Upper key stage 2 - years 5 and 6

- The principal focus of mathematics teaching in upper key stage 2 is to ensure that pupils extend their understanding of the number system and place value to include larger integers. This should develop the connections that pupils make between multiplication and division with fractions, 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 demanding efficient written and mental methods of calculation. With this foundation in arithmetic, pupils are introduced to the language of algebra as a means for solving a variety of problems. Teaching in geometry and measures should consolidate and extend knowledge developed in number. Teaching should also ensure that pupils classify shapes with increasingly complex geometric properties and that they learn the vocabulary they need to describe them.
- By the end of year 6, pupils should be fluent in written methods for all 4 operations, including long multiplication and division, and in working with fractions, decimals and percentages.
- Pupils should read, spell and pronounce mathematical vocabulary correctly.

Overview of Progression in Year 5

Number and place value
Children work with numbers up to at least 1,000,000, using knowledge of place value to work out the value of digits. They continue working with negative numbers in different contexts, and practise reading Roman numerals to 1000 (M), which helps them work out years written in Roman numerals. They continue using techniques introduced in earlier years for approximation and estimation.

Addition and subtraction
Children use columns in written addition and subtraction, accurately adding and subtracting numbers with more than four digits. They use mental methods to add and subtract increasingly large numbers, and use rounding to check their answers. With support they choose appropriate operations and methods, and work out the level of accuracy required to answer a particular problem. They will continue to develop this work in Year 6.

Multiplication and division
Children identify multiples and factors, and find all the factor pairs of a given number. With support, they use factors to help solve multiplication and division problems involving larger numbers, and they confidently use written methods to multiply and divide large numbers. They extend their mathematical vocabulary and understanding, beginning to work with prime numbers, prime factors, composite (non-prime) numbers, square and cubed numbers.

Fractions (including decimals and percentages)
Children compare fractions with denominators that are multiples of the same number (comparing 3/7 with 6/14). They also identify equivalent fractions of a given fraction including tenths and hundredths. They learn about mixed numbers and improper fractions, and understand how mixed numbers could be converted to improper fractions, and vice versa. With support and using practical equipment and diagrams, they multiply proper fractions and mixed numbers by whole numbers.
Children convert decimal numbers into fractions (0.65 = 65/100). Extending their work from previous years, they use thousandths and make connections between these and tenths, hundredths and their decimal equivalents. They round decimals to the nearest whole number, and to one decimal place, and begin to work with numbers with three decimal places. Children begin to work with percentages and find solutions to problems using percentage and decimal equivalents of 1/2, 1/4, 1/5, 2/5, 4/5, for example. This forms a basis for further work on percentages in Year 6.

Measurement
In Year 4, children calculated the perimeter of rectilinear shapes; they now extend this to composite (or compound) rectilinear shapes, and calculate the area of squares and rectangles. They begin to understand and estimate volume and capacity, and compare metric with common imperial units. They will build on this work in Year 6.

Geometry: properties of shapes
Children extend their work on angles from Year 4, estimating, measuring, comparing and drawing a variety of angles using degrees. They use given dimensions to help them draw shapes accurately, and use techniques learnt in the context of missing number problems to help them work out missing angles.

Geometry: position and direction
Building on work with coordinate grids from Year 4, children work out the position of shapes following reflection or translation, in the first quadrant.

Statistics
In Year 4, children were introduced to line graphs; now they use information from line graphs to solve problems. They practise completing and reading tables, including timetables.

Key Maths Concepts in Year 5

Introducing negative numbers in context
Children will have encountered negative numbers during Year 4, but in Year 5 they extend their understanding, meeting negative numbers in a range of different contexts. The idea of negative numbers may seem counterintuitive in some ways – it's clear what we mean by 3 in the context of sweets, jumpers or sheep, but what about –3? Fortunately, there are several everyday contexts which will give children a sense of how useful negative numbers can be. Probably the most familiar context for negative numbers in daily life is temperature. Children will see negative numbers used on a thermometer scale for values below 0°, and they will have heard weather forecasters predicting an overnight drop in temperature, for example to –2°.

Children may also be familiar with negative numbers in terms of distances above and below sea level, such as a particular location might be –8 metres (8 metres below sea level). Or they may have used a lift in a large building where the ground floor is marked as 0 on the lift buttons, in which case basement levels may be called –1 and –2. When introducing negative numbers, it's a good idea to use a vertical number line rather than a horizontal line, because this will help children to use accurate language to describe number relationships above and below zero – for example, they will naturally describe numbers as *falling*, *dropping* or *rising*, and will speak in terms of one number being below or above another. It can be helpful to display the vertical number line like a scale on a giant thermometer.
Refer to numbers less than zero as ***negative*** numbers.

Comparing percentages with fractions and decimals
Children will need to understand that a percentage is really a fraction with a denominator of 100, so 25% is equivalent to 25/100. Children will begin to make connections between percentages and decimals when they look at patterns such as this:
15% = 0.15
43% = 0.43
75% = 0.75
The digits are the same, but the decimal point is in a different place. 15% is the same as 15/100, so drawing on their knowledge of place value, children should begin to understand why the decimal equivalent of 15% is written 0.15.
Percentages below 10% can cause problems because, for example, 5% is not written 0.5 but 0.05 (0.5 being equivalent to 1/2 or 50%). However, place value should also help children avoid giving the wrong decimal equivalent for smaller percentages and fractions.

Year 5 programme of study (statutory requirements)

Number and place value	Addition and subtraction	Multiplication and division	Fractions (including decimals and percentages)	Measurement	Geometry: properties of shapes	Geometry: position and direction	Statistics
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 zero ▪ round any number up to 1 000 000 to the nearest 10, 100, 1000, 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	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	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 a one- or two-digit number 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 addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign ▪ solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates	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 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 two decimal places to the nearest whole number and to one decimal place ▪ read, write, order and compare numbers with up to three decimal places ▪ solve problems involving number up to three decimal places ▪ recognise the per cent symbol (%) and understand that per cent relates to "number of parts per hundred", and write percentages as a fraction with denominator 100, and as a decimal ▪ 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 with a denominator of a multiple of 10 or 25	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) using standard units, square centimetres (cm^2) and square metres (m^2) and estimate the area of irregular shapes ▪ estimate volume [for example, using 1 cm^3 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	Pupils should be taught to: ▪ identify 3-D shapes, including cubes and other cuboids, from 2-D representations ▪ know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles ▪ draw given angles, and measure them in degrees (^{o}) ▪ identify: - angles at a point and one whole turn (total 360^o) - angles at a point on a straight line and ½ a turn (total 180^o) - other multiples of 90^o ▪ 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	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	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

Y5 notes and guidance (non-statutory)

Number and place value	Addition and subtraction	Multiplication and division	Fractions (including decimals and percentages)	Measurement	Geometry: properties of shapes	Geometry: position and direction	Statistics
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 numbers and fractions that they have met so far. They should recognise and describe linear number sequences (for example, 3, 3 ½ , 4, 4 1/2 ...), including those involving fractions and decimals, and find the term-to-term rule in words (for example, add ½).	Pupils practise using the formal written methods of columnar addition and subtraction with increasingly large numbers to aid fluency (see Mathematics Appendix 1). They practise mental calculations with increasingly large numbers to aid fluency (for example, 12 462 – 2 300 = 10 162).	Pupils practise and extend their use of the formal written methods of short multiplication and short division (see Mathematics Appendix 1). They apply all the 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 = 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, by multiplying and dividing by powers of 10 in scale drawings or by multiplying and dividing by powers of a 1000 in converting between units such as kilometres and metres. Distributivity can be expressed as a(b + c) = ab + ac. They understand the terms factor, multiple and prime, square and cube numbers and use them to construct equivalence statements (for example, 4 x 35 = 2 x 2 x 35; 3 x 270 = 3 x 3 x 9 x 10 = 9^2 x 10). Pupils use and explain the equals sign to indicate equivalence, including in missing number problems (for example, 13 + 24 = 12 + 25; 33 = 5 x □).	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 these to improper and mixed fractions. Pupils connect multiplication by a fraction to using fractions as operators (fractions of), and to division, building on work from previous years. 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 extend counting from year 4, using decimals and fractions including bridging zero, 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, by solving puzzles involving decimals. Pupils should make connections between percentages, fractions and decimals (for example, 100% represents a whole quantity and 1% is 1/100, 50% is 50/100, 25% is 25/100) and relate this to finding 'fractions of'.	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 relations of perimeter or area to find unknown lengths. Missing measures questions such as these can be expressed algebraically, for example 4 + 2b = 20 for a rectangle of sides 2 cm and b cm and perimeter of 20cm. Pupils calculate the area from scale drawings using given measurements. Pupils use all four operations in problems involving time and money, including conversions (for example, days to weeks, expressing the answer as weeks and days).	Pupils become accurate in drawing lines with a ruler to the nearest millimetre, and measuring with a protractor. They use conventional markings for parallel lines and right angles. Pupils use the term diagonal and make conjectures about the angles formed between sides, and between diagonals and parallel sides , and other properties of quadrilaterals, for example using dynamic geometry ICT tools. Pupils use angle sum facts and other properties to make deductions about missing angles and relate these to missing number problems.	Pupils recognise and use reflection and translation in a variety of diagrams, including continuing to use a 2-D grid and coordinates in the first quadrant. Reflection should be in lines that are parallel to the axes.	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.