Teaching programme: Year 5

Numbers and the number system

2–15 Place value, ordering and rounding

2–3 • Read and write whole numbers in figures and words, and know what each digit represents.
(For decimals, see page 29.)

6–7 • **Multiply and divide any positive integer up to 10 000 by 10 or 100 and understand the effect**
(e.g. 9900 ÷ 10, 737 ÷ 10, 2060 ÷ 100).

8–9 • Use the vocabulary of comparing and ordering numbers, including symbols such as <, >, ≤, ≥, =.
Give one or more numbers lying between two given numbers.
Order a set of integers less than 1 million.
(For decimals, see page 29.)

10–13 • Use the vocabulary of estimation and approximation.
Make and justify estimates of large numbers, and estimate simple proportions such as one third, seven tenths.
Round any integer up to 10 000 to the nearest 10, 100 or 1000.
(For rounding decimals, see page 31.)

14–15 • **Order a given set of positive and negative integers**
(e.g. on a number line, on a temperature scale).
Calculate a temperature rise or fall across 0 °C.

16–21 Properties of numbers and number sequences

16–17 • Recognise and extend number sequences formed by counting from any number in steps of constant size, extending beyond zero when counting back. For example:
– count on in steps of 25 to 1000, and then back;
– count on or back in steps of 0.1, 0.2, 0.3…

18–19 • Make general statements about odd or even numbers, including the outcome of sums and differences.

18–19 • Recognise multiples of 6, 7, 8, 9, up to the 10th multiple.
Know and apply tests of divisibility by 2, 4, 5, 10 or 100.

20–1 • Know squares of numbers to at least 10 × 10.

20–1 • Find all the pairs of factors of any number up to 100.

22–33 Fractions, decimals and percentages, ratio and proportion

22–3 • Use fraction notation, including mixed numbers, and the vocabulary *numerator* and *denominator*.
Change an improper fraction to a mixed number (e.g. change $^{13}/_{10}$ to $1^{3}/_{10}$).
Recognise when two simple fractions are equivalent, including relating hundredths to tenths (e.g. $^{70}/_{100} = {}^{7}/_{10}$).

22–3 • Order a set of fractions such as 2, 2¾, 1¾, 2½, 1½, and position them on a number line.

24–5 • **Relate fractions to division,** and use division to find simple fractions, including tenths and hundredths, of numbers and quantities (e.g. ¾ of 12, $^{1}/_{10}$ of 50, $^{1}/_{100}$ of £3).

26–7 • Solve simple problems using ideas of ratio and proportion (‘one for every …’ and ‘one in every …’).

28–9 • **Use decimal notation for tenths and hundredths.**
Know what each digit represents in a number with up to two decimal places.
Order a set of numbers or measurements with the same number of decimal places.

30–1 • **Round a number with one or two decimal places to the nearest integer.**

30–1 • **Relate fractions to their decimal representations:** that is, recognise the equivalence between the decimal and fraction forms of one half, one quarter, three quarters… and tenths and hundredths (e.g. $^{7}/_{10} = 0.7$, $^{27}/_{100} = 0.27$).

32–3 • Begin to understand percentage as the number of parts in every 100, and find simple percentages of small whole-number quantities (e.g. 25% of £8).
Express one half, one quarter, three quarters, and tenths and hundredths, as percentages (e.g. know that ¾ = 75%).

Calculations

38–9 Rapid recall of addition and subtraction facts

38–9 • Derive quickly or continue to derive quickly:
– decimals that total 1 (e.g. 0.2 + 0.8) or 10 (e.g. 6.2 + 3.8);
– all two-digit pairs that total 100 (e.g. 43 + 57);
– all pairs of multiples of 50 with a total of 1000 (e.g. 350 + 650).

40–7 Mental calculation strategies (+ and –)

40–1 • Find differences by counting up through next multiple of 10, 100 or 1000, e.g. **calculate mentally a difference such as 8006 – 2993.**

40–1 • Partition into H, T and U, adding the most significant digits first.

40–1 • Identify near doubles, such as 1.5 + 1.6.

40–1 • Add or subtract the nearest multiple of 10 or 100, then adjust.

42–3 • Develop further the relationship between addition and subtraction.

42–3 • Add several numbers (e.g. four or five single digits, or multiples of 10 such as 40 + 50 + 80).

44–7 • Use known number facts and place value for mental addition and subtraction (e.g. 470 + 380, 810 – 380, 7.4 + 9.8, 9.2 – 8.6).

48–51 Pencil and paper procedures (+ and –)

48–51 • Use informal pencil and paper methods to support, record or explain additions and subtractions.
Extend written methods to:
– **column addition/subtraction of two integers less than 10 000;**
– addition of more than two integers less than 10 000;
– addition or subtraction of a pair of decimal fractions, both with one or both with two decimal places (e.g. £29.78 + £53.34).

52–7 Understanding multiplication and division

52–5 • Understand the effect of and relationships between the four operations, and the principles (not the names) of the arithmetic laws as they apply to multiplication. Begin to use brackets.

56–7 • Begin to express a quotient as a fraction, or as a decimal when dividing a whole number by 2, 4, 5 or 10, or when dividing £.p.
Round up or down after division, depending on the context.

58–9 Rapid recall of multiplication and division facts

58–9 • **Know by heart all multiplication facts up to 10 × 10.**

58–9 • Derive quickly or continue to derive quickly:
– division facts corresponding to tables up to 10 × 10;
– doubles of all whole numbers 1 to 100 (e.g. 78 × 2);
– doubles of multiples of 10 to 1000 (e.g. 670 × 2);
– doubles of multiples of 100 to 10 000 (e.g. 6500 × 2);
and the corresponding halves.

60–5 Mental calculation strategies (× and ÷)

60–1 • Use doubling or halving, starting from known facts. For example:
– double/halve any two-digit number by doubling/halving the tens first;
– double one number and halve the other;
– to multiply by 25, multiply by 100 then divide by 4;
– find the ×16 table facts by doubling the ×8 table;
– find sixths by halving thirds.

60–1 • Use factors (e.g. 8 × 12 = 8 × 4 × 3).

62–3 • Use closely related facts (e.g. multiply by 19 or 21 by multiplying by 20 and adjusting; develop the ×12 table from the ×10 and ×2 tables).

62–3 • Partition (e.g. 47 × 6 = (40 × 6) + (7 × 6)).

62–3 • Use the relationship between multiplication and division.

64–5 • Use known facts and place value to multiply and divide mentally.

66–9 Pencil and paper procedures (× and ÷)

66–9 • Approximate first. Use informal pencil and paper methods to support, record or explain multiplications and divisions.
Extend written methods to:
– **short multiplication of HTU** or U.t **by U;**
– **long multiplication of TU by TU;**
– **short division of HTU by U** (with integer remainder).

70–1 Using a calculator

70–1 • Develop calculator skills and use a calculator effectively.

72–3 Checking results of calculations

72–3 • Check with the inverse operation when using a calculator.

72–3 • Check the sum of several numbers by adding in the reverse order.

72–3 • Check with an equivalent calculation.

72–3 • Estimate by approximating (round to nearest 10 or 100), then check result.

72–3 • Use knowledge of sums and differences of odd/even numbers.

Solving problems

74–5 Making decisions

74–5 • Choose and use appropriate number operations to solve problems, and appropriate ways of calculating: mental, mental with jottings, written methods, calculator.
(For examples of problems see pages 34–7, 78–9, 82–9, 100–1.)

76–81 Reasoning and generalising about numbers or shapes

76–7 • Explain methods and reasoning, orally and in writing.

78–9 • Solve mathematical problems or puzzles, recognise and explain patterns and relationships, generalise and predict. Suggest extensions by asking 'What if…?'

80–1 • Make and investigate a general statement about familiar numbers or shapes by finding examples that satisfy it.
Explain a generalised relationship (formula) in words.

82–9 Problems involving 'real life', money and measures

82–9 • **Use all four operations to solve simple word problems involving numbers and quantities** based on 'real life', money and measures **(including time)**, using one or more steps, including making simple conversions of pounds to foreign currency and finding simple percentages.
Explain methods and reasoning.

Shape, space and measures

90–101 Measures

90–1 • Use, read and write standard metric units (km, m, cm, mm, kg, g, l, ml), including their abbreviations, and relationships between them.
Convert larger to smaller units (e.g. km to m, m to cm or mm, kg to g, l to ml).
Know imperial units (mile, pint, gallon).

92–5 • Suggest suitable units and measuring equipment to estimate or measure length, mass or capacity.
Measure and draw lines to the nearest millimetre.
Record estimates and readings from scales to a suitable degree of accuracy.

96–7 • **Understand area measured in square centimetres (cm^2).**
Understand and use the formula in words 'length × breadth' for the area of a rectangle.
Understand, measure and calculate perimeters of rectangles and regular polygons.

98–101 • Use units of time; read the time on a 24-hour digital clock and use 24-hour clock notation, such as 19:53. Use timetables.

102–11 Shape and space

102–3 • **Recognise properties of rectangles.**
Classify triangles (isosceles, equilateral, scalene), using criteria such as equal sides, equal angles, lines of symmetry.

104–5 • Make shapes with increasing accuracy.
Visualise 3-D shapes from 2-D drawings and identify different nets for an open cube.

106–7 • Recognise reflection symmetry in regular polygons: for example, know that a square has four axes of symmetry and an equilateral triangle has three.
Complete symmetrical patterns with two lines of symmetry at right angles (using squared paper or pegboard).
Recognise where a shape will be after reflection in a mirror line parallel to one side (sides not all parallel or perpendicular to the mirror line).
Recognise where a shape will be after a translation.

108–9 • Recognise positions and directions.
Read and plot coordinates in the first quadrant.
Recognise perpendicular and parallel lines.

110–11 • Understand and use angle measure in degrees.
Identify, estimate and order acute and obtuse angles.
Use a protractor to measure and draw acute and obtuse angles to the nearest 5°.
Calculate angles in a straight line.

Handling data

112–17 Organising and interpreting data

112–13 • Discuss the chance or likelihood of particular events.

114–17 • Solve a problem by representing and interpreting data in tables, charts, graphs and diagrams, including those generated by a computer, for example:
bar-line charts, vertical axis labelled in 2s, 5s, 10s, 20s or 100s, first where intermediate points have no meaning (e.g. scores on a dice rolled 50 times), then where they may have meaning (e.g. room temperature over time).

116–17 • Find the mode of a set of data.

NOTES
- Key objectives are highlighted in **bold type**.
- Page references are to the supplement of examples for Years 4, 5 and 6 (see primary Framework).

Teaching programme: Year 6

Numbers and the number system

2–15 Place value, ordering and rounding

6–7 • **Multiply and divide decimals mentally by 10 or 100, and integers by 1000, and explain the effect**.
(For more on place value with decimals, see page 29.)

10–13 • Use the vocabulary of estimation and approximation. Consolidate rounding an integer to the nearest 10, 100 or 1000.
(For rounding of decimals, see page 31.)

14–15 • Find the difference between a positive and a negative integer, or two negative integers, in a context such as temperature or the number line, and order a set of positive and negative integers.

16–21 Properties of numbers and number sequences

16–17 • Recognise and extend number sequences, such as the sequence of square numbers, or the sequence of triangular numbers 1, 3, 6, 10, 15…
Count on in steps of 0.1, 0.2, 0.25, 0.5…, and then back.

18–19 • Make general statements about odd or even numbers, including the outcome of products.

18–19 • Recognise multiples up to 10 × 10.
Know and apply simple tests of divisibility.
Find simple common multiples.

20–1 • Recognise squares of numbers to at least 12 × 12.

20–1 • Recognise prime numbers to at least 20.
Factorise numbers to 100 into prime factors.

22–33 Fractions, decimals, percentages, ratio and proportion

22–3 • Change a fraction such as $3\frac{3}{8}$ to the equivalent mixed number $4\frac{1}{8}$, and vice versa.
Recognise relationships between fractions: for example, that $\frac{1}{10}$ is ten times $\frac{1}{100}$, and $\frac{1}{16}$ is half of $\frac{1}{8}$.
Reduce a fraction to its simplest form by cancelling common factors in the numerator and denominator.

22–3 • Order fractions such as $\frac{2}{3}$, $\frac{3}{4}$ and $\frac{5}{6}$ by converting them to fractions with a common denominator, and position them on a number line.

24–5 • **Use a fraction as an 'operator' to find fractions,** including tenths and hundredths, **of numbers or quantities (e.g. $\frac{5}{8}$ of 32, $\frac{7}{10}$ of 40, $\frac{9}{100}$ of 400 centimetres).**

26–7 • **Solve simple problems involving ratio and proportion.**

28–9 • Use decimal notation for tenths and hundredths in calculations, and tenths, hundredths and thousandths when recording measurements.
Know what each digit represents in a number with up to three decimal places.
Give a decimal fraction lying between two others (e.g. between 3.4 and 3.5).
Order a mixed set of numbers or measurements **with up to three decimal places.**

30–1 • Round a number with two decimal places to the nearest tenth or to the nearest whole number.

30–1 • Recognise the equivalence between the decimal and fraction forms of one half, one quarter, three quarters, one eighth… and tenths, hundredths and thousandths (e.g. $\frac{70}{1000} = \frac{7}{100} = \frac{7}{10} = 0.7$).
Begin to convert a fraction to a decimal using division.

32–3 • **Understand percentage as the number of parts in every 100.**
Express simple fractions such as one half, one quarter, three quarters, one third, two thirds…, and tenths and hundredths, as percentages (e.g. know that $\frac{1}{3} = 33\frac{1}{3}\%$).
Find simple percentages of small whole-number quantities (e.g. find 10% of £500, then 20%, 40% and 80% by doubling).

Calculations

40–7 Mental calculation strategies (+ and –)

40–3 • Consolidate all strategies from previous year, including:
– find a difference by counting up;
– add or subtract the nearest multiple of 10, 100 or 1000, then adjust;
– use the relationship between addition and subtraction;
– add several numbers.

44–7 • Use known number facts and place value to consolidate mental addition/subtraction (e.g. 470 + 380, 810 – 380, 7.4 + 9.8, 9.2 – 8.6).

48–51 Pencil and paper procedures (+ and –)

48–51 • Use informal pencil and paper methods to support, record or explain additions and subtractions.
Extend written methods to column addition and subtraction of numbers involving decimals.

52–57 Understanding multiplication and division

52–5 • Understand and use the relationships between the four operations, and the principles (not the names) of the arithmetic laws.
Use brackets.

56–7 • Express a quotient as a fraction or as a decimal rounded to one decimal place.
Divide £.p by a two-digit number to give £.p.
Round up or down after division, depending on the context.

58–9 Rapid recall of multiplication and division facts

58–9 • Consolidate knowing by heart:
multiplication facts up to 10 × 10.

58–9 • **Derive quickly:**
– **division facts corresponding to tables up to 10 × 10;**
– squares of multiples of 10 to 100 (e.g. 60 × 60);
– doubles of two-digit numbers (e.g. 3.8 × 2, 0.76 × 2);
– doubles of multiples of 10 to 1000 (e.g. 670 × 2);
– doubles of multiples of 100 to 10 000 (e.g. 6500 × 2);
and the corresponding halves.

60–5 Mental calculation strategies (× and ÷)

60–1 • Use related facts and doubling or halving. For example:
double or halve the most significant digit first;
to multiply by 25, multiply by 100 then divide by 4;
double one number and halve the other;
find the ×24 table by doubling the ×6 table twice.

60–1 • Use factors (e.g. 35 × 18 = 35 × 6 × 3).

62–3 • Use closely related facts: for example, multiply by 49 or 51 by multiplying by 50 and adjusting.
Develop the ×17 table by adding facts from the ×10 and ×7 tables.

62–3 • Partition (e.g. 87 × 6 = (80 × 6) + (7 × 6); 3.4 × 3 = (3 × 3) + (0.4 × 3)).

62–3 • Use the relationship between multiplication and division.

64–5 • Use known number facts and place value to consolidate mental multiplication and division.

66–9 Pencil and paper procedures (× and ÷)

66–9 • Approximate first. Use informal pencil and paper methods to support, record or explain multiplications and divisions.
Extend written methods to:
– multiplication of ThHTU × U (short multiplication);
– **short multiplication of numbers involving decimals;**
– **long multiplication of a three-digit by a two-digit integer;**
– short division of TU or HTU by U (mixed-number answer);
– division of HTU by TU (long division, whole-number answer);
– **short division of numbers involving decimals.**

70–1 Using a calculator

70–1 • Develop calculator skills and use a calculator effectively.

72–3 Checking results of calculations

72–3 • Check with the inverse operation when using a calculator.

72–3 • Check the sum of several numbers by adding in reverse order.

72–3 • Check with an equivalent calculation.

72–3 • Estimate by approximating (round to nearest 10, 100 or 1000), then check result.

72–3 • Use knowledge of sums, differences, products of odd/even numbers.

72–3 • Use tests of divisibility.

Solving problems

74–5 Making decisions

74–5 • Choose and use appropriate number operations to solve problems, and appropriate ways of calculating: mental, mental with jottings, written methods, calculator.
(For examples of problems see pages 34–7, 78–9, 82–9, 100–1.)

76–81 Reasoning and generalising about numbers or shapes

76–7 • Explain methods and reasoning, orally and in writing.

78–9 • Solve mathematical problems or puzzles, recognise and explain patterns and relationships, generalise and predict.
Suggest extensions by asking 'What if…?'

80–1 • Make and investigate a general statement about familiar numbers or shapes by finding examples that satisfy it.
Develop from explaining a generalised relationship in words to expressing it in a formula using letters as symbols (e.g. the cost of *n* articles at 15p each).

82–9 Problems involving 'real life', money or measures

82–9 • **Identify and use appropriate operations (including combinations of operations) to solve word problems involving numbers and quantities** based on 'real life', money or measures (including time), using one or more steps, including converting pounds to foreign currency, or vice versa, and calculating percentages such as VAT.
Explain methods and reasoning.

Handling data

112–17 Handling data

112–13 • Use the language associated with probability to discuss events, including those with equally likely outcomes.

114–17 • **Solve a problem by** representing, **extracting and interpreting data in tables, graphs, charts** and diagrams, including those generated by a computer, for example:
– line graphs (e.g. for distance–time, for a multiplication table, a conversion graph, a graph of pairs of numbers adding to 8);
– frequency tables and bar charts with grouped discrete data (e.g. test marks 0–5, 6–10, 11–15…).

116–17 • Find the mode and range of a set of data.
Begin to find the median and mean of a set of data.

Shape, space and measures

90–101 Measures

90–1 • Use, read and write standard metric units (km, m, cm, mm, kg, g, l, ml), including their abbreviations, and relationships between them.
Convert smaller to larger units (e.g. m to km, cm or mm to m, g to kg, ml to l) and vice versa.
Know imperial units (mile, pint, gallon, lb, oz).
Know rough equivalents of lb and kg, oz and g, miles and km, litres and pints or gallons.

92–5 • Suggest suitable units and measuring equipment to estimate or measure length, mass or capacity.
Record estimates and readings from scales to a suitable degree of accuracy.

96–7 • **Calculate the perimeter and area of simple compound shapes that can be split into rectangles.**

98–101 • Appreciate different times around the world.

102–11 Shape and space

102–9 • Describe and visualise properties of solid shapes such as parallel or perpendicular faces or edges.
Classify quadrilaterals, using criteria such as parallel sides, equal angles, equal sides…

104–5 • Make shapes with increasing accuracy.
Visualise 3-D shapes from 2-D drawings and identify different nets for a closed cube.

106–7 • Recognise where a shape will be after reflection:
– in a mirror line touching the shape at a point (sides of shape not necessarily parallel or perpendicular to the mirror line);
– in two mirror lines at right angles (sides of shape all parallel or perpendicular to the mirror line).
Recognise where a shape will be after two translations.

108–9 • **Read and plot coordinates in all four quadrants.**

110–11 • Recognise and estimate angles.
Use a protractor to measure and draw **acute and obtuse angles to the nearest degree.**
Check that the sum of the angles of a triangle is 180°: for example, by measuring or paper folding.
Calculate angles in a triangle or around a point.
Recognise where a shape will be after a rotation through 90° about one of its vertices.

NOTES • Key objectives are highlighted in **bold type**.
• Page references are to the supplement of examples for Years 4, 5 and 6 (see primary Framework).

Teaching programme: Year 7

Using and applying mathematics to solve problems

2–35 Applying mathematics and solving problems

2–25 • **Solve word problems and investigate in a range of contexts:** number, algebra, shape, space and measures, and handling data; compare and evaluate solutions.

26–7 • Identify the necessary information to solve a problem; represent problems mathematically, making correct use of symbols, words, diagrams, tables and graphs.

28–9 • **Break a complex calculation into simpler steps, choosing and using appropriate and efficient operations, methods** and resources, including ICT.

30–1 • Present and interpret solutions in the context of the original problem; **explain and justify methods and conclusions,** orally and in writing.

32–5 • Suggest extensions to problems by asking 'What if…?'; begin to generalise and to understand the significance of a counter-example.

Numbers and the number system

36–47 Place value, ordering and rounding

36–9 • Understand and use decimal notation and place value; multiply and divide integers and decimals by 10, 100, 1000, and explain the effect.

40–1 • Compare and order decimals in different contexts; know that when comparing measurements they must be in the same units.

42–5 • Round positive whole numbers to the nearest 10, 100 or 1000 and decimals to the nearest whole number or one decimal place.

48–59 Integers, powers and roots

48–51 • Understand negative numbers as positions on a number line; order, add and subtract positive and negative integers in context.

52–5 • Recognise and use multiples, factors (divisors), common factor, highest common factor and lowest common multiple in simple cases, and primes (less than 100); use simple tests of divisibility.

56–9 • Recognise the first few triangular numbers, squares of numbers to at least 12×12 and the corresponding roots.

60–81 Fractions, decimals, percentages, ratio and proportion

60–5 • Use fraction notation to describe parts of shapes and to express a smaller whole number as a fraction of a larger one; **simplify fractions by cancelling all common factors and identify equivalent fractions;** convert terminating decimals to fractions, e.g. 0.23 = $^{23}/_{100}$; use a diagram to compare two or more simple fractions.

66–9 • Begin to add and subtract simple fractions and those with common denominators; calculate simple fractions of quantities and measurements (whole-number answers); multiply a fraction by an integer.

70–7 • Understand percentage as the 'number of parts per 100'; **recognise the equivalence of percentages, fractions and decimals;** calculate simple percentages and use percentages to compare simple proportions.

78–81 • Understand the relationship between ratio and proportion; use direct proportion in simple contexts; use ratio notation, reduce a ratio to its simplest form and divide a quantity into two parts in a given ratio; solve simple problems about ratio and proportion using informal strategies.

Calculations

82–7 Number operations and the relationships between them

82–5 • Understand addition, subtraction, multiplication and division as they apply to whole numbers and decimals; know how to use the laws of arithmetic and inverse operations.

86–7 • **Know and use the order of operations,** including brackets.

88–103 Mental methods and rapid recall of number facts

88–91 • Consolidate the rapid recall of number facts, including positive integer complements to 100 and multiplication facts to 10×10, and quickly derive associated division facts.

92–101 • Consolidate and **extend mental methods of calculation to include decimals, fractions and percentages,** accompanied where appropriate by suitable jottings; solve simple word problems mentally.

102–3 • Make and justify estimates and approximations of calculations.

104–7 Written methods

104–5 • Use standard column procedures to add and subtract whole numbers and decimals with up to two places.

104–7 • **Multiply and divide three-digit by two-digit whole numbers; extend to multiplying and dividing decimals with one or two places by single-digit whole numbers.**
For calculations with fractions and percentages, see above.

108–9 Calculator methods

108–9 • Carry out calculations with more than one step using brackets and the memory; use the square root and sign change keys.

108–9 • Enter numbers and interpret the display in different contexts (decimals, percentages, money, metric measures).

110–11 Checking results

110–11 • **Check a result by considering whether it is of the right order of magnitude** and by working the problem backwards.

Algebra

112–43 Equations, formulae and identities

112–13 • **Use letter symbols to represent unknown numbers or variables;** know the meanings of the words *term*, *expression* and *equation*.

114–15 • **Understand that algebraic operations follow the same conventions and order as arithmetic operations** (see also pages 82–7).

116–19 • Simplify linear algebraic expressions by collecting like terms; begin to multiply a single term over a bracket (integer coefficients).

122–5 • Construct and solve simple linear equations with integer coefficients (unknown on one side only) using an appropriate method (e.g. inverse operations).

138–43 • Use simple formulae from mathematics and other subjects; substitute positive integers into simple linear expressions and formulae and, in simple cases, derive a formula.

144–77 Sequences, functions and graphs

144–7 • Generate and describe simple integer sequences.

148–51 • Generate terms of a simple sequence, given a rule (e.g. finding a term from the previous term, finding a term given its position in the sequence).

154–7 • Generate sequences from practical contexts and describe the general term in simple cases.

160–3 • Express simple functions in words, then using symbols; represent them in mappings.

164–7 • Generate coordinate pairs that satisfy a simple linear rule; **plot the graphs of simple linear functions,** where y is given explicitly in terms of x, on paper and using ICT; recognise straight-line graphs parallel to the x-axis or y-axis.

172–7 • Begin to plot and interpret the graphs of simple linear functions arising from real-life situations.

Shape, space and measures

178–201 Geometrical reasoning: lines, angles and shapes

178–9 • Use correctly the vocabulary, notation and labelling conventions for lines, angles and shapes.

180–3 • **Identify parallel and perpendicular lines; know the sum of angles at a point, on a straight line and in a triangle,** and recognise vertically opposite angles.

184–9 • Begin to identify and use angle, side and symmetry properties of triangles and quadrilaterals; solve geometrical problems involving these properties, using step-by-step deduction and explaining reasoning with diagrams and text.

198–201 • Use 2-D representations to visualise 3-D shapes and deduce some of their properties.

202–17 Transformations

202–3 • Understand and use the language and notation associated with reflections, translations and rotations.

202–12 • Recognise and visualise the transformation and symmetry of a 2-D shape:
- reflection in given mirror lines, and line symmetry;
- rotation about a given point, and rotation symmetry;
- translation;

explore these transformations and symmetries using ICT.

218–19 Coordinates

218–19 • Use conventions and notation for 2-D coordinates in all four quadrants; find coordinates of points determined by geometric information.

220–3 Construction

220–3 • Use a ruler and protractor to:
- measure and draw lines to the nearest millimetre and angles, including reflex angles, to the nearest degree;
- construct a triangle given two sides and the included angle (SAS) or two angles and the included side (ASA);

explore these constructions using ICT.

222–3 • Use ruler and protractor to construct simple nets of 3-D shapes, e.g. cuboid, regular tetrahedron, square-based pyramid, triangular prism.

228–41 Measures and mensuration

228–31 • Use names and abbreviations of units of measurement to measure, estimate, calculate and solve problems in everyday contexts involving length, area, mass, capacity, time and angle;
convert one metric unit to another (e.g. grams to kilograms); read and interpret scales on a range of measuring instruments.

232–3 • Use angle measure; distinguish between and estimate the size of acute, obtuse and reflex angles.

234–7 • Know and use the formula for the area of a rectangle; calculate the perimeter and area of shapes made from rectangles.

238–41 • Calculate the surface area of cubes and cuboids.

Handling data

248–55 Specifying a problem, planning and collecting data

248–9 • Given a problem that can be addressed by statistical methods, suggest possible answers.

250–1 • Decide which data would be relevant to an enquiry and possible sources.

252–5 • Plan how to collect and organise small sets of data; design a data collection sheet or questionnaire to use in a simple survey; construct frequency tables for discrete data, grouped where appropriate in equal class intervals.

254–5 • Collect small sets of data from surveys and experiments, as planned.

256–67 Processing and representing data, using ICT as appropriate

256–61 • Calculate statistics for small sets of discrete data:
- find the mode, median and range, and the modal class for grouped data;
- calculate the mean, including from a simple frequency table, using a calculator for a larger number of items.

262–5 • Construct, on paper and using ICT, graphs and diagrams to represent data, including:
- bar-line graphs;
- frequency diagrams for grouped discrete data;

use ICT to generate pie charts.

268–75 Interpreting and discussing results

268–71 • Interpret diagrams and graphs (including pie charts), and draw simple conclusions based on the shape of graphs and simple statistics for a single distribution.

272–3 • **Compare two simple distributions using the range and one of the mode, median or mean.**

272–3 • Write a short report of a statistical enquiry and illustrate with appropriate diagrams, graphs and charts, using ICT as appropriate; justify the choice of what is presented.

276–85 Probability

276–77 • Use vocabulary and ideas of probability, drawing on experience.

278–81 • **Understand and use the probability scale from 0 to 1; find and justify probabilities based on equally likely outcomes in simple contexts;** identify all the possible mutually exclusive outcomes of a singe event.

282–3 • Collect data from a simple experiment and record in a frequency table; estimate probabilities based on this data.

284–5 • Compare experimental and theoretical probabilities in simple contexts.

NOTES
- Key objectives are highlighted in **bold type**.
- Page references are to the supplement of examples for Years 7, 8 and 9.

Teaching programme: Year 8

Using and applying mathematics to solve problems

2–35 Applying mathematics and solving problems

2–25 • Solve more demanding problems and investigate in a range of contexts: number, algebra, shape, space and measures, and handling data; compare and evaluate solutions.

26–7 • **Identify the necessary information to solve a problem; represent problems and interpret solutions in algebraic, geometric or graphical form,** using correct notation and appropriate diagrams.

28–9 • Solve more complex problems by breaking them into smaller steps or tasks, choosing and using efficient techniques for calculation, algebraic manipulation and graphical representation, and resources, including ICT.

30–1 • **Use logical argument to establish the truth of a statement;** give solutions to an appropriate degree of accuracy in the context of the problem.

32–5 • Suggest extensions to problems, conjecture and generalise; identify exceptional cases or counter-examples.

Numbers and the number system

36–47 Place value, ordering and rounding

36–9 • Read and write positive integer powers of 10; multiply and divide integers and decimals by 0.1, 0.01.

40–1 • Order decimals.

42–5 • Round positive numbers to any given power of 10; round decimals to the nearest whole number or to one or two decimal places.

48–59 Integers, powers and roots

48–51 • **Add, subtract, multiply and divide integers.**

52–5 • Recognise and use multiples, factors (divisors), common factor, highest common factor, lowest common multiple and primes; find the prime factor decomposition of a number (e.g. 8000 = $2^6 \times 5^3$).

56–9 • Use squares, positive and negative square roots, cubes and cube roots, and index notation for small positive integer powers.

60–81 Fractions, decimals, percentages, ratio and proportion

60–5 • Know that a recurring decimal is a fraction; use division to convert a fraction to a decimal; order fractions by writing them with a common denominator or by converting them to decimals.

66–9 • Add and subtract fractions by writing them with a common denominator; calculate fractions of quantities (fraction answers); multiply and divide an integer by a fraction.

70–7 • Interpret percentage as the operator 'so many hundredths of' and express one given number as a percentage of another; **use the equivalence of fractions, decimals and percentages to compare proportions; calculate percentages and find the outcome of a given percentage increase or decrease.**

78–81 • Consolidate understanding of the relationship between ratio and proportion; reduce a ratio to its simplest form, including a ratio expressed in different units, recognising links with fraction notation; **divide a quantity into two or more parts in a given ratio; use the unitary method to solve simple word problems involving ratio and direct proportion.**

Calculations

82–7 Number operations and the relationships between them

82–5 • Understand addition and subtraction of fractions and integers, and multiplication and division of integers; use the laws of arithmetic and inverse operations.

86–7 • Use the order of operations, including brackets, with more complex calculations.

88–103 Mental methods and rapid recall of number facts

88–91 • Recall known facts, including fraction to decimal conversions; use known facts to derive unknown facts, including products involving numbers such as 0.7 and 6, and 0.03 and 8.

92–101 • Consolidate and extend mental methods of calculation, working with

92–101 decimals, fractions and percentages, squares and square roots, cubes and cube roots; solve word problems mentally.

102–3 • Make and justify estimates and approximations of calculations.

104–7 Written methods

104–5 • Consolidate standard column procedures for addition and subtraction of integers and decimals with up to two places.

104–7 • **Use standard column procedures for multiplication and division of integers and decimals, including by decimals such as 0.6 or 0.06; understand where to position the decimal point by considering equivalent calculations.**
For calculations with fractions and percentages, see above.

108–9 Calculator methods

108–9 • Carry out more difficult calculations effectively and efficiently using the function keys for sign change, powers, roots and fractions; use brackets and the memory.

108–9 • Enter numbers and interpret the display in different contexts (negative numbers, fractions, decimals, percentages, money, metric measures, time).

110–11 Checking results

110–11 • Check a result by considering whether it is of the right order of magnitude and by working the problem backwards.

Algebra

112–43 Equations, formulae and identities

112–13 • Begin to distinguish the different roles played by letter symbols in equations, formulae and functions; know the meanings of the words *formula* and *function*.

114–15 • Know that algebraic operations follow the same conventions and order as arithmetic operations; use index notation for small positive integer powers.

116–19 • **Simplify or transform linear expressions by collecting like terms; multiply a single term over a bracket.**

122–5 • Construct and solve linear equations with integer coefficients (unknown on either or both sides, without and with brackets) using appropriate methods (e.g. inverse operations, transforming both sides in same way).

136–7 • Begin to use graphs and set up equations to solve simple problems involving direct proportion.

138–43 • Use formulae from mathematics and other subjects; **substitute integers into simple formulae,** including examples that lead to an equation to solve, and positive integers into expressions involving small powers (e.g. $3x^2 + 4$ or $2x^3$); derive simple formulae.

144–77 Sequences, functions and graphs

144–7 • Generate and describe integer sequences.

148–51 • Generate terms of a linear sequence using term-to-term and position-to-term definitions of the sequence, on paper and using a spreadsheet or graphical calculator.

154–7 • Begin to use linear expressions to describe the nth term of an arithmetic sequence, justifying its form by referring to the activity or practical context from which it was generated.

160–3 • Express simple functions in symbols; represent mappings expressed algebraically.

164–7 • Generate points in all four quadrants and **plot the graphs of linear functions, where y is given explicitly in terms of x,** on paper and using ICT; **recognise that equations of the form $y = mx + c$ correspond to straight-line graphs.**

172–7 • Construct linear functions arising from real-life problems and plot their corresponding graphs; discuss and interpret graphs arising from real situations.

Shape, space and measures

178–201 Geometrical reasoning: lines, angles and shapes

178–83 • **Identify alternate angles and corresponding angles; understand a proof that:**
– **the sum of the angles of a triangle is 180° and of a quadrilateral is 360°;**
– the exterior angle of a triangle is equal to the sum of the two interior opposite angles.

184–9 • Solve geometrical problems using side and angle properties of equilateral, isosceles and right-angled triangles and special quadrilaterals, explaining reasoning with diagrams and text; classify quadrilaterals by their geometric properties.

190–1 • Know that if two 2-D shapes are congruent, corresponding sides and angles are equal.

198–201 • Know and use geometric properties of cuboids and shapes made from cuboids; begin to use plans and elevations.

202–17 Transformations

202–11 • Transform 2-D shapes by simple combinations of rotations, reflections and translations, on paper and using ICT; identify all the symmetries of 2-D shapes.

212–15 • Understand and use the language and notation associated with enlargement; **enlarge 2-D shapes, given a centre of enlargement and a positive whole-number scale factor;** explore enlargement using ICT.

216–17 • Make simple scale drawings.

218–19 Coordinates

218–19 • Given the coordinates of points A and B, find the mid-point of the line segment AB.

220–7 Construction and loci

220–3 • **Use straight edge and compasses to construct:**
– **the mid-point and perpendicular bisector of a line segment;**
– **the bisector of an angle;**
– **the perpendicular from a point to a line;**
– **the perpendicular from a point on a line;**
construct a triangle, given three sides (SSS);
use ICT to explore these constructions.

224–7 • Find simple loci, both by reasoning and by using ICT, to produce shapes and paths, e.g. an equilateral triangle.

228–41 Measures and mensuration

228–31 • Use units of measurement to estimate, calculate and solve problems in everyday contexts involving length, area, volume, capacity, mass, time, angle and bearings; know rough metric equivalents of imperial measures in daily use (feet, miles, pounds, pints, gallons).

232–3 • Use bearings to specify direction.

234–7 • **Deduce and use formulae for the area of a triangle, parallelogram** and trapezium; calculate areas of compound shapes made from rectangles and triangles.

238–41 • **Know and use the formula for the volume of a cuboid; calculate volumes and surface areas of cuboids** and shapes made from cuboids.

Handling data

248–55 Specifying a problem, planning and collecting data

248–9 • Discuss a problem that can be addressed by statistical methods and identify related questions to explore.

250–1 • Decide which data to collect to answer a question, and the degree of accuracy needed; identify possible sources.

252–5 • Plan how to collect the data, including sample size; construct frequency tables with given equal class intervals for sets of continuous data; design and use two-way tables for discrete data.

254–5 • Collect data using a suitable method, such as observation, controlled experiment, including data logging using ICT, or questionnaire.

256–67 Processing and representing data, using ICT as appropriate

256–61 • Calculate statistics, including with a calculator; recognise when it is appropriate to use the range, mean, median and mode and, for grouped data, the modal class; calculate a mean using an assumed mean; construct and use stem-and-leaf diagrams.

262–7 • **Construct, on paper and using ICT:**
– **pie charts for categorical data;**
– **bar charts and frequency diagrams for discrete and continuous data;**
– **simple line graphs for time series;**
– **simple scatter graphs;**
identify which are most useful in the context of the problem.

268–75 Interpreting and discussing results

268–71 • Interpret tables, graphs and diagrams for both discrete and continuous data, and draw inferences that relate to the problem being discussed; relate summarised data to the questions being explored.

272–3 • Compare two distributions using the range and one or more of the mode, median and mean.

272–3 • Communicate orally and on paper the results of a statistical enquiry and the methods used, using ICT as appropriate; justify the choice of what is presented.

276–85 Probability

276–7 • Use the vocabulary of probability when interpreting the results of an experiment; appreciate that random processes are unpredictable.

278–81 • Know that if the probability of an event occurring is p, then the probability of it not occurring is $1 - p$; **find and record all possible mutually exclusive outcomes for single events and two successive events in a systematic way,** using diagrams and tables.

282–3 • Estimate probabilities from experimental data; understand that:
– if an experiment is repeated there may be, and usually will be, different outcomes;
– increasing the number of times an experiment is repeated generally leads to better estimates of probability.

284–5 • Compare experimental and theoretical probabilities in different contexts.

NOTES • Key objectives are highlighted in **bold type**.
• Page references are to the supplement of examples for Years 7, 8 and 9.

Teaching programme: Year 9

Using and applying mathematics to solve problems

2–35 Applying mathematics and solving problems

2–25 • Solve increasingly demanding problems and evaluate solutions; explore connections in mathematics across a range of contexts: number, algebra, shape, space, and measures, and handling data; *generate fuller solutions.*

26–7 • Represent problems and synthesise information in algebraic, geometric or graphical form; move from one form to another to gain a different perspective on the problem.

28–9 • **Solve substantial problems by breaking them into simpler tasks, using a range of efficient techniques, methods and resources, including ICT;** use trial and improvement where a more efficient method is not obvious.

30–1 • **Present a concise, reasoned argument, using symbols, diagrams, graphs and related explanatory text; give solutions to problems to an appropriate degree of accuracy,** *recognising limitations on the accuracy of data and measurements; give reasons for choice of presentation, explaining selected features and showing insight into the problem's structure.*

32–5 • Suggest extensions to problems, conjecture and generalise; identify exceptional cases or counter-examples, explaining why; *justify generalisations, arguments or solutions; pose extra constraints and investigate whether particular cases can be generalised further.*

Numbers and the number system

36–47 Place value, ordering and rounding

36–9 • Extend knowledge of integer powers of 10; multiply and divide by any integer power of 10; *begin to write numbers in standard form.*

42–7 • Use rounding to make estimates; round numbers to the nearest whole number or to one, two *or three* decimal places, *and to a given number of significant figures; understand upper and lower bounds.*

48–59 Integers, powers and roots

52–5 • Use the prime factor decomposition of a number.

56–7 • Use ICT to estimate square roots and cube roots.

56–9 • Use index notation for integer powers and simple instances of the index laws; *know and use the index laws for multiplication and division of positive integer powers; begin to extend understanding of index notation to negative and fractional powers, recognising that the index laws can be applied to these as well.*

60–81 Fractions, decimals, percentages, ratio and proportion

60–5 • Understand the equivalence of simple algebraic fractions; know that a recurring decimal is an exact fraction; *use algebraic methods to convert a recurring decimal to a fraction in simple cases.*

66–9 • Use efficient methods to **add, subtract, multiply and divide fractions,** interpreting division as a multiplicative inverse; cancel common factors before multiplying or dividing.

75–7 • Recognise when fractions or percentages are needed to compare proportions; solve problems involving percentage changes.

78–81 • **Use proportional reasoning to solve a problem, choosing the correct numbers to take as 100%, or as a whole;** *understand and use proportionality and calculate the result of any proportional change using multiplicative methods; understand the implications of enlargement for area and volume;* compare two ratios; interpret and use ratio in a range of contexts, including solving word problems.

Calculations

82–7 Number operations and the relationships between them

82–5 • Understand the effects of multiplying and dividing by numbers between 0 and 1**;** use the laws of arithmetic and inverse operations; *recognise and use reciprocals.*

86–7 • Understand the order of precedence and effect of powers.

88–103 Mental methods and rapid recall of number facts

88–101 • Use known facts to derive unknown facts; extend mental methods of calculation, working with decimals, fractions, percentages, factors, powers and roots; solve word problems mentally.

102–3 • **Make and justify estimates and approximations of calculations;** *estimate calculations by rounding numbers to one significant figure and multiplying or dividing mentally.*

104–7 Written methods

104–7 • Use standard column procedures to add and subtract integers and decimals of any size, including a mixture of large and small numbers with differing numbers of decimal places; multiply and divide by decimals, dividing by transforming to division by an integer.
For calculations with fractions and percentages, see above.

108–9 Calculator methods

108–9 • Use a calculator efficiently and appropriately to perform complex calculations with numbers of any size, knowing not to round during intermediate steps of a calculation; use the constant, π and sign change keys, function keys for powers, roots and fractions, brackets and the memory; *use the reciprocal key.*

108–9 • Enter numbers and interpret the display in context (negative numbers, fractions, decimals, percentages, money, metric measures, time, *numbers in standard form*).

110–11 Checking results

110–11 • Check results using appropriate methods.

Algebra

112–43 Equations, formulae and identities

112–13 • Distinguish the different roles played by letter symbols in equations, identities, formulae and functions.

114–15 • Use index notation for integer powers and simple instances of the index laws; *know and use the index laws in generalised form for multiplication and division of integer powers (see also pages 56–9).*

116–21 • Simplify or transform algebraic expressions by taking out single-term common factors; add simple algebraic fractions; *square a linear expression, expand the product of two linear expressions of the form $x \pm n$ and simplify the corresponding quadratic expression; establish identities such as $a^2 - b^2 = (a + b)(a - b)$.*

122–5 • **Construct and solve linear equations with integer coefficients** (with and without brackets, negative signs anywhere in the equation, positive or negative solution), **using an appropriate method**.

126–9 • *Solve a pair of simultaneous linear equations by eliminating one variable; link a graphical representation of an equation or a pair of equations to the algebraic solution; consider cases that have no solution or an infinite number of solutions.*

130–1 • *Solve linear inequalities in one variable, and represent the solution set on a number line; begin to solve inequalities in two variables.*

132–5 • Use systematic trial and improvement methods and ICT tools to find approximate solutions to equations such as $x^3 + x = 20$.

136–7 • Solve problems involving direct proportion using algebraic methods, relating algebraic solutions to graphical representations of the equations; use ICT as appropriate.

138–43 • Use formulae from mathematics and other subjects; substitute numbers into expressions and formulae; derive a formula and, in simple cases, change its subject; *derive and use more complex formulae, and change the subject of a formula.*

144–77 Sequences, functions and graphs

148–53 • **Generate terms of a sequence using term-to-term and position-to-term definitions of the sequence, on paper and using ICT;** *find the next term and the nth term of quadratic sequences and functions and explore their properties.*

154–9 • Generate sequences from practical contexts and **write an expression to describe the *n*th term of an arithmetic sequence;** *deduce properties of the sequences of triangular and square numbers from spatial patterns.*

160–3 • Find the inverse of a linear function *and plot its graph; know simple properties of quadratic functions.*

164–71 • Generate points and plot graphs of linear functions (y given implicitly in terms of x), e.g. $ay + bx = 0$, $y + bx + c = 0$, on paper and using ICT; **given values for *m* and *c*, find the gradient of lines given by equations of the form $y = mx + c$;** *investigate the gradients of parallel lines and lines perpendicular to these lines; plot graphs of simple quadratic and cubic functions, e.g. $y = x^2$, $y = 3x^2 + 4$, $y = x^3$.*

172–7 • **Construct functions arising from real-life problems and plot their corresponding graphs; interpret graphs arising from real situations,** including distance–time graphs.

Shape, space and measures

178–201 Geometrical reasoning: lines, angles and shapes

178–9 • Distinguish between conventions, definitions and derived properties; *distinguish between practical demonstration and proof; know underlying assumptions, recognising their importance and limitations, and the effect of varying them.*

182–3 • Explain how to find, calculate and use:
– the sums of the interior and exterior angles of quadrilaterals, pentagons and hexagons;
– the interior and exterior angles of regular polygons.

184–9 • **Solve problems using properties of angles, of parallel and intersecting lines, and of triangles and other polygons,** justifying inferences and explaining reasoning with diagrams and text; *understand and apply Pythagoras' theorem.*

190–1 • Understand congruence; *apply the conditions SSS, SAS, ASA or RHS to establish the congruence of triangles.*

192–3 • *Know that if two 2-D shapes are similar, corresponding angles are equal and corresponding sides are in the same ratio.*

194–7 • Know the definition of a circle and the names of its parts; explain why inscribed regular polygons can be constructed by equal divisions of a circle; *know that the tangent at any point on a circle is perpendicular to the radius at that point; explain why the perpendicular from the centre to the chord bisects the chord.*

198–201 • Visualise and use 2-D representations of 3-D objects; analyse 3-D shapes through 2-D projections, including plans and elevations.

202–17 Transformations

202–7 • Transform 2-D shapes by combinations of translations, rotations and reflections, on paper and using ICT; **know that translations, rotations and reflections preserve length and angle and map objects on to congruent images;** identify reflection symmetry in 3-D shapes.

212–15 • Enlarge 2-D shapes, given a centre of enlargement and a whole-number scale factor, on paper and using ICT; *extend to enlarging 2-D shapes, given a fractional scale factor; recognise the similarity of the resulting shapes;* identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments; recognise that enlargements preserve angle but not length, and understand the implications of enlargement for perimeter, *area and volume.*

216–17 • Use and interpret maps and scale drawings.

218–19 Coordinates

218–19 • *Find points that divide a line in a given ratio, using the properties of similar triangles; given the coordinates of points A and B, calculate the length of AB.*

220–7 Construction and loci

220–3 • Use straight edge and compasses to construct a triangle, given right angle, hypotenuse and side (RHS); use ICT to explore constructions of triangles and other 2-D shapes; *know from experience of constructing them that triangles given SSS, SAS, ASA or RHS are unique, but that triangles given SSA or AAA are not.*

224–7 • Find the locus of a point that moves according to a simple rule, both by reasoning and by using ICT; *extend to more complex rules involving loci and simple constructions.*

228–47 Measures and mensuration

228–31 • Use units of measurement to calculate, estimate, measure and solve problems in a variety of contexts; convert between area measures (mm^2 to cm^2, cm^2 to m^2, and vice versa) and between volume measures (mm^3 to cm^3, cm^3 to m^3, and vice versa); *recognise that measurements given to the nearest whole unit may be inaccurate by up to one half of the unit in either direction.*

232–3 • *Understand and use measures of speed (and other compound measures such as density or pressure) to solve problems; solve problems involving constant or average rates of change.*

234–7 • **Know and use the formulae for the circumference and area of a circle,** *and arcs and sectors of circles.*

238–41 • Calculate the surface area and volume of right prisms; *calculate lengths, areas and volumes in right prisms, including cylinders.*

242–7 • *Begin to use sine, cosine and tangent in right-angled triangles to solve problems in two dimensions.*

Handling data

248–55 Specifying a problem, planning and collecting data

248–9 • Suggest a problem to explore using statistical methods, frame questions and raise conjectures.

250–1 • Discuss how data relate to a problem; identify possible sources, including primary and secondary sources; *identify possible sources of bias and plan how to minimise it.*

252–5 • **Design a survey or experiment to capture the necessary data from one or more sources; determine the sample size and degree of accuracy needed; design, trial and if necessary refine data collection sheets;** construct tables for large discrete and continuous sets of raw data, choosing suitable class intervals; design and use two-way tables.

254–5 • Gather data from specified secondary sources, including printed tables and lists from ICT-based sources; *identify what extra information may be required to pursue a further line of enquiry.*

256–67 Processing and representing data, using ICT as appropriate

256–61 • Find summary values that represent the raw data, and select the statistics most appropriate to the problem; *find the median and quartiles for large data sets; estimate the mean, median and interquartile range of a large set of grouped data.*

262–7 • Select, construct and modify, on paper and using ICT, suitable graphical representation to progress an enquiry, including:
– *frequency polygons;*
– line graphs for time series;
– scatter graphs to develop further understanding of correlation;
– *lines of best fit by eye, understanding what they represent;*
identify key features present in the data.

268–75 Interpreting and discussing results

268–71 • Interpret graphs and diagrams and draw inferences to support or cast doubt on initial conjectures; have a basic understanding of correlation; *analyse data to find patterns and exceptions, look for cause and effect and try to explain anomalies.*

272–3 • Compare two or more distributions and make inferences, using the shape of the distributions, the range of data and appropriate statistics.

272–5 • **Communicate interpretations and results of a statistical enquiry using selected tables, graphs and diagrams in support,** using ICT as appropriate; *examine critically the results of a statistical enquiry, and justify choice of statistical representation in written presentations, recognising the limitations of any assumptions and their effect on conclusions drawn.*

276–85 Probability

276–7 • Use the vocabulary of probability in interpreting results involving uncertainty and prediction.

278–81 • Identify all the mutually exclusive outcomes of an experiment; **know that the sum of probabilities of all mutually exclusive outcomes is 1 and use this when solving problems.**

282–3 • Estimate probabilities from experimental data; *understand relative frequency as an estimate of probability and use this to compare outcomes of experiments.*

284–5 • Compare experimental and theoretical probabilities in a range of contexts; appreciate the difference between mathematical explanation and experimental evidence.

NOTES
- Key objectives are highlighted in **bold type**.
- Objectives appropriate for able pupils are in *blue italic*; see pages 12–13 for more details, including key objectives.
- Page references are to the supplement of examples for Years 7, 8 and 9.

Teaching programme: Year 9 objectives for able pupils

Using and applying mathematics to solve problems

2–35 Applying mathematics and solving problems

2–25 • **Generate fuller solutions to problems.**

30–1 • **Recognise limitations on accuracy of data and measurements;** give reasons for choice of presentation, explaining selected features and showing insight into the problem's structure.

32–3 • Justify generalisations, arguments or solutions; pose extra constraints and investigate whether particular cases can be generalised further.

Calculations

82–7 Number operations and the relationships between them

82–3 • Recognise and use reciprocals.

88–107 Mental methods and rapid recall of number facts; written methods

102–7 • Estimate calculations by rounding numbers to one significant figure and multiplying or dividing mentally.

108–9 Calculator methods

108–9 • Use a calculator efficiently and appropriately, including using the reciprocal key and entering and interpreting numbers in standard form.

Numbers and the number system

36–47 Place value, ordering and rounding

38–9 • Write numbers in standard form.

44–7 • Understand upper and lower bounds; round numbers to three decimal places and a given number of significant figures.

48–59 Integers, powers and roots

58–9 • **Know and use the index laws for multiplication and division of positive integer powers;** begin to extend understanding of index notation to negative and fractional powers, recognising that the index laws can be applied to these as well.

60–81 Fractions, decimals, percentages, ratio and proportion

64–5 • Use algebraic methods to convert a recurring decimal to a fraction in simple cases.

78–81 • **Understand and use proportionality and calculate the result of any proportional change using multiplicative methods;** understand the implications of enlargement for area and volume.

Algebra

112–43 Equations, formulae and identities

114–15 • Know and use the index laws in generalised form for multiplication and division of positive integer powers (see also pages 56–9).

118–21 • **Square a linear expression, expand the product of two linear expressions of the form $x \pm n$ and simplify the corresponding quadratic expression; establish identities** such as $a^2 - b^2 = (a + b)(a - b)$.

126–9 • **Solve a pair of simultaneous linear equations by eliminating one variable; link a graphical representation of an equation or a pair of equations to the algebraic solution;** consider cases that have no solution or an infinite number of solutions.

130–1 • Solve linear inequalities in one variable, and represent the solution set on a number line; begin to solve inequalities in two variables.

138–41 • Derive and use more complex formulae, and **change the subject of a formula.**

144–77 Sequences, functions and graphs

148–53 • Find the next term and the nth term of quadratic sequences and functions and explore their properties.

158–9 • Deduce properties of the sequences of triangular and square numbers from spatial patterns.

162–3 • Plot the graph of the inverse of a linear function; know simple properties of quadratic functions.

168–9 • Investigate the gradients of parallel lines and lines perpendicular to these lines.

170–1 • Plot graphs of simple quadratic and cubic functions, e.g. $y = x^2$, $y = 3x^2 + 4$, $y = x^3$.

Shape, space and measures

178–201 Geometrical reasoning: lines, angles and shapes

178–9 • Distinguish between practical demonstration and proof; know underlying assumptions, recognising their importance and limitations and the effect of varying them.

186–9 • **Understand and apply Pythagoras' theorem.**

190–1 • **Apply the conditions SSS, SAS, ASA or RHS to establish the congruence of triangles.**

192–3 • **Know that if two 2-D shapes are similar, corresponding angles are equal and corresponding sides are in the same ratio.**

196–7 • Know that the tangent at any point on a circle is perpendicular to the radius at that point; explain why the perpendicular from the centre to the chord bisects the chord.

202–17 Transformations

212–17 • Enlarge 2-D shapes, given a fractional scale factor; recognise the similarity of the resulting shapes; understand the implications of enlargement for area and volume.

218–19 Coordinates

218–19 • Find points that divide a line in a given ratio, using the properties of similar triangles; given the coordinates of points A and B, calculate the length of AB.

220–7 Construction and loci

222–3 • **Know from experience of constructing them that triangles given SSS, SAS, ASA or RHS are unique, but that triangles given SSA or AAA are not.**

224–7 • Find the locus of a point that moves according to a more complex rule involving loci and simple constructions, both by reasoning and by using ICT.

228–47 Measures and mensuration

230–1 • Recognise that measurements given to the nearest whole unit may be inaccurate by up to one half of the unit in either direction.

232–3 • **Understand and use measures of speed (and other compound measures such as density or pressure) to solve problems;** solve problems involving constant or average rates of change.

234–7 • Know and use the formulae for length of arcs and and area of sectors of circles.

238–41 • Calculate lengths, areas and volumes in right prisms, including cylinders.

242–7 • Begin to use sine, cosine and tangent in right-angled triangles to solve problems in two dimensions.

Handling data

248–55 Specifying a problem, planning and collecting data

250–1 • **Identify possible sources of bias and plan how to minimise it.**

254–5 • Identify what extra information may be required to pursue a further line of enquiry.

256–67 Processing and representing data, using ICT as appropriate

256–61 • Find the median and quartiles for large data sets; estimate the mean, median and interquartile range of a large set of grouped data.

262–7 • Select, construct and modify, on paper and using ICT, suitable graphical representation to progress an enquiry, including:
– frequency polygons;
– lines of best fit by eye, understanding what they represent;
identify key features present in the data.

268–75 Interpreting and discussing results

270–1 • Analyse data to find patterns and exceptions, look for cause and effect and try to explain anomalies.

274–5 • **Examine critically the results of a statistical enquiry, and justify choice of statistical representation in written presentations,** recognising the limitations of any assumptions and their effect on conclusions drawn.

276–85 Probability

282–3 • Understand relative frequency as an estimate of probability and use this to compare outcomes of experiments.

NOTES
- For ease of reference the objectives are printed here in black upright type instead of blue italic.
- Key objectives are highlighted in **bold type**.
- Page references are to the supplement of examples for Years 7, 8 and 9.