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, Year 10A

AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

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The Australian Curriculum
Mathematics

Mathematics - How the Subject works

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

The Australian Curriculum

Mathematics

Curriculum F-10

Foundation Year Level Description

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

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 - Scootle)

Elaborations

reading stories from other cultures featuring counting in sequence to assist students to recognise ways of counting in local languages and across cultures

identifying the number words in sequence, backwards and forwards, and reasoning with the number sequences, establishing the language on which subsequent counting experiences can be built

developing fluency with forwards and backwards counting in meaningful contexts, including stories and rhymes

understanding that numbers are said in a particular order and there are patterns in the way we say them

Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond (ACMNA002 - Scootle)

Elaborations

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

Subitise small collections of objects (ACMNA003 - Scootle)

Elaborations

using subitising as the basis for ordering and comparing collections of numbers

Compare, order and make correspondences between collections, initially to 20, and explain reasoning (ACMNA289 - Scootle)

Elaborations

comparing and ordering items of like and unlike characteristics using the words ‘more’, ‘less’, ‘same as’ and ‘not the same as’ and giving reasons for these answers

understanding and using terms such as ‘first’ and ‘second’ to indicate ordinal position in a sequence.

using objects which are personally and culturally relevant to students

Represent practical situations to model addition and sharing (ACMNA004 - Scootle)

Elaborations

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

Patterns and algebra

Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings (ACMNA005 - Scootle)

Elaborations

observing natural patterns in the world around us

creating and describing patterns using materials, sounds, movements or drawings

Measurement and Geometry

Using units of measurement

Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language (ACMMG006 - Scootle)

Elaborations

comparing objects directly, by placing one object against another to determine which is longer or by pouring from one container into the other to see which one holds more

using suitable language associated with measurement attributes, such as ‘tall’ and ‘taller’, ‘heavy’ and ‘heavier’, ‘holds more’ and ‘holds less’

Compare and order duration of events using everyday language of time (ACMMG007 - Scootle)

Elaborations

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 - Scootle)

Elaborations

choosing events and actions that make connections with students’ everyday family routines

Shape

Sort, describe and name familiar two-dimensional shapes and three-dimensional objects in the environment (ACMMG009 - Scootle)

Elaborations

sorting and describing squares, circles, triangles, rectangles, spheres and cubes

Location and transformation

Describe position and movement (ACMMG010 - Scootle)

Elaborations

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

Answer yes/no questions to collect information and make simple inferences (ACMSP011 - Scootle)

Elaborations

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 Standards

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 Level Description

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

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 - Scootle)

Elaborations

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

Recognise, model, read, write and order numbers to at least 100. Locate these numbers on a number line (ACMNA013 - Scootle)

Elaborations

modelling numbers with a range of material and images

identifying numbers that are represented on a number line and placing numbers on a prepared number line

Count collections to 100 by partitioning numbers using place value (ACMNA014 - Scootle)

Elaborations

understanding partitioning of numbers and the importance of grouping in tens

understanding two-digit numbers as comprised of tens and ones/units

Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts (ACMNA015 - Scootle)

Elaborations

developing a range of mental strategies for addition and subtraction problems

Fractions and decimals

Recognise and describe one-half as one of two equal parts of a whole. (ACMNA016 - Scootle)

Elaborations

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

Recognise, describe and order Australian coins according to their value (ACMNA017 - Scootle)

Elaborations

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

Investigate and describe number patterns formed by skip-counting and patterns with objects

(ACMNA018 - Scootle)

Elaborations

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

Measure and compare the lengths and capacities of pairs of objects using uniform informal units (ACMMG019 - Scootle)

Elaborations

understanding that in order to compare objects, the unit of measurement must be the same size

Tell time to the half-hour (ACMMG020 - Scootle)

Elaborations

reading time on analogue and digital clocks and observing the characteristics of half-hour times

Describe duration using months, weeks, days and hours (ACMMG021 - Scootle)

Elaborations

describing the duration of familiar situations such as 'how long is it until we next come to school?'

Shape

Recognise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features (ACMMG022 - Scootle)

Elaborations

focusing on geometric features and describing shapes and objects using everyday words such as 'corners', 'edges' and 'faces'

Location and transformation

Give and follow directions to familiar locations (ACMMG023 - Scootle)

Elaborations

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

Identify outcomes of familiar events involving chance and describe them using everyday language such as ‘will happen’, ‘won’t happen’ or ‘might happen’ (ACMSP024 - Scootle)

Elaborations

justifying that some events are certain or impossible

Data representation and interpretation

Choose simple questions and gather responses and make simple inferences (ACMSP262 - Scootle)

Elaborations

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 - Scootle)

Elaborations

understanding one-to-one correspondence

describing displays by identifying categories with the greatest or least number of objects

Year 1 Achievement Standards

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 Level Description

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

Investigate number sequences, initially those increasing and decreasing by twos, threes, fives and tens from any starting point, then moving to other sequences (ACMNA026 - Scootle)

Elaborations

developing fluency and confidence with numbers and calculations by saying number sequences

recognising patterns in number sequences, such as adding 10 always results in the same final digit

Recognise, model, represent and order numbers to at least 1000 (ACMNA027 - Scootle)

Elaborations

recognising there are different ways of representing numbers and identifying patterns going beyond 100

developing fluency with writing numbers in meaningful contexts

Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting (ACMNA028 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Recognise and interpret common uses of halves, quarters and eighths of shapes and collections (ACMNA033 - Scootle)

Elaborations

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

Count and order small collections of Australian coins and notes according to their value (ACMNA034 - Scootle)

Elaborations

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

Describe patterns with numbers and identify missing elements (ACMNA035 - Scootle)

Elaborations

describing a pattern created by skip counting and representing the pattern on a number line

investigating features of number patterns resulting from adding twos, fives or 10s

Solve problems by using number sentences for addition or subtraction (ACMNA036 - Scootle)

Elaborations

representing a word problem as a number sentence

writing a word problem to represent a number sentence

Measurement and Geometry

Using units of measurement

Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units (ACMMG037 - Scootle)

Elaborations

comparing lengths using finger length, hand span or a piece of string

comparing areas using the palm of the hand or a stone comparing capacities using a range of containers

Compare masses of objects using balance scales (ACMMG038 - Scootle)

Elaborations

using balance scales to determine whether the mass of different objects is more, less or about the same, or to find out how many marbles are needed to balance a tub of margarine or a carton of milk

Tell time to the quarter-hour, using the language of 'past' and 'to' (ACMMG039 - Scootle)

Elaborations

describing the characteristics of quarter-past times on an analogue clock, and identifying that the small hand is pointing just past the number and the big hand is pointing to the three

Name and order months and seasons (ACMMG040 - Scootle)

Elaborations

investigating the seasons used by Aboriginal people, comparing them to those used in Western society and recognising the connection to weather patterns.

Use a calendar to identify the date and determine the number of days in each month (ACMMG041 - Scootle)

Elaborations

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

Describe and draw two-dimensional shapes, with and without digital technologies (ACMMG042 -

Scootle)

Elaborations

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 - Scootle)

Elaborations

identifying geometric features such as the number of faces, corners or edges

Location and transformation

Interpret simple maps of familiar locations and identify the relative positions of key features (ACMMG044 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Identify practical activities and everyday events that involve chance. Describe outcomes as ‘likely’ or ‘unlikely’ and identify some events as ‘certain’ or ‘impossible’ (ACMSP047 - Scootle)

Elaborations

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

Identify a question of interest based on one categorical variable. Gather data relevant to the question (ACMSP048 - Scootle)

Elaborations

determining the variety of birdlife in the playground and using a prepared table to record observations

Collect, check and classify data (ACMSP049 - Scootle)

Elaborations

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 - Scootle)

Elaborations

creating picture graphs to represent data using one-to-one correspondence

comparing the usefulness of different data displays

Year 2 Achievement Standards

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 Level Description

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

Investigate the conditions required for a number to be odd or even and identify odd and even numbers (ACMNA051 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

establishing multiplication facts using number sequences

Represent and solve problems involving multiplication using efficient mental and written strategies and appropriate digital technologies (ACMNA057 - Scootle)

Elaborations

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

Model and represent unit fractions including 1/2, 1/4, 1/3, 1/5 and their multiples to a complete whole (ACMNA058 - Scootle)

Elaborations

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

Represent money values in multiple ways and count the change required for simple transactions to the nearest five cents (ACMNA059 - Scootle)

Elaborations

recognising the relationship between dollars and cents, and that not all countries use these denominations and divisions (for example Japanese Yen)

Patterns and algebra

Describe, continue, and create number patterns resulting from performing addition or subtraction (ACMNA060 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

Elaborations

creating a map of the classroom or playground

Identify symmetry in the environment (ACMMG066 - Scootle)

Elaborations

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 - Scootle)

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

Conduct chance experiments, identify and describe possible outcomes and recognise variation in results (ACMSP067 - Scootle)

Elaborations

conducting repeated trials of chance experiments such as tossing a coin or drawing a ball from a bag and identifying the variations between trials

Data representation and interpretation

Identify questions or issues for categorical variables. Identify data sources and plan methods of data collection and recording (ACMSP068 - Scootle)

Elaborations

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?')

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 - Scootle)

Elaborations

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

Interpret and compare data displays (ACMSP070 - Scootle)

Elaborations

comparing various student-generated data representations and describing their similarities and differences

Year 3 Achievement Standards

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 Level Description

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

Investigate and use the properties of odd and even numbers (ACMNA071 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Investigate equivalent fractions used in contexts (ACMNA077 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Solve problems involving purchases and the calculation of change to the nearest five cents with and without digital technologies (ACMNA080 - Scootle)

Elaborations

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

Explore and describe number patterns resulting from performing multiplication (ACMNA081 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (ACMMG084 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

identifying and using the correct operation for converting units of time

Use ‘am’ and ‘pm’ notation and solve simple time problems (ACMMG086 - Scootle)

Elaborations

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

Compare the areas of regular and irregular shapes by informal means (ACMMG087 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Select and trial methods for data collection, including survey questions and recording sheets (ACMSP095 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 Standards

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 Level Description

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

Identify and describe factors and multiples of whole numbers and use them to solve problems (ACMNA098 - Scootle)

Elaborations

exploring factors and multiples using number sequences

using simple divisibility tests

Use estimation and rounding to check the reasonableness of answers to calculations (ACMNA099 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

using calculators to check the reasonableness of answers

Fractions and decimals

Compare and order common unit fractions and locate and represent them on a number line (ACMNA102 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

locating decimals on a number line

Money and financial mathematics

Create simple financial plans (ACMNA106 - Scootle)

Elaborations

creating a simple budget for a class fundraising event

identifying the GST component of invoices and receipts

Patterns and algebra

Describe, continue and create patterns with fractions, decimals and whole numbers resulting from addition and subtraction (ACMNA107 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

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

Use a grid reference system to describe locations. Describe routes using landmarks and directional language (ACMMG113 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

using digital technologies to enlarge shapes

using a grid system to enlarge a favourite image or cartoon

Geometric reasoning

Estimate, measure and compare angles using degrees. Construct angles using a protractor (ACMMG112 - Scootle)

Elaborations

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

List outcomes of chance experiments involving equally likely outcomes and represent probabilities of those outcomes using fractions (ACMSP116 - Scootle)

Elaborations

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 - Scootle)

Elaborations

investigating the probabilities of all outcomes for a simple chance experiment and verifying that their sum equals 1

Data representation and interpretation

Pose questions and collect categorical or numerical data by observation or survey (ACMSP118 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

using and comparing data representations for different data sets to help decision making

Year 5 Achievement Standards

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 Level Description

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

Identify and describe properties of prime, composite, square and triangular numbers (ACMNA122 - Scootle)

Elaborations

understanding that some numbers have special properties and that these properties can be used to solve problems

representing composite numbers as a product of their prime factors and using this form to simplify calculations by cancelling common primes

understanding that if a number is divisible by a composite number then it is also divisible by the prime factors of that number (for example 216 is divisible by 8 because the number represented by the last three digits is divisible by 8, and hence 216 is also divisible by 2 and 4)

Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers (ACMNA123 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Compare fractions with related denominators and locate and represent them on a number line (ACMNA125 - Scootle)

Elaborations

demonstrating equivalence between fractions using drawings and models

Solve problems involving addition and subtraction of fractions with the same or related denominators (ACMNA126 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Multiply and divide decimals by powers of 10 (ACMNA130 - Scootle)

Elaborations

multiplying and dividing decimals by multiples of powers of 10

Make connections between equivalent fractions, decimals and percentages (ACMNA131 - Scootle)

Elaborations

connecting fractions, decimals and percentages as different representations of the same number, moving fluently between representations and choosing the appropriate one for the problem being solved

Money and financial mathematics

Investigate and calculate percentage discounts of 10%, 25% and 50% on sale items, with and without digital technologies (ACMNA132 - Scootle)

Elaborations

using authentic information to calculate prices on sale goods

Patterns and algebra

Continue and create sequences involving whole numbers, fractions and decimals. Describe the rule used to create the sequence (ACMNA133 - Scootle)

Elaborations

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

Explore the use of brackets and order of operations to write number sentences (ACMNA134 - Scootle)

Elaborations

appreciating the need for rules to complete multiple operations within the same number sentence

Measurement and Geometry

Using units of measurement

Connect decimal representations to the metric system (ACMMG135 - Scootle)

Elaborations

recognising the equivalence of measurements such as 1.25 metres and 125 centimetres

Convert between common metric units of length, mass and capacity (ACMMG136 - Scootle)

Elaborations

identifying and using the correct operations when converting units including millimetres, centimetres, metres, kilometres, milligrams, grams, kilograms, tonnes, millilitres, litres, kilolitres and megalitres

recognising the significance of the prefixes in units of measurement

Solve problems involving the comparison of lengths and areas using appropriate units (ACMMG137 - Scootle)

Elaborations

recognising and investigating familiar objects using concrete materials and digital technologies

Connect volume and capacity and their units of measurement (ACMMG138 - Scootle)

Elaborations

recognising that 1ml is equivalent to 1cm^3

Interpret and use timetables (ACMMG139 - Scootle)

Elaborations

planning a trip involving one or more modes of public transport

developing a timetable of daily activities

Shape

Construct simple prisms and pyramids (ACMMG140 - Scootle)

Elaborations

considering the history and significance of pyramids from a range of cultural perspectives including those structures found in China, Korea and Indonesia

constructing prisms and pyramids from nets, and skeletal models

Location and transformation

Investigate combinations of translations, reflections and rotations, with and without the use of digital technologies (ACMMG142 - Scootle)

Elaborations

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

Introduce the Cartesian coordinate system using all four quadrants (ACMMG143 - Scootle)

Elaborations

understanding that the Cartesian plane provides a graphical or visual way of describing location

Geometric reasoning

Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles (ACMMG141 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

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 judgements

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

Elaborations

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 Standards

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 Level Description

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

Investigate index notation and represent whole numbers as products of powers of prime numbers (ACMNA149 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

understanding that arithmetic laws are powerful ways of describing and simplifying calculations

Compare, order, add and subtract integers (ACMNA280 - Scootle)

Real numbers

Compare fractions using equivalence. Locate and represent positive and negative fractions and mixed numbers on a number line (ACMNA152 - Scootle)

Elaborations

exploring equivalence among families of fractions by using a fraction wall or a number line (for example by using a fraction wall to show that 2/3 is the same as 4/6 and 6/9)

Solve problems involving addition and subtraction of fractions, including those with unrelated denominators (ACMNA153 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

using authentic problems to express quantities as percentages of other amounts

Recognise and solve problems involving simple ratios (ACMNA173 - Scootle)

Elaborations

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

Investigate and calculate 'best buys', with and without digital technologies (ACMNA174 - Scootle)

Elaborations

applying the unitary method to identify 'best buys' situations, such as comparing the cost per 100g

Patterns and algebra

Introduce the concept of variables as a way of representing numbers using letters (ACMNA175 - Scootle)

Elaborations

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 - Scootle)

Elaborations

using authentic formulas to perform substitutions

Extend and apply the laws and properties of arithmetic to algebraic terms and expressions (ACMNA177 - Scootle)

Elaborations

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

Given coordinates, plot points on the Cartesian plane, and find coordinates for a given point (ACMNA178 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

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

Classify triangles according to their side and angle properties and describe quadrilaterals (ACMMG165 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

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

Elaborations

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 - Scootle)

Elaborations

expressing probabilities as decimals, fractions and percentages

Data representation and interpretation

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

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 Standards

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 Level Description

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

Use index notation with numbers to establish the index laws with positive integral indices and the zero index (ACMNA182 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Investigate terminating and recurring decimals (ACMNA184 - Scootle)

Elaborations

recognising terminating, recurring and non-terminating decimals and choosing their appropriate representations

Investigate the concept of irrational numbers, including π (ACMNA186 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Solve problems involving profit and loss, with and without digital technologies (ACMNA189 - Scootle)

Elaborations

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

Extend and apply the distributive law to the expansion of algebraic expressions (ACMNA190 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

understanding that the laws used with numbers can also be used with algebra

Linear and non-linear relationships

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

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

identifying regions in Australia and countries in Asia that are in the same time zone

Geometric reasoning

Define congruence of plane shapes using transformations (ACMMG200 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

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

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

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

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

using sample properties to predict characteristics of the population

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

Elaborations

using displays of data to explore and investigate effects

Year 8 Achievement Standards

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 Level Description

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

Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems (ACMNA208 - Scootle)

Elaborations

identifying direct proportion in real-life contexts

Apply index laws to numerical expressions with integer indices (ACMNA209 - Scootle)

Elaborations

simplifying and evaluating numerical expressions, using involving both positive and negative integer indices

Express numbers in scientific notation (ACMNA210 - Scootle)

Elaborations

representing extremely large and small numbers in scientific notation, and numbers expressed in scientific notation as whole numbers or decimals

Money and financial mathematics

Solve problems involving simple interest (ACMNA211 - Scootle)

Elaborations

understanding that financial decisions can be assisted by mathematical calculations

Patterns and algebra

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

Elaborations

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 - Scootle)

Elaborations

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

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

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Measurement and Geometry

Using units of measurement

Calculate areas of composite shapes (ACMMG216 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

solving practical problems involving surface area and volume of right prisms

Investigate very small and very large time scales and intervals (ACMMG219 - Scootle)

Elaborations

investigating the usefulness of scientific notation in representing very large and very small numbers

Geometric reasoning

Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar (ACMMG220 - Scootle)

Elaborations

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 - Scootle)

Elaborations

establishing the relationship between areas of similar figures and the ratio of corresponding sides (scale factor)

Pythagoras and trigonometry

Investigate Pythagoras' Theorem and its application to solving simple problems involving right angled triangles (ACMMG222 - Scootle)

Elaborations

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 - Scootle)

Elaborations

developing understanding of the relationship between the corresponding sides of similar right-angled triangles

Apply trigonometry to solve right-angled triangle problems (ACMMG224 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 Standards

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 Level Description

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

Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies (ACMNA229 - Scootle)

Elaborations

working with authentic information, data and interest rates to calculate compound interest and solve related problems

Patterns and algebra

Factorise algebraic expressions by taking out a common algebraic factor (ACMNA230 - Scootle)

Elaborations

using the distributive law and the index laws to factorise algebraic expressions

understanding the relationship between factorisation and expansion

Simplify algebraic products and quotients using index laws (ACMNA231 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

solving simple equations arising from formulas

Linear and non-linear relationships

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

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

Solve problems involving parallel and perpendicular lines (ACMNA238 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

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 - Scootle)

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 - Scootle)

Elaborations

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

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

Elaborations

applying Pythagoras' Theorem and trigonometry to problems in surveying and design

Statistics and Probability

Chance

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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

using arrays and tree diagrams to determine probabilities

Data representation and interpretation

Determine quartiles and interquartile range (ACMSP248 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

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 Standards

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 Level Description

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

Year 10A Content Descriptions

Number and Algebra

Real numbers

Define rational and irrational numbers and perform operations with surds and fractional indices (ACMNA264 - Scootle)

Elaborations

understanding that the real number system includes irrational numbers

extending the index laws to rational number indices

performing the four operations with surds

Use the definition of a logarithm to establish and apply the laws of logarithms (ACMNA265 - Scootle)

Elaborations

investigating the relationship between exponential and logarithmic expressions

simplifying expressions using the logarithm laws

Patterns and algebra

Investigate the concept of a polynomial and apply the factor and remainder theorems to solve problems (ACMNA266 - Scootle)

Elaborations

investigating the relationship between algebraic long division and the factor and remainder theorems

Linear and non-linear relationships

Solve simple exponential equations (ACMNA270 - Scootle)

Elaborations

investigating exponential equations derived from authentic mathematical models based on population growth

Describe, interpret and sketch parabolas, hyperbolas, circles and exponential functions and their transformations (ACMNA267 - Scootle)

Elaborations

applying transformations, including translations, reflections in the axes and stretches to help graph parabolas, rectangular hyperbolas, circles and exponential functions

Apply understanding of polynomials to sketch a range of curves and describe the features of these curves from their equation (ACMNA268 - Scootle)

Elaborations

investigating the features of graphs of polynomials including axes intercepts and the effect of repeated factors

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

Elaborations

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 - Scootle)

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 - Scootle)

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 - Scootle)

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 - Scootle)

Elaborations

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 - Scootle)

Elaborations

using periodicity and symmetry to solve equations

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

Elaborations

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 - Scootle)

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 - Scootle)

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 - Scootle)

Elaborations

investigating different techniques for finding a 'line of best fit'

Year 10A Achievement Standards

There are no achievement standards for Year 10A in the Australian Curriculum: Mathematics. Please refer to the Year 10 Achievement Standards.

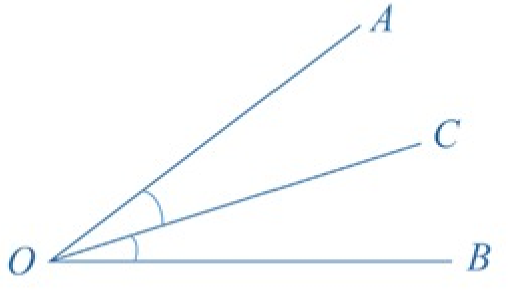
Glossary

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, ∠AOC and ∠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 $2x+\div3$ is not one because it is ambiguous.

algebraic fraction

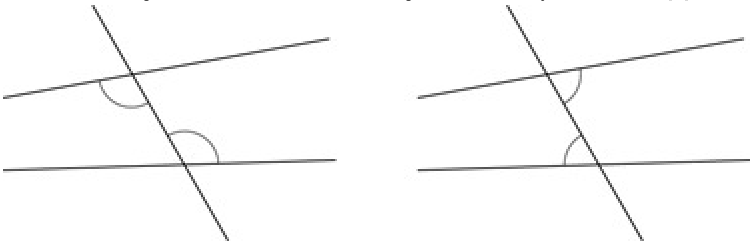
An *algebraic fraction* is a fraction in which both, *numerator* and *denominator*, are *algebraic expressions*.

algebraic term

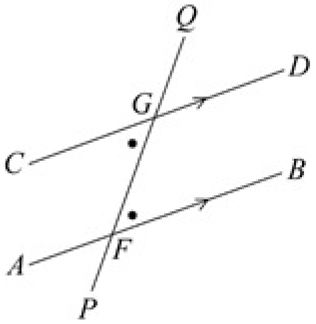
An algebraic term forms a part of an algebraic expression. For example, $\;2,\text{ }3x$, and $\;5x^2$ are terms of the algebraic expression $2+3x-5x^2.$. Terms are separated by + or – signs.

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.



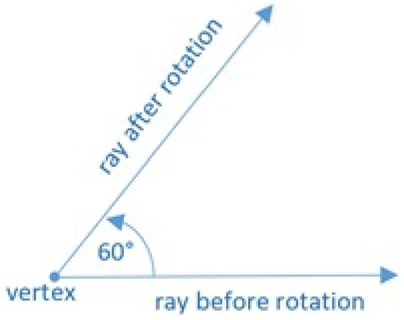
If the lines AB and CD are parallel, then each pair of alternate angles are equal.



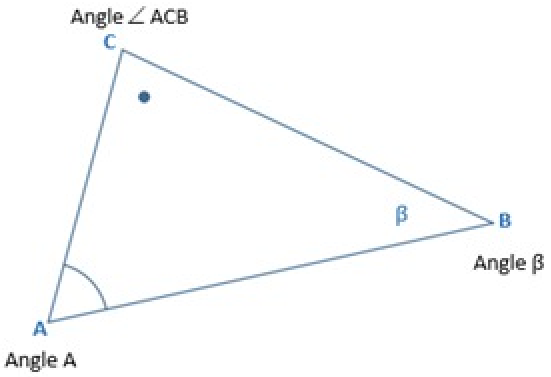
Conversely, if a pair of alternate angles are equal, then the lines are parallel. Line segment CD is parallel to line segment AB, because ∠CGF equals ∠GFB.

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 (°).

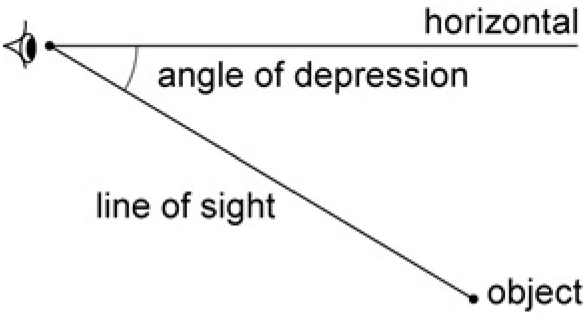


There are different ways of depicting and naming angles. Angles may be depicted using as symbol such as an arc, a dot or a letter (often from the Greek alphabet). Angles are named using different conventions, such as the angle symbol ∠ followed by three letters denoting points, where the middle letter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



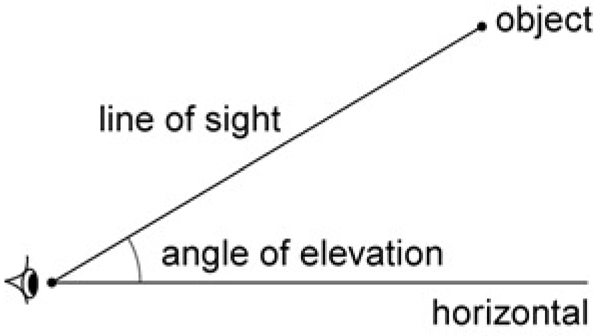
angle of depression

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.



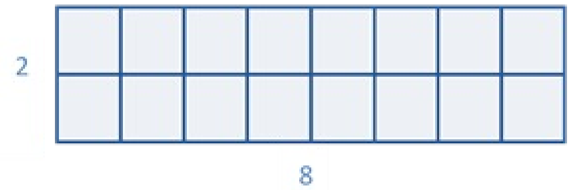
angle of elevation

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 8×2=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: (ab)c=a(bc) 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≠7-(4-3) and (12÷6)÷2≠12÷(6÷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

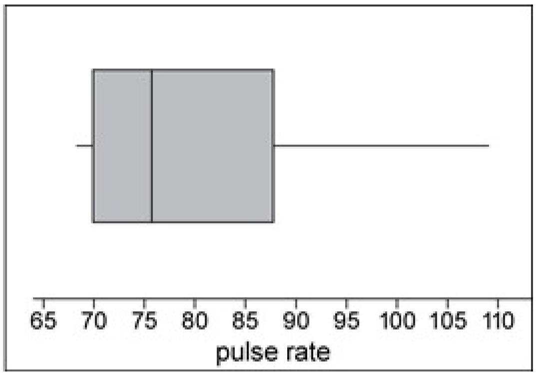
Bivariate data relates to two *variables*. For example, the arm spans and heights of 16-year-olds or the sex of primary school students and their attitudes toward playing sports.

bivariate numerical data

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

box-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.



box plot

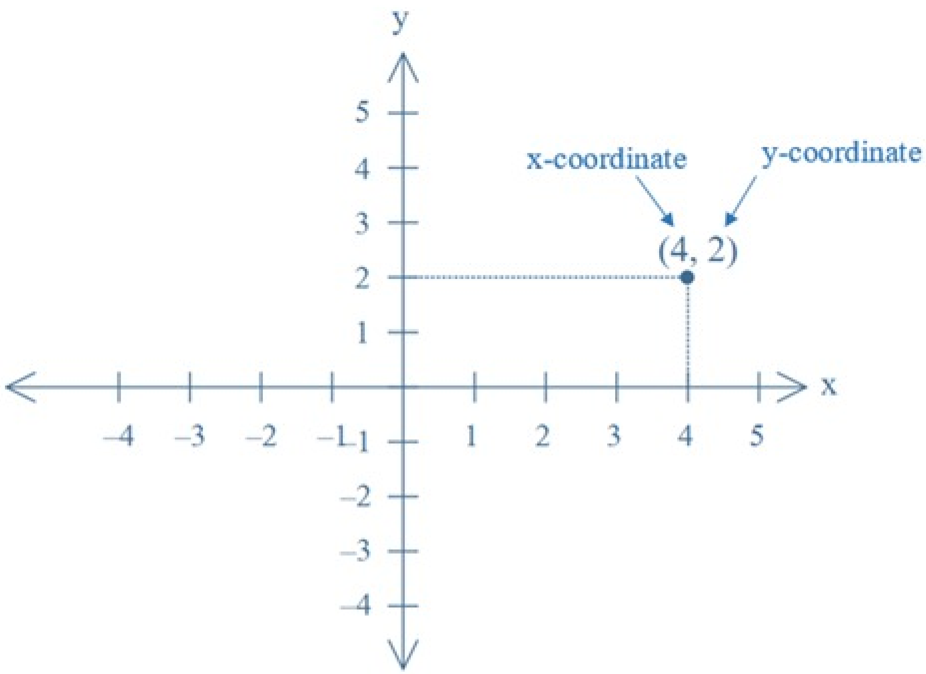
The term *box plot* is a synonym for a *box-and-whisker plot*.

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

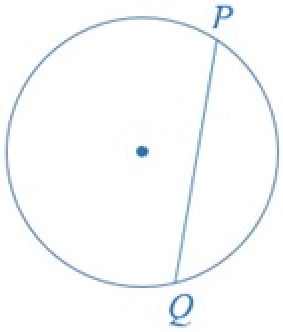
A *categorical variable* is a *variable* whose values are categories. For example, blood group is a categorical variable; its common values are: A, B, AB or O.

census

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

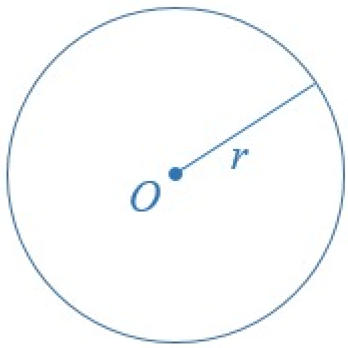
chord

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

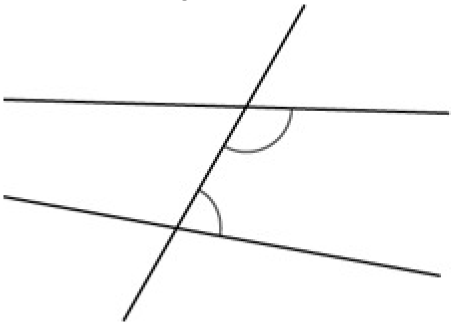
Circumference refers to the boundary of a circle. The length of the circumference c is given by $c=\pi d$, where d is the diameter. Alternatively, it is given by $c=2\pi r$, where r is the radius.

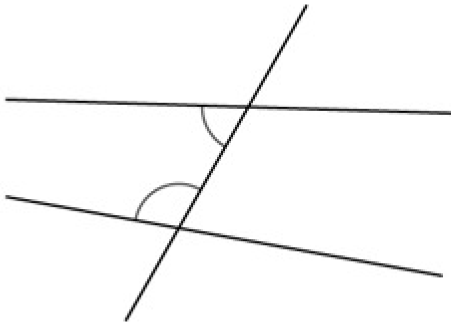
classification of angles

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

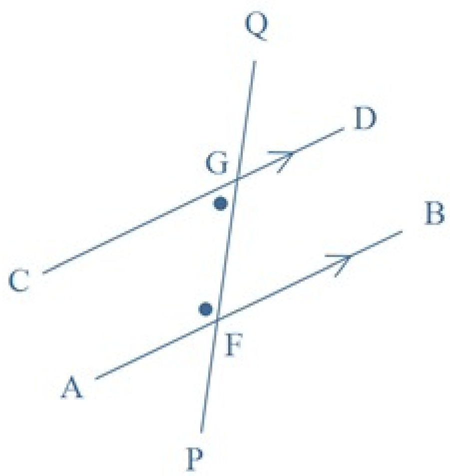
co-interior angles

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





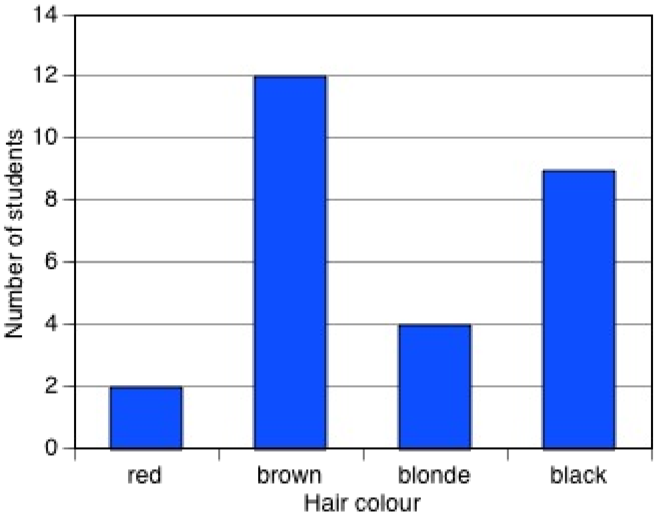
In each diagram the two marked angles are called co-interior angles.
If the two lines are parallel, then co-interior angles add to give 180^{o} and so are supplementary. In the diagram below the angles ∠CGF and ∠AFG are supplementary.



Conversely, if a pair of angles are supplementary, then the lines are parallel. Line segment CD is parallel to line segment AB, because ∠CGF + ∠AFG = 180°.

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 $24=6\times4$, $54=6\times9$, and $66=6\times11$. 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, 4×7=7×4.
Subtraction and division are not commutative because 5-3≠3-5 and 12÷4≠4÷12.

complementary angles

Two *angles* that add to 90^{o} are called *complementary*; for example, 23^{o} and 67^{o} 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

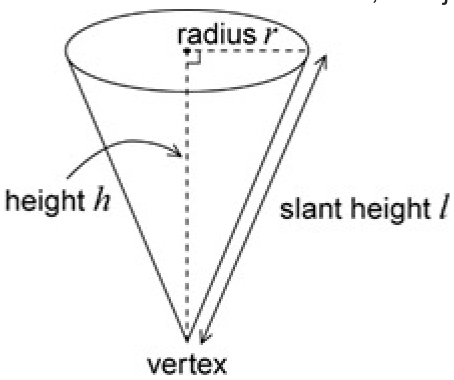
The interest earned by investing a sum of money (the principal) is compound interest if each successive interest payment is added to the principal for the purpose of calculating the next interest payment. For example, if the principal \(\$P\) earns compound interest at the rate of ***r%*** per period,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

computation

Computation is mathematical calculation.

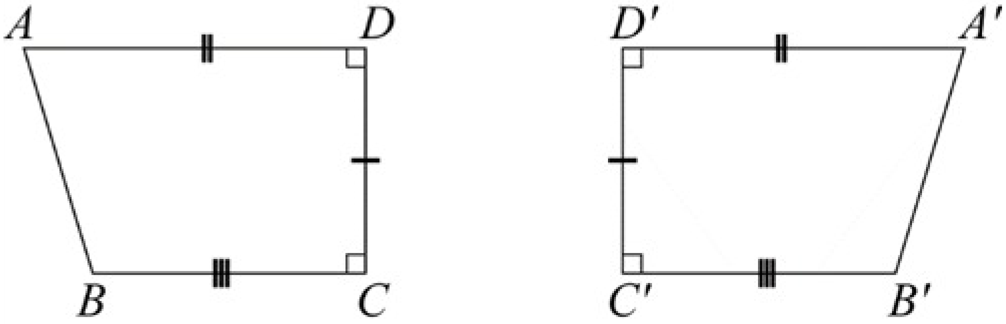
cone

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.



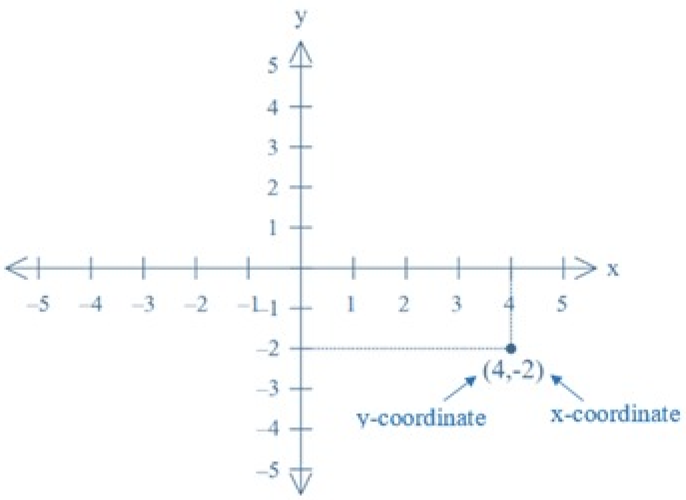
The four standard congruence tests for triangles
Two triangles are congruent if:
SSS: the three sides of one triangle are respectively equal to the three sides of the other triangle, or
SAS: two sides and the included angle of one triangle are respectively equal to two sides and the included angle of 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.

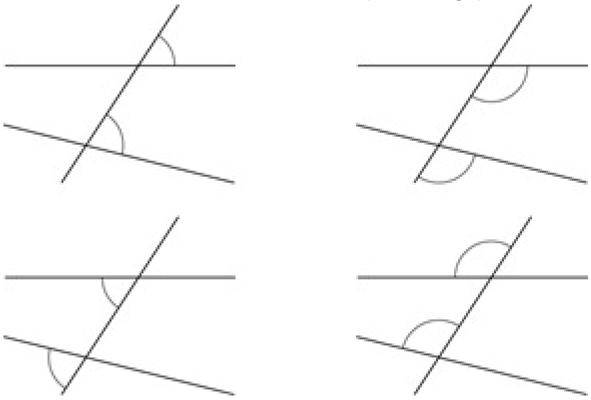


coordinate system

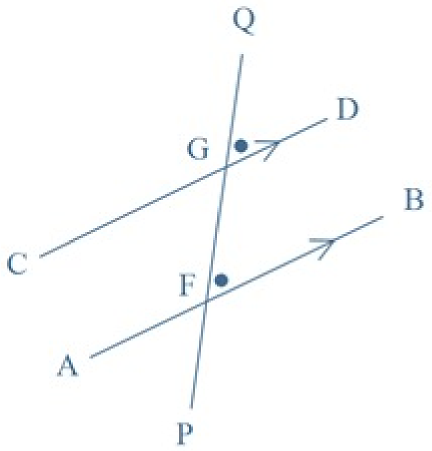
see Cartesian plane.

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.



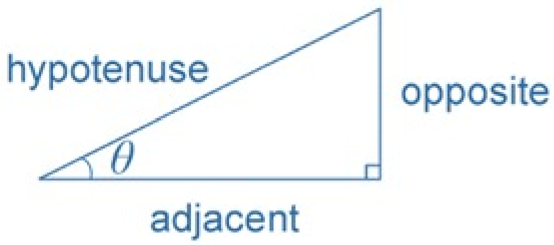
If the lines are parallel, then each pair of corresponding angles is equal (as are the angles ∠QGD and ∠GFB in the diagram shown below).



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

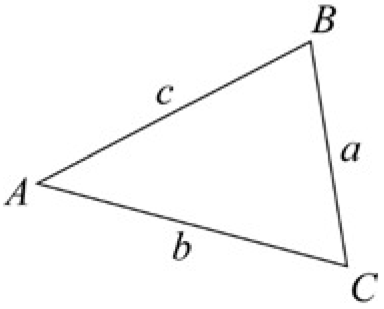
cosine

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

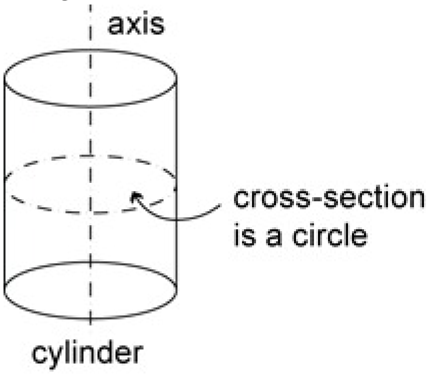
Counting numbers are the *positive integers*, that is, the numbers 1, 2, 3, … .
Sometimes it is taken to mean the non-negative *integers*, which include zero.

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

$1\times10^2+2\times10^1+3\times10^0+4\times10^{-1}+5\times10^{-2}$

$=1\times100+2\times10+3\times1+4\times\frac1{10}+5\times\frac1{100}$

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 $\frac13$, 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.

$\frac13=0.333333\dots=0.\dot3$

Similarly, the fraction $\frac17$ results in a recurring group of digits, which is represented by a bar above the whole group of repeating digits

$\frac17=0.142857142857142857\dots=0.\overline{142857}$

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,

$\pi=3.14159265358979323846264338327950288419716939937510582097494\dots$

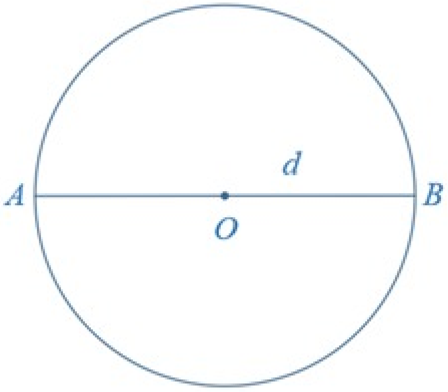
Irrational numbers can only be approximated in the decimal number system.

denominator

In any fraction in the form $\frac ab$, 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 $\frac15\;\;.$

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

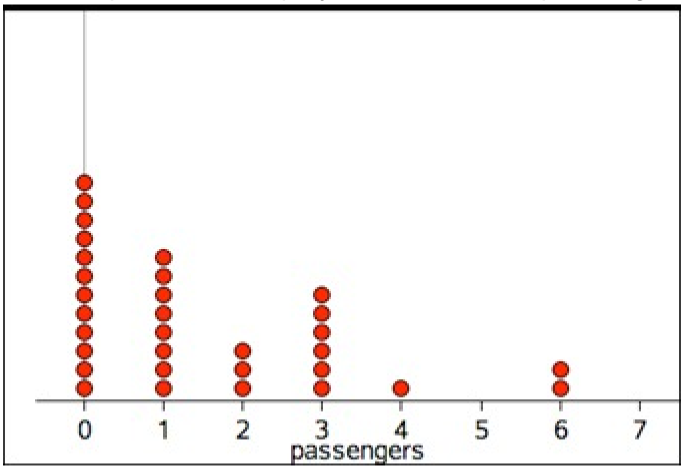
Multiplication of numbers is said to be 'distributive over addition', because the product of one number with the sum of two others equals the sum of the products of the first number with each of the others. For example, the product of 3 with (4+5) gives the same result as the sum of 3×4 and 3×5:
3×(4+5)=3×9=27 and 3×4+3×5=12+15=27
This distributive law is expressed algebraically as follows:
a(b+c)=ab+ac, for all numbers a,b 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=3×4.

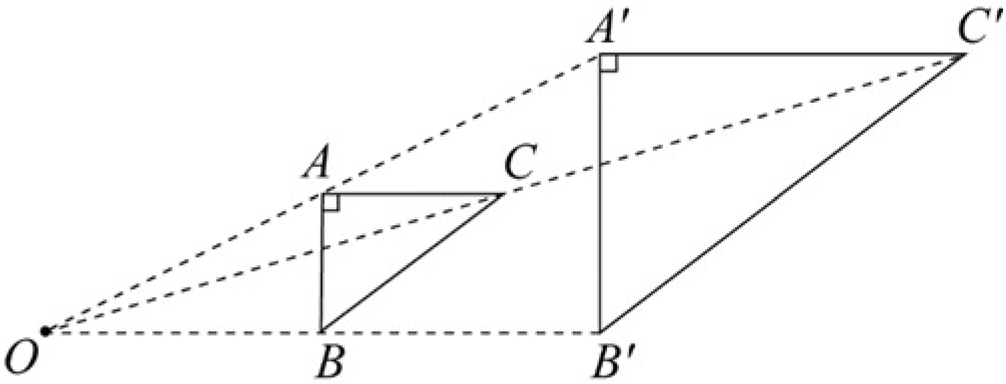
dot plot

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

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, $\frac12=\frac24=\frac36\cdots$. Two fractions $\frac ab$ and $\frac cd$ 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.

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’.

even number

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

exponential function

An exponential function is a function where the independent variable is in the exponent (or index), that is, in the simplest form, $\;f(x)=a^x$, 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, $17–9, 8×(2+3), (2a+3b)^2$ 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 3×4=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 \(px=q(x)(x-a)+p(a)\), 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 \(p(2)=2^3-3×2^2+5×2-6=0\). 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=3×5.
\(x^2-3x+2\) 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* \(\frac ab\) (written alternatively as a/b), where a and b are integers unequal to zero. For example, \(\frac35\) refers to 3 of 5 equal parts of the whole.
In the fraction \(\frac ab\) 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 \(\frac fn\), 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

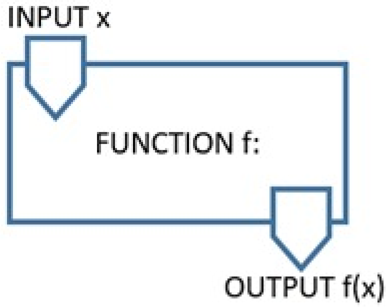
A frequency table lists the frequency (number of occurrences) of observations in different ranges, called class intervals.
The frequency distribution of the heights (in cm) of a sample of 46 people is displayed in the form of a frequency table below.

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

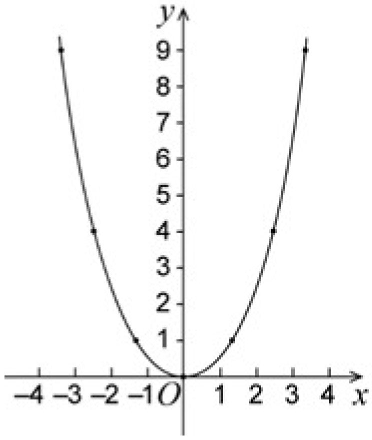
The information in a frequency table can also be displayed graphically in the form of a histogram or using a column graph.

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.

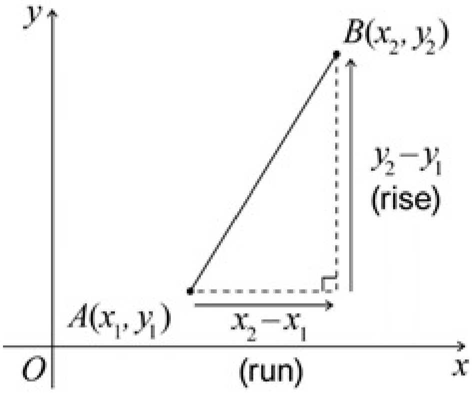


Functions are usually defined by a formula for $f(x)$ in terms of x; for example, the formula $f(x)=x^2$ defines the 'squaring function' that maps each real number x to its square x^2. The graph of this function is shown below.

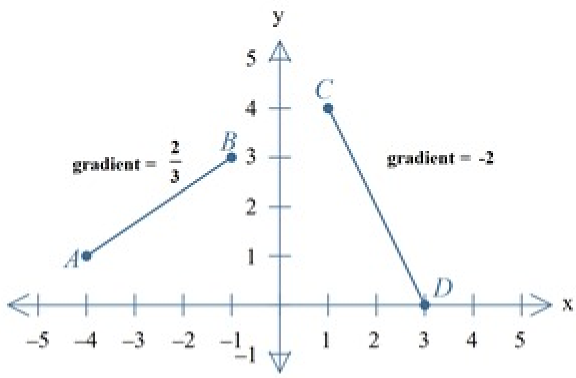


gradient

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
$AB=\frac{\text{rise}}{\text{run}}=\frac{y_2-y_1}{x_2-x_1}$, provided that $x_2-x_1\neq0$



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:
$gradient(AB)=\frac{3-1}{-1-(-4)}=\frac23$
$gradient(CD)=\frac{0-4}{3-1}=\frac{-4}2=-2$

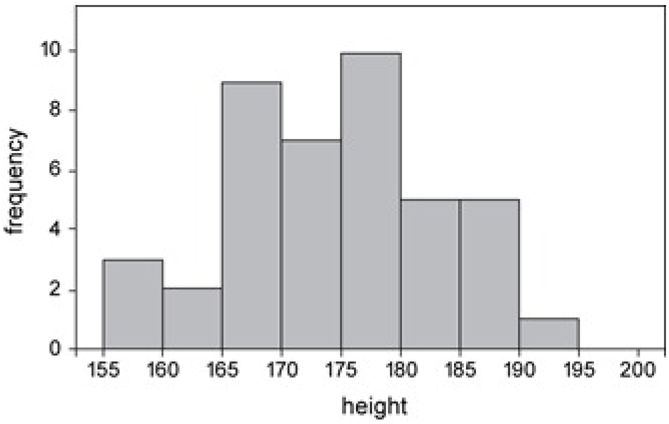


grid reference

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.

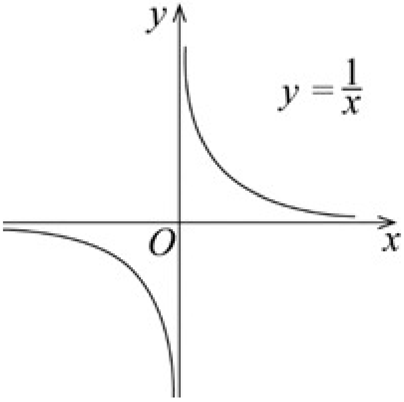
histogram

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.



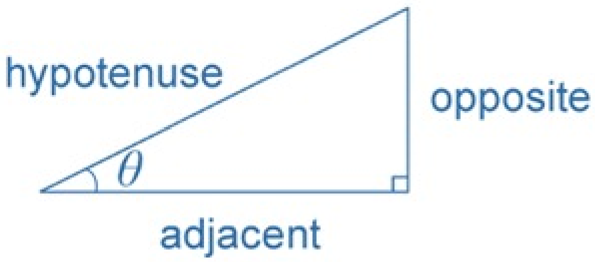
hyperbola

A hyperbola is the graph of a curve in two parts separated by straight lines called asymptotes. The simplest example is the graph of $y=\frac1x,\;x\neq0$, 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
$x^ax^b=x^{a+b};\text{ }\left(x^a\right)^b=x^{ab}\text{ }$
$x^ay^a=\left(xy\right)^a$
and
$x^0=1;\text{ }x^{-a}=\frac1{x^a};\text{ and }x^{1/a}=\sqrt[a]x$

index notation

When the product of $a×a×a$ 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 $a\le b$
a is greater than or equal to b is written $a\ge b$.
a is unequal to b is written $a\ne b$.

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 ⋯-3, -2, -1, 0, 1, 2, 3⋯. 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

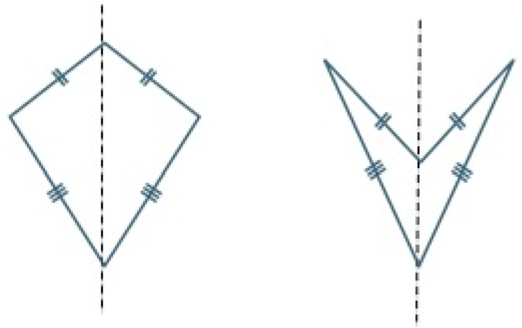
An irrational number is a real number that is not rational, that means, it cannot be represented as a fraction. Some commonly used irrational numbers are \(\pi,e\text{ and }\sqrt[{}]2\).
Decimal representations of irrational numbers are non-terminating. For example, the Euler Number e is an irrational real number whose decimal expansion begins
\(e=2.718281828···\).

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.



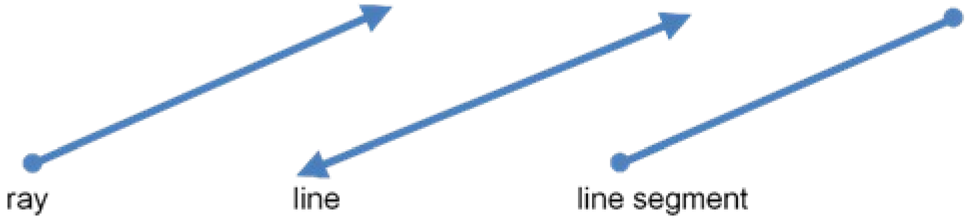
A kite may be convex as shown in the diagram above to the left or non-convex as shown above to the right. The axis of symmetry of the kite is shown.

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.

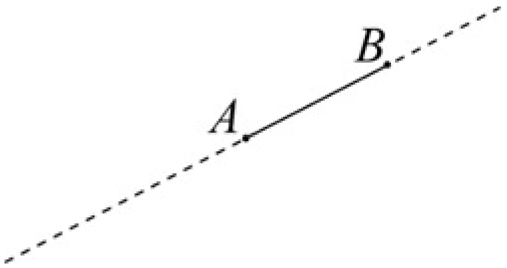


linear equation

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≠0, then the point where the line intersects the x-axis (the x-intercept) is $\frac ca$.
If b≠0, then the point where the line intersects the y-axis (the y-intercept) is $\frac cb$.
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.

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.



location

In Measurement and Geometry, the relative position of an object is referred to as its *location*. It can be expressed in terms of a description (such as ‘next to’, ‘behind’, ‘on top of’), a grid reference (such as ‘A5’), or a coordinate (such as ‘(-2,7)’).
In Statistics and Probability, 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 $\;\log_bx$. Algebraically, the statements $\log_bx=y$ 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 $\log_2\left(\frac1{32}\right)=-5$ because $2^{-5}=\frac1{32}$.

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.

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*.

mean

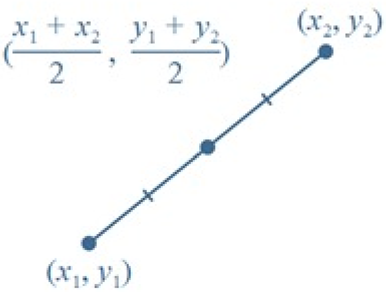
The arithmetic mean of a list of numbers is the sum of the data values divided by the number of numbers in the list.
In everyday language, the arithmetic mean is commonly called the average; for example, for the following list of five numbers, {2, 3, 3, 6, 8}, the mean equals $\frac{2+3+3+6+8}5=\frac{22}5=4.4$

median

The *median* is the value in a set of ordered data that divides the *data* into two parts. It is frequently called the ‘middle value’.
Where the number of observations is odd, the median is the middle value; for example, for the following ordered data set with an odd number of observations, the median value is five.
1 3 3 4 5 6 8 9 9
Where the number of observations is even, the median is calculated as the *mean* of the two central values; for example, in the following ordered data set, the two central values are 5 and 6, and median value is the mean of these two values, 5.5.
1 3 3 4 5 6 8 9 9 10
The median provides a measure of location of a data set that is suitable for both *symmetric* and *skewed* distributions and is also relatively insensitive to *outliers*.

midpoint

The midpoint M of a line segment AB, which extends between points A and B, is the point that divides the segment into two equal parts.
If $A\;\left(x_1,\;y_1\right)$ and $B\;(x_2,\;y_2)$ are points on a Cartesian plane, then the midpoint M of the line segment AB has coordinates $\left(\frac{x_1+\;x_2}2,\;\;\frac{y_1+\;y_2}2\right)$



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=3×1.5 and -13.5=-9×1.5.

natural number

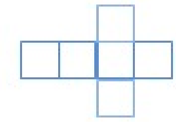
A *natural number* can refer either to a *positive integer* (which excludes negative numbers and zero) or a *counting number* (which excludes negative numbers but includes zero). The *set* of natural numbers is usually denoted by N.

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

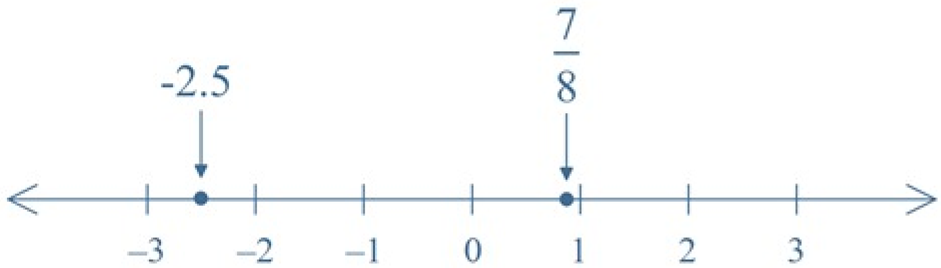
A *non-negative* integer is an *integer* that is not negative, and is either zero or positive. It differs from a *positive integer*, which excludes zero. Non-negative integers are 0, 1, 2, 3, 4, 5⋯.

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.

numerator

In the *fraction* $$\frac ab$$, ***a*** is the numerator. If an object is divided into ***b*** equal parts, then the fraction $$\frac ab$$ 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 $$\frac35$$.

numeral

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

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 ⋯-5,-3,-1, 1, 3, 5⋯.

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.

ordered pair

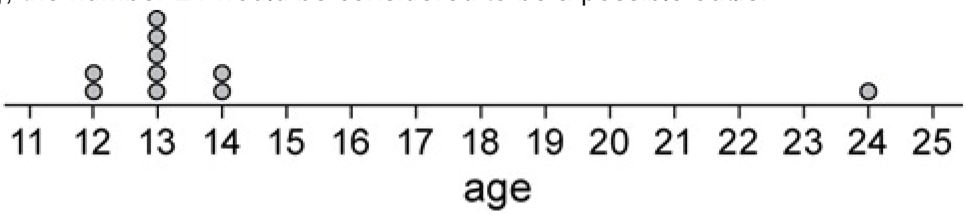
In mathematics, an *ordered pair* is a collection of two numbers whose order is significant. Ordered pairs are used to describe the location of a point in the *Cartesian plane*.

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÷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.

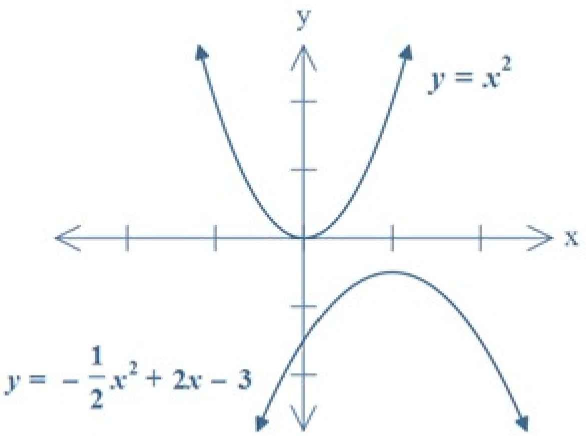
outlier

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, 14, 14, 14, 24}, the number 24 would be considered to be a possible outlier.



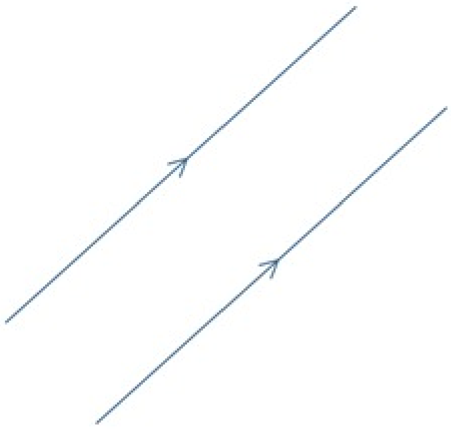
parabola

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≠0***. Two examples of parabolas are shown below.



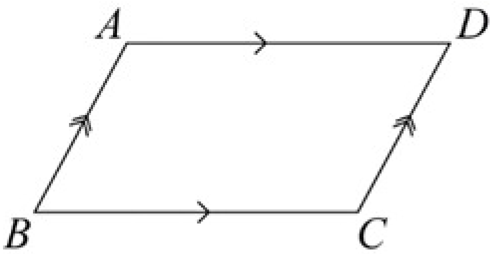
parallel

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∥DC and AD∥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 $\frac{6}{100}$.
Similarly, 40 as a percentage of 250 is $\frac{40}{250}\times100=16\%$.

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 25^{th} percentile, the *median* is the 50^{th} percentile and the upper quartile is the 75^{th} percentile.
Percentiles are often used to report comparative test results. A student who scores in the 90^{th} percentile for a given test has scored higher than 90% of other students who took the test. A student who scores in the 10^{th} 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 $\frac{22}{7}$ is a rational approximation. The decimal expansion of π begins:

$$\pi=3.141\text{ }592\text{ }653\text{ }589\text{ }79\dots$$

picture graphs

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

place value

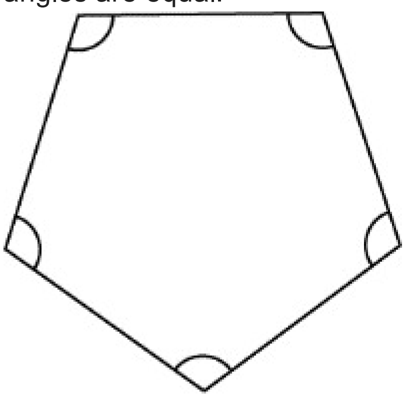
Place value refers to the value of a digit as determined by its position in a number, relative to the ones (or units) place. For integers, the ones place is occupied by the rightmost digit in the number; for example, in the number 2 594.6 the 4 denotes 4 ones, the 9 denotes 90 ones or 9 tens, the 5 denotes 500 ones or 5 hundreds, the 2 denotes 2000 ones or 2 thousands, and the 6 denotes $\frac{6}{10}$ 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 $a_0+a_1x+a_2x^2+\cdots+a_nx^n,$ where n is a non-negative integer and $a_n\neq0$.
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

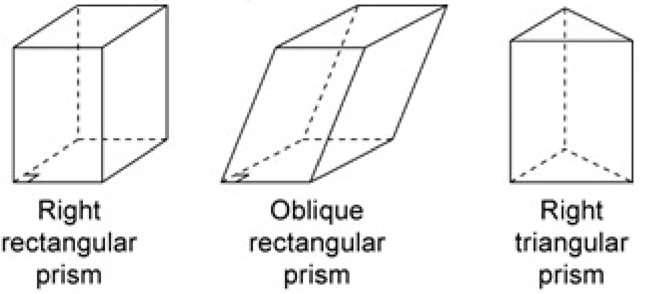
A *prime factor* of a number is a *factor* of that number which is prime.

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.



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

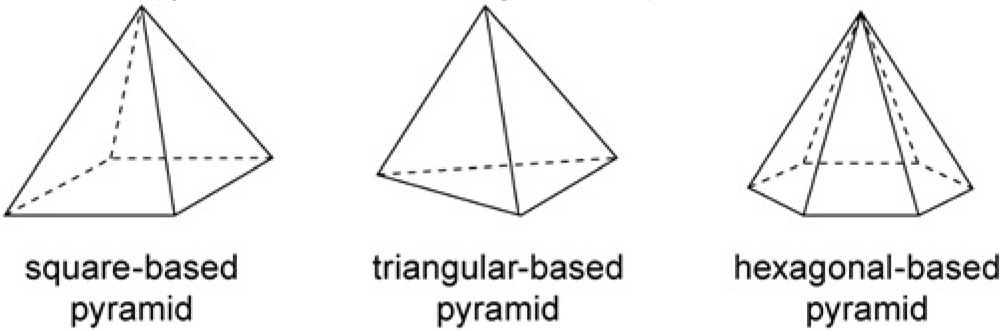
Two quantities are in *proportion*, if there is a constant *ratio* between them.

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°).

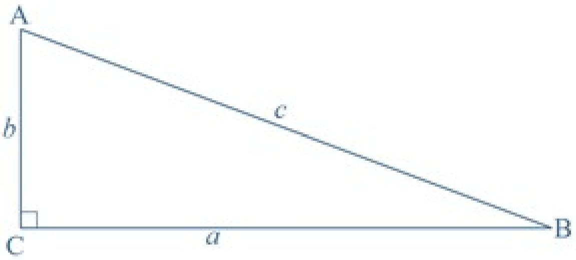
pyramid

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.



Pythagoras’ theorem

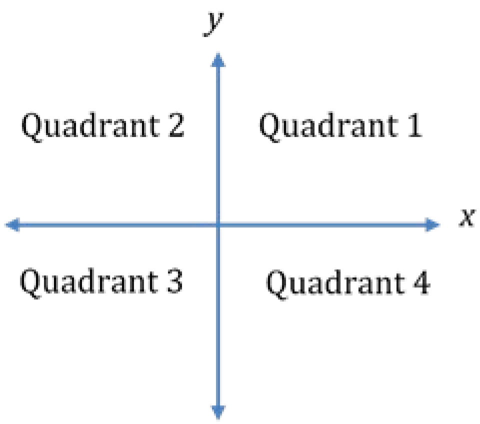
Pythagoras’ theorem states that for a right-angled triangle:
The square of the hypotenuse of a right-angled triangle equals the sum of the squares of the lengths of the other two sides.
In symbols, $c^2=a^2+b^2$.



The converse
If $c^2=a^2+b^2$ in a triangle ABC, then ∠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 $$a\neq0$$.
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

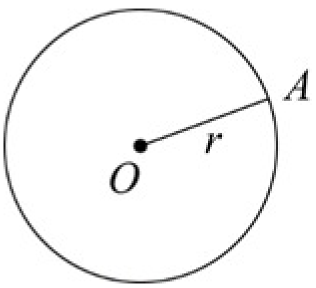
Quartiles are the values that divide an ordered *data set* into four (approximately) equal parts. It is only possible to divide a data set into exactly four equal parts, when the number of data values is a *multiple* of four.
There are three quartiles. The first, the *lower quartile* (Q_1) divides off (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

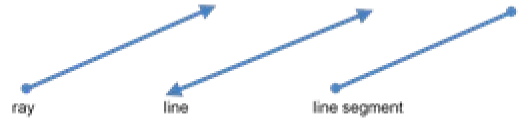
A ratio is a quotient of two numbers, magnitudes, or algebraic expressions. It is often used as a measure of the relative size of two objects; for example, the ratio of the length of a side of a square to the length of a diagonal is $1:\sqrt{2}\;$ that is, $\frac{1}{\sqrt{2}}.$

rational numbers

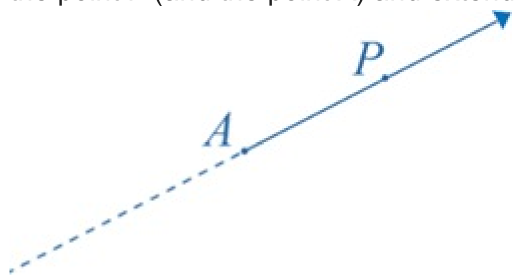
The *rational numbers* are the set of all numbers that can be expressed as fractions, that is, as quotients of two *integer values*. The *decimal* expansion of a rational number is either *terminating* or *recurring*.

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.

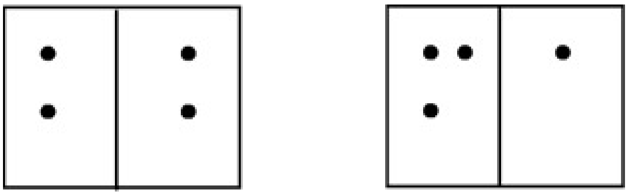


real number

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.

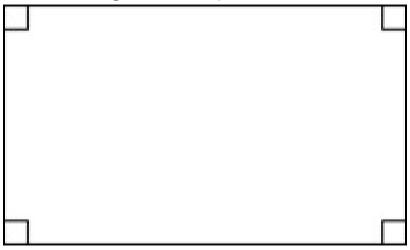


reasonableness

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.

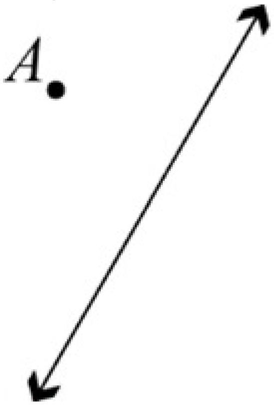


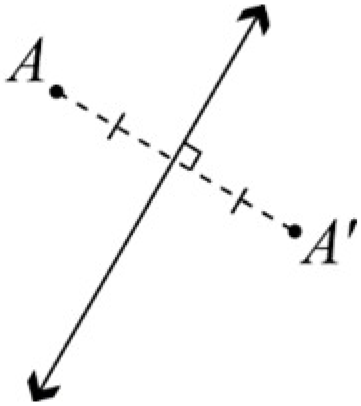
reflex angle

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

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.

regular shape

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

related denominators

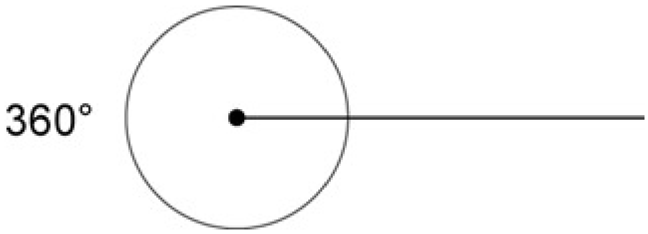
Related denominators occur where one denominator is a multiple of the other; for example, the fractions $$\frac13$$ and $$\frac59$$ have related denominators because 9 is a multiple of 3. Fractions with related denominators are more easily added and subtracted than fractions with unrelated denominators, because only one needs to be rewritten; for example, to add $$\frac13$$ and $$\frac59$$ we can rewrite $$\frac13$$ as the equivalent fraction $$\frac39$$ and then compute $$\frac39+\frac59$$ = $$\frac89$$.

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=6×11+2.

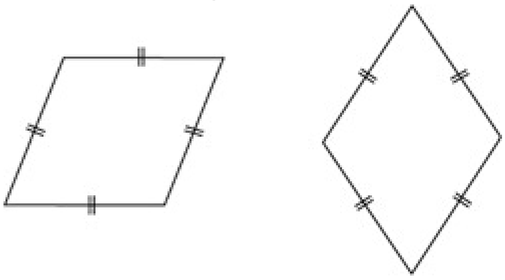
revolution

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°.



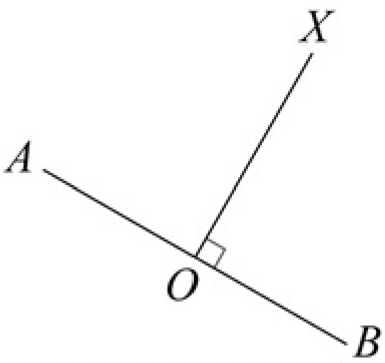
rhombus

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°.



rounding

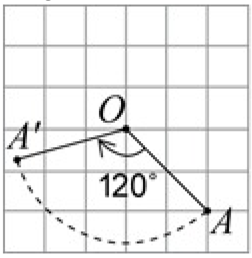
The decimal expansion of a real number is rounded when it is approximated by a terminating decimal that has a given number of decimal digits to the right of the decimal point.
Rounding to n decimal places is achieved by removing all decimal digits beyond (to the right of) the n^{th} digit to the right 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.

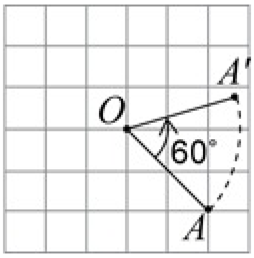
rotation

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.

sample

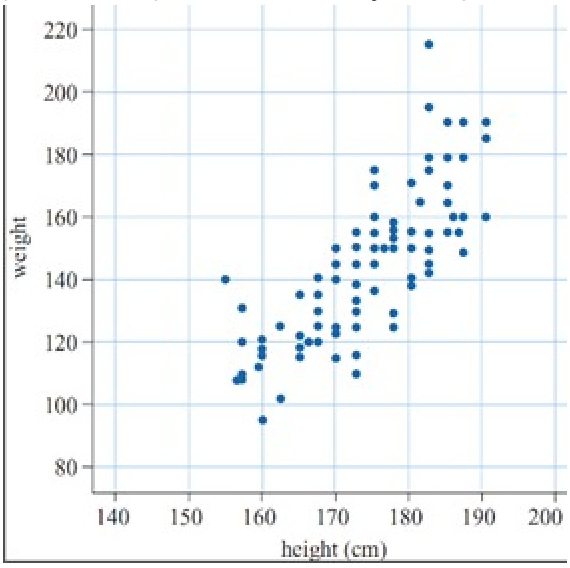
A *sample* is part of a *population*. It is a *subset* of the population, often randomly selected for the purpose of estimating the value of a characteristic of the population as a whole.
For instance, a randomly selected group of eight-year old children (the sample) might be selected to *estimate* the 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 $$3.459\times10^4,$$ and the scientific notation for 0.000004567 is 4.567×10-6.
Many electronic calculators will show these as 3.459E4 and $$4.567\times10^{-6}.$$

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…).

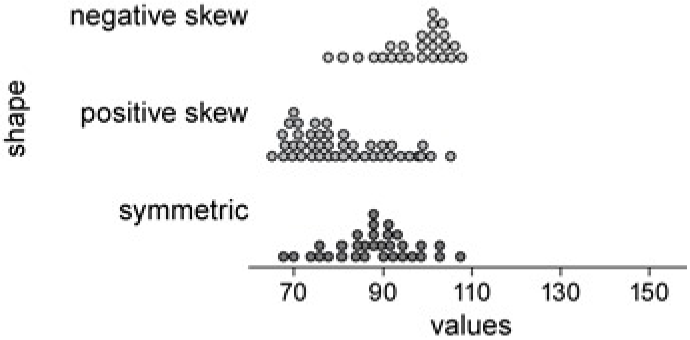
set

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.

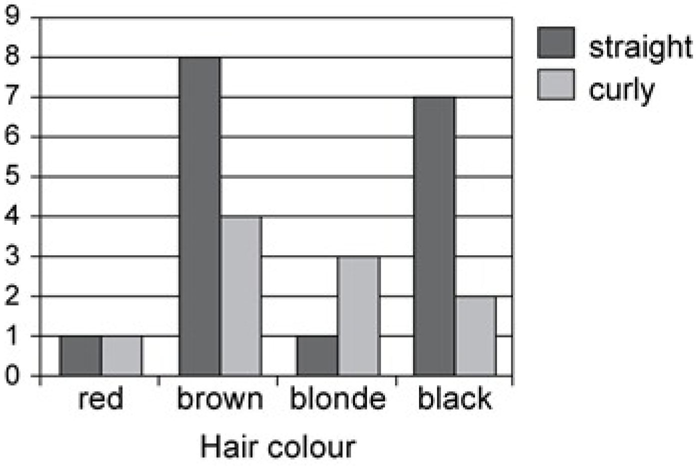


Dot plots, histograms and stem plots can all be used to investigate the shape of a data distribution.

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

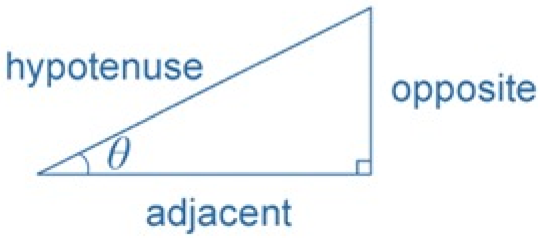
Simple interest is the interest accumulated when the interest payment in each period is a fixed fraction of the principal; for example, if the principle ***$P*** earns simple interest at the rate of *i%* per period, then after n periods the accumulated simple interest is **$Pni/100**.

simultaneous equations

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

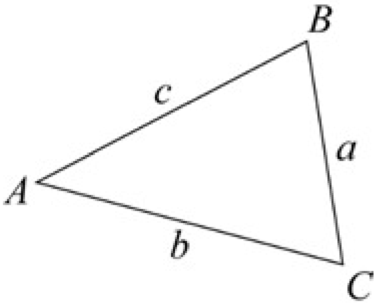
sine

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°<θ<90°.



sine rule

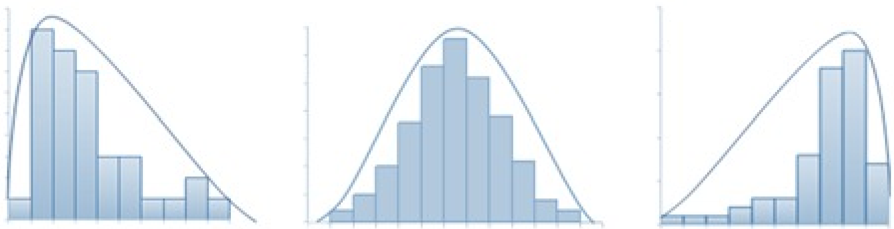
In any triangle ABC, $\frac a{\sin A}=\frac b{\sin B}=\frac c{\sin C}$.



In words it says:
Any side of a triangle over the sine of the opposite angle equals any other side of the triangle over the sine of its opposite angle.

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

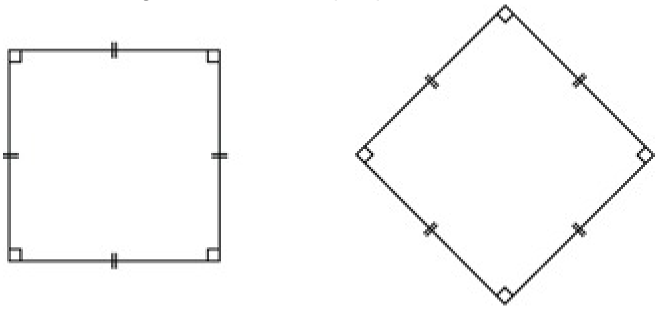
Skip counting is counting by a number that is not 1; for example, skip counting forwards by 2 would be 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 ···. Skip counting backwards by 3 from 21 would be 21, 18, 15, 12, 9, 6, 3, 0.

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

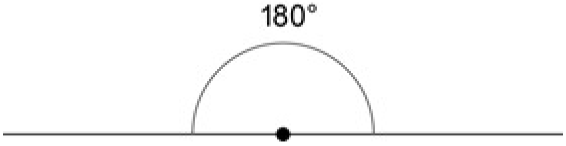
In this plot, the stem unit is ‘10’ and the leaf unit is ‘1’. Thus the top row in the plot 6 | 8 8 8 9 displays pulse rates of 68, 68, 68 and 69.

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 of more numbers or *algebraic expressions*. In the *equation* 8+6=14, the sum is 14.

supplementary

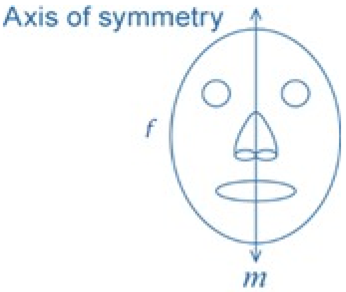
Two angles that add to 180° are called *supplementary angles*; for example, 45° and 135° are supplementary angles.

surd

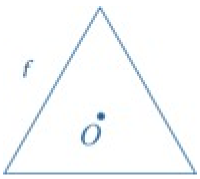
A surd is a numerical expression involving one or more irrational roots of numbers. Examples of surds include $$\sqrt[{}]2,$$,$$\sqrt[3]{5,}\;$$ and $$\;4\sqrt[{}]3+7\sqrt[3]6$$

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.



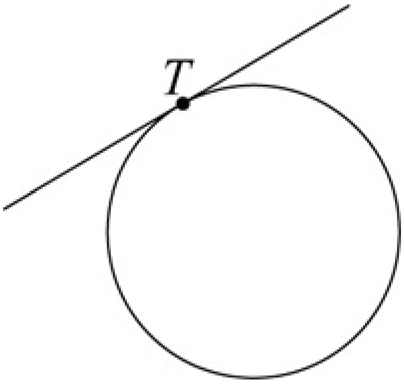
A plane figure f has rotational symmetry about a point O if there is a rotation such that the image of f under the rotation is f itself.



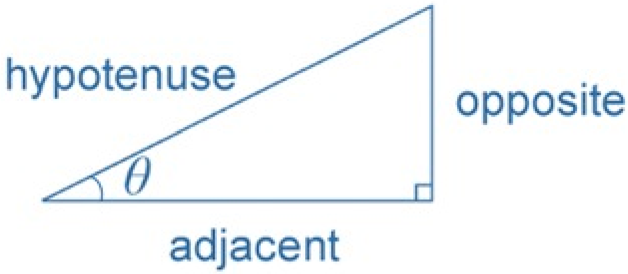
A rotation of 120° around O moves the equilateral triangle onto itself.

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°<θ<90°***.



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

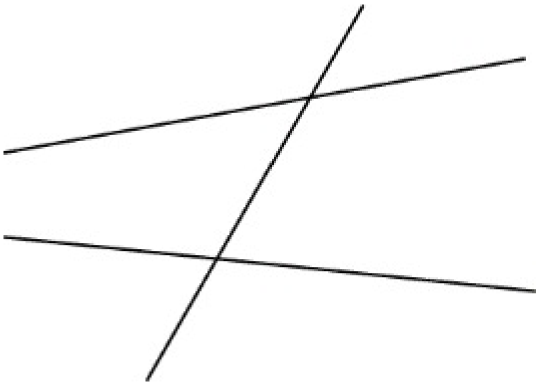
The *transformations* included in this glossary are *enlargements*, *reflections*, *rotations,* and *translations*.

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.

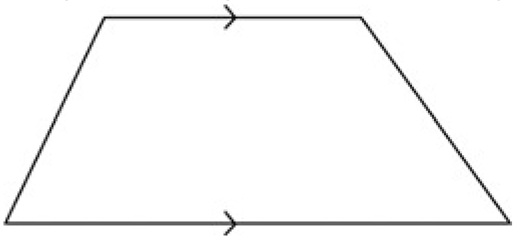
transversal

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



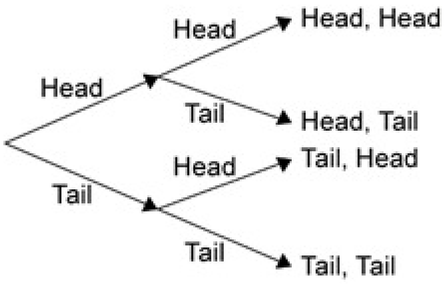
trapezium

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



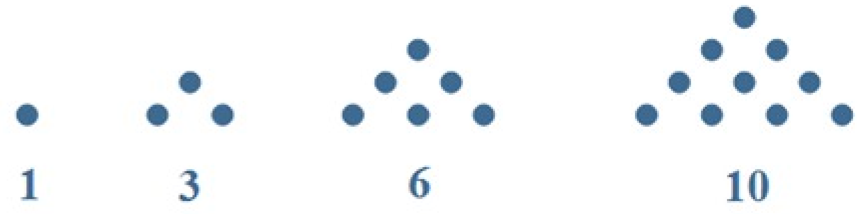
tree diagram

A tree diagram is a diagram that can 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

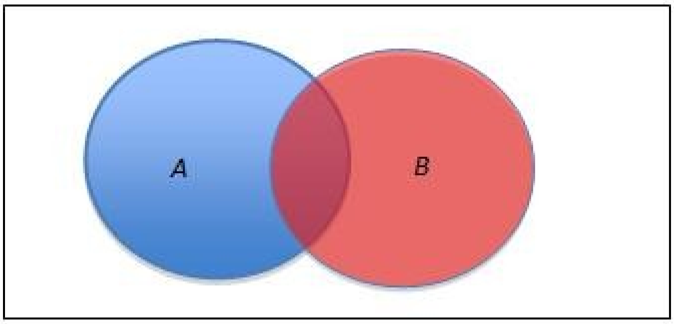
A *unit fraction* is a simple *fraction* whose numerator is 1, that is, a fraction of the form 1/n, where n is a *natural number*.

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, … 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*.

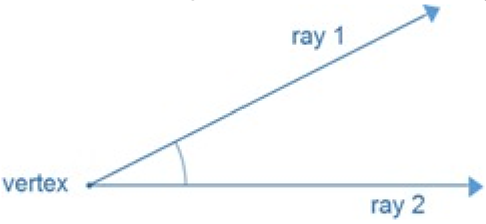
Venn diagram

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).



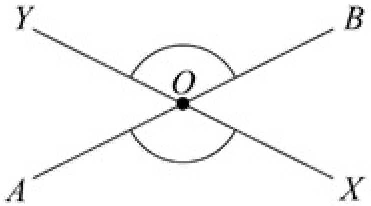
vertex

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 ∠AOX and ∠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* × *Width* × *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*.