torres Strait Islander contexts. Students will deepen their understanding of the lives of Aboriginal and Torres Strait Islander Peoples through the application and evaluation of statistical data.

Asia and Australia's engagement with Asia

The Asia and Australia's engagement with Asia priority provides a regional context for learning in all areas of the curriculum. China, India and other Asian nations are growing rapidly and the power and influence they have in all areas of global endeavour is extensive. An understanding of Asia underpins the capacity of Australian students to be active and informed citizens working together to build harmonious local, regional and global communities, and build Australia's social, intellectual and creative capital.

This priority is concerned with Asia literacy for all Australian students. Asia literacy develops knowledge, skills and understanding about the histories, geographies, cultures, arts, literatures and languages of the diverse countries of our region. It fosters social inclusion in the Australian community. It enables students to communicate and engage with the peoples of Asia so they can effectively live, work and learn in the region. Australia now has extensive engagement with Asia in areas such as trade, investment, immigration, tourism, education and humanitarian assistance and this engagement is vital to the prosperity of all Australians.

The Australian Curriculum: mathematics provides opportunities for students to learn about the understandings and applications of mathematics in Asia. In the past, mathematicians from the Asia region have made significant contributions to the development of the human understanding of number, algebra and trigonometry. Mathematicians from Asia continue to contribute to the ongoing development of mathematical understanding.

In this learning area, students investigate the concept of chance using Asian games. They explore the way Asian societies apply other mathematical concepts such as patterns and symmetry in art and architecture. Investigations involving data collection and representation can be used to examine issues pertinent to the Asia region.

Sustainability

Sustainability addresses the ongoing capacity of Earth to maintain all life.

Sustainable patterns of living meet the needs of the present without compromising the ability of future generations to meet their needs. Actions to improve sustainability are both individual and collective endeavours shared across local and global communities. They necessitate a renewed and balanced approach to the way humans interact with each other and the environment.

Education for sustainability develops the knowledge, skills and values necessary for people to act in ways that contribute to more sustainable patterns of living. It is futures-oriented, focusing on protecting environments and creating a more ecologically and socially just world through action that recognises the relevance and interdependence of environmental, social, cultural and economic considerations.

The Australian Curriculum: mathematics provides the foundation for the exploration of issues of sustainability. It equips students with the skills of measurement, mathematical modelling, and data collection, representation and analysis. These skills are needed to investigate data, evaluate and communicate findings and to make predictions based on those findings.

Mathematical understandings and skills are necessary to monitor and quantify both the impact of human activity on ecosystems and changes to conditions in the biosphere. Actions to improve sustainability involve students in processes such as auditing, reading measures and gauges, and interpreting data on invoices and accounts. Mathematical and statistical analysis enables informed decision making about present and future action.

Learning in mathematics involves the use of knowledge and skills learnt in other areas, particularly in English, science and history.

The Australian National Numeracy Review Report (2008) identified numeracy as requiring an across-the-school commitment, including mathematical, strategic and contextual aspects. This across-the-school commitment can be managed by including specific references to other curriculum areas in the mathematics curriculum, and the identification of key numeracy capacities in the descriptions of other curriculum areas being developed. For example, the following are some of the numeracy perspectives that could be relevant to English, science and history.

English

One aspect of the link with English and literacy is that, along with other elements of study, numeracy can be understood and acquired only within the context of the social, cultural, political, economic and historical practices to which it is integral. Students need to be able to draw on quantitative and spatial information to derive meaning from certain types of texts encountered in the subject of English.

Science

Practical work and problem solving across all the sciences require the capacity to organise and represent data in a range of forms; plot, interpret and extrapolate graphs; estimate and solve ratio problems; use formulas flexibly in a range of situations; perform unit conversions; and use and interpret rates including concentrations, sampling, scientific notation, and significant figures.

History

Learning in history includes interpreting and representing large numbers and a range of data such as those associated with population statistics and growth, financial data, figures for exports and imports, immigration statistics, mortality rates, war enlistments and casualty figures; chance events, correlation and causation; imagining timelines and time frames to reconcile related events; and the perception and spatial visualisation required for geopolitical considerations, such as changes in borders of states and in ecology.

Implications for teaching, assessment and reporting

In mathematics, challenging problems can be posed using basic age-appropriate content. Accelerating students by using content beyond their year level may not be the best way to extend proficient mathematicians. Choosing engaging experiences as contexts for a variety of tasks assists in making mathematics inclusive, and these tasks can be effectively differentiated both for students experiencing difficulty and those who complete tasks easily. The proficiency strands apply expectations of the range and nature of how mathematical content is enacted, and can help focus teaching.

Teachers use the Australian Curriculum content and achievement standards first to identify current levels of learning and achievement and then to select the most appropriate content (possibly from across several year levels) to teach individual students and/or groups of students. This takes into account that in each class there may be students with a range of prior achievement (below, at, and above the year level expectations) and that teachers plan to build on current learning.

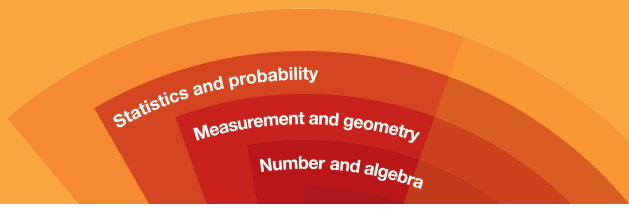
Teachers also use the achievement standards, at the end of a period of teaching, to make on-balance judgments about the quality of learning demonstrated by the students – that is whether they have achieved below, at, or above the standard. To make these judgments, teachers draw on assessment data that they have collected as evidence during the course of the teaching period. These judgments about the quality of learning are one source of feedback to students and their parents and inform formal reporting processes.

If a teacher judges that a student's achievement is below the expected standard, this suggests that the teaching programs and practice should be reviewed to better assist individual students in their learning in the

future. It also suggests that additional support and targeted teaching will be needed to ensure that the student does not fall behind.

Assessment of the Australian Curriculum takes place in different levels and for different purposes, including:

- ongoing formative assessment within classrooms for the purposes of monitoring learning and providing feedback, to teachers to inform their teaching, and for students to inform their learning
- summative assessment for the purposes of twice-yearly reporting by schools to parents and carers on the progress and achievement of students
- annual testing of Years 3, 5, 7 and 9 students' levels of achievement in aspects of literacy and numeracy, conducted as part of the National Assessment Program – Literacy and Numeracy (NAPLAN)
- periodic sample testing of specific learning areas within the Australian Curriculum as part of the National Assessment Program (NAP).



Foundation Year

The proficiency strands *Understanding, Fluency, Problem Solving* and *Reasoning* are an integral part of mathematics content across the three content strands: *Number and Algebra*, *Measurement and Geometry,* and *Statistics and Probability.* The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes connecting names, numerals and quantities

Fluency includes counting numbers in sequences readily, continuing patterns, and comparing the lengths of objects directly

Problem Solving includes using materials to model authentic problems, sorting objects, using familiar counting sequences to solve unfamiliar problems, and discussing the reasonableness of the answer

Reasoning includes explaining comparisons of quantities, creating patterns, and explaining processes for indirect comparison of length

Number and Algebra

Number and place value	Elaborations
Establish understanding of the language and processes of counting by naming numbers in sequences, initially to and from 20, moving from any starting point (ACMNA001)	• reading stories from other cultures featuring counting in sequence to assist students to recognise ways of counting in local languages and across cultures • identifying the number words in sequence, backwards and forwards, and reasoning with the number sequences, establishing the language on which subsequent counting experiences can be built • developing fluency with forwards and backwards counting in meaningful contexts, including stories and rhymes • understanding that numbers are said in a particular order and there are patterns in the way we say them
Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond (ACMNA002)	• understanding that each object must be counted only once, that the arrangement of objects does not affect how many there are, and that the last number counted answers the 'how many' question • using scenarios to help students recognise that other cultures count in a variety of ways, such as by placing one pebble in a bag to represent one object (for example to count the number of cattle).
Subitise small collections of objects (ACMNA003)	• using subitising as the basis for ordering and comparing collections of numbers
Compare, order and make correspondences between collections, initially to 20, and explain reasoning (ACMNA289)	• comparing and ordering items of like and unlike characteristics using the words 'more', 'less', 'same as' and 'not the same as' and giving reasons for these answers • understanding and using terms such as 'first' and 'second' to indicate ordinal position in a sequence. • using objects which are personally and culturally relevant to students
Represent practical situations to model addition and sharing (ACMNA004)	• using a range of practical strategies for adding and subtracting small groups of numbers, such as visual displays or concrete materials • using Aboriginal and Torres Strait Islander methods of adding and subtracting, including spatial patterns and reasoning
Patterns and algebra	Elaborations
Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings (ACMNA005)	• observing natural patterns in the world around us • creating and describing patterns using materials, sounds, movements or drawings

Measurement and Geometry

Using units of measurement	Elaborations
Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language (ACMMG006)	• comparing objects directly, by placing one object against another to determine which is longer or by pouring from one container into the other to see which one holds more • using suitable language associated with measurement attributes, such as 'tall' and 'taller', 'heavy' and 'heavier', 'holds more' and 'holds less'
Compare and order the duration of events using the everyday language of time (ACMMG007)	• knowing and identifying the days of the week and linking specific days to familiar events • sequencing familiar events in time order
Connect days of the week to familiar events and actions (ACMMG008)	• choosing events and actions that make connections with students' everyday family routines
Shape	Elaborations
Sort, describe and name familiar two-dimensional shapes and three-dimensional objects in the environment (ACMMG009)	• sorting and describing squares, circles, triangles, rectangles, spheres and cubes
Location and transformation	Elaborations
Describe position and movement (ACMMG010)	• interpreting the everyday language of location and direction, such as 'between', 'near', 'next to', 'forwards', 'towards' • following and giving simple directions to guide a friend around an obstacle path and vice versa

Statistics and Probability

Data representation and interpretation	Elaborations
Answer yes/no questions to collect information (ACMSP011)	• posing questions about themselves and familiar objects and events • representing responses to questions using simple displays, including grouping students according to their answers • using data displays to answer simple questions such as 'how many students answered "yes" to having brown hair?'

Foundation Year achievement standard

By the end of the Foundation Year, students make the connections between number names, numerals and quantities up to 10. Students are able to compare and sort shapes and objects. They make connections between events and the days of the week.

Year 1

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level: Understanding includes connecting names, numerals and quantities, and partitioning numbers in various ways

Fluency includes counting number in sequences readily forward and backwards, locating numbers on a line, and naming the days of the week

Problem Solving includes using materials to model authentic problems, giving and receiving directions to unfamiliar places, and using familiar counting sequences to solve unfamiliar problems and discusing the reasonableness of the answer

Reasoning includes explaining direct and indirect comparisons of length using uniform informal units, justifying representations of data, and explaining patterns that have been created

Number and Algebra

Number and place value	Elaborations
Develop confidence with number sequences to and from 100 by ones from any starting point. Skip count by twos, fives and tens starting from zero (ACMNA012)	• using the traditional Korean counting game (sam yew gew) for skip counting • developing fluency with forwards and backwards counting in meaningful contexts such as circle games
Recognise, model, read, write and order numbers to at least 100. Locate these numbers on a number line (ACMNA013)	• modelling numbers with a range of material and images • identifying numbers that are represented on a number line and placing numbers on a prepared number line
Count collections to 100 by partitioning numbers using place value (ACMNA014)	• understanding partitioning of numbers and the importance of grouping in tens • understanding two-digit numbers as comprised of tens and ones/units
Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts (ACMNA015)	• developing a range of mental strategies for addition and subtraction problems
Fractions and decimals	**Elaborations**
Recognise and describe one-half as one of two equal parts of a whole. (ACMNA016)	• sharing a collection of readily available materials into two equal portions • splitting an object into two equal pieces and describing how the pieces are equal
Money and financial mathematics	**Elaborations**
Recognise, describe and order Australian coins according to their value (ACMNA017)	• showing that coins are different in other countries by comparing Asian coins to Australian coins • understanding that the value of Australian coins is not related to size • describing the features of coins that make it possible to identify them
Patterns and algebra	**Elaborations**
Investigate and describe number patterns formed by skip counting and patterns with objects (ACMNA018)	• using place-value patterns beyond the teens to generalise the number sequence and predict the next number • investigating patterns in the number system, such as the occurrence of a particular digit in the numbers to 100

Measurement and Geometry

Using units of measurement	Elaborations

Measure and compare the lengths and capacities of pairs of objects using uniform informal units (ACMMG019)	• understanding that in order to compare objects, the unit of measurement must be the same size
Tell time to the half-hour (ACMMG020)	• reading time on analogue and digital clocks and observing the characteristics of half-hour times
Describe duration using months, weeks, days and hours (ACMMG021)	• describing the duration of familiar situations such as 'how long is it until we next come to school?'
Shape	Elaborations
Recognise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features (ACMMG022)	• focusing on geometric features and describing shapes and objects using everyday words such as 'corners', 'edges' and 'faces'
Location and transformation	Elaborations
Give and follow directions to familiar locations (ACMMG023)	• understanding that people need to give and follow directions to and from a place, and that this involves turns, direction and distance • understanding the meaning and importance of words such as 'clockwise', 'anticlockwise', 'forward' and 'under' when giving and following directions • interpreting and following directions around familiar locations

Statistics and Probability

Chance	Elaborations
Identify outcomes of familiar events involving chance and describe them using everyday language such as 'will happen', 'won't happen' or 'might happen' (ACMSP024)	• justifying that some events are certain or impossible
Data representation and interpretation	Elaborations
Choose simple questions and gather responses (ACMSP262)	• determining which questions will gather appropriate responses for a simple investigation
Represent data with objects and drawings where one object or drawing represents one data value. Describe the displays (ACMSP263)	• understanding one-to-one correspondence • describing displays by identifying categories with the greatest or least number of objects

Year 1 achievement standard

By the end of Year 1, students recognise and communicate number sequences. They solve simple addition and subtraction problems, and are familiar with Australian coins. They describe a representation of a half. Students collect data from questions to draw and describe simple data displays. Students compare lengths and describe two-dimensional shapes and three-dimensional objects. They communicate time duration and can follow simple directions.

Year 2

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry,** and **Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes connecting number calculations with counting sequences, partitioning and combining numbers flexibly, identifying and describing the relationship between addition and subtraction and between multiplication and division

Fluency includes counting numbers in sequences readily, using units iteratively to compare measurements, listing possible outcomes of chance events, and describing and comparing time durations

Problem Solving includes formulating problems from authentic situations, making models and using number sentences that represent problem situations, planning routes on maps, and matching transformations with their original shape

Reasoning includes using known facts to derive strategies for unfamiliar calculations, comparing and contrasting related models of operations, describing connections between 2-D and 3-D representations, and creating and interpreting simple representations of data

Number and Algebra

Number and place value	Elaborations
Investigate number sequences, initially those increasing and decreasing by twos, threes, fives and ten from any starting point, then moving to other sequences. (ACMNA026)	• developing fluency and confidence with numbers and calculations by saying number sequences • recognising patterns in number sequences, such as adding 10 always results in the same final digit
Recognise, model, represent and order numbers to at least 1000 (ACMNA027)	• recognising there are different ways of representing numbers and identifying patterns going beyond 100 • developing fluency with writing numbers in meaningful contexts
Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting (ACMNA028)	• using an abacus to model and represent numbers • understanding three-digit numbers as comprised of hundreds, tens and ones/units • demonstrating and using models such as linking blocks, sticks in bundles, place-value blocks and Aboriginal bead strings and explaining reasoning
Explore the connection between addition and subtraction (ACMNA029)	• becoming fluent with partitioning numbers to understand the connection between addition and subtraction • using counting on to identify the missing element in an additive problem
Solve simple addition and subtraction problems using a range of efficient mental and written strategies (ACMNA030)	• becoming fluent with a range of mental strategies for addition and subtraction problems, such as commutativity for addition, building to 10, doubles, 10 facts and adding 10 • modelling and representing simple additive situations using materials such as 10 frames, 20 frames and empty number lines
Recognise and represent multiplication as repeated addition, groups and arrays (ACMNA031)	• representing array problems with available materials and explaining reasoning • visualising a group of objects as a unit and using this to calculate the number of objects in several identical groups
Recognise and represent division as grouping into equal sets and solve simple problems using these representations (ACMNA032)	• dividing the class or a collection of objects into equal-sized groups • identifying the difference between dividing a set of objects into three equal groups and dividing the same set of objects into groups of three
Fractions and decimals	Elaborations
Recognise and interpret common uses of halves, quarters and eighths of shapes and	• recognising that sets of objects can be partitioned in different ways to demonstrate fractions

collections (ACMNA033)	• relating the number of parts to the size of a fraction
Money and financial mathematics	Elaborations
Count and order small collections of Australian coins and notes according to their value (ACMNA034)	• identifying equivalent values in collections of coins or notes, such as two five-cent coins having the same value as one 10-cent coin • counting collections of coins or notes to make up a particular value, such as that shown on a price tag
Patterns and algebra	Elaborations
Describe patterns with numbers and identify missing elements (ACMNA035)	• describing a pattern created by skip counting and representing the pattern on a number line • investigating features of number patterns resulting from adding twos, fives or 10s
Solve problems by using number sentences for addition or subtraction (ACMNA036)	• representing a word problem as a number sentence • writing a word problem to represent a number sentence

Measurement and Geometry

Using units of measurement	Elaborations
Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units (ACMMG037)	• comparing lengths using finger length, hand span or a piece of string • comparing areas using the palm of the hand or a stone • comparing capacities using a range of containers
Compare masses of objects using balance scales (ACMMG038)	• using balance scales to determine whether the mass of different objects is more, less or about the same, or to find out how many marbles are needed to balance a tub of margarine or a carton of milk
Tell time to the quarter-hour, using the language of 'past' and 'to' (ACMMG039)	• describing the characteristics of quarter-past times on an analogue clock, and identifying that the small hand is pointing just past the number and the big hand is pointing to the three
Name and order months and seasons (ACMMG040)	• investigating the seasons used by Aboriginal people and comparing them to those used in Western society, and recognising the connection to weather patterns.
Use a calendar to identify the date and determine the number of days in each month (ACMMG041)	• using calendars to locate specific information, such as finding a given date on a calendar and saying what day it is, and identifying personally or culturally specific days
Shape	Elaborations
Describe and draw two-dimensional shapes, with and without digital technologies (ACMMG042)	• identifying key features of squares, rectangles, triangles, kites, rhombuses and circles, such as straight lines or curved lines, and counting the edges and corners
Describe the features of three-dimensional objects (ACMMG043)	• identifying geometric features such as the number of faces, corners or edges
Location and transformation	Elaborations
Interpret simple maps of familiar locations and identify the relative positions of key features (ACMMG044)	• understanding that we use representations of objects and their positions, such as on maps, to allow us to receive and give directions and to describe place • constructing arrangements of objects from a set of directions
Investigate the effect of one-step slides and flips with and without digital technologies (ACMMG045)	• understanding that objects can be moved but changing position does not alter an object's size or features
Identify and describe half and quarter turns (ACMMG046)	• predicting and reproducing a pattern based around half and quarter turns of a shape and sketching the next element in the pattern

Statistics and Probability

Chance	Elaborations
Identify practical activities and everyday events that involve chance. Describe outcomes as 'likely' or 'unlikely' and identify some events as 'certain' or 'impossible' (ACMSP047)	• classifying a list of everyday events according to how likely they are to happen, using the language of chance, and explaining reasoning
Data representation and interpretation	**Elaborations**
Identify a question of interest based on one categorical variable. Gather data relevant to the question (ACMSP048)	• determining the variety of birdlife in the playground and using a prepared table to record observations
Collect, check and classify data (ACMSP049)	• recognising the usefulness of tally marks • identifying categories of data and using them to sort data
Create displays of data using lists, table and picture graphs and interpret them (ACMSP050)	• creating picture graphs to represent data using one-to-one correspondence • comparing the usefulness of different data displays

Year 2 achievement standard

By the end of Year 2, students recognise and communicate number sequences involving twos threes and fives. They are familiar with collections up to 1000 and recognise the connection between addition and subtraction. Students describe patterns with numbers and represent problems involving addition and subtraction by number sentences. They understand the value of collections of Australian coins. Students collect information and create data displays and interpret the information. They describe outcomes for everyday events.Students compare and order different shapes and objects using informal units. They use calendars to identify dates and seasons. They draw two-dimensional shapes and describe one-step transformations.

Year 3

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes connecting number representations with number sequences, partitioning and combining numbers flexibly, representing unit fractions, using appropriate language to communicate times, and identifying environmental symmetry

Fluency includes recalling multiplication facts, using familiar metric units to order and compare objects, identifying and describing outcomes of chance experiments, interpreting maps and communicating positions

Problem Solving includes formulating and modelling authentic situations involving planning methods of data collection and representation, making models of three-dimensional objects and using number properties to continue number patterns

Reasoning includes using generalising from number properties and results of calculations, comparing angles, creating and interpreting variations in the results of data collections and data displays

Number and Algebra

Number and place value	Elaborations
Investigate the conditions required for a number to be odd or even and identify odd and even numbers (ACMNA051)	• identifying even numbers using skip counting by twos or by grouping even collections of objects in twos • explaining why all numbers that end in the digits 0, 2, 4, 6 and 8 are even and that numbers ending in 1, 3, 5, 7 and 9 are odd
Recognise, model, represent and order numbers to at least 10 000 (ACMNA052)	• placing four-digit numbers on a number line using an appropriate scale • reproducing numbers in words using their numerical representations and vice versa
Apply place value to partition, rearrange and regroup numbers to at least 10 000 to assist calculations and solve problems (ACMNA053)	• recognising that 10 000 equals 10 thousands, 100 hundreds, 1000 tens and 10 000 ones • justifying choices about partitioning and regrouping numbers in terms of their usefulness for particular calculations
Recognise and explain the connection between addition and subtraction (ACMNA054)	• demonstrating the connection between addition and subtraction using partitioning or by writing equivalent number sentences
Recall addition facts for single-digit numbers and related subtraction facts to develop increasingly efficient mental strategies for computation (ACMNA055)	• recognising that certain single-digit number combinations always result in the same answer for addition and subtraction, and using this knowledge for addition and subtraction of larger numbers • combining knowledge of addition and subtraction facts and partitioning to aid computation (for example 57 + 19 = 57 + 20 – 1)
Recall multiplication facts of two, three, five and ten and related division facts (ACMNA056)	• establishing multiplication facts using number sequences
Represent and solve problems involving multiplication using efficient mental and written strategies and appropriate digital technologies (ACMNA057)	• writing simple word problems in numerical form and vice versa • using a calculator to check the solution and reasonableness of the answer
Fractions and decimals	Elaborations
Model and represent unit fractions including 1/2, 1/4, 1/3, 1/5 and their multiples to a complete whole (ACMNA058)	• partitioning areas, lengths and collections to create halves, thirds, quarters and fifths, such as folding the same sized sheets of paper to illustrate different unit fractions and comparing the number of parts with their sizes

	• locating unit fractions on a number line • recognising that in English the term 'one third' is used (order: numerator, denominator) but that in other languages this concept may be expressed as 'three parts, one of them' (order: denominator, numerator) for example Japanese
Money and financial mathematics	Elaborations
Represent money values in multiple ways and count the change required for simple transactions to the nearest five cents (ACMNA059)	• recognising the relationship between dollars and cents, and that not all countries use these denominations and divisions (for example Japanese Yen)
Patterns and algebra	Elaborations
Describe, continue, and create number patterns resulting from performing addition or subtraction (ACMNA060)	• identifying and writing the rules for number patterns • describing a rule for a number pattern, then creating the pattern

Measurement and Geometry

Using units of measurement	Elaborations
Measure, order and compare objects using familiar metric units of length, mass and capacity (ACMMG061)	• recognising and using centimetres and metres, grams and kilograms, and millilitres and litres • recognising the importance of using common units of measurement • recognising that metric units are not the only units used throughout the world, for example measuring the area of floor space using tatami mats (Japan), using squares for room and house area (Australia) and miles for distance (Britain, USA)
Tell time to the minute and investigate the relationship between units of time (ACMMG062)	• recognising there are 60 minutes in an hour and 60 seconds in a minute
Shape	Elaborations
Make models of three-dimensional objects and describe key features (ACMMG063)	• exploring the creation of three-dimensional objects using origami, including prisms and pyramids
Location and transformation	Elaborations
Create and interpret simple grid maps to show position and pathways (ACMMG065)	• creating a map of the classroom or playground
Identify symmetry in the environment (ACMMG066)	• identifying symmetry in Aboriginal rock carvings or art • identifying symmetry in the natural and built environment
Geometric reasoning	Elaborations
Identify angles as measures of turn and compare angle sizes in everyday situations (ACMMG064)	• opening doors partially and fully and comparing the size of the angles created • recognising that analogue clocks use the turning of arms to indicate time, and comparing the size of angles between the arms for familiar times

Statistics and Probability

Chance	Elaborations
Conduct chance experiments, identify and describe possible outcomes and recognise variation in results (ACMSP067)	• conducting repeated trials of chance experiments such as tossing a coin or drawing a ball from a bag and identifying the variations between trials
Data representation and interpretation	Elaborations
Identify questions or issues for categorical variables. Identify data sources and plan methods of data collection and recording	• refining questions and planning investigations that involve collecting data, and carrying out the investigation (for example narrowing the focus of a question such as 'which is the most popular breakfast cereal?' to 'which is the most popular breakfast cereal

(ACMSP068)	among Year 3 students in our class?')
Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies (ACMSP069)	• exploring meaningful and increasingly efficient ways to record data, and representing and reporting the results of investigations
Interpret and compare data displays (ACMSP070)	• comparing various student-generated data representations and describing their similarities and differences

Year 3 achievement standard

By the end of Year 3 students recall number facts for single digit numbers and are familiar with collections up to 10 000. They describe number patterns involving addition and subtraction and recognise the connection between multiplication and division. They model and represent unit fractions. They count the change required and represent money values in various ways.Students conduct chance experiments and describe the possible outcomes. They create, interpret and compare data displays. Students compare objects using familiar units. They compare angle sizes and identify symmetry. They tell the time and interpret positions and pathways on maps.

Year 4

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes making connections between representations of numbers, partitioning and combining numbers flexibly, extending place value to decimals, using appropriate language to communicate times, using informal units for comparing, and describing properties of symmetrical shapes

Fluency includes recalling multiplication tables, communicating sequences of simple fractions, using instruments to measure accurately, creating patterns with shapes and their transformations, and collecting and recording data

Problem Solving includes formulating, modelling and recording authentic situations involving operations, comparing large numbers and time durations, and using properties of numbers to continue patterns

Reasoning includes using generalising from number properties and results of calculations, deriving strategies for unfamiliar multiplication and division tasks, comparing angles, communicating information using graphical displays and evaluating the appropriateness of different displays

Number and Algebra

Number and place value	Elaborations
Investigate and use the properties of odd and even numbers (ACMNA071)	• using the four operations with pairs of odd or even numbers or one odd and one even number, then using the relationships established to check the accuracy of calculations
Recognise, represent and order numbers to at least tens of thousands (ACMNA072)	• reproducing five-digit numbers in words using their numerical representations, and vice versa
Apply place value to partition, rearrange and regroup numbers to at least tens of thousands to assist calculations and solve problems (ACMNA073)	• recognising and demonstrating that the place-value pattern is built on the operations of multiplication or division of tens
Investigate number sequences involving multiples of 3, 4, 6, 7, 8, and 9 (ACMNA074)	• recognising that number sequences can be extended indefinitely, and determining any patterns in the sequences
Recall multiplication facts up to 10 × 10 and related division facts (ACMNA075)	• using known multiplication facts to calculate related division facts
Develop efficient mental and written strategies and use appropriate digital technologies for multiplication and for division where there is no remainder (ACMNA076)	• using known facts and strategies, such as commutativity, doubling and halving for multiplication, and connecting division to multiplication when there is no remainder
Fractions and decimals	**Elaborations**
Investigate equivalent fractions used in contexts (ACMNA077)	• exploring the relationship between families of fractions (halves, quarters and eighths or thirds and sixths) by folding a series of paper strips to construct a fraction wall
Count by quarters halves and thirds, including with mixed numerals. Locate and represent these fractions on a number line (ACMNA078)	• converting mixed numbers to improper fractions and vice versa • investigating the use of fractions and sharing as a way of managing Country: for example taking no more than half the eggs from a nest to protect future bird populations
Recognise that the place value system can be extended to tenths and hundredths.	• using division by 10 to extend the place-value system • using knowledge of fractions to establish equivalences between fractions and decimal

Make connections between fractions and decimal notation (ACMNA079)	notation

Money and financial mathematics	Elaborations
Solve problems involving purchases and the calculation of change to the nearest five cents with and without digital technologies (ACMNA080)	• recognising that not all countries use dollars and cents, eg India uses rupees. • Carrying out calculations in another currency as well as in dollars and cents, and identifying both as decimal systems

Patterns and algebra	Elaborations
Explore and describe number patterns resulting from performing multiplication (ACMNA081)	• identifying examples of number patterns in everyday life
Solve word problems by using number sentences involving multiplication or division where there is no remainder (ACMNA082)	• representing a word problem as a number sentence • writing a word problem using a given number sentence
Use equivalent number sentences involving addition and subtraction to find unknown quantities (ACMNA083)	• writing number sentences to represent and answer questions such as: 'When a number is added to 23 the answer is the same as 57 minus 19. What is the number?' • using partitioning to find unknown quantities in number sentences

Measurement and Geometry

Using units of measurement	Elaborations
Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (ACMMG084)	• reading and interpreting the graduated scales on a range of measuring instruments to the nearest graduation
Compare objects using familiar metric units of area and volume (ACMMG290)	• comparing areas using grid paper • comparing volume using centicubes
Convert between units of time (ACMMG085)	• identifying and using the correct operation for converting units of time
Use am and pm notation and solve simple time problems (ACMMG086)	• calculating the time spent at school during a normal school day • calculating the time required to travel between two locations • determining arrival time given departure time

Shape	Elaborations
Compare the areas of regular and irregular shapes by informal means (ACMMG087)	• comparing areas using metric units, such as counting the number of square centimetres required to cover two areas by overlaying the areas with a grid of centimetre squares
Compare and describe two dimensional shapes that result from combining and splitting common shapes, with and without the use of digital technologies (ACMMG088)	• identifying common two-dimensional shapes that are part of a composite shape by re-creating it from these shapes • creating a two-dimensional shapes from verbal or written instructions

Location and transformation	Elaborations
Use simple scales, legends and directions to interpret information contained in basic maps (ACMMG090)	• identifying the scale used on maps of cities and rural areas in Australia and a city in Indonesia and describing the difference • using directions to find features on a map
Create symmetrical patterns, pictures and shapes with and without digital technologies (ACMMG091)	• using stimulus materials such as the motifs in Central Asian textiles, Tibetan artefacts, Indian lotus designs and symmetry in Yolngu or Central and Western Desert art

Geometric reasoning	Elaborations
Compare angles and classify them as equal	• creating angles and comparing them to a right angle using digital technologies

to, greater than or less than a right angle (ACMMG089)	

Statistics and Probability

Chance	Elaborations
Describe possible everyday events and order their chances of occurring (ACMSP092)	• using lists of events familiar to students and ordering them from 'least likely' to 'most likely' to occur
Identify everyday events where one cannot happen if the other happens (ACMSP093)	• using examples such as weather, which cannot be dry and wet at the same time
Identify events where the chance of one will not be affected by the occurrence of the other (ACMSP094)	• explaining why the probability of a new baby being either a boy or a girl does not depend on the sex of the previous baby
Data representation and interpretation	**Elaborations**
Select and trial methods for data collection, including survey questions and recording sheets (ACMSP095)	• comparing the effectiveness of different methods of collecting data • choosing the most effective way to collect data for a given investigation
Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values (ACMSP096)	• exploring ways of presenting data and showing the results of investigations • investigating data displays using many-to-one correspondence
Evaluate the effectiveness of different displays in illustrating data features including variability (ACMSP097)	• interpreting data representations in the media and other forums in which symbols represent more than one data value • suggesting questions that can be answered by a given data display and using the display to answer questions

Year 4 achievement standard

By the end of Year 4 students recall multiplication facts up to 10 x 10 and the related division facts. They are familiar with collections up to 100 000. Students recognise and locate familiar fractions on a number line and make connections between fraction and decimal notations. They solve problems by using relevant number sentences involving the four operations. Students describe the probabilities of everyday events. They investigate different methods for data collection, construct data displays and evaluate their effectiveness. Students convert between units of time and solve problems involving time duration. They compare areas of regular and irregular shapes and classify angles. They create symmetrical patterns and interpret the information contained in maps.

Year 5

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes making connections between representations of numbers, using fractions to represent probabilities, comparing and ordering fractions and decimals and representing them in various ways

Fluency includes choosing appropriate units of measurement for calculation of perimeter and area, using estimation to check the reasonableness of answers to calculations and using instruments to measure angles

Problem Solving includes formulating and solving authentic problems using numbers and measurements, creating transformations and identifying line and rotational symmetries

Reasoning includes investigating strategies to perform calculations efficiently, creating financial plans, interpreting results of chance experiments and interpreting data sets

Number and Algebra

Number and place value	Elaborations
Identify and describe factors and multiples of whole numbers and use them to solve problems (ACMNA098)	• exploring factors and multiples using number sequences • using simple divisibility tests
Use estimation and rounding to check the reasonableness of answers to calculations (ACMNA099)	• recognising the usefulness of estimation to check calculations • applying mental strategies to estimate the result of calculations, such as estimating the cost of a supermarket trolley load
Solve problems involving multiplication of large numbers by one- or two-digit numbers using efficient mental, written strategies and appropriate digital technologies (ACMNA100)	• exploring techniques for multiplication such as the area model, the Italian lattice method or the partitioning of numbers • applying the distributive law and using arrays to model multiplication and explain calculation strategies
Solve problems involving division by a one digit number, including those that result in a remainder (ACMNA101)	• using the fact that equivalent division calculations result if both numbers are divided by the same factor • interpreting and representing the remainder in division calculations sensibly for the context
Use efficient mental and written strategies and apply appropriate digital technologies to solve problems (ACMNA291)	• using calculators to check the reasonableness of answers
Fractions and decimals	**Elaborations**
Compare and order common unit fractions and locate and represent them on a number line (ACMNA102)	• recognising the connection between the value of a unit fraction and its denominator
Investigate strategies to solve problems involving addition and subtraction of fractions with the same denominator (ACMNA103)	• modelling and solving addition and subtraction problems involving fractions by using jumps on a number line, or making diagrams of fractions as parts of shapes
Recognise that the number system can be extended beyond hundredths (ACMNA104)	• using knowledge of place value and division by 10 to extend the number system to thousandths and beyond • recognising the equivalence of thousandths and 0.001

Compare, order and represent decimals (ACMNA105)	• locating decimals on a number line • recognising that the number of digits after the decimal place is not equivalent to the value of the fraction
Money and financial mathematics	Elaborations
Create simple financial plans (ACMNA106)	• creating a simple budget for a class fundraising event • identifying the GST component of invoices and receipts
Patterns and algebra	Elaborations
Describe, continue and create patterns with fractions, decimals and whole numbers resulting from addition and subtraction (ACMNA107)	• using the number line or diagrams to create patterns involving fractions or decimals
Use equivalent number sentences involving multiplication and division to find unknown quantities (ACMNA121)	• using relevant problems to develop number sentences

Measurement and Geometry

Using units of measurement	Elaborations
Choose appropriate units of measurement for length, area, volume, capacity and mass (ACMMG108)	• recognising that some units of measurement are better suited for some tasks than others, for example kilometres rather than metres to measure the distance between two towns • investigating alternative measures of scale to demonstrate that these vary between countries and change over time, for example temperature measurement in Australia, Indonesia, Japan and USA
Calculate the perimeter and area of rectangles using familiar metric units (ACMMG109)	• exploring efficient ways of calculating the perimeters of rectangles such as adding the length and width together and doubling the result • exploring efficient ways of finding the areas of rectangles, such as recognising that counting the number of square centimetres in a grid gives the same result as multiplying the length and width
Compare 12- and 24-hour time systems and convert between them (ACMMG110)	• investigating the ways time was and is measured in different Aboriginal Country, such as using tidal change • using units hours, minutes and seconds
Shape	Elaborations
Connect three-dimensional objects with their nets and other two-dimensional representations (ACMMG111)	• identifying the shape and relative position of each face of a solid to determine the net of the solid, including that of prisms and pyramids • representing two-dimensional shapes such as photographs, sketches and images created by digital technologies
Location and transformation	Elaborations
Use a grid reference system to describe locations. Describe routes using landmarks and directional language (ACMMG113)	• comparing aerial views of Country, desert paintings and maps with grid references • creating a grid reference system for the classroom and using it to locate objects and describe routes from one object to another
Describe translations, reflections and rotations of two-dimensional shapes. Identify line and rotational symmetries (ACMMG114)	• identifying and describing the line and rotational symmetry of a range of two-dimensional shapes, by manually cutting, folding and turning shapes and by using digital technologies • identifying the effects of transformations by manually flipping, sliding and turning two-dimensional shapes and by using digital technologies
Apply the enlargement transformation to familiar two dimensional shapes and explore the properties of the resulting image compared with the original (ACMMG115)	• using digital technologies to enlarge shapes • using a grid system to enlarge a favourite image or cartoon

Geometric reasoning	Elaborations
Estimate, measure and compare angles using degrees. Construct angles using a protractor (ACMMG112)	• measuring and constructing angles using both 180° and 360° protractors

Statistics and Probability

Chance	Elaborations
List outcomes of chance experiments involving equally likely outcomes and represent probabilities of those outcomes using fractions (ACMSP116)	• commenting on the likelihood of winning simple games of chance by considering the number of possible outcomes and the consequent chance of winning in simple games of chance such as jan-ken-pon (rock-paper-scissors)
Recognise that probabilities range from 0 to 1 (ACMSP117)	• investigating the probabilities of all outcomes for a simple chance experiment and verifying that their sum equals 1
Data representation and interpretation	Elaborations
Pose questions and collect categorical or numerical data by observation or survey (ACMSP118)	• posing questions about insect diversity in the playground, collecting data by taping a one-metre-square piece of paper to the playground and observing the type and number of insects on it over time
Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies (ACMSP119)	• identifying the best methods of presenting data to illustrate the results of investigations and justifying the choice of representations
Describe and interpret different data sets in context (ACMSP120)	• using and comparing data representations for different data sets to help decision making, such as choosing the best mobile phone plan

Year 5 achievement standard

By the end of Year 5 students identify and describe factors and multiples and use estimation and rounding to check the reasonableness of answers. They solve multiplication and division problems and compare, order and represent decimals. Students perform addition and subtraction of fractions with the same denominator and continue patterns with fractions and decimals. They plan simple budgets. Students list the outcomes of chance experiments as fractions. They pose questions to gather data and construct, describe and interpret different data sets. Students calculate perimeter and area of rectangles using appropriate units. They connect three dimensional objects with two dimensional representations. They measure and construct different angles and describe transformations of two-dimensional shapes, including the enlargement transformation. They identify line and rotational symmetry.

Year 6

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes describing properties of different sets of numbers, using fractions and decimals to describe probabilities, representing fractions and decimals in various ways and describing connections between them, and making reasonable estimations

Fluency includes representing negative numbers on a number line, calculating simple percentages, using brackets appropriately, converting between fractions and decimals, using operations with fractions, decimals and percentages, measuring using metric units, and interpreting timetables

Problem Solving includes formulating and solving authentic problems using numbers and measurements, creating similar shapes through enlargements, representing secondary data, and calculating angles

Reasoning includes explaining mental strategies for performing calculations, describing results for continuing number sequences, investigating new situations using known properties of angles, explaining the transformation of one shape into another, and inferring from the results of experiments

Number and Algebra

Number and place value	Elaborations
Identify and describe properties of prime, composite, square and triangular numbers (ACMNA122)	• understanding that some numbers have special properties and that these properties can be used to solve problems • representing composite numbers as a product of their prime factors and using this form to simplify calculations by cancelling common primes • understanding that if a number is divisible by a composite number then it is also divisible by the prime factors of that number (for example 216 is divisible by 8 because the number represented by the last three digits is divisible by 8, and hence 216 is also divisible by 2 and 4)
Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers (ACMNA123)	• applying strategies already developed for solving problems involving small numbers to those involving large numbers • applying a range of strategies to solve realistic problems and commenting on the efficiency of different strategies
Investigate everyday situations that use positive and negative whole numbers and zero. Locate and represent these numbers on a number line (ACMNA124)	• understanding that whole numbers can be positive and negative and continue indefinitely in both directions • investigating everyday situations that use positive and negative integers, such as temperatures, to understand how the positive numbers (whole numbers, fractions, decimals and percentages) can be extended to include negative numbers • using number lines to position and order positive and negative integers around zero • solving everyday additive problems involving positive and negative integers without developing formal rules for the operations (for example using a number line and counting to find the resulting outside temperature if it is 5°C at 7pm and drops by 8°C overnight)
Fractions and decimals	Elaborations
Compare fractions with related denominators and locate and represent them on a number line (ACMNA125)	• demonstrating equivalence between fractions using drawings and models
Solve problems involving addition and subtraction of fractions with the same or	• understanding the processes for adding and subtracting fractions with related denominators and fractions as an operator, in preparation for calculating with all

related denominators (ACMNA126)	fractions • solving realistic additive (addition and subtraction) problems involving fractions to develop understanding of equivalent fractions and the use of fractions as operators • modelling and solving additive problems involving fractions by using methods such as jumps on a number line, or by making diagrams of fractions as parts of shapes
Find a simple fraction of a quantity where the result is a whole number, with and without digital technologies (ACMNA127)	
Add and subtract decimals, with and without digital technologies, and use estimation and rounding to check the reasonableness of answers (ACMNA128)	• extending whole-number strategies to explore and develop meaningful written strategies for addition and subtraction of decimal numbers to thousandths • exploring and practising efficient methods for solving problems requiring operations on decimals, to gain fluency with calculating with decimals and with recognising appropriate operations
Multiply decimals by whole numbers and perform divisions that result in terminating decimals, with and without digital technologies (ACMNA129)	• interpreting and representing the remainder in division calculations, including non-integral remainders, appropriate to the context (for example understanding that the result of 6.5 ÷ 4 is sensibly expressed as 1.625km if the context involves dividing a 6.5km running course into four equal legs; $1.63 if it represents the price of one item where four sell for $6.50)
Multiply and divide decimals by powers of 10 (ACMNA130)	• understanding and using the fact that equivalent division calculations result if both numbers are multiplied or divided by the same amount (for example 34.87 ÷ 7 is equivalent to 3487 ÷ 700) • using and explaining the use of multiplication and division by powers of 10 to multiply decimal numbers mentally (for example 1.4 × 0.6 can be calculated by multiplying 14 by 6 and dividing the result by 100)
Make connections between equivalent fractions, decimals and percentages (ACMNA131)	• connecting fractions, decimals and percentages as different representations of the same number, moving fluently between representations and choosing the appropriate one for the problem being solved
Money and financial mathematics	Elaborations
Investigate and calculate percentage discounts of 10%, 25% and 50% on sale items, with and without digital technologies (ACMNA132)	• using authentic information to calculate prices on sale goods
Patterns and algebra	Elaborations
Continue and create sequences involving whole numbers, fractions and decimals. Describe the rule used to create the sequence (ACMNA133)	• identifying and generalising number patterns as the beginning of algebraic thinking • investigating additive and multiplicative patterns such as the number of tiles in a geometric pattern, or the number of dots or other shapes in successive repeats of a strip or border pattern, looking for patterns in the way the numbers increase/decrease
Explore the use of brackets and order of operations to write number sentences (ACMNA134)	• appreciating the need for rules to complete multiple operations within the same number sentence

Measurement and Geometry

Using units of measurement	Elaborations
Connect decimal representations to the metric system (ACMMG135)	• recognising the equivalence of measurements such as 1.25 metres and 125 centimetres
Convert between common metric units of length, mass and capacity (ACMMG136)	• identifying and using the correct operations when converting units including millimetres, centimetres, metres, kilometres, milligrams, grams, kilograms, tonnes, millilitres, litres, kilolitres and megalitres • recognising the significance of the prefixes in units of measurement
Solve problems involving the comparison of	• recognising and investigating familiar objects using concrete materials and digital

lengths and areas using appropriate units (ACMMG137)	technologies
Connect volume and capacity and their units of measurement (ACMMG138)	• recognising that 1ml is equivalent to $1cm^3$
Interpret and use timetables (ACMMG139)	• planning a trip involving one or more modes of public transport
Shape	Elaborations
Construct simple prisms and pyramids (ACMMG140)	• considering the history and significance of pyramids from a range of cultural perspectives including those structures found in China, Korea and Indonesia • constructing prisms and pyramids from nets, and skeletal models
Location and transformation	Elaborations
Investigate combinations of translations, reflections and rotations, with and without the use of digital technologies (ACMMG142)	• understanding that translations, rotations and reflections can change the position and orientation of shapes and objects but not their geometric features or size • visualising, demonstrating and describing the effects of transformations, such as using computer technology to visualise, test and record the movement of two-dimensional shapes, or designing a school or brand logo using transformation of one or more shapes
Introduce the Cartesian coordinate system using all four quadrants (ACMMG143)	• understanding that the Cartesian plane provides a graphical or visual way of describing location, and can be used to represent relationships
Geometric reasoning	Elaborations
Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles (ACMMG141)	• building on students' understanding of turn and rotation in mapping and rotational symmetry to measure, estimate and compare angles in degrees and classify angles according to their sizes • investigating the use of rotation and symmetry in the diagrammatic representations of kinship relationships of Central and Western Desert people • estimating, measuring and comparing angles, for example, by recognising the magnitude of angles including 30°, 45°, 90°, 180° and 270° to make reasonable estimates of angles up to a complete turn of 360°, or using a protractor to measure angles to the nearest degree • identifying that angles have arms and a vertex, and that size is the amount of turn required for one arm to coincide with the other; the size is measured in degrees with a protractor using the two alternate conventions for naming angles • identifying that the size of a right angle is 90° and defining acute, obtuse and reflex angles and rotation by relating them to right angles

Statistics and Probability

Chance	Elaborations
Describe probabilities using fractions, decimals and percentages (ACMSP144)	• investigating games of chance popular in different cultures and evaluating the relative benefits to the organisers and participants (for example Pachinko)
Conduct chance experiments with both small and large numbers of trials using appropriate digital technologies (ACMSP145)	• conducting repeated trials of chance experiments, identifying the variation between trials and realising that the results tend to the prediction with larger numbers of trials
Compare observed frequencies across experiments with expected frequencies (ACMSP146)	• predicting likely outcomes from a run of chance events and distinguishing these from surprising results
Data representation and interpretation	Elaborations
Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables	• understanding that data can be represented in different ways, sometimes with one symbol representing more than one piece of data, and that it is important to read all information about a representation before making judgments

(ACMSP147)	• exploring ways of presenting data and showing the results of investigations, including creating dot plots with many-to-one correspondence between data and symbols • comparing different student-generated diagrams, tables and graphs, and describing their similarities and differences and commenting on the usefulness of each representation for interpreting the data
Interpret secondary data presented in digital media and elsewhere (ACMSP148)	• developing an understanding of sampling and the ability to interpret secondary data in order to critique data-based claims made in the media, advertising and elsewhere • investigating data representations in the media and discussing what they illustrate and the messages the people who created them might want to convey • understanding the various influences on data collection and display, including who created the representation, who funded the data collection and whether the representation is part of an advertisement; in order to be alert to possible biases in data representations • identifying potentially misleading data representations in the media, such as graphs with 'broken' axes or non-linear scales, graphics not drawn to scale, data not related to the population about which the claims are made, and pie charts in which the whole pie does not represent the entire population about which the claims are made • considering the need for sampling and recognising when a census of an entire population is not possible or not necessary, and identifying examples of sampling in the media

Year 6 achievement standard

By the end of Year 6, students recognise the properties of special numbers. They connect fractions, decimals and percentages as different representations of the same number and solve associated problems. They write correct number sentences. Students predict and communicate probabilities using simple fractions, decimals and percentages and construct and interpret a range of data displays. Students connect decimal representations to the metric system and choose appropriate units of measurement to solve problems. They interpret and use timetables. Students investigate angles. They investigate combinations of transformations and apply the enlargement transformation.

Year 7

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes describing patterns in uses of indices with whole numbers, recognising commonalities between fractions, decimals, percentages and ratios, plotting points on the Cartesian plane, identifying angles formed by a transversal crossing a pair of parallel lines, and connecting the laws and properties of numbers to algebraic terms and expressions

Fluency includes calculating accurately with integers, representing fractions and decimals in various ways, investigating best buys, evaluating measures of central tendency and calculating areas of shapes and volumes of prisms

Problem Solving includes formulating and solving authentic problems using numbers and measurements, creating transformations and identifying symmetry, calculating angles and interpreting sets of data collected through chance experiments

Reasoning includes applying the number laws to calculations, applying known geometric facts to draw conclusions about shapes, applying an understanding of ratio and interpreting data displays

Number and Algebra

Number and place value	Elaborations
Investigate index notation and represent whole numbers as products of powers of prime numbers (ACMNA149)	• defining and comparing prime and composite numbers and explaining the difference between them • applying knowledge of factors to strategies for expressing whole numbers as products of powers of prime factors, such as repeated division by prime factors or creating factor trees • solving problems involving lowest common multiples and greatest common divisors (highest common factors) for pairs of whole numbers by comparing their prime factorisation
Investigate and use square roots of perfect square numbers (ACMNA150)	• investigating square numbers such as 25 and 36 and developing square-root notation • investigating between which two whole numbers a square root lies
Apply the associative, commutative and distributive laws to aid mental and written computation (ACMNA151)	• understanding that arithmetic laws are powerful ways of describing and simplifying calculations
Compare, order, add and subtract integers (ACMNA280)	
Real numbers	**Elaborations**
Compare fractions using equivalence. Locate and represent fractions and mixed numerals on a number line (ACMNA152)	• exploring equivalence among families of fractions by using a fraction wall or a number line (for example by using a fraction wall to show that 2/3 is the same as 4/6 and 6/9)
Solve problems involving addition and subtraction of fractions, including those with unrelated denominators (ACMNA153)	• exploring and developing efficient strategies to solve additive problems involving fractions (for example by using fraction walls or rectangular arrays with dimensions equal to the denominators)
Multiply and divide fractions and decimals using efficient written strategies and digital technologies (ACMNA154)	• investigating multiplication of fractions and decimals, using strategies including patterning and multiplication as repeated addition, with both concrete materials and digital technologies, and identifying the processes for division as the inverse of multiplication
Express one quantity as a fraction of another, with and without the use of digital	• using authentic examples for the quantities to be expressed and understanding the reasons for the calculations

technologies (ACMNA155)	
Round decimals to a specified number of decimal places (ACMNA156)	• using rounding to estimate the results of calculations with whole numbers and decimals, and understanding the conventions for rounding
Connect fractions, decimals and percentages and carry out simple conversions (ACMNA157)	• understanding that quantities can be represented by different number types and calculated using various operations, and that choices need to be made about each • justifying choices of written, mental or calculator strategies for solving specific problems including those involving large numbers
Find percentages of quantities and express one quantity as a percentage of another, with and without digital technologies. (ACMNA158)	• using authentic problems to express quantities as percentages of other amounts
Recognise and solve problems involving simple ratios (ACMNA173)	• understanding that rate and ratio problems can be solved using fractions or percentages and choosing the most efficient form to solve a particular problem
Money and financial mathematics	Elaborations
Investigate and calculate 'best buys', with and without digital technologies (ACMNA174)	• applying the unitary method to identify ‘best buys’ situations, such as comparing the cost per 100g
Patterns and algebra	Elaborations
Introduce the concept of variables as a way of representing numbers using letters (ACMNA175)	• understanding that arithmetic laws are powerful ways of describing and simplifying calculations and that using these laws leads to the generality of algebra
Create algebraic expressions and evaluate them by substituting a given value for each variable (ACMNA176)	• using authentic formulas to perform substitutions
Extend and apply the laws and properties of arithmetic to algebraic terms and expressions (ACMNA177)	• identifying order of operations in contextualised problems, preserving the order by inserting brackets in numerical expressions, then recognising how order is preserved by convention • moving fluently between algebraic and word representations as descriptions of the same situation
Linear and non-linear relationships	Elaborations
Given coordinates, plot points on the Cartesian plane, and find coordinates for a given point (ACMNA178)	• plotting points from a table of integer values and recognising simple patterns, such as points that lie on a straight line
Solve simple linear equations (ACMNA179)	• solving equations using concrete materials, such as the balance model, and explain the need to do the same thing to each side of the equation • using strategies such as backtracking and guess, check and improve to solve equations • using substitution to check solutions • solving real-life problems by using pronumerals to represent unknowns • writing an equation, estimating the answer, solving and checking the solution and creating linear relationships to represent the answer/sequence of operation
Investigate, interpret and analyse graphs from authentic data (ACMNA180)	• using travel graphs to investigate and compare the distance travelled to and from school • interpreting features of travel graphs such as the slope of lines and the meaning of horizontal lines • using graphs of evaporation rates to explore water storage

Measurement and Geometry

Using units of measurement	Elaborations

Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving (ACMMG159)	• building on the understanding of the area of rectangles to develop formulas for the area of triangles, using manual strategies and digital technologies • establishing that the area of a triangle is half the area of an appropriate rectangle and using the formula A = ½bh, where b is the base and h is the perpendicular height of the triangle • using area formulas for rectangles and triangles to solve problems involving areas of surfaces, such as how many litres of paint will be needed to paint a shed wall if each litre covers 16m^2
Calculate volumes of rectangular prisms (ACMMG160)	• investigating volumes of cubes and rectangular prisms and establishing and using the formula V = l × b × h • understanding and using cubic units when interpreting and finding volumes of cubes and rectangular prisms
Shape	Elaborations
Draw different views of prisms and solids formed from combinations of prisms (ACMMG161)	• using aerial views of buildings and other 3-D structures to visualise the structure of the building or prism
Location and transformation	Elaborations
Describe translations, reflections in an axis, and rotations of multiples of 90° on the Cartesian plane using coordinates. Identify line and rotational symmetries (ACMMG181)	• understanding transformations to help identify the movement of shapes and rotational and line symmetry • describing patterns and investigating different ways to produce the same transformational changes, such as using two successive reflections to provide the same result as a translation, or using digital technologies to experiment with, create and re-create patterns using combinations of flips, slides, turns and enlargements or reductions • building on students' understanding of the reflection and rotation of figures, and reflection and rotational symmetry, to identify combinations of transformations that produce the same result, and to distinguish this as an example of how mathematical results can often be obtained using multiple alternative methods
Geometric reasoning	Elaborations
Classify triangles according to their side and angle properties and describe quadrilaterals (ACMMG165)	• identifying side and angle properties of scalene, isosceles, right-angled and obtuse-angled triangles • describing squares, rectangles, rhombuses, parallelograms, kites and trapeziums
Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral (ACMMG166)	• using concrete materials and digital technologies to investigate the angle sum of a triangle and quadrilateral
Identify corresponding, alternate and co-interior angles when two parallel straight lines are crossed by a transversal (ACMMG163)	• defining and classifying angles such as acute, right, obtuse, straight, reflex and revolution, and pairs of angles such as complementary, supplementary, adjacent and vertically opposite • constructing parallel and perpendicular lines using their properties, a pair of compasses and a ruler, and dynamic geometry software
Investigate conditions for two lines to be parallel and solve simple numerical problems using reasoning (ACMMG164)	• defining and identifying alternate, corresponding and allied angles and the relationships between them for a pair of parallel lines cut by a transversal, including using dynamic geometry software

Statistics and Probability

Chance	Elaborations
Construct sample spaces for single-step experiments with equally likely outcomes (ACMSP167)	• distinguishing between 'equally likely' outcomes and outcomes that are 'not equally likely' • discussing the meaning of probability terminology (for example probability, sample space, favourable outcomes, trial, chance events and experiments)
Assign probabilities to the outcomes of	• expressing probabilities in common and decimal fractional and percentage forms

events and determine probabilities for events (ACMSP168)	• understanding the advantages and limitations of calculating theoretical probabilities
Data representation and interpretation	Elaborations
Identify and investigate issues involving continuous or large count data collected from primary and secondary sources (ACMSP169)	• investigating secondary data sets to answer comparative questions (for example the most common country of birth for a class in a Chinese school or a school in the Philippines) • investigating the relationship between wealth or education and the health of populations from different countries
Construct and compare a range of data displays including stem-and-leaf plots and dot plots (ACMSP170)	• understanding that some data representations are more appropriate than others for particular data sets, and answering questions about those data sets • using ordered stem-and-leaf plots to record and display numerical data collected in a class investigation, such as constructing a class plot of height in centimetres on a shared stem-and-leaf plot for which the stems 12, 13, 14, 15, 16 and 17 have been provided
Calculate mean, median, mode and range for sets of data. Interpret these statistics in the context of data (ACMSP171)	• understanding that summarising data by calculating measures of centre and spread can help make sense of the data • calculating mean areas set aside for parkland, manufacturing, retail and residential dwellings to compare land use in the local municipality
Describe and interpret data displays and the relationship between the median and mean (ACMSP172)	• using mean and median to compare data sets and explaining how outliers may affect the comparison • locating mean, median and range on graphs and connecting them to real life

Year 7 achievement standard

By the end of Year 7, students interpret integers in real world contexts. They make connections between whole numbers and index notation. They move flexibly between representations of fractions, decimals and percentages. Students generalise using variables, solve simple linear equations and identify points on the Cartesian plane. They compare costs of items to make financial decisions. Students investigate questions involving the collection of a range of data. They calculate mean, mode, median and range for sets of data and describe the relationship between median and mode in data displays. Students classify triangles and quadrilaterals and establish the formulas for the area and perimeter of rectangles. They calculate the volume of rectangular prisms and draw and build three dimensional objects. They identify angles formed by a transversal through parallel lines and describe transformations on the Cartesian plane.

Year 8

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes describing patterns in uses of indices and repeating decimals, identifying commonalities between operations with algebra and arithmetic, connecting rules of relations and functions and their graphs, explaining the function of statistical measures, and contrasting measurements of perimeter and area

Fluency includes calculating accurately with simple decimals, indices and integers, recognising equivalence of common decimals and fractions including repeating decimals, factorising and simplifying basic algebraic expressions, evaluating perimeters, areas and volumes of common shapes, and calculating the mean and median of small sets of data

Problem Solving includes formulating and modelling, with comparisons of ratios, profit and loss, authentic situations involving areas and perimeters of common shapes and analysing and interpreting data using two-way tables

Reasoning includes justifying the result of a calculation or estimation as reasonable, explaining formal and intuitive use of ratios for comparing rates and prices, deriving one probability from its complement, using congruence to deduce properties of triangles, and making inferences about data

Number and Algebra

Number and place value	Elaborations
Use index notation with numbers to establish the index laws with positive integral indices and the zero index (ACMNA182)	• evaluating numbers expressed as powers of positive integers
Carry out the four operations with integers, using efficient mental and written strategies and appropriate digital technologies (ACMNA183)	
Real numbers	**Elaborations**
Investigate terminating and recurring decimals (ACMNA184)	• recognising terminating, recurring and non-terminating decimals and choosing their appropriate representations
Investigate the concept of irrational numbers, including π (ACMNA186)	• understanding that the real number system includes irrational numbers and that certain subsets of the real number system have particular properties
Solve problems involving the use of percentages, including percentage increases and decreases, with and without digital technologies (ACMNA187)	• using percentages to solve problems, including those involving mark-ups, discounts, profit and loss and GST
Solve a range of problems involving rates and ratios, with and without digital technologies (ACMNA188)	• understanding that rate and ratio problems can be solved using fractions or percentages and choosing the most efficient form to solve a particular problem • calculating population growth rates in Australia and Asia and explaining their difference
Money and financial mathematics	**Elaborations**
Solve problems involving profit and loss, with and without digital technologies (ACMNA189)	• expressing profit and loss as a percentage of cost or selling price, comparing the difference • investigating the methods used in retail stores to express discounts
Patterns and algebra	**Elaborations**

Extend and apply the distributive law to the expansion of algebraic expressions (ACMNA190)	• applying the distributive law to the expansion of algebraic expressions using strategies such as the area model
Factorise algebraic expressions by identifying numerical factors (ACMNA191)	• recognising that factorising is the opposite of expanding • identifying the greatest common divisor (highest common factor) of numeric and algebraic expressions and using a range of strategies to factorise algebraic expressions
Simplify algebraic expressions involving the four operations (ACMNA192)	• understanding that arithmetic laws are powerful ways of describing and simplifying calculations and that using these laws leads to the generality of algebra • understanding that the laws that apply to number can be generalised using variables
Linear and non-linear relationships	Elaborations
Plot linear relationships on the Cartesian plane with and without the use of digital technologies (ACMNA193)	• plotting points for tables of values from non-rule-based data, such as water consumption over a month
Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution (ACMNA194)	• using variables to symbolise simple linear equations and using a variety of strategies to solve them • solving equations using concrete materials, such as the balance model, and explain the need to do the same thing to each side of the equation • using strategies, such as backtracking and guess, check and improve to solve equations

Measurement and Geometry

Using units of measurement	Elaborations
Choose appropriate units of measurement for area and volume and convert from one unit to another (ACMMG195)	• choosing units for area including mm^2, cm^2, m^2, hectares, km^2, and units for volume including mm^3, cm^3, m^3 • recognising that the conversion factors for area units are the squares of those for the corresponding linear units • recognising that the conversion factors for volume units are the cubes of those for the corresponding linear units
Find perimeters and areas of parallelograms, rhombuses and kites (ACMMG196)	• exploring the use of parallelograms, rhombuses and kites in art and architecture
Investigate the relationship between features of circles such as circumference, area, radius and diameter. Use formulas to solve problems involving circumference and area (ACMMG197)	• investigating the circumference and area of circles with materials or by measuring, to establish an understanding of formulas • investigating the area of circles using a square grid or by rearranging a circle divided into sectors
Develop the formulas for volumes of rectangular and triangular prisms and prisms in general. Use formulas to solve problems involving volume (ACMMG198)	• investigating the relationship between volumes of rectangular and triangular prisms
Solve problems involving duration, including using 12- and 24-hour time within a single time zone (ACMMG199)	• identifying regions in Australia and countries in Asia that are in the same time zone
Geometric reasoning	Elaborations
Define congruence of plane shapes using transformations (ACMMG200)	• understanding the properties that determine congruence of triangles and recognising which transformations create congruent figures • establishing that two figures are congruent if one shape lies exactly on top of the other after one or more transformations (translation, reflection, rotation), and recognising the equivalence of corresponding sides and angles
Develop the conditions for congruence of	• constructing triangles using the conditions for congruence

triangles (ACMMG201)	• solving problems using the properties of congruent figures, justifying reasoning and making generalisations • investigating the minimal conditions needed for the unique construction of triangles, leading to the establishment of the conditions for congruence (SSS, SAS, ASA and RHS), and demonstrating which conditions do not prescribe congruence (ASS, AAA) • plotting the vertices of two-dimensional shapes on the Cartesian plane, translating, rotating or reflecting the shape and using coordinates to describe the transformation
Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related numerical problems using reasoning (ACMMG202)	• establishing the properties of squares, rectangles, parallelograms, rhombuses, trapeziums and kites • identifying properties related to side lengths, parallelism, angles, diagonals and symmetry

Statistics and Probability

Chance	Elaborations
Identify complementary events and use the sum of probabilities to solve problems (ACMSP204)	• understanding that probabilities range between 0 to 1 and that calculating the probability of an event allows the probability of its complement to be identified • identifying the complement of familiar events (for example the complement of getting a head on a coin is getting a tail, the complement of winning a game is not winning the game)
Describe events using language of 'at least', exclusive 'or' (A or B but not both), inclusive 'or' (A or B or both) and 'and'. (ACMSP205)	• posing ‘and’, ‘or’, ‘not’ and ‘given’ probability questions about objects or people
Represent such events in two-way tables and Venn diagrams and solve related problems (ACMSP292)	• understanding that representing data in Venn diagrams or two-way tables facilitates the calculation of probabilities • using Venn diagrams and two-way tables to calculate probabilities for events, satisfying ‘and’, ‘or’, ‘given’ and ‘not’ conditions • collecting data to answer the questions using Venn diagrams or two-way tables
Data representation and interpretation	Elaborations
Explore the practicalities and implications of obtaining representative data using a variety of investigative processes (ACMSP206)	• understanding that making decisions and drawing conclusions based on data may differ from those based on preferences and beliefs • investigating an international issue where media reporting and the use of data reflects different cultural or social emphases (for example whaling, football World Cup outcomes)
Explore the variation of means and proportions in representative data (ACMSP293)	
Investigate the effect of individual data values , including outliers, on the mean and median (ACMSP207)	• using sample properties (for example mean, median, range, large gaps visible on a graph) to predict characteristics of the population (for example using mean height for a class to predict year-group mean height), acknowledging uncertainty • using displays of data to explore and investigate effects

Year 8 achievement standard

By the end of Year 8 students use efficient mental and written strategies to carry out the four operations with integers. They round decimals and solve problems involving percentages. Students recognise the index laws and apply them to whole numbers and variables. They simplify a variety of algebraic expressions and solve linear equations. They graph linear relationships on the Cartesian plane. They solve a range of everyday problems involving rates and ratios. Students determine complementary events and use the sum of probabilities to solve problems. They understand the challenges of collecting representative data and the effect on medians and means of outliers. Students choose appropriate units of measurement for area and volume and solve problems. They recognise the features of circles and solve problems involving circumference and area. Students identify conditions for congruence of plane shapes and establish properties of quadrilaterals and solve related numerical problems. They solve problems involving time duration.

Year 9

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability.** The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes describing the relationship between graphs and equations, simplifying a range of algebraic expressions, explaining the function of relative frequencies and probabilities, calculating areas of shapes and surface areas of prisms and the constancy of the trigonometric ratios for right-angle triangles

Fluency includes applying the index laws to expressions with integer indices, expressing numbers in scientific notation, listing outcomes for experiments and developing familiarity with calculations involving the Cartesian plane

Problem Solving includes calculating surface areas and volumes of right prisms, applying ratio and scale factors to similar figures, solving problems involving right-angle trigonometry, and collecting data from secondary sources to investigate an issue

Reasoning includes following mathematical arguments, evaluating media reports and using statistical knowledge to draw conclusions, developing strategies in investigating similarity and sketching linear graphs

Number and Algebra

Real numbers	Elaborations
Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems (ACMNA208)	• understanding the difference between direct and inverse proportion, identifying these in real-life contexts and using these relationships to solve problems
Apply index laws to numerical expressions with integer indices (ACMNA209)	• connecting different strategies for simplifying expressions with indices to illustrate the meaning of negative indices • moving fluently between representations of numeric and algebraic terms with negative indices, and applying understanding of negative indices to calculations • applying knowledge of index laws to algebraic terms and simplifying algebraic expressions, using both positive and negative integral indices
Express numbers in scientific notation (ACMNA210)	• understanding that the use of index notation is an efficient way of representing numbers and symbols and has many applications, particularly in science • representing extremely large and small numbers in scientific notation, and numbers expressed in scientific notation as whole numbers or decimals
Money and financial mathematics	**Elaborations**
Solve problems involving simple interest (ACMNA211)	• understanding that financial decisions can be assisted by mathematical calculations
Patterns and algebra	**Elaborations**
Extend and apply the index laws to variables, using positive integral indices and the zero index (ACMNA212)	• understanding that index laws apply to variables as well as numbers • evaluating numbers expressed as powers of positive integers
Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate (ACMNA213)	• understanding that the distributive law can be applied to algebraic expressions as well as numbers, and understanding the inverse relationship between expansion and factorisation
Linear and non-linear relationships	**Elaborations**
Find the distance between two points located on a Cartesian plane using a range	• investigating graphical and algebraic techniques for finding distance

of strategies, including graphing software (ACMNA214)	
Find the midpoint and gradient of a line segment (interval) on the Cartesian plane using a range of strategies, including graphing software (ACMNA294)	• investigating graphical and algebraic techniques for finding midpoint and gradient
Sketch linear graphs using the coordinates of two points (ACMNA215)	• determining linear rules from suitable diagrams, tables of values and graphs and describing them both using words and algebra
Sketch simple non-linear relations with and without the use of digital technologies (ACMNA296)	• sketching parabolas, hyperbolas, circles

Measurement and Geometry

Using units of measurement	Elaborations
Calculate the areas of composite shapes (ACMMG216)	• understanding that partitioning composite shapes into rectangles and triangles is a strategy for solving problems involving perimeter and area
Calculate the surface area and volume of cylinders and solve related problems (ACMMG217)	• analysing nets of prisms and cylinders to establish formulas for surface area
Solve problems involving the surface area and volume of right prisms (ACMMG218)	• building on the understanding of area and volume to become fluent with calculation, and identifying that area and volume relationships are used in the workplace and everyday life
Investigate very small and very large time scales and intervals (ACMMG219)	• investigating the usefulness of scientific notation in representing very large and very small numbers
Geometric reasoning	**Elaborations**
Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar (ACMMG220)	• understanding that similarity and congruence help describe relationships between geometrical shapes and form the basis of reasoning and proof • using the enlargement transformation to establish similarity • establishing the conditions for similarity of two triangles and comparing this to the conditions for congruence • using the properties of similarity and ratio, and correct mathematical notation and language, to solve problems involving enlargement (for example scale diagrams)
Solve problems using ratio and scale factors in similar figures (ACMMG221)	• establishing the relationship between areas of similar figures and the ratio of corresponding sides (scale factor)
Pythagoras and trigonometry	**Elaborations**
Investigate Pythagoras' Theorem and its application to solving simple problems involving right angled triangles (ACMMG222)	• understanding that Pythagoras' Theorem is a useful tool in determining unknown lengths in right-angled triangles and has widespread applications • recognising that right-angled triangle calculations may generate results that can be integral, fractional or irrational numbers known as surds
Use similarity to investigate the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles (ACMMG223)	• developing understanding of the relationship between the corresponding sides of similar right-angled triangles
Apply trigonometry to solve right-angled triangle problems (ACMMG224)	• understanding the terms 'adjacent' and 'opposite' sides in a right-angled triangle • selecting and accurately using the correct trigonometric ratio to find unknown sides (adjacent, opposite and hypotenuse) and angles in right-angled triangles

Statistics and Probability

Chance	Elaborations
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 (ACMSP225)	
Calculate relative frequencies from given or collected data to estimate probabilities of events involving 'and' or 'or' (ACMSP226)	• posing 'and', 'or', 'not' and 'given' probability questions about objects or people • collecting data to answer the questions using Venn diagrams or two-way tables
Investigate reports of surveys in digital media and elsewhere for information on how data were obtained to estimate population means and medians (ACMSP227)	• investigating a range of data and its sources, for example the age of residents in Australia, Cambodia and Tonga; the number of subjects studied at school in a year by 14-year-old students in Australia, Japan and Timor-Leste
Data representation and interpretation	**Elaborations**
Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly from secondary sources (ACMSP228)	• comparing the annual rainfall in various parts of Australia, Pakistan, New Guinea and Malaysia
Construct back-to-back stem-and-leaf plots and histograms and describe data, using terms including 'skewed', 'symmetric' and 'bi modal' (ACMSP282)	
Compare data displays using mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread (ACMSP283)	
Investigate techniques for collecting data, including census, sampling and observation (ACMSP284)	

Year 9 achievement standard

By the end of Year 9, students express numbers in scientific notation and apply the index laws to numbers. They expand and factorise algebraic expressions and solve problems involving simple interest. Students solve linear equations using graphical and algebraic techniques. Students list outcomes, assign and determine probabilities for events. They construct displays and investigate the position of the mean and median and describe the shape of the distribution. Students calculate areas of shapes and volume and surface area of right prisms. They investigate similar and congruent triangles and problems involving Pythagoras' theorem. Students recognise the connection between similarity and the trigonometric ratios and use trigonometry to solve right-angled triangle problems.

Year 10

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes describing patterns in uses of indices, applying the four operations to algebraic fractions, finding unknowns in formulas after substitution, making the connection between algebraic and graphical representations of relations, connecting simple and compound interest in financial contexts and determining probabilities of multiple experiments

Fluency includes formulating proofs using congruent triangles and angle properties, factorising and expanding algebraic expressions, using a range of strategies to solve equations and using calculations to investigate the shape of data sets

Problem Solving includes calculating the surface area and volume of a diverse range of prisms, finding unknown lengths and angles using applications of trigonometry, using algebraic and graphical techniques to find solutions to simultaneous equations and inequalities, and investigating independence of events and their probabilities

Reasoning includes formulating geometric proofs involving congruence and similarity, interpreting and evaluating media statements and interpreting and comparing data sets

Number and Algebra

Money and financial mathematics	Elaborations
Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies (ACMNA229)	• working with authentic information, data and interest rates to calculate compound interest and solve related problems
Patterns and algebra	**Elaborations**
Factorise algebraic expressions by taking out a common algebraic factor (ACMNA230)	• factorising a range of expressions by taking out a common factor, including those where the common factor is an algebraic expression
Simplify algebraic products and quotients using index laws (ACMNA231)	• understanding that the use of index notation is an efficient way of representing numbers and symbols and has many applications, particularly in science • connecting different strategies for simplifying expressions with indices to illustrate the meaning of negative indices, expanding and simplifying results • moving fluently between representations of numeric and algebraic terms with negative indices, and applying understanding of negative indices to calculations • applying knowledge of index laws to algebraic terms, and simplifying algebraic expressions using both positive and negative integral indices
Apply the four operations to simple algebraic fractions with numerical denominators (ACMNA232)	• solving a wide range of linear equations, including those involving one or two simple algebraic fractions, and checking solutions by substitution
Expand binomial products and factorise monic quadratic expressions using a variety of strategies (ACMNA233)	• identifying and using common factors, including binomial terms, to factorise algebraic expressions using the technique of grouping in pairs to factorise algebraic expressions with four terms • using expansion patterns for the special binomial products $(a + b)(a - b)$ and $(a \pm b)^2$ inversely to factorise quadratic • using the area model inversely to factorise quadratic expressions of the form $ax^2 + bx + c$, where $a = \pm 1$ • exploring the method of completing the square to factorise quadratic expressions and solve quadratic equations
Substitute values into formulas to determine an unknown (ACMNA234)	• representing word problems with simple linear equations and solving them to answer questions

Linear and non-linear relationships	Elaborations
Solve problems involving linear equations, including those derived from formulas (ACMNA235)	• solving equations that are the result of substitution into common formulas from mathematics and elsewhere, including those that involve rearrangement • checking the solution by substitution into the equation
Solve linear inequalities and graph their solutions on a number line (ACMNA236)	• representing word problems with simple linear inequalities and solving them to answer questions
Solve linear simultaneous equations, using algebraic and graphical techniques including using digital technology (ACMNA237)	• using simple algebraic techniques to solve pairs of linear simultaneous equations • generalising pairs of equations from word problems and choosing an appropriate strategy for solving them simultaneously
Solve problems involving parallel and perpendicular lines (ACMNA238)	• Developing fluency with the geometric calculations which connect the graphical and analytical representations of parallel and perpendicular lines, using geometric software to carry out investigations with parallel and perpendicular lines
Explore the connection between algebraic and graphical representations of relations such as simple quadratics, circles and exponentials using digital technology as appropriate (ACMNA239)	• identifying, matching and describing algebraic and graphical representations of parabolas, rectangular hyperbolas, exponential functions and circles, including those that have undergone a single transformation • sketching the graphical representations of parabolas, exponential functions and circles
Solve linear equations involving simple algebraic fractions (ACMNA240)	• solving a wide range of linear equations, including those involving one or two simple algebraic fractions, and checking solutions by substitution • representing word problems, including those involving fractions, as equations and solving them to answer the question
Solve simple quadratic equations using a range of strategies (ACMNA241)	• developing an understanding that many relationships are non-linear and that these can also be represented graphically and algebraically • identifying the connection between algebraic and graphical solutions of equations (for example understanding that the x-intercepts are the solutions of f(x) = 0) exploring the method of completing the square to factorise quadratic expressions and solve quadratic equations

Measurement and Geometry

Using units of measurement	Elaborations
Solve problems involving surface area and volume for a range of prisms, cylinders and composite solids (ACMMG242)	• building on understanding of surface areas and volumes of prisms and cylinders, to include pyramids, cones and spheres

Geometric reasoning	Elaborations
Formulate proofs involving congruent triangles and angle properties (ACMMG243)	• proving that a quadrilateral with equal-length diagonals bisecting at right angles is a square
Apply logical reasoning, including the use of congruence and similarity, to proofs and numerical exercises involving plane shapes (ACMMG244)	• presenting formal geometric arguments to develop skills in mathematical reasoning and presenting reasoned arguments (proofs) • using mathematical language and notation, based on congruence and similarity • applying an understanding of relationships to deduce properties of geometric figures (for example the base angles of an isosceles triangle are equal) • distinguishing between a practical demonstration and a proof (for example demonstrating triangles are congruent by placing them on top of each other, as compared to using congruence tests to establish that triangles are congruent)

Pythagoras and trigonometry	Elaborations
Solve right-angled triangle problems including those involving direction and angles of elevation and depression (ACMMG245)	• applying Pythagoras's Theorem and trigonometry to problems in surveying and design

Statistics and Probability

Chance	Elaborations
Describe the results of two- and three-step chance experiments, both with and without replacements, assign probabilities to outcomes and determine probabilities of events. Investigate the concept of independence (ACMSP246)	• recognising and identifying that some sets of chance events are dependent on a previous result and others are not, that this distinction is important when calculating probabilities, and that events are independent if P(A) x P(B) = P(A and B) • distinguishing that event A is mathematically dependent on event B if the occurrence of event B affects the chance of the occurrence of event A (for example, selecting a ball from a bag where one ball has already been taken and not replaced)
Use the language of 'if ....then, 'given', 'of', 'knowing that' to investigate conditional statements and identify common mistakes in interpreting such language (ACMSP247)	• evaluating media reports that refer to data from a range of contexts, where the evaluation allows students to demonstrate their statistical literacy
Data representation and interpretation	Elaborations
Determine quartiles and interquartile range (ACMSP248)	• finding the five-number summary (minimum and maximum values, median and upper and lower quartiles) and using its graphical representation, the box plot, as tools for both numerically and visually comparing the centre and spread of data sets
Construct and interpret box plots and use them to compare data sets (ACMSP249)	• understanding that box plots are an efficient and common way of representing and summarising data and can facilitate comparisons between data sets • using parallel box plots to compare data about the distribution of Aboriginal and Torres Strait Islander people by age with that of the Australian population as a whole
Compare shapes of box plots to corresponding histograms and dot plots (ACMSP250)	• Investigating data in different ways to make comparisons and draw conclusions
Use scatter plots to investigate and comment on relationships between two continuous variables (ACMSP251)	• using authentic data to construct scatter plots, make comparisons and draw conclusions
Investigate and describe bivariate numerical data where the independent variable is time (ACMSP252)	• constructing and interpreting data displays representing bivariate data over time • investigating biodiversity changes in Australia since white settlement
Evaluate statistical reports in the media and other places by linking claims to displays, statistics and representative data (ACMSP253)	• investigating real-life examples that demonstrate that predicted outcomes can be accompanied by unpredicted effects, and understanding the causes for this (for example, Chinese one-child policy becoming the 'one-male' policy) • evaluating statistical reports comparing the life expectancy of Aboriginal and Torres Strait Islander people with that of the Australian population as a whole

Year 10 achievement standard

By the end of Year 10, students expand and factorise monic quadratic expressions and find unknown values after substitution into formulas. They represent relations on the Cartesian plane and solve linear and quadratic equations. They make connections between simple and compound interest. Students list outcomes, assign and determine probabilities for chance experiments and investigate independent events. They construct box-plots and compare data sets. Students investigate and describe statistical relationships and evaluate statistical reports. Students solve problems involving volume and surface area of a range of prisms and apply reasoning to proofs and numerical exercises. They apply trigonometry to solve right-angled triangle problems.

Year 10A

Number and Algebra

Real numbers	Elaborations
Define rational and irrational numbers and perform operations with surds and fractional indices (ACMNA264)	• understanding that the real number system includes irrational numbers and that certain subsets of the real number system have particular properties • applying the index laws to numeric and algebraic expressions and evaluating or simplifying them as required
Use the definition of a logarithm to establish and apply the laws of logarithms (ACMNA265)	• investigating the relationship between exponential and logarithmic expressions • investigating the use of logarithmic scale
Patterns and algebra	**Elaborations**
Investigate the concept of a polynomial and apply the factor and remainder theorems to solve problems (ACMNA266)	• investigating the relationship between algebraic long division and the factor and remainder theorems
Linear and non-linear relationships	**Elaborations**
Describe, interpret and sketch parabolas, hyperbolas, circles and exponential functions and their transformations (ACMNA267)	• using a range of strategies to investigate the effect of multiplying by a constant term, including negative numbers • connecting the graphical and algebraic representations and describing the transformation
Solve simple exponential equations (ACMNA270)	• investigating exponential equations derived from authentic mathematical models based on population growth
Apply understanding of polynomials to sketch a range of curves and describe the features of these curves from their equation (ACMNA268)	• investigating the features of graphs of polynomials using digital technology
Factorise monic and non-monic quadratic expressions and solve a wide range of quadratic equations derived from a variety of contexts (ACMNA269)	• developing fluency with algebraic techniques associated with quadratics to facilitate describing relationships and solving problems

Measurement and Geometry

Using units of measurement	Elaborations
Solve problems involving surface area and volume of right pyramids, right cones, spheres and related composite solids (ACMMG271)	• using formulas to solve problems • using authentic situations to apply knowledge and understanding of surface area and volume
Geometric reasoning	**Elaborations**
Prove and apply angle and chord properties of circles (ACMMG272)	• applying properties of circles to develop formal proofs
Pythagoras and trigonometry	**Elaborations**
Establish the sine, cosine and area rules for any triangle and solve related problems (ACMMG273)	• applying knowledge of sine, cosine and area rules to authentic problems such as those involving surveying and design

Use the unit circle to define trigonometric functions, and graph them with and without the use of digital technologies (ACMMG274)	• establishing the symmetrical properties of trigonometric functions • investigating angles of any magnitude
Solve simple trigonometric equations (ACMMG275)	• understanding that trigonometric functions are periodic and that this can be used to describe motion • using the notion of periodicity and symmetry to consider an infinite number of solutions
Apply Pythagoras' theorem and trigonometry to solving three-dimensional problems in right-angled triangles (ACMMG276)	• investigating the applications of Pythagoras's theorem in authentic problems

Statistics and Probability

Chance	Elaborations
Investigate reports of studies in digital media and elsewhere for information on the planning and implementation of such studies, and the reporting of variability (ACMSP277)	• evaluating media reports that refer to data from a range of contexts • evaluating whether graphs in a report could mislead, and whether graphs and numerical information support the claims • evaluating the appropriateness of sampling methods and sample size in reports where statements about a population are based on a sample
Data representation and interpretation	**Elaborations**
Calculate and interpret the mean and standard deviation of data and use these to compare data sets (ACMSP278)	• evaluating the appropriateness of sampling methods and sample size in reports where statements about a population are based on a sample
Use information technologies to investigate bivariate numerical data sets. Where appropriate use a straight line to describe the relationship allowing for variation (ACMSP279)	• investigating different techniques for finding a 'line of best fit'

Algebraic expression

An **algebraic expression** is formed by combining numbers and algebraic symbols using arithmetic operations. The expression must be constructed unambiguously according to the rules of algebra.

For example, $a^2 + 3ab - 2b^2$, and $(x+1)e^x$ are algebraic expressions, but $2x ++ 3y$ is not because it is incomplete.

Algebraic fraction

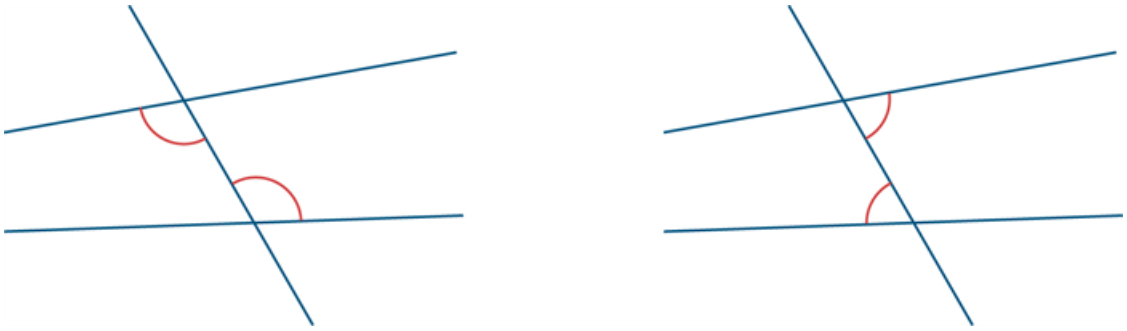
An **algebraic fraction** is a fraction in which both the numerator and denominator are algebraic expressions.

Algebraic term

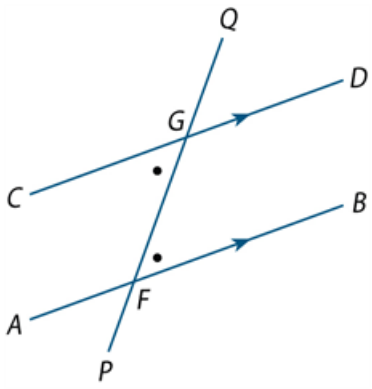
An **algebraic term** is an algebraic expression that forms a 'separable' part of some other algebraic expression. For example, x^2 and $5x^{-1}$ are terms in the inequality $x^2 \leq 5x^{-1}$, and $2, 3x, 5x^2$ are terms of the polynomial $2 + 3x + 5x^2$.

Alternate

In each diagram below, the two marked angles are called **alternate angles** (since they are on alternate sides of the transversal).



If the lines *AB* and *CD* are parallel, then each pair of alternate angles are equal.

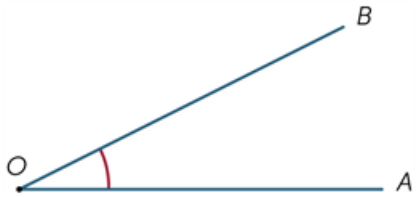


Angle

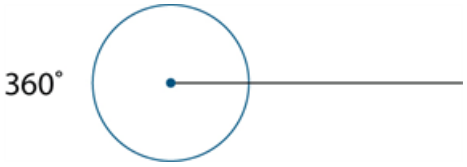
An **angle** is the figure formed by two rays sharing a common endpoint, called the vertex of the angle.

The size of an angle

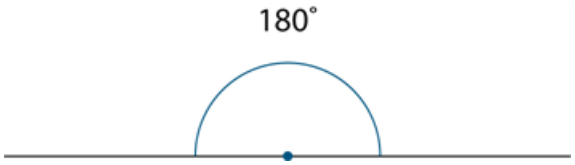
Imagine that the ray *OB* is rotated about the point *O* until it lies along *OA*. The amount of turning is called the size of the angle *AOB*.



A **revolution** is the amount of turning required to rotate a ray about its endpoint until it falls back onto itself. The size of 1 revolution is 360^{O}.



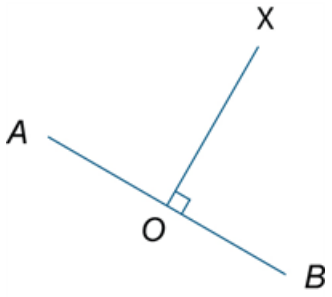
A **straight angle** is the angle formed by taking a ray and its opposite ray. A straight angle is half of a revolution, and so has size equal to 180^{O}.



Right angle

Let *AOB* be a line, and let *OX* be a ray making equal angles with the ray *OA* and the ray *OB*. Then the equal angles $\angle AOX$ and $\angle BOX$ are called right angles.

A right angle is half of a straight angle, and so is equal to 90^{O}.



Classification of angles

Angles are classified according to their size.

We say that

- An angle with size α is **acute** if $0^{O} < \alpha < 90^{O}$,
- An angle with size α is **obtuse** if $90^{O} < \alpha < 180^{O}$,

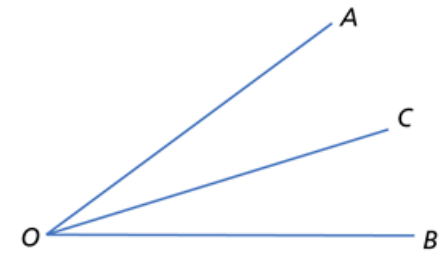
- An angle with size α is **reflex** if $180^0 < \alpha < 360^o$

Adjacent angles

Two angles at a point are called **adjacent** if they share a common ray and a common vertex.

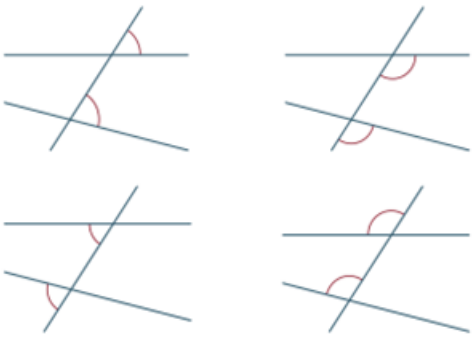
Hence, in the diagram,

- $\angle AOC$ and $\angle BOC$ are adjacent, and
- $\angle AOB$ and $\angle AOC$ are adjacent.

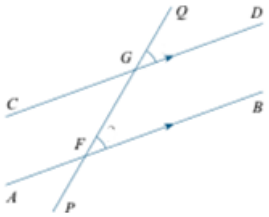


Two angles that add to 90^o are called **complementary**. For example, 23^o and 67^o are complementary angles.

In each diagram the two marked angles are called **corresponding angles**.



If the lines are parallel, then each pair of corresponding angles are equal.

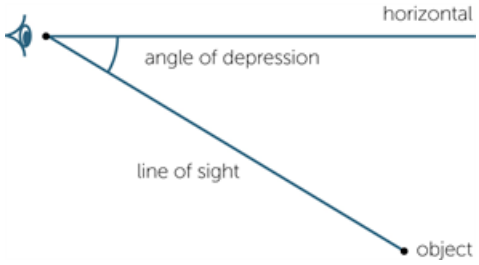


Conversely, if a pair of corresponding angles are equal, then the lines are parallel.

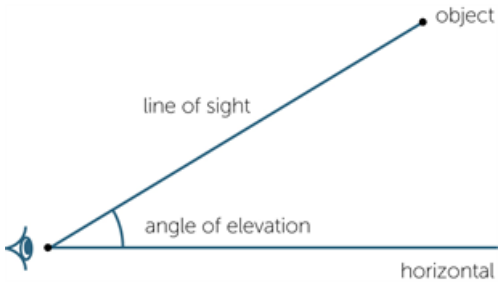
Two angles that add to 180^o are called **supplementary angles**. For example, 45^o and 135^o are supplementary angles.

Angles of elevation and depression

When an observer looks at an object that is lower than 'the eye of' the observer', the angle between the line of sight and the horizontal is called the **angle of depression**.



When an observer looks at an object that is higher than 'the eye of' the observer', the angle between the line of sight and the horizontal is called the **angle of elevation**.



Array

An array is an ordered collection of objects or numbers. Rectangular arrays are commonly used in primary mathematics.

Associative

A method of combining two numbers or algebraic expressions is **associative** if the result of the combination of three objects does not depend on the way in which the objects are grouped.

For example, addition of numbers is associative and the corresponding **associative law** is:

$(a + b) + c = a + (b + c)$ for all numbers a, b and c.

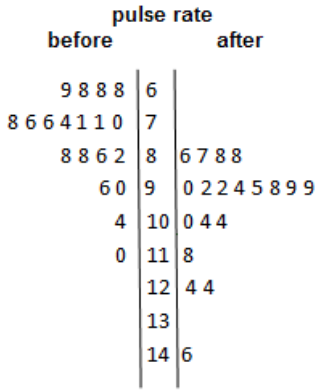
Multiplication is also associative: $(ab)c = a(bc)$ for all numbers a, and c, but subtraction and division are not, because, for example,

$(7 - 4) - 3 \neq 7 - (4 - 3)$ and $(12 \div 6) \div 2 \neq 12 \div (6 \div 2)$.

Back-to-back stem-and-leaf plot

A **back-to-back stem-and-leaf plot** is a method for comparing two data distributions by attaching two sets of 'leaves' to the same 'stem' in a stem-and-leaf plot.

For example, the stem-and-leaf plot below displays the distribution of pulse rates of 19 students before and after gentle exercise.



Bi modal

Bi modal data is data whose distribution has two modes.

Bivariate data

Bivariate data is data relating to two variables, for example, the arm spans and heights of 16 year olds, the sex of primary school students and their attitude to playing sport.

Bivariate numerical data

Bivariate numerical data is data relating to two numerical variables, for example height and weight.

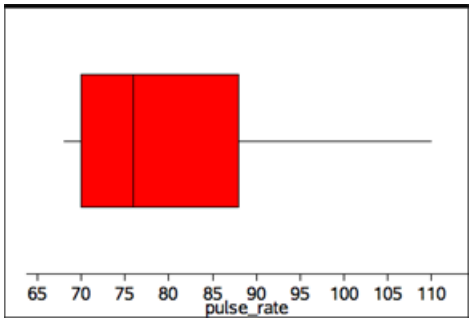
Box plot

The term **box plot** is a synonym for a box-and-whisker plot

A **box-and-whisker plot** is a graphical display of a five-number summary.

In a box-and-whisker plot, the 'box' covers the interquartile range (IQR), with 'whiskers' reaching out from each end of the box to indicate maximum and minimum values in the data set. A vertical line in the box is used to indicate the location of the median.

The box-and-whisker plot below has been constructed from the five -number summary of the resting pulse rates of 17 students.



The term 'box-and-whisker plot' is commonly abbreviated to 'box plot'.

A **five-number-summary** is a method for summarising a data set using five statistics, the minimum value, the lower quartile, the median, the upper quartile and the maximum value.

Capacity

Capacity is a term used to describe how much a container will hold. It is often used in relation to the volume of fluids. Units of capacity (volume of fluids or gases) include litres and millilitres.

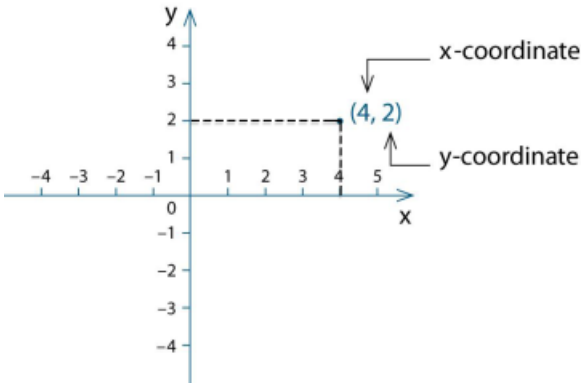
Cartesian coordinate system

Two intersecting number lines are taken intersecting at right angles at their origins to form the axes of the coordinate system.

The plane is divided into four quadrants by these perpendicular axes called the *x*-axis (horizontal line) and the *y*-axis (vertical line).

The position of any point in the plane can be represented by an **ordered pair** of numbers (*x*, *y*). These ordered are called the coordinates of the point. This is called the **Cartesian coordinate system.** The plane is called the **Cartesian plane.**

The point with coordinates (4, 2) has been plotted on the Cartesian plane shown. The coordinates of the origin are (0, 0).



Categorical variable

A **categorical variable** is a variable whose values are categories.

Examples: *blood group* is a categorical variable; its values are: A, B, AB or O. So too is *construction type* of a house; its values might be brick, concrete, timber, or steel.

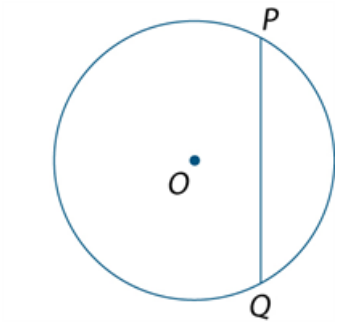
Categories may have numerical labels, for example, for the variable *postcode* the category labels would be numbers like 3787, 5623, 2016, etc, but these labels have no numerical significance. For example, it makes no sense to use these numerical labels to calculate the average postcode in Australia.

Census

A **census** is an attempt to collect information about the whole population.

A **population** is the complete set of individuals, objects, places, etc, that we want information about.

Chord



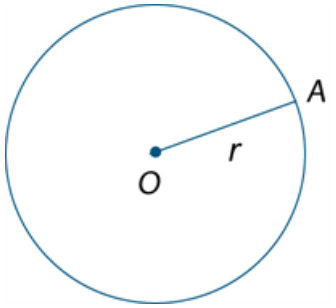
A **chord is a** line segment (interval) joining two points on a circle

A **diameter** is a chord passing through the centre.

The word diameter is also used for the length of the diameter.

Circle

The **circle** with **centre** *O* and **radius** *r* is the set of all points in the plane whose distance from *O* is *r*.



The line segment *OA* (interval *OA*) is also called a radius of the circle.

Putting the point of a pair of compasses at the centre and opening the arms to the radius can draw a circle.

Pi is the name of the Greek letter π, that is used to denote the ratio of the circumference of any circle to its diameter. The number π is irrational, but $22/7$ is a rational approximation accurate to 2 decimal places. The decimal expansion of π begins

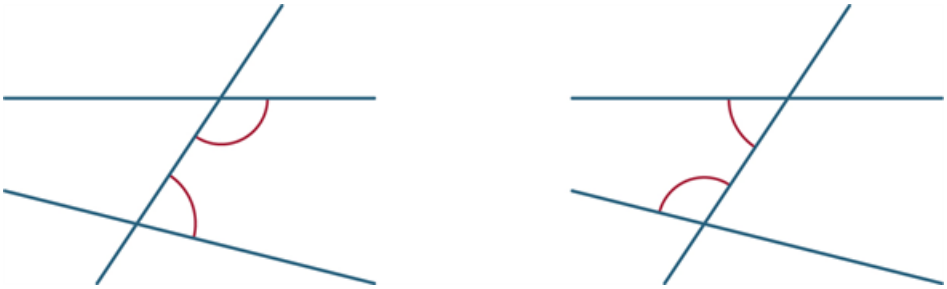
$$\pi = 3.141\,592\,653\,589\,79\cdots$$

There is a very long history of attempts to estimate π accurately. One of the early successes was due to Archimedes (287–212 BC) who showed that $3\frac{10}{71} < \pi < 3\frac{1}{7}$.

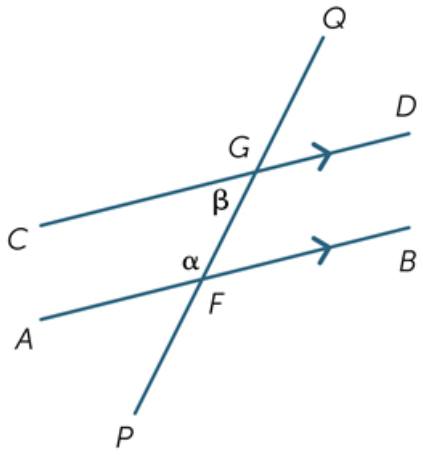
The decimal expansion of π has now been calculated to at least the first 10^{12} places.

Cointerior angles

In each diagram the two marked angles are called co-interior angles and lie on the same side of the transversal.



If the lines *AB* and *CD* are parallel then a + *b* = 180^{o}



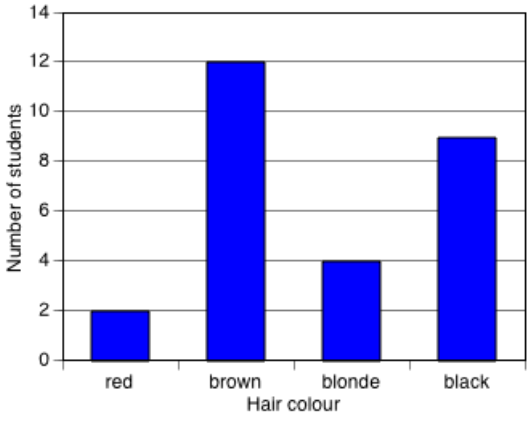
Cointerior angles formed by parallel lines are supplementary.

Conversely, if a pair of cointerior angles is supplementary then the lines are parallel.

Column graph

A **column graph** is a graph used in statistics for organising and displaying categorical data.

To construct a column graph, equal width rectangular bars are constructed for each category with height equal to the observed frequency of the category as shown in the example below which displays the hair colours of 27 students.

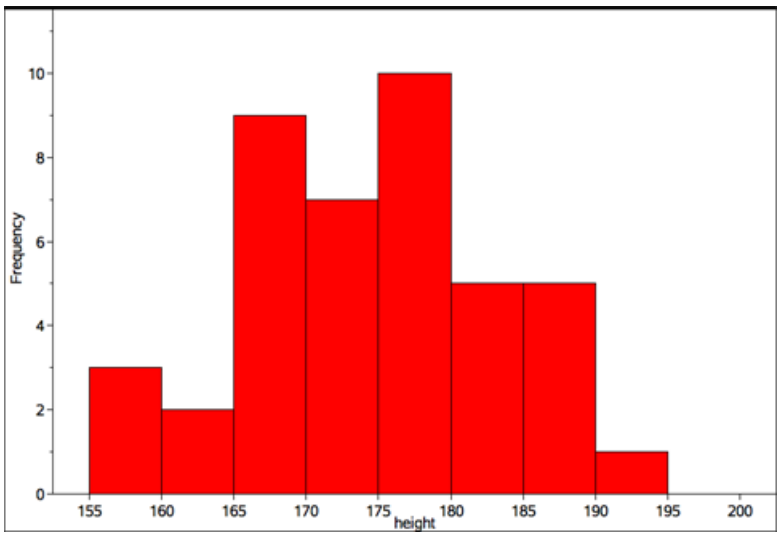


Column graphs are frequently called **bar graphs** or **bar charts**. In a bar graph or chart, the bars can be either vertical or horizontal.

A **histogram** is a statistical graph for displaying the frequency distribution of continuous data.

A histogram is a graphical representation of the information contained in a frequency table. In a histogram, class frequencies are represented by the areas of rectangles centred on each class interval. The class frequency is proportional to the rectangle's height when the class intervals are all of equal width.

The histogram below displays the frequency distribution of the heights (in cm) of a sample of 42 people with class intervals of width 5 cm.



Common factor

A **common factor** (or **common divisor**) of a set of numbers or algebraic expression is a factor of each element of that set.

For example, 6 is a common factor of $24, 54$ and 66, and $x + 1$ is a common factor of $x^2 - 1$ and $x^2 + 5x + 4$.

Commutative

A method of combining two numbers or algebraic expressions is **commutative** if the result of the combination does not depend on the order in which the objects are given.

For example, addition of numbers is commutative, and the corresponding **commutative law** is:

$a + b = b + a$ for all numbers a and b.

Multiplication is also commutative: $ab = ba$ for all numbers a and b, but subtraction and division are not, because, for example, $5 - 3 \neq 3 - 5$ and $12 \div 4 \neq 4 \div 12$.

Complementary events

Events *A* and *B* are **complementary** events, if A and B are mutually exclusive and Pr(*A*) + Pr(*B*) = 1.

Composite number

A natural number that has a factor other than 1 and itself is a **composite number**.

Compound interest

The interest earned by investing a sum of money (the principal) is **compound interest** if each successive interest payment is added to the principal for the purpose of calculating the next interest payment.

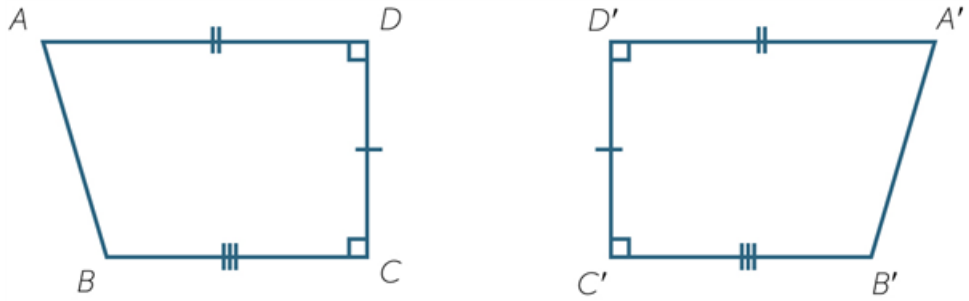
For example, if the principal $\$P$ earns compound interest at the rate of r per period, then after n periods the principal plus interest is $\$P(1+r)^n$

Congruence

Two plane figures are called **congruent** if one can be moved by a sequence of translations, rotations and reflections so that it fits exactly on top of the other figure.

Two figures are congruent when we can match every part of one figure with the corresponding part of the other figure. For example, the two figures below are congruent.

Matching intervals have the same length, and matching angles have the same size.



Congruent triangles

The four standard congruence tests for triangles.

Two triangles are congruent if:

SSS: the three sides of one triangle are respectively equal to the three sides of the other triangle, or

SAS: two sides and the included angle of one triangle are respectively equal to two sides and the included angle of the other triangle, or

AAS: two angles and one side of one triangle are respectively equal to two angles and the matching side of the other triangle, or

RHS: the hypotenuse and one side of one right-angled triangle are respectively equal to the hypotenuse and one side of the other right-angled triangle.

Continuous variable

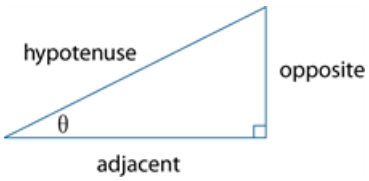
A **continuous variable** is a numerical variable that can take any value that lies within an interval. In practice, the values taken are subject to the accuracy of the measurement instrument used to obtain these values.

Examples include height, reaction time to a stimulus and systolic blood pressure.

Cosine

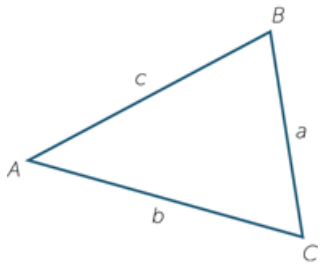
In any right-angled triangle,

$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$ where $0^O < \theta < 90^O$



In any triangle *ABC*,

$c^2 = a^2 + b^2 - 2ab\cos C$



Counting number

The **counting numbers** are the non-negative integers, that is, one of the numbers $0,1,2,3,\cdots$

Sometimes it is taken to mean only a positive integer.

A **natural number** is a positive integer or counting number. The natural numbers are $1,2,3,\cdots$. The set of natural numbers is usually denoted by $\mathbb{N}$.

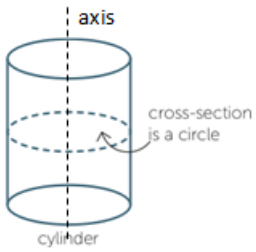
Counting on

Counting a collection, or reciting a sequence of number words, from a point beyond the beginning of the sequence.

For example, when a child has counted to established that there are 6 objects in a collection and is then asked “How Many?” after several more are added might *count on* from 6 saying “7, 8, 9, ...” to reach the total. This is considered a more sophisticated strategy than counting the whole collection from 1.

Cylinder

A **cylinder** is a solid that has parallel circular discs of equal radius at the ends. Each cross-section parallel to the ends is a circle with the same radius, and the centres of these circular cross-sections lie on a straight line, called the **axis of the cylinder**.



Data

Data is a general term for a set of observations and measurements collected during any type of systematic investigation.

Primary data is data collected by the user. **Secondary data** is data collected by others. Sources of secondary data include, web-based data sets, the media, books, scientific papers, etc.

Univariate data is data relating to a single variable, for example, hair colour or the number of errors in a test.

Data display

A **data display** is a visual format for organising and summarising data.

Examples include, box plots, column graphs, frequency tables and stem plots.

Decimal

A **decimal** is a numeral in the decimal number system.

For example, the decimal expansion of $6\frac{3}{4}$ is 6.75 . The integer part is 6 and the fractional part is 0.75

A decimal is terminating if the fractional part has only finitely many decimal digits. It is non-terminating if it has infinitely digits.

For example, 6.75 is a terminating decimal, whereas $0.3161616\cdots$, where the pattern 16 repeats indefinitely, is non-terminating.

Non-terminating decimals may be recurring, that is, contain a pattern of digits that repeats indefinitely after a certain number of places.

For example, $0.3161616\cdots$ is a recurring decimal, whereas $0.101001000100001\cdots$, where the number of 0's between the 1's increases indefinitely, is not recurring.

It is common practice to indicate the repeating part of a recurring decimal by using dots or lines as superscripts.

For example, $0.3161616\cdots$ could be written as $0.3\dot{1}\dot{6}$ or $0.3\overline{16}$

The **decimal number system** is the base 10, place-value system most commonly used for representing real numbers. In this system positive numbers are expressed as sequences of Arabic numerals 0 to 9, in which each successive digit to the left or right of the decimal point indicates a multiple of successive powers (respectively positive or negative) of 10.

For example, the number represented by the decimal 12.345 is the sum $1\times10^{1}+2\times10^{0}+3\times10^{-1}+4\times10^{-2}+5\times10^{-3}$.

Denominator

In the fraction $\frac{a}{b}$, b is the **denominator**. It is the number of equal parts into which the whole is divided in order to obtain fractional parts. For example, if a line segment is divided into 5 equal parts, each of those parts is one fifth of the whole and corresponds to the unit fraction $\frac{1}{5}$.

Dependent variable

Two events are **independent** if knowing the outcome of one event tells us nothing about the outcome of the other event.

Difference

A difference is the result of subtraction one number or algebraic quantity from another.

Distributive

Multiplication of numbers is **distributive** over addition because the product of one number with the sum of two others equals the sum of the products of the first number with each of the others. This means that we can multiply two numbers by expressing one (or both) as a sum and then multiplying each part of the sum by the other number (or each part of its sum.)

For example,

$$8 \times 17 = 8 \times (10 + 7) = 8 \times 10 + 8 \times 7 = 80 + 56 = 136$$

This **distributive law** is expressed algebraically as follows:

$$a(b + c) = ab + ac, \text{ for all numbers } a, b \text{ and } c$$

Divisible

In general, a number or algebraic expression x is **divisible** by another y if there exists a number or algebraic expression q of a specified type for which $x = yq$.

A natural number m is divisible by a natural number n if there is a natural number q such that $m = nq$.

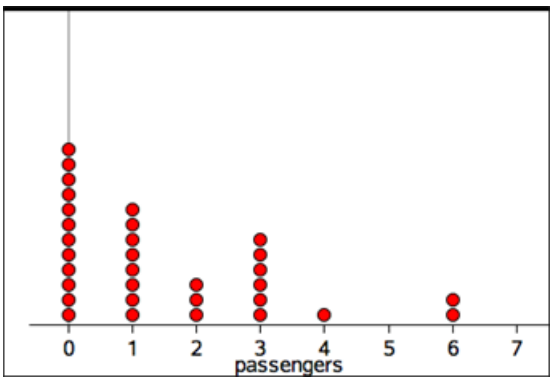
For example, 12 is divisible by 4 because $12 = 3 \times 4$.

Dot plot

A **dot plot** is a graph used in statistics for organising and displaying numerical data.

Using a number line, a dot plot displays a dot for each observation. Where there is more that one observation, or observations are close in value, the dots are stacked vertically. If there are a large number of observations, dots can represent more than one observation. Dot plots are ideally suited for organising and displaying discrete numerical data.

The dot plot below displays the number of passengers observed in 32 cars stopped at a traffic light.



Dot plots can also be used to display categorical data, with the numbers on the number line replaced by category labels.

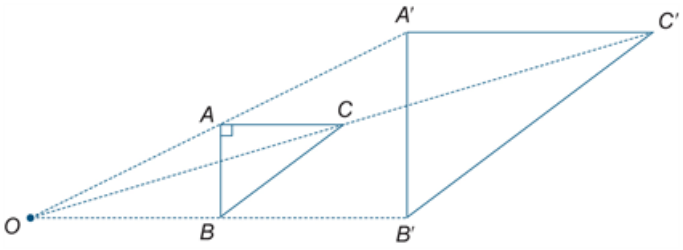
Element

An **element** of a set is a member of that set. For example, the elements of the set $\{2,3,4,6,8\}$ are the numbers 2,3,4,6 and 8. We write $x \in S$ to indicate that x is a member of the set S.

Enlargement (Dilation)

An enlargement is a scaled up (or down) version of a figure in which the transformed figure is in proportion to the original figure. The relative positions of points are unchanged and the two figures are similar.

In the diagram below triangle *A′B′C′* is the image of triangle *ABC* under the enlargement with enlargement factor 2 and centre of enlargement *O*.



Equally Likely outcomes

Equally likely outcomes occur with the same probability.

For example, in tossing a fair coin, the outcome ‘head’ and the outcome ‘tail’ are equally likely.

In this situation, Pr(head) = Pr(tail) = 0.5

Equation

An **equation** is a statement that asserts that two numbers or algebraic expressions are equal in value. An equation must include an equal sign. For example, $3 + 14 = 11 + 6$.

An **identity** is an equation involving algebraic expressions that is true for all values of the variables involved.

For example $x^2 - 4 = (x - 2)(x + 2)$.

An identity is an equation that is true for all values of the variables involved.

Example: $x^2 - y^2 = (x - y)(x + y)$

An **inequality** is a statement that one number or algebraic expression is less than (or greater than) another. There are four types of inequalities:

- The relation a is less than b is written $a < b$,
- a is greater than b is written $a > b$,
- a is less than or equal to b is written $a \leq b$, and
- a is greater than or equal to b is written $a \geq b$.

Equivalent fractions

Two fractions $\frac{a}{b}$ and $\frac{c}{d}$ are **equivalent** if they are equal, that is, $ad = bc$.

Equivalent fractions are alternative ways of writing the same fraction.

For example, $\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \cdots$

Estimate

In statistical terms, an **estimate** is information about a population extrapolated from a sample of the population.

For example, the mean number of decayed teeth in a randomly selected group of eight-year old children is an estimate of the mean number of decayed teeth in eight-year old children in Australia.

Even number

A whole number is **even** if it is divisible by 2. The even whole numbers are $0,2,4,6,\cdots$.

Event

An **event** is a subset of the sample space for a random experiment.

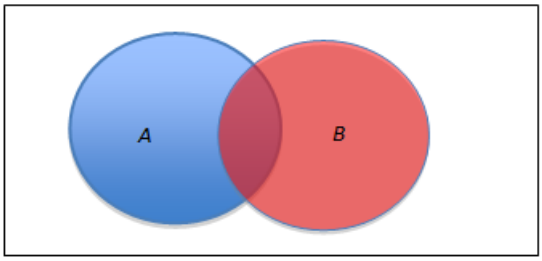
For example, the set of outcomes from tossing two coins is { HH,HT,TH,TT }, where H represents a 'head' and T a 'tail'.

For example, if *A* is the event 'at least one head is obtained', then *A* = { HT,TH, HH }.

Two events *A* and *B* are **mutually exclusive** if one is incompatible with the other; that is, if they cannot be simultaneous outcomes in the same chance experiment.

For example, when a fair coin is tossed twice, the events 'HH' and 'TT' cannot occur at the same time and are, therefore, mutually exclusive.

In a Venn diagram, as shown below, mutually exclusive events do not overlap.



Expression

Two or more numbers or variables connected by operations. For example, 17 – 9, 8 x (2 + 3), 2*a* + 3*b* are all expressions. Expressions do not include an equal sign.

Factor

In general, a number or algebraic expression x is a **factor** (or **divisor**) of another y if there exists a number or algebraic expression q of a specified type for which $y = xq$.

A natural number m is a factor of a natural number n if there is a natural number q such that $n = mq$.

For example, 4 is a factor of 12 because $12 = 3 \times 4$.

A polynomial $a(x)$ is divisible by a polynomial $b(x)$ if there is a polynomial $q(x)$ for which $a(x) = b(x)q(x)$.

For example, $x - 2$ is a factor $x^2 - 6x + 8$ because $x^2 - 6x + 8 = (x - 4)(x - 2)$.

A **prime factor** of a natural number n is a factor of n that is a prime number.

For example, the prime factors of 330 are $2,3,5$ and 11.

Factor and remainder theorem

According to the **factor theorem**, if $p(x)$ is a polynomial and $p(a) = 0$ for some number a, then $p(x)$ is divisible by $x - a$.

This follows easily from the remainder theorem, because for $p(x) \div (x - a)$ the remainder is $p(a)$. So if $p(a) = 0$, the remainder is 0 and $p(x)$ is divisible by $x - a$.

The factor theorem can be used to obtain factors of a polynomial.

For example, if $p(x) = x^3 - 3x^2 + 5x - 6$, then it is easy to check that $p(2) = 2^3 - 3 \times 2^2 + 5 \times 2 - 6 = 0$. So by the factor theorem $x - 2$ is a factor of $x^3 - 3x^2 + 5x - 6$.

According to the **remainder theorem**, if a polynomial $p(x)$ is divided by $x - a$. where a is any real number, the remainder is $p(a)$. That is, $p(x) = q(x)(x - a) + p(a)$, for some polynomial $q(x)$

Factorise

To **factorise** a number or algebraic expression is to express it as a product.

For example, 15 is factorised when expressed as a product: $15 = 3 \times 5$, and $x^2 - 3x + 2$ is factorised when written as a product:

$$x^2 - 3x + 2 = (x - 1)(x - 2).$$

Fraction

The **fraction** $\frac{a}{b}$ (written alternatively as a/b), where a is a non negative integer and b is a positive integer, was historically obtained by dividing a unit length into b equal parts and taking a of these parts.

For example, $\frac{3}{5}$ refers to 3 of 5 equal parts of the whole, taken together.

In the fraction $\frac{a}{b}$ the number a is the numerator and the number b is the denominator.

It is a **proper fraction** if $a < b$ and an **improper fraction** otherwise.

Frequencies

Frequency, or **observed frequency**, is the number of times that a particular value occurs in a data set.

For grouped data, it is the number of observations that lie in that group or class interval.

An **expected frequency** is the number of times that a particular event is expected to occur when a chance experiment is repeated a number of times. For example, If the experiment is repeated *n* times, and on each of those times the probability that the event occurs is *p*, then the expected frequency of the event is *np*.

For example, suppose that a fair coin is tossed 5 times and the number of heads showing recorded. Then the expected frequency of 'heads' is 5/2.

This example shows that the expected frequency is not necessarily an observed frequency, which in this case is one of the numbers 0,1,2,3,4 or 5.

A **frequency table** lists the frequency (number of occurrences) of observations in different ranges, called class intervals.

The frequency distribution of the heights (in cm) of a sample of 42 people is displayed in the **frequency table** below

Height (cm)

Class interval	Frequency
155-<160	3
160-<165	2
165-<170	9
170-<175	7
175-<180	10
180-<185	5
185-<190	5
185-<190	5

A **frequency distribution** is the division of a set of observations into a number of classes, together with a listing of the number of observations (the frequency) in that class.

Frequency distributions can be displayed in tabular or graphical form.

Frequency, or **observed frequency**, is the number of times that a particular value occurs in a data set.

For grouped data, it is the number of observations that lie in that group or class interval.

Relative frequency is given by the ratio $\frac{f}{n}$, where f is the frequency of occurrence of a particular data value or group of data values in a data set and n is the number of data values in the data set.

Frequency table

A **two-way frequency table** is commonly used to for displaying the two-way frequency distribution that arises when a group of individuals or things are categorised according to two criteria.

For example, the two-way table below displays the two-way frequency distribution that arises when 27 children are categorised according to *hair type* (straight or curly) and *hair colour* (red, brown, blonde, black).

Hair colour	Hair type		Total
red	1	1	2
brown	8	4	12
blonde	1	3	4
black	7	2	9
Total	17	10	27

The information in a two-way frequency table can also be displayed graphically using a side-by-side column graph.

Function

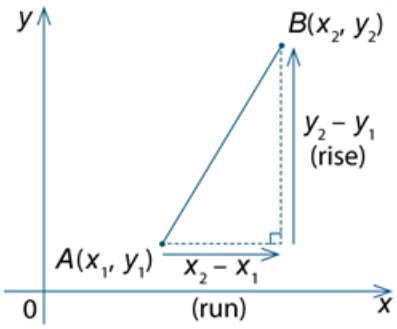
A **function** f assigns to each element of one set S precisely one element of a second set T .

The functions most commonly encountered in elementary mathematics are real functions of real variables. For such functions, the domain and codomain are sets of real numbers.

Functions are usually defined by a formula for $f(x)$ in terms of x. For example, the formula $f(x) = x^2$ defines the 'squaring function' that maps each real number x to its square x^2.

Gradient

If $A(x_1, y_1)$ and points $B(x_2, y_2)$ are points in the plane, $x_2 - x_1 \neq 0$, the **gradient** of the line segment (interval) $AB = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$.



The **gradient of a line** is the gradient of any line segment (interval) within the line.

Greatest common divisor

The **greatest common divisor (**gcd), **greatest common factor** (gcf) or **highest common factor** (hcf), of a given set of natural numbers is the common divisor of the set that is greater than each of the other common divisors.

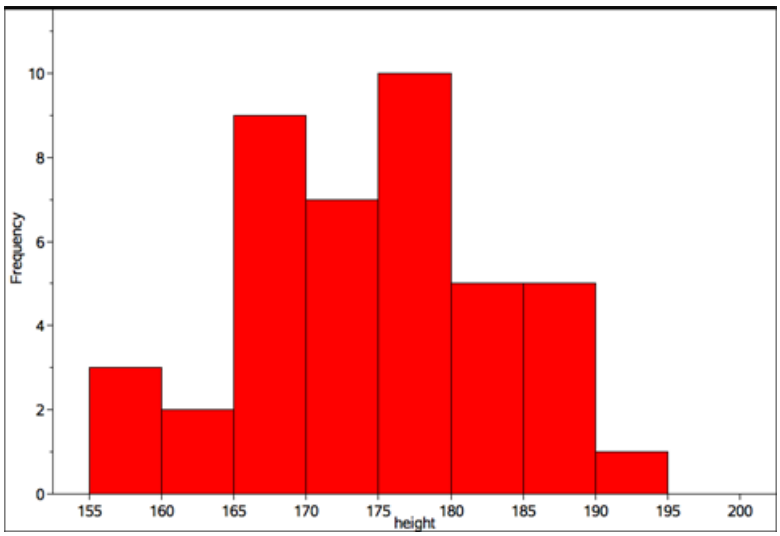
For example, 1,2,3, and 6 are the common factors of 24,54 and 66 and 6 is the greatest common divisor.

Histogram

A **histogram** is a statistical graph for displaying the frequency distribution of continuous data.

A histogram is a graphical representation of the information contained in a frequency table. In a histogram, class frequencies are represented by the areas of rectangles centred on each class interval. The class frequency is proportional to the rectangle's height when the class intervals are all of equal width.

The histogram below displays the frequency distribution of the heights (in cm) of a sample of 42 people with class intervals of width 5 cm.



Independent event

Two events are **independent** if knowing the outcome of one event tells us nothing about the outcome of the other event.

Independent variable

When investigating relationships in bivariate data, the **explanatory variable** is the variable that may explain or cause a difference in the r **esponse variable**.

For example, when investigating the relationship between the temperature of a loaf of bread and the time it has spent in a hot oven, *temperature* is the response variable and *time* is the explanatory variable.

With numerical bivariate data it is common to attempt to model such relationships with a mathematic equation and to call the response variable the **dependent variable** and the explanatory variable the **independent variable**.

When graphing numerical data, the convention is to display the response (dependent) variable on the vertical axis and the explanatory (independent) variable on the horizontal axis.

When there is no clear causal link between the events, the classification of the variables as either the dependent or independent variable is quite arbitrary.

Index

Index is synonymous with exponent.

The **exponent** or index of a number or algebraic expression is the power to which the latter is be raised. The exponent is written as a superscript. Positive integral exponents indicate the number of times a term is to be multiplied by itself. For example, $a^3 = a \times a \times a$.

Index law

Index laws are rules for manipulating indices (**exponents**). They include

$$x^a x^b = x^{a+b}; \quad (x^a)^b = x^{ab}; \quad \text{and} \quad x^a y^a = (xy)^a$$

and

$$x^0 = 1; \quad x^{-a} = \frac{1}{x^a}; \quad \text{and} \quad x^{1/a} = \sqrt[a]{x}$$

Informal unit

Informal units are not part of a standardised system of units for measurement. For example, an informal unit for length could paperclips of uniform length. An informal unit for area could be uniform paper squares of any size. Informal units are sometimes referred to as non-standard units.

Integer

The **integers** are the 'whole numbers' $\cdots, -3, -2, -1, 0, 1, 2, 3, \cdots$. The set of integers is usually denoted by $\mathbb{Z}$. Integers are basic building blocks in mathematics.

Interquartile range

The **interquartile range** (IQR) is a measure of the spread within a numerical data set. It is equal to the upper quartile (Q_3) minus the lower quartiles (Q_1); that is, $IQR = Q_3 - Q_1$

The IQR is the width of an interval that contains the middle 50% (approximately) of the data values. To be exactly 50%, the sample size must be a multiple of four.

Interval

An interval is a certain type of subset of the number line.

A **finite interval** is the set of all real numbers between two given real numbers called the **end points** of the interval. The end points may or may not be included in the interval.

Irrational number

An irrational number is a real number that is not rational. Some commonly used irrational numbers are π, e and $\sqrt{2}$.

The Euler number is an irrational real number whose decimal expansion begins

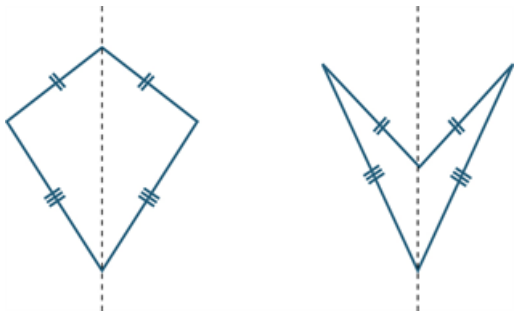
$$e = 2.718281828\cdots$$

Irregular shape

An irregular shape can be a polygon. A polygon that is not regular is irregular.

Kite

A **kite** is a quadrilateral with two pairs of adjacent sides equal.

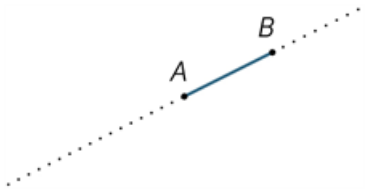


A kite may be convex as shown in the diagram above to the left or non-convex as shown above to the right. The **axis** of the kite is shown.

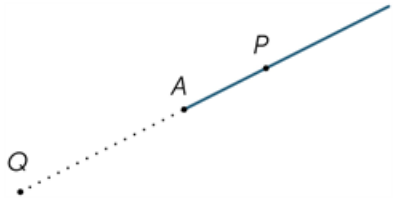
Line segment (Interval)

If *A* and *B* are two points on a line, the part of the line between and including *A* and *B* is called a **line segment** or **interval**.

The **distance** *AB* is a measure of the size or length of *AB*.



Any point *A* on a line divides the line into two pieces called rays. The **ray** *AP* is that ray which contains the point P (and the point A). The point *A* is called the **vertex** of the ray and it lies on the ray.



Linear equation

A **linear equation** is an equation involving just linear terms, that is, polynomials of degree 1. The general form of a linear equation in one variable is $ax + b = 0$

Location (statistics)

A measure of **location** is a single number that can be used to indicate a central or 'typical value' within a set of data.

The most commonly used measures of location are the mean and the median although the mode is also sometimes used for this purpose.

Logarithm

The **logarithm** of a positive number x is the power to which a given number b , called the **base**, must be raised in order to produce the number x. . The logarithm of x , to the base b is denoted by $\log_b x$. Algebraically: $\log_b x = y \leftrightarrow b^y = x$

For example, $\log_{10} 100 = 2$ because $10^2 = 100$, and $\log_2\left(\frac{1}{32}\right) = -5$ because $2^{-5} = \frac{1}{32}$.

Many-to-one correspondence

A **many-to-one correspondence** is a function or mapping that takes the same value for at least two different elements of its domain. For example, the squaring function $x \mapsto x^2$ is many-to-one because $x^2 = (-x)^2$ for all real numbers. x

Mean

The arithmetic **mean** of a list of numbers is the sum of the data values divided by the number of numbers in the list.

In everyday language, the arithmetic mean is commonly called the **average**.

For example, for the following list of five numbers { 2, 3, 3, 6, 8 } the mean equals

$$\frac{2+3+3+6+8}{5} = \frac{22}{5} = 4.4$$

Median

The **median** is the value in a set of ordered data that divides the data into two parts. It is frequently called the 'middle value'.

Where the number of observations is odd, the median is the middle value.

For example, for the following ordered data set with an **odd** number of observations, the median value is five.

1 3 3 4 5 6 8 9 9

Where the number of observations is **even**, the median is calculated as the mean of the two central values.

For example, in the following ordered data set, the two central values are 5 and 6, and median value is the mean of these two values, 5.5

1 3 3 4 5 6 8 9 9 10

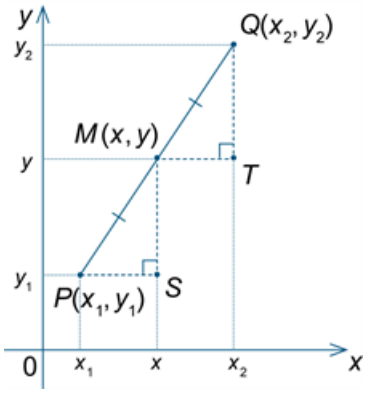
The median provides a measure of location of a data set that is suitable for both symmetric and skewed distributions and is also relatively insensitive to outliers.

Midpoint

The **midpoint** *M* of a line segment (interval) *AB* is the point that divides the segment into two equal parts.

Let $A(x_1, y_1)$ be points in the Cartesian plane. Then the **midpoint** *M* of line segment *AB* has coordinates $\left(\frac{x_1 + x_2}{2}, \frac{x_1 + x_2}{2}\right)$.

This can be seen from the congruent triangles below.



Mode

The **mode** is the most frequently occurring value in a set of data. There can be more than one mode. When there are two modes, the data set is said to be **bimodal**.

The mode is sometimes used as a measure of location.

Monic

A **monic** polynomial is one in which the coefficient of the leading term is 1. For example, $x^3 + 2x^2 - 7$ is monic, but $4x^2 - x + 1$ is not.

Multiple

A multiple of a number is the product of that number and an integer.

A multiple of a real number x is any number that is a product of x and an integer. For example, 4.5 and -13.5 are multiples of 1.5 because $4.5 = 3 \times 1.5$ and $13.5 = -7 \times 1.5$.

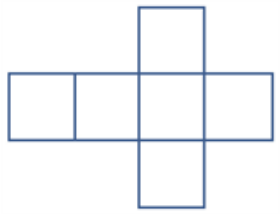
Multiplication

Multiplicative situations are problems or contexts that involve multiplication (or division). Calculating the number of seats in a theatre that has 30 rows of 24 seats, finding equivalent fractions, and working with ratios and percentages are all multiplicative situations.

Net

A **net** is a plane figure that can be folded to form a polyhedron.

One possible net for a cube is shown below.



Number

A real number is **rational** if it can be expressed as a quotient of integers. It is **irrational** otherwise.

Number line

A **number line** gives a pictorial representation of real numbers.

Numeral

A figure or symbol used to represent a number. For example, -3, 0, 45, IX

Numerator

In the fraction $\frac{a}{b}$, a is the **numerator**. If an object is divided into b equal parts, then the fraction $\frac{a}{b}$ represents a of these parts taken together. For example, if a line segment is divided into 5 equal parts, each of those parts is one fifth of the whole and 3 of these parts taken together corresponds to the fraction $\frac{3}{5}$.

Numerical data

Numerical data is data associated with a numerical variable.

Numerical variables are variables whose values are numbers, and for which arithmetic processes such as adding and subtracting, or calculating an average, make sense.

Odd and even number

A whole number is **even** if it is divisible by 2. The even whole numbers are $0,2,4,6,\cdots$.

An **odd number** is an integer that is not divisible by 2. The odd numbers are $\cdots -5,-3,-1,1,3,5,\cdots$.

One-to-one correspondence

In early counting development one-to-one correspondence refers to the matching of one and only one number word to each element of a collection.

More generally it refers to a relationship between two sets such that every element of the first set corresponds to one and only one element of the second set.

Operation

The process of combining numbers or expressions. In the primary years operations include addition, subtraction, multiplication and division. In later years operations include substitution and differentiation.

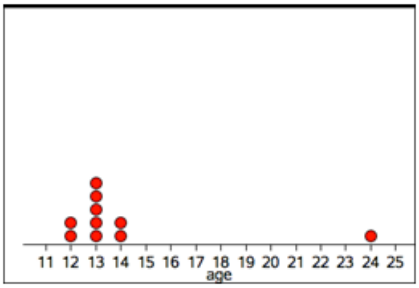
Order of operations

A convention for simplifying expressions that stipulates that multiplication and division are performed before addition and subtraction and in order from left to right. For example, in 5 – 6 ÷ 2 +7, the division is performed first and the expression becomes 5 – 3 + 7 = 9. If the convention is ignored and the operations are performed in order, the incorrect result, 6.5 is obtained.

Outlier

An **outlier** is a data value that appears to stand out from the other members of the data set by being unusually high or low. The most effective way of identifying outliers in a data set is to graph the data.

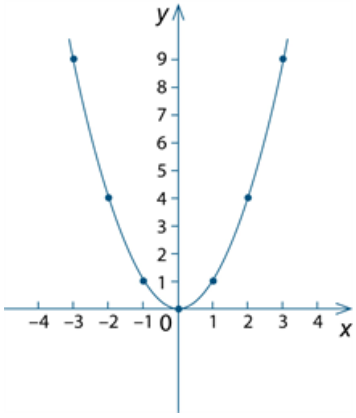
For example, in following list of ages of a group of 10 people, { 12, 12, 13, 13, 13, 13, 13, 14, 14, 14, 24 }, the 24 would be considered to be a possible outlier.



Parabola

Definition 1

The graph of $y = x^2$ is called a **parabola**. The point (0, 0) is called the **vertex** of the parabola and the y axis is the axis of symmetry of the parabola called simply the **axis**.



Some other parabolas are the graphs of $y = ax^2 + bx + c$ where $a \neq 0$.

More generally, every **parabola** is similar to the graph of $y = x^2$.

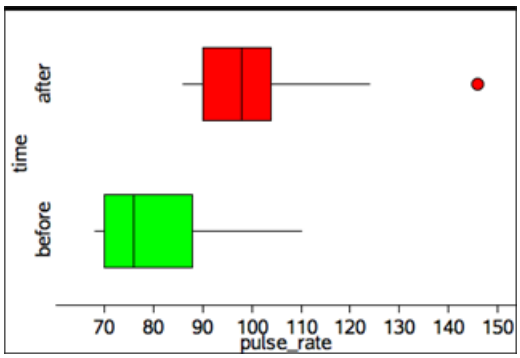
Definition 2

A parabola is the locus of all points P such that the distance from P to a fixed point F is equal to the distance from P to a fixed line l.

Parallel box plots

Parallel box-and-whisker-plots are used to visually compare the five-number summaries of two or more data sets.

For example, box-and-whisker-plots below can be used to compare the five-number summaries for the pulse rates of 19 students before and after gentle exercise.



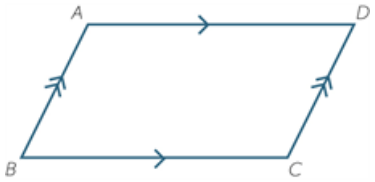
Note that the box plot for pulse rates after exercise shows the pulse rate of 146 as a possible outlier (.). This is because the distance of this data point above the upper quartile 42 (146-104) is more than 21 (1.5 ´ IQRs = 1.5 ´ (104 – 90) = 1.5 ´ 14 = 21).

The term 'parallel box-and-whisker plots' is commonly abbreviated to 'parallel boxplots'.

Parallelogram

A **parallelogram** is a quadrilateral whose opposite sides are parallel.

Thus the quadrilateral *ABCD* shown below is a parallelogram because *AB* || *DC* and *DA* || *CB*.



Properties of a parallelogram

- The opposite angles of a parallelogram are equal.
- The opposite sides of a parallelogram are equal.
- The diagonals of a parallelogram bisect each other.

Partitioning

Dividing a quantity into parts. In the early years it commonly refers to the ability to think about numbers as made up of two parts, for example, 10 is 8 and 2. In later years it refers to dividing both continuous and discrete quantities into equal parts.

Percentage

A **percentage** is a fraction whose denominator is 100.

For example, 6 percent (written as 6%) is the percentage whose value is $\frac{6}{100}$

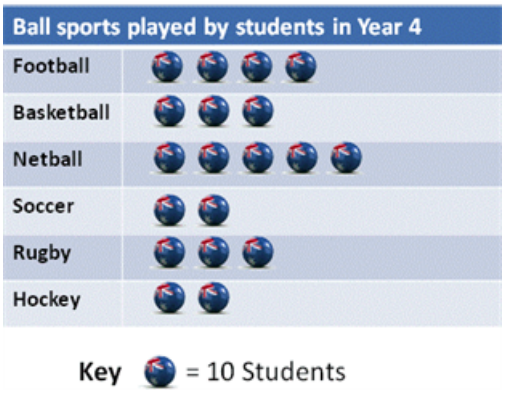
Similarly, 40 as a percentage of 250 is $\frac{40}{250} \times 100 = 16\%$

Perimeter

The **perimeter** of a plane figure is the length of its boundary.

Picture graphs

A **picture graph** is a statistical graph for organising and displaying categorical data.



Place value

The value of digit as determined by its position in a number relative to the ones (or units) place. For integers the ones place is occupied by the rightmost digit in the number.

For example in the number 2 594.6 the 4 denotes 4 ones, the 9 denotes 90 ones or 9 tens, the 5 denotes 500 ones or 5 hundreds, the 2 denotes 2000 ones or 2 thousands, and the 6 denotes $\frac{6}{10}$ of a one or 6 tenths.

Point

A **point** marks a position, but has no size.

Polynomial

A polynomial in one variable x (simply called a **polynomial**) is a finite sum of terms of the form ax^k, where a is a number and k is a non-negative integer.

A non-zero polynomial can be written in the form $a_0 + a_1x + a_2x^2 + \cdots + a_nx^n$, where n is a non-negative integer and $a_n \neq 0$.

Population

A **population** is the complete set of individuals, objects, places, etc, that we want information about.

A **census** is an attempt to collect information about the whole population.

Prime number

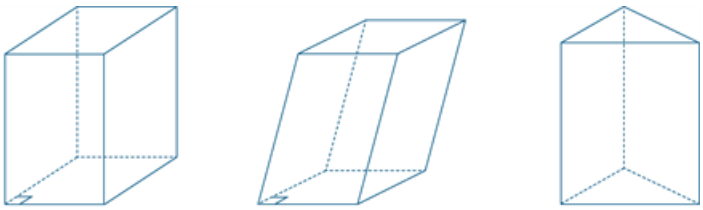
A prime number is a natural number greater than 1 that has no factor other 1 and itself.

Prism

A **prism** is a convex polyhedron that has two congruent and parallel faces and all its remaining faces are parallelograms.

A right **prism** is a convex polyhedron that has two congruent and parallel faces and all its remaining faces are rectangles. A prism that is not a right prism is often called an **oblique prism**.

Some examples of prisms are shown below.



Right rectangular prism | Oblique rectangular prism | Right triangular prism

Probability

The probability of an event is a number between 0 and 1 that indicates the chance of something happening.

For example the probability that the sun will come up tomorrow is 1, the probability that a fair coin will come up 'heads' when tossed is 0.5, while the probability of someone being physically present in Adelaide and Brisbane at exactly the same time is zero.

Product

A **product** is the result of multiplying together two or more numbers or algebraic expressions.

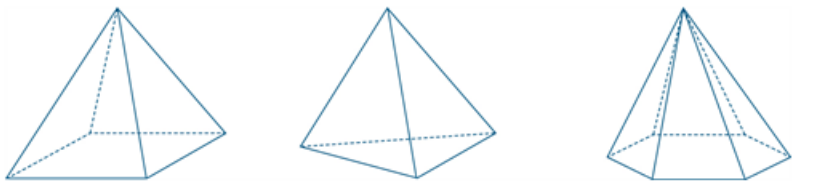
For example, 36 is the product of 9 and 4, and $x^2 - y^2$ is product of $x - y$ and $x + y$.

Proportion

Corresponding elements of two sets are in proportion if there is a constant ratio. For example, the circumference and diameter of a circle are in proportion because for any circle the ratio of their lengths is the constant π .

Pyramid

A **pyramid** is a convex polyhedron with a polygonal base and triangular sides that meet at a point called the vertex. The pyramid is named according to the shape of its base.



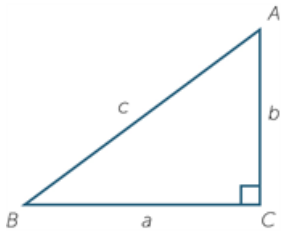
square-based pyramid | triangular-based pyramid | hexagonal-based pyramid

Pythagoras' theorem

Pythagoras' theorem

For a right-angled triangle

- The square of the hypotenuse of a right-angled triangle equals the sum of the squares of the lengths of the other two sides.
- In symbols, $c^2 = a^2 + b^2$.



The converse

If $c^2 = a^2 + b^2$ in a triangle *ABC*, then ∠C is a right angle.

Quadratic equation

The general quadratic equation in one variable is $ax^2 + bx + c = 0$, where $a \neq 0$.

The roots are given by the quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Quadratic expression

A **quadratic expression** or function contains one or more of the terms in which the variable is raised to the second power, but no variable is raised to a higher power. Examples of quadratic expressions include $3x^2 + 7$ and $x^2 + 2xy + y^2 - 2x + y + 5$.

Quartile

Quartiles are the values that divide an ordered data set into four (approximately) equal parts. It is only possible to divide a data set into exactly four equal parts when the number of data of values is a multiple of four.

There are three quartiles. The first, the **lower quartile** (Q_1) divides off (approximately) the lower 25% of data values. The second quartile (Q_2) is the median. The third quartile, the **upper quartile** (Q_3), divides off (approximately) the upper 25% of data values.

Percentiles are the values that divide an ordered data set into 100 (approximately) equal parts. It is only possible to divide a data set into exactly 100 equal parts when the number of data values is a multiple of one hundred.

There are 99 percentiles. Within the above limitations, the first percentile divides off the lower 1% of data values. The second, the lower 2% and so on. In particular, the **lower quartile** (Q_1) is the 25th percentile, the **median** is the 50th percentile and the **upper quartile** is the 75th percentile.

Quotient

A **quotient** is the result of dividing one number or algebraic expression by another. See also remainder.

Random number

A random number is one whose value is governed by chance; for example, the number of dots showing when a fair die is tossed. The value of a random number cannot be predicted in advance.

Range (statistics)

The **range** is the difference between the largest and smallest observations in a data set.

The range can be used as a measure of spread in a data set, but it is extremely sensitive to the presence of outliers and should only be used with care.

Rate

A rate is particular kind of ratio in which the two quantities are measured in different units. For example, the ratio of distance to time, known as speed is a rate because distance and time are measured in different units (such as kilometres and hours). The value of the rate depends on the units in which of the quantities are expressed.

Ratio

A **ratio** is a quotient or proportion of two numbers, magnitudes or algebraic expressions. It is often used as a measure of the relative size of two objects. For example the ratio of the length of a side of a square to the length of a diagonal is $1:\sqrt{2}$ that is, $\frac{1}{\sqrt{2}}$.

Real numbers

The numbers generally used in mathematics, in scientific work and in everyday life are the **real numbers**. They can be pictured as points on a number line, with the integers evenly spaced along the line, and a real number b to the right of a real number a if $a < b$.

A real number is either rational or irrational.

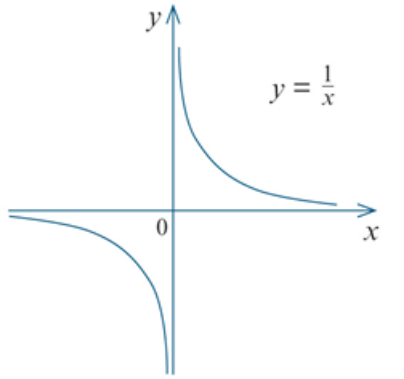
Every real number has a decimal expansion. Rational numbers are the ones whose decimal expansions are either terminating or recurring.

Rectangle

A **rectangle** is a quadrilateral in which all angles are right angles

Rectangular Hyperbola

The graph of $y = 1/x$ is called a **rectangular hyperbola**. The x and y axes are asymptotes as the curve gets as close as we like to them.



Recurring decimal

A **recurring decimal** is a decimal that contains a pattern of digits that repeats indefinitely after a certain number of places.

For example,

$$0.1\dot{0}\dot{7} = 0.1070707\cdots,$$

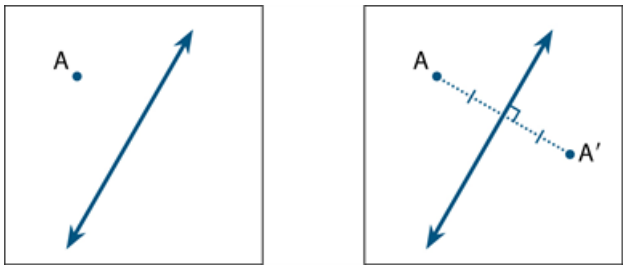
and this is the decimal expansion of the rational number

$$\frac{1}{10}+\frac{7}{1000}+\frac{7}{100000}+\frac{7}{10000000}+\cdots=\frac{1}{10}+\left(\frac{7/1000}{1-1/100}\right)=\frac{1}{10}+\frac{7}{990}=\frac{106}{990}$$

Every recurring decimal is the decimal expansion of a rational number

Reflection

To **reflect** the point A in an **axis of reflection,** a line has been drawn at right angles to the axis of reflection and the point A′ is marked at the same distance from the axis of reflection as A, but on the other side.



The point A′ is called the reflection image of A.

A **reflection** is a transformation that moves each point to its reflection image.

Related denominators

Denominators are related when one is a multiple of the other. For example, the fractions $\frac{1}{3}$ and $\frac{5}{9}$ have related denominators because 9 is a multiple of 3.

Fractions with related denominators are more easily added and subtracted than fractions with unrelated denominators because only one needs to be renamed. For example to add $\frac{1}{3}$ and $\frac{5}{9}$ we can rename $\frac{1}{3}$ as $\frac{3}{9}$ and then compute $\frac{3}{9}+\frac{5}{9}=\frac{8}{9}$.

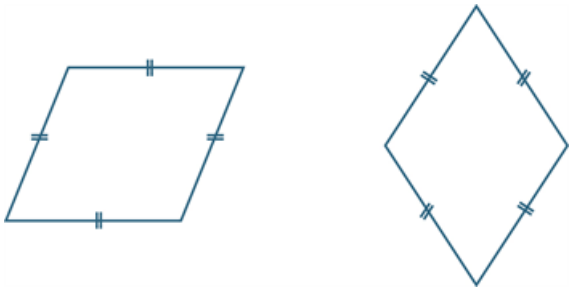
Remainder

A **remainder** is the amount left over when one number or algebraic quantity a is divided by another b . If a is divisible by b then the remainder is 0.

For example, when 68 is divided by 11, the remainder is 2, because 68 can be expressed as $68 = 6 \times 11 + 2$.

Rhombus

A rhombus is a quadrilateral with all sides equal.



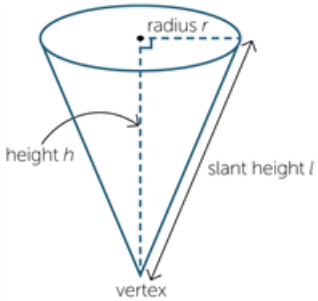
Right Cone

A **cone** is a solid that is formed by taking a circle called the base and a point not in the plane of the circle, called the vertex, which lies above or below the circle and joining the vertex to each point on the circle.

If the vertex is directly above or below the centre of the circular base, we call the cone a **right cone**.

The **height of the cone** is the distance from the vertex to the centre of the circular base.

The **slant height** of a cone is the distance from any point on the circle to the vertex to the circle.



Rotation

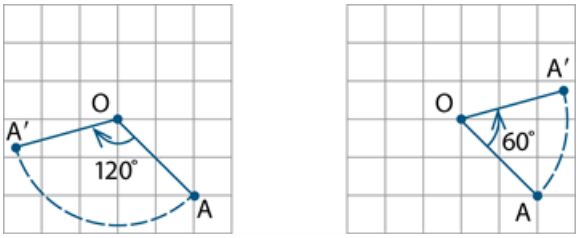
A **rotation** turns a figure about a fixed point, called the **centre of rotation**.

A rotation is specified by:

- the centre of rotation *O*
- the angle of rotation

- the direction of rotation (clockwise or anticlockwise).

In the first diagram below, the point A is rotated through 120^{O} clockwise about O. In the second diagram, it is rotated through 60^{O} anticlockwise about O.



A **rotation** is a transformation that moves each point to its rotation image.

Rounding

The decimal expansion of a real number is **rounded** when it is approximated by a terminating decimal that has a given number of decimal digits to the right of the decimal point.

Rounding to n decimal places is achieved by removing all decimal digits beyond (to the right of) the n^{th} digit to the right of the decimal place, and adjusting the remaining digits where necessary.

If the first digit removed (the $(n+1)^{th}$ digit) is less than 5 the preceding digit is not changed.

For example, 4.02749 becomes 4.027 when rounded to 3 decimal places.

If the first digit removed is greater than 5, or 5 and some succeeding digit is non-zero, the preceding digit is increased by 1. For example, 6.1234586 becomes 6.12346 when rounded to 5 decimal places.

Sample

A **sample** is part of a population. It is a subset of the population, often randomly selected for the purpose of estimating the value of a characteristic of the population as a whole.

For instance, a randomly selected group of eight-year old children (the sample) might be selected to estimate the incidence of tooth decay in eight-year old children in Australia (the population).

Sample space

A **sample space** is the set of all possible outcomes of a chance experiment. For example, the set of outcomes (also called **sample points**) from tossing two heads is { HH, HT, TH, TT }, where H represents a 'head' and T a 'tail'.

Scientific notation

A positive real number is expressed in **scientific notation** when it is written as the product of a power of 10 and a decimal that has just one digit to the left of the decimal point.

For example, the scientific notation for 3459 is 3.459×10^{3}, and the scientific notation for 0.000004567 is 4.567×10^{-6}.

Many electronic calculators will show these as $3.459E3$ and $4.567E-6$

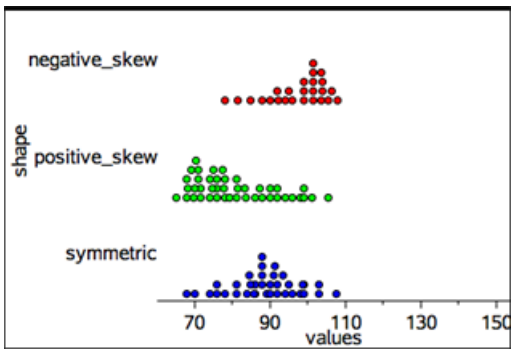
Secondary data set

Primary data is data collected by the user. **Secondary data** is data collected by others. Sources of secondary data include, web-based data sets, the media, books, scientific papers, etc.

Shape (statistics)

The **shape** of a numerical data distribution is mostly simply described as **symmetric** if it is roughly evenly spread around some central point or **skewed**, if it is not. If a distribution is skewed, it can be further described as **positively skewed** ('tailing-off' to the upper end of the distribution) or **negatively skewed** ('tailing-off' to the lower end of the distribution).

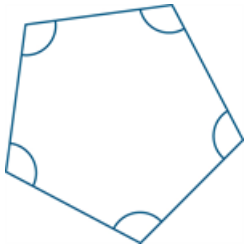
These three distribution shapes are illustrated in the parallel dot plot display below.



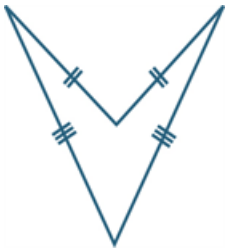
Dot plots, histograms and stem plots can all be used to investigate the shape of a data distribution.

Shapes (geometry)

A **polygon** is plane figure bounded by line segments.

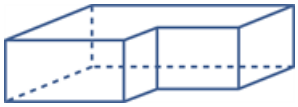


The figure shown above is a **regular pentagon.** It is a convex five-sided polygon. It is called a **pentagon** because it has five sides. It is called **regular** because all sides have equal length and all interior angles are equal.



A **polyhedron** is a solid figure bounded by plane polygonal faces. Two adjacent faces intersect at an edge and each edge joins two vertices.

The polyhedron shown above is a pyramid with a square base. It has 5 vertices, 8 edges and 5 faces. It is a convex polyhedron.



The figure above is a non-convex polyhedron.

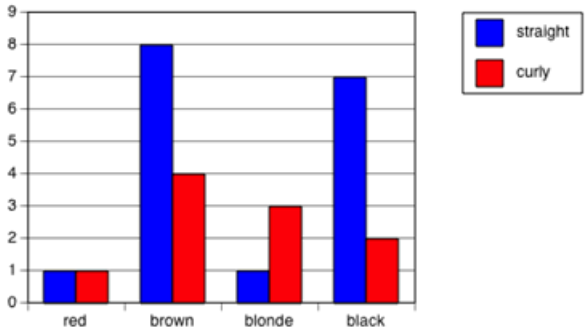
A **convex polyhedron** is a finite region bounded by planes, in the sense that the region lies entirely on one side of the plane.

A regular shape can be a polygon. A polygon is regular if all of its sides are the same length and all of its angles have the same measure.

Side-by-side column graph

A side-by-side **column graph** can be used to organise and display the data that arises when a group of individuals or things are categorised according to two or more criteria.

For example, the side-by-side column graph below displays the data obtained when 27 children are categorised according to *hair type* (straight or curly) and *hair colour* (red, brown, blonde, black). The legend indicates that blue columns represent children with straight hair and red columns children with curly hair.



Side-by-side column graphs are frequently called **side-by-side bar graphs** or **bar charts**. In a bar graph or chart, the bars can be either vertical or horizontal.

Similar

The four standard tests for two triangles to be similar.

AAA: If two angles of one triangle are respectively equal to two angles of another triangle, then the two triangles are similar.

SAS: If the ratio of the lengths of two sides of one triangle is equal to the ratio of the lengths of two sides of another triangle, and the included angles are equal, then the two triangles are similar.

SSS: If we can match up the sides of one triangle with the sides of another so that the ratios of matching sides are equal, then the two triangles are similar.

RHS: If the ratio of the hypotenuse and one side of a right-angled triangle is equal to the ratio of the hypotenuse and one side of another right-angled triangle, then the two triangles are similar.

Similarity

Two plane figures are called **similar** if an enlargement of one figure is congruent to the other.

That is, if one can be mapped to the other by a sequence of translations, rotations, reflections and enlargements.

Similar figures thus have the same shape, but not necessarily the same size.

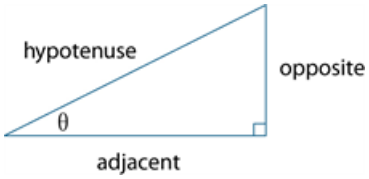
Simple interest

Simple interest is the interest accumulated when the interest payment in each period is a fixed fraction of the principal. For example, if the principle $\$P$ earns simple interest at the rate of $i\%$ per period, then after n periods the accumulated simple interest is $\$Pni/100$.

Sine

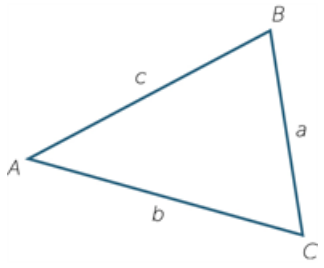
In any right-angled triangle,

$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$, where $0^{O} < \theta < 90^{O}$



In any triangle *ABC,*

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

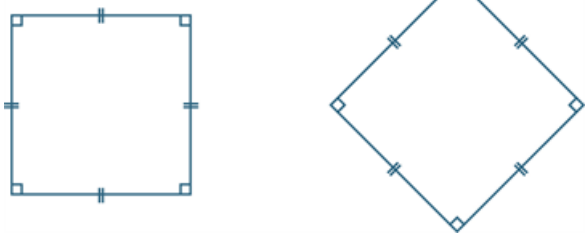


In words it says:

Any side of a triangle over the sine of the opposite angle equals any other side of the triangle over the sine of its opposite angle.

Square

A **square** is a quadrilateral that is both a rectangle and a rhombus.



A square thus has all the properties of a rectangle, and all the properties of a rhombus.

Standard deviation

Standard deviation is a measure of the variablity or spread of a data set. It gives an indication of the degree to which the individual data values are spread around their mean.

Stem and leaf plot

A **stem-and-leaf plot** is a method of organising and displaying numerical data in which each data value is split in to two parts, a 'stem' and a 'leaf'.

For example, the stem-and-leaf plot below displays the resting pulse rates of 19 students.

pulse rate

6	8 8 8 9
7	0 1 1 4 6 6 8
8	2 6 8 8
9	0 6
10	4
11	0

In this plot, the stem unit is '10' and the leaf unit is '1'. Thus the top row in the plot 6|8 8 8 9 displays pulse rates of 68, 68, 68 and 69.

Stemplot is a synonym for stem-and-leaf plot.

Subitising

Recognising the number of objects in a collection without consciously counting

Sum

A **sum** is the result of adding together two of more numbers or algebraic expressions.

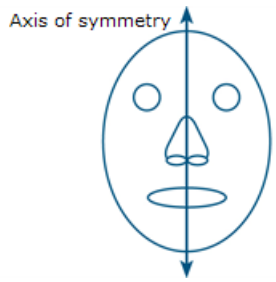
Surd

A **surd** is a numerical expression involving one or more irrational roots of numbers. Examples of surds include $\sqrt{2}$,, $\sqrt[3]{5}$, and $4\sqrt{3}+7\sqrt[3]{6}$

Symmetrical

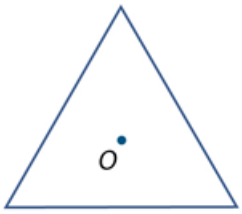
Line symmetry

A plane figure F has line symmetry in a line m if the image of F under the reflection in m is F itself. The line m is called the axis of symmetry.



Rotational symmetry

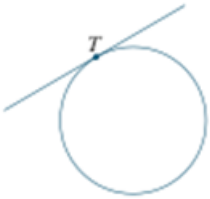
A plane figure *F* has **rotational symmetry** about a point *O* if there is a non-trivial rotation such that the image of *F* under the rotation is *F* itself.



A rotation of 120^{O} around O moves the equilateral triangle onto itself.

Tangent

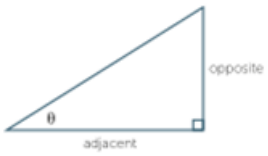
A **tangent** to a circle is a line that intersects a circle at just one point. It touches the circle at that point of contact, but does not pass inside it.



Tangent

In any right-angled triangle,

tan θ = opposite / adjacent, where $0° < \theta < 90°$.



Terminating decimal

A **terminating decimal** is a decimal that contains only finitely many decimal digits.

Every terminating decimal represents a rational number $10.$ where the denominator is a power of For example, 54.321 is the decimal expansion of the sum

$$5 \times 10^{1} + 4 \times 10^{0} + 3 \times 10^{-1} + 2 \times 10^{-2} + 3 \times 10^{-3} = \frac{54321}{1000}$$

Transformation

The transformations included in this glossary are enlargements, reflections, rotations and translations.

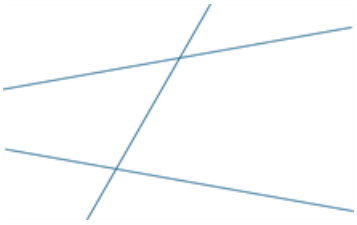
Translation

Shifting a figure in the plane without turning it is called **translation**. To describe a translation, it is enough to say how far left or right and how far up or down the figure is moved.

A translation is a transformation that moves each point to its translation image.

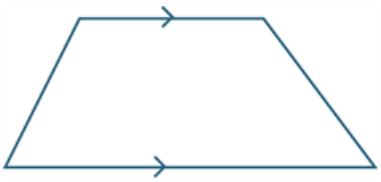
Transversal

A **transversal** is a line that meets two or more other lines in a plane.



Trapezium

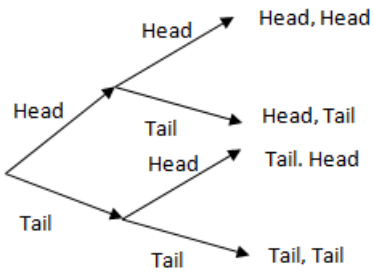
A **trapezium** is a quadrilateral with one pair of opposite sides parallel.



Tree diagram

A **tree diagram** is a diagram that can used to enumerate the outcomes of a multi-step random experiment.

The diagram below shows a tree diagram that has been used to enumerate all of the possible outcomes when a coin is tossed twice This is an example of a **two-step random experiment**.



Triangular number

A triangular number is the number of dots required to make a triangular array of dots in which the top row consists of just one dot, and each of the other rows contains one more dot than the row above it. So the first triangular number is 1, the second is $3\ (=1+2)$, the third is $6\ (=1+2+3)$ and so on.

Trigonometric ratios

Sine, Cosine, Tangent

Unit fraction

A unit fraction is a simple fraction whose numerator is 1, that is, a fraction of the form $1/n$, where n is a natural number.

Variable

Numerical variables are variables whose values are numbers, and for which arithmetic processes such as adding and subtracting, or calculating an average, make sense.

A **discrete numerical variable** is a numerical variable, each of whose possible values is separated from the next by a definite 'gap'. The most common numerical variables have the counting numbers 0,1,2,3,… as possible values. Others are prices, measured in dollars and cents.

Examples include the number of children in a family or the number of days in a month.

Variable (algebra)

A **variable** is a symbol, such as x, y or z, used to represent an unspecified member of some set. For example, the variable x could represent an unspecified real number.

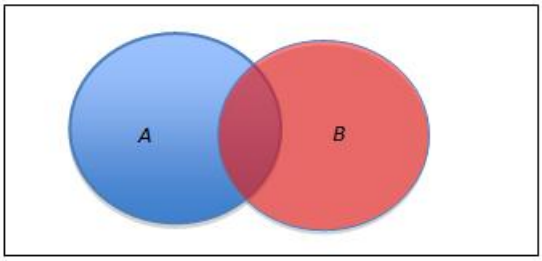
Variable (statistics)

A **variable** is something measurable or observable that is expected to either change over time or between individual observations.

Examples of variables in statistics include the age of students, their hair colour or a playing field's length or its shape.

Venn diagram

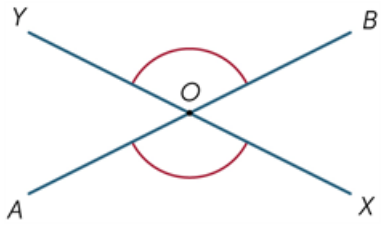
A **Venn diagram** is a graphical representation of the extent to which two or more events, for example *A* and *B*, are mutually inclusive (overlap) or mutually exclusive (do not overlap).



Vertically opposite angle

When two lines intersect, four angles are formed at the point of intersection. In the diagram, the angles marked $\angle AOX$ and $\angle BOY$ are called **vertically opposite**.

Vertically opposite angles are equal.



Volume

The **volume** of a solid region is a measure of the size of a region.

For a rectangular prism, *Volume = Length × Width × Height*

Whole number

A **whole number** is a non–negative integer, that is, one of the numbers $0,1,2,3,\cdots$,

Sometimes it is taken to mean only a positive integer, or any integer.

Mathematics Scope and Sequence: Foundation to Year 6

		Foundation Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Number and Algebra	**Number and place value**	Establish understanding of the language and processes of counting by naming numbers in sequences, initially to and from 20, moving from any starting point Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond Subitise small collections of objects Represent practical situations to model addition and sharing Compare, order and make correspondences between collections, initially to 20, and explain reasoning	Develop confidence with number sequences to and from 100 by ones from any starting point. Skip count by twos, fives and tens starting from zero Recognise, model, read, write and order numbers to at least 100. Locate these numbers on a number line Count collections to 100 by partitioning numbers using place value Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts	Investigate number sequences, initially those increasing and decreasing by twos, threes, fives and ten from any starting point, then moving to other sequences. Recognise, model, represent and order numbers to at least 1000 Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting Explore the connection between addition and subtraction Solve simple addition and subtraction problems using a range of efficient mental and written strategies Recognise and represent multiplication as repeated addition, groups and arrays Recognise and represent division as grouping into equal sets and solve simple problems using these representations	Investigate the conditions required for a number to be odd or even and identify odd and even numbers Recognise, model, represent and order numbers to at least 10 000 Apply place value to partition, rearrange and regroup numbers to at least 10 000 to assist calculations and solve problems Recognise and explain the connection between addition and subtraction Recall addition facts for single-digit numbers and related subtraction facts to develop increasingly efficient mental strategies for computation Recall multiplication facts of two, three, five and ten and related division facts Represent and solve problems involving multiplication using efficient mental and written strategies and appropriate digital technologies	Recall multiplication facts up to 10 _ 10 and related division facts Investigate and use the properties of odd and even numbers Recognise, represent and order numbers to at least tens of thousands Apply place value to partition, rearrange and regroup numbers to at least tens of thousands to assist calculations and solve problems Investigate number sequences involving multiples of 3, 4, 6, 7, 8, and 9 Develop efficient mental and written strategies and use appropriate digital technologies for multiplication and for division where there is no remainder	Identify and describe factors and multiples of whole numbers and use them to solve problems Use estimation and rounding to check the reasonableness of answers to calculations Solve problems involving multiplication of large numbers by one- or two-digit numbers using efficient mental, written strategies and appropriate digital technologies Solve problems involving division by a one digit number, including those that result in a remainder Use efficient mental and written strategies and apply appropriate digital technologies to solve problems	Identify and describe properties of prime, composite, square and triangular numbers Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers Investigate everyday situations that use positive and negative whole numbers and zero. Locate and represent these numbers on a number line
	Fractions and decimals		Recognise and describe one-half as one of two equal parts of a whole.	Recognise and interpret common uses of halves, quarters and eighths of shapes and collections	Model and represent unit fractions including 1/2, 1/4, 1/3, 1/5 and their multiples to a complete whole	Investigate equivalent fractions used in contexts Count by quarters halves and thirds, including with mixed numerals. Locate and represent these fractions on a number line Recognise that the place value system can be extended to tenths and hundredths. Make connections between fractions and decimal notation	Compare and order common unit fractions and locate and represent them on a number line Investigate strategies to solve problems involving addition and subtraction of fractions with the same denominator Recognise that the number system can be extended beyond hundredths Compare, order and represent decimals	Compare fractions with related denominators and locate and represent them on a number line Solve problems involving addition and subtraction of fractions with the same or related denominators Find a simple fraction of a quantity where the result is a whole number, with and without digital technologies Add and subtract decimals, with and without digital technologies, and use estimation and rounding to check the reasonableness of answers Multiply decimals by whole numbers and perform divisions that result in terminating decimals, with and without digital technologies Multiply and divide decimals by powers of 10 Make connections between equivalent fractions, decimals and percentages
	Real numbers							This sequence starts at this year level

Version 1.2
8th March 2011

Mathematics Scope and Sequence: Year 6 to Year 10

		Year 6	Year 7	Year 8	Year 9	Year 10	Year 10 A
Number and Algebra	**Number and place value**	Identify and describe properties of prime, composite, square and triangular numbers Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers Investigate everyday situations that use positive and negative whole numbers and zero. Locate and represent these numbers on a number line	Investigate index notation and represent whole numbers as products of powers of prime numbers Investigate and use square roots of perfect square numbers Apply the associative, commutative and distributive laws to aid mental and written computation Compare, order, add and subtract integers	Use index notation with numbers to establish the index laws with positive integral indices and the zero index Carry out the four operations with integers, using efficient mental and written strategies and appropriate digital technologies	This sequence ends at this year level		
	Fractions and decimals	Compare fractions with related denominators and locate and represent them on a number line Solve problems involving addition and subtraction of fractions with the same or related denominators Find a simple fraction of a quantity where the result is a whole number, with and without digital technologies Add and subtract decimals, with and without digital technologies, and use estimation and rounding to check the reasonableness of answers Multiply decimals by whole numbers and perform divisions that result in terminating decimals, with and without digital technologies Multiply and divide decimals by powers of 10 Make connections between equivalent fractions, decimals and percentages	This sequence ends at this year level				
	Real numbers	This sequence starts at this year level	Compare fractions using equivalence. Locate and represent fractions and mixed numerals on a number line Solve problems involving addition and subtraction of fractions, including those with unrelated denominators Multiply and divide fractions and decimals using efficient written strategies and digital technologies Express one quantity as a fraction of another, with and without the use of digital technologies Round decimals to a specified number of decimal places Connect fractions, decimals and percentages and carry out simple conversions Find percentages of quantities and express one quantity as a percentage of another, with and without digital technologies. Recognise and solve problems involving simple ratios	Investigate terminating and recurring decimals Investigate the concept of irrational numbers, including π Solve problems involving the use of percentages, including percentage increases and decreases, with and without digital technologies Solve a range of problems involving rates and ratios, with and without digital technologies	Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems Apply index laws to numerical expressions with integer indices Express numbers in scientific notation		Define rational and irrational numbers and perform operations with surds and fractional indices Use the definition of a logarithm to establish and apply the laws of logarithms

Version 1.2
8th March 2011

Mathematics Scope and Sequence: Foundation to Year 6

		Foundation Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Number and Algebra	**Money and financial mathematics**		Recognise, describe and order Australian coins according to their value	Count and order small collections of Australian coins and notes according to their value	Represent money values in multiple ways and count the change required for simple transactions to the nearest five cents	Solve problems involving purchases and the calculation of change to the nearest five cents with and without digital technologies	Create simple financial plans	Investigate and calculate percentage discounts of 10%, 25% and 50% on sale items, with and without digital technologies
	Patterns and algebra	Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings	Investigate and describe number patterns formed by skip counting and patterns with objects	Describe patterns with numbers and identify missing elements Solve problems by using number sentences for addition or subtraction	Describe, continue, and create number patterns resulting from performing addition or subtraction	Explore and describe number patterns resulting from performing multiplication Solve word problems by using number sentences involving multiplication or division where there is no remainder Use equivalent number sentences involving addition and subtraction to find unknown quantities	Describe, continue and create patterns with fractions, decimals and whole numbers resulting from addition and subtraction Use equivalent number sentences involving multiplication and division to find unknown quantities	Continue and create sequences involving whole numbers, fractions and decimals. Describe the rule used to create the sequence Explore the use of brackets and order of operations to write number sentences
	Linear and non-linear relationships	This sequence starts at this year level						

Mathematics Scope and Sequence: Year 6 to Year 10

		Year 6	Year 7	Year 8	Year 9	Year 10	Year 10 A
Number and Algebra	**Money and financial mathematics**	Investigate and calculate percentage discounts of 10%, 25% and 50% on sale items, with and without digital technologies	Investigate and calculate 'best buys', with and without digital technologies	Solve problems involving profit and loss, with and without digital technologies	Solve problems involving simple interest	Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies	
	Patterns and algebra	Continue and create sequences involving whole numbers, fractions and decimals. Describe the rule used to create the sequence Explore the use of brackets and order of operations to write number sentences	Introduce the concept of variables as a way of representing numbers using letters Create algebraic expressions and evaluate them by substituting a given value for each variable Extend and apply the laws and properties of arithmetic to algebraic terms and expressions	Extend and apply the distributive law to the expansion of algebraic expressions Factorise algebraic expressions by identifying numerical factors Simplify algebraic expressions involving the four operations	Extend and apply the index laws to variables, using positive integral indices and the zero index Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate	Factorise algebraic expressions by taking out a common algebraic factor Simplify algebraic products and quotients using index laws Apply the four operations to simple algebraic fractions with numerical denominators Expand binomial products and factorise monic quadratic expressions using a variety of strategies Substitute values into formulas to determine an unknown	Investigate the concept of a polynomial and apply the factor and remainder theorems to solve problems
	Linear and non-linear relationships	This sequence starts at this year level	Given coordinates, plot points on the Cartesian plane, and find coordinates for a given point Solve simple linear equations Investigate, interpret and analyse graphs from authentic data	Plot linear relationships on the Cartesian plane with and without the use of digital technologies Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution	Find the distance between two points located on a Cartesian plane using a range of strategies, including graphing software Sketch linear graphs using the coordinates of two points Find the midpoint and gradient of a line segment (interval) on the Cartesian plane using a range of strategies, including graphing software Sketch simple non-linear relations with and without the use of digital technologies	Solve problems involving linear equations, including those derived from formulas Solve linear inequalities and graph their solutions on a number line Solve linear simultaneous equations, using algebraic and graphical techniques including using digital technology Solve problems involving parallel and perpendicular lines Explore the connection between algebraic and graphical representations of relations such as simple quadratics, circles and exponentials using digital technology as appropriate Solve linear equations involving simple algebraic fractions Solve simple quadratic equations using a range of strategies	Describe, interpret and sketch parabolas, hyperbolas, circles and exponential functions and their transformations Solve simple exponential equations Apply understanding of polynomials to sketch a range of curves and describe the features of these curves from their equation Factorise monic and non-monic quadratic expressions and solve a wide range of quadratic equations derived from a variety of contexts

Version 1.2
8th March 2011

Mathematics Scope and Sequence: Foundation to Year 6

		Foundation Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Measurement and Geometry	**Using units of measurement**	Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language Compare and order the duration of events using the everyday language of time Connect days of the week to familiar events and actions	Measure and compare the lengths and capacities of pairs of objects using uniform informal units Tell time to the half-hour Describe duration using months, weeks, days and hours	Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units Compare masses of objects using balance scales Tell time to the quarter-hour, using the language of 'past' and 'to' Name and order months and seasons Use a calendar to identify the date and determine the number of days in each month	Measure, order and compare objects using familiar metric units of length, mass and capacity Tell time to the minute and investigate the relationship between units of time	Use scaled instruments to measure and compare lengths, masses, capacities and temperatures Convert between units of time Use am and pm notation and solve simple time problems Compare objects using familiar metric units of area and volume	Choose appropriate units of measurement for length, area, volume, capacity and mass Calculate the perimeter and area of rectangles using familiar metric units Compare 12- and 24-hour time systems and convert between them	Connect decimal representations to the metric system Convert between common metric units of length, mass and capacity Solve problems involving the comparison of lengths and areas using appropriate units Connect volume and capacity and their units of measurement Interpret and use timetables
	Shape	Sort, describe and name familiar two-dimensional shapes and three-dimensional objects in the environment	Recognise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features	Describe and draw two-dimensional shapes, with and without digital technologies Describe the features of three-dimensional objects	Make models of three-dimensional objects and describe key features	Compare the areas of regular and irregular shapes by informal means Compare and describe two dimensional shapes that result from combining and splitting common shapes, with and without the use of digital technologies	Connect three-dimensional objects with their nets and other two-dimensional representations	Construct simple prisms and pyramids
	Location and transformation	Describe position and movement	Give and follow directions to familiar locations	Interpret simple maps of familiar locations and identify the relative positions of key features Investigate the effect of one-step slides and flips with and without digital technologies Identify and describe half and quarter turns	Create and interpret simple grid maps to show position and pathways Identify symmetry in the environment	Use simple scales, legends and directions to interpret information contained in basic maps Create symmetrical patterns, pictures and shapes with and without digital technologies	Use a grid reference system to describe locations. Describe routes using landmarks and directional language Describe translations, reflections and rotations of two-dimensional shapes. Identify line and rotational symmetries Apply the enlargement transformation to familiar two dimensional shapes and explore the properties of the resulting image compared with the original	Investigate combinations of translations, reflections and rotations, with and without the use of digital technologies Introduce the Cartesian coordinate system using all four quadrants
	Geometric reasoning	This sequence starts at this year level			Identify angles as measures of turn and compare angle sizes in everyday situations	Compare angles and classify them as equal to, greater than or less than a right angle	Estimate, measure and compare angles using degrees. Construct angles using a protractor	Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles
	Pythagoras and trigonometry	This sequence starts at this year level						

Mathematics Scope and Sequence: Year 6 to Year 10

		Year 6	Year 7	Year 8	Year 9	Year 10	Year 10 A
Measurement and Geometry	**Using units of measurement**	Connect decimal representations to the metric system Convert between common metric units of length, mass and capacity Solve problems involving the comparison of lengths and areas using appropriate units Connect volume and capacity and their units of measurement Interpret and use timetables	Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving Calculate volumes of rectangular prisms	Choose appropriate units of measurement for area and volume and convert from one unit to another Find perimeters and areas of parallelograms, rhombuses and kites Investigate the relationship between features of circles such as circumference, area, radius and diameter. Use formulas to solve problems involving circumference and area Develop the formulas for volumes of rectangular and triangular prisms and prisms in general. Use formulas to solve problems involving volume Solve problems involving duration, including using 12- and 24-hour time within a single time zone	Calculate the areas of composite shapes Calculate the surface area and volume of cylinders and solve related problems Solve problems involving the surface area and volume of right prisms Investigate very small and very large time scales and intervals	Solve problems involving surface area and volume for a range of prisms, cylinders and composite solids	Solve problems involving surface area and volume of right pyramids, right cones, spheres and related composite solids
	Shape	Construct simple prisms and pyramids	Draw different views of prisms and solids formed from combinations of prisms	This sequence ends at this year level			
	Location and transformation	Investigate combinations of translations, reflections and rotations, with and without the use of digital technologies Introduce the Cartesian coordinate system using all four quadrants	Describe translations, reflections in an axis, and rotations of multiples of 90° on the Cartesian plane using coordinates. Identify line and rotational symmetries	This sequence ends at this year level			
	Geometric reasoning	Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles	Identify corresponding, alternate and co-interior angles when two parallel straight lines are crossed by a transversal Investigate conditions for two lines to be parallel and solve simple numerical problems using reasoning Classify triangles according to their side and angle properties and describe quadrilaterals Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral	Define congruence of plane shapes using transformations Develop the conditions for congruence of triangles Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related numerical problems using reasoning	Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar Solve problems using ratio and scale factors in similar figures	Formulate proofs involving congruent triangles and angle properties Apply logical reasoning, including the use of congruence and similarity, to proofs and numerical exercises involving plane shapes	Prove and apply angle and chord properties of circles
	Pythagoras and trigonometry	This sequence starts at this year level			Investigate Pythagoras' Theorem and its application to solving simple problems involving right angled triangles Use similarity to investigate the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles Apply trigonometry to solve right-angled triangle problems	Solve right-angled triangle problems including those involving direction and angles of elevation and depression	Establish the sine, cosine and area rules for any triangle and solve related problems Use the unit circle to define trigonometric functions, and graph them with and without the use of digital technologies Solve simple trigonometric equations Apply Pythagoras' theorem and trigonometry to solving three-dimensional problems in right-angled triangles

Version 1.2
8th March 2011

Mathematics Scope and Sequence: Foundation to Year 6

		Foundation Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Statistics and Probability	**Chance**		Identify outcomes of familiar events involving chance and describe them using everyday language such as 'will happen', 'won't happen' or 'might happen'	Identify practical activities and everyday events that involve chance. Describe outcomes as 'likely' or 'unlikely' and identify some events as 'certain' or 'impossible'	Conduct chance experiments, identify and describe possible outcomes and recognise variation in results	Describe possible everyday events and order their chances of occurring Identify everyday events where one cannot happen if the other happens Identify events where the chance of one will not be affected by the occurrence of the other	List outcomes of chance experiments involving equally likely outcomes and represent probabilities of those outcomes using fractions Recognise that probabilities range from 0 to 1	Describe probabilities using fractions, decimals and percentages Conduct chance experiments with both small and large numbers of trials using appropriate digital technologies Compare observed frequencies across experiments with expected frequencies
	Data representation and interpretation	Answer yes/no questions to collect information	Choose simple questions and gather responses Represent data with objects and drawings where one object or drawing represents one data value. Describe the displays	Identify a question of interest based on one categorical variable. Gather data relevant to the question Collect, check and classify data Create displays of data using lists, table and picture graphs and interpret them	Identify questions or issues for categorical variables. Identify data sources and plan methods of data collection and recording Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies Interpret and compare data displays	Select and trial methods for data collection, including survey questions and recording sheets Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values Evaluate the effectiveness of different displays in illustrating data features including variability	Pose questions and collect categorical or numerical data by observation or survey Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies Describe and interpret different data sets in context	Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables Interpret secondary data presented in digital media and elsewhere

Mathematics Scope and Sequence: Year 6 to Year 10

		Year 6	Year 7	Year 8	Year 9	Year 10	Year 10 A
Statistics and Probability	**Chance**	Describe probabilities using fractions, decimals and percentages Conduct chance experiments with both small and large numbers of trials using appropriate digital technologies Compare observed frequencies across experiments with expected frequencies	Construct sample spaces for single-step experiments with equally likely outcomes Assign probabilities to the outcomes of events and determine probabilities for events	Identify complementary events and use the sum of probabilities to solve problems Describe events using language of 'at least', exclusive 'or' (A or B but not both), inclusive 'or' (A or B or both) and 'and'. Represent such events in two-way tables and Venn diagrams and solve related problems	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 Calculate relative frequencies from given or collected data to estimate probabilities of events involving 'and' or 'or' Investigate reports of surveys in digital media and elsewhere for information on how data were obtained to estimate population means and medians	Describe the results of two- and three-step chance experiments, both with and without replacements, assign probabilities to outcomes and determine probabilities of events. Investigate the concept of independence Use the language of 'if ....then, 'given', 'of', 'knowing that' to investigate conditional statements and identify common mistakes in interpreting such language	Investigate reports of studies in digital media and elsewhere for information on the planning and implementation of such studies, and the reporting of variability
	Data representation and interpretation	Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables Interpret secondary data presented in digital media and elsewhere	Identify and investigate issues involving continuous or large count data collected from primary and secondary sources Construct and compare a range of data displays including stem-and-leaf plots and dot plots Calculate mean, median, mode and range for sets of data. Interpret these statistics in the context of data Describe and interpret data displays and the relationship between the median and mean	Explore the practicalities and implications of obtaining representative data using a variety of investigative processes Investigate the effect of individual data values , including outliers, on the mean and median Explore the variation of means and proportions in representative data	Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly from secondary sources Construct back-to-back stem-and-leaf plots and histograms and describe data, using terms including 'skewed', 'symmetric' and 'bi modal' Compare data displays using mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread Investigate techniques for collecting data, including census, sampling and observation	Determine quartiles and interquartile range Construct and interpret box plots and use them to compare data sets Compare shapes of box plots to corresponding histograms and dot plots Use scatter plots to investigate and comment on relationships between two continuous variables Investigate and describe bivariate numerical data where the independent variable is time Evaluate statistical reports in the media and other places by linking claims to displays, statistics and representative data	Calculate and interpret the mean and standard deviation of data and use these to compare data sets Use information technologies to investigate bivariate numerical data sets. Where appropriate use a straight line to describe the relationship allowing for variation