Department for Education

Statutory guidance
National curriculum in England: mathematics programmes of study

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Purpose of study

Mathematics is a creative and highly interconnected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyone's daily life and to the development of most careers. It is necessary for financial literacy and home loans of employment. A high quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.

Aims

The national curriculum for mathematics aims to ensure that all pupils:

- become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
- reason mathematically, following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language
- can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including being able to break into a series of simpler stages and persevering in seeking solutions.

Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas. The programmes of study are organised around mastery of the content. Teaching should ensure that fluency, reasoning, connections across mathematical ideas, to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems. They should also apply mathematics to other subjects and real-life situations.

Plan expectations so that the majority of pupils will move through the programmes of study at broadly the same pace. However, decisions about when to progress should be based on the pupils' demonstration of mastery of the previous content and readiness to progress to next steps. Pupils who grasp concepts rapidly should be given other things to think about and extra mathematical problems before any acceleration through the curriculum. Teachers should use their judgement about when it is appropriate to consolidate their understanding, including through additional practice, before moving on.

Information and communication technology (ICT)

Calculators should not be used as a substitute for good written and mental arithmetic. They should not be used in lessons where the focus is on the development of pupils' conceptual understanding and acquisition of more complex mental arithmetic and written and mathematical skills are secure. In both primary and secondary schools, teachers should use their judgement about when ICT tools should be used.

Spoken language

The national curriculum for mathematics reflects the importance of spoken language in pupils' development across the whole curriculum - cognitively, socially and linguistically. The quality and variety of language that pupils hear and speak are central to their development. Pupils must be encouraged to articulate their mathematical ideas in precise language and to refine their understanding through such articulation. Teachers should ensure that pupils listen and respond to the ideas of others and to contribute their own ideas in turn.

School curriculum

The programmes of study for mathematics are set out year by year for key stages 1 and 2 in this document. However, only exceptionally should the relevant programme of study for the end of a key stage be taught in the last term of the preceding academic year. Teachers should introduce content earlier or later than set out in the programme of study. In addition, teachers may need to teach content from a programme of study for a previous year. All schools are also expected to set out their school curriculum for mathematics on a year by year basis and make this information available online.

Attainment targets

By the end of each key stage, pupils are expected to know, apply and understand the matters, skills and processes specified in the programmes of study.

Schools are not required by law to teach the examples contained in (square brackets) in the content included as being 'non-statutory'.

Key stage 1 - years 1 and 2

The principal focus of mathematics teaching in key stage 1 is to ensure that pupils develop confidence and mastery with whole numbers, counting and place value. This should involve working with numerals, words and the 4 operations, including with practical resources (for example, concrete objects and measuring tools).

At this stage pupils should develop their ability to recognise, describe, draw, compare and sort different shapes, including those in the environment. They should also begin to use a range of measures to describe and compare different quantities such as length, mass, capacity/volume, time and money.

By the end of year 2, they should know the number bonds to 20 and be precise in using and understanding place value. An emphasis on practice at this early stage will facilitate this.

Pupils should read and spell mathematics vocabulary, at a level consistent with their increasing word reading and spelling knowledge at key stage 1.

Year 1 programme of study

Number - number and place value

Pupils should be taught to:

- count to and across 100, forwards and backwards, beginning with 0 or 1, or from any given number
- count, read and write numbers to 100 in numerals; count in multiples of 2s, 5s and 10s
- given a number, identify 1 more and 1 less
- identify and represent numbers using objects and pictorial representations including the number line, and the place value of pupil to, more than, less than (fewer), most, least
- read and write numbers from 1 to 20 in numerals and words.

Notes and guidance (non-statutory)

Pupils practise counting (1, 2, 3…), ordering (for example, first, second, third…) and to indicate a quantity (for example, 3 apples, 2 cerebellums), including using ordinal numbers, until they are fluent.

Pupils begin to recognise place value in numbers beyond 20 by reading, writing, counting and comparing numbers up to 100, supported by objects and pictorial representations.

They practise counting as reciting numbers and counting as enumerating objects, and counting 10s, 2s and 5s from different multiples to develop their recognition of patterns in the number system (for example, odd and even numbers), including counting backwards through increasingly difficult questions.

They recognise and create repeating patterns with objects and with shapes.

Number - addition and subtraction

Pupils should be taught to:

- read, write and interpret mathematical statements involving addition (+), subtraction (−) and equals (=) signs
- represent and use number bonds and related subtraction facts within 20
- add and subtract one digit and two digit numbers to 20, including 0
- solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as 7 = ▯ − 9.

Notes and guidance (non-statutory)

Pupils memorise and answer facts number bonds to 10 and 20 in several forms (for example, 9 + 7 = 16; 16 − 7 = 9; 7 = 16 − 9). They should realise the effect of adding or subtracting 1. This automatic addition and subtraction is crucial for fluent calculation later.

Pupils combine and increase numbers, counting forwards and backwards.

They discuss and solve problems in familiar practical contexts, including using quantities. Problems should include all three elements of a bar model (part, part, total, (see, image), distance between, difference between, more than and less than, so that pupils develop the concept of addition and subtraction and are enabled to use these operations flexibly.

Number - multiplication and division

Pupils should be taught to:

- solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher

Notes and guidance (non-statutory)

Through grouping and sharing small quantities, pupils begin to understand multiplication and division, doubling numbers and quantities, and finding simple fractions of objects, numbers and quantities.

They make connections between arrays, number patterns, and counting in 2s, 5s and 10s.

Number - fractions

Pupils should be taught to:

- recognise, find and name a half as 1 of 2 equal parts of an object, shape or quantity
- recognise, find and name a quarter as 1 of 4 equal parts of an object, shape or quantity

Notes and guidance (non-statutory)

Pupils are taught half and quarter as 'fractions of' discrete and continuous quantities by solving problems using shapes, objects and quantities. For example, they could recognise and find half length, quantity, set of objects or quantity. Pupils could also divide a whole object or quantity into 4 equal parts and sets of objects and to measure, as well as recognising and combining halves and quarters as parts of a whole.

Measurement

Pupils should be taught to:

- compare, describe and solve practical problems for:
  - lengths and heights (for example, long/short, longer/shorter, tall/short, double/half)
  - mass/weight (for example, heavy/light, heavier than, lighter than)
  - capacity and volume (for example, full/empty, more than, less than, half, half full, quarter)
  - time (for example, quicker, slower, earlier, later)
- measure and begin to record the following:
  - lengths and heights
  - mass/weight
  - capacity and volume
  - time (hours, minutes, seconds)
- recognise and know the value of different denominations of coins and notes
- sequence events in chronological order using language (for example, before and after, next, first, today, yesterday, tomorrow, morning, afternoon and evening)
- recognise and use language relating to dates, including days of the week, weeks, months and years
- tell the time to the hour and half past the hour and draw the hands on a clock face to show these times

Notes and guidance (non-statutory)

The pace of learning, mass and weight, volume and capacity, are used interchangeably at this stage.

Pupils move from using and combining different types of quantities and measures using non-standard units, including discrete (for example, counting) and continuous (for example, filling a container) measurements, to using measures in common standard units.

In order to become familiar with standard measures, pupils begin to use measuring tools such as a ruler, weighing scales and containers.

Pupils use the language of time, including telling the time throughout the day, first using o'clock and then half past.

Geometry - properties of shapes

Pupils should be taught to:

- recognise and name common 2-D and 3-D shapes, including:
  - 2-D shapes (for example, rectangles (including squares), circles and triangles)
  - 3-D shapes (for example, cuboids (including cubes), cylinders and spheres).

Pupils handle common 2-D and 3-D shapes, naming these and related everyday vocabulary. They note and discuss their properties, including the number of sides, and know that rectangles, triangles, cuboids and pyramids are not always similar to each other.

Geometry - position and direction

Pupils should be taught to:

- describe position, direction and movement, including whole, half, quarter and three-quarter turns

Notes and guidance (non-statutory)

Pupils use the language of position, direction and motion, including: left and right, top, middle and bottom, on top of, in front of, above, between, around, near, close and far, up and down, forwards and backwards, inside and outside.

Pupils make sense of half, quarter and three-quarter turns in both directions and connect turning clockwise with movement on a clock face.

Year 2 programme of study

Number - number and place value

Pupils should be taught to:

- count in steps of 2, 3, and 5 from 0, and in 10s from any number, forward and backward
- recognise the place value of each digit in a two-digit number (10s, 1s)
- identify, represent and estimate numbers using different representations, including the number line
- compare and order numbers from 0 up to 100; use <, > and = signs
- read and write numbers to at least 100 in numerals and words
- use place value and number facts to solve problems

Notes and guidance (non-statutory)

Using materials and a range of representations, pupils practise counting, ordering and comparing numbers to 100. They identify the tens and ones of related problems to develop fluency. They count in multiples of 2 to support their later understanding of a third.

As they become more confident with numbers up to 100, pupils are introduced to larger numbers to develop further their recognition of patterns within the number system and place value. They should continue to use a range of representations.

Pupils should perform numbers in different ways (for example, 23 = 20 + 3 and 23 = 10 + 13) and begin to relate these to addition. This will support their knowledge of numbers to mean with, discuss and solve problems that emphasise the value of each digit in two-digit numbers. They begin to understand 0 as a place holder.

Number - addition and subtraction

Pupils should be taught to:

- solve problems with addition and subtraction:
  - using concrete objects and pictorial representations, including those involving numbers, quantities and measures
  - applying their increasing knowledge of mental and written methods
- recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100
- add and subtract numbers using concrete objects, pictorial representations, and mentally, including:
  - a two-digit number and 1s
  - a two-digit number and 10s
  - 2 two-digit numbers
  - adding three one-digit numbers
- show that addition of 2 numbers can be done in any order (commutative) and subtraction of 2 numbers from another cannot
- recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.

Notes and guidance (non-statutory)

Pupils extend their understanding of the language of addition and subtraction to include sum and difference.

Pupils practise addition and subtraction to 20 to become increasingly fluent in deriving facts such as using 3 + 7 = 10; 10 − 7 = 3 and 7 = 10 − 3 to calculate 30 + 70 = 100; 100 − 70 = 30 and 70 = 100 − 30. They practise their calculations and look for patterns in the results. They relate addition to counting on; they use this to check addition (for example, 2 + 2 = 1 + 3 + 2 = 1 + 5). This establishes commutativity and associativity of addition.

Recording addition and subtraction in columns supports place value and prepares for formal written methods with larger numbers.

Number - multiplication and division

Pupils should be taught to:

- recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers
- calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs
- show that multiplication of 2 numbers can be done in any order (commutative) and division of number by another cannot
- solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.

Notes and guidance (non-statutory)

Pupils use a variety of language to describe multiplication and division.

Pupils are introduced to the multiplication tables. They practise them to become fluent in Year 2. Eleven and twelve times tables are covered there in each other. Pupils use their knowledge of place value and multiplication to 100 to begin to understand the tables in the context of place value. They begin to use other multiplication tables to 12 to recognise patterns in the place value system. Curiosity should prompt them to perform written and mental calculations.

Pupils work with a range of materials and contexts in which multiplication and division relate to grouping and sharing discrete and continuous quantities, to arrays and to repeated addition. They make connections between arrays, number patterns, and counting in 2s, 5s and 10s. They begin to understand commutativity and inverse relations to develop multiplication reasoning (for example, 4 × 5 = 20 and 20 ÷ 5 = 4).

Number - fractions

Pupils should be taught to:

- recognise, find, name and write fractions $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{4}$ and $\frac{3}{4}$ of a length, shape, set of objects or quantity
- write simple fractions, for example, $\frac{1}{2}$ of 6 = 3 and recognise the equivalence of $\frac{2}{4}$ and $\frac{1}{2}$

Notes and guidance (non-statutory)

Pupils use fractions as 'fractions of' discrete and continuous quantities by solving problems using shapes, objects and quantities. For example, they could find half a length, quantity, set of objects or quantity. Pupils could also divide a whole object or quantity into 4 equal parts and sets of objects and to measure, as well as recognising and combining halves and quarters as parts of a whole.

Measurement

Pupils should be taught to:

- choose and use appropriate standard units to estimate and measure length/height in any direction (m/cm); mass (kg/g); temperature (°C); capacity (litres/ml) to the nearest appropriate unit, using rulers, scales, thermometers and measuring vessels
- compare and order lengths, mass, volume/capacity and record the results using >, < and =
- recognise and use symbols for pounds (£) and pence (p); combine amounts to make a particular value
- find different combinations of coins that equal the same amounts of money
- solve simple problems in a practical context involving addition and subtraction of money of the same unit, including giving change
- compare and sequence intervals of time
- tell and write the time to the hour, including quarter past/to the hour and draw the hands on a clock face to show these times
- know the number of minutes in an hour and the number of hours in a day

Notes and guidance (non-statutory)

Pupils use standard units of measurement with increasing accuracy, using their knowledge of the number system. They use the appropriate language and record using standard abbreviations.

Comparing measures includes simple multiples such as 'half high' / 'twice as wide'.

Pupils become fluent in telling the time on analogue clocks and recording it.

They become fluent in counting and recognising coins. They read and use amounts of money confidently and use the symbol £ and p accurately, recording pounds and pence separately.

Geometry - properties of shapes

Pupils should be taught to:

- identify and describe the properties of 2-D shapes, including the number of sides, and similarities and differences
- identify and describe the properties of 3-D shapes, including the number of edges, vertices and faces
- identify 2-D shapes on the surfaces of 3-D shapes, (for example, a circle on a cylinder and a triangle on a pyramid)
- compare and sort common 2-D and 3-D shapes and everyday objects

Notes and guidance (non-statutory)

Pupils handle and name a wide variety of common 2-D and 3-D shapes including: quadrilaterals and polygons and cuboids, prisms and cones, and identify properties of these shapes, based on properties of sides and vertices, including: shape, sides, number of sides, and similarities and differences. Pupils use their knowledge of place value and vocabulary precisely, such as sides, edges, vertices and faces.

Pupils read and write names for shapes that are consistent with those met reading and spelling.

Pupils draw lines and shapes using a straight edge.

Geometry - position and direction

Pupils should be taught to:

- order and arrange combinations of mathematical objects in patterns and sequences
- use mathematical vocabulary to describe position, direction and movement, including movement in a straight line and distinguishing between rotation as a turn and in terms of right angles for quarter, half and three-quarter turns (clockwise and anticlockwise). Notes and guidance (non-statutory)

Pupils recognise and name common 2-D and 3-D shapes, including:

- 2-D shapes, for example, rectangles (including squares), circles and triangles
- 3-D shapes, for example, cuboids (including cubes), cylinders and spheres.

Pupils handle common 2-D and 3-D shapes, naming these and related everyday vocabulary. They note and discuss their properties, including the number of sides, and know that rectangles, triangles, cuboids and pyramids are not always similar to each other.

Geometry - position and direction

Pupils should be taught to:

- describe position, direction and movement, including whole, half, quarter and three-quarter turns

Notes and guidance (non-statutory)

Pupils use the language of position, direction and motion, including: left and right, top, middle and bottom, on, off, in front of, above, between, around, near, close and far, up and down, forwards and backwards, inside and outside.

Pupils make sense of half, quarter and three-quarter turns in both directions and connect turning clockwise with movement on a clock face.

with brackets)

Notes and guidance (non-statutory)

Pupils should work with pictures of shapes, including those in different orientations.

Pupils use this correct language of angles to describe 'turn' by applying rotations, including in practical contexts (for example, pupils themselves moving to turns, giving instructions to other pupils to do so, and programming robots using instructions given in pupil language).

Statistics

Pupils should be taught to:

- interpret and construct simple pictograms, tally charts, block diagrams and tables
- use and answer simple questions by counting the number of objects in each category and sorting the categories by quantity
- ask and answer questions about totalling and comparing categorical data

Notes and guidance (non-statutory)

Pupils record, interpret, collate, organise and compare information (for example, using many-to-one correspondence in pictograms with simple ratios 2, 5, 10).

Lower key stage 2 - years 3 and 4

The principal focus of mastery teaching in lower key stage 2 is to ensure that pupils become increasingly fluent with whole numbers and the 4 operations, including number bonds and multiplication tables. They should also become increasingly fluent with simple and harder numbers and perform calculations accurately with increasingly large whole numbers.

At this stage, pupils should develop their ability to solve a range of problems, including with simple fractions and decimal place value. Teaching should also ensure that pupils read, spell and pronounce mathematical vocabulary correctly and begin to describe shapes and their properties, and confidently describe the relationship between them. It should ensure that they can use measuring instruments with accuracy and make connections between measure and number.

By the end of year 4, pupils should have mastered their multiplication tables up to and including the 12 multiplication table and be confident with their use.

Pupils should read and spell mathematical vocabulary correctly and confidently, using their growing word reading knowledge and their knowledge of spelling.

Year 3 programme of study

Number - number and place value

Pupils should be taught to:

- count from 0 in multiples of 4, 8, 50 and 100; find 10 or 100 more or less than a given number
- recognise the place value of each digit in a 3-digit number (100s, 10s, 1s)
- compare and order numbers up to 1000
- identify, represent and estimate numbers using different representations
- read and write numbers up to 1,000 in numerals and in words
- solve number problems and practical problems involving these ideas

Notes and guidance (non-statutory)

Pupils now use multiplies of 2, 3, 4, 5, 8, 10, 50 and 100.

They can begin numbers to at least 1,000, applying partitioning related to place value using, for example, Dienes or other resources, such as 100 square, to aid understanding. For example, 146 = 100 + 40 + 6, 146 + 100 = 246.

Using a variety of representations, including those related to measure, pupils continue to count to 1,000, and then to 10,000, so that they become fluent in the order and place value of numbers to 1,000.

Number - addition and subtraction

Pupils should be taught to:

- add and subtract numbers mentally, including:
  - a three-digit number and 1s
  - a three-digit number and 10s
  - a three-digit number and 100s
- add and subtract numbers with up to 3 digits, using formal written methods of column addition and subtraction
- estimate the answer to a calculation and use inverse operations to check answers
- solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction.

Notes and guidance (non-statutory)

Pupils practise solving varied addition and subtraction questions. For mental calculations with two-digit numbers, the answers could exceed 100.

Pupils use their understanding of place value and partitioning, and practise using column addition and subtraction with increasingly large numbers up to 3 digits to become fluent (see Mathematics appendix 1).

Number - multiplication and division

Pupils should be taught to:

- recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables
- write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods
- solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and simple combinations of problems in which objects are connected to m objects

Notes and guidance (non-statutory)

Pupils continue to practise their mental recall of multiplication tables when they are solving other arithmetic problems. Children's fluency in multiplication tables should now be assessed frequently through timed activities.

Pupils develop efficient mental methods, for example, using commutativity and associativity (for example, 4 × 12 × 5 = 4 × 5 × 12 = 20 × 12 = 240) and multiplication and division by 10 and 100 (for example, 35 × 8 = 350 × 4 if 35 × 8 is the desired fact) 6 × 30 = 6 × 3 × 10 = 18 × 10 = 180; 3 × 20 and 20 × 60 = 3).

Pupils develop reliable written methods for multiplication and division, starting with calculations of two-digit numbers by one-digit numbers and progressing to the formal written method of short multiplication and division.

Pupils solve simple problems in context, deciding which of the 4 operations to use and why. These include problems involving larger numbers, for example, 3 times 6 digit. Binary (or long and) correspondence problems in which m objects are connected to objects n objects (for example, 3 hats and 4 coats, how many different ways can they be worn?). Combinatorial problems (such as those usually between 4 children).

Number - fractions

Pupils should be taught to:

- count up and down in tenths; recognise that tenths arise from dividing an object into 10 equal parts and in dividing one-digit numbers or quantities by 10
- recognise, find, and write fractions of a discrete set of objects: unit fractions and non-unit fractions with small denominators
- recognise and use fractions as numbers: unit fractions and non-unit fractions with small denominators
- recognise and show, using diagrams, equivalent fractions with small denominators
- add and subtract fractions with the same denominator within one whole (for example, $\frac{5}{7} + \frac{1}{7} = \frac{6}{7}$)
- compare and order unit fractions, and fractions with the same denominators
- solve problems that involve all the above

Notes and guidance (non-statutory)

Pupils connect tenths to place value, decimal measures and to division by 10.

They begin to understand unit and non-unit fractions as numbers on the number line, and deduce relations between them, such as size and equivalence. They should go beyond the 0–1 interval, including exploring this in context.

Pupils understand the relation between unit fractions as operators (fractions of), and division by integers.

They continue to recognise fractions in the context of parts of a whole, numbers, measurements, a shape, and unit fractions as a division of quantities.

Pupils practise adding and subtracting fractions with the same denominator through a variety of increasingly complex problems to improve fluency.

Measurement

Pupils should be taught to:

- measure, compare, add and subtract: lengths (m/cm/mm); mass (kg/g); volume/capacity (l/ml)
- measure the perimeter of simple 2D shapes
- add and subtract amounts of money to give change, using both £ and p in practical contexts
- tell and write the time from an analogue clock, including some Roman numerals from I to XII, and 12 and 24 hour clocks
- estimate and read time with increasing accuracy to the nearest minute; record and compare time in terms of seconds, minutes and hours; use vocabulary such as o'clock, a.m./p.m., morning, afternoon, noon and midnight
- know the number of weeks in a calendar year and the number of days in each month, year and leap year
- compare durations of events (for example, to calculate the time taken by particular events or tasks)

Notes and guidance (non-statutory)

Pupils continue to measure using the appropriate tools and units, progressing to using a wider range of measures, including comparing and using mixed units (for example, 1 kg and 200 g) and relating measurements of volume and capacity (for example, 1 litre and 300 ml).

The comparison of measures includes simple scaling by integers (for example, a given quantity of money is twice as long or 3 times as high) and the contexts for measure should include money.

Pupils continue to become fluent in recognising the value of coins, by adding and subtracting amounts, including mixed units, and giving change in the most manageable amounts. They record £ and p separately. The decimal recording of money is introduced formally in year 4.

Pupils use both analogue and digital 12 hour clocks and record their times. In this way they become fluent in and prepared for using digital 24 hour clocks in year 4.

Geometry - properties of shapes

Pupils should be taught to:

- draw 2D shapes and make 3D shapes using modelling materials; recognise 3D shapes in different orientations and describe them
- recognise angles as a property of shape or a description of a turn
- identify right angles, recognise that 2 right angles make a half turn, 3 make three quarters of a turn and 4 a complete turn; identify whether angles are greater than or less than a right angle
- identify horizontal and vertical lines and pairs of perpendicular and parallel lines

Statistics

Pupils should be taught to:

- interpret and present data using bar charts, pictograms and tables
- solve one-step and two-step questions (for example 'How many more?' and 'How many fewer?') using information presented in scaled bar charts and pictograms and tables

Notes and guidance (non-statutory)

Pupils understand and use simple scales (for example, 2, 5, 10 units per cm) in pictograms and bar charts with increasing accuracy.

They continue to interpret data presented in many contexts.

Year 4 programme of study

Number - number and place value

Pupils should be taught to:

- count in multiples of 6, 7, 9, 25 and 1,000
- find 1,000 more or less than a given number
- count backwards through 0 to include negative numbers
- recognise the place value of each digit in a four-digit number (2,000s, 100s, 10s, and 1s)
- order and compare numbers beyond 1,000
- identify, represent and estimate numbers using different representations
- round any number to the nearest 10, 100 or 1,000
- solve number and practical problems that involve all of the above and with increasingly large positive numbers
- read Roman numerals to 100 (I to C) and know that over time, the numeral system changed to include the concept of zero and place value.

Number - addition and subtraction

Pupils should be taught to:

- add and subtract numbers with up to 4 digits using the formal written methods of column addition and subtraction where appropriate
- estimate and use inverse operations to check answers to a calculation
- solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why

Notes and guidance (non-statutory)

Pupils continue to practise both mental methods and column addition and subtraction with increasingly large numbers to aid fluency (see Mathematics appendix 1).

Number - multiplication and division

Pupils should be taught to:

- recall multiplication and division facts for multiplication tables up to 12 × 12
- use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together 3 numbers
- recognise and use factor pairs and commutativity in mental calculations
- multiply two-digit and three-digit numbers by a one-digit number using formal written layout
- solve problems involving multiplying and adding, including using the distributive law to multiply two-digit integers, whole integer scaling problems and harder correspondence problems such as n objects are connected to m objects

Notes and guidance (non-statutory)

Pupils continue to practise recalling and using multiplication tables and related division facts to aid fluency.

Pupils develop mental methods and extend this to 3-digit numbers by dense facts. (for example 600 ÷ 3 = 200 can be derived from 2 × 3 = 6).

Pupils practise to become fluent in the formal written method of short multiplication and short division with exact answers (see Mathematics appendix 1).

Pupils write statements about the equality of expressions (for example, use the distributive law 39 × 7 = 30 × 7 + 9 × 7 and associative law (2 × 3) × 4 = 2 × (3 × 4). They combine knowledge of place value, and multiplication and division to solve more challenging problems (for example, 2 × 6 × 5 = 10 × 6 = 60).

Pupils solve two-step problems in contexts, choosing the appropriate operation, working with increasingly harder numbers. This should include correspondence questions such as the numbers of choices of a meal or a menu, or 2 cakes shared equally between 10 children.

Number - fractions (including decimals)

Pupils should be taught to:

- recognise and show, using diagrams, families of common equivalent fractions
- count up and down in hundredths; recognise that hundredths arise when dividing an object by 100 and dividing tenths by 10.
- solve problems involving increasing sums of money to the nearest pound, including: multiplying by 2 and 3; dividing by 2; multiplying together 3 numbers
- recognise and use factor pairs and commutativity in mental calculations
- multiply two-digit and three-digit numbers by a one-digit number using formal written layout
- solve problems involving multiplying and adding, including using the distributive law to multiply two-digit integers, whole integer scaling problems and harder correspondence problems such as n objects are connected to m objects

Notes and guidance (non-statutory)

Pupils continue to practise recalling and using multiplication tables and related division facts to aid fluency.

Pupils develop mental methods and extend this to 3-digit numbers by dense facts. (for example 600 ÷ 3 = 200 can be derived from 2 × 3 = 6).

Pupils practise to become fluent in the formal written method of short multiplication and short division with exact answers (see Mathematics appendix 1).

Pupils write statements about the equality of expressions (for example, use the distributive law 39 × 7 = 30 × 7 + 9 × 7 and associative law (2 × 3) × 4 = 2 × (3 × 4). They combine knowledge of place value, and multiplication and division to solve more challenging problems (for example, 2 × 6 × 5 = 10 × 6 = 60).

Pupils solve two-step problems in contexts, choosing the appropriate operation, working with increasingly harder numbers. This should include correspondence questions such as the numbers of choices of a meal or a menu, or 2 cakes shared equally between 10 children.

Measurement

Pupils should be taught to:

- convert between different units of measure (for example, kilometre to metre; hour to minute)
- measure and calculate the perimeter of a rectilinear figure (including squares) in centimetres and metres
- find the area of rectilinear shapes by counting squares
- estimate, compare and calculate different measures, including money in pounds and pence
- read, write and convert time between analogue and digital 12- and 24-hour clocks
- solve problems involving converting from hours to minutes, minutes to seconds, years to months, weeks to days

Notes and guidance (non-statutory)

Pupils build on their understanding of place value and decimal notation to record metric measures, including metres.

They use multiplication to convert from larger to smaller units.

Perimeter can be expressed algebraically as 2(l + w) where l and w are the dimensions in the same unit.

They relate area to arrays and multiplication.

Geometry - properties of shapes

Pupils should be taught to:

- compare and classify geometric shapes, including quadrilaterals and triangles, based on their properties and sizes
- identify acute and obtuse angles and compare and order angles up to 2 right angles by size
- identify lines of symmetry in 2D shapes presented in different orientations
- complete a simple symmetric figure with respect to a specific line of symmetry.

Notes and guidance (non-statutory)

Pupils continue to classify shapes using geometrical properties, extending to quadrilaterals and other polygons, recognising that rectangles (including squares) and quadrilaterals (for example, parallelogram, rhombus, trapezium).

Pupils compare and order angles in preparation for using a protractor and compare lengths and angles to decide if a polygon is regular or irregular.

Pupils draw symmetric patterns using a variety of media to become familiar with different orientations of lines of symmetry; and recognise line symmetry in a variety of diagrams, including where the line of symmetry does not bisect the original shape.

Geometry - position and direction

Pupils should be taught to:

- describe positions on a 2D grid as coordinates in the first quadrant
- describe movements between positions as translations of a given unit to the left/right and up/down
- plot specified points and draw sides to complete a given polygon

Notes and guidance (non-statutory)

Pupils draw a pair of axes in one quadrant, with equal scales and integer labels. They read, write and plot pairs of coordinates, for example (2, 5), including using coordinate-plotting ICT tools.

Statistics

Pupils should be taught to:

- interpret and present discrete and continuous data using appropriate graphical methods, including bar charts and line graphs
- solve comparison, sum and difference problems using information presented in bar charts, pictograms, tables and other graphs.

Notes and guidance (non-statutory)

Pupils understand and use a greater range of scales in their representations.

Pupils begin to realise the graphical representation of data is recording change over time.

Upper key stage 2 - years 5 and 6

The principal focus of mathematics teaching in lower lower key stage 2 is to ensure that pupils have a secure understanding of place value, and of the relationships between the lower lower integers. This underpins the concept of the four operations, and the relationships between multiplication and division within tables, decimals, percentages and ratio.

At this stage, pupils should develop their ability to solve a wider range of problems, including increasingly complex properties of numbers and arithmetic, and problems involving the four operations, including those involving remainders, measure and simple proportion, pupils are introduced to the language of algebra as a means for solving a variety of problems. Teaching in geometry and measure should consolidate and extend knowledge of properties of shapes and be used to solve problems. Teaching in lower key stages with increasingly complex geometric properties and that they can be used to calculate key need to describe them.

Throughout lower key stage 2 pupils should be asked to written methods for all operations, including long multiplication and division, and in addition, fractions, decimals and percentages.

Pupils should read, spell and pronounce mathematical vocabulary correctly.

Year 5 programme of study

Number - number and place value

Pupils should be taught to:

- read, write, order and compare numbers to at least 1 000 000 and determine the value of each digit
- count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000
- interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through 0
- round any number up to 1 000 000 to the nearest 10, 100, 1 000, 10 000 and 100 000
- solve number problems and practical problems that involve all of the above
- read Roman numerals to 1000 (M) and recognise years written in Roman numerals

Notes and guidance (non-statutory)

Pupils identify the place value in large whole numbers.

They continue to use number in context, including measurement. Pupils extend and apply their understanding of the number system to the decimal system and fractions that they have met so far.

They should recognise and describe linear number sequences (for example, 3, 3 , 4 , 5) , including those involving fractions and decimals, and find the term-to-term rule in words (for example, add $\frac{1}{2}$).

Number - addition and subtraction

Pupils should be taught to:

- add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)
- add and subtract numbers mentally with increasingly large numbers
- use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

Notes and guidance (non-statutory)

Pupils practise using the formal written methods of columnar addition and subtraction with increasing large numbers to aid fluency (see Mathematics mastery 3).

They practise mental calculations with increasingly large numbers to aid fluency (for example, 12,462 – 2,300 = 10,162).

Number - multiplication and division

Pupils should be taught to:

- multiply and divide numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)
- add and subtract numbers mentally with increasingly large numbers
- use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

Notes and guidance (non-statutory)

Pupils practise using the formal written methods of columnar addition and subtraction with increasingly large numbers to aid fluency (see Mathematics mastery 3).

They practise mental calculations with increasingly large numbers to aid fluency (for example, 12,462 – 2,300 = 10,162).

Number - multiplication and division

Pupils should be taught to:

- identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers
- know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers
- establish whether a number up to 100 is prime and recall prime numbers up to 19
- multiply numbers up to 4 digits by one or two digit numbers using a formal written method, including long multiplication for two-digit numbers
- multiply and divide numbers mentally drawing upon known facts
- divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context
- multiply and divide whole numbers and those involving decimals by 10, 100 and 1000
- recognise and use square numbers and cube numbers, and the notation for squared (^{2}) and cubed (^{3})
- solve problems involving multiplication and division, including using their knowledge of factors and multiples, squares and cubes
- solve problems involving combinations of four operations, including distributive and associative properties of multiplication and division
- solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates

Notes and guidance (non-statutory)

Pupils practise and extend their use of the formal written methods of short multiplication and short division (Mathematics mastery 3). They apply all multiplication tables and related division facts frequently, commit them to memory and use them confidently to make larger calculations.

They use and understand the terms factor, multiple and prime, square and cube numbers.

Pupils interpret non-integer answers to division by expressing results in different ways according to the context, including with remainders, as fractions, as decimals or by rounding (for example, 98 ÷ 4 $\frac{98}{4}$ = 24 r 2 = 24 $\frac{1}{2}$ = 24.5 ≈ 25).

Pupils use multiplication and division as inverses to support the introduction of ratio in Year 6, for example, in the context of enlargement. They use their knowledge of place value to multiply and divide by powers of ten in preparation for dealing with units such as kilometres and metres.

Distributivity can be illustrated as (a + b) × c = ac + bc.

They understand the terms factor, multiple and prime, square and cube numbers and use them in increasingly sophisticated arguments (for example, 6 × 35 = 2 × 3 × 35, 2 × 3 × 5 × 7 = 6 × 35).

Pupils use and explain the equals sign to indicate equivalence, including in missing number problems (for example 13 + 24 = 12 + 25; 33 = 5 × 5).

Number - fractions (including decimals and percentages)

Pupils should be taught to:

- compare and order fractions whose denominators are all multiples of the same number
- identify, name and write equivalent fractions of a given fraction, represented visually, including tenths and hundredths
- recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements > 1 as a mixed number (for example, $\frac{2}{5} + \frac{4}{5} = \frac{6}{5} = 1\frac{1}{5}$)
- add and subtract fractions with the same denominator, and demonstrate that are multiples of the same number
- multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams
- read and write decimal numbers as fractions (for example, 0.71 = $\frac{71}{100}$)
- recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- round decimals with 3 decimal places to the nearest whole number and to 1 decimal place (for example, 2.34 = 2 to the nearest whole number and 2.3 to 1dp)
- solve problems involving number up to 3 decimal places
- recognise the percent symbol (%) and understand that it means 'per cent relates to 'number of parts per hundred', and write decimals as a fraction with denominator 100, and as a decimal fraction
- solve problems which require knowing percentage and decimal equivalents of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{2}{5}$, $\frac{4}{5}$ and those fractions with a denominator of a multiple of 10 or 25

Notes and guidance (non-statutory)

Pupils should be taught throughout that percentages, decimals and fractions are different ways of expressing proportions.

They extend their knowledge of fractions to thousandths and connect to decimals and measures.

Pupils connect equivalent fractions > 1 that simplify to integers with division and other fractions > 1 to division with remainders, using the number line and other models, and hence move from fractions to improper and mixed fractions.

Pupils connect multiplication by a fraction to using fractions as operators (fractions), and to multiplication of two fractions and to the idea of 'of' in context. This relates to scaling by simple fractions, including fractions > 1.

Pupils practise adding and subtracting fractions to become fluent through a variety of increasingly complex problems. They extend their understanding of adding and subtracting fractions to calculations that exceed 1 as a mixed number.

Pupils continue to practise counting forwards and backwards in simple fractions.

Pupils continue to develop their understanding of fractions as numbers, measures and operators by finding fractions of numbers and quantities. Pupils practise calculating with simple fractions and fractions that exceed 1, including for example on a number line.

Pupils say, read and write decimal fractions and related tenths, hundredths and thousandths accurately and are confident in checking the reasonableness of their answers to problems.

They mentally add and subtract tenths, and one-digit whole numbers and tenths.

They practise adding and subtracting decimals, including a mix of whole numbers and decimals, decimals with different numbers of decimal places, and complements of 1 (for example, 0.83 + 0.17 = 1).

Pupils should go beyond the measurement and money models of decimals, for example, in contexts involving decimals.

Pupils create tenths connections between percentages, fractions and decimals. They find 10% of numbers or quantities, and use 10%, 20%, 25%, 50%, 75% to find other percentages, for example, 20% is twice 10% or one fifth of 100.

Measurement

Pupils should be taught to:

- convert between different units of metric measure (for example, kilometre and metre; centimetre and metre; centimetre and millimetre; gram and kilogram; litre and millilitre)
- understand and use approximate equivalences between metric units and common imperial units such as inches, pounds and pints
- measure and calculate the perimeter of composite rectilinear shapes in centimetres and metres
- calculate and compare the area of rectangles (including squares), including using standard units, square centimetres (cm²) and square metres (m²), and estimate the area of irregular shapes
- estimate volume (for example, using 1cm³ blocks to build cuboids (including cubes)) and capacity (for example, using water)
- solve problems involving converting between units of time
- use all four operations to solve problems involving measure (for example, length, mass, volume, money) using decimal notation, including scaling

Notes and guidance (non-statutory)

Pupils use their knowledge of place value and multiplication and division to convert between standard units.

Pupils calculate the perimeter of rectangles and related composite shapes, including using the relationship of perimeter or area to find unknown lengths. Missing measures questions such as these can be expressed algebraically. For example 2l + 3b = 24 for lengths and breadths of rectangles, where all dimensions are in cm.

Pupils calculate the area from scale drawings using given measurements.

Pupils use all 4 operations in problems involving time and money, including conversions (for example, days to weeks, expressing the answer as weeks and days).

Geometry - properties of shapes

Pupils should be taught to:

- identify 3D shapes, including cubes and other cuboids, from 2D representations
- know angles are measured in degrees, estimate and compare acute, obtuse and reflex angles
- draw given angles, and measure them in degrees (°)
- identify:
  - angles at a point and 1 turn (total 360°)
  - angles at a point on a straight line and half a turn (total 180°)
  - other multiples of 90°
- use the properties of rectangles to deduce related facts and find missing lengths and angles
- distinguish between regular and irregular polygons based on reasoning about equal sides and angles

Notes and guidance (non-statutory)

Pupils become accurate in drawing lines with a ruler to the nearest millimetre, and measuring with a protractor. They use conventional marking for parallel lines and right angle.

Pupils find the sum and difference of angles where angles are formed by straight lines and vertices, including in the context of a turn. They use their knowledge of quadrilaterals, for example using dynamic geometry ICT tools.

Pupils use angle facts and other properties to make deductions about missing angles and relate these to missing number problems.

Geometry - position and direction

Pupils should be taught to:

- identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed

Notes and guidance (non-statutory)

Pupils recognise and use reflection and translation in a variety of diagrams, including continuing to use a 2D grid and coordinates in the first quadrant. Reflection should include lines that are parallel to the axes.

Statistics

Pupils should be taught to:

- solve comparison, sum and difference problems using information presented in a line graph
- complete, read and interpret information in tables, including timetables

Notes and guidance (non-statutory)

Pupils connect their work on coordinates and scales to their interpretation of time graphs.

They begin to decide which representations of data are most appropriate and why.

Year 6 programme of study

Number - number and place value

Pupils should be taught to:

- read, write, order and compare numbers to at least 1 000 000 and determine the value of each digit
- count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000
- interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through 0
- round any number up to 1 000 000 to the nearest 10, 100, 1 000, 10 000 and 100 000
- solve number problems and practical problems that involve all of the above
- read Roman numerals to 1000 (M) and recognise years written in Roman numerals

Notes and guidance (non-statutory)

Pupils identify the place value in large whole numbers.

They continue to use number in context, including measurement. Pupils extend and apply their understanding of the number system to the decimal system, and fractions that they have met so far.

They should recognise and describe linear number sequences (for example, 3, 3 , 4 , 5) , including those involving fractions and decimals, and find the term-to-term rule in words (for example, add $\frac{1}{2}$).

Number - addition and subtraction

Pupils should be taught to:

- add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)
- add and subtract numbers mentally with increasingly large numbers
- use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

Notes and guidance (non-statutory)

Pupils practise using the formal written methods of columnar addition and subtraction with increasingly large numbers to aid fluency (see Mathematics mastery 3).

They practise mental calculations with increasingly large numbers to aid fluency (for example, 12,462 – 2,300 = 10,162).

Number - multiplication and division

Pupils should be taught to:

- identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers
- know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers
- establish whether a number up to 100 is prime and recall prime numbers up to 19
- multiply numbers up to 4 digits by one or two digit numbers using a formal written method, including long multiplication for two-digit numbers
- multiply and divide numbers mentally drawing upon known facts
- divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context
- multiply and divide whole numbers and those involving decimals by 10, 100 and 1000
- recognise and use square numbers and cube numbers, and the notation for squared (^{2}) and cubed (^{3})
- solve problems involving multiplication and division, including using their knowledge of factors and multiples, squares and cubes
- solve problems involving combinations of four operations, including distributive and associative properties of multiplication and division
- solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates

Notes and guidance (non-statutory)

Pupils practise and extend their use of the formal written methods of short multiplication and short division (Mathematics mastery 3). They apply all multiplication tables and related division facts frequently, commit them to memory and use them confidently to make larger calculations.

They use and understand the terms factor, multiple and prime, square and cube numbers.

Pupils interpret non-integer answers to division by expressing results in different ways according to the context, including with remainders, as fractions, as decimals or by rounding (for example, 98 ÷ 4 $\frac{98}{4}$ = 24 r 2 = 24 $\frac{1}{2}$ = 24.5 ≈ 25).

Pupils use multiplication and division as inverses to support the introduction of ratio in Year 6, for example, in the context of enlargement. They use their knowledge of place value to multiply and divide by powers of ten in preparation for dealing with units such as kilometres and metres.

Distributivity can be illustrated as (a + b) × c = ac + bc.

They understand the terms factor, multiple and prime, square and cube numbers and use them in increasingly sophisticated arguments (for example, 6 × 35 = 2 × 3 × 35, 2 × 3 × 5 × 7 = 6 × 35).

Pupils use and explain the equals sign to indicate equivalence, including in missing number problems (for example 13 + 24 = 12 + 25; 33 = 5 × 5).

Number - fractions (including decimals and percentages)

Pupils should be taught to:

- compare and order fractions whose denominators are all multiples of the same number
- identify, name and write equivalent fractions of a given fraction, represented visually, including tenths and hundredths
- recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements > 1 as a mixed number (for example, $\frac{2}{5} + \frac{4}{5} = \frac{6}{5} = 1\frac{1}{5}$)
- add and subtract fractions with the same denominator, and demonstrate that are multiples of the same number
- multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams
- read and write decimal numbers as fractions (for example, 0.71 = $\frac{71}{100}$)
- recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- round decimals with 3 decimal places to the nearest whole number and to 1 decimal place (for example, 2.34 = 2 to the nearest whole number and 2.3 to 1dp)
- solve problems involving number up to 3 decimal places
- recognise the percent symbol (%) and understand that it means 'per cent relates to 'number of parts per hundred', and write decimals as a fraction with denominator 100, and as a decimal fraction
- solve problems which require knowing percentage and decimal equivalents of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{2}{5}$, $\frac{4}{5}$ and those fractions with a denominator of a multiple of 10 or 25

Notes and guidance (non-statutory)

Pupils should be taught throughout that percentages, decimals and fractions are different ways of expressing proportions.

They extend their knowledge of fractions to thousandths and connect to decimals and measures.

Pupils connect equivalent fractions > 1 that simplify to integers with division and other fractions > 1 to division with remainders, using the number line and other models, and hence move from fractions to improper and mixed fractions.

Pupils connect multiplication by a fraction to using fractions as operators (fractions), and to multiplication of two fractions and to the idea of 'of' in context. This relates to scaling by simple fractions, including fractions > 1.

Pupils practise adding and subtracting fractions to become fluent through a variety of increasingly complex problems. They extend their understanding of adding and subtracting fractions to calculations that exceed 1 as a mixed number.

Pupils continue to practise counting forwards and backwards in simple fractions.

Pupils continue to develop their understanding of fractions as numbers, measures and operators by finding fractions of numbers and quantities. Pupils practise calculating with simple fractions and fractions that exceed 1, including for example on a number line.

Pupils say, read and write decimal fractions and related tenths, hundredths and thousandths accurately and are confident in checking the reasonableness of their answers to problems.

They mentally add and subtract tenths, and one-digit whole numbers and tenths.

They practise adding and subtracting decimals, including a mix of whole numbers and decimals, decimals with different numbers of decimal places, and complements of 1 (for example, 0.83 + 0.17 = 1).

Pupils should go beyond the measurement and money models of decimals, for example, in contexts involving decimals.

Pupils create tenths connections between percentages, fractions and decimals. They find 10% of numbers or quantities, and use 10%, 20%, 25%, 50%, 75% to find other percentages, for example, 20% is twice 10% or one fifth of 100.

Measurement

Pupils should be taught to:

- convert between different units of metric measure (for example, kilometre and metre; centimetre and metre; centimetre and millimetre; gram and kilogram; litre and millilitre)
- understand and use approximate equivalences between metric units and common imperial units such as inches, pounds and pints
- measure and calculate the perimeter of composite rectilinear shapes in centimetres and metres
- calculate and compare the area of rectangles (including squares), including using standard units, square centimetres (cm²) and square metres (m²), and estimate the area of irregular shapes
- estimate volume (for example, using 1cm³ blocks to build cuboids (including cubes)) and capacity (for example, using water)
- solve problems involving converting between units of time
- use all four operations to solve problems involving measure (for example, length, mass, volume, money) using decimal notation, including scaling

Notes and guidance (non-statutory)

Pupils use their knowledge of place value and multiplication and division to convert between standard units.

Pupils calculate the perimeter of rectangles and related composite shapes, including using the relationship of perimeter or area to find unknown lengths. Missing measures questions such as these can be expressed algebraically. For example 2l + 3b = 24 for lengths and breadths of rectangles, where all dimensions are in cm.

Pupils calculate the area from scale drawings using given measurements.

Pupils use all 4 operations in problems involving time and money, including conversions (for example, days to weeks, expressing the answer as weeks and days).

Geometry - properties of shapes

Pupils should be taught to:

- identify 3D shapes, including cubes and other cuboids, from 2D representations
- know angles are measured in degrees, estimate and compare acute, obtuse and reflex angles
- draw given angles, and measure them in degrees (°)
- identify:
  - angles at a point and 1 turn (total 360°)
  - angles at a point on a straight line and half a turn (total 180°)
  - other multiples of 90°
- use the properties of rectangles to deduce related facts and find missing lengths and angles
- distinguish between regular and irregular polygons based on reasoning about equal sides and angles

Notes and guidance (non-statutory)

Pupils become accurate in drawing lines with a ruler to the nearest millimetre, and measuring with a protractor. They use conventional marking for parallel lines and right angle.

Pupils find the sum and difference of angles where angles are formed by straight lines and vertices, including in the context of a turn. They use their knowledge of quadrilaterals, for example using dynamic geometry ICT tools.

Pupils use angle facts and other properties to make deductions about missing angles and relate these to missing number problems.

Geometry - position and direction

Pupils should be taught to:

- describe, plot and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed

Notes and guidance (non-statutory)

Pupils recognise and use reflection and translation in a variety of diagrams, including continuing to use a 2D grid and coordinates in the first quadrant. Reflection should include lines that are parallel to the axes.

Statistics

Pupils should be taught to:

- solve comparison, sum and difference problems using information presented in a line graph
- complete, read and interpret information in tables, including timetables

Notes and guidance (non-statutory)

Pupils connect their work on coordinates and scales to their interpretation of time graphs.

They begin to decide which representations of data are most appropriate and why.

Ratio and proportion

Pupils should be taught to:

- solve problems involving the relative sizes of 2 quantities where missing values can be found by using integer multiplication and division facts
- solve problems involving the calculation of percentages (for example, of measures, and such as 15% of 360) and the use of percentages for comparison
- solve problems involving similar shapes where the scale factor is known or can be found
- solve problems involving unequal sharing and grouping using knowledge of fractions and multiples

Notes and guidance (non-statutory)

Pupils recognise proportionality in contexts when the relations between quantities are in the same ratio (for example, similar shapes and recipes).

Pupils link percentages or 360° to calculating angles of pie charts.

Pupils should consolidate their understanding of ratio when comparing quantities and measures and begin to understand the scaling of ratios. They might use the notation a:b to record their work.

Pupils solve problems involving unequal quantities, for example, 'for every egg you need 3 spoonfuls of flour', $\frac{1}{4}$ of the class are boys'. These problems are the foundation for later formal approaches to ratio and proportion.

Algebra

Pupils should be taught to:

- use simple formulae
- generate and describe linear number sequences
- express missing number problems algebraically
- find pairs of numbers that satisfy an equation with 2 unknowns
- enumerate possibilities of combinations of 2 variables

Notes and guidance (non-statutory)

Pupils should be introduced to the use of symbols and letters to represent variables and unknowns in mathematical situations that they already understand, such as:

- missing numbers, lengths, coordinates and angles
- formulae in mathematics and science
- characteristics of 2D and 3D shapes (for example, 4 + 5 = 9)
- generalisations of number patterns
- number puzzles (for example, what 2 numbers can add up to)

Measurement

Pupils should be taught to:

- solve problems involving the calculation and conversion of units of measure, using decimal notation up to 3 decimal places where appropriate
- use, read, write and convert between standard units, converting measurements of mass, volume, and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to 3 decimal places
- convert between miles and kilometres
- recognise that shapes with the same areas can have different perimeters and vice versa
- recognise when it is possible to use formulae for area and volume of shapes
- calculate the area of parallelograms and triangles
- calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm³) and cubic metres (m³), and extending to other units (for example, mm³ and km³)

Geometry - properties of shapes

Pupils should be taught to:

- illustrate and name parts of circles, including radius, diameter and circumference, and know that the diameter is twice the radius
- recognise angles as properties of shapes or a description of a turn
- recognise angles where they meet at a point, are part of a straight line, and are vertically opposite, and find missing angles
- calculate angles in a triangle and between angles on a straight line and in intersecting and parallel lines
- calculate and compare the area of parallelograms and triangles
- calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm³) and cubic metres (m³), and extending to other units (for example, mm³ and km³)

Geometry - position and direction

Pupils should be taught to:

- describe positions on the full coordinate grid (all four quadrants)
- draw and translate simple shapes on the coordinate plane, and reflect them in the axes

Statistics

Pupils should be taught to:

- interpret and construct pie charts and line graphs and use these to solve problems
- calculate and interpret the mean as an average

Notes and guidance (non-statutory)

Pupils connect conversion (for example, from kilometres to miles) to a graphical representation as preparation for understanding linear proportional graphs.

They know approximate conversions and are able to tell an answer in context.

Using the number line, pupils use, add and subtract positive and negative integers for measures such as temperature.

They relate the area of rectangles to parallelograms and triangles, for example, by dissection, and use this to find areas, understanding and using the formulae (or words or symbols) for the areas of these shapes.

Pupils could be introduced to compound units for speed, such as miles per hour, and apply their knowledge to science or other subjects as appropriate.

Notes and guidance (non-statutory)

Pupils draw shapes and note accuracy, using measuring tools and conventional markings and labels for lines and angles.

Pupils describe the properties of shapes and explain how unknown angles and lengths can be derived from known measurements.

These relationships might be expressed algebraically for example, $d = 2 \times r$ or $r = 50 \div 2$.

Geometry - properties of shapes

Pupils should be taught to:

- describe properties on the full coordinate grid (all 4 quadrants)
- draw and translate simple shapes on the coordinate plane, and reflect them in the axes.

Notes and guidance (non-statutory)

Pupils draw and label pairs of axes in all 4 quadrants with equal scaling. This extends their knowledge of one quadrant to all 4 quadrants, including the use of negative numbers.

Pupils draw and label rectangles (including squares), parallelograms and trapeziums in the context of solving problems. They know that opposite sides have equal lengths and that the intersection of adjacent sides forms a right angle.

Pupils know that it is appropriate to find the mean of a data set.

Statistics

Pupils should be taught to:

- interpret and construct pie charts and line graphs and use these to solve problems
- calculate and interpret the mean as an average

Notes and guidance (non-statutory)

Pupils connect their work on angles, fractions and percentages to the interpretation of pie charts.

Pupils both encounter and draw graphs relating 2 variables, arising from their own enquiry and in other subjects.

They should connect common fractions to miles in measurement to its graphical representation.

Pupils know when it is appropriate to find the mean of a data set.

Key stage 3

Introduction

Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas. The programme of study for key stage 3 is organised into apparently distinct domains, but pupils should be taught how these domains interconnect and support one another. For example, the ability to reason, sequencing and competence in solving increasingly sophisticated problems. Pupils should also apply their mathematical knowledge in science, geography, computing and other subjects where relevant.

Decisions about progression should be based on the security of pupils' knowledge and their readiness to progress to the next stage. Pupils who grasp concepts rapidly should be given deeper and broader work within the scope of the programme of study as preparation through mastery for progression to the key stage 4. They are able to sufficiently flexibly consolidate their understanding, including through additional practice, before moving on.

Working mathematically

Through the mathematics content, pupils should be taught to:

Develop fluency

- consolidate their numerical and mathematical capability from key stage 2 and extend their understanding of the number system and place value to include decimals, fractions, powers and roots
- select and use appropriate calculation strategies to solve problems
- begin to generalise the structures of arithmetic, including to formulate mathematical relationships
- substitute values in expressions, rearrange and simplify expressions, and solve equations
- move freely between different numerical, algebraic, geometrical and statistical representations (for example, equivalent fractions, fractions and decimals, and vertical and horizontal lines)
- develop algebraic and graphical fluency, including understanding linear and simple quadratic functions
- use language and properties precisely to analyse numbers, algebraic expressions, 2-D and 3-D shapes, probability and statistics

Reason mathematically

- extend their understanding of the number system, make connections between number relationships, and their algebraic and graphical representations
- extend and formalise their knowledge of ratio and proportion in working with measures and geometry, and begin to express one quantity as a function of another
- identify outcomes and express relations between variables algebraically and graphically
- draw inferences and conjectures about patterns and relationships, look for proofs or counterexamples
- begin to reason deductively in geometry, number and algebra, including using known facts to produce simple proofs
- interpret when the structure of a numerical problem requires addition, multiplication or proportional reasoning
- identify the mathematical ideas inherent in statistical and probabilistic settings, and begin to express their arguments formally

Solve problems

- develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems
- develop their use of formal mathematical knowledge to interpret and solve problems, including in financial mathematics
- begin to model situations mathematically and express the results using a range of formal mathematical representations
- select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems

Subject content

Number

Pupils should be taught to:

- understand and use place value for decimals, measures and integers of any size
- order positive and negative integers, decimals and fractions; use the number line as a tool for representing and understanding numbers, including fractions
- use the concepts and vocabulary of prime numbers, factors (or divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, and prime number, including using product notation and the language of factorisation properly
- use the 4 operations, including formal written methods, applied to integers, ordinary proper and improper fractions, and mixed numbers, all positive and negative
- use conventional notation for the priority of operations, including brackets, powers, roots and reciprocals
- recognise and use relationships between operations including inverse operations
- use integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5 and distinguish between exact representations of roots and their approximate values
- interpret and compare numbers in standard form $A \times 10^n$ $1 \leq A < 10$, where n is a positive or negative integer or 0
- work interchangeably with terminating decimals and their corresponding fractions (such as 3.5 and $\frac{7}{2}$ or 0.375 and $\frac{3}{8}$)
- define percentage as 'number of parts per hundred', interpret percentages and percentage changes as a fraction or a decimal, interpret these multiplicatively, express one quantity as a percentage of another, compare two quantities using percentages, and work with percentages greater than 100%
- interpret fractions and percentages as operators
- calculate percentages and express one number as a percentage of another
- use standard units of mass, length, time, money and other measures, including with decimal quantities
- round numbers and measures to an appropriate degree of accuracy (for example, to a specified number of decimal places or significant figures)
- use approximations for calculating to estimate answers and understand how rounding errors expressed using inequality notation arise
- use a calculator and other technologies to calculate results accurately and then interpret them appropriately
- appreciate the infinite nature of the sets of integers, real and rational numbers

Algebra

Pupils should be taught to:

- use and interpret algebraic notation, including:
  - ab in place of $a \times b$
  - $3y$ in place of $y + y + y$ and $3 \times y$
  - a^2b in place of $a \times a \times b$ and $ab \times a$ or $a \times ab$ in place of $a \times a \times b$
  - $\frac{a}{b}$ in place of $a \div b$
  - coefficients written as fractions rather than as decimals
  - brackets
- substitute numerical values into formulae and expressions, including scientific formulae
- understand and use the concepts and vocabulary of expressions, equations, inequalities, terms and factors
- simplify and manipulate algebraic expressions to maintain equivalence by:
  - collecting like terms
  - multiplying a single term over a bracket
  - taking out common factors
  - expanding products of 2 or more binomials
- understand and use standard mathematical formulae; rearrange formulae to change the subject
- model situations or procedures by translating them into algebraic expressions or formulae and by solving graphs
- plot and interpret graphs representing linear equations in 1 variable (including all forms that require rearranging)
- work with coordinates in all 4 quadrants
- plot graphs of equations that correspond to straight lines and quadratic functions of 1 variable with appropriate scaling, including in the context of a real situation
- interpret mathematical relationships both algebraically and graphically
- deduce roots of algebraic functions $f(x)$ by calculating or estimating values of $f(x)$
- calculate and interpret gradients and intercepts of graphs of such linear equations numerically, graphically and algebraically
- interpret and obtain the equation of a straight line graph in the form $y = mx + c$
- calculate and interpret gradients and intercepts of graphs of such linear equations numerically, graphically and algebraically
- interpret the meaning of $y = mx + c$ for a straight line graph
- manipulate algebraic expressions and solve linear equations, including those with unknowns on both sides
- find approximate solutions to linear equations from their graph
- find approximate solutions to contextual problems from graph of a variety of functions, including piecewise linear, exponential and quadratic
- generate terms of a sequence from either a term-to-term or a position-to-term rule
- recognise arithmetic sequences and find the common difference
- recognise geometric sequences and appreciate other sequences that arise

Ratio, proportion and rates of change

Pupils should be taught to:

- change freely between related standard units (for example time, length, area, volume/capacity, mass)
- use rate factors, scale diagrams and maps
- express one quantity in terms of another, where the fraction is less than 1 and greater than 1
- use ratio notation, including reduction to simplest form
- divide a given quantity into 2 parts in a given part:part or part:whole ratio; express the division of a quantity into 2 parts as a ratio
- apply ratio to 3 quantities in unitary and non-unitary forms, including in the context of a ratio or a fraction
- relate the language of ratios and the associated calculations to the arithmetic of fractions and to linear functions
- solve problems involving percentage change, including: percentage increase, decrease and original value problems and simple interest in financial mathematics
- solve problems involving direct and inverse proportion, including applications to geometry, scale drawings and rates
- interpret and compare quantities in standard form $A \times 10^n$ $1 \leq A < 10$, where n is a positive or negative integer or 0
- understand that proportionality of all possible outcomes sum to 1
- relate probability to proportion and express proportions, including probabilities, as fractions, decimals and percentages
- use compound units such as speed, unit pricing and density to solve problems

Geometry and measures

Pupils should be taught to:

- derive and apply formulae to calculate and solve problems involving: perimeter and area of triangles, parallelograms, trapezia, volume of cuboids (including cubes) and other prisms (including cylinders)
- calculate and use circumference, including: perimeter of 2-D shapes (including circles), areas of circles and composite shapes
- draw and measure line segments and angles in geometric figures, including: interpret scales on various measuring instruments
- derive and use the standard ruler and compass constructions (perpendicular bisector of the segment, constructing a perpendicular to a given line from/at a given point, bisecting a given angle); recognise and use the perpendicular distance from a point to a line as the shortest distance to the line
- describe, sketch and draw using conventional terms and notations: points, lines, parallel lines, perpendicular lines, right angles, regular polygons, and other polygons in terms of properties and number of sides, including quadrilaterals
- use the standard conventions for labelling the vertices and sides of polygons, and for lines and use the criteria for congruence of triangles
- derive and illustrate properties of triangles, quadrilaterals, circles, and other plane figures (for example, equal lengths and angles) using geometric reasoning and properties
- distinguish between exact and approximate representations of the figures
- use the standard conventions for labelling the vertices and sides of polygons, and for lines and use the criteria for congruence of triangles
- derive and illustrate properties of triangles, quadrilaterals, circles, and other plane figures (for example, equal lengths and angles) using geometric reasoning and properties, including: the sum of the angles in a triangle and in a quadrilateral, the sum of the angles at a point, vertically opposite angles, and angles formed by parallel lines
- use the standard conventions for labelling the vertices and sides of polygons, and for lines and use the criteria for congruence of triangles
- derive and illustrate properties of triangles, quadrilaterals, circles, and other plane figures (for example, equal lengths and angles) using geometric reasoning and properties
- distinguish between exact and approximate representations of the figures
- calculate and interpret gradients and intercepts of graphs of such linear equations numerically, graphically and algebraically
- interpret and obtain the equation of a straight line graph in the form $y = mx + c$
- understand that proportionality of all possible outcomes sum to 1
- relate probability to proportion and express proportions, including probabilities, as fractions, decimals and percentages
- use compound units such as speed, unit pricing and density to solve problems

Geometry and measures

Pupils should be taught to:

- the mathematics content that should be taught to all pupils, in standard type, additional mathematical content to be taught to more highly attaining pupils, in italics [1]

Together, the mathematics content set out in the key stage 3 and key stage 4 programmes of study, in standard type, lays the foundation for the study of Mathematics qualifications. Wherever it is appropriate, given pupils' security of understanding and readiness to progress, pupils should be taught the full content set out in the programme of study.

Working mathematically

Through the mathematics content, pupils should be taught to:

Develop fluency

- consolidate their numerical and mathematical capability from key stage 3 and extend their understanding of the number system to include powers, roots and fractional indices
- select and use appropriate calculation strategies to solve increasingly complex problems, including exact calculations involving multiples of π (and surds), use of standard trigonometric ratios and Pythagoras' theorem in 2-D
- identify their algebraic capability from key stage 3 and extend their understanding of algebraic simplification and manipulation to include quadratic expressions, including those in the form of differences of 2 squares
- extend fluency with expressions and equations from key stage 3 to include: equations, simultaneous equations and inequalities
- graph and manipulate inequalities in 2 variables, including those in geometrical representations, including of lines, quadratic, reciprocal, exponential and trigonometric functions
- use mathematical language and properties precisely

Reason mathematically

- extend and formalise their knowledge of ratio and proportion, including: trigonometric ratios, in working with measures and geometry, and in working with quadratic, exponential and trigonometric functions
- extend their ability to identify variables and express relations between variables algebraically and graphically
- make and test conjectures about the generalisations that underlie arithmetic and mathematical relationships, look for proofs or counter-examples, begin to use algebra to support and construct formal arguments
- reason deductively in geometry, number and algebra, including using known facts to produce proofs
- understand that the structure of a numerical problem requires addition, multiplication or proportional reasoning
- explore what can and cannot be inferred in statistical and probabilistic settings, and begin to express their arguments formally
- assess the validity of an argument and the accuracy of a given way of presenting information

Solve problems

- develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems
- develop their use of formal mathematical knowledge to interpret and solve problems, including in financial mathematics
- make and use connections between different parts of mathematics in order to solve more complex problems, including those involving several steps
- model situations mathematically and express the results using a range of formal mathematical representations, reflect on how these results might have been affected by any modelling assumptions
- select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems, interpret their solution in the context of the given problem

Subject content

Number

In addition to the compulsory subject content from key stage 3 pupils should be taught to:

- apply systematic listing strategies, (including use of the product rule for counting)
- understand and use the hierarchy of operations (including the use of brackets, including in complex contexts)
- calculate with roots, and with integer and rational indices
- calculate exactly with fractions, (surds) and multiples of π (including self-generated examples such as for example $(\sqrt{5} + 1)(\sqrt{5} - 1)$ or $\sqrt{2}(\sqrt{6} + \sqrt{3})$ or $\sqrt{2}(\sqrt{6} + \sqrt{3})$ or $\sqrt{2}(\sqrt{6} + \sqrt{3})$ (recommended)
- calculate with numbers in standard form $A \times 10^n$, where $1 \leq A < 10$ (and is to a stated number of significant figures) and where n is a positive or negative integer or 0
- identify and work with fractions in ratio problems
- apply and interpret limits of accuracy when rounding or truncating, (including upper and lower bounds)

Algebra

In addition to the compulsory subject content from key stage 3 pupils should be taught to:

- simplify and manipulate algebraic expressions (including those involving surds [and algebraic fractions])by:
  - factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of 2 squares; and quadratic expressions in the form $ax^2 + bx + c$
  - simplifying/manipulating surds, products and powers, including the laws of indices
  - the difference between an equation and an identity; argue mathematically to show algebraic expressions are equivalent, and use algebraic reasoning and construct arguments (and proofs)
- solve linear equations in 1 variable, including those with unknowns on both sides, including those with brackets and those in the form "the reciprocal of the reciprocal of the unknown is 2 times the unknown" (for example $\frac{1}{x} = \frac{1}{2}$)
- solve quadratic equations (including those that require rearrangement) algebraically by factorising, by completing the square and by using the quadratic formula; find approximate solutions using a graph
- solve 2 simultaneous equations in 2 variables (linear/linear [2 straight lines] or linear/quadratic) algebraically; find approximate solutions using a graph
- translate statements of the form "x is proportional to y" as $y = kx$
- translate simple situations or procedures into algebraic expressions or formulae; derive an equation (or 2 simultaneous equations), solve the equation(s) and interpret the solution
- solve linear inequalities in 1 or 2 variables (2, [and quadratic inequalities in 1 variable]), represent the solution set on a number line, [using set notation and on a coordinate grid]
- recognise and use expressions of triangular, square and cubic numbers, in simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions (r^n where n is an integer and r is a positive rational number [or a surd]) [and other sequences]
- deduce expressions to calculate the nth term of linear [and quadratic] sequences

Ratio, proportion and rates of change

In addition to the compulsory subject content from key stage 3 pupils should be taught to:

- compare lengths, areas and volumes using ratio notation and/or scale factors, make and use scale drawings and construct bar charts
- convert between related compound units (speed, rates of flow, unit pricing, density [mass/volume]) in numerical and algebraic contexts
- understand that inverse proportionality is $y = \frac{k}{x}$ or equivalent $xy = k$ [or $\frac{y}{x} = k$]
- construct and interpret equations that describe direct and inverse proportion
- interpret the gradient of a straight line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion
- interpret the gradient of a point on a curve as the instantaneous rate of change; apply the concepts of average and instantaneous rate of change (gradients of tangents and chords) in numerical, algebraic and graphical contexts
- set up, solve and interpret the answers in growth and decay problems, including compound interest [and work with geometric progressions]

Geometry and measures

In addition to the compulsory subject content from key stage 3 pupils should be taught to:

- interpret and use fractional [and negative] scale factors for enlargements
- similarity including: recognize an object or diagram is enlarged by a combination of translation, reflection and/or enlargement
- identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment
- apply and prove the standard circle theorems concerning angles, radii, tangents and chords, including angles in the same segment
- construct and interpret plans and elevations of 3-D shapes
- interpret and use bearings
- calculate arc lengths, angles and areas of sectors of circles
- calculate surface area and volume of spheres, pyramids, cones and composite solids
- prove the properties of congruence and similarity, including the relationships between lengths, areas and volumes in similar figures
- apply Pythagoras' Theorem and trigonometric ratios to find angles and lengths in right-angled triangles and in 2-D figures, including those in real-life situations

- know the exact values of sin θ and cos θ for θ = 0°, 30°, 45°, 60° and 90°; know the exact value of tan θ for θ = 0°, 30°, 45°, 60°
- {know and apply the sine rule, $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$, and cosine rule, $a^2 = b^2 + c^2 - 2bc \cos A$, to find unknown lengths and angles}
- {know and apply Area = $\frac{1}{2}$ ab sin C to calculate the area, sides or angles of any triangle}
- describe translations as 2D vectors
- apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors; {use vectors to construct geometric arguments and proofs}

Probability

In addition to consolidating subject content from key stage 3, pupils should be taught to:

- apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to 1
- use a probability model to predict the outcomes of future experiments; understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size
- calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions
- {calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams}

Statistics

In addition to consolidating subject content from key stage 3, pupils should be taught to:

- infer properties of populations or distributions from a sample, whilst knowing the limitations of sampling
- interpret and construct tables and line graphs for time series data
- {construct and interpret diagrams for grouped discrete data and continuous data, ie, histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use}
- interpret, analyse and compare the distributions of data sets from univariate empirical distributions through:
  - appropriate graphical representation involving discrete, continuous and grouped data, {including box plots}
  - appropriate measures of central tendency (including modal class) and spread {including quartiles and inter-quartile range}
- apply statistics to describe a population
- use and interpret scatter graphs of bivariate data; recognise correlation and know that it does not indicate causation; draw estimated lines of best fit; make predictions; interpolate and extrapolate apparent trends whilst knowing the dangers of so doing.

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Coronavirus (COVID-19)

Coronavirus (COVID-19): guidance and support

The UK has left the EU

Get ready for new rules in January 2021

Services and information

Benefits
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Business and self-employed
Childcare and parenting
Citizenship and living in the UK
Crime, justice and the law
Disabled people
Driving and transport
Education and learning
Employing people
Environment and countryside
Housing and local services
Money and tax
Passports, travel and living abroad
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