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TransformED

Northern Ireland Curriculum 2028

An entitlement to excellence and equity

Mathematics

Draft curriculum framework for Public Consultation

This document forms part of a suite of curriculum materials published for consultation

Contents

Vision statement

The discipline of mathematics is immense and powerful. It probes the deep structures of thought and reality, revealing eternal truths about the patterns and logic that underpin our world. Mathematical knowledge is also profoundly useful since its deep structures recur throughout the world and so mathematics illuminates fields from medicine to economics, from the laboratory to the supermarket.

To know mathematics is to join a tradition that stretches across human history, across barriers of time, culture and language. All of us can and should benefit from the knowledge this tradition has produced.

The study of mathematics should not be reduced to a list of things that happen to have everyday use. Mathematics is a worthy pursuit in its own right. It exposes beauty that is encoded deep within the universe: truths that existed before us and which will outlast us. It is much more than a set of practical tools, and all children deserve the experience of marvelling at its elegance.

Yet the practical utility of mathematics is immense. All of us rely on it every day. Without knowledge of mathematics, we cannot fully participate in a modern economy or democracy. Mathematical knowledge is increasingly important at the frontier of other disciplines too. Progress in the sciences and social sciences is dependent on the development and application of mathematical techniques, just as it is on knowledge that is distinct to those disciplines.

Mathematics is powerful because of the kind of knowledge it seeks: the deep structures of problems, to discover what is contingent and what will always be the case. When applied to the world around us, this allows us to model reality, see through complexities and identify what really matters.

School mathematics requires passing on the tradition of mathematics and inviting pupils to make use of this knowledge. One cannot meaningfully take part in mathematics without a body of knowledge to deploy. This may be early knowledge, such as the composition of numbers, or later knowledge, such as the relationship between side lengths on a right-angled triangle.

Knowledge in mathematics is hierarchical. Each piece of knowledge opens up others, just as each is inaccessible without those upon which it depends. In mathematics it is therefore crucial that all children are secure in their knowledge before moving on, as insecurity prevents future learning. Many children who see themselves as 'bad at maths' today simply never mastered the foundations and attribute their failure to learn to a deficit in themselves rather than in their education. We must prevent this recurring.

Possessing mathematical knowledge is the foundation, but its acquisition should not be the sole experience pupils have. They must also make use of their mathematical knowledge, using it to solve problems or model the world. Grappling with challenges where you do not immediately know a path to the solution is core to the discipline of mathematics, and every child should experience it.

These two experiences of mathematics can feel different. Mastering new knowledge requires deliberate practice until its use becomes automatic, freeing up working memory to think further. Application should occur once knowledge is secure, and space in working memory is available to translate knowledge into a new context or problem. Acquiring knowledge can involve lots of similar exercises or questions, as you explore every nook and cranny of a new fact or procedure. Applying it may involve a smaller number of more varied problems.

School mathematics goes wrong when we fail to recognise the symbiosis of knowledge and problem-solving. Dismissing the importance of knowledge in favour of problem-solving leads to pupils who flounder due to their lack of knowledge, and so never achieve the satisfaction their teachers aspire to for them. Dismissing problem-solving for a diet solely of new knowledge acquisition denies pupils the chance to challenge themselves against problems that have inspired generations to dedicate themselves to the tradition of mathematics.

School mathematics also goes wrong when we fail to be honest about the experience. Learning mathematics requires effort. It is hard to learn a novel technique or internalise a new fact. It is hard to solve meaningful problems. Too often pupils believe that struggling in mathematics is a sign they are not good at it and should give up. In fact, anything worth doing requires effort. Learning mathematics is effortful, as well as fulfilling and rewarding.

Subject-specific categories

This framework organises mathematical knowledge into three broad and interconnected categories: number and algebra, geometry and measure, and probability and statistics. This structure will support teachers in thinking about coherence and progression. These categories are not isolated strands to be taught separately. Instead, they describe different but complementary ways in which mathematics represents quantity, space and uncertainty. Together they provide a coherent picture of the subject.

Number and algebra

Number and algebra concerns the structure of the number system and the relationships that govern it. Pupils learn how numbers are composed, represented and manipulated, and how operations act upon them. Over time, this knowledge becomes increasingly abstract, moving from counting and calculation towards generalisation, symbolisation and reasoning about relationships.

This category includes arithmetic, fractions, decimals, percentages, algebraic representation, sequences, equations, ratio and proportion. Through secure, cumulative learning in this domain, pupils develop fluency and precision, as well as the capacity to reason about patterns and structures that hold universally. Number and algebra form the foundation for much of mathematics and underpin work across all other categories.

Geometry and measure

Geometry and measure focuses on the mathematics of shape, space, size and position. Pupils learn how spatial relationships are described, represented and reasoned about, and how quantities such as length, area, volume, angle and time are measured and related.

This category includes properties of 2-D and 3-D shapes, angle relationships, symmetry, transformation, similarity, coordinate geometry, perimeter, area and volume, as well as work with units and scales. Through geometry and measure, pupils come to see mathematics as a way of modelling the physical world, developing visualisation, spatial reasoning and an appreciation of how abstract relationships apply to concrete contexts.

Probability and statistics

Probability and statistics concerns the collection, representation, interpretation and evaluation of data, as well as reasoning about uncertainty and likelihood. Pupils learn how data can be

organised and displayed to reveal patterns, variation and relationships, and how conclusions can be drawn, and challenged, on the basis of evidence.

This category includes data collection, charts and graphs, measures of central tendency and spread, probability models and inference. As pupils progress, they develop a more critical understanding of reliability, bias, correlation and causation. Probability and statistics equip pupils with the mathematical tools needed to make informed judgements about information, risk and claims in the wider world.

Number and algebra	Geometry and measure	Probability and statistics
Integers	Measurement	Using data
Operations	Geometry	Data collection
Rounding and estimation	Perimeter, area and volume	Probability
Fractions	Coordinate geometry	
Decimals		
Percentages		
Equivalences		
Sequences		
Algebraic representation		
Functions and graphs		
Equations and inequalities		
Ratio		
Proportion		

Foundation Stage

In the Foundation Stage, children take their first steps into the world of mathematics: they learn the language for describing pattern, structure and quantity. They begin to count, to compare, to sort and to notice pattern. They develop an understanding of number through counting and subitising, building a sense of how abstract numbers represent concrete things in the world. They notice what stays the same and what changes. Children begin to recognise even and odd numbers by pairing, explore simple addition and subtraction through concrete objects, and encounter early fraction language through halves and quarters. From the start, children are encouraged to enjoy moments of new mathematical discovery that come from careful thinking.

In geometry, they sort and describe shapes, explore positional language, and build pictures and models from familiar 2-D and 3-D shapes. In measurement, they compare length, mass and capacity using non-standard units, and learn to sequence events in time. Children also begin to handle data by sorting objects, recording simple observations and talking about what the information shows.

Number and algebra

Integers

Primary 1

Pupils should learn:

- even numbers are numbers that can be made into pairs with none left over
- odd numbers are numbers that leave one over when you make pairs

Pupils should learn to:

- recite, forwards and backwards, within 10, from any starting point
- apply the following principles of counting with groups of up to 10 objects:
    - stable order (e.g. the sequence of numbers does not change)
    - 1:1 correspondence (e.g. each number in the count sequence corresponds to one object)
    - cardinality (i.e. the last number said corresponds to the total amount)

  - order irrelevance (i.e. the order objects are counted in does not affect the total amount)
  - abstraction (e.g. any collection of things can be counted even if they are different)
- perceptually subitise quantities up to and including 6
- conceptually subitise quantities up to and including 10
- identify and represent numbers to 10 using objects and pictorial representations, including on a number track
- identify one more or one less than a given number within 10
- sort small sets of objects into even and odd by pairing, explaining whether an object is left over
- compare and order numbers/quantities between 0 and 10, using the language of more/most, less/least, fewer/fewest, greater/greatest, the same as
- write the number sequence 0–10 and use numerals (digits) to represent quantities

Primary 2

Pupils should learn:

- zero represents nothing

Pupils should learn to:

- apply the principles of counting with groups of up to 20 objects
- identify and represent numbers to 20 using objects and pictorial representations
- compare and order numbers/quantities within 20, using the language of more/most, less/least, fewer/fewest, greater/greatest, the same as
- recite, forwards and backwards, within 100, from any starting point
- place numbers between 0 and 100 on a number line and identify one more or one less
- read and write numbers between 0 and 100

Integers (operations)

Primary 1

Pupils should learn that:

- numbers can be broken into parts, and these parts can be used to aid efficient calculation

Pupils should learn to:

- add within numbers up to 10 by counting all or counting on
- subtract within numbers up to 10 by taking away and counting back
- recall and use number bonds up to and within 10
- represent addition and subtraction problems with concrete objects and pictorial representations
- represent problems involving equal groups with concrete objects and pictorial representations

Primary 2

Pupils should learn that:

- addition is commutative but subtraction is not
- addition and subtraction are inverse operations
- the additive structures include partitioning, augmentation, reduction, aggregation and comparison

Pupils should learn to:

- recall and use number bonds up to and within 20
- use addition and subtraction facts to solve problems (e.g. using near doubles or 'bridge to 10') using appropriate representations (including symbols, bar models, number lines, and ten frames) and choosing efficient strategies
- recognise multiplication as repeated addition, and complete simple multiplication using concrete objects or pictorial representations including arrays
- recognise division as grouping or sharing, and complete simple division using concrete objects or pictorial representations including arrays

Rounding and estimation

Primary 1

Pupils should learn to:

- estimate how many are in a set within 10, and check by counting
- estimate which of two sets is greater, without counting

Primary 2

Pupils should learn to:

- estimate how many are in a set within 20, and check by counting

Fractions

Primary 2

Pupils should learn:

- a half is a unit whole split into two equal parts, displayed through objects, shapes or quantities
- a quarter is a unit whole split into four equal parts, displayed through objects, shapes or quantities

Sequences

Primary 2

Pupils should learn to:

- complete, continue and create a repeating pattern involving shapes, colours or numbers
- continue and create repeating patterns (including by size, colour and shape), incorporating AAB and ABC patterns into their creations

Algebraic representation

Primary 2

Pupils should learn that:

- equations can be balanced (e.g. 2 + 3 = 4 + 1) and this can be demonstrated using pan balances, manipulatives, and bar models

Geometry and measure

Measurement

Primary 1

Pupils should learn:

- the days of the week and months of the year

Pupils should learn to:

- use the language of:
    - long(er)/longest, short(er)/shortest, big(ger)/biggest, tall(er), tallest
    - heavy/heavier/heaviest, light(er)/lightest, more/most, less/least, full/empty, more than/less than
- measure length/mass/capacity using non-standard units
- sequence the events of their day or well-known stories using ordinal language and image prompts

Primary 2

Pupils should learn to:

- measure and compare length/mass/capacity using non-standard units, describing the difference found during comparison
- tell the time using the language of 'o clock' and 'half past' (on both analogue and digital clocks)
- order days, months, and seasons, and describe the duration of each category (for example, there are 7 days in a week)

Geometry

Primary 1

Pupils should learn to:

- describe the position of objects relative to themselves and to other objects using positional language (e.g. next to, behind, above, below)
- recognise that position and direction depend on the orientation of the observer (e.g. understanding that left and right change when you turn around)
- continue and create repeating patterns using familiar shapes
- make 3-D shapes from other shapes
- build pictures and models using 2-D and 3-D shapes
- sort and describe shapes based on similarities, differences and observable attributes

Primary 2

Pupils should learn to:

- recognise and name common 2-D and 3-D shapes, including in the environment, regardless of their size, colour or orientation:
    - 2-D shapes: rectangles (including squares), circles and triangles
    - 3-D shapes: cuboids, cubes, pyramids and sphere

Coordinate geometry

Primary 1

Pupils should learn to:

- follow and give simple directions to move objects using arrows (left, right, up, down, above, below, beside)
- give simple descriptions of familiar routes

Primary 2

Pupils should learn to:

- connect clockwise (turning right) and anticlockwise (turning left) on a clock face, and use angles to turn directions in the form quarter turn, half turn, three-quarter turn in both ways
- describe horizontal and vertical directions to give directions on a grid

Probability and statistics

Using data

Primary 2

Pupils should learn to:

- organise a given data set into a tally chart
- answer simple questions about data collection (e.g. the most popular colour)

Data collection

Primary 1

Pupils should learn to:

- sort a range of objects into categories (e.g. sorting counters by colour)

Primary 2

Pupils should learn to:

- collect categorical data from their immediate environment (e.g. classmates' favourite colours)

Key Stage 1

In Key Stage 1, pupils build on their Foundation Stage experiences to develop secure knowledge of number, the beginnings of formal calculation, and a growing repertoire of mathematical language. This is the stage at which fluency is established in the most foundational ideas that unlock later learning, ideas that must be secure before later learning can proceed. Through practice, key facts and methods become automatic and 'natural'.

In number and algebra, pupils extend their understanding of place value from tens to thousands, learning to read, write, compare and order numbers. They develop addition and subtraction through a range of representations and begin to work with multiplication and division, understanding these operations through grouping, sharing, repeated addition and arrays. They begin to work with fractions, with an emphasis on these as numbers on a number line.

In geometry and measure, pupils name and describe a growing range of 2-D and 3-D shapes, identify angles and turns, and begin to work with standard units of length, mass and capacity. They read scales, tell the time, work with money, and start to navigate grids. In probability and statistics, they collect, organise and represent data, and answer simple questions about what it shows.

Number and algebra

Integers

Primary 3

Pupils should learn:

- < and > symbols
- the place value of both digits in a two-digit number, knowing that 10 units are exchanged/regrouped for a single ten

Pupils should learn to:

- read and write numbers to 100 in numerals and words
- compare, order and estimate numbers/quantities within 100, including using the language of equal to and between
- identify and represent numbers to 100 using objects and pictorial representations

- count in steps of 2, 3, and 5 from zero forwards and backwards within 100
- count in tens to and from any number within 100
- identify a missing value(s) between two numbers within 100
- partition any two-digit number into tens and units (e.g. 56 = 50 + 6 and 56 = 40 + 16)

Primary 4

Pupils should learn:

- 1000 is equal to ten hundreds or one hundred tens
- the place value of any digit in a three-digit number

Pupils should learn to:

- read and write numbers to 1000 in numerals and words
- count forwards and backwards in multiples of 10, 50 and 100 up to 1000
- count in ones, tens, and hundreds to/from any number within 1000
- identify and represent numbers to 1000 using objects and pictorial representations
- compare, order, and estimate numbers up to 1000
- partition any three-digit number into hundreds, tens and units (e.g. 156 = 100 + 50 + 6 and 156 = 140 + 16)
- count forwards and backwards within 1000 using step increments

Integers (Operations)

Primary 3

Pupils should learn that:

- multiplication is commutative but division is not
- multiplication and division are inverse operations
- a number is even if there are none left over when dividing by two
- a number is odd if there is one left over when dividing by two
- multiplication and division can be understood through several related structures: multiplication can be represented as repeated addition and scaling, while division can be interpreted as either quotitive or partitive division[1]

1 Teachers do not need to use these terms with pupils, but they should understand the distinctions.

Pupils should learn to:

- recall and use addition and subtraction facts up to 20 fluently, and derive and use related facts up to 100
- add and subtract, using appropriate representations (including symbols, bar models and number lines) and choosing efficient strategies:
    - a two-digit number and a single-digit number
    - a two-digit number and a multiple of ten
    - two two-digit numbers
- recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables (these and all other multiplication tables to be learned up to × 10)
- multiply and divide using appropriate representations (including symbols, bar models, and arrays) and choose efficient strategies

Primary 4

Pupils should learn to:

- add and subtract numbers of up to three digits using the formal written methods of column addition and subtraction, including with regrouping
- add and subtract up to three-digit numbers using efficient mental strategies:
    - by partitioning, bridging, and compensation, including cases that cross tens and hundreds
    - by counting on or back in multiples of ten and one hundred
- recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables
- use appropriate representations (including symbols, bar models, number lines and arrays) for addition, subtraction, multiplication and division problems, choosing efficient strategies
- use known multiplication facts to derive related facts (e.g. by doubling or multiplying by ten)
- multiply a two-digit number by a one-digit number using mental and written strategies

Rounding and estimation

Primary 3

Pupils should learn to:

- identify the two nearest multiples of 10 for a given number and state which one it is closest to
- estimate the position of a value on a number line to 100

Primary 4

Pupils should learn to:

- round numbers of up to 1000 to the nearest 10 and 100
- estimate the position of a value on a number line to 1000
- estimate answers to calculations by rounding one or more numbers

Fractions

Primary 3

Pupils should learn that:

- a fraction is part of a whole
- unequal partitions are not halves or quarters
- the numerator and denominator describe different parts of the fraction. A fraction can be written with a slanted line or horizontal line (e.g. ¾ or $\frac{3}{4}$)
- a unit fraction is a fraction where the numerator is one

Pupils should learn to:

- read and write unit fractions, indicate them by shading a simple diagram, and place them on a number line
- compare and order unit fractions

Primary 4

Pupils should learn that:

- the same fraction can be written as many equivalent fractions without changing the value
- a non-unit fraction is a fraction where the numerator is not one

Pupils should learn to:

- read and write non-unit fractions (including those greater than one whole), indicate them by shading a simple diagram, and place them on a number line
- compare and order unit and non-unit fractions with the same denominator
- demonstrate equivalency of two or more equivalent fractions using a pictorial representation or double number line
- compare and order non-unit fractions with the same numerator
- add and subtract fractions with the same denominator where the total is less than a whole

Sequences

Primary 3

Pupils should learn to:

- continue and create a repeating pattern involving numbers
- recognise skip counting is a repeating numeric pattern

Primary 4

Pupils should learn to:

- recognise, complete, continue and create a repeating pattern involving an increasing or decreasing constant amount (limited to integers)

Algebraic representation

Primary 3

Pupils should learn that:

- a symbol, such as a box or question mark, can be used to represent an unknown number

Equations and inequalities

Primary 3

Pupils should learn that:

- the equals sign means 'is equal to' and is not directional

Pupils should learn to:

- express equalities involving differently partitioned quantities (e.g. $5 + 2 = 3 + 4 = 6 + 1$)

Geometry and measure

Measurement

Primary 3

Pupils should learn to:

- estimate, measure and compare length/mass/capacity using standard units:
    - length – centimetres/metres
    - mass – kilograms
    - capacity – litres
- read scales of 2, 5 and 10 when measuring length/mass/capacity
- tell the time using the language of 'quarter to/quarter past' (on both an analogue and digital clock)
- tell the time to the nearest five minutes (drawing times accurately on analogue clocks)
- know the length of different units with time (e.g. 60 minutes in an hour, 24 hours in a day)
- find different combinations of coins to create the same amount of money
- add and subtract quantities of money using coins to give change

Primary 4

Pupils should learn to:

- estimate, measure, compare, and add and subtract length/mass/capacity using standard units:
    - length – millimetres/centimetres/metres/kilometres
    - mass – grams/kilograms
    - capacity – millilitres/centilitres/litres
- choose appropriate units when solving problems involving standard units of measure
- read scales of 20, 25 and 50 when measuring length/mass/capacity
- tell the time to the nearest minute (drawing times accurately on analogue clocks)
- calculate time periods in whole numbers of hours (e.g. earlier or later)
- follow and give simple directions to move objects for multiple movements (left, right, up, down, above, below, beside)

- compare and order units of measurements and use symbols to compare <, >, =
- recognise, use, compare and order different units of money presented in pounds (£) and pence (p)
- know the number of seconds in a minute, number of days in each month, number of days in a year and a leap year

Geometry

Primary 3

Pupils should learn to:

- name and sketch 2-D shapes, identifying and describing their properties using the terms sides and vertices, regardless of their size or orientation (including pentagon, hexagon, octagon and decagon)
- name 3-D shapes, identifying and describing their properties using the terms faces, edges and vertices (including cube, cuboid, pyramid and prism)
- name cones and cylinders, identifying and describing their properties
- compare and sort shapes into groups based on their properties
- identify angles as a property of a shape between two lines meeting
- identify the following angles, and their corresponding turn (including within shapes):
    - right angle, quarter turn
    - two right angles, half a turn
    - three right angles, three quarter turns

Primary 4

Pupils should learn to:

- name 2-D shapes, identifying and describing their properties using the terms sides and vertices, regardless of their size or orientation (including septagon, heptagon, nonagon and dodecagon)
- identify and describe the properties of more complex 3-D shapes (including tetrahedron, octahedron, dodecahedron)
- recognise the 2-D shape of a cross-sectional face of a 3-D shape (e.g. the cross section of a cuboid could be rectangles, or rectangles and squares)
- identify and describe 3-D shapes using the terms faces (flat surfaces) and curved surfaces, including when presented in different orientations

Perimeter, area and volume

Primary 4

Pupils should learn to:

- recognise perimeter as the distance around the boundary of a shape
- find the perimeter of shapes by counting or adding non-standard equal-length units
- identify and measure the perimeter of a 2-D shape as the sum of its side lengths
- recognise area as the amount of surface a 2-D shape covers
- measure area by counting the number of equal-sized units used (e.g. counting how many squares cover a shape)

Coordinate geometry

Primary 3

Pupils should learn to:

- identify, describe and draw horizontal and vertical lines
- use positional and directional vocabulary to describe and follow movements along straight lines and turns, including rotations in right-angle steps, recognising that each right-angle turn is a quarter turn

Primary 4

Pupils should learn to:

- describe positions on a 2-D grid, identifying rows and columns
- locate objects and label positions using two reference early coordinate systems (e.g. letter/number, A3)

Probability and statistics

Using data

Primary 3

Pupils should learn to:

- organise a given data set into a table, including with tallying
- represent and interpret data using pictographs, block charts and bar charts, including using many-to-one correspondence and scales with simple ratios (e.g. 2, 5, 10)

- answer questions about a data set using a given representation, including calculating and comparing totals (e.g. 'how many more people prefer X to Y?')
- organise and classify data by sorting items into two or more groups according to their properties, including using Venn diagrams and Carroll diagrams

Primary 4

Pupils should learn to:

- represent and interpret data choosing scales with the most appropriate ratio

Data collection

Primary 3

Pupils should learn to:

- collect discrete numerical data from their immediate environment (e.g. how many siblings classmates have)

Primary 4

Pupils should learn to:

- differentiate between categorical or numerical data
- consider whether data collection was fair

Key Stage 2

In Key Stage 2, pupils develop the breadth and depth of their mathematical knowledge. Numbers grow larger and more varied, methods become more efficient, and mathematics begins to reveal its capacity to model and make sense of the world. Pupils are helped to see through complexity to identify what matters.

In number and algebra, pupils work fluently across all four operations, including with multi-digit numbers and using formal written methods. They develop a thorough understanding of fractions, decimals and percentages, and the relationships between them. Pupils begin early algebraic thinking: exploring sequences, using symbols to represent unknowns, and reasoning about functions.

In geometry and measure, pupils work with a wider range of 2-D and 3-D shapes, including complex polygons and composite figures. They calculate perimeter and area, encounter volume, and develop skill with measurement across multiple units.

In probability and statistics, pupils collect, represent and interpret increasingly complex data sets using bar charts, line graphs, frequency tables and pie charts. They calculate the mean and range, compare data sets, and begin to consider bias and fairness in data collection.

Number and algebra

Integers

Primary 5

Pupils should learn:

- the notation used for square and cube numbers

Pupils should learn to:

- read and write numbers to 10,000 in numerals and words
- compare, order and estimate numbers up to 10,000
- identify and represent numbers to 10,000 using objects and pictorial representations
- count forwards and backwards within 10,000 using increments of 10, 25, 50, 100, 1000
- partition numbers up to 10,000 into thousands, hundreds, tens and units/ones

- identify the value of each digit in a number up to 10,000
- compare and order positive and negative numbers

Primary 6

Pupils should learn:

- the prime numbers below 30
- the square numbers up to 144 and their corresponding roots

Pupils should learn to:

- read and write numbers to 100,000 in numerals and words
- compare, order and estimate numbers up to 100,000
- identify and represent numbers to 100,000 using objects and pictorial representations
- count forwards and backwards within 100,000 using increments of 10, 25, 50, 100, 1000, 10,000
- partition numbers up to 100,000 into tens of thousands, thousands, hundreds, tens and units/ones
- identify the value of each digit in a number up to 100,000
- count forwards and backwards across zero to include negative numbers
- identify factors and multiples of whole numbers (e.g. list the factors of 60, or list the first ten multiples of 13)
- identify common factors in two numbers up to 100

Primary 7

Pupils should learn:

- the cube numbers up to 125 and their corresponding roots

Pupils should learn to:

- read and write numbers to 10,000,000 in numerals and words
- compare, order and estimate numbers up to 10,000,000
- identify and represent numbers to 10,000,000 using objects and pictorial representations

- count forwards and backwards within 10,000,000 using increments of powers of 10
- partition numbers up to 10,000,000 into hundreds of thousands, tens of thousands, thousands, hundreds, tens and units/ones
- identify the value of each digit in a number up to 10,000,000
- identify the lowest common multiple in a set of two or more numbers up to 12
- identify the highest common factor in a set of two or more numbers under 100
- identify whether a number within 100 is prime or composite
- use negative numbers in real-life contexts, such as temperature and money, including calculating the difference between two numbers where at least one is negative

Integers (Operations)

Primary 5

Pupils should learn:

- multiplying and dividing by 1 have the same effect on the calculation

Pupils will learn to:

- add and subtract any numbers up to 10,000, choosing efficient mental strategies or formal written methods
- recall and use multiplication and division facts up to 12×12
- multiply numbers of up to two digits by 10 and one-digit numbers by multiples of 10
- multiply any number by a one-digit number using the formal written method
- divide two-digit numbers by numbers up to 12 with remainders using division facts (e.g. $\frac{43}{6} = 7$ r 1 and $7\frac{1}{6}$)
- divide any multiple of ten up to 10,000 by 10
- use inverse operations to check answers to calculations

Primary 6

Pupils should learn:

- that multiplication and division occur before addition and subtraction in the order of operation

Pupils should learn to:

- mentally multiply any number by a power of ten, or any two-digit number by a single digit using partitioning or factors (e.g. 21 × 7)
- mentally divide any multiple of ten by a power of ten where the solution is an integer
- multiply any number by a one-digit number, or a two-digit by two-digit number using the formal written method
- divide up to four-digit numbers by one-digit numbers choosing efficient mental strategies or the formal written method, interpreting remainders depending on context

Primary 7

Pupils should learn:

- that calculations contained inside brackets happen first in the order of operations

Pupils should learn to:

- multiply up to four-digit numbers by two-digit numbers using the formal written method
- divide any number by an integer up to and including 12 using a formal written method, including calculations leading to a remainder or terminating decimals
- add, subtract, multiply and divide choosing efficient mental strategies where appropriate

Rounding and estimation

Primary 5

Pupils should learn:

- the significance of the digit 5 when rounding

Pupils should learn to:

- round any number up to 10,000 to any power of 10
- round any number of up to one decimal place to the nearest unit

Primary 6

Pupils should learn to:

- round any whole number below 100,000 to any power of 10
- round any number of up to three decimal places to a given number of decimal places (including to the nearest unit)

Primary 7

Pupils should learn to:

- round any number to a required degree of accuracy, and use this to check a result is reasonable

Fractions

Primary 5

Pupils should learn:

- the denominator is the divisor when finding fractions of amounts

Pupils should learn to:

- express a given fraction as an equivalent fraction, including writing a fraction in its simplest form
- find a fraction of an amount using a bar model (e.g. $\frac{1}{8}$ of 24, $\frac{4}{5}$ of 20, $\frac{2}{3}$ of 9)
- find a fraction of an amount using mental methods (e.g. $\frac{3}{20}$ of 60, $\frac{9}{40}$ of 160)
- given a fraction of an integer amount, find the value of the whole (e.g. $\frac{2}{3}$ of a number = 10, what is the number?)
- compare and order fractions where one denominator is a multiple of the other
- add and subtract fractions (including fractions greater than one) with the same denominator using a number line, a bar model, and a formal written method

Primary 6

Pupils should learn:

- the calculation to find a fraction of an amount can be written with a multiplication symbol

Pupils should learn to:

- write and connect the decimal representation and fraction representation of tenths, and hundredths and thousandths
- recognise and convert between a mixed number and an improper fraction and vice versa
- compare and order unlike fractions, including fractions greater than one
- add and subtract fractions (including fractions greater than one) where one denominator is a multiple of the other using a number line, a bar model, and a formal written method

Primary 7

Pupils should learn to:

- add and subtract fractions with the same or different denominators using a formal written method ($\frac{6}{7} - \frac{2}{7}$, $\frac{1}{2} + \frac{3}{8}$, $\frac{11}{15} - \frac{3}{4}$), including fractions greater than one

Decimals

Primary 5

Pupils should learn:

- a tenth is a whole divided by 10 equal parts and can be written as a decimal

Pupils should learn to:

- read, write, order and compare decimals with one decimal place
- identify, recognise, write and represent on a number line any number of tenths, writing decimal equivalents as fractions and vice versa
- add and subtract numbers with one decimal place
- mentally multiply numbers with one decimal place by 10 or 100 and divide numbers by 10 or 100 including where the solution is a decimal with one decimal place

Primary 6

Pupils should learn:

- a hundredth is a whole divided by 100 equal parts, and a thousandth is a whole divided by 1000 equal parts. These can be written as decimals
- the place value of each successive decimal place is ten times smaller than the previous decimal place

Pupils should learn to:

- partition decimals (less than 1 and greater than 1) into tenths, hundredths and thousandths
- read, write, order and compare decimals with the same or a different number of decimal places (including decimal greater than 1) up to three decimal places
- identify, recognise, write and represent on a number line any number of tenths and hundredths

- add and subtract numbers with up to three decimal places
- mentally multiply and divide integers and decimals by powers of ten, including where the solution is a decimal (up to three decimal places)

Primary 7

Pupils should learn to:

- multiply decimals with up to three decimal places by whole numbers using the formal written method of long multiplication
- divide decimals with up to three decimal places by a single-digit integer using a formal written method, where the solution is an integer or terminating decimal

Percentages

Primary 6

Pupils should learn:

- a percentage is a fraction where the denominator is 100, and that 100% means the whole
- the per cent symbol (%) is related to 'number of parts per hundred'

Pupils should learn to:

- find benchmark percentages (10%, 25% and 50%) of quantities

Primary 7

Pupils should learn:

- percentages are commutative (25% of 40 is the same as 40% of 25)

Pupils should learn to:

- find 1%, 5% and 20% of quantities
- use benchmark percentages to derive other percentages (e.g. by recombining or scaling including using a double number line)
- given a percentage of an amount, find the value of the whole (where the percentage is a benchmark or suitably favourable number)

Equivalences

Primary 5

Pupils should learn:

- the decimal equivalent of $\frac{1}{2}$ and fractions with the denominator 10

Primary 6

Pupils should learn:

- the following common equivalences:

Fraction	Decimal	Percentage
$\frac{1}{1}$	1	100%
$\frac{1}{2}$	0.5	50%
$\frac{1}{4}$	0.25	25%
$\frac{3}{4}$	0.75	75%
$\frac{1}{10}$	0.1	10%
$\frac{1}{100}$	0.01	1%

Pupils should learn to:

- convert between, compare, and order fractions, decimals and percentages using the common equivalencies and facts derived from these
- write any number up to three decimal places as a fraction, and any fraction where the denominator is 10, 100 or 1000 as a decimal

Primary 7

Pupils should learn:

- the following common equivalences:

Fraction	Decimal	Percentage
$\frac{1}{3}$	0.33333…	33 %
$\frac{1}{5}$	0.2	20%

Pupils should learn to:

- convert between a decimal (up to three decimal places) and a percentage (up to one decimal place), and convert either of these into a fraction

Sequences

Primary 5

Pupils should learn to:

- recognise, complete, continue and create a repeating pattern involving an increasing or decreasing constant amount, where the amount is a fraction or decimal (to one decimal place)

Primary 6

Pupils should learn to:

- generate or continue a numerical sequence for a given term-to-term rule (up to two-step rules using simple operations, including triangular numbers)

Primary 7

Pupils should learn to:

- identify a one-step term-to-term rule for a given numerical sequence and represent this using words, pictorial symbols, or as a function machine

Algebraic representation

Primary 7

Pupils should learn to:

- use simple formulae expressed in words
- generalise number relationships using words or pictorial symbols

Functions and graphs

Primary 6

Pupils should learn to:

- represent a one- or two-step rule as a function machine and use this to calculate both inputs and outputs
- plot a simple line graph using the positive-positive coordinate quadrant to represent change over time

Primary 7

Pupils should learn to:

- use a linear graph for conversions between two variables

Equations and inequalities

Primary 5

Pupils should learn:

- the equals sign can be thought of as a balanced scale

Primary 6

Pupils should learn to:

- apply the same operation to both sides of the equals sign
- use inequality symbols in equations with operations on both sides of the symbol

Ratio

Primary 7

Pupils should learn:

- introductory language for ratio (e.g. 'part' and 'whole' and 'part-to-part' descriptions within worded problems)

Pupils should learn to:

- find parts and wholes in worded problems, without using ratio notation

Geometry and measure

Measurement

Primary 5

Pupils should learn:

- equivalents of length, mass and capacity (e.g. 1 km = 1000 m)

Pupils should learn to:

- estimate length, mass and capacity in real life, choosing appropriate units
- convert between cm and mm by multiplying or dividing by 10, including decimals to one decimal place

- read scales of any increment when measuring length/mass/capacity
- convert between units of time (hours to minutes, minutes to seconds, years to months, weeks to days) and between analogue and 12- and 24-hour clocks
- calculate the time that has elapsed between two given points in time, where the elapsed time is a multiple of 10 minutes
- interpret scales on maps and drawings

Primary 6

Pupils should learn to:

- convert between different metric units by multiplying or dividing by powers of 10
- compare and order metric measures where conversion may be necessary
- calculate the time that has elapsed between two given points in time
- solve money problems including calculating change where money is written in decimal notation

Primary 7

Pupils should learn:

- approximate equivalences between:
    - inches and centimetres
    - miles and kilometres
    - pints and litres
    - pounds and kilograms

Pupils should learn to:

- compare and order mixed measures (e.g. hours and days, pints and litres)
- convert between metric and imperial units, either using known approximations or where the conversion factor is given
- convert between currencies where an exchange rate is given
- read a timetable

Geometry

Primary 5

Pupils should learn:

- acute angles are less than 1 right angle
- obtuse angles are between 1 and 2 right angles
- reflex angles are greater than 2 right angles

Pupils should learn to:

- identify all the lines of symmetry in a 2-D shape, regardless of orientation
- complete a partial drawing of a 2-D shape using a given line of symmetry
- identify whether a given angle is acute, obtuse or reflex
- identify, describe and compare the following shapes:
    - triangles: equilateral triangle, isosceles triangle, scalene
    - quadrilaterals: parallelogram, rhombus, trapezia, kite
- identify and define parallel and perpendicular lines (including vertical and horizontal lines); draw parallel and perpendicular lines on a grid

Primary 6

Pupils should learn:

- the angle sum of a triangle is 180 degrees
- a regular polygon has equal sides and equal angles

Pupils should learn to:

- estimate angles to the nearest ten degrees
- use a ruler to draw lines to the nearest millimetre
- measure and draw angles to the nearest two degrees
- identify and distinguish between regular and irregular polygons
- identify and state the number of lines of symmetry and order of rotational symmetry for a regular polygon
- calculate unknown angles in triangles

Primary 7

Pupils should learn:

- congruent shapes are exactly the same size and shape
- the following angle rules:
    - angles on a straight line sum to 180 degrees
    - angles at a point sum to 360 degrees
    - vertically opposite angles are equal

Pupils should learn to:

- identify and sketch 3-D shapes using their properties (e.g. cubes, cuboids, triangular prism, cylinder, cone, pyramid [square-based, triangular-based])
- identify spheres and hemispheres
- accurately draw 2-D shapes using given dimensions and angles
- find missing angles using known angle rules

Perimeter, area and volume

Primary 5

Pupils should learn:

- different shapes can have the same perimeter or the same area
- shapes with the same perimeter do not necessarily have the same area (and vice versa)

Pupils should learn to:

- find the perimeter of rectangles by counting squares
- find the area of rectangles by counting squares
- explain the relationship between rows, columns, and total area in a rectangle

Primary 6

Pupils should learn:

- the perimeter of a rectangle can be calculated as double the length plus double the width
- the area of a rectangle can be calculated by multiplying length by width

Pupils should learn to:

- find the perimeter of rectangles
- find the area of rectangles
- estimate and compare area of shapes (including square centimetres, and square metres)

Primary 7

Pupils should learn to:

- calculate the area of triangles and parallelograms
- recognise volume as the amount of 3-D space an object occupies, explaining how changes to length, width or height impact the volume
- measure volume by counting equal-sized 3-D units (e.g. counting cubes used to fill a box)
- find the volume of rectangular prisms by counting layers and units within each layer, including using cubic centimetres or cubic metres

Coordinate geometry

Primary 6

Pupils should learn to:

- identify and plot x and y coordinates on the first quadrant of the cartesian plane
- construct 2-D shapes by plotting coordinates on the first quadrant of the cartesian plane
- describe movements on a coordinate grid – left, right, up, down

Primary 7

Pupils should learn to:

- translate simple shapes in the first quadrant of the cartesian plane
- interpret and construct grid maps to show positions and movement, using alphanumeric references, directional language and eight compass points

Probability and statistics

Using data

Primary 5

Pupils should learn:

- the conventions used when creating visual representations, including alignment, labels, and scale

Pupils should learn to:

- represent and interpret data using frequency tables
- interpret data from charts and graphs and use this to make comparisons or calculations (e.g. sums of and differences between categories)

Primary 6

Pupils should learn to:

- represent and interpret data using grouped frequency tables
- represent and interpret time-series data using line graphs, including identifying if the data shows a trend
- interpret and complete tables, including timetables

Primary 7

Pupils should learn:

- suitable representations for different types of data, and the justifications for this
- the mean is found by dividing the total of all the values by the number of values in a given set
- the range is found by subtracting the lowest value from the highest value in a given set

Pupils should learn to:

- interpret pie charts (e.g. comparing the relative sizes of segments)
- compare two or more data sets by comparing charts that represent them
- identify and state the mode for a frequency table, and the modal interval for a grouped frequency table

- summarise and compare data sets using the mean and range
- generate and investigate hypotheses using data (e.g. 'boys in our class are taller than girls'), including considering issues of bias

Data collection

Primary 5

Pupils should learn to:

- collect time-series data

Primary 6

Pupils should learn to:

- collect continuous numerical data from their immediate environment (e.g. how tall classmates are)
- collect bivariate data from their immediate environment (e.g. height and arm length of classmates)
- consider the most appropriate categories or class intervals to use for data collection
- use rounding, where appropriate, when collecting data (e.g. recorded lengths being rounded to nearest cm, 12.7 cm = 13 cm)

Primary 7

Pupils should learn to:

- generate hypotheses about their environment, consider what data should be collected to test the hypothesis, and consider how to collect this data fairly

Probability

Primary 7

Pupils should learn to:

- describe real-world events as: impossible, unlikely, even-chance, likely or certain

Pupils should learn to:

- represent the likelihood of real-world events on a line from 0–1, impossible to certain

Key Stage 3

In Key Stage 3, mathematics becomes more powerful and more abstract. Pupils apply and extend the knowledge they have built across the primary years, learning the mathematical techniques they need to reason systematically, solve problems, and construct arguments. They learn that difficulty is not a barrier but part of the discipline.

In number and algebra, pupils deepen their understanding of the number system, working with standard form and prime factors. Fractions, decimals and percentages are treated as a unified system, and pupils begin applying them to more complex real-world problems. Formal algebra is introduced as a way to express general relationships, including proportion, and to manipulate symbols with purpose.

In geometry and measure, pupils learn a broader range of angle facts and properties of shapes, and apply these to solve geometric problems. They work with similarity and scale, applying proportional reasoning to shapes and space. In coordinate geometry, pupils work with representations of relationships between variables and with transformations of shapes.

In probability and statistics, pupils handle a wider range of data types and representations, including scatter graphs and lines of best fit, and reason carefully about correlation and causation. They encounter probability, including the difference between theoretical and experimental probability. They use these ideas to evaluate claims and make informed mathematical predictions.

Number and algebra

Integers

Pupils should learn:

- the symbols $\neq$, $\leq$, $\geq$
- the square numbers from 169 up to 225 and their corresponding roots
- the cube numbers from 216 up to 1000 and their corresponding roots
- the notation for square and cube roots

Pupils should learn to:

- identify the integer values between which the square root of a non-square number lies (e.g. the square root of 40 is between 6 and 7)

- use their knowledge of square numbers and decimal multiplication to state square and cube roots that can be derived from known facts (e.g. the square root of 0.49 is 0.7)
- write repeated multiplication using index notation, and calculate powers of integers
- write, interpret and compare numbers in standard form
- express a number as a product of its prime factors
- find highest common factor / lowest common multiple of two numbers using prime factorisation

Integers (Operations)

Pupils should learn to:

- extend the four operations to calculations that include negative numbers
- evaluate calculations using the order of operations, including brackets, powers and roots for positive and negative integers
- apply the four operations to numbers presented in standard form and manipulate place value to present the result in standard form

Rounding and estimation

Pupils should learn to:

- state the range of possible values of a number or measure, given knowledge of how it was rounded
- express error intervals using inequality notation

Fractions

Pupils should learn that:

- fractions and integers can be multiplied together and that this is commutative
- the reciprocal of n is $\frac{1}{n}$ and the reciprocal of $\frac{a}{b}$ is $\frac{b}{a}$
- a number multiplied by its reciprocal equals 1
- multiplying by a fraction is equivalent to finding that fraction of the amount (e.g. $\frac{2}{3}$ multiplied by 12 is equivalent to $\frac{2}{3}$ of 12 and $\frac{1}{2}$ multiplied by $\frac{1}{4}$ is equivalent to finding $\frac{1}{2}$ of $\frac{1}{4}$)
- dividing by a fraction is equivalent to multiplying by its reciprocal

Pupils should learn to:

- multiply a fraction by an integer, including by representing this as repeated addition
- state reciprocals of integers and fractions
- multiply two or more fractions, including fractions greater than one (e.g. $\frac{1}{4} \times \frac{1}{5}$, $\frac{2}{3} \times \frac{4}{15}$)
- divide:
    - a unit fraction by an integer and vice versa (e.g. $\frac{1}{10} \div 6$, $8 \div \frac{1}{3}$)
    - an integer by any fraction (e.g. $6 \div \frac{2}{5}$)
    - a proper fraction by a proper fraction (e.g. $\frac{4}{5} \div \frac{1}{2}$, $\frac{2}{3} \div \frac{3}{4}$)
    - any two fractions/mixed numbers (e.g. $1\frac{1}{4} \div \frac{1}{2}$, $1\frac{2}{5} \div \frac{5}{8}$)
- interpret a fraction as a division calculation, and write a division calculation as a fraction
- state the fraction equivalent to terminating decimals (e.g. $\frac{9}{2} = 4.5$, $\frac{5}{8} = 0.625$)

Decimals

Pupils should learn:

- the definition of recurring and terminating decimals and the notation for recurring decimals

Pupils should learn to:

- multiply two (or more) numbers less than one (to one decimal place) together mentally (e.g. 0.2×0.4)
- multiply two or more decimal numbers (up to three decimal places) using a formal written method
- divide an integer by a positive number less than 1 (up to two decimal places) (e.g. $4 \div 0.1$, $10 \div 0.25$, $9 \div 0.3$)
- divide a decimal number by another decimal number (up to three decimal places) (e.g. $0.45 \div 0.5$, $1.275 \div 0.005$, $0.9 \div 0.003$)

Percentages

Pupils should learn that:

- to find a percentage of an amount you can multiply by the equivalent decimal value (e.g. to find 45% of 75 you can multiply 0.45 by 75)

Pupils should learn to:

- calculate any percentage of an amount using an appropriate method, including decimal multipliers
- increase or decrease an amount by a given percentage in a range of contexts (e.g. in a sale clothes are reduced by 15%, what is the new cost of a jacket that cost £60)
- express one quantity as a percentage of another number (e.g. if 7 of a class of 30 pupils wear glasses, what percentage of pupils wear glasses?)
- compare and order two or more quantities using percentages (e.g. compare 120% of 30 and 80% of 40)
- calculate change between two quantities and express as a percentage (e.g. profit/loss problems)
- calculate the original amount of a quantity if given the amount after a percentage change has taken place (e.g. a coat was discounted by 20% and now costs £60, what did it cost before?)

Equivalences

Pupils should learn:

- decimal and percentage equivalents of further common fractions ($\frac{1}{8}$, $\frac{1}{5}$, $\frac{2}{5}$, $\frac{3}{5}$, $\frac{4}{5}$) including fractions with denominators of 10 or 100
- a fraction can be converted to a decimal by dividing the numerator by the denominator

Pupils should learn to:

- interpret percentages and percentage changes as a fraction or a decimal
- convert between, compare and order any fraction, decimal and percentage (including less than 1% or greater than 100%) using mental methods and with the help of a calculator

Sequences

Pupils should learn that:

- a number pattern increasing or decreasing by a constant amount (through addition and subtraction) is an arithmetic sequence
- a number pattern increasing or decreasing by a constant amount (through multiplication and division) is a geometric sequence
- there are sequences that are neither arithmetic or geometric: triangular numbers, square numbers, cube numbers, and the Fibonacci sequence

Pupils should learn to:

- recognise, complete, continue and create a repeating pattern involving an increasing or decreasing constant amount (involving fractions and decimal numbers)
- identify the constant increase or decrease in a linear relationship algebraically
- generate terms of a sequence using either the term-to-term rule or position-to-term rule
- determine an expression for the nth term of an arithmetic sequence

Algebraic representation

Pupils should learn that:

- the perimeter of a rectangle can be expressed algebraically as $2(a + b)$, where a and b are perpendicular dimensions in the same unit
- the area of a rectangle can be expressed algebraically as $ab = a \times b$, where a and b are perpendicular dimensions in the same unit

Pupils should learn:

- the following algebraic notation:
  - $1a = 1 \times a = a$
  - $0 \times a = 0a = 0$
  - $1a + 1a = 2a$
  - $a^0 = 1$
  - $a^1 = a$
  - $a + b = b + a$
  - $a \times b = b \times a = ab$
  - $a^1 \times a^1 = a^2$
  - $a^1 \times a^1 \times a^1 = a^3$
  - $\frac{a}{b} = a \div b = a \times \frac{1}{b}$
- the definitions of a constant, a variable, a term, an expression, an equation, a function, an identity and an inequality and how they differ

Pupils should learn to:

- form expressions to represent the generalised structure of arithmetic, including from real-world contexts (e.g. if the cost of a taxi is £2 per mile plus a fixed charge of £5, this can be represented as $C = 2m + 5$)

- substitute values into expressions, equations and formulae and evaluate the result
- manipulate algebraic expressions to maintain equivalence, including by:
    - collecting or separating like terms
    - multiplying and dividing by a constant
    - expanding single brackets
    - factorising by removing a common factor
    - using exponent laws
- compare algebraic expressions and determine whether two expressions are equivalent (e.g. are $2(x + 3)$ and $2x + 3$ equivalent?)

Functions and graphs

Pupils should learn that:

- a straight line on a graph represents a linear relationship where there is a constant rate of change given by the gradient
- the gradient is a ratio that can be interpreted as the 'steepness', and that steeper gradients represent a greater rate of change
- a linear relationship that passes through the origin is directly proportional, meaning one value is a multiple of the other

Pupils should learn to:

- sketch a graph to represent a linear relationship
- draw accurately a graph to represent a linear function of one variable with appropriate scaling on a cartesian plane, including generating a table of values from an equation and drawing graphs of the form $x = a$ or $y = b$
- calculate the gradient and write down the intercept of a linear graph
- write a linear equation in the form of $y = mx + c$, and interpret a given equation of a line
- use a graph, including of non-linear functions, to estimate a value of y for a given value of x and vice versa
- recognise the equivalence of numerical, algebraic and graphical representations of a linear relationship, use these interchangeably, and explain the relationships between the variables
- draw and interpret graphs of change relative to time (e.g. distance, speed, electricity consumption, water flow)

Equations and inequalities

Pupils should learn that:

- performing the same operation to the expressions on both sides of the equals sign preserves equivalence

Pupils should learn to:

- form and solve linear equations in one variable, with rational solutions, by conducting operations that preserve equivalence
- rearrange formulae by conducting operations that preserve equivalence
- form and solve linear equations with unknowns on both sides, including fractional expressions
- represent an inequality on a number line
- form and solve linear inequalities in one variable by conducting operations that preserve equivalence, except where solution involves multiplication or division by a negative number

Ratio

Pupils should learn:

- that ratio is a method of splitting wholes into parts, so that the part-to-part relationship is shown
- that ratios can have three or more parts
- that a multiplicative relationship between two or more quantities can be expressed as a ratio or a fraction (e.g. 2:5 can be expressed as $\frac{2}{7}$ and $\frac{5}{7}$)

Pupils should learn to:

- read and write ratios with any number of layers, and represent ratios as a bar model
- identify and convert between equivalent ratios, including writing ratios in the form 1:n or n:1 and writing ratios in their simplest form
- combine two or more ratios into a single ratio
- use a ratio to share a quantity, and calculate the total quantity given information about the parts
- write and use a ratio to model information from a worded problem
- convert ratios into fractions and vice versa

Proportion

Pupils should learn:

- that a proportional relationship is one which expresses a ratio with two layers
- that a directly proportional relationship is always linear, but the converse is not necessarily true
- that an inversely proportional relationship is always non-linear
- that compound measures are an application of unitary ratios/directly proportional relationships (e.g. 20 mph means 20 miles for every one hour)

Pupils should learn to:

- identify a directly proportional graph and use it to convert between variables
- represent a directly proportional relationship algebraically and use this to calculate values (e.g. $y = kx$)
- identify an inversely proportional graph and use it to convert between variables
- represent an inversely proportional relationship algebraically and use this to calculate values (e.g. $y = \frac{k}{x}$)
- recognise proportionality in context (e.g. recipes, similar shapes, scale drawings)

Geometry and measure

Measurement

Pupils should learn to:

- convert between metric units of area and volume (e.g. convert from square kilometres into square metres and vice versa)

Geometry

Pupils should learn:

- where similar shapes have had all side lengths enlarged by a common scale factor, the angles have not changed
- enlargement is the only transformation where the size of the original shape is altered by the transformation
- to identify and mark conventional line and angle notation: points, lines, parallel lines, perpendicular lines, equal side lengths, equal angle size, right angles, and geometric facts demonstrating regular polygons and symmetry

- the following angle facts:
    - angles in a quadrilateral sum to 360 degrees
    - exterior angles of a polygon sum to 360 degrees
    - given a pair of parallel lines and a transversal:
        - alternate angles are equal
        - corresponding angles are equal
        - co-interior angles sum to 180 degrees
- the relationships between:
    - the radius and diameter of a circle
    - the diameter and circumference of a circle
    - the radius and area of a circle
- Pythagoras' Theorem and the first two Pythagorean triples (3, 4, 5 and 5, 12, 13)

Pupils should learn to:

- classify triangles using their angle and side length properties
- find missing angles using known angle facts
- identify whether a pair of shapes are similar or not, and use similarity to find missing side lengths
- calculate the sum of interior angles of a polygon; calculate the size of each interior or exterior angle on a regular polygon
- identify, describe and draw circles using the features: radius, diameter, sector, segment, arc, chord and circumference
- use information about the radius, diameter, circumference or area of a circle to find other given missing values
- recognise, and draw a net of a 3-D shape, with or without scaled dimensions
- use a standard ruler and compass to construct accurately:
    - perpendicular bisector of a line segment
    - a perpendicular to a given line
    - a perpendicular to a given point bisecting a given angle
- identify, apply and represent shapes using one or more of the transformations on a square grid or coordinate grid (positive scale factors only):

  - reflection
  - rotation
  - translation
  - enlargements
- describe a transformation between two or more shapes using the necessary properties for the appropriate transformation
- identify, use and calculate unknown angles in maps using bearings in different contexts (e.g. coordinate systems, grid reference systems)
- use Pythagoras' Theorem to find a missing side length

Perimeter, area and volume

Pupils should learn that:

- Pi is an irrational number that is the ratio of the circumference of any circle to its diameter and can be approximated to 3.14
- the surface area is the total area of each face of a 3-D shape

Pupils should learn to:

- calculate the perimeter of rectilinear shapes, regular polygons and composite shapes (including triangles, regular polygons and trapezia)
- calculate the perimeter of a circle using either the radius or diameter
- calculate the area of
  - rectilinear shapes
  - rhombi, trapezia and kites
  - compound shapes composed of the above
- calculate the area of a circle using either the radius or diameter, and composite shapes including semi-circles and quarter circles
- calculate the surface area of a cube, cuboid, and a triangular prism
- calculate the volume of
  - cubes and cuboids
  - prisms, including cylinders

Coordinate geometry

Pupils should learn to:

- identify and plot x and y coordinates on all four quadrants of the cartesian plane, using ordered pairs or values from a table
- construct and transform 2-D shapes by plotting coordinates on the cartesian plane
- calculate the midpoint of a line segment drawn on a cartesian plane

Probability and statistics

Using data

Pupils should learn that:

- correlation is not causation

Pupils should learn to:

- represent and interpret data using pie charts, dot plots and scatter graphs
- interpret time-series graphs showing the change of a real-life variable (e.g. temperature, population growth, cost)
- draw a line of best fit for bivariate data and describe the correlation
- calculate the median of a dataset
- calculate the mean from a frequency table and an estimate of the mean from a grouped frequency table
- compare two data sets using their averages and ranges; select the most appropriate average to use for comparison and explain the consequences of that selection
- identify outliers and consider whether or not to remove them, explaining the impact on averages and the range of doing so

Data collection

Pupils should learn to:

- identify the type of data collected, including discrete, continuous, qualitative, quantitative, primary and secondary data
- understand the term bias and identify possible sources of bias in samples or surveys

Probability

Pupils should learn that:

- probabilities are on a scale between 0 and 1, where 0 is impossible and 1 is certain
- probabilities can be described as fractions, decimals or percentages
- the probabilities of all possible outcomes sum to 1
- there is a difference between theoretical and experimental probability

Pupils should learn to:

- list all possible outcomes of an event or combined event, including using a sample space
- calculate a theoretical probability as the number of favourable outcomes from the total number of possible outcomes
- add probabilities of events to find a combined probability
- calculate expected frequency as the product of theoretical probability and the number of trials
- conduct an experiment and calculate the experimental probability of each outcome
- know the difference between experimental probability and theoretical probability
- identify and explain when events are and are not mutually exclusive

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