

The Australian Curriculum

Subjects	Mathematics
Year levels	Foundation Year, Year 1, Year 2, Year 3, Year 4, Year 5, Year 6, Year 7, Year 8, Year 9, Year 10 and Year 10A
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The Australian Curriculum Mathematics

Overview

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, reasoning, and problem-solving skills. These proficiencies 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.

Key ideas

In Mathematics, the key ideas are the proficiency strands of understanding, fluency, problem-solving and reasoning. 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.

Click here for further information, illustrations of practice and student work samples portfolios for the Mathematics proficiencies

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. The strands provide a meaningful basis for the development of concepts in the learning of mathematics and have been incorporated into the content descriptions of the three content strands. 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 judgements and decisions, as well as building skills to critically evaluate statistical information and develop intuitions about data.

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.

Table 1: Content strands and sub-strands in the Australian Curriculum: Mathematics (F–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)	N/A
Money and financial mathematics (1–10)	Location and transformation (F–7)	N/A
Patterns and algebra (F–10)	Pythagoras and trigonometry (9–10)	N/A
Linear and non-linear relationships (7–10)	N/A	N/A

PDF documents

Resources and support materials for the Australian Curriculum: Mathematics are available as PDF documents.

Mathematics: Sequence of content

Mathematics: Sequence of achievement

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. The achievement standards reflect the content and encompass the proficiencies.

At this year level:

- **understanding** includes connecting names, numerals and quantities
- **fluency** includes readily counting numbers in sequences, continuing patterns and comparing the lengths of objects
- **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.

Foundation Year Content Descriptions

Number and Algebra

Number and place value	Elaborations
<p>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)</p> 	<ul style="list-style-type: none"> • 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 
<p>Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond (ACMNA002)</p> 	<ul style="list-style-type: none"> • 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 the Wotjoballum number systems 

<p>Subitise small collections of objects (ACMNA003)</p> 	<ul style="list-style-type: none"> • using subitising as the basis for ordering and comparing collections of numbers 
<p>Compare, order and make correspondences between collections, initially to 20, and explain reasoning (ACMNA289)</p> 	<ul style="list-style-type: none"> • 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   
<p>Represent practical situations to model addition and sharing (ACMNA004)</p> 	<ul style="list-style-type: none"> • using a range of practical strategies for adding small groups of numbers, such as visual displays or concrete materials • using Aboriginal and Torres Strait Islander methods of adding, including spatial patterns and reasoning  
<p>Patterns and algebra</p>	<p>Elaborations</p>
<p>Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings (ACMNA005)</p> 	<ul style="list-style-type: none"> • observing natural patterns in the world around us • creating and describing patterns using materials, sounds, movements or drawings 
<p>Measurement and Geometry</p>	<p>Elaborations</p>
<p>Using units of measurement</p>	<p>Elaborations</p>
<p>Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language (ACMMG006)</p> 	<ul style="list-style-type: none"> • 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' 
<p>Compare and order duration of events using everyday language of time (ACMMG007)</p> 	<ul style="list-style-type: none"> • 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', 'forward', 'toward'



- 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 and make simple inferences (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 connections between number names, numerals and quantities up to 10. They compare objects using mass, length and capacity. Students connect events and the days of the week. They explain the order and duration of events. They use appropriate language to describe location.

Students count to and from 20 and order small collections. They group objects based on common characteristics and sort shapes and objects. Students answer simple questions to collect information and make simple inferences.

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. The achievement standards reflect the content and encompass the proficiencies.

At this year level:

- **understanding** includes connecting names, numerals and quantities, and partitioning numbers in various ways
- **fluency** includes readily counting number in sequences forwards 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, using familiar counting sequences to solve unfamiliar problems and discussing 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.

Year 1 Content Descriptions

Number and Algebra

Number and place value	Elaborations
<p>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)</p> <p></p>	<ul style="list-style-type: none"> • using the popular Korean counting game (sam-yuk-gu) for skip counting • developing fluency with forwards and backwards counting in meaningful contexts such as circle games <p></p>
<p>Recognise, model, read, write and order numbers to at least 100. Locate these numbers on a number line (ACMNA013)</p> <p></p>	<ul style="list-style-type: none"> • 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 <p></p>
<p>Count collections to 100 by partitioning numbers using place value (ACMNA014)</p> <p></p>	<ul style="list-style-type: none"> • understanding partitioning of numbers and the importance of grouping in tens • understanding two-digit numbers as comprised of tens and ones/units <p></p>
<p>Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts (ACMNA015)</p> <p></p>	<ul style="list-style-type: none"> • developing a range of mental strategies for addition and subtraction problems <p></p>

Fractions and decimals	Elaborations
<p>Recognise and describe one-half as one of two equal parts of a whole. (ACMNA016)</p> <p> </p>	<ul style="list-style-type: none"> 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
<p>Recognise, describe and order Australian coins according to their value (ACMNA017)</p> <p> </p>	<ul style="list-style-type: none"> 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
<p>Investigate and describe number patterns formed by skip-counting and patterns with objects (ACMNA018)</p> <p> </p>	<ul style="list-style-type: none"> 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
<p>Measure and compare the lengths and capacities of pairs of objects using uniform informal units (ACMMG019)</p> <p></p>	<ul style="list-style-type: none"> understanding that in order to compare objects, the unit of measurement must be the same size  
<p>Tell time to the half-hour (ACMMG020)</p> <p> </p>	<ul style="list-style-type: none"> reading time on analogue and digital clocks and observing the characteristics of half-hour times  
<p>Describe duration using months, weeks, days and hours (ACMMG021)</p> <p> </p>	<ul style="list-style-type: none"> 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 and make simple inferences (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 describe number sequences resulting from skip counting by 2s, 5s and 10s. They identify representations of one half. They recognise Australian coins according to their value. Students explain time durations. They describe two-dimensional shapes and three-dimensional objects. Students describe data displays.

Students count to and from 100 and locate numbers on a number line. They carry out simple additions and subtractions using counting strategies. They partition numbers using place value. They continue simple patterns involving numbers and objects. Students order objects based on lengths and capacities using informal units. They tell time to the half-hour. They use the language of direction to move from place to place. Students classify outcomes of simple familiar events. They collect data by asking questions, draw simple data displays and make simple inferences.

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. The achievement standards reflect the content and encompass the proficiencies.

At this year level:

- **understanding** includes connecting number calculations with counting sequences, partitioning and combining numbers flexibly and identifying and describing the relationship between addition and subtraction and between multiplication and division
- **fluency** includes readily counting numbers in sequences, using informal units iteratively to compare measurements, using the language of chance to describe outcomes of familiar 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, 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 and creating and interpreting simple representations of data.

Year 2 Content Descriptions

Number and Algebra	
Number and place value	Elaborations
<p>Investigate number sequences, initially those increasing and decreasing by twos, threes, fives and tens from any starting point, then moving to other sequences (ACMNA026)</p> <p></p>	<ul style="list-style-type: none"> • 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 
<p>Recognise, model, represent and order numbers to at least 1000 (ACMNA027)</p> <p></p>	<ul style="list-style-type: none"> • recognising there are different ways of representing numbers and identifying patterns going beyond 100  • developing fluency with writing numbers in meaningful contexts 
<p>Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting (ACMNA028)</p> <p></p>	<ul style="list-style-type: none"> • 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 collections (ACMNA033)



- recognising that sets of objects can be partitioned in different ways to demonstrate fractions



- 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
<p>Describe patterns with numbers and identify missing elements (ACMNA035)</p> 	<ul style="list-style-type: none"> 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 
<p>Solve problems by using number sentences for addition or subtraction (ACMNA036)</p> 	<ul style="list-style-type: none"> 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
<p>Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units (ACMMG037)</p> 	<ul style="list-style-type: none"> 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 
<p>Compare masses of objects using balance scales (ACMMG038)</p> 	<ul style="list-style-type: none"> 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 
<p>Tell time to the quarter-hour, using the language of 'past' and 'to' (ACMMG039)</p> 	<ul style="list-style-type: none"> 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 
<p>Name and order months and seasons (ACMMG040)</p> 	<ul style="list-style-type: none"> investigating the seasons used by Aboriginal people, comparing them to those used in Western society and recognising the connection to weather patterns. 
<p>Use a calendar to identify the date and determine the number of days in each month (ACMMG041)</p> 	<ul style="list-style-type: none"> 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 increasing and decreasing number sequences involving 2s, 3s and 5s. They represent multiplication and division by grouping into sets. They associate collections of Australian coins with their value. Students identify the missing element in a number sequence. Students recognise the features of three-dimensional objects. They interpret simple maps of familiar locations. They explain the effects of one-step transformations. Students make sense of collected information.

Students count to and from 1000. They perform simple addition and subtraction calculations using a range of strategies. They divide collections and shapes into halves, quarters and eighths. Students order shapes and objects using informal units. They tell time to the quarter-hour and use a calendar to identify the date and the months included in seasons. They draw two-dimensional shapes. They describe outcomes for everyday events. Students collect, organise and represent data to make simple inferences.

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. The achievement standards reflect the content and encompass the proficiencies.

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 and creating and interpreting variations in the results of data collections and data displays.

Year 3 Content Descriptions

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) 	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • 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

Measure, order and compare objects using familiar metric units of length, mass and capacity (ACMMG061)



Elaborations

- recognising the importance of using common units of measurement



- recognising and using centimetres and metres, grams and kilograms, and millilitres and litres



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

Make models of three-dimensional objects and describe key features (ACMMG063)



Elaborations

- exploring the creation of three-dimensional objects using origami, including prisms and pyramids



Location and transformation

Create and interpret simple grid maps to show position and pathways (ACMMG065)



Elaborations

- 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

Identify angles as measures of turn and compare angle sizes in everyday situations (ACMMG064)



Elaborations

- 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
<p>Conduct chance experiments, identify and describe possible outcomes and recognise variation in results (ACMSP067)</p> <p>  </p>	<ul style="list-style-type: none"> conducting repeated trials of chance experiments such as tossing a coin or drawing a ball from a bag and identifying the variations between trials <p> </p>
Data representation and interpretation	Elaborations
<p>Identify questions or issues for categorical variables. Identify data sources and plan methods of data collection and recording (ACMSP068)</p> <p>  </p>	<ul style="list-style-type: none"> 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 among Year 3 students in our class?') <p> </p>
<p>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)</p> <p>   </p>	<ul style="list-style-type: none"> exploring meaningful and increasingly efficient ways to record data, and representing and reporting the results of investigations collecting data to investigate features in the natural environment <p>  </p> <p>  </p>
<p>Interpret and compare data displays (ACMSP070)</p> <p>  </p>	<ul style="list-style-type: none"> comparing various student-generated data representations and describing their similarities and differences <p>  </p>

Year 3 Achievement Standard

By the end of Year 3, students recognise the connection between addition and subtraction and solve problems using efficient strategies for multiplication. They model and represent unit fractions. They represent money values in various ways. Students identify symmetry in the environment. They match positions on maps with given information. Students recognise angles in real situations. They interpret and compare data displays.

Students count to and from 10 000. They classify numbers as either odd or even. They recall addition and multiplication facts for single-digit numbers. Students correctly count out change from financial transactions. They continue number patterns involving addition and subtraction. Students use metric units for length, mass and capacity. They tell time to the nearest minute. Students make models of three-dimensional objects. Students conduct chance experiments and list possible outcomes. They conduct simple data investigations for categorical variables.

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. The achievement standards reflect the content and encompass the proficiencies.

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 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 with each other, comparing 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.

Year 4 Content Descriptions

Number and Algebra	
Number and place value	Elaborations
Investigate and use the properties of odd and even numbers (ACMNA071) 	<ul style="list-style-type: none"> • 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)  	<ul style="list-style-type: none"> • 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)   	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • 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. Make connections between fractions and decimal notation (ACMNA079)



- using division by 10 to extend the place-value system



- using knowledge of fractions to establish equivalences between fractions and decimal 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



Find unknown quantities in number sentences involving addition and subtraction and identify equivalent number sentences involving addition and subtraction (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



- 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)



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

Use simple scales, legends and directions to interpret information contained in basic maps (ACMMG090)



Elaborations

- 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

Compare angles and classify them as equal to, greater than, or less than, a right angle (ACMMG089)



Elaborations

- creating angles and comparing them to a right angle using digital technologies



Statistics and Probability

Chance

Describe possible everyday events and order their chances of occurring (ACMSP092)



Elaborations

- 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 choose appropriate strategies for calculations involving multiplication and division. They recognise common equivalent fractions in familiar contexts and make connections between fraction and decimal notations up to two decimal places. Students solve simple purchasing problems. They identify and explain strategies for finding unknown quantities in number sentences. They describe number patterns resulting from multiplication. Students compare areas of regular and irregular shapes using informal units. They solve problems involving time duration. They interpret information contained in maps. Students identify dependent and independent events. They describe different methods for data collection and representation, and evaluate their effectiveness.

Students use the properties of odd and even numbers. They recall multiplication facts to 10 x 10 and related division facts. Students locate familiar fractions on a number line. They continue number sequences involving multiples of single digit numbers. Students use scaled instruments to measure temperatures, lengths, shapes and objects. They convert between units of time. Students create symmetrical shapes and patterns. They classify angles in relation to a right angle. Students list the probabilities of everyday events. They construct data displays from given or collected data.

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. The achievement standards reflect the content and encompass the proficiencies.

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, describing transformations and identifying line and rotational symmetry
- **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 whole numbers and measurements and creating financial plans
- **reasoning** includes investigating strategies to perform calculations efficiently, continuing patterns involving fractions and decimals, interpreting results of chance experiments, posing appropriate questions for data investigations and interpreting data sets.

Year 5 Content Descriptions

Number and Algebra	
Number and place value	Elaborations
Identify and describe factors and multiples of whole numbers and use them to solve problems (ACMNA098) 	<ul style="list-style-type: none"> • exploring factors and multiples using number sequences  • using simple divisibility tests 
Use estimation and rounding to check the reasonableness of answers to calculations (ACMNA099) 	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • 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 order of unit fractions and their denominators



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 place value 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 one thousandths and 0.001



Compare, order and represent decimals (ACMNA105)



- locating decimals on a number line



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



Find unknown quantities in number sentences involving multiplication and division and identify equivalent number sentences involving multiplication and division (ACMNA121)



- using relevant problems to develop number sentences



Measurement and Geometry

Using units of measurement

Choose appropriate units of measurement for length, area, volume, capacity and mass (ACMMG108)



Elaborations

- 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 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



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

Connect three-dimensional objects with their nets and other two-dimensional representations (ACMMG111)



Elaborations

- 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



- recognising that angles have arms and a vertex, and that size is the amount of turn required for one arm to coincide with the other



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



Year 5 Achievement Standard

By the end of Year 5, students solve simple problems involving the four operations using a range of strategies. They check the reasonableness of answers using estimation and rounding. Students identify and describe factors and multiples. They identify and explain strategies for finding unknown quantities in number sentences involving the four operations. They explain plans for simple budgets. Students connect three-dimensional objects with their two-dimensional representations. They describe transformations of two-dimensional shapes and identify line and rotational symmetry. Students interpret different data sets.

Students order decimals and unit fractions and locate them on number lines. They add and subtract fractions with the same denominator. Students continue patterns by adding and subtracting fractions and decimals. They use appropriate units of measurement for length, area, volume, capacity and mass, and calculate perimeter and area of rectangles. They convert between 12- and 24-hour time. Students use a grid reference system to locate landmarks. They measure and construct different angles. Students list outcomes of chance experiments with equally likely outcomes and assign probabilities between 0 and 1. Students pose questions to gather data, and construct data displays appropriate for the data.

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. The achievement standards reflect the content and encompass the proficiencies.

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 integers 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 fractions, decimals, percentages and measurements, interpreting secondary data displays and finding the size of unknown angles
- **reasoning** includes explaining mental strategies for performing calculations, describing results for continuing number sequences, explaining the transformation of one shape into another and explaining why the actual results of chance experiments may differ from expected results.

Year 6 Content Descriptions

Number and Algebra

Number and place value	Elaborations
<p>Identify and describe properties of prime, composite, square and triangular numbers (ACMNA122)</p> <p> </p>	<ul style="list-style-type: none"> • 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)  
<p>Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers (ACMNA123)</p> <p>   </p>	<ul style="list-style-type: none"> • 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 integers. Locate and represent these numbers on a number line (ACMNA124)



- understanding that integers are ...-3, -2, -1, 0, 1, 2, 3,.....



- solving everyday additive problems using a number line



- investigating everyday situations that use integers, such as temperatures



- using number lines to position and order integers around zero



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 related denominators (ACMNA126)



- understanding the processes for adding and subtracting fractions with related denominators and fractions as an operator, in preparation for calculating with all 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)



- recognising that finding one third of a quantity is the same as dividing by 3



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 by non-zero whole numbers where the results are terminating decimals, with and without digital technologies (ACMNA129)



- interpreting the results of calculations to provide an answer appropriate to the context



<p>Multiply and divide decimals by powers of 10 (ACMNA130)</p> 	<ul style="list-style-type: none"> • multiplying and dividing decimals by multiples of powers of 10 
<p>Make connections between equivalent fractions, decimals and percentages (ACMNA131)</p> 	<ul style="list-style-type: none"> • 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  
<p>Money and financial mathematics Elaborations</p>	
<p>Investigate and calculate percentage discounts of 10%, 25% and 50% on sale items, with and without digital technologies (ACMNA132)</p>    	<ul style="list-style-type: none"> • using authentic information to calculate prices on sale goods   
<p>Patterns and algebra Elaborations</p>	
<p>Continue and create sequences involving whole numbers, fractions and decimals. Describe the rule used to create the sequence (ACMNA133)</p>   	<ul style="list-style-type: none"> • identifying and generalising number patterns • 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    
<p>Explore the use of brackets and order of operations to write number sentences (ACMNA134)</p> 	<ul style="list-style-type: none"> • appreciating the need for rules to complete multiple operations within the same number sentence 
<p>Measurement and Geometry</p>	
<p>Using units of measurement Elaborations</p>	
<p>Connect decimal representations to the metric system (ACMMG135)</p> 	<ul style="list-style-type: none"> • recognising the equivalence of measurements such as 1.25 metres and 125 centimetres  
<p>Convert between common metric units of length, mass and capacity (ACMMG136)</p> 	<ul style="list-style-type: none"> • 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    

<p>Solve problems involving the comparison of lengths and areas using appropriate units (ACMMG137)</p> 	<ul style="list-style-type: none"> recognising and investigating familiar objects using concrete materials and digital technologies 
<p>Connect volume and capacity and their units of measurement (ACMMG138)</p> 	<ul style="list-style-type: none"> recognising that 1ml is equivalent to 1cm³ 
<p>Interpret and use timetables (ACMMG139)</p> 	<ul style="list-style-type: none"> planning a trip involving one or more modes of public transport developing a timetable of daily activities  
<p>Shape</p>	<p>Elaborations</p>
<p>Construct simple prisms and pyramids (ACMMG140)</p> 	<ul style="list-style-type: none"> 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  
<p>Location and transformation</p>	<p>Elaborations</p>
<p>Investigate combinations of translations, reflections and rotations, with and without the use of digital technologies (ACMMG142)</p> 	<ul style="list-style-type: none"> designing a school or brand logo using transformation of one or more shapes understanding that translations, rotations and reflections can change the position and orientation but not shape or size  
<p>Introduce the Cartesian coordinate system using all four quadrants (ACMMG143)</p> 	<ul style="list-style-type: none"> understanding that the Cartesian plane provides a graphical or visual way of describing location 
<p>Geometric reasoning</p>	<p>Elaborations</p>

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)



- identifying the size of a right angle as 90° and defining acute, obtuse, straight and reflex angles
- measuring, estimating and comparing angles in degrees and classifying 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
- recognising and using the two alternate conventions for naming angles

Statistics and Probability

Chance

Describe probabilities using fractions, decimals and percentages (ACMSP144)



Elaborations

- 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

Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables (ACMSP147)



Elaborations

- comparing different student-generated diagrams, tables and graphs, describing their similarities and differences and commenting on the usefulness of each representation for interpreting the data
- 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



Interpret secondary data presented in digital media and elsewhere (ACMSP148)



- investigating data representations in the media and discussing what they illustrate and the messages the people who created them might want to convey



- 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



Year 6 Achievement Standard

By the end of Year 6, students recognise the properties of prime, composite, square and triangular numbers. They describe the use of integers in everyday contexts. They solve problems involving all four operations with whole numbers. Students connect fractions, decimals and percentages as different representations of the same number. They solve problems involving the addition and subtraction of related fractions. Students make connections between the powers of 10 and the multiplication and division of decimals. They describe rules used in sequences involving whole numbers, fractions and decimals. Students connect decimal representations to the metric system and choose appropriate units of measurement to perform a calculation. They make connections between capacity and volume. They solve problems involving length and area. They interpret timetables. Students describe combinations of transformations. They solve problems using the properties of angles. Students compare observed and expected frequencies. They interpret and compare a variety of data displays including those displays for two categorical variables. They interpret secondary data displayed in the media.

Students locate fractions and integers on a number line. They calculate a simple fraction of a quantity. They add, subtract and multiply decimals and divide decimals where the result is rational. Students calculate common percentage discounts on sale items. They write correct number sentences using brackets and order of operations. Students locate an ordered pair in any one of the four quadrants on the Cartesian plane. They construct simple prisms and pyramids. Students describe probabilities using simple fractions, decimals and percentages.

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. The achievement standards reflect the content and encompass the proficiencies.

At this year level:

- **understanding** includes describing patterns in uses of indices with whole numbers, recognising equivalences between fractions, decimals, percentages and ratios, plotting points on the Cartesian plane, identifying angles formed by a transversal crossing a pair of 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, finding 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, working with 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.

Year 7 Content Descriptions

Number and Algebra	
Number and place value	Elaborations
Investigate index notation and represent whole numbers as products of powers of prime numbers (ACMNA149) 	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • 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 positive and negative fractions and mixed numbers 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 $\frac{2}{3}$ is the same as $\frac{4}{6}$ and $\frac{6}{9}$)



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 technologies (ACMNA155)



- using authentic examples for the quantities to be expressed and understanding the reasons for the calculations



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)



- justifying choices of written, mental or calculator strategies for solving specific problems including those involving large numbers



- understanding that quantities can be represented by different number types and calculated using various operations, and that choices need to be made about each



- calculating the percentage of the total local municipal area set aside for parkland, manufacturing, retail and residential dwellings to compare land use



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 substitution to check solutions



- investigating a range of strategies to solve equations



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

Establish the formulas for areas of rectangles, triangles and parallelograms, and use these in problem-solving (ACMMG159)



Elaborations

- building on the understanding of the area of rectangles to develop formulas for the area of triangles
- establishing that the area of a triangle is half the area of an appropriate rectangle
- using area formulas for rectangles and triangles to solve problems involving areas of surfaces



Calculate volumes of rectangular prisms (ACMMG160)



- investigating volumes of cubes and rectangular prisms and establishing and using the formula $V = l \times b \times h$
- understanding and using cubic units when interpreting and finding volumes of cubes and rectangular prisms



Shape

Draw different views of prisms and solids formed from combinations of prisms (ACMMG161)



Elaborations

- using aerial views of buildings and other 3-D structures to visualise the structure of the building or prism



Location and transformation

Describe translations, reflections in an axis and rotations of multiples of 90° on the Cartesian plane using coordinates. Identify line and rotational symmetries (ACMMG181)



Elaborations

- describing patterns and investigating different ways to produce the same transformation such as using two successive reflections to provide the same result as a translation
- experimenting with, creating and re-creating patterns using combinations of reflections and rotations using digital technologies



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 straight lines are crossed by a transversal (ACMMG163)



- defining and classifying pairs of angles as complementary, supplementary, adjacent and vertically opposite



Investigate conditions for two lines to be parallel and solve simple numerical problems using reasoning (ACMMG164)



- constructing parallel and perpendicular lines using their properties, a pair of compasses and a ruler, and dynamic geometry software



- defining and identifying the relationships between alternate, corresponding and co-interior angles for a pair of parallel lines cut by a transversal



Statistics and Probability

Chance

Elaborations

Construct sample spaces for single-step experiments with equally likely outcomes (ACMSP167)



- discussing the meaning of probability terminology (for example probability, sample space, favourable outcomes, trial, events and experiments)



- distinguishing between equally likely outcomes and outcomes that are not equally likely



Assign probabilities to the outcomes of events and determine probabilities for events (ACMSP168)



- expressing probabilities as decimals, fractionals and percentages



Data representation and interpretation

Elaborations

Identify and investigate issues involving numerical data collected from primary and secondary sources (ACMSP169)



- obtaining secondary data from newspapers, the Internet and the Australian Bureau of Statistics



- investigating secondary data relating to the distribution and use of non-renewable resources around the world



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 produced



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



Describe and interpret data displays using median, mean and range (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 solve problems involving the comparison, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving percentages and all four operations with fractions and decimals. They compare the cost of items to make financial decisions. Students represent numbers using variables. They connect the laws and properties for numbers to algebra. They interpret simple linear representations and model authentic information. Students describe different views of three-dimensional objects. They represent transformations in the Cartesian plane. They solve simple numerical problems involving angles formed by a transversal crossing two lines. Students identify issues involving the collection of continuous data. They describe the relationship between the median and mean in data displays.

Students use fractions, decimals and percentages, and their equivalences. They express one quantity as a fraction or percentage of another. Students solve simple linear equations and evaluate algebraic expressions after numerical substitution. They assign ordered pairs to given points on the Cartesian plane. Students use formulas for the area and perimeter of rectangles and calculate volumes of rectangular prisms. Students classify triangles and quadrilaterals. They name the types of angles formed by a transversal crossing parallel line. Students determine the sample space for simple experiments with equally likely outcomes and assign probabilities to those outcomes. They calculate mean, mode, median and range for data sets. They construct stem-and-leaf plots and dot-plots.

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. The achievement standards reflect the content and encompass the proficiencies.

At this year level:

- **understanding** includes describing patterns involving indices and recurring decimals, identifying commonalities between operations with algebra and arithmetic, connecting rules for linear relations with their graphs, explaining the purpose of statistical measures and explaining measurements of perimeter and area
- **fluency** includes calculating accurately with simple decimals, indices and integers; recognising equivalence of common decimals and fractions including recurring decimals; factorising and simplifying basic algebraic expressions and evaluating perimeters and areas of common shapes and volumes of three-dimensional objects
- **problem-solving** includes formulating and modelling practical situations involving ratios, profit and loss, areas and perimeters of common shapes and using two-way tables and Venn diagrams to calculate probabilities
- **reasoning** includes justifying the result of a calculation or estimation as reasonable, deriving probability from its complement, using congruence to deduce properties of triangles, finding estimates of means and proportions of populations.

Year 8 Content Descriptions

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) 	<ul style="list-style-type: none"> • evaluating numbers expressed as powers of positive integers 
Carry out the four operations with rational numbers and integers, using efficient mental and written strategies and appropriate digital technologies (ACMNA183) 	<ul style="list-style-type: none"> • using patterns to assist in finding rules for the multiplication and division of integers  • using the number line to develop strategies for adding and subtracting rational numbers 
Real numbers	Elaborations
Investigate terminating and recurring decimals (ACMNA184) 	<ul style="list-style-type: none"> • recognising terminating, recurring and non-terminating decimals and choosing their appropriate representations 
Investigate the concept of irrational numbers, including π (ACMNA186) 	<ul style="list-style-type: none"> • understanding that the real number system includes irrational numbers 

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, and GST



- using percentages to calculate population increases and decreases



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 the relationship between factorising and 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 the laws used with numbers can also be used with algebra



Linear and non-linear relationships

Elaborations

Plot linear relationships on the Cartesian plane with and without the use of digital technologies (ACMNA193)



- completing a table of values, plotting the resulting points and determining whether the relationship is linear



- finding the rule for a linear relationship



Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution (ACMNA194)



- solving real life problems by using variables to represent unknowns



Measurement and Geometry

Using units of measurement

Choose appropriate units of measurement for area and volume and convert from one unit to another (ACMMG195)



Elaborations

- 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, trapeziums, rhombuses and kites (ACMMG196)



- establishing and using formulas for areas such as trapeziums, 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 (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 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 that the matching sides and the matching angles are equal



Develop the conditions for congruence of triangles (ACMMG201)



- 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)



- solving problems using the properties of congruent figures



- constructing triangles using the conditions for congruence



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, parallel sides, angles, diagonals and symmetry



Statistics and Probability

Chance

Elaborations

Identify complementary events and use the sum of probabilities to solve problems (ACMSP204)



- identifying the complement of familiar events



- understanding that probabilities range between 0 to 1 and that calculating the probability of an event allows the probability of its complement to be found



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' and 'not' probability questions about objects or people



Represent events in two-way tables and Venn diagrams and solve related problems (ACMSP292)



- using Venn diagrams and two-way tables to calculate probabilities for events, satisfying 'and', 'or' and 'not' conditions



- understanding that representing data in Venn diagrams or two-way tables facilitates the calculation of probabilities



- collecting data to answer the questions using Venn diagrams or two-way tables



Data representation and interpretation

Elaborations

Investigate techniques for collecting data, including census, sampling and observation (ACMSP284)



- identifying situations where data can be collected by census and those where a sample is appropriate



Explore the practicalities and implications of obtaining data through sampling using a variety of investigative processes (ACMSP206)



- investigating the uses of random sampling to collect data



Explore the variation of means and proportions of random samples drawn from the same population (ACMSP293)



- using sample properties to predict characteristics of the population



Investigate the effect of individual data values, including outliers, on the mean and median (ACMSP207)



- using displays of data to explore and investigate effects



Year 8 Achievement Standard

By the end of Year 8, students solve everyday problems involving rates, ratios and percentages. They describe index laws and apply them to whole numbers. They describe rational and irrational numbers. Students solve problems involving profit and loss. They make connections between expanding and factorising algebraic expressions. Students solve problems relating to the volume of prisms. They make sense of time duration in real applications. They identify conditions for the congruence of triangles and deduce the properties of quadrilaterals. Students model authentic situations with two-way tables and Venn diagrams. They choose appropriate language to describe events and experiments. They explain issues related to the collection of data and the effect of outliers on means and medians in that data.

Students use efficient mental and written strategies to carry out the four operations with integers. They simplify a variety of algebraic expressions. They solve linear equations and graph linear relationships on the Cartesian plane. Students convert between units of measurement for area and volume. They perform calculations to determine perimeter and area of parallelograms, rhombuses and kites. They name the features of circles and calculate the areas and circumferences of circles. Students determine the probabilities of complementary events and calculate the sum of probabilities.

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. The achievement standards reflect the content and encompass the proficiencies.

At this year level:

- **understanding** includes describing the relationship between graphs and equations, simplifying a range of algebraic expressions and explaining the use of relative frequencies to estimate probabilities and 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, developing familiarity with calculations involving the Cartesian plane and calculating areas of shapes and surface areas of prisms
- **problem-solving** includes formulating and modelling practical situations involving 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 clarify situations, developing strategies in investigating similarity and sketching linear graphs.

Year 9 Content Descriptions

Number and Algebra	
Real numbers	Elaborations
Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems (ACMNA208)   	<ul style="list-style-type: none"> • identifying direct proportion in real-life contexts  
Apply index laws to numerical expressions with integer indices (ACMNA209) 	<ul style="list-style-type: none"> • simplifying and evaluating numerical expressions, using involving both positive and negative integer indices  
Express numbers in scientific notation (ACMNA210) 	<ul style="list-style-type: none"> • 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)   	<ul style="list-style-type: none"> • understanding that financial decisions can be assisted by mathematical calculations  
Patterns and algebra	Elaborations

Extend and apply the index laws to variables, using positive integer indices and the zero index (ACMNA212)



- understanding that index laws apply to variables as well as numbers



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



- understanding the relationship between expansion and factorisation and identifying algebraic factors in algebraic expressions



Linear and non-linear relationships

Elaborations

Find the distance between two points located on the Cartesian plane using a range of strategies, including graphing software (ACMNA214)



- investigating graphical and algebraic techniques for finding distance between two points



- using Pythagoras' theorem to calculate distance between two points



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



- recognising that the gradient of a line is the same as the gradient of any line segment on that line



Sketch linear graphs using the coordinates of two points and solve linear equations (ACMNA215)



- determining linear rules from suitable diagrams, tables of values and graphs and describing them using both words and algebra



Graph simple non-linear relations with and without the use of digital technologies and solve simple related equations (ACMNA296)



- graphing parabolas, and circles connecting x-intercepts of a graph to a related equation



Measurement and Geometry

Using units of measurement

Elaborations

Calculate areas of composite shapes (ACMMG216)



- understanding that partitioning composite shapes into rectangles and triangles is a strategy for solving problems involving area



Calculate the surface area and volume of cylinders and solve related problems (ACMMG217)



- analysing nets of cylinders to establish formulas for surface area



- connecting the volume and capacity of a cylinder to solve authentic problems



Solve problems involving the surface area and volume of right prisms (ACMMG218)



- solving practical problems involving surface area and volume of right prisms



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)



- 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)



- using the enlargement transformation to establish similarity, understanding that similarity and congruence help describe relationships between geometrical shapes and are important elements of reasoning and proof



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 integers, fractions or irrational numbers



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

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)



Elaborations

- conducting two-step chance experiments



- using systematic methods to list outcomes of experiments and to list outcomes favourable to an event



- comparing experiments which differ only by being undertaken with replacement or without replacement



Calculate relative frequencies from given or collected data to estimate probabilities of events involving 'and' or 'or' (ACMSP226)



- using Venn diagrams or two-way tables to calculate relative frequencies of events involving 'and', 'or' questions



- using relative frequencies to find an estimate of probabilities of 'and', 'or' events



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

Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly and from secondary sources (ACMSP228)



Elaborations

- 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)



- using stem-and-leaf plots to compare two like sets of data such as the heights of girls and the heights of boys in a class



- describing the shape of the distribution of data using terms such as 'positive skew', 'negative skew' and '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 (ACMSP283)



- comparing means, medians and ranges of two sets of numerical data which have been displayed using histograms, dot plots, or stem and leaf plots



Year 9 Achievement Standard

By the end of Year 9, students solve problems involving simple interest. They interpret ratio and scale factors in similar figures. Students explain similarity of triangles. They recognise the connections between similarity and the trigonometric ratios. Students compare techniques for collecting data from primary and secondary sources. They make sense of the position of the mean and median in skewed, symmetric and bi-modal displays to describe and interpret data.

Students apply the index laws to numbers and express numbers in scientific notation. They expand binomial expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment. They sketch linear and non-linear relations. Students calculate areas of shapes and the volume and surface area of right prisms and cylinders. They use Pythagoras' Theorem and trigonometry to find unknown sides of right-angled triangles. Students calculate relative frequencies to estimate probabilities, list outcomes for two-step experiments and assign probabilities for those outcomes. They construct histograms and back-to-back stem-and-leaf plots.

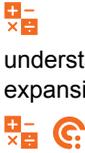
Year 10

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. The achievement standards reflect the content and encompass the proficiencies.

At this year level:

- **understanding** includes applying the four operations to algebraic fractions, finding unknowns in formulas after substitution, making the connection between equations of relations and their graphs, comparing simple and compound interest in financial contexts and determining probabilities of two- and three-step experiments
- **fluency** includes 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 to solve practical problems, 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
- **reasoning** includes formulating geometric proofs involving congruence and similarity, interpreting and evaluating media statements and interpreting and comparing data sets.

Year 10 Content Descriptions

Number and Algebra	
Money and financial mathematics	Elaborations
<p>Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies (ACMNA229)</p> 	<ul style="list-style-type: none"> • working with authentic information, data and interest rates to calculate compound interest and solve related problems 
Patterns and algebra	Elaborations
<p>Factorise algebraic expressions by taking out a common algebraic factor (ACMNA230)</p> 	<ul style="list-style-type: none"> • using the distributive law and the index laws to factorise algebraic expressions • understanding the relationship between factorisation and expansion 
<p>Simplify algebraic products and quotients using index laws (ACMNA231)</p> 	<ul style="list-style-type: none"> • 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)



- expressing the sum and difference of algebraic fractions with a common denominator



- using the index laws to simplify products and quotients of algebraic fractions



Expand binomial products and factorise monic quadratic expressions using a variety of strategies (ACMNA233)



- exploring the method of completing the square to factorise quadratic expressions and solve quadratic equations



- identifying and using common factors, including binomial expressions, to factorise algebraic expressions using the technique of grouping in pairs



- using the identities for perfect squares and the difference of squares to factorise quadratic expressions



Substitute values into formulas to determine an unknown (ACMNA234)



- solving simple equations arising from formulas



Linear and non-linear relationships

Elaborations

Solve problems involving linear equations, including those derived from formulas (ACMNA235)



- representing word problems with simple linear equations and solving them to answer questions



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)



- associating the solution of simultaneous equations with the coordinates of the intersection of their corresponding graphs



Solve problems involving parallel and perpendicular lines (ACMNA238)



- solving problems using the fact that parallel lines have the same gradient and conversely that if two lines have the same gradient then they are parallel



- solving problems using the fact that the product of the gradients of perpendicular lines is -1 and conversely that if the product of the gradients of two lines is -1 then they are perpendicular



Explore the connection between algebraic and graphical representations of relations such as simple quadratics, circles and exponentials using digital technology as appropriate (ACMNA239)



- sketching graphs of parabolas, and circles
- applying translations, reflections and stretches to parabolas and circles
- sketching the graphs of exponential functions using transformations

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)



- using a variety of techniques to solve quadratic equations, including grouping, completing the square, the quadratic formula and choosing two integers with the required product and sum

Measurement and Geometry

Using units of measurement

Solve problems involving surface area and volume for a range of prisms, cylinders and composite solids (ACMMG242)



Elaborations

- investigating and determining the volumes and surface areas of composite solids by considering the individual solids from which they are constructed

Geometric reasoning

Formulate proofs involving congruent triangles and angle properties (ACMMG243)



Elaborations

- applying an understanding of relationships to deduce properties of geometric figures (for example the base angles of an isosceles triangle are equal)

Apply logical reasoning, including the use of congruence and similarity, to proofs and numerical exercises involving plane shapes (ACMMG244)



- 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)



- performing a sequence of steps to determine an unknown angle giving a justification in moving from one step to the next.



- communicating a proof using a sequence of logically connected statements



Pythagoras and trigonometry

Elaborations

Solve right-angled triangle problems including those involving direction and angles of elevation and depression (ACMMG245)



- applying Pythagoras' 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 that an event can be dependent on another event and that this will affect the way its probability is calculated



Use the language of 'if ...then', 'given', 'of', 'knowing that' to investigate conditional statements and identify common mistakes in interpreting such language (ACMSP247)



- using two-way tables and Venn diagrams to understand conditional statements



- using arrays and tree diagrams to determine probabilities



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 age distribution of Aboriginal and Torres Strait Islander people 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 numerical 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)



- investigating biodiversity changes in Australia since European occupation



- constructing and interpreting data displays representing bivariate data over time



Evaluate statistical reports in the media and other places by linking claims to displays, statistics and representative data (ACMSP253)



- investigating the use of statistics in reports regarding the growth of Australia's trade with other countries of the Asia region



- 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 recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities. They make the connections between algebraic and graphical representations of relations. Students solve surface area and volume problems relating to composite solids. They recognise the relationships between parallel and perpendicular lines. Students apply deductive reasoning to proofs and numerical exercises involving plane shapes. They compare data sets by referring to the shapes of the various data displays. They describe bivariate data where the independent variable is time. Students describe statistical relationships between two continuous variables. They evaluate statistical reports.

Students expand binomial expressions and factorise monic quadratic expressions. They find unknown values after substitution into formulas. They perform the four operations with simple algebraic fractions. Students solve simple quadratic equations and pairs of simultaneous equations. They use triangle and angle properties to prove congruence and similarity. Students use trigonometry to calculate unknown angles in right-angled triangles. Students list outcomes for multi-step chance experiments and assign probabilities for these experiments. They calculate quartiles and inter-quartile ranges.

Year 10A

Year 10A Content Descriptions

Number and Algebra	
Real numbers	Elaborations
<p>Define rational and irrational numbers and perform operations with surds and fractional indices (ACMNA264)</p> <p></p>	<ul style="list-style-type: none"> understanding that the real number system includes irrational numbers extending the index laws to rational number indices performing the four operations with surds <p>  </p>
<p>Use the definition of a logarithm to establish and apply the laws of logarithms (ACMNA265)</p> <p></p>	<ul style="list-style-type: none"> investigating the relationship between exponential and logarithmic expressions simplifying expressions using the logarithm laws <p> </p>
Patterns and algebra	Elaborations
<p>Investigate the concept of a polynomial and apply the factor and remainder theorems to solve problems (ACMNA266)</p> <p></p>	<ul style="list-style-type: none"> investigating the relationship between algebraic long division and the factor and remainder theorems <p></p>
Linear and non-linear relationships	Elaborations
<p>Describe, interpret and sketch parabolas, hyperbolas, circles and exponential functions and their transformations (ACMNA267)</p> <p></p>	<ul style="list-style-type: none"> applying transformations, including translations, reflections in the axes and stretches to help graph parabolas, rectangular hyperbolas, circles and exponential functions <p></p>
<p>Solve simple exponential equations (ACMNA270)</p> <p></p>	<ul style="list-style-type: none"> investigating exponential equations derived from authentic mathematical models based on population growth <p></p>
<p>Apply understanding of polynomials to sketch a range of curves and describe the features of these curves from their equation (ACMNA268)</p> <p></p>	<ul style="list-style-type: none"> investigating the features of graphs of polynomials including axes intercepts and the effect of repeated factors <p></p>

Factorise monic and non-monic quadratic expressions and solve a wide range of quadratic equations derived from a variety of contexts (ACMNA269)



- writing quadratic equations that represent practical problems



Measurement and Geometry

Using units of measurement

Solve problems involving surface area and volume of right pyramids, right cones, spheres and related composite solids (ACMMG271)



Elaborations

- using formulas to solve problems
- using authentic situations to apply knowledge and understanding of surface area and volume



Geometric reasoning

Prove and apply angle and chord properties of circles (ACMMG272)



Elaborations

- performing a sequence of steps to determine an unknown angle or length in a diagram involving a circle, or circles, giving a justification in moving from one step to the next



- communicating a proof using a logical sequence of statements



- proving results involving chords of circles



Pythagoras and trigonometry

Establish the sine, cosine and area rules for any triangle and solve related problems (ACMMG273)



Elaborations

- 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



- understanding that trigonometric functions are periodic and that this can be used to describe motion



Solve simple trigonometric equations (ACMMG275)



- using periodicity and symmetry to solve equations



Apply Pythagoras' Theorem and trigonometry to solving three-dimensional problems in right-angled triangles (ACMMG276)



- investigating the applications of Pythagoras' theorem in authentic problems



Statistics and Probability

Chance

Investigate reports of studies in digital media and elsewhere for information on their planning and implementation (ACMSP277)



Elaborations

- evaluating the appropriateness of sampling methods in reports where statements about a population are based on a sample
- evaluating whether graphs in a report could mislead, and whether graphs and numerical information support the claims



Data representation and interpretation

Calculate and interpret the mean and standard deviation of data and use these to compare data sets (ACMSP278)



Elaborations

- using the standard deviation to describe the spread of a set of data
- using the mean and standard deviation to compare numerical data sets



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'



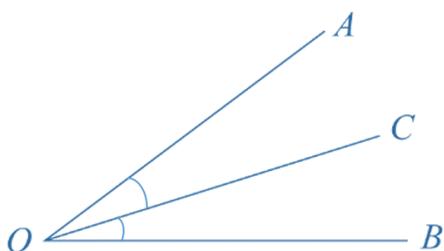
Glossary

acute angle

An *acute angle* is bigger than 0° but smaller than 90° .

adjacent angles

Adjacent angles share a common *ray* and a common *vertex*, and lie on opposite sides of the common *ray*. In the diagram, $\angle AOC$ and $\angle COB$ are *adjacent angles*.



algebraic expression

An *algebraic expression* is formed by combining numbers and *algebraic terms* using arithmetic operations (addition, subtraction, multiplication, division, and exponentiation). The expression must be unambiguous. For example, $a^2+3ab-2b^2$ is an algebraic expression, but $2x++3$ is not one because it is ambiguous.

algebraic fraction

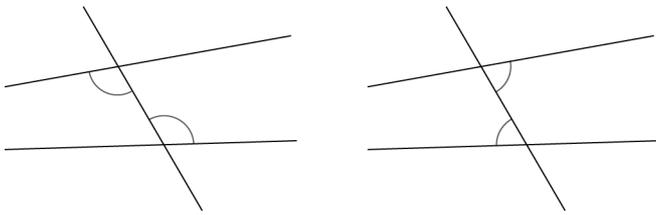
An *algebraic fraction* is a fraction in which both, *numerator* and *denominator*, are *algebraic expressions*.

algebraic term

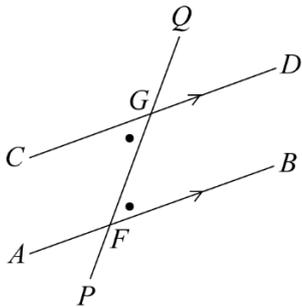
An *algebraic term* forms a part of an *algebraic expression*. For example, 2, $3x$, and $5x^2$ are terms of the *algebraic expression* $2+3x-5x^2$. Terms are separated by + or – signs.

alternate angles

Alternate angles are formed when two lines are crossed by another line (the *transversal*). The *alternate angles* are on opposite sides of the *transversal*, but inside the two lines. In each diagram below, the two marked *angles* are *alternate angles* as they are on opposite sides of the transversal.



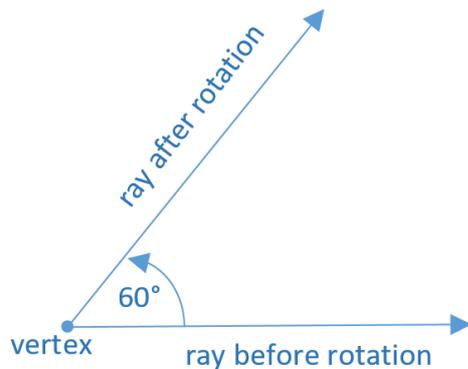
If the lines AB and CD are *parallel*, then each pair of *alternate* angles are equal.



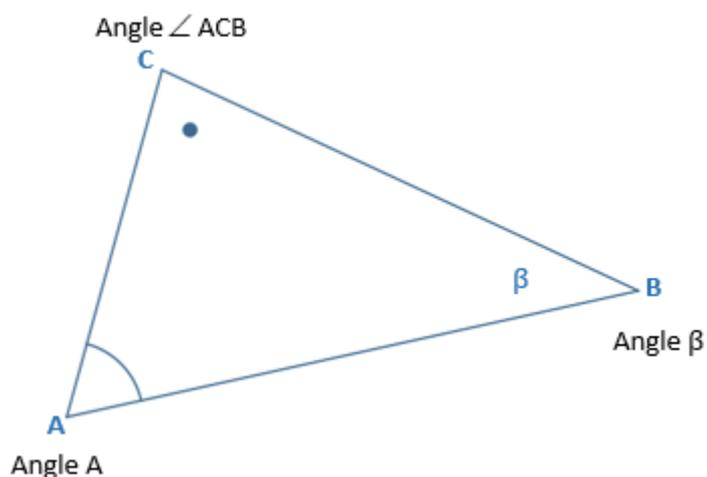
Conversely, if a pair of *alternate* angles are equal, then the lines are *parallel*. Line segment CD is parallel to line segment AB, because $\angle CGF$ equals $\angle GFB$.

angle

An *angle* is the figure formed by the rotation of a *ray* about a point, called the *vertex* of the angle. The size of an angle is usually measured in degrees ($^{\circ}$).

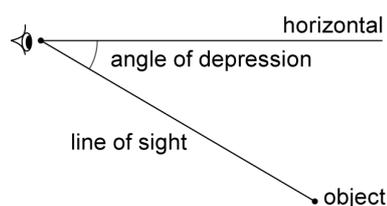


There are different ways of depicting and naming angles. Angles may be depicted using as symbol such as an arc, a dot or a letter (often from the Greek alphabet). Angles are named using different conventions, such as the angle symbol \angle followed by three letters denoting points, where the middle letter is the vertex, or using just the label of the vertex.



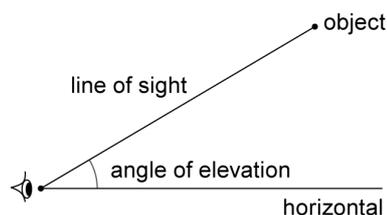
angle of depression

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*.



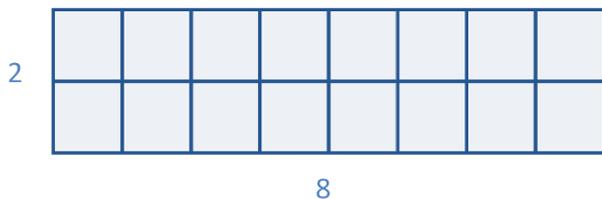
angle of elevation

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*.



area

Area is a measure of how many units are required to cover a surface. The units are usually standard units, such as square centimetres or square metres. The area of a *rectangle* can be found by multiplying the size of its length by the size of its width. For example, the area of the rectangle below is given by $8 \times 2 = 16$ units.



array

An *array* is an ordered collection of objects or numbers. Rectangular arrays are commonly used in primary mathematics. For example, the two arrays of dots shown below are two different representations of the number 24.



associative

Operations are *associative* if the order in which *operations* take place does not affect the result.

For example, *addition* of numbers is *associative*, since the order in which they are added does not change their sum. The corresponding associative law is: $a+b+c=a+(b+c)$ for all numbers a, b and c .

Multiplication is also *associative*, as the *product* of the numbers does not vary with the order of their multiplication. The corresponding associative law is: $abc=abc$ for all numbers a, b and c .

Subtraction and division are not *associative*, as the order of operations changes the value of the expression; for example: $7-4-3 \neq 7-4-3$ and $12 \div 6 \div 2 \neq 12 \div (6 \div 2)$.

average

An *average* is a number expressing a central or typical value in a *set of data*. While it usually refers to the arithmetic *mean*, that is, the *sum* of a set of numbers divided by the number of numbers in the set, it may also refer to other *measures of central tendency*.

axes

(plural) See *axis*.

axis

(singular) An *axis* is one of the horizontal or vertical lines that make up the *Cartesian plane*. The horizontal line is called the *x axis*, and the vertical line is called the *y axis*. The *x* and *y axes* intersect at *point O*, called the origin, which defines the centre of the *coordinate system*.

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

pulse rate	
before	after
9 8 8 8	6
8 6 6 4 1 1 0	7
8 8 6 2	8 6 7 8 8
6 0	9 0 2 2 4 5 8 9 9
4	10 0 4 4
0	11 8
	12 4 4
	13
	14 6

In this plot, the stem unit is '10' and the leaf unit is '1'. Thus, the third row in the plot, 8 8 6 2 | 8 | 6 7 8 8, displays pulse rates of 88, 88, 86, 82 before exercise and 86, 87, 88, 88 after exercise.

bimodal data

Bimodal data has two *modes*.

binomial

A *binomial* is an *algebraic expression* containing two distinct *algebraic terms*. For example, $2x+a$ and $2x+8$ are *binomial* expressions but $3x+2x$ is not, as it can be simplified to $5x$.

bivariate data

Bivariate data relates to two *variables*. For example, the arm spans and heights of 16-year-olds or the sex of primary school students and their attitudes toward playing sports.

bivariate numerical data

Bivariate numerical data relates to two *numerical variables*. For example, height and weight.

box plot

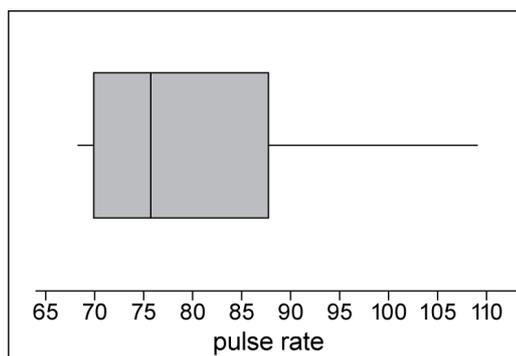
The term *box plot* is a synonym for a *box-and-whisker plot*.

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), the middle 50% of scores, 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.



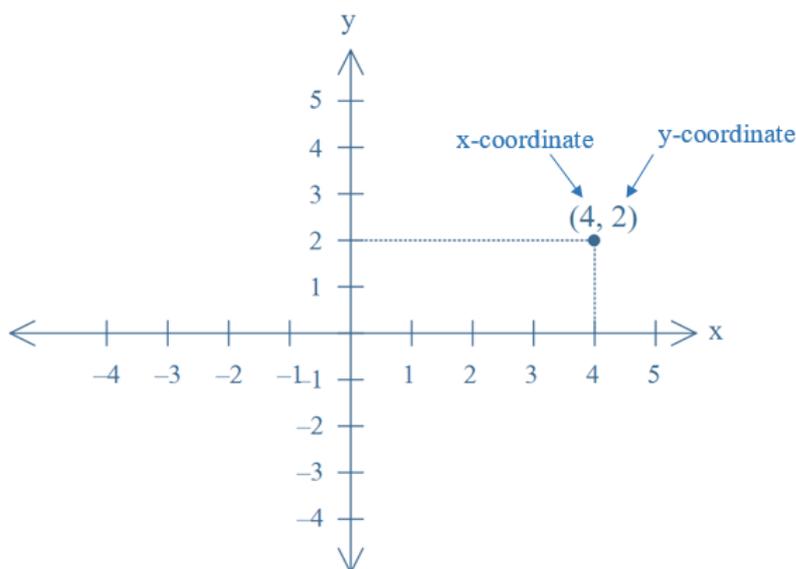
capacity

In the given context, *capacity* is a term that describes how much a container will hold. It is used in reference to the volume of fluids or gases and is measured in units such as litres or millilitres.

Cartesian plane

The *Cartesian plane* or *Cartesian coordinate system* is a system that describes the exact location of any *point* in a plane using an *ordered pair* of numbers, called *coordinates*. It is defined by the intersection of a *horizontal* and *vertical* number line at a *point* called the origin. The coordinates of the origin are $(0, 0)$.

The Cartesian plane is divided into four *quadrants* by these *perpendicular axes* called the *x-axis* (horizontal line) and the *y-axis* (vertical line). The axes can be used to identify any point in the plane using a pair of coordinates, as shown in the diagram below.



categorical variable

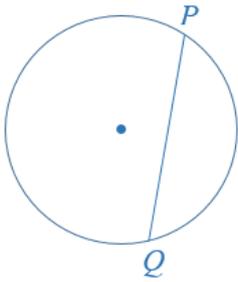
A *categorical variable* is a *variable* whose values are categories. For example, blood group is a categorical variable; its common values are: A, B, AB or O.

census

A *census* is a survey of a whole *population*.

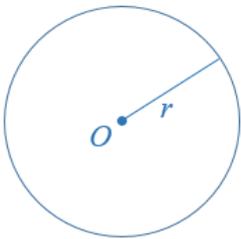
chord

A *chord* in a *circle* is a *line segment* joining any two *points* on the *circle*. Chord PQ, illustrated below, joins points P and Q.



circle

A *circle*, with centre O and *radius* r , is the set of all *points* on a *plane* whose distance from O is r .



circumference

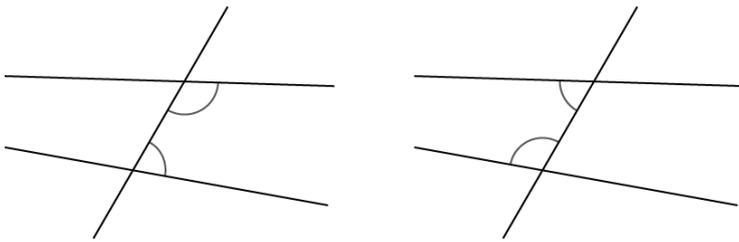
Circumference refers to the boundary of a *circle*. The length of the circumference c is given by $c=\pi d$, where d is the *diameter*. Alternatively, it is given by $c=2\pi r$, where r is the *radius*.

classification of angles

Angles are classified according to their size. See *acute angle*, *obtuse angle*, *reflex angle*, *right angle*, *straight angle* and *revolution*.

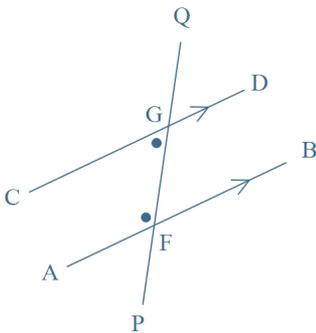
co-interior angles

Co-interior angles lie between two lines and on the same side of a *transversal*.



In each diagram the two marked *angles* are called *co-interior angles*.

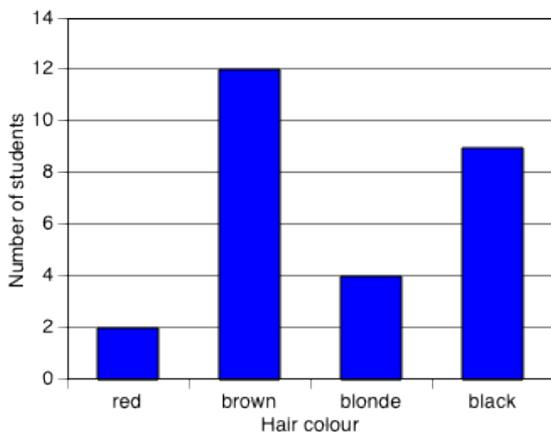
If the two lines are *parallel*, then *co-interior angles* add to give 180° and so are *supplementary*. In the diagram below the angles $\angle CGF$ and $\angle GFB$ are supplementary.



Conversely, if a pair of angles are supplementary, then the lines are *parallel*. Line segment CD is parallel to line segment AB, because $\angle CGF + \angle GFB = 180^\circ$.

column graph

A *column graph* is a graph used in statistics for organising and displaying *categorical data*. It consists of a series of equal-width rectangular columns, one for each category. Each column has a height equal to the *frequency* of the category. This is 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.

common factor

A *common factor* (or *common divisor*) of a set of numbers or *algebraic expressions* is a *factor* of each *element* of that set. For example, 6 is a common factor of 24, 54 and 66, since $24=6\times 4$, $54=6\times 9$, and $66=6\times 11$. Similarly, $x+1$ is a common factor of x^2-1 and x^2+5x+4 , since $x^2-1=(x+1)(x-1)$ and $x^2+5x+4=(x+1)(x+4)$.

commutative operations

Operations are *commutative* if the order in which terms are given does not affect the result.

The *commutative law* for addition is: $a+b=b+a$ for all numbers a and b .

For example, $3+5=5+3$.

The *commutative law* for multiplication is: $ab=ba$ for all numbers a and b .

For example, $4\times 7=7\times 4$.

Subtraction and *division* are not commutative because $5-3\neq 3-5$ and $12\div 4\neq 4\div 12$.

complementary angles

Two *angles* that add to 90° are called *complementary*; for example, 23° and 67° are *complementary angles*.

complementary events

Events A and B are complementary events if A and B are mutually exclusive (have no overlap) and $\Pr(A) + \Pr(B) = 1$, where the symbol $\Pr(A)$ denotes the probability of event A occurring.

composite number

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

compound interest

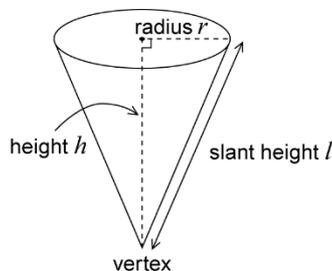
The interest earned by investing a sum of money (the principal) is *compound interest* if each successive interest payment is added to the principal for the purpose of calculating the next interest payment. For example, if the principal $\$P$ earns compound interest at the rate of $r\%$ per period, then after n periods the principal plus interest is $\$P(1+r)^n$.

computation

Computation is mathematical calculation.

cone

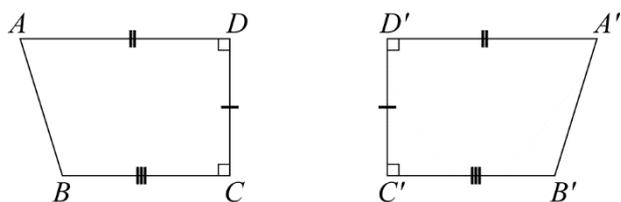
A *cone* is a *solid* that is formed by taking a *circle*, called the *base*, and a *point*, called the *vertex*, which lies above or below the *circle*, and joining the *vertex* to each point on the *circle*.



congruence

Two plane shapes are *congruent* if they are identical in size and shape and one can be moved or reflected so that it fits exactly on top of the other figure.

Matching sides have the same length, and matching *angles* have the same size.



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.

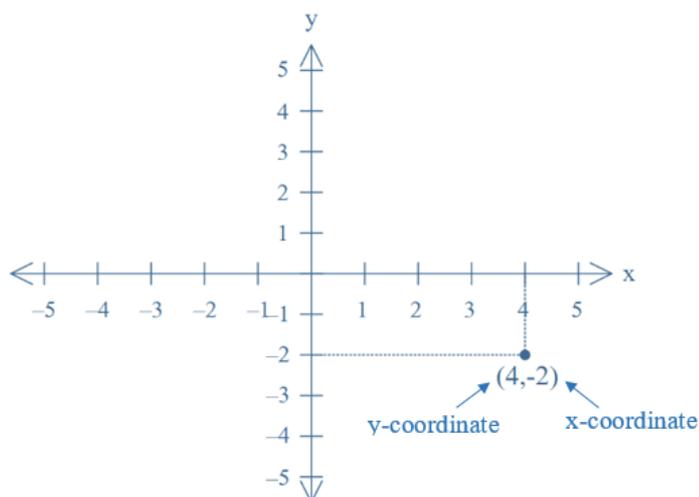
continuous numerical data

Continuous numerical data includes 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. Height, reaction time to a stimulus and systolic blood pressure are all types of continuous numerical data that can be collected.

coordinate

A *coordinate* is one value of an *ordered pair* that describes the location of a point along an *axis* in the *Cartesian plane*. By definition, the first number (*xcoordinate*) of the ordered pair denotes the horizontal distance, the second number (*ycoordinate*) gives the vertical distance from the centre (origin) of the *coordinate system*. Positive *x* coordinates indicate that the point is located to the right (East), negative to the left (West) of the origin. Positive *y* coordinates indicate a location above (North of), negative below (South of) the origin. The origin has the coordinates (0,0).

For instance, in the ordered pair (4, -2) the number 4 denotes the *x* coordinate of a point situated at a horizontal distance of 4 units to the origin. The number -2 denotes the *y* coordinate of the same point indicating a vertical distance of 2 units below the origin.

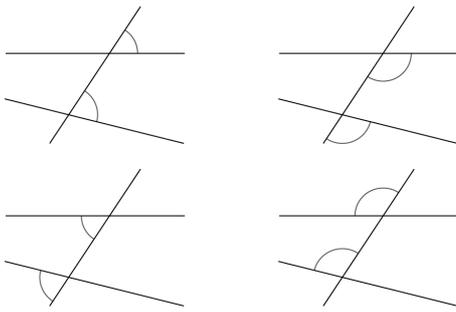


coordinate system

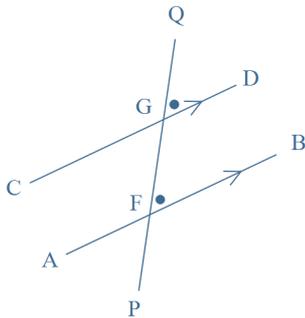
see Cartesian plane.

corresponding angles

Corresponding angles are formed when two lines are crossed by another line (the *transversal*). In each diagram the two marked *angles* are called *corresponding angles* because they are on the same side of the *transversal* and in *corresponding* positions in relation to the lines.



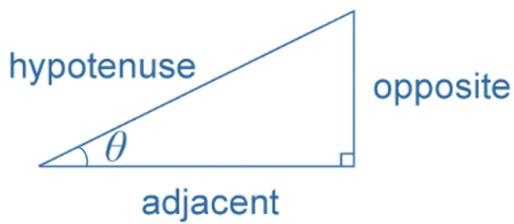
If the lines are *parallel*, then each pair of *corresponding angles* is equal (as are the angles $\angle QGD$ and $\angle GFB$ in the diagram shown below).



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

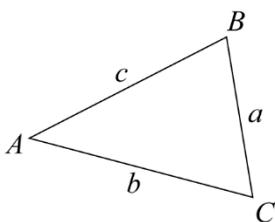
cosine

In any right-angled triangle, $\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$, where $0 < \theta < 90^\circ$.



cosine rule

In any triangle ABC , $c^2 = a^2 + b^2 - 2ab \cos C$



counting numbers

Counting numbers are the *positive integers*, that is, the numbers 1, 2, 3,

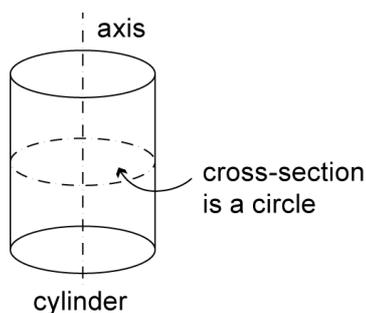
Sometimes it is taken to mean the non-negative *integers*, which include zero.

counting on

Counting on is a strategy for solving simple addition problems. For example, a student can add 6 and 4 by counting on from 6, saying '7, 8, 9, 10'. If students are asked how many more objects need to be added to a collection of 8 to give a total of 13, they can count '9, 10, 11, 12, 13' to find the answer 5.

cylinder

A *cylinder* is a *solid* that has *parallel* circular discs of equal *radius* at the ends, and whose horizontal cross-section is a *circle* with the same radius. 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 information (observations and/or measurements) collected during any type of systematic investigation.

data display

A *data display* is a visual format for organising and summarising *data*. Examples include *box plots*, *column graphs*, *frequency tables*, *scatter plots*, and *stem plots*.

decimal

A *decimal* is a numeral in the decimal number system, which is the place-value system most commonly used for representing *real numbers*. In this system 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 of 10; for example, the number represented by the decimal 123.45 is the sum

$$1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0 + 4 \times 10^{-1} + 5 \times 10^{-2}$$

$$= 1 \times 100 + 2 \times 10 + 3 \times 1 + 4 \times 10^{-1} + 5 \times 10^{-2}$$

The digits after the decimal point can be terminating or non-terminating. A *terminating decimal* is a *decimal* that contains a finite number of digits, as shown in the example above. A decimal is non-terminating, if it has an infinite number of digits after the decimal point. Non-terminating decimals may be recurring, that is, contain a pattern of digits that repeats indefinitely after a certain number of places. For example, the fraction $\frac{1}{3}$, written in the decimal number system, results in an infinite sequence of 3s after the decimal point. This can be represented by a dot above the recurring decimal.

$$\frac{1}{3} = 0.333333\dots = 0.\dot{3}$$

Similarly, the fraction $\frac{1}{7}$ results in a recurring group of digits, which is represented by a bar above the whole group of repeating digits

$$\frac{1}{7} = 0.142857142857142857\dots = 0.14285\overline{7}$$

Non-terminating decimals may also be non-recurring, that is the digits after the decimal point never repeat in a pattern. This is the case for irrational number, such as pi, e, or $\sqrt{2}$. For example,

$$\pi = 3.1415926535897932384626433832795028841971693993751058209749\dots$$

Irrational numbers can only be approximated in the decimal number system.

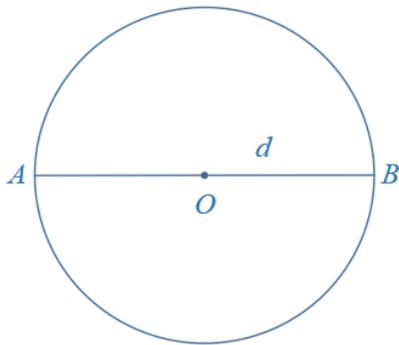
denominator

In any *fraction* in the form $\frac{a}{b}$, *b* is the *denominator*. It represents the number of equal parts into which the whole has been divided. For example, in the diagram below, a rectangle has been divided into 5 equal parts. Each of those parts is one fifth of the whole and corresponds to the *unit fraction* $\frac{1}{5}$.



diameter

A *diameter* is a *chord* that passes through the centre of a circle. The word *diameter* is also used to refer to the length of the *diameter*. The diameter *d* of the circle below is represented by *line segment AB*.



difference

A *difference* is the result of subtracting one number or algebraic quantity from another. For example, the difference between 8 and 6 is 2, written as $8-6=2$.

distributive

Multiplication of numbers is said to be '*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. For example, the product of 3 with $4+5$ gives the same result as the sum of 3×4 and 3×5 :

$$3\times 4+5=3\times 9=27 \text{ and } 3\times 4+3\times 5=12+15=27$$

This *distributive law* is expressed algebraically as follows:

$$ab+bc=ab+bc, \text{ for all numbers } a, b \text{ and } c.$$

divisible

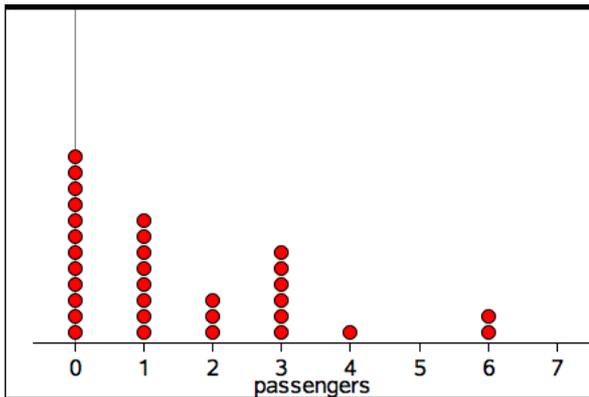
In general, a number or *algebraic expression* x is *divisible* by another y , if there exists a number or algebraic expression q of a specified type for which $x=yq$.

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 *categorical data* or discrete *numerical data*.

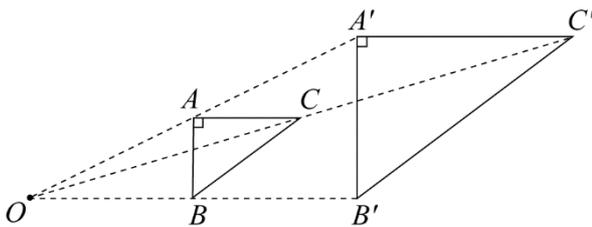
The dot plot below displays the number of passengers observed in 32 cars stopped at a traffic light.



enlargement

An *enlargement* is a scaled up (or down) version of a figure so that the new 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 have the same probability of occurring. For example, in tossing a fair coin, the *outcome* 'head' and the *outcome* 'tail' are *equally likely*. In this situation,

$$\text{Pr}(\text{head}) = \text{Pr}(\text{tail}) = 0.5.$$

equation

An *equation* is a statement that asserts that two mathematical *expressions* are equal in value. An equation must include an equal sign.

Examples of equations are $3+14=6+11$ or $2x+ 5=21$.

equivalent fractions

Equivalent fractions are alternative ways of writing the same fraction; for example, $\frac{12}{24}=\frac{36}{72}$... Two *fractions* $\frac{a}{b}$ and $\frac{c}{d}$ are equivalent, if they are equal in value, that is, if $ad=bc$.

estimate

To estimate is to judge the value, number, or quantity of a calculation roughly.

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

An *even number* is an *integer* that is *divisible* by 2. The even numbers are ..., -4, -2, 0, 2, 4, ...

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'.

exponential function

An *exponential function* is a *function* where the *independent variable* is in the exponent (or *index*), that is, in the simplest form, $f(x) = ax$, where a is a positive *real number* not equal to zero.

expression

An *expression* refers to two or more numbers or *variables* connected by *operations*. For example, $17 - 9$, $8 \times (2 + 3)$, $2a + 3b^2$ are all expressions. Expressions do not include an equal sign.

factor

Numbers or *algebraic expressions* are *factors* (or *divisors*) of another number if they multiply to give that number. For example, 3 and 4 are factors of 12 as $3 \times 4 = 12$. This can be written algebraically as

x and y are factors of m , if $m = xy$.

For polynomial expressions the same rule applies. For example, $x - 4$ and $x - 2$ are factors of the quadratic expression $x^2 - 6x + 8$ because $(x - 4)(x - 2) = x^2 - 6x + 8$.

factor and remainder theorem

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

This follows from the more general *remainder theorem*, which states that the *remainder* of the division of a polynomial $p(x)$ by a linear polynomial $x-a$ is equal to $p(a)$. This relationship is often stated in the form $p(x)=q(x)(x-a)+p(a)$, where $q(x)$ is another polynomial, usually referred to as the quotient. It follows that, 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 .

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: $15=3\times 5$.

x^2-3x+2 is factorised when written as a product: $x^2-3x+2=(x-1)(x-2)$.

five-number summary

A *five-number summary* is a method of summarising a data set using five *statistics*: the minimum value, the lower *quartile*, the *median*, the upper *quartile* and the maximum value. *Box plots* are a useful method of graphically depicting five-number summaries.

fraction

The *fraction* $\frac{a}{b}$ (written alternatively as a/b), where a and b are *integers* unequal to zero. For example, $\frac{3}{5}$ refers to 3 of 5 equal parts of the whole.

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

frequency

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. 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 any one of the numbers 0, 1, 2, 3, 4 or 5.

The relative frequency is given by the ratio 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 distribution

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 the form of a *frequency table*, a *two-way-table* or in graphical form.

frequency table

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

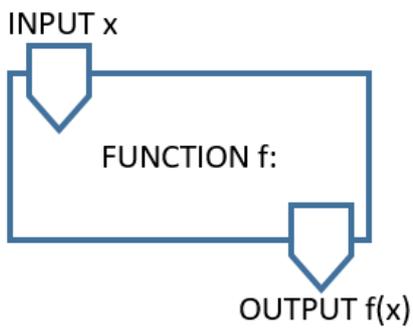
The frequency distribution of the heights (in cm) of a sample of 46 people is displayed in the form of a frequency table below.

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
190-195	5

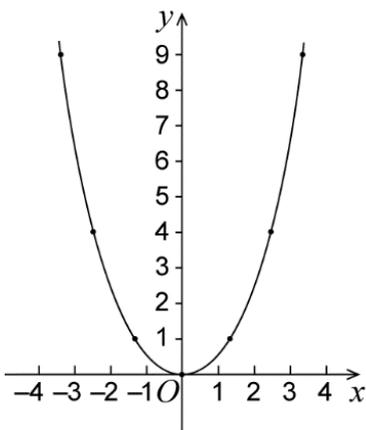
The information in a frequency table can also be displayed graphically in the form of a *histogram* or using a *column graph*.

function

A *function* f assigns to each *element* of a set of input values (called the domain) precisely one element of a set of output values (called the range). In mathematical modelling, the *independent variable* is usually chosen as the input values for the function. The output values then represent the dependent variable.



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 . The graph of this function is shown below.

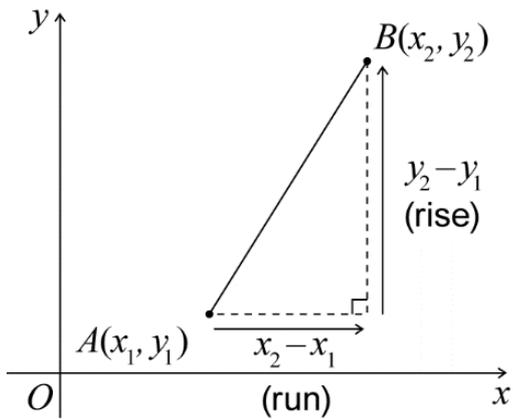


gradient

The gradient of a line is sometimes also called a *slope* and is a measure of how steeply a line is rising or falling.

If $A(x_1, y_1)$ and $B(x_2, y_2)$ are *points* on the plane, the *gradient* of the *line segment* AB is given by

$\text{gradient} = \frac{y_2 - y_1}{x_2 - x_1}$, provided that $x_2 - x_1 \neq 0$.

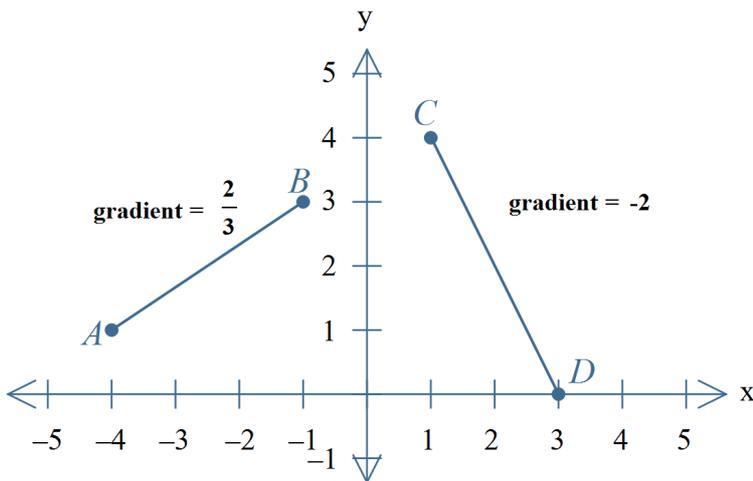


The gradient of a line is the gradient of any line segment within the line.

Gradients can be positive or negative, indicating whether the line is increasing or decreasing from left to right. The graph below shows two examples:

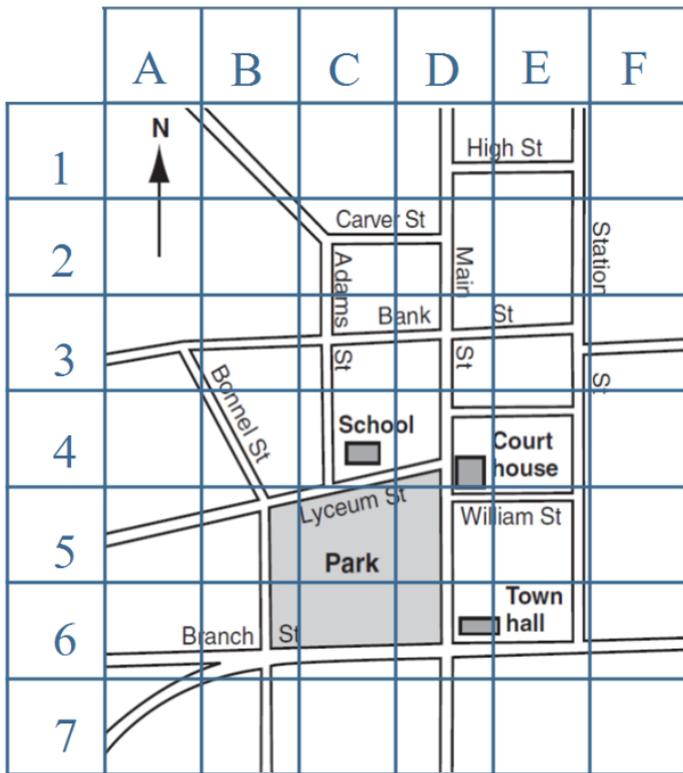
$$\text{gradient}_{AB} = 3 - 1 - 1 - (-4) = 23$$

$$\text{gradient}_{CD} = 0 - 43 - 1 = -42 = -2$$



grid reference

A *grid reference* identifies a region on a map. *Coordinates* and gridlines are used to refer to specific features or locations. For example, in the map below, the school is located at the grid reference C4.

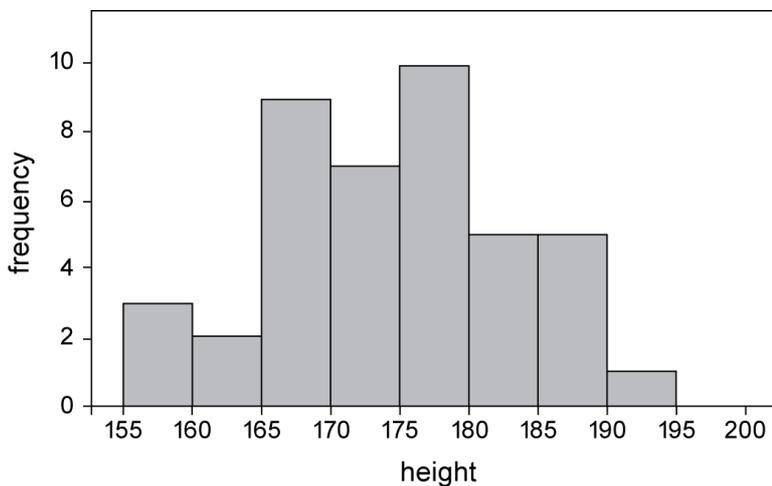


histogram

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

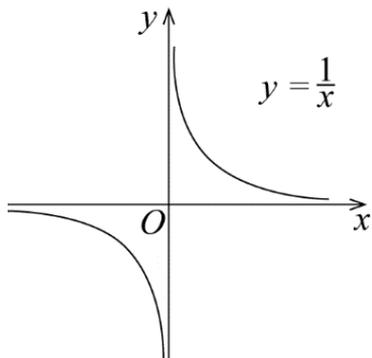
A histogram is a graphical representation of the information contained in a frequency table. In a histogram, class frequencies are represented by the areas of rectangles centred on each class *interval*. The class frequency is *proportional* to the rectangle's height when the class intervals are all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



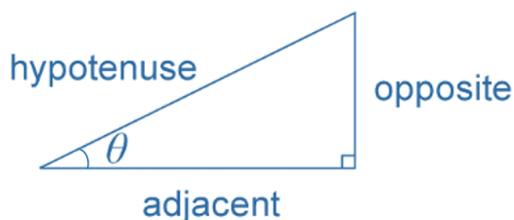
hyperbola

A *hyperbola* is the graph of a curve in two parts separated by straight lines called asymptotes. The simplest example is the graph of $y=1/x$, $x \neq 0$, called a *rectangular hyperbola*.



hypotenuse

The hypotenuse is the side opposite the *right angle*. It is also always the longest side in a *right-angled triangle*.



image

In geometry, an *image* refers to the result of a *transformation* of a figure.

independent and dependent variables

In mathematical modelling, the independent variable is a measurable or observable quantity that has a relation to (or a causal effect on) one or more other quantities, called the dependent variables.

For example, a scientific investigation considers the relationship between the amount of water supplied and the growth of a plant. It is assumed that there is a causal link between the two quantities. A choice is made to make the amount of water the independent variable, because it is the quantity whose effect is to be investigated, thus making the growth of the plant the dependent variable.

When graphing the results of such an investigation, the convention is to display the independent variable (the amount of water) on the horizontal axis and the dependent variable (the growth of the plant) on the vertical axis.

independent event

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

index laws

Index laws are rules for manipulating *indices*. They include

$$x^a x^b = x^{a+b}; \quad x^a = x^a$$

$$x^a y^a = x^a y^a$$

and

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

index notation

When the product of $a \times a \times a$ is written as a^3 , the number 3 is called the *index*, often also referred to as the 'power' or the 'exponent'.

indices

(plural) See *index*.

inequality

An *inequality* is a statement that one number or algebraic expression is less than (or greater than) another. There are five 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 $a \leq b$

a is greater than or equal to b is written $a \geq b$.

a is unequal to b is written $a \neq b$.

informal unit

Informal units are not part of a standardised system of units for measurement; for example, an informal unit for length could be 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*” including those with negative sign $\dots -3, -2, -1, 0, 1, 2, 3 \dots$. In Latin, the word *integer* means “whole.” The set of integers is usually denoted by 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 quartile (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 *subset* of the *number line*.

irrational number

An *irrational number* is a *real number* that is not *rational*, that means, it cannot be represented as a *fraction*. Some commonly used irrational numbers are π , e and $2^{\sqrt{2}}$.

Decimal representations of irrational numbers are non-terminating. For example, the Euler Number e is an irrational real number whose *decimal expansion* begins

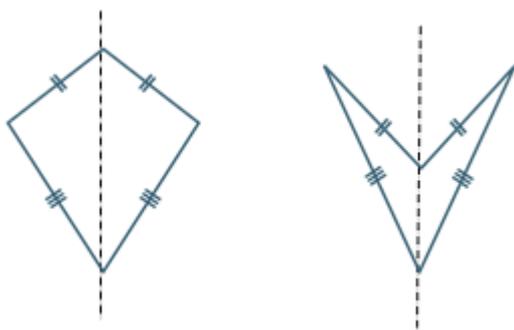
$e = 2.718281828\dots$

irregular shape

An *irregular shape* is a shape where not all sides and angles are equal in length or magnitude. By contrast, a *regular shape* has sides and *angles* that are equal in length and magnitude; for example, a square is a regular shape, while a scalene triangle 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 *symmetry* of the kite is shown.

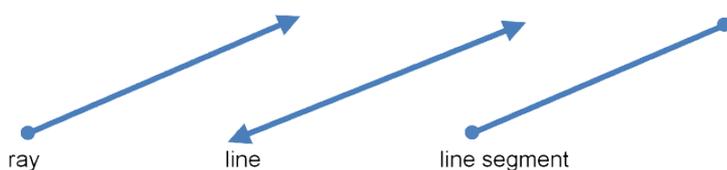
leading term

The *leading term* of a *polynomial* is the term that contains the variable raised to the highest power. For example, in the polynomial $3x^2-5x+2$, the leading term is $3x^2$.

line

In geometry, a *line* extends infinitely in both directions.

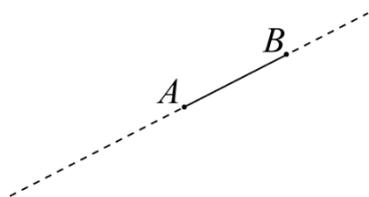
A line is different from a *ray* (which extends from a point toward infinity) and a *line segment* (which extends between two points). Lines are depicted with arrow heads on both ends to distinguish them from rays and line segments.



line segment

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 length of AB .



linear equation

A *linear equation* is an *equation* involving just linear terms, that is, no variables are raised to a power greater than one. The general form of a linear equation in one *variable* is $ax+b=0$, where a and b cannot both be 0. The solution of a linear equation in general form is $x=-\frac{b}{a}$.

A linear equation with two variables takes the general form $ax+by+c=0$, where a and b cannot both be 0. If $a \neq 0$, then the point where the line intersects the x -axis (the x -intercept) is $-\frac{c}{a}$.

If $b \neq 0$, then the point where the line intersects the y -axis (the y -intercept) is $-\frac{c}{b}$.

Two-variable, or two-dimensional linear equations also come in the form $y=mx+b$. The constant m indicates the *gradient* or slope of a line, while b represents the y -intercept.

location

In 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, the statements $\log_b x = y$ and $b^y = x$ are equivalent in the sense that both statements express the identical relationship between x , y and b . For example, $\log_{10} 100 = 2$ because $10^2 = 100$, and $\log_2 132 = -5$ because $2^{-5} = \frac{1}{32}$.

mass

Mass is the measure of how much matter is in a person, object, or substance. Mass is measured in grams, kilograms, tonnes, ounces, or pounds. It is distinct from weight, which refers to the amount of gravitational force acting on matter. If you travelled to Mars, your mass would be the same as it was on Earth, but your weight would be less due to the weaker gravitational force on Mars.

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

measures of central tendency

In statistics, the term *measures of central tendency* refers to different methods of calculating typical values (commonly called averages) within a *set*. The most commonly used measures of central tendency are the *mean*, *median*, and *mode*.

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.

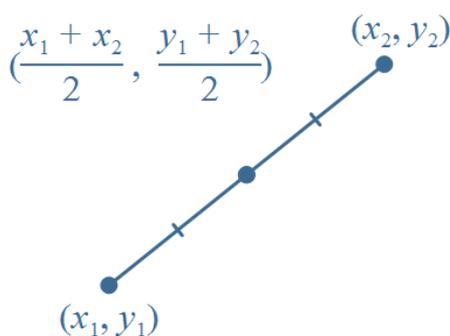
1 3 3 4 5 6 8 9 9 10

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* AB , which extends between points A and B , is the point that divides the segment into two equal parts.

If $A(x_1, y_1)$ and $B(x_2, y_2)$ are points on a *Cartesian plane*, then the midpoint M of the line segment AB has coordinates $\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}$.



mode

The *mode* is a measure calculated by identifying the value that appears with greatest *frequency* in a *set of data*. If two numbers occur in a set with equal frequency, the set is said to contain *bimodal data*. If there are more than two numbers in a set that occur with equal frequency, the set is said to contain *multimodal data*. The mode of the set {1, 2, 3, 4, 4, 5} is 4. In the set {1, 2, 2, 4, 5, 7, 7}, the modes are both 2 and 7, making the set 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.

multimodal data

Multimodal data is *data* whose distribution has more than two *modes*.

multiples

A *multiple* of a whole 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 $13.5=-7\times 1.5$.

natural number

A *natural number* can refer either to a *positive integer* (which excludes negative numbers and zero) or a *counting number* (which excludes negative numbers but includes zero). The *set* of natural numbers is usually denoted by N .

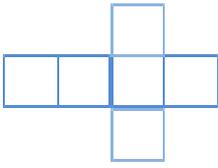
negative integer

A *negative integer* is any *integer* whose value is below zero. That is, -1, -2, -3, -4, -5, -6 ...

net

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

One possible net for a cube is shown



non-monic

A *polynomial* in one variable is said to be *non-monic*, if the *coefficient* of the *leading term* is unequal to one. For example, $2x^3+2x^2+3x-4$ is a non-monic polynomial, whereas x^3+2x^2+3x-4 is a monic polynomial.

non-negative integers

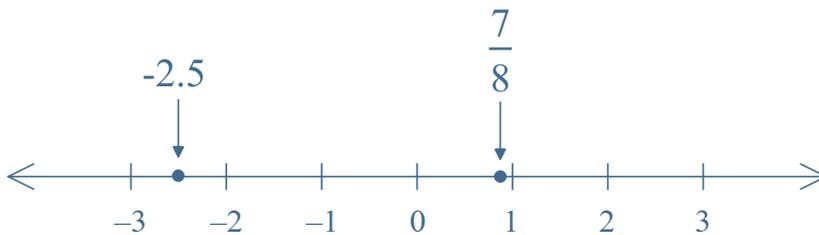
A *non-negative integer* is an *integer* that is not negative, and is either zero or positive. It differs from a *positive integer*, which excludes zero. Non-negative integers are 0, 1, 2, 3, 4, 5...

non-zero whole numbers

Non-zero whole numbers are *whole numbers* that explicitly exclude zero. Non-zero whole numbers are 1, 2, 3, 4, 5, 6 ...

number line

A *number line*, like the one below, gives a pictorial representation of *real numbers*. An example is given below depicting the location of a negative decimal and a positive fraction.



number sentence

A *number sentence* is typically an equation or inequality expressed using numbers and common symbols; for example, $10 + 10 = 3 + 7 + 5 + 5$ could describe a situation where 2 packets of 10 coloured pens contained 3 red, 7 green, 5 yellow and 5 white.

numeral

A *numeral* is a figure or symbol used to represent a number; for example, -3, 0, 45, IX, π .

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.

obtuse angle

An *obtuse angle* is bigger than 90° but smaller than 180° .

odd number

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

operation

Operation is the process of combining numbers or expressions. In the primary years, operations include addition, subtraction, multiplication, and division. In later years, operations include, for instance, raising to a power, taking the logarithm, and more complex operations, such as integration.

order of operations

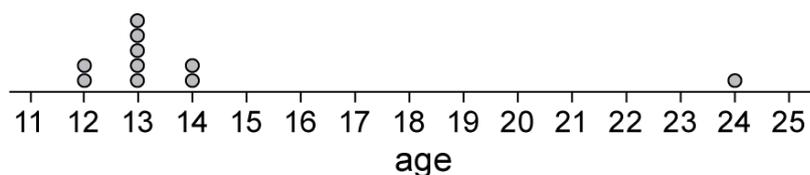
Order of operations refers to a collection of rules for simplifying expressions. It stipulates that calculations in brackets must be made first, followed by calculations involving *indices* (*powers*, *exponents*), then multiplication and division (working from left to right), and lastly, addition and subtraction (also in order from left to right); for example, in $5-6\div 2+7$, the division is performed first and the expression becomes $5-3+7=9$. If the convention is ignored and the *operations* are performed in the order they are written, the incorrect result, 6.5 is obtained.

ordered pair

In mathematics, an *ordered pair* is a collection of two numbers whose order is significant. Ordered pairs are used to describe the location of a point in the *Cartesian plane*.

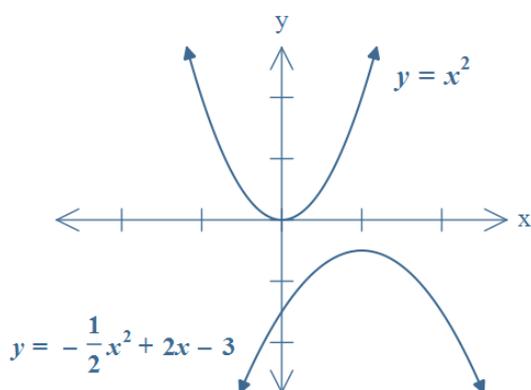
outlier

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



parabola

In algebra, a parabola is the graph of a function of the general form $y=ax^2+bx+c$, where a , b and c are real numbers and $a \neq 0$. Two examples of parabolas are shown below.

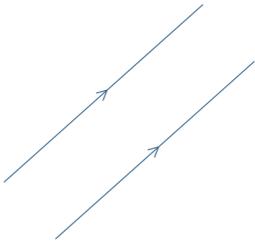


parallel

Parallel lines are *lines* in a plane which do not intersect or touch each other at any point. Parallel lines can never intersect, even if they were to continuously extend toward infinity.

Two lines are parallel, if they have the same *gradient* (or *slope*).

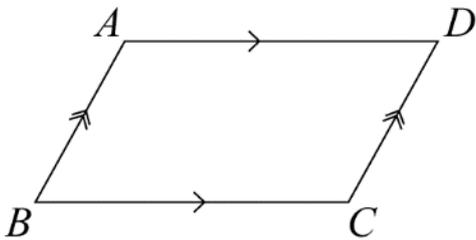
The lines below are parallel to one another, as indicated by the use of the arrow signs. In text, the symbol $//$ is used to denote parallel lines; for example, $a // b$ is read as "line a is parallel to line b ".



parallelogram

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

Thus the quadrilateral $ABCD$ shown below is a parallelogram because $AB \parallel DC$ and $AD \parallel BC$.



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

Partitioning means 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, such as, 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 6/100.

Similarly, 40 as a percentage of 250 is $40 \div 250 \times 100 = 16\%$.

percentile

Percentiles are the 99 *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.

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.

Percentiles are often used to report comparative test results. A student who scores in the 90th percentile for a given test has scored higher than 90% of other students who took the test. A student who scores in the 10th percentile would have scored better than only 10% of students who took the test.

perimeter

The *perimeter* of a plane figure is the length of its boundary. The perimeter of a figure can be calculated by adding the lengths of all its sides.

perpendicular

In geometry, two lines are said to be *perpendicular* to each other, if they meet at a *right angle* (90 degrees).

Pi

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 227 is a *rational* approximation. The decimal expansion of π begins:

$\pi=3.141\ 592\ 653\ 589\ 79\dots$

picture graphs

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

Ball sports played by students in Year 4

Football	   
Basketball	  
Netball	    
Soccer	 
Rugby	  
Hockey	 

Key  = 10 Students

place value

Place value refers to the value of a 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 610 of a one or 6 tenths.

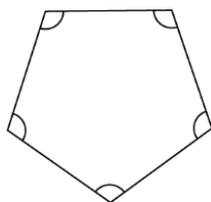
point

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

polygon

A *polygon* is a plane figure bounded by three or more *line segments*. The word derives from Greek *polys* “many” and *gonia* “angle”.

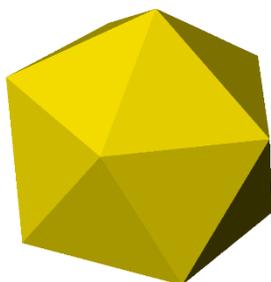
The regular pentagon shown below is an example of a polygon. It is called a pentagon because it has five sides (and five angles). It is called regular because all sides have equal length and all interior angles are equal.



polyhedron

A *polyhedron* is a *three-dimensional object*, or a *solid*, which consists of a collection of *polygons*, joined at their edges and making up the faces of the solid. The word derives from Greek *polys* “many” and *hedra* “base” or “seat”.

The solid below is an example of a polyhedron (called an icosahedra and consisting of 20 faces).



polynomial

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

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

The term that contains the variable x raised to the highest power, that is a_nx^n , is called the *leading term*.

The numbers a_0,a_1,\dots,a_n are called the *coefficients* of the terms. Coefficients include the preceding sign.

For example, in the polynomial $3x^2-5x+2$, the leading term is $3x^2$ and the coefficient of the second term is -5 .

population

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

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

positive integer

A *positive integer* is an *integer* that excludes negative numbers and zero. Positive integers are 1, 2, 3, 4, 5, 6,

primary data

Primary data is original *data* collected by the user. Primary data might include data obtained from interviews the user has conducted herself, or observations the user has made during an experiment.

prime factor

A *prime factor* of a number is a *factor* of that number which is prime.

prime number

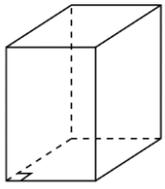
A *prime number* is a *natural number* greater than 1 that has no *factor* other than 1 and itself.

prism

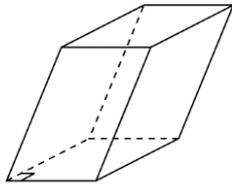
A *prism* is a *polyhedron* that has two *congruent* and *parallel* faces and all its remaining faces are *parallelograms*.

A right *prism* is a *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*.

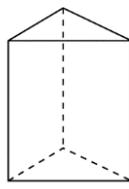
Some examples of prisms are shown below.



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 that event 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 $x + y$.

proof

A *proof* is a rigorous mathematical argument that demonstrates the truth of a given proposition. A mathematical statement that has been established by means of a proof is called a *theorem*.

proportion

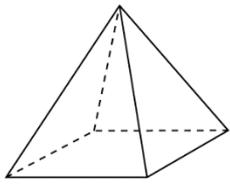
Two quantities are in *proportion*, if there is a constant *ratio* between them.

protractor

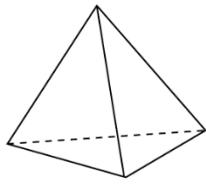
A *protractor* is an instrument for measuring *angles*. It uses degrees as the unit of measurement and is commonly in the shape of a semi-circle (180°) or circle (360°).

pyramid

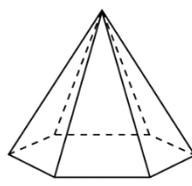
A *pyramid* is a *polyhedron* with a *polygonal* base and triangular sides that meet at a *point* called the *vertex*. The pyramid is named according to the shape of its base.



square-based pyramid



triangular-based pyramid



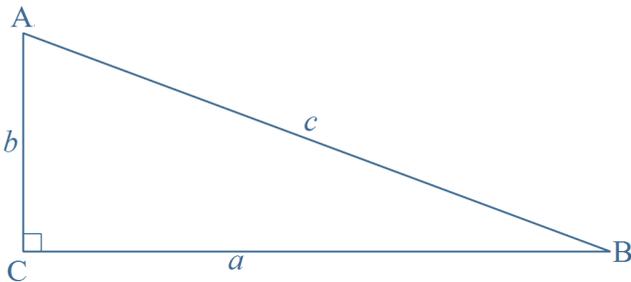
hexagonal-based pyramid

Pythagoras' theorem

Pythagoras' theorem states that 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, $c^2 = a^2 + b^2$.

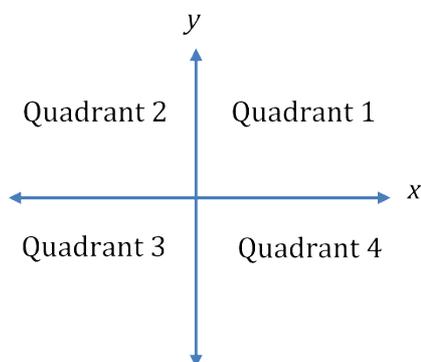


The converse

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

quadrant

Quadrant refers to the four sections of the *Cartesian plane* created through the intersection of the x and y-axes. They are numbered 1 through 4, beginning with the top right quadrant and moving counter clockwise around the plane. Each of the four quadrants is labelled on the plane below.



quadratic equation

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

The solutions 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 *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 $x^2+2xy+y^2-2x+y+5$.

quadrilateral

A *quadrilateral* is a polygon with four sides.

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 values is a *multiple* of four.

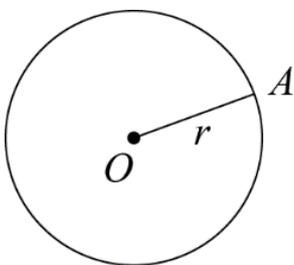
There are three quartiles. The first, the *lower quartile* (Q_1) divides off (approximately) the lower 25% of data values. The second quartile (Q_2) is the *median*. The third quartile, the *upper quartile* (Q_3), divides off (approximately) the upper 25% of data values.

quotient

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

radius

The *radius* of a *circle* (r) is the distance from its centre to any *point* (A) on its *perimeter*, and is equal to half of the circle's *diameter*.



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

random number

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

random sample

A sample is called a *random sample* (or a *simple random sample*), if it is selected from a *population* at random. That is, all the *elements* of the population had an equal *probability* of being included in the sample.

range

In 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.

ratio

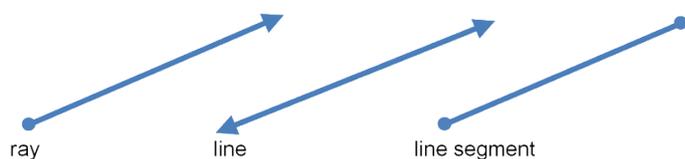
A *ratio* is a *quotient* of two numbers, magnitudes, or *algebraic expressions*. It is often used as a measure of the relative size of two objects; for example, the ratio of the length of a side of a square to the length of a diagonal is 1:2 that is, 1/2.

rational numbers

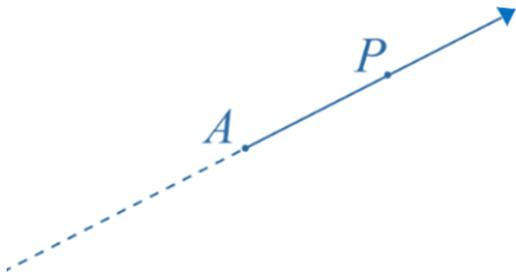
The *rational numbers* are the set of all numbers that can be expressed as fractions, that is, as quotients of two *integer values*. The *decimal* expansion of a rational number is either *terminating* or *recurring*.

ray

A *ray* is the part of a *line* that starts at a *point* and continues in a particular direction to infinity. Rays are usually depicted with an arrow head, which indicates the direction in which the line continues to infinity.



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*) and extends toward infinity. The point *A* is called the *vertex* of the ray.



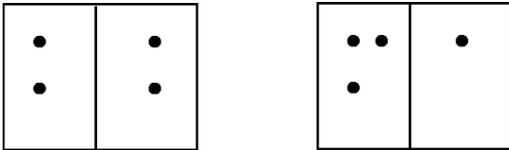
real number

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 $b > a$.

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*, while irrational numbers can only be approximated in the decimal number system.

rearranging parts

Rearranging parts refers to moving counters, numbers, etc., in order to change the visual representation of the number; for example, '4' could be represented as either of the two combinations below.

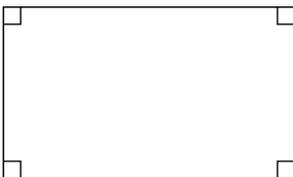


reasonableness

Reasonableness refers to how appropriate an answer is. "Does this answer make sense?" and "Does this answer sound right?" are two questions that should be asked when thinking about reasonableness.

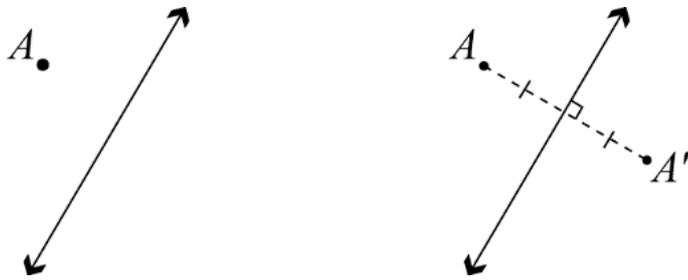
rectangle

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



reflection

To *reflect* the point A in an *axis of reflection*, a line is 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.

reflex angle

A *reflex angle* is an *angle* with a size that is larger than 180° but smaller than 360° .

regular shape

A *regular shape* has sides and *angles* that are equal in length and magnitude.

related denominators

Related denominators occur where one denominator is a *multiple* of the other; for example, the *fractions* $\frac{1}{3}$ and $\frac{1}{9}$ have related *denominators* because 9 is a multiple of 3.

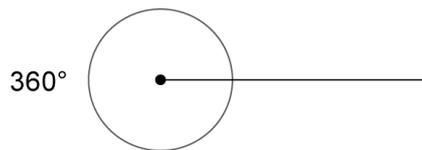
Fractions with related denominators are more easily added and subtracted than fractions with unrelated denominators, because only one needs to be rewritten; for example, to add $\frac{1}{3}$ and $\frac{1}{9}$ we can rewrite $\frac{1}{3}$ as the *equivalent fraction* $\frac{3}{9}$ and then compute $\frac{3}{9} + \frac{1}{9} = \frac{4}{9}$.

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 $68 = 6 \times 11 + 2$.

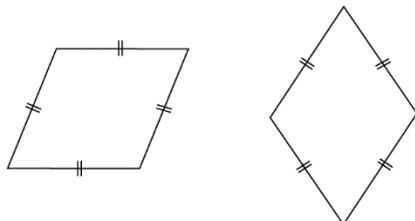
revolution

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° .



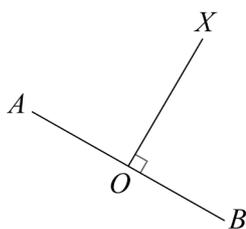
rhombus

A *rhombus* is a *quadrilateral* with all sides equal.



right angle

A *right angle* is half a *straight angle*, and so is equal to 90° .



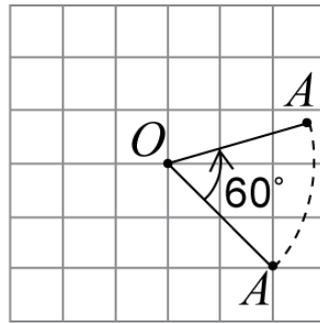
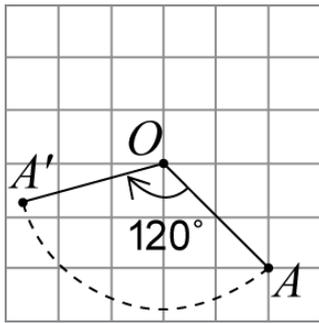
rotation

In a plane, a *rotation* is a *transformation* that 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 counter-clockwise).

In the first diagram below, the point A is rotated through 120° clockwise about O . In the second diagram, it is rotated through 60° counter-clockwise 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 or equal to 5, then 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.

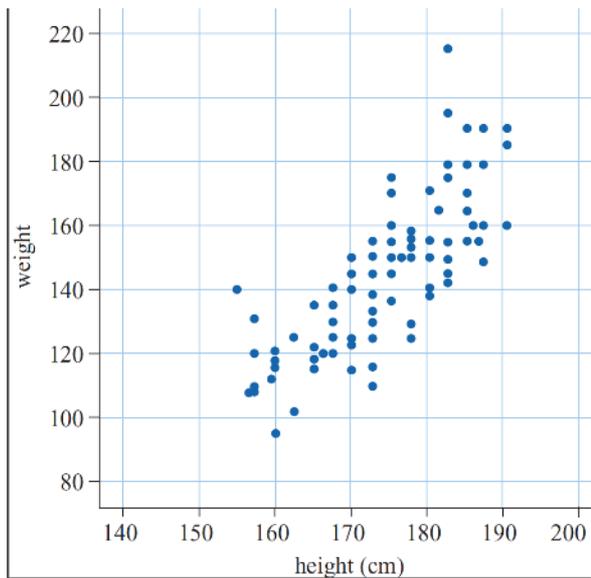
For instance, a randomly selected group of eight-year old children (the sample) might be selected to *estimate* the incidence of tooth decay in eight-year old children in Australia (the population).

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'.

scatter plots

When two *variables* are numerical then a *scatter plot* (or bivariate plot) may be constructed. This is an important tool in the analysis of *bivariate data*, and should always be examined before further analysis is undertaken. The pairs of data *points* are plotted on a *Cartesian plane*, with each pair contributing one point to the plot. The following example examines the features of the scatterplot in more detail.



Suppose we record the heights and weights of a group of 100 people. The scatterplot of those data would be 100 points. Each point represents one person's height and weight.

scientific notation

Scientific notation is a distinct way of writing numbers that are too big or too small to be written in an accessible way. Numbers are expressed as a product of the power of 10 and a *decimal* that has just one digit to the left of the decimal point; for example, the scientific notation for 34,590 is 3.459×10^4 , and the scientific notation for 0.000004567 is 4.567×10^{-6} .

Many electronic calculators will show these as 3.459E4 and 4.567E-6.

secondary data

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

sequence

A *sequence* is an ordered collection of *elements*. When written, the elements are separated by commas. Sequences can be finite (e.g., 1, 2, 3, 4), or infinite (1, 2, 3, 4, 5, 6...).

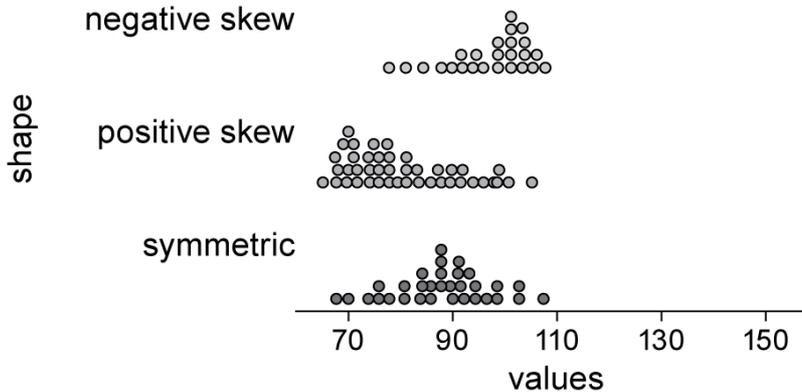
set

In probability and statistics, a *set* is a well-defined collection of objects, *events* or outcomes. Each item within a set is called an *element* of the set.

shape

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.

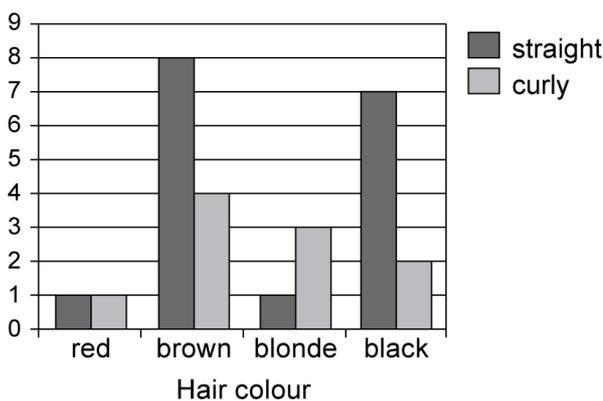


Dot plots, *histograms* and *stem plots* can all be used to investigate the shape of a data distribution.

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.



similarity

Similarity (general):

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.

Similarity (triangles):

There are four standard tests to determine if two triangles are 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.

simple interest

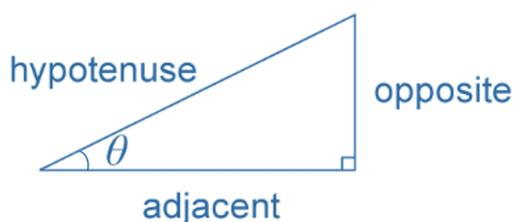
Simple interest is the interest accumulated when the interest payment in each period is a fixed fraction of the principal; for example, if the principle \$P earns simple interest at the rate of $i\%$ per period, then after n periods the accumulated simple interest is $\$Pni/100$.

simultaneous equations

Two or more *equations* form a set of *simultaneous equations* if there are conditions imposed simultaneously on all of the *variables* involved.

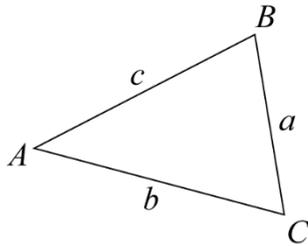
sine

In any *right-angled triangle*, the sine of an angle is defined as the length of the side opposite the angle divided by the length of the hypotenuse; $\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$, where $0^\circ < \theta < 90^\circ$.



sine rule

In any triangle ABC , $a \sin A = b \sin B = c \sin C$.



In words it says:

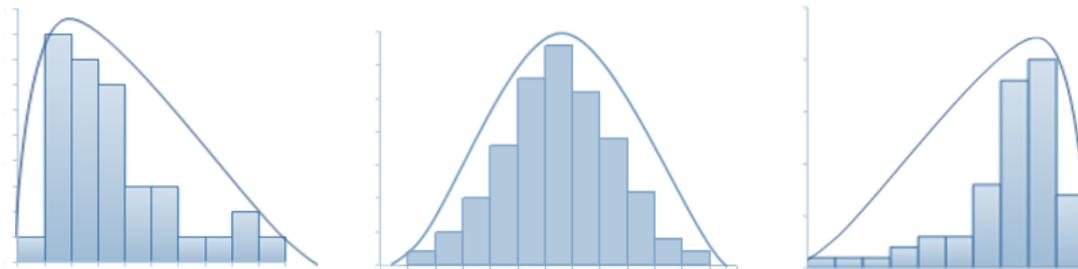
Any side of a triangle over the sine of the opposite angle equals any other side of the triangle over the sine of its opposite angle.

skewness

Skewness is a measure of asymmetry (non-symmetry) in a distribution of values about the *mean* of a *set of data*.

In the diagrams below, the histogram to the left is *positively skewed*. Data values are concentrated at the beginning of the number line, causing the graph to have a long tail to the right and a very short tail to the left. The histogram to the right is *negatively skewed*. Data values are concentrated further right along the number line, causing the graph to have a long tail to the left and a very short tail to the right. The mode, median and mean will not coincide.

When the distribution of values in a set of data is symmetrical about the mean, the data is said to have *normal distribution*. The histogram in the middle is normally distributed.



skip counting

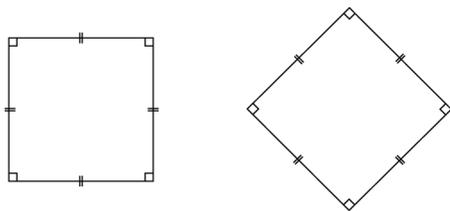
Skip counting is counting by a number that is not 1; for example, skip counting forwards by 2 would be 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 ... Skip counting backwards by 3 from 21 would be 21, 18, 15, 12, 9, 6, 3, 0.

solid

A *solid* is any *three-dimensional* geometrical figure.

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 variability 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

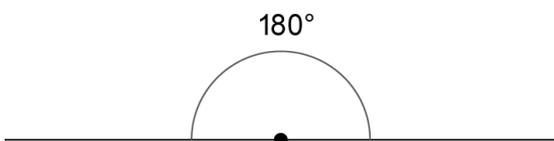
In this plot, the stem unit is '10' and the leaf unit is '1'. Thus the top row in the plot 6 | 8 8 8 9 displays pulse rates of 68, 68, 68 and 69.

stemplot

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

straight angle

A *straight angle* is half a *revolution*, and so is equal to 180° .



subitising

Subitising refers to the recognition of the number of objects in a collection without consciously counting.

subset

In probability and statistics, a *set* is a well-defined collection of objects, *events* or outcomes. Each item within a *set* is called an *element* of the set. If every element in set 1 is also in set 2, then set 1 is a *subset* of set 2.

In a *random experiment*, each *event* or outcome is a subset of the broader *sample space*.

sum

A *sum* is the result of adding together two or more numbers or *algebraic expressions*. In the *equation* $8+6=14$, the sum is 14.

supplementary

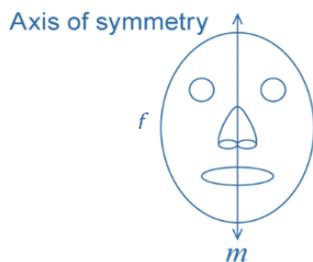
Two angles that add to 180° are called *supplementary angles*; for example, 45° and 135° are supplementary angles.

surd

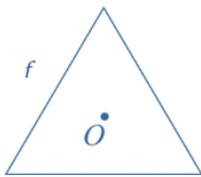
A *surd* is a numerical expression involving one or more *irrational* roots of numbers. Examples of surds include $2, 5, 3$ and $43+763$.

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.



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

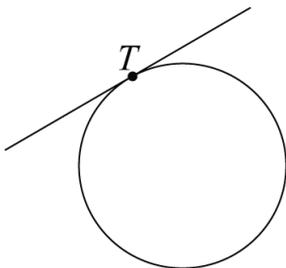


A rotation of 120° around O moves the equilateral triangle onto itself.

tangent

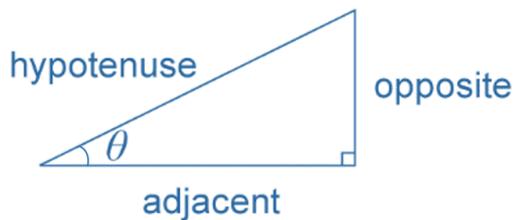
1. Plane-geometry:

In plane-geometry, 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.



2. Trigonometry:

In any *right-angled triangle*, the tangent of an angle is defined as the length of the side opposite the angle divided by the length of its adjacent side; $\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$, where $0^\circ < \theta < 90^\circ$.



theorem

A *theorem* is a mathematical statement that has been established by means of a *proof*.

three-dimensional

An object is *three-dimensional* when it possesses the dimensions of height, width and depth. *Two dimensional* objects only have two dimensions: length and width. A *solid* is any geometrical object with three-dimensions.

transformation

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

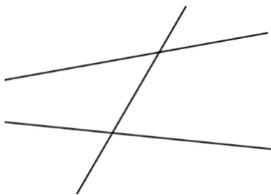
translation

Shifting a figure in the plane without turning it is called *translation*. To describe a translation in the plane, 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.

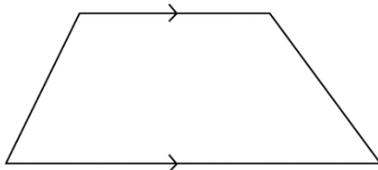
transversal

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



trapezium

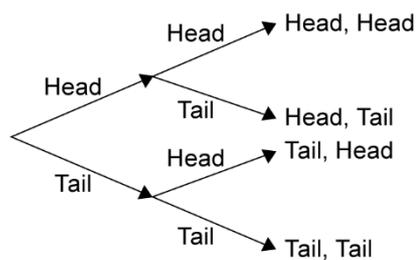
A *trapezium* is a *quadrilateral* with one pair of opposite sides *parallel*.



tree diagram

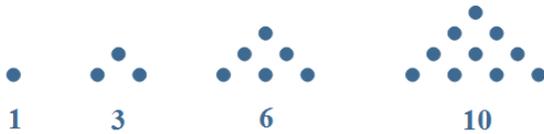
A *tree diagram* is a diagram that can be used to enumerate the outcomes of a multi-step random experiment.

The diagram below shows a tree diagram that has been used to enumerate all of the possible outcomes when a coin is tossed twice. Below 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

Trigonometric ratios describe the relationships between the *angles* and sides of right triangles. The three basic trigonometric ratios covered in this glossary are: *Sine*, *Cosine*, and *Tangent*.

two-dimensional

A shape is *two-dimensional* when it only possesses the dimensions of length and width.

two-way table

A *two-way 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).

	Curly hair	Straight hair	Total
Red hair	1	1	2
Brown hair	8	4	12
Blonde hair	1	3	4
Black hair	7	2	9
Total	17	10	27

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

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

In 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.

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

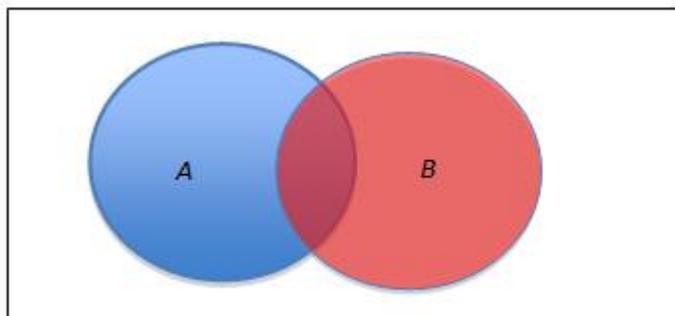
Examples include the number of children in a family or the number of days in a month.

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 $0, 1, 2, 3, \dots$ as possible values. Others are prices, measured in dollars and cents.

In algebra, a *variable* is a symbol, such as x, y or z , used to represent an unspecified number of a specific type; for example, the variable x could represent an unspecified *real number*.

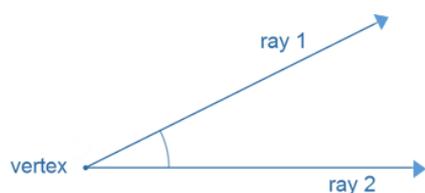
Venn diagram

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).



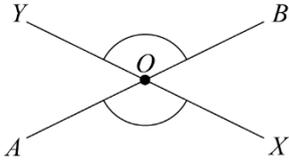
vertex

A *vertex* is the point where two *line segments* or *rays* meet, join, or intersect.



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.



Vertically opposite angles are equal

volume

The *volume* of a *solid* is a measure of the space enclosed by the solid.

For a rectangular prism, $Volume = Length \times Width \times Height$.

whole number

A *whole number* is a *non-negative integer*, that is, one of the numbers 0, 1, 2, 3, ...

Sometimes it is taken to mean only a *positive integer*.
