NORFOLK COUNTY COUNCIL EDUCATION

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TO: All Middle Schools

FAO: Year 7 Co-ordinator

Dear Colleague,

In response to the evaluation forms following the training course for *'Strengthening teaching and learning in Year 7 Part 1'*, I enclose a copy of the Sample medium-term plans for mathematics and a Mathematics glossary for teachers.

To support Key Stage 3 Year 7 teachers in middle schools, I would like to offer the opportunity of a one-to-one session with a Key Stage 3 Mathematics adviser to discuss your school priorities.

One To One Session **Key Stage 3 Mathematics for Middle Schools**
Any Wednesday 4.30pm - 6.30pm To book your one to one, please contact Louise Flynn 01603 433276

These sessions are fully funded. Please ring Louise Flynn to book an appointment at the Norwich Professional Development Centre, making it clear the focus for the meeting.

We look forward to hearing from you.

Yours sincerely

Brenda Emmott

Brenda Emmott
Key Stage 3 Line Manager

Key Stage 3 *National Strategy*

Sample medium-term plans for mathematics

Contents

Introduction

The *Framework for teaching mathematics: Years 7, 8 and 9* provides teachers with guidance on meeting the National Curriculum requirements for mathematics. It sets out yearly teaching programmes showing how objectives for teaching mathematics can be planned from Year 7 to Year 9. A key task in developing medium-term plans for Key Stage 3 mathematics is to identify the objectives for the units of work that are going to be taught. In doing this, schools may choose to start from their existing schemes of work or, alternatively, may find that these sample plans provide a useful starting point.

The sample plans are designed to continue the progression and expectations established in the yearly teaching programmes up to Year 6. They are based on the examples of planning charts in the Framework. There are many other ways to organise the mathematics curriculum in Key Stage 3. The planning charts indicate dependencies between topics but the order and content of the units can be adjusted.

Each sample plan identifies **core objectives that define a minimum expectation for the majority of pupils in a particular year group**. Plans for particular year groups are designed to show:

- progression in the teaching objectives for each strand of the curriculum;
- links between the teaching objectives, bringing together related ideas across the strands;
- opportunities to revisit topics during the year (the pitch of the second and subsequent units of a topic needs careful adjusting in the light of teachers' assessment of pupils' progress);
- how objectives for using and applying mathematics can be incorporated into units.

For each term, suggested objectives for oral and mental mathematics are also identified. Oral and mental work can both support the main teaching programme as well as provide a means of regularly revisiting important elements.

Many schools set pupils for mathematics. Teachers of higher sets may well base their pupils' work on the programme for a later year group, while teachers of lower sets may need to draw on objectives in the teaching programmes from a previous year group. As always, the success of setting depends on teachers in the mathematics department being involved in careful monitoring, close teamwork and co-operative planning to make sure that expectations for all pupils are suitably high and that lower expectations are not justified simply because pupils are in a lower set.

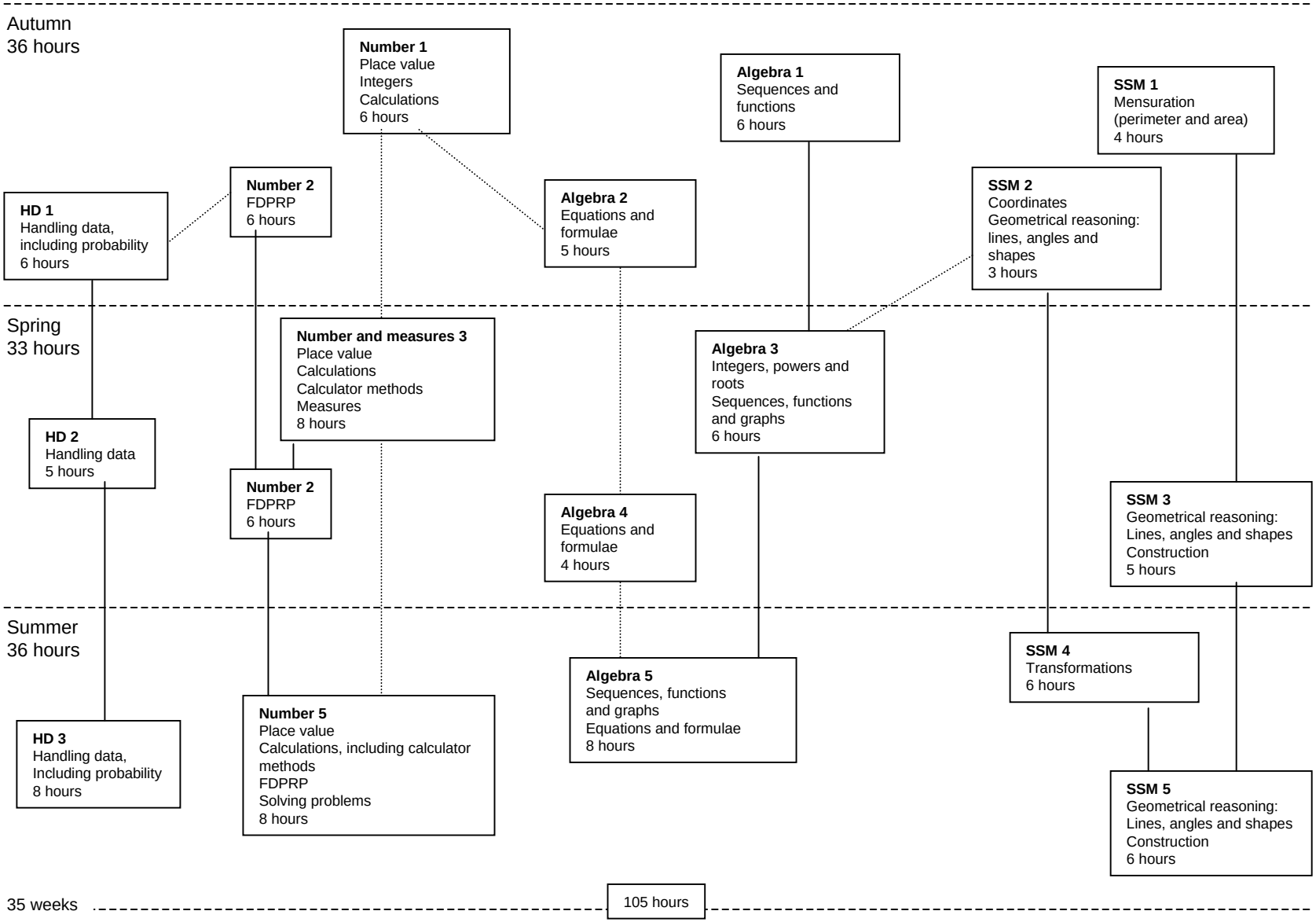
There are some secondary schools where, at present, relatively few pupils attain level 5 or above at the end of Key Stage 3. Pupils may lack a secure understanding of some of the work they have been taught earlier. To begin with, these schools should look carefully at the programmes for Year 5 and Year 6 and draw suitable teaching objectives from them when they are planning work for Year 7, making corresponding adjustments for Years 8 and 9. A decision like this would need to be reviewed before the start of the next school year to allow for improving standards over time.

How the plans are set out

Teaching objectives for oral and mental activities are placed at the beginning of the plan for each term. Objectives for the main activities are set out in four columns:

- The first identifies the areas of mathematics studied in the unit and identifies links to the supplement of examples in the Framework.
- The second identifies support objectives from previous yearly teaching programmes, as in *Springboard 7*. These are linked to the core objectives for each unit.
- The third column sets out the core objectives for the year group, the ones you would expect to focus on for the majority of pupils.
- The fourth provides extension objectives, to stretch able pupils, drawn from the next year's teaching programme. These are linked to the core objectives for the unit.

Year 7 planning chart



Using and applying mathematics to solve problems should be integrated into each unit

YEAR 7: AUTUMN TERM

Teaching objectives for the oral and mental activities

• Read and write whole numbers in figures and words. • Multiply and divide whole numbers by 10, 100, 1000. • Count on and back in steps of 0.1, 0.2, 0.25, $^1/_2$, $^1/_4$… • Round whole numbers to the nearest 10 or 100. • Order, add and subtract positive and negative numbers in context. • Recognise multiples and use simple tests of divisibility. • Know pairs of factors of numbers to 100. • Know or derive quickly prime numbers less than 30. • Know or derive quickly squares to at least 12×12 and the corresponding roots. • Convert between fractions, decimals and percentages. • Find simple fractions of quantities. • Know addition and subtraction facts to 20 and whole number complements of 100. • Find two decimals (one decimal place) with a sum of 1. • Add and subtract several small numbers or several multiples of 10, e.g. 50 – 40 + 80 – 100.	• Add and subtract pairs of numbers, e.g. 76 ± 38, 760 ± 380. • Find doubles and halves of numbers, e.g. 670, 5.6. • Recall multiplication facts to 10×10 and derive associated division facts. • Multiply and divide a two-digit number by a one-digit number. • Visualise, describe and sketch 2-D shapes in different orientations. • Estimate and order acute and obtuse angles. • Use metric units (length, mass, capacity) and units of time for calculations. • Use metric units for estimation (length, mass, capacity). • Convert between m, cm and mm, km and m, kg and g, litres and ml. • Know rough metric equivalents of common imperial units. • Apply mental skills to solve simple problems.

Teaching objectives for the main activities

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Algebra 1 (6 hours) Sequences and functions (144–163)	• Recognise and extend number sequences formed by counting from any number in steps of constant size, extending beyond zero when counting back. • Know squares to at least 10×10.	• Generate and describe simple integer sequences.	
		• 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). • Generate sequences from practical contexts and describe the general term in simple cases.	• 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. • Begin to use linear expressions to describe the *n*th term of an arithmetic sequence.
Formulae and identities (112–113) Solving problems (32–35)		• Express simple functions in words, then using symbols; represent them in mappings. • **Use letter symbols to represent unknown numbers or variables.** • Suggest extensions to problems by asking 'What if…?'; begin to generalise and to understand the significance of a counter-example.	• Represent mappings expressed algebraically.

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Number 1 (6 hours) Place value (36–41)	• Read and write whole numbers in figures and words. • **Use decimal notation for tenths and hundredths;** know what each digit represents in numbers with up to two decimal places.	• Understand and use decimal notation and place value; multiply and divide integers and decimals by 10, 100, 1000, and explain the effect.	
		• Compare and order decimals in different contexts; know that when comparing measurements they must be in the same units.	
Integers (48–51)	• Calculate a temperature rise and fall across 0 °C.	• Understand negative numbers as positions on a number line; order, add and subtract positive and negative integers in context.	• **Add, subtract, multiply and divide integers.**
Calculations (88–91, 102–105)	• Know squares to at least 10×10.	• 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.	• Recall known facts, including fraction to decimal conversions; use known facts to derive unknown facts, including products such as 0.7 and 6, and 0.03 and 8.
	• Use informal pencil and paper methods to support, record or explain additions and subtractions.	• Make and justify estimates and approximations of calculations. • Use standard column procedures to add and subtract whole numbers and decimals with up to two places.	
Calculator methods (108–109)	• Develop calculator skills and use a calculator effectively.	• Enter numbers and interpret the display in different contexts (decimals, money).	
Solving problems (2–11)		• **Solve word problems and investigate in a range of contexts:** number; compare and evaluate solutions.	

Shape, space and measures 1 (4 hours) Mensuration (198–201, 228–231, 234–241)	• Identify different nets for an open cube. • Measure and draw lines to the nearest millimetre. • Record estimates and readings from scales to a suitable degree of accuracy.	• Use 2-D representations to visualise 3-D shapes and deduce some of their properties. • Use names and abbreviations of units of measurement to measure, estimate, calculate and solve problems in everyday contexts involving length, area.	• Make simple scale drawings.
	• **Understand that area is measured in square centimetres (cm²).** • Understand, measure and calculate perimeters of rectangles and regular polygons.	• Know and use the formula for the area of a rectangle; calculate the perimeter and area of shapes made from rectangles.	• **Deduce and use formulae for the area of a triangle, parallelogram** and trapezium.
		• Calculate the surface area of cubes and cuboids.	• **Know and use the formula for the volume of a cuboid.**
Solving problems (18–21)		• **Solve word problems and investigate in a range of contexts:** length, perimeter and area.	

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Number 2 (6 hours) Fractions, decimals, percentages (60–77)	• Change an improper fraction to a mixed number; recognise when two simple fractions are equivalent, including relating hundredths to tenths. • **Use decimal notation for tenths and hundredths.**	• 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.	• Know that a recurring decimal is a fraction; use division to convert a fraction to a decimal; order fractions by converting them to decimals.
		• 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. • Understand percentage as the 'number of parts per 100'; **recognise the equivalence of percentages, fractions and decimals;** calculate simple percentages.	• Calculate fractions of quantities and measurements (fraction answers); multiply and divide an integer by a fraction. • **Find the outcome of a given percentage increase or decrease.**
Calculations (92–101, 110–111)	• Find a difference by counting up through the next multiple of 10, 100 or 1000. • Add and subtract mentally pairs of two-digit numbers.	• Consolidate and **extend mental methods of calculation to include decimals, fractions and percentages,** accompanied where appropriate by suitable jottings; solve simple word problems mentally. • **Check a result by considering whether it is of the right order of magnitude** and by working the problem backwards.	• Recall fraction to decimal conversions.
Solving problems (28–31)		• **Break a complex calculation into simpler steps, choosing and using appropriate and efficient operations, methods** and resources, including ICT. • Present and interpret solutions in the context of the original problem; **explain and justify methods and conclusions,** orally and in writing.	
Handling data 1 (6 hours) Handling data (256–261, 268–271)	• **Solve a problem by** representing, **extracting and interpreting data in tables, graphs, charts** and diagrams, for example: - line graphs; - frequency tables and bar charts.	• 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. • Interpret diagrams and graphs (including pie charts), and draw conclusions based on the shape of graphs and simple statistics for a single distribution.	• Recognise when it is appropriate to use the range, mean, median and mode; calculate a mean using an assumed mean.
Probability (276–283)		• Use vocabulary and ideas of probability, drawing on experience. • **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 single event.	• 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 two successive events in a systematic way,** using diagrams and tables.
		• Collect data from a simple experiment and record in a frequency table; estimate probabilities based on this data.	

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Algebra 2 (5 hours) Equations, formulae and identities (112–119, 138–143)		• **Use letter symbols to represent unknown numbers or variables;** know the meanings of the words *term*, *expression* and *equation*.	• Begin to distinguish the different roles played by letter symbols in equations, formulae and functions; know the meanings of the words *formula* and *function*.
	• Understand and use the relationships between the four operations, and the principles (not the names) of the arithmetic laws. Use brackets.	• **Understand that algebraic operations follow the same conventions and order as arithmetic operations.**	• Know that algebraic operations follow the same conventions and order as arithmetic operations; use index notation for small positive integer powers.
		• Simplify linear algebraic expressions by collecting like terms; begin to multiply a single term over a bracket (integer coefficients). • Use simple formulae from mathematics and other subjects, substitute positive integers into simple linear expressions and formulae and, in simple cases, derive a formula.	• **Simplify or transform linear expressions by collecting like terms; multiply a single term over a bracket.** • **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 $2x^3$).
Solving problems (26–27)		• Identify the necessary information to solve a problem; represent problems mathematically, making correct use of symbols, words, diagrams and tables.	

Shape, space and measures 2 (3 hours) Geometrical reasoning: lines, angles and shapes (178–189)	• Recognise positions.	• Use correctly the vocabulary, notation and labelling conventions for lines, angles and shapes.	
		• **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.	• **Identify alternate 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.
	• **Recognise properties of rectangles.** Classify triangles (isosceles, equilateral, scalene), using criteria such as equal sides, equal angles, lines of symmetry.	• Begin to identify and use angle, side and symmetry properties of triangles and quadrilaterals.	• Classify quadrilaterals by their geometric properties.
Coordinates (218–219)	• Read and plot coordinates in the first quadrant.	• Use conventions and notation for 2-D coordinates in all four quadrants; find coordinates of points determined by geometric information.	
Mensuration (232–233)		• Use angle measure; distinguish between and estimate the size of acute, obtuse and reflex angles.	

YEAR 7: SPRING TERM

Teaching objectives for the oral and mental activities

• Read and write whole numbers in figures and words. • Multiply and divide decimals by 10, 100, 1000. • Count on and back in steps of 0.4, 0.75, $^3/_4$… • Order decimals in different contexts. • Round decimals to the nearest whole number. • Order, add and subtract integers. • Recognise multiples and use tests of divisibility. • Know pairs of factors of numbers to 100. • Know or derive quickly prime numbers less than 30. • Know or derive quickly squares to at least 12 × 12 and the corresponding roots. • Find simple equivalent fractions. • Know whole-number complements of 50 and 100. • Find two decimals with a sum of 1 or 0.1 (two decimal places). • Add several small numbers and find their mean. • Add and subtract pairs of numbers, e.g. 7.6 ± 3.8, 760 ± 380.	• Find doubles and halves of numbers, e.g. 6500, 0.76, $^3/_4$. • Recall multiplication and division facts to 10 × 10. • Derive answers to calculations, e.g. 60 × 80, 0.4 × 9. • Multiply and divide a two-digit number by a one-digit number. • Visualise, describe and sketch 2-D shapes. • Estimate and order acute and obtuse angles. • Use metric units (length and area) and units of time for calculations. • Convert between m, cm and mm, km and m. • Calculate perimeter and area of rectangles. • Discuss and interpret graphs. • Apply mental skills to solve simple problems.

Teaching objectives for the main activities

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Handling data 2 (5 hours) Handling data (248–255, 262–265, 268–271)	• **Solve a problem by** representing, **extracting and interpreting data in tables, graphs, charts** and diagrams.	• Given a problem that can be addressed by statistical methods, suggest possible answers.	
		• Decide which data would be relevant to an enquiry and possible sources. • 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. • Collect small sets of data from surveys and experiments, as planned.	• Decide the degree of accuracy needed for the data. • Plan how to collect the data, including sample size; construct frequency tables with given equal class intervals for sets of continuous data.
		• 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.	• **Construct on paper and using ICT:** **- pie charts for categorical data;** **- simple line graphs for time series.**
	• Solve problems by representing data in a bar chart and line graph.	• Interpret diagrams and graphs (including pie charts), and draw simple conclusions based on the shape of graphs.	
Solving problems (24–25)		• **Solve word problems and investigate in a range of contexts:** handling data.	

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Number and measures 3 (8 hours) Place value (42–45)		• Round positive whole numbers to the nearest 10, 100 or 1000 and decimals to the nearest whole number or one decimal place.	• Round positive numbers to any given power of 10; round decimals to the nearest whole number or to one or two decimal places.
Calculations (82–87, 92–103, 104–107, 110–111)	• Understand and use the relationships between the four operations, and the principles (not the names) of the arithmetic laws.	• 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.	
	• Know multiplication facts up to 10 × 10.	• **Know and use the order of operations**, including brackets.	• Recall products such as 0.7 and 6, and 0.03 and 8.
	• Add several numbers. • Use doubling and halving. • Partition to multiply mentally TU × U.	• Consolidate and **extend mental methods of calculation to include decimals, fractions and percentages,** accompanied where appropriate by suitable jottings; solve simple word problems mentally.	
		• Make and justify estimates and approximations of calculations.	
	• **Extend written methods to:** **- HTU × U** and U.t × U; **- TU × TU;** **- HTU ÷ U.** • Divide £.p by a two-digit number to give £.p. • Round up or down after division, depending on the context.	• **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.**	• **Multiply and divide integers and decimals including by decimals such as 0.6 and 0.06; understand where to position the decimal point by considering equivalent calculations.**
		• **Check a result by considering whether it is of the right order of magnitude** and by working the problem backwards.	
Calculator methods (108–109)	• Develop calculator skills and use a calculator effectively.	• Carry out calculations with more than one step using brackets and the memory; use the square root and sign change keys.	
Measures (228–231)	• Use, read and write standard metric units of length, mass and capacity. • Suggest suitable units and measuring equipment to estimate or measure length, mass or capacity.	• Use names and abbreviations of units of measurement to measure, estimate, calculate and solve problems in everyday contexts involving length, area, mass, capacity and time; **convert one metric unit to another** (e.g. grams to kilograms); **read and interpret scales on a range of measuring instruments.**	• Know rough metric equivalents of imperial measures in daily use.
Solving problems (28–31)	• **Use all four operations to solve word problems,** including time.	• **Break a complex calculation into simpler steps, choosing and using appropriate and efficient operations, methods** and resources, including ICT.	
		• Present and interpret solutions in the context of the original problem; **explain and justify methods and conclusions,** orally and in writing.	• Give solutions to an appropriate degree of accuracy in the context of the problem.

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Algebra 3 (6 hours) Integers, powers and roots (52–59)	• Recognise multiples up to 10×10; know and apply simple tests of divisibility. • Identify factors of two-digit numbers.	• Recognise and use multiples, factors (divisors), common factor and primes (less than 100); use simple tests of divisibility.	• Find the prime factor decomposition of a number.
		• Recognise the first few triangular numbers, squares of numbers to at least 12×12, and the corresponding roots.	• Use squares, and positive and negative square roots.
Calculator methods (108–109)	• Use a calculator to square numbers.	• Use the square root key.	• Use the function keys for sign change, powers and roots.
Sequences, functions and graphs (148–167)	• Recognise and extend number sequences.	• 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).	• Generate terms of a linear sequence using term-to-term and position-to-term definitions, on paper and using a spreadsheet or graphical calculator.
		• Generate sequences from practical contexts and describe the general term in simple cases.	• Begin to use linear expressions to describe the *n*th term of an arithmetic sequence.
		• Express simple functions in words, then using symbols; represent them in mappings.	• Express simple functions in symbols; represent mappings expressed algebraically.
	• Read and plot coordinates in the first quadrant. • Represent and **interpret data in a graph** (e.g. for a multiplication table).	• 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.	• Generate points in all four quadrants and **plot the graphs of linear functions; recognise that equations of the form *y = mx + c* correspond to straight-line graphs.**
Solving problems (2–13, 26–27)	• Solve mathematical problems, explaining patterns and relationships.	• **Solve word problems and investigate in a range of contexts:** number and algebra. • Identify the necessary information to solve a problem; represent problems mathematically, making correct use of symbols, words, diagrams, tables and graphs.	• Solve more complex problems by breaking them into smaller steps. • **Represent problems and interpret solutions in algebraic or graphical form,** using correct notation.
Shape, space and measures 3 (5 hours) Geometrical reasoning: lines, angles and shapes (184–189, 198–201)	• Recognise reflection symmetry. • Recognise where a shape will be after reflection. • Recognise where a shape will be after a translation. • Calculate angles on a straight line. • Calculate angles in a triangle or around a point.	• 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.	• Solve geometrical problems using side and angle properties of equilateral, isosceles and right-angled triangles and special quadrilaterals.
		• Use 2-D representations to visualise 3-D shapes and deduce some of their properties.	
Construction (220–223)	• **Use a protractor to measure** and draw **acute and obtuse angles to the nearest degree.**	• Use a ruler and protractor to: - measure and draw lines to 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.	• **Use straight edge and compasses to construct:** **- the mid-point and perpendicular bisector of a line segment;** **- the bisector of an angle;** construct a triangle given three sides (SSS).

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Number 4 (5 hours) Fractions, decimals, percentages, ratio and proportion (70–81)	• **Relate fractions to division.** • Find simple fractions of whole-number quantities. • Find simple percentages of whole-number quantities. • Solve simple problems using ideas of ratio and proportion ('one for every…' and 'one in every…').	• **Recognise the equivalence of percentages, fractions and decimals;** calculate simple percentages and use percentages to compare simple proportions. • 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.	• Express one given number as a percentage of another; **use the equivalence of fractions, decimals and percentages to compare proportions.** • **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 (110–111)		• **Check a result by considering whether it is of the right order of magnitude** and by working the problem backwards.	
Algebra 4 (4 hours) Equations, formulae and identities (112–125)		• **Use letter symbols to represent unknown numbers or variables;** know the meanings of the words *term*, *expression* and *equation*.	• Begin to distinguish between the different roles played by letter symbols in equations, formulae and functions; know the meanings of the words *formula* and *function*.
	• Understand and use the relationships between the four operations, and the principles (not the names) of the arithmetic laws. Use brackets.	• **Understand that algebraic operations follow the same conventions and order as arithmetic operations.** • Simplify linear algebraic expressions by collecting like terms; begin to multiply a single term over a bracket (integer coefficients).	
		• Construct and solve simple linear equations with integer coefficients (unknown on one side only) using an appropriate method (e.g. inverse operations).	• 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 the same way).

YEAR 7: SUMMER TERM

Teaching objectives for the oral and mental activities

• Multiply and divide decimals by 10, 100, 1000 and small multiples of 10. • Round numbers, including to one or two decimal places. • Order decimals and simple fractions in different contexts. • Recognise multiples and use tests of divisibility. • Know pairs of factors of numbers to 100. • Know or derive quickly prime numbers less than 30. • Know or derive squares to at least 12 × 12, multiples of 10, 0.1 to 0.9 and corresponding square roots. • Convert between fractions, decimals and percentages. • Find fractions and percentages of quantities. • Know complements of 0.1, 1, 10, 50, 100. • Add and subtract pairs of numbers, e.g. 0.65 + 3.8, 765 + 47. • Use jottings to support addition and subtraction of whole numbers and decimals. • Find doubles and halves of decimals and fractions. • Recall multiplication and division facts to 10 × 10. • Use doubling and halving to calculate, e.g. 6 × 4.5, 1.38 × 50.	• Use factors to multiply and divide mentally, e.g. 35 × 12, 144 ÷ 36, 3.2 × 30. • Derive answers to calculations, e.g. 0.4 × 9, 0.7 × 0.9. • Multiply and divide a two-digit number by a one-digit number. • Use approximations to estimate the answers to calculations, e.g. 39 × 2.8. • Solve equations such as 100 = *x* + 37. • Visualise and describe 2-D and 3-D shapes. • Estimate and order acute, obtuse and reflex angles. • Use metric units (length, mass, capacity) and units of time for calculations. • Convert between m, cm and mm, km and m, kg and g, litres and ml. • Convert between metric and common imperial units. • Discuss and interpret graphs. • Apply mental skills to solve simple problems.

Teaching objectives for the main activities

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Shape, space and measures 4 (6 hours) Transformations (202–212)	• Recognise reflection symmetry. • Recognise where a shape will be after reflection. • Recognise where a shape will be after a translation.	• Understand and use the language and notation associated with reflections, translations and rotations. • 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.	• 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. • 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.**
Solving problems (14–17, 32–35)		• **Solve word problems and investigate in a range of contexts:** shape and space. • Suggest extensions to problems by asking 'What if...?'; begin to generalise and to understand the significance of a counter-example.	

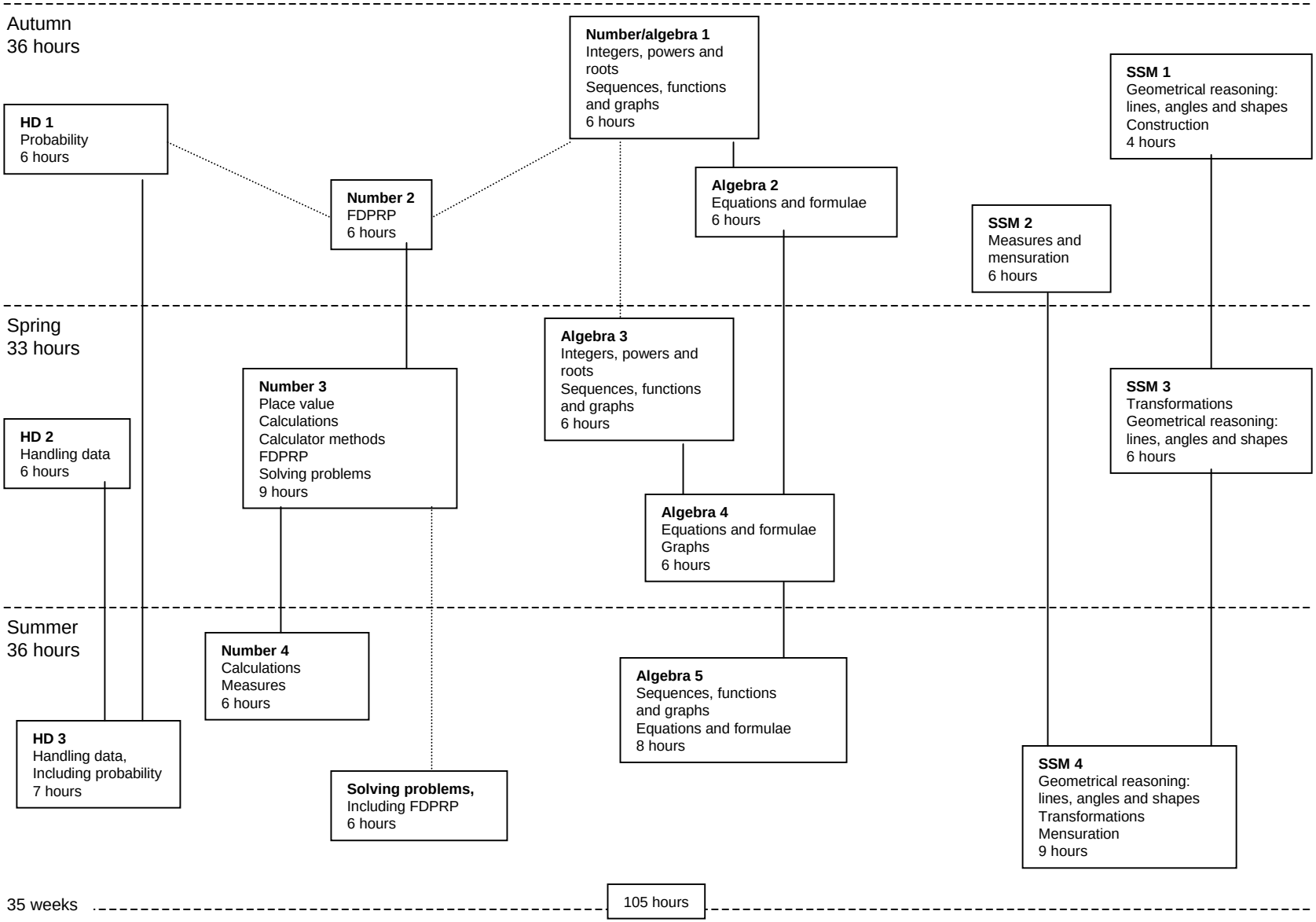
	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Handling data 3 (8 hours) Handling data (250–273)		• Decide which data would be relevant to an enquiry and possible sources. • Plan how to collect and organise small sets 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.	
	• Find the mode and range of a set of data. • Begin to find the median and the mean of a set of data.	• 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. • 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.	• 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 on paper and using ICT:** **- pie charts for categorical data;** **- simple line graphs for time series.**
	• **Solve a problem by** representing, **extracting and interpreting data in tables, graphs and charts.**	• Interpret diagrams and graphs (including pie charts), and draw conclusions based on the shape of graphs and simple statistics for a single distribution. • **Compare two simple distributions using the range and one of the mode, median or mean.** • 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.	• Interpret tables, graphs and diagrams for both discrete and continuous data.
Probability (278–285)		• **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 single event. • Collect data from a simple experiment and record in a frequency table; estimate probabilities based on this data. • Compare experimental and theoretical probabilities in simple contexts.	• 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 two successive events in a systematic way,** using diagrams and tables. • 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.

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Number 5 (8 hours) Place value (52–55)	• Recognise multiples up to 10 × 10; know simple tests of divisibility. • Identify factors of two-digit numbers.	• 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.	• Find the prime factor decomposition of a number.
Calculations (88–107, 110–111)		• 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.	• Recall known facts, including fraction to decimal conversions; use known facts to derive unknown facts, including products such as 0.7 and 6, and 0.03 and 8.
	• Consolidate mental methods: - find a difference by counting up; - add or subtract a multiple of 10 then adjust. • Add and subtract mentally pairs of two-digit numbers.	• Consolidate and **extend mental methods to include decimals, fractions and percentages,** accompanied where appropriate by suitable jottings; solve simple word problems mentally.	• Extend mental calculations to squares and square roots, cubes and cube roots.
		• Make and justify estimates and approximations of calculations.	
	• Approximate first and use informal pencil and paper methods to EXTENSION addition and subtraction.	• Use standard column procedures to add and subtract whole numbers and decimals with up to two places.	
	• **Extend written methods to:** **- ThHTU × U** and U.t × U; **- TU × TU;** **- HTU ÷ U.** • Divide £.p by a two-digit number to give £.p. • Round up or down after division, depending on context.	• **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.**	• **Multiply and divide integers and decimals, including by decimals such as 0.6 and. 0.06; understand where to position the decimal point by considering equivalent calculations.**
		• **Check a result by considering whether it is of the right order of magnitude** and by working the problem backwards.	
Calculator methods (108–109)		• Carry out calculations with more than one step using brackets and the memory; use the square root and sign change keys. • Interpret the display of a calculator in different contexts (decimals, percentages).	
Fractions and percentages (66–77)		• Calculate simple fractions of quantities and measurements (whole-number answers); multiply a fraction by an integer.	• Calculate fractions of quantities and measurements (fraction answers); multiply and divide an integer by a fraction.
		• **Recognise the equivalence of percentages, fractions and decimals;** calculate simple percentages and use percentages to compare simple proportions.	
Solving problems (28–29)		• **Break a complex calculation into simpler steps, choosing and using appropriate and efficient operations, methods** and resources, including ICT.	

	SUPPORT From the Y5 and Y6 teaching programmes	**CORE** From the Y7 teaching programme	**EXTENSION** From the Y8 teaching programme
Algebra 5 (8 hours) Equations, formulae and identities (122–143)		• Construct and solve simple linear equations with integer coefficients (unknown on one side only) using an appropriate method (e.g. inverse operations).	• 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 the same way).
	• Understand and use the relationships between the four operations, and the principles (not the names) of the arithmetic laws. Use brackets.	• Use simple formulae from mathematics and other subjects, substitute positive integers in simple linear expressions and formulae and, in simple cases, derive a formula.	• **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 $2x^3$).
Sequences, functions and graphs (154–177)		• Generate sequences from practical contexts and describe the general term in simple cases. • Express simple functions (in words, then) using symbols; represent them in mappings.	• Begin to use linear expressions to describe the *n*th term of an arithmetic sequence.
	• **Read and plot coordinates in all four quadrants.**	• 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.	• Generate points in all four quadrants and **plot the graphs of linear functions; recognise that equations of the form *y = mx + c* correspond to straight-line graphs.**
Solving problems (32–35)		• Begin to plot and interpret the graphs of simple linear functions arising from real-life situations. • Suggest extensions to problems by asking 'What if…?'; begin to generalise and to understand the significance of a counter-example.	

Shape, space and measures 5 (6 hours) Geometrical reasoning: lines, angles and shapes (184–212)	• Recognise reflection symmetry. • Recognise where a shape will be after reflection. • Recognise where a shape will be after a translation. • Calculate angles on a straight line, in a triangle, or around a point.	• 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.	• Solve geometrical problems using side and angle properties of equilateral, isosceles and right-angled triangles and special quadrilaterals. • Classify quadrilaterals by their geometric properties.
Construction (220–223)	• **Use a protractor to measure** and draw **acute and obtuse angles to the nearest degree.**	• Explore transformations and symmetries using ICT. • Use a ruler and protractor to: - construct a triangle given two sides and the included angle (SAS) or two angles and the included side (ASA); explore these constructions using ICT.	• **Use straight edge and compasses to construct:** **- the mid-point and perpendicular bisector of a line segment;** **- the bisector of an angle;** construct a triangle given three sides (SSS).
	• Visualise 3-D shapes from 2-D drawings and identify different nets for a closed cube.	• Use a ruler and protractor to construct simple nets of 3-D shapes, e.g. cuboid, regular tetrahedron, square-based pyramid, triangular prism.	

Year 8 planning chart



Using and applying mathematics to solve problems should be integrated into each unit

YEAR 8: AUTUMN TERM

Teaching objectives for the oral and mental activities

• Order, add, subtract, multiply and divide integers. • Multiply and divide decimals by 10, 100, 1000. • Count on and back in steps of 0.4, 0.75, $^3/_4$… • Round numbers, including to one or two decimal places. • Know and use squares, positive and negative square roots, cubes of numbers 1 to 5 and corresponding roots. • Convert between fractions, decimals and percentages. • Find fractions and percentages of quantities. • Know or derive complements of 0.1, 1, 10, 50, 100, 1000. • Add and subtract several small numbers or several multiples of 10, e.g. 250 + 120 – 190. • Use jottings to support addition and subtraction of whole numbers and decimals. • Calculate using knowledge of multiplication and division facts and place value, e.g. 432×0.01, $37 \div 0.01$. • Recall multiplication and division facts to 10×10. • Use factors to multiply and divide mentally, e.g. 22×0.02, $420 \div 15$.	• Multiply and divide a two-digit number by a one-digit number. • Use partitioning to multiply, e.g. 13×1.4. • Use approximations to estimate the answers to calculations, e.g. 39×2.8. • Solve equations, e.g. $3a - 2 = 31$. • Visualise, describe and sketch 2-D shapes. • Estimate and order acute, obtuse and reflex angles. • Use metric units (length, mass, capacity) and units of time for calculations. • Use metric units for estimation (length, mass, capacity). • Convert between m, cm and mm, km and m, kg and g, litres and ml, cm^2 and mm^2. • Discuss and interpret graphs. • Apply mental skills to solve simple problems.

Teaching objectives for the main activities

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Number/algebra 1 (6 hours) Integers, powers and roots (48–59)	• Understand negative numbers as positions on a number line; order, add and subtract positive and negative integers in context.	• **Add, subtract, multiply and divide integers.**	
	• Use simple tests of divisibility.	• 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. $8000 = 2^6 \times 5^3$).	• Use the prime factor decomposition of a number.
	• Recognise the first few triangular numbers, squares of numbers to at least 12×12 and the corresponding roots.	• Use squares, positive and negative square roots, cubes and cube roots, and index notation for small positive integer powers.	• Use ICT to estimate square roots and cube roots. • Use index notation for integer powers and simple instances of the index laws.
Sequences and functions (144–157)	• Generate terms of a simple sequence given a rule.	• Generate and describe integer sequences. • 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.	
	• Generate sequences from practical contexts and describe the general term in simple cases.	• Begin to use linear expressions to describe the *n*th term of an arithmetic sequence, justifying its form by referring to the activity or practical context from which it was generated.	

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Shape, space and measures 1 (6 hours) Geometrical reasoning: lines, angles and shapes (178–189)	• Use correctly the vocabulary, notation and labelling conventions for lines, angles and shapes.		
	• **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. • Use angle measure; distinguish between and estimate the size of acute, obtuse and reflex angles.	• **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.	• 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.
		• 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.	• **Solve problems using properties of angles, of parallel and intersecting lines, and of triangles and other polygons.** • Know the definition of a circle and the names of its parts.
Construction (220–223)	• 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).	• **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.**	• Use straight edge and compasses to construct a triangle, given right angle, hypotenuse and side (RHS).
Solving problems (14–17)		• Investigate in a range of contexts: shape and space.	

Handling data 1 (6 hours) Probability (276--283)		• Use the vocabulary of probability when interpreting the results of an experiment; appreciate that random processes are unpredictable.	
	• **Understand and use the probability scale from 0 to 1; find and justify probabilities based on equally likely outcomes in simple contexts.**	• 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.	• 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.**
	• Collect data from a simple experiment and record in a frequency table; estimate probabilities based on this data.	• 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.	• Compare experimental and theoretical probabilities in a range of contexts; appreciate the difference between mathematical explanation and experimental evidence.

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Number 2 (6 hours) Fractions, decimals, percentages (60–77)	• Use fraction notation 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.	• 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.	
	• Add and subtract fractions with common denominators; calculate fractions of quantities (whole-number answers); multiply a fraction by an integer.	• 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.	• Use efficient methods to **add, subtract, multiply and divide fractions,** interpreting division as a multiplicative inverse; cancel common factors before multiplying or dividing.
	• Understand percentage as the 'number of parts per 100'; calculate simple percentages.	• 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.**	• Solve problems involving percentage changes.
Calculations (82–85, 88–101)		• Understand addition and subtraction of fractions; use the laws of arithmetic and inverse operations.	
	• 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.	• Recall known facts, including fraction to decimal conversions; use known facts to derive unknown facts, including products such as 0.7 and 6, and 0.03 and 8.	• Use known facts to derive unknown facts.
		• Consolidate and extend mental methods of calculation, working with decimals, fractions and percentages; solve word problems mentally.	• Extend mental methods of calculation, working with factors, powers and roots.
Algebra 2 (6 hours) Equations and formulae (112–119, 138–143)	• **Use letter symbols to represent unknown numbers or variables;** know the meanings of the words *term*, *expression* and *equation*.	• Begin to distinguish the different roles played by letter symbols in equations, formulae and functions; know the meanings of the words *formula* and *function*.	
		• Know that algebraic operations follow the same conventions and order as arithmetic operations; use index notation for small positive integer powers.	• Use index notation for integer powers and simple instances of the index laws.
	• Simplify linear algebraic expressions by collecting like terms.	• **Simplify or transform linear expressions by collecting like terms; multiply a single term over a bracket.**	• Simplify or transform algebraic expressions by taking out single term common factors.
		• Use formulae from mathematics and other subjects; **substitute integers into simple formulae,** and positive integers into expressions involving small powers (e.g. $3x^2 + 4$ or $2x^3$); derive simple formulae.	

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Shape, space and measures 2 (6 hours) Measures and mensuration (228–231, 234–241)	• **Convert one metric unit to another** (e.g. grams to kilograms); **read and interpret scales on a range of measuring instruments.**	• Use units of measurement to estimate, calculate and solve problems in everyday contexts involving length, area, volume, capacity, mass, time and angle; know rough metric equivalents of imperial measures in daily use (feet, miles, pounds, pints, gallons).	• 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).
	• Know and use the formula for the area of a rectangle; calculate the perimeter and area of shapes made from rectangles. • Calculate the surface area of cubes and cuboids.	• **Deduce and use formulae for the area of a triangle, parallelogram** and trapezium; calculate areas of compound shapes made from rectangles and triangles. • **Know and use the formula for the volume of a cuboid; calculate volumes and surface areas of cuboids** and shapes made from cuboids.	• **Know and use the formulae for the circumference and area of a circle.** • Calculate the surface area and volume of right prisms.
Solving problems (18–21)		• Investigate in a range of contexts: measures.	

YEAR 8: SPRING TERM

Teaching objectives for the oral and mental activities

• Order, add, subtract, multiply and divide integers. • Round numbers, including to one or two decimal places. • Know and use squares, positive and negative square roots, cubes of numbers 1 to 5 and corresponding roots. • Know or derive quickly prime numbers less than 30. • Convert between improper fractions and mixed numbers. • Find the outcome of a given percentage increase or decrease. • Know complements of 0.1, 1, 10, 50, 100, 1000. • Add and subtract several small numbers or several multiples of 10, e.g. 250 + 120 – 190. • Calculate using knowledge of multiplication and division facts and place value, e.g. 432 × 0.01, 37 ÷ 0.01, 0.04 × 8, 0.03 ÷ 5. • Recall multiplication and division facts to 10 × 10. • Use factors to multiply and divide mentally, e.g. 22 × 0.02, 420 ÷ 15. • Multiply and divide a two-digit number by a one-digit number. • Multiply by near 10s, e.g. 75 × 29, 8 × ¯19. • Use partitioning to multiply, e.g. 13 × 1.4.	• Use approximations to estimate the answers to calculations, e.g. 39 × 2.8. • Solve equations, e.g. $n(n - 1) = 56$. • Visualise, describe and sketch 2-D shapes, 3-D shapes and simple loci. • Estimate and order acute, obtuse and reflex angles. • Use metric units (length, area and volume) and units of time for calculations. • Use metric units for estimation (length, area and volume). • Recall and use the formula for perimeter of rectangles and calculate areas of rectangles and triangles. • Calculate volumes of cuboids. • Discuss and interpret graphs. • Apply mental skills to solve simple problems.

Teaching objectives for the main activities

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Algebra 3 (6 hours) Sequences, functions, graphs (160–177)	• Express simple functions in words. • Generate coordinate pairs that satisfy a simple linear rule; recognise straight-line graphs parallel to the *x*-axis or *y*-axis.	• Express simple functions in symbols; represent mappings expressed algebraically. • 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.** • Construct linear functions arising from real-life problems and plot their corresponding graphs; discuss and interpret graphs arising from real situations.	• Find the inverse of a linear function. • 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*.** • Discuss and interpret distance–time graphs.

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Number 3 (9 hours) Place value (36–47)	• Understand and use decimal notation and place value; multiply and divide integers and decimals by 10, 100 and 1000, and explain the effect.	• Read and write positive integer powers of 10; multiply and divide integers and decimals by 0.1, 0.01. • Order decimals.	• Extend knowledge of integer powers of 10; multiply and divide by any integer power of 10.
	• Round positive whole numbers to the nearest 10, 100 or 1000 and decimals to the nearest whole number or one decimal place.	• Round positive numbers to any given power of 10; round decimals to the nearest whole number or to one or two decimal places.	
Calculations (92–107, 110–111)	• Consolidate and **extend mental methods of calculation to include decimals, fractions and percentages,** accompanied where appropriate by suitable jottings.	• Consolidate and extend mental methods of calculation, working with decimals, squares and square roots, cubes and cube roots; solve word problems mentally.	• Extend mental methods of calculation, working with decimals, fractions, percentages, factors, powers and roots.
		• Make and justify estimates and approximations of calculations. • Consolidate standard column procedures for addition and subtraction of integers and decimals with up to two places.	• 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 three-digit by two-digit whole numbers; extend to multiplying and dividing decimals with one or two places by single-digit whole numbers.**	• **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.**	• Multiply and divide by decimals, dividing by transforming to division by an integer.
		• Check a result by considering whether it is of the right order of magnitude and by working the problem backwards	
Calculator methods (108--109)	• Carry out calculations with more than one step using brackets and the memory.	• Carry out more difficult calculations effectively and efficiently using the function keys of a calculator for sign change, powers, roots and fractions; use brackets and the memory. • Enter numbers and interpret the display of a calculator in different contexts (negative numbers, fractions, decimals, percentages, money, metric measures, time).	• 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.

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Shape, space and measures 3 (6 hours) Geometrical reasoning: lines, angles and shapes (190–191)		• Know that if two 2-D shapes are congruent, corresponding sides and angles are equal.	
Transformations (202–215)	• 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.	• 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.	• **Know that translations, rotations and reflections preserve length and angle and map objects on to congruent images;** identify reflection symmetry in 3-D shapes.
		• 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.	• Enlarge 2-D shapes, given a centre of enlargement and a negative whole-number scale factor, on paper; 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.
Ratio and proportion (78–81)	• Understand the relationship between ratio and proportion; solve simple problems about ratio and proportion using informal strategies.	• 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.	• **Use proportional reasoning to solve a problem;** interpret and use ratio in a range of contexts.
Algebra 4 (6 hours) Equations and formulae (112–113, 122–125, 138–143)	• **Use letter symbols to represent unknown numbers or variables;** know the meanings of the words *term*, *expression* and *equation*. • Construct and solve simple linear equations with integer coefficients (unknown on one side only) using an appropriate method (e.g. inverse operations).	• Begin to distinguish the different roles played by letter symbols in equations, formulae and functions; know the meanings of the words *formula* and *function*. • 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 the same way).	• **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.**
		• Use formulae from mathematics and other subjects; **substitute integers into simple formulae,** including examples that lead to an equation to solve; derive simple formulae.	• Use formulae from mathematics and other subjects; substitute numbers into expressions and formulae; derive a formula and, in simple cases, change its subject.

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Handling data 2 (6 hours) Handling data (248–273)	• Given a problem that can be addressed by statistical methods, suggest possible answers.	• Discuss a problem that can be addressed by statistical methods and identify related questions to explore.	
		• Decide which data to collect to answer a question, and the degree of accuracy needed; identify possible sources.	• Discuss how data relate to a problem; identify possible sources, including primary and secondary sources.
	• Design a data collection sheet or questionnaire to use in a simple survey; construct frequency tables for discrete data.	• Plan how to collect the data, including sample size; design and use two-way tables for discrete data.	
		• Collect data using a suitable method, such as observation, controlled experiment using ICT, or questionnaire.	• Gather data from specified secondary sources, including printed tables and lists from ICT-based sources.
	• Calculate statistics for small sets of discrete data: - find the mode, median and range; - calculate the mean, including from a simple frequency table, using a calculator for a larger number of items.	• Calculate statistics, including with a calculator; recognise when it is appropriate to use the range, mean, median and mode; construct and use stem-and-leaf diagrams.	
	• Construct, on paper and using ICT, graphs and diagrams to represent data, including: - bar-line graphs; use ICT to generate pie charts.	• **Construct, on paper and using ICT:** **- pie charts for categorical data;** **- bar charts and frequency diagrams for discrete data;** **- simple scatter graphs;** **identify which are most useful in the context of the problem**.	
		• Interpret tables, graphs and diagrams for discrete data and draw inferences that relate to the problem being discussed; relate summarised data to the questions being explored.	• Interpret graphs and diagrams and draw inferences to support or cast doubt on initial conjectures; have a basic understanding of correlation.
	• Write a short report of a statistical enquiry and illustrate with appropriate diagrams, graphs and charts, using ICT as appropriate; justify choice of what is presented.	• 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.	
Solving problems (28–29)		• Solve more complex problems by breaking them into smaller steps or tasks, choosing and using resources, including ICT.	

YEAR 8: SUMMER TERM

Teaching objectives for the oral and mental activities

• Order, add, subtract, multiply and divide integers. • Multiply and divide decimals by 10, 100, 1000, 0.1, 0.01. • Round numbers, including to one or two decimal places. • Know and use squares, cubes, roots and index notation. • Know or derive prime factorisation of numbers to 30. • Convert between fractions, decimals and percentages. • Find the outcome of a given percentage increase or decrease. • Know complements of 0.1, 1, 10, 50, 100. • Add and subtract several small numbers or several multiples of 10, e.g. 250 + 120 – 190. • Use jottings to support addition and subtraction of whole numbers and decimals. • Calculate using knowledge of multiplication and division facts and place value, e.g. 432×0.01, $37 \div 0.01$, 0.04×8, $0.03 \div 5$. • Recall multiplication and division facts to 10×10. • Use factors to multiply and divide mentally, e.g. 22×0.02, $420 \div 15$. • Multiply by near 10s, e.g. 75×29, $8 \times {}^{-}19$.	• Use partitioning to multiply, e.g. 13×1.4. • Use approximations to estimate the answers to calculations, e.g. 39×2.8. • Solve equations, e.g. $n(n - 1) = 56$, ❣ + ❣ = ⁻46. • Visualise, describe and sketch 2-D shapes, 3-D shapes and simple loci. • Estimate and order acute, obtuse and reflex angles. • Use metric units (length, mass, capacity, area and volume) and units of time for calculations. • Use metric units for estimation (length, mass, capacity, area and volume). • Convert between m, cm and mm, km and m, kg and g, litres and ml, cm^2 and mm^2. • Discuss and interpret graphs. • Calculate a mean using an assumed mean. • Apply mental skills to solve simple problems.

Teaching objectives for the main activities

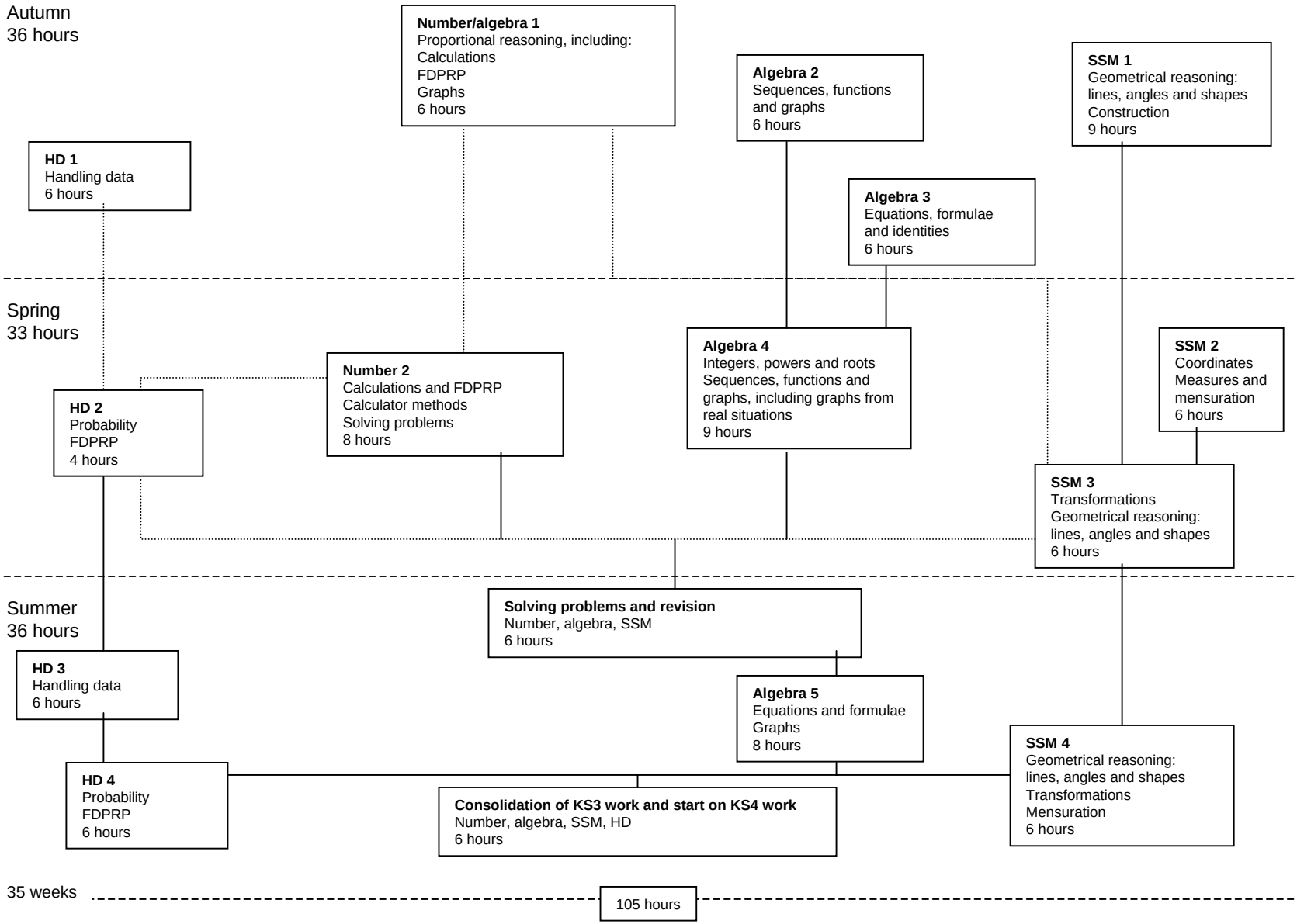
	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Number 4 (6 hours) Calculations (82–87, 92–107, 110–111)		• Understand addition and subtraction of fractions and integers, and multiplication and division of integers; use the laws of arithmetic and inverse operations. • Use the order of operations, including brackets, with more complex calculations.	• **Understand the effects of multiplying and dividing by numbers between 0 and 1.** • Understand the order of precedence and effect of powers.
	• Consolidate and **extend mental methods of calculation to include decimals, fractions and percentages,** accompanied where appropriate by suitable jottings.	• Consolidate and extend mental methods of calculation, working with decimals, fractions and percentages, squares and square roots, cubes and cube roots; solve word problems mentally.	• Extend mental methods of calculation, working with decimals, fractions, percentages, factors, powers and roots.
		• Make and justify estimates and approximations of calculations. • Consolidate standard column procedures for addition and subtraction of integers and decimals with up to two places.	• Use standard column procedures to add and subtract integers and decimals of any size.
	• **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.**	• **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.**	• Multiply and divide by decimals, dividing by transforming to division by an integer.
		• Check a result by considering whether it is of the right order of magnitude and by working the problem backwards.	
Measures (228–231)	• **Convert one metric unit to another** (e.g. grams to kilograms).	• Use units of measurement to estimate, calculate and solve problems in everyday contexts.	

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Algebra 5 (8 hours) Equations and formulae (116–137)	• Simplify linear algebraic expressions by collecting like terms.	• **Simplify or transform linear expressions by collecting like terms; multiply a single term over a bracket.**	• Simplify or transform algebraic expressions by taking out single term common factors.
	• Construct and solve simple linear equations with integer coefficients (unknown on one side only) using an appropriate method (e.g. inverse operations).	• 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 the same way).	• **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.**
			• Use systematic trial and improvement methods and ICT tools to find approximate solutions of equations such as $x^3 + x = 20$.
		• Begin to use graphs and set up equations to solve simple problems involving direct proportion.	• Solve problems involving direct proportion using algebraic methods, relating algebraic solutions to graphical representations of the equations; use ICT as appropriate.
Sequences, functions and graphs (164–177)	• Generate coordinate pairs that satisfy a simple linear rule; recognise straight-line graphs parallel to the *x*-axis or *y*-axis.	• **Plot the graphs of linear functions, where *y* is given explicitly in terms of *x*,** on paper and using ICT.	• 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.
		• Construct linear functions arising from real-life problems and plot their corresponding graphs; discuss and interpret graphs arising from real situations.	
Solving problems (6–13, 28–29)		• Solve more demanding problems and investigate in a range of contexts: algebra.	
	• **Break a complex calculation into simpler steps, choosing and using appropriate and efficient operations, methods** and resources, including ICT.	• Solve more complex problems by breaking them into smaller steps or tasks, choosing and using efficient techniques for algebraic manipulation.	• Use trial and improvement methods where a more efficient method is not obvious.

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Solving problems (6 hours) Solving problems (2–35)	• Represent problems mathematically, making correct use of symbols, words, diagrams, tables and graphs. • **Break a complex calculation into simpler steps, choosing and using appropriate and efficient operations, methods** and resources, including ICT. • Understand the significance of a counter-example.	• Solve more demanding problems and investigate in a range of contexts: number and measures. • **Identify the necessary information to solve a problem; represent problems and interpret solutions in algebraic or graphical form,** using correct notation. • Solve more complex problems by breaking them into smaller steps or tasks, choosing and using efficient techniques for calculation. • **Use logical argument to establish the truth of a statement;** give solutions to an appropriate degree of accuracy in the context of the problem. • Suggest extensions to problems, conjecture and generalise; identify exceptional cases or counter-examples.	• Solve increasingly demanding problems and evaluate solutions; explore connections in mathematics across a range of contexts. • **Present a concise, reasoned argument, using symbols, diagrams and graphs and related explanatory text.**
Ratio and proportion (78–81)	• Understand the relationship between ratio and proportion; solve simple problems about ratio and proportion using informal strategies.	• 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.**	• **Use proportional reasoning to solve a problem, choosing the correct numbers to take as 100%, or as a whole;** compare two ratios; interpret and use ratio in a range of contexts, including solving word problems.
Shape, space and measures 4 (9 hours) Geometrical reasoning: lines, angles and shapes (198–201)	• Use 2-D representations to visualise 3-D shapes and deduce some of their properties. • Use ruler and protractor to construct simple nets of 3-D shapes, e.g. cuboid, regular tetrahedron, square-based pyramid, triangular prism.	• Know and use geometric properties of cuboids and shapes made from cuboids; begin to use plans and elevations.	• Visualise and use 2-D representations of 3-D objects; analyse 3-D shapes through 2-D projections, including plans and elevations.
Transformations (216–217)		• Make simple scale drawings.	• Use and interpret maps, scale drawings.
Coordinates (218–219)	• Use conventions and notation for 2-D coordinates in all four quadrants; find coordinates of points determined by geometric information.	• Given the coordinates of points A and B, find the mid-point of the line segment AB.	
Construction and loci (220–227)	• 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.	• **Use straight edge and compasses to construct:** - a triangle, given three sides (SSS); use ICT to explore this construction. • Find simple loci, both by reasoning and by using ICT, to produce shapes and paths, e.g. an equilateral triangle. • Use bearings to specify direction.	• Use straight edge and compasses to construct a triangle, given right angle, hypotenuse and side (RHS).
Mensuration (232–233, 238–241)	• Calculate the surface area of cubes and cuboids.	• **Know and use the formula for the volume of a cuboid; calculate volumes and surface areas of cuboids** and shapes made from cuboids.	• Calculate the surface area and volume of right prisms.

	SUPPORT From the Y7 teaching programme	**CORE** From the Y8 teaching programme	**EXTENSION** From the Y9 teaching programme
Handling data 3 (7 hours) Handling data (248–275)	• Given a problem that can be addressed by statistical methods, suggest possible answers.	• Discuss a problem that can be addressed by statistical methods and identify related questions to explore.	
		• Decide which data to collect to answer a question, and the degree of accuracy needed; identify possible sources.	• Discuss how data relate to a problem; identify possible sources, including primary and secondary sources.
	• 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.	• Plan how to collect the data, including sample size; construct frequency tables with given equal class intervals for sets of continuous data.	• **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.
		• Collect data using a suitable method, such as observation, controlled experiment, including data logging using ICT, or questionnaire.	
	• 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.	• Calculate statistics, including with a calculator; calculate a mean using an assumed mean; know when it is appropriate to use the modal class for grouped data.	
	• Construct, on paper and using ICT, graphs and diagrams to represent data, including: - frequency diagrams for grouped discrete data; use ICT to generate pie charts.	• **Construct, on paper and using ICT:** **- bar charts and frequency diagrams for continuous data;** **- simple line graphs for time series;** **identify which are most useful in the context of the problem**.	
		• Interpret tables, graphs and diagrams for continuous data and draw inferences that relate to the problem being discussed; relate summarised data to the questions being explored.	
		• Compare two distributions using the range and one or more of the mode, median and mean.	• Compare two or more distributions and make inferences, using the shape of the distributions, the range of data and appropriate statistics.
	• Write a short report of a statistical enquiry and illustrate with appropriate diagrams, graphs and charts, using ICT as appropriate; justify choice of what is presented.	• 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.	
Probability (284–285)		• Compare experimental and theoretical probabilities in different contexts.	• Appreciate the difference between mathematical explanation and experimental evidence.
Solving problems (28–29)		• Solve more complex problems by breaking them into smaller steps or tasks, choosing and using graphical representation, and also resources, including ICT.	

Year 9 planning chart



Using and applying mathematics to solve problems should be integrated into each unit

YEAR 9: AUTUMN TERM

Teaching objectives for the oral and mental activities

- Order, add, subtract, multiply and divide integers.
- Multiply and divide decimals by 10, 100, 1000, 0.1 and 0.01.
- Count on and back in steps of 0.4, 0.75, $^3/_4$…
- Round numbers, including to one or two decimal places.
- Know and use squares, cubes, roots and index notation.
- Know or derive quickly prime numbers less than 30 and factor pairs for a given number.
- Convert between fractions, decimals and percentages.
  Know that 0.005 is half of one per cent.
- Find fractions and percentages of quantities.

- Know or derive complements of 0.1, 1, 10, 50, 100, 1000.
- Add and subtract several small numbers or several multiples of 10, e.g. 250 + 120 – 190.
- Use jottings to support addition and subtraction of whole numbers and decimals.
- Use knowledge of place value to multiply and divide, e.g. 432×0.01, $37 \div 0.01$, 0.04×8, $0.03 \div 5$, 13×1.4.
- Recall multiplication and division facts to 10×10. Derive products and quotients of multiples of 10, 100, 1000.
- Use factors to multiply and divide mentally, e.g. 22×0.02, $420 \div 15$.

- Multiply and divide a two-digit number by a one-digit number.
- Use approximations to estimate the answers to calculations, e.g. 39×2.8.

- Solve equations, e.g. $n(n - 1) = 56$, ❣ + ❣ = ⁻46.

- Visualise, describe and sketch 2-D shapes.
- Recall and use formulae for the perimeter of a rectangle, and areas of rectangles and triangles.
- Calculate volumes of cuboids.
- Estimate and order acute, obtuse and reflex angles.

- Use metric units (length, mass, capacity) and units of time for calculations.
- Use metric units for estimation (length, mass, capacity).
- Convert between metric units, including area, volume and capacity measures.

- Discuss and interpret graphs.
- Calculate a mean using an assumed mean.

- Apply mental skills to solve simple problems.

Teaching objectives for the main activities

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Algebra 1/2 (6 hours) Sequences, functions and graphs (148–163, 172–177)	• Generate and describe integer sequences.	• **Generate terms of a sequence using term-to-term and position-to-term definitions of the sequence, on paper and using ICT.** • Generate sequences from practical contexts and **write an expression to describe the *n*th term of an arithmetic sequence.** • Find the inverse of a linear function.	• Find the next term and the *n*th term of quadratic sequences and functions and explore their properties. • Deduce properties of the sequences of triangular and square numbers from spatial patterns. • Plot the graph of the inverse of a linear function; know simple properties of quadratic functions.
	• Express simple functions in symbols; represent mappings expressed algebraically. • **Plot the graphs of linear functions, where *y* is given explicitly in terms of *x*,** on paper and using ICT.	• **Construct functions arising from real-life problems and plot their corresponding graphs.**	
Solving problems (26–27)		• 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.	

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Number 1 (9 hours) Proportional reasoning, including: Fractions, decimals, percentages, ratio and proportion (66–81)	• Order decimals. • 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. • Interpret percentage as the operator 'so many hundredths of'; express one given number as a percentage of another. • Reduce a ratio to its simplest form, including a ratio expressed in different units; **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.**	• Use efficient methods to **add, subtract, multiply and divide fractions,** interpreting division as a multiplicative inverse; cancel common factors before multiplying or dividing. • Recognise when fractions or percentages are needed to compare proportions; solve problems involving percentage changes. • **Use proportional reasoning to solve a problem, choosing the correct numbers to take as 100%, or as a whole;** compare two ratios; interpret and use ratio in a range of contexts, including solving word problems.	• **Understand and use proportionality and calculate the result of any proportional change using only multiplicative methods;** understand the implications of enlargement for area and volume.
Calculations (82–103, 110–111)	• Recall known facts, including fraction to decimal conversions.	• **Understand the effects of multiplying and dividing by numbers between 0 and 1;** use the laws of arithmetic and inverse operations. • Understand the order of precedence and effect of powers. • 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.	• Recognise and use reciprocals.
	• Round positive numbers to any given power of 10 and decimals to the nearest whole number, 1 or 2 decimal places.	• **Make and justify estimates and approximations of calculations.** • Check results using appropriate methods.	• Estimate calculations by rounding numbers to one significant figure and multiplying or dividing mentally.

Algebra 3 (6 hours) Equations, formulae and identities (112–113, 122–125, 132–137)	• Know the meanings of the words *formula* and *function*. • Construct and solve linear equations with integer coefficients (unknown on either or both sides) using appropriate methods (e.g. inverse operations, transforming both sides in the same way).	• Distinguish the different roles played by letter symbols in equations, identities, formulae and functions. • **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.**	• **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.
	• Begin to use graphs and set up equations to solve simple problems involving direct proportion.	• Use systematic trial and improvement methods and ICT tools to find approximate solutions of equations such as $x^3 + x = 20$. • Solve problems involving direct proportion using algebraic methods, relating algebraic solutions to graphical representations of the equations; use ICT as appropriate.	

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Shape, space and measures 1 (9 hours) Geometrical reasoning: lines, angles and shapes (178–189, 194–197)		• 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.
	• **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.	• 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.	
	• 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.	• **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.**
		• 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.
Construction and loci (220–227)	• **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.	• 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.**
		• Find the locus of a point that moves according to a simple rule, both by reasoning and by using ICT.	• Find the locus of a point that moves according to a more complex rule, involving loci and simple constructions.
Solving problems (14–17)		• Explore connections in mathematics across a range of contexts: shape and space.	

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Handling data 1 (6 hours) Handling data (248–275)		• Suggest a problem to explore using statistical methods, frame questions and raise conjectures.	
	• Decide which data to collect to answer a question, and the degree of accuracy needed; identify possible sources.	• 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.**
	• Collect data using a suitable method, such as observation, controlled experiment, including data logging using ICT, or questionnaire.	• **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.	
	• Calculate statistics, including with a calculator; recognise when it is appropriate to use the range, mean, median and mode.	• 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.
	• **Construct, on paper and using ICT:** **- pie charts for categorical data;** **- bar charts and frequency diagrams for discrete data;** **identify which are most useful in the context of the problem**.	• Select, construct and modify, on paper and using ICT, suitable graphical representation to progress an enquiry, including: - line graphs for time series; - scatter graphs to develop further understanding of correlation; identify key features present in the data.	• 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.
	• Interpret tables, graphs and diagrams for discrete data and draw inferences that relate to the problem being discussed; relate summarised data to the questions being explored.	• 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.
	• Compare two distributions using the range and one or more of the mode, median and mean..	• Compare two or more distributions and make inferences, using the shape of the distributions, the range of data and appropriate statistics.	
		• **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.

YEAR 9: SPRING TERM

Teaching objectives for the oral and mental activities

• Order, add, subtract, multiply and divide integers. • Find products of small integer powers. • Know and use squares, cubes, roots and index notation. • Know or derive quickly the prime factorisation of numbers to 30 and factor pairs for a given number. • Find highest common factors (HCF) and lowest common multiples (LCM), e.g. the HCF of 36 and 48. • Convert between improper fractions and mixed numbers. Simplify fractions by cancelling. • Find the outcome of a given percentage increase or decrease. • Know or derive complements of 0.1, 1, 10, 50, 100, 1000. • Use jottings to support addition, subtraction, multiplication and division. • Recall multiplication and division facts to 10×10. Derive products and quotients of multiples of 10, 100, 1000. • Use known facts to derive unknown facts, e.g. derive 36×24 from 36×25. • Use knowledge of place value to multiply and divide decimals by multiples of 0.1 and 0.01, e.g. 0.24×0.4, $720 \div 0.03$.	• Use approximations to estimate the answers to calculations, e.g. 39×2.8. • Solve equations, e.g. $n(n - 1) = 56$, ❣ + ❣ = ⁻46, $(3 + x)^2 = 25$. • Visualise, describe and sketch 2-D shapes, 3-D shapes and simple loci. • Estimate bearings. • Use metric units (length, area and volume) and units of time for calculations. • Use metric units for estimation (length, area and volume). • Convert between metric units, including area, volume and capacity measures. • Recall and use formulae for areas of rectangle, triangle, parallelogram, trapezium and circle. • Calculate volumes of cuboids and prisms. • Discuss and interpret graphs. • Solve simple problems involving probabilities. • Apply mental skills to solve simple problems.

Teaching objectives for the main activities

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Shape, space and measures 2 (6 hours) Coordinates (218–219)	• Given the coordinates of points A and B, find the mid-point of the line segment AB.		• 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.
Measures and mensuration (228–231, 234–241)	• Know rough metric equivalents of imperial measures in daily use (feet, miles, pounds, pints, gallons).	• 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. • **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.
	• **Deduce and use formulae for the area of a triangle, parallelogram** and trapezium; calculate areas of compound shapes made from rectangles and triangles.	• **Know and use the formulae for the circumference and area of a circle.**	• Know and use the formulae for length of arcs and area of sectors of circles.
	• **Know and use the formula for the volume of a cuboid; calculate volumes and surface areas of cuboids** and shapes made from cuboids.	• Calculate the surface area and volume of right prisms.	• Calculate lengths, areas and volumes in right prisms, including cylinders.

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Number 2 (8 hours) Place value (36–47)	• Read and write positive integer powers of 10; multiply and divide integers and decimals by 0.1, 0.01.	• Extend knowledge of integer powers of 10; multiply and divide by any integer power of 10. • Use rounding to make estimates; round numbers to the nearest whole number or to one or two decimal places.	• Write numbers in standard form. • Understand upper and lower bounds; round numbers to three decimal places and a given number of significant figures.
Fractions, decimals, percentages, ratio and proportion (60–65)		• Know that a recurring decimal is an exact fraction.	• Use algebraic methods to convert a recurring decimal to a fraction in simple cases.
Calculations (104–107, 110–111)	• Consolidate standard column procedures for addition and subtraction of integers and decimals with up to two places. • **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.**	• 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.	
Calculator methods (108–109)		• Check results using appropriate methods. • 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. • Enter numbers into a calculator and interpret the display in context (negative numbers, fractions, decimals, percentages, money, metric measures, time).	• Use the reciprocal key of a calculator. • Enter numbers in standard form into a calculator and interpret the display.
Solving problems (28–29)	• Solve more complex problems by breaking them into smaller steps or tasks, choosing and using efficient techniques for calculation.	• **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.	

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Algebra 4 (9 hours) Integers, powers and roots (52–59)	• Recognise and use multiples, factors (divisors), common factor, highest common factor, lowest common multiple and primes.	• Use the prime factor decomposition of a number. • Use ICT to estimate square roots and cube roots.	
	• Use squares, positive and negative square roots, cubes and cube roots, and index notation for small positive integer powers.	• Use index notation for integer powers and simple instances of the index laws.	• **Know and use the index laws** (including in generalised form) **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.
Sequences, functions and graphs (164–177)	• **Recognise that equations of the form *y = mx + c* correspond to straight-line graphs.**	• **Given values for *m* and *c*, find the gradient of lines given by equations of the form *y = mx + c*.** • **Construct functions arising from real-life problems and plot their corresponding graphs; interpret graphs arising from real situations,** including distance–time graphs.	• Investigate the gradients of parallel lines and lines perpendicular to these lines. • Plot graphs of simple quadratic and cubic functions, e.g. $y = x^2$, $y = 3x^2 + 4$, $y = x^3$.
Solving problems (26–27)		• 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.	

Handling data 2 (4 hours) Probability (276–283)	• 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. • 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.	• Use the vocabulary of probability in interpreting results involving uncertainty and prediction. • 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.** • Estimate probabilities from experimental data.	• Understand relative frequency as an estimate of probability and use this to compare outcomes of experiments.
Fractions (66–69)		• Use efficient methods to **add, subtract, multiply and divide fractions,** interpreting division as a multiplicative inverse; cancel common factors before multiplying or dividing.	

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Shape, space and measures 3 (6 hours) Geometrical reasoning: lines, angles and shapes (178–179, 190–191)		• 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.
		• Understand congruence.	• **Apply the conditions SSS, SAS, ASA or RHS to establish the congruence of triangles.** • **Know that if two 2-D shapes are similar, corresponding angles are equal and corresponding sides are in the same ratio.**
Transformations (202–217)	• Identify all the symmetries of 2-D shapes.	• 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.	
	• Understand and use the language and notation associated with enlargement.	• Enlarge 2-D shapes, given a centre of enlargement and a whole-number scale factor, on paper and using ICT; 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.	• 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.
	• Make simple scale drawings.	• Use and interpret maps and scales drawings.	
Mensuration (242–247)			• Begin to use sine, cosine and tangent in right-angled triangles to solve problems in two dimensions.
Ratio and proportion (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.	• **Use proportional reasoning to solve a problem;** interpret and use ratio in a range of contexts.	

YEAR 9: SUMMER TERM

Teaching objectives for the oral and mental activities

• Order, add, subtract, multiply and divide integers. • Round integers and decimals. • Know and use squares, cubes, roots and index notation. • Find highest common factors (HCF) and lowest common multiples (LCM). • Convert between fractions, decimals and percentages, and between improper fractions and mixed numbers. • Find fractions and percentages of quantities and the outcome of a given percentage increase or decrease. • Know or derive complements of 0.1, 1, 10, 50, 100, 1000. • Use jottings to support addition, subtraction, multiplication and division. • Recall multiplication and division facts to 10×10. Derive products and quotients of multiples of 10, 100, 1000. • Use knowledge of place value to multiply and divide decimals by 0.1 and 0.01, e.g. 0.24×0.4, $720 \div 0.03$. • Use approximations to estimate the answers to calculations, e.g. 0.39×2.8.	• Solve equations, e.g. $n(n - 1) = 56$, ❣ + ❣ = ⁻46, $(3 + x)^2 = 25$, $(12 - x)^2 = 49$, ❣ × ❣ × ❣ = 0.008 • Visualise, describe and sketch 2-D shapes, 3-D shapes and simple loci. • Estimate and order angles and bearings. • Use metric units (length, mass, capacity, area and volume) and units of time for calculations. • Use metric units for estimation (length, mass, capacity, area and volume). • Convert between metric units including area, volume and capacity measures. • Recall and use formulae for the perimeter of a rectangle and the circumference of a circle. • Recall and use formulae for areas of rectangle, triangle, parallelogram, trapezium and circle. • Calculate volumes of cuboids and prisms. • Discuss and interpret graphs. • Solve simple problems involving probabilities. • Apply mental skills to solve simple problems.

Teaching objectives for the main activities

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Algebra 5 (6 hours) Equations, formulae and identities (116–121, 138–143)	• **Simplify or transform linear expressions by collecting like terms; multiply a single term over a bracket.**	• Simplify or transform algebraic expressions by taking out single-term common factors.	• **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 $a^2 - b^2 = (a + b)(a - b)$. • Solve linear inequalities in one variable, and represent the solution set on a number line; begin to solve inequalities in two variables.
Graphs (164–171) Solving problems (6–13)	• **Plot the graphs of linear functions, where *y* is given explicitly in terms of *x*,** on paper and using ICT.	• Use formulae from mathematics and other subjects; substitute numbers into expressions and formulae; derive a formula and, in simple cases, change its subject. • 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. • Solve increasingly demanding problems; explore connections in mathematics across a range of contexts: algebra.	• Derive and use more complex formulae, and **change the subject of a formula.**

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Solving problems and revision (6 hours) Number, algebra, shape, space and measures, handling data Solving problems (2–35)	• **Identify the necessary information to solve a problem.**	• Solve increasingly demanding problems and evaluate solutions; explore connections in mathematics across a range of contexts: number, algebra, shape, space and measures, handling data.	• **Generate fuller solutions to increasingly demanding problems.**
		• 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.	
	• Solve more complex problems by breaking them into smaller steps or tasks, choosing and using efficient techniques for calculation.	• **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.	
	• **Use logical argument to establish the truth of a statement.**	• **Present a concise, reasoned argument, using symbols, diagrams, graphs and related explanatory text; give solutions to problems to an appropriate degree of accuracy.**	• **Recognise 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.
		• 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.
Percentages and proportion (75–81)		• Solve problems involving percentage changes.	
	• **Use the unitary method to solve simple word problems involving ratio and direct proportion.**	• **Use proportional reasoning to solve a problem, choosing the correct numbers to take as 100%, or as a whole;** interpret and use ratio in a range of contexts, including solving word problems.	
Sequences, functions and graphs (172–177)		• **Construct functions arising from real-life problems and plot their corresponding graphs.**	
Geometrical reasoning: lines, angles and shapes (184–189)	• 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.	• **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.	

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Handling data 3 (6 hours) Handling data (250–251, 254–275)	• Decide which data to collect to answer a question, and the degree of accuracy needed; identify possible sources.	• 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.**
	• Plan how to collect the data, including sample size; construct frequency tables with given equal class intervals for sets of continuous data.	• 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.
	• Calculate statistics, including with a calculator; calculate a mean using an assumed mean; recognise when it is appropriate to use the modal class for grouped data.	• 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.
	• **Construct, on paper and using ICT:** **- bar charts and frequency diagrams for continuous data.**	• Select, construct and modify, on paper and using ICT, suitable graphical representation to progress an enquiry.	• 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.
	• Interpret tables, graphs and diagrams for continuous data, and draw inferences that relate to the problem being discussed; relate summarised data to the questions being explored.	• 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.
	• Construct and use stem-and-leaf diagrams.	• Compare two or more distributions and make inferences, using the shape of the distributions, the range of data and appropriate statistics.	
		• **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.
Solving problems (28–29)		• **Solve substantial problems by breaking them into simpler tasks, using a range of efficient techniques, methods and resources, including ICT.**	

	SUPPORT From the Y8 teaching programme	**CORE** From the Y9 teaching programme	**EXTENSION** From the Y9 objectives for able pupils
Shape, space and measures 4 (6 hours) Geometrical reasoning: lines, angles and shapes (184–189, 198–201)	• 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.	• **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.**
	• Know and use geometric properties of cuboids and shapes made from cuboids.	• Visualise and use 2-D representations of 3-D objects; analyse 3-D shapes through 2-D projections, including plans and elevations.	
Transformations (216–217)	• Make simple scale drawings.	• Use and interpret maps and scale drawings.	
Mensuration (238–241)	• **Know and use the formula for the volume of a cuboid; calculate volumes and surface areas of cuboids** and shapes made from cuboids.	• Calculate the surface area and volume of right prisms.	• Calculate lengths, areas and volumes in right prisms, including cylinders.
			• Begin to use sine, cosine and tangent in right-angled triangles to solve problems in two dimensions.
Solving problems (30–31)		• **Present a concise, reasoned argument, using symbols, diagrams and related explanatory text; give solutions to problems to an appropriate degree of accuracy.**	• **Recognise limitations on the accuracy of measurements.**
Handling data 4 (6 hours) Probability (276–285)		• Use the vocabulary of probability in interpreting results involving uncertainty and prediction.	
	• 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.	• 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.**	
	• 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.	• Estimate probabilities from experimental data.	• Understand relative frequency as an estimate of probability and use this to compare outcomes of experiments.
		• Compare experimental and theoretical probabilities in a range of contexts; appreciate the difference between mathematical explanation and experimental evidence.	
Consolidation of KS3 work and start on KS4 work (6 hours) Number Algebra Shape, space and measures Handling data			

Planning in secondary special schools

Planning for mathematics presents a particular challenge to teachers in secondary special schools as pupils' different rates of progress are likely to have resulted in a wide range of attainment. Some special schools and units will adapt the mainstream plans. The following pages show examples of medium-term plans trialled by special schools where the range of attainment is wide, with some pupils having complex learning difficulties and almost all are working below age-related expectations of the National Curriculum in mathematics. The principle used was to start from the main yearly teaching programme and to 'track back' to appropriate objectives, thus maintaining the principle of the class working on similar topics.

The *Framework for teaching mathematics: Years 7, 8 and 9* offers example planning charts for each year. These show one way of covering the curriculum for all pupils. Topics such as 'sequences and functions', 'transformations' and 'probability' may appear to be inaccessible to many pupils with special needs. The following medium-term plans indicate how planning might be adapted to allow pupils in special schools to access the mathematics curriculum to which they are entitled.

Example

Planning for a Year 7 class needs to address the needs of pupils working at:

- Levels P1 to P3;
- Levels P4 to P8;
- National Curriculum levels 1 and 2;
- National Curriculum levels 3, 4 and above.

One possible approach might be to use the optional Year 7 planning chart and the Year 7 sample medium-term plan as a basis for planning. The following sample units show how a teacher might track back along the strands through Year 6, Year 5… to Year 1 objectives and then refer to the P scales.

The timing and balance of topics may need to be altered to meet pupils' particular needs.

All pupils in the class could be working on the same topic, providing opportunities for whole-class activity at the beginning and end of lessons and for class, group or individual work in the main part of the lesson.

YEAR 7: AUTUMN TERM

Teaching objectives for the main activities

	SUPPORT From levels P1 to P3	**SUPPORT** From levels P4 to P8	**SUPPORT** From Y1, Y2 and Y3	**SUPPORT** From Y4, Y5 and Y6	**CORE** From the Y7 teaching programme
Number 1 (6 hours) Place value (36–41)	• Remember learned responses for longer. (P2) • Anticipate known events. (P3) • Accept and engage in exploration with help from others. (P2) • Focus attention on certain objects. (P1)	• Use practical methods to associate names and symbols with numbers. (P6) • Join in rote-counting up to 5/10 and use the numbers in familiar activities and games. (P6/P7)	• Say number names to at least 100, from and back to zero. • Know what each digit in a two-digit number represents including 0 as a place holder. • Use decimal notation in the context of money.	• Read and write whole numbers in figures and words. • **Use decimal notation for tenths and hundredths;** know what each digit represents in numbers with up to two decimal places. • Order a set of decimals or measurements with the same number of decimal places.	• Understand and use decimal notation and place value; multiply and divide integers and decimals by 10, 100, 1000, and explain the effect. • Compare and order decimals in different contexts; know that when comparing measurements they must be in the same units.
Integers (48–51)				• Calculate a temperature rise or fall across 0 °C.	• Understand negative numbers as positions on a number line; order, add and subtract positive and negative integers in context.
Mental calculations (88–91)		• In practical situations, add one to or take one away from a number of objects. (P8) • Begin to recognise differences in quantity. (P7)	• Recall addition and subtraction facts of numbers to 10.	• Recall addition and subtraction facts of numbers to 20. • Know squares up to 10×10.	• 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.
Written calculations (102–105)				• Approximate first and use informal pencil and paper methods to support addition and subtraction.	• Make and justify estimates and approximations of calculations. • Use standard column procedures to add and subtract whole numbers and decimals with up to two places.
Calculator methods (108–109)				• Develop calculator skills and use a calculator effectively.	• Enter numbers and interpret the display in different contexts.
Solving problems (2–11)	• Apply potential solutions systematically to solve problems. (P3)	• Solve simple problems.	• Solve simple word problems.	• Solve word problems.	• **Solve word problems and investigate in a range of contexts:** number; compare and evaluate solutions.

	SUPPORT From levels P1 to P3	**SUPPORT** From levels P4 to P8	**SUPPORT** From Y1, Y2 and Y3	**SUPPORT** From Y4, Y5 and Y6	**CORE** From the Y7 teaching programme
Algebra 1 (6 hours) Sequences (144–163)	• Begin to show anticipation in response to familiar people, routines, activities and actions. (P3) • Remember learned responses over short periods of time. (P2) • Show emerging awareness of activities and experiences. (P1)	• Show awareness of time through some familiarity with significant times of the day such as meal times. (P8) • Count items up to 5/10.	• Count and order numbers to 20/50/100. • Count in fives. • Count to 5/10/20 forwards and backwards in ones.	• Recognise and extend number sequences formed by counting from any number in steps of constant size, extending beyond zero when counting back. • Know squares to at least 10×10.	• Generate and describe simpler integer sequences. • 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). • Generate sequences from practical contexts and describe the general term in simple cases.
Formulae and identities (112–113)			• Know the days of the week. • Order the months of the year.		• Express simple functions in words, then using symbols; represent them in mappings. • **Use letter symbols to represent unknown numbers or variables.**
Solving problems (32–35)	• Apply potential solutions systematically to solve problems. (P3)	• Demonstrate an interest in the relationship between objects. (P4)	• Recognise all coins. • Solve money and 'real-life' problems.	• Solve simple word problems.	• Suggest extensions to problems by asking 'What if…?'; begin to generalise and to understand the significance of a counter-example.

	SUPPORT From levels P1 to P3	**SUPPORT** From levels P4 to P8	**SUPPORT** From Y1, Y2 and Y3	**SUPPORT** From Y4, Y5 and Y6	**CORE** From the Y7 teaching programme
Shape, space and measures 1 (4 hours)	• Explore materials in increasingly complex ways. (P3) • Co-operate in shared exploration and supported participation. (P2) • Show simple reflex responses. (P1)	• Start to pick out named shapes from a collection. (P7) • Manipulate 3-dimensional shapes. (P6)	• Classify and describe 3-D and 2-D shapes.	• Identify different nets for an open cube. • Know the names and language of 2-D and 3-D shapes.	• Use 2-D representations to visualise 3-D shapes and deduce some of their properties.
Mensuration (198–201, 228–231, 234–241)				• Measure and draw lines to the nearest millimetre. • Record estimates and readings from scales to a suitable degree of accuracy.	• Use names and abbreviations of units of measurement to measure, estimate, calculate and solve problems in everyday contexts involving length, area.
			• Calculate the perimeter of a shape made from rectangles. • Calculate the area of a rectangle by counting squares.	• **Understand that area is measured in square centimetres (cm^2).** • Understand, measure and calculate perimeters of rectangles and regular polygons.	• Know and use the formula for the area of a rectangle; calculate the perimeter and area of shapes made from rectangles. • Calculate the surface area of cubes and cuboids.
Solving problems (18–21)					• **Solve word problems and investigate in a range of contexts:** length, perimeter and area.

	SUPPORT From levels P1 to P3	**SUPPORT** From levels P4 to P8	**SUPPORT** From Y1, Y2 and Y3	**SUPPORT** From Y4, Y5 and Y6	**CORE** From the Y7 teaching programme
Handling data 1 (6 hours) Handling data (256–61, 268–271)					• 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.
	• Respond to options and choices with actions or gestures. (P3) • May give intermittent reactions to activities and experiences. (P1) • Apply potential solutions systematically to problems. (P3)	• Complete a range of classification activities using given criteria. (P7) • Begin to identify when an object is different and does not belong to given categories. (P6) • Begin to sort sets of objects according to a single attribute. (P5)	• Solve a problem by sorting, classifying and organising information in a table, pictogram, block graph or bar chart.	• **Solve a problem by** representing, **extracting and interpreting data in tables, graphs, charts** and diagrams, for example: - line graphs; - frequency tables and bar charts.	• Interpret diagrams and graphs (including pie charts), and draw conclusions based on the shape of graphs and simple statistics for a single distribution.
Probability (276–283)	• Perform actions often by trial and improvement. (P2)			• Discuss the chance or likelihood of particular events.	• Use vocabulary and ideas of probability, drawing on experience. • **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 single event. • Collect data from a simple experiment and record in a frequency table; estimate probabilities based on this data.

Appendix 3

Mathematics glossary for teachers in Key Stages 1 to 4

This glossary is reproduced from the document located on the Qualifications and Curriculum Authority (QCA) website, www.qca.org.uk.

Mathematics glossary for teachers in key stages 1 to 4

July 2001

This glossary is being developed in response to requests from teachers and others during the national curriculum consultation in 1999. In the longer term it will lie behind the programmes of study for mathematics on the National Curriculum web site. Mathematical terms in the programmes of study will be linked to a definition in the glossary. The definitions refer to the terms as they are used in the programmes of study. Other terms defined are taken from supporting publications, including:

1 National Numeracy Strategy
Framework for teaching mathematics from Reception to Year 6
DfEE, 1999

2 National Numeracy Strategy,
Mathematical vocabulary
BEAM for DfEE, 1999

3 Qualifications and Curriculum Authority / National Numeracy Strategy,
Standards in mathematics: exemplification of key learning objectives from reception to year 6
QCA 1999

4 Qualifications and Curriculum Authority / National Numeracy Strategy,
Teaching mental calculation strategies: guidance for teachers at key stages 1 and 2
QCA 1999

5 Qualifications and Curriculum Authority / National Numeracy Strategy,
Teaching written calculations: guidance for teachers at key stages 1 and 2
QCA 1999

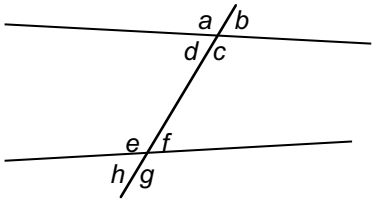
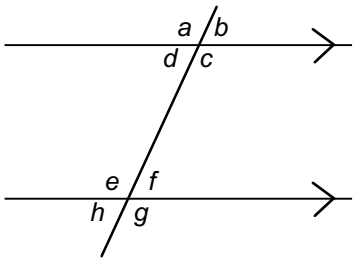
6 Key Stage 3 National Strategy
Framework for teaching mathematics: Years 7, 8 and 9
DfEE, 2001

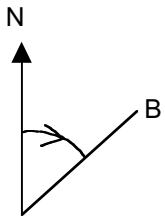
The glossary is a work in progress. As well as in this printed document, the glossary is currently located on the QCA website, www.qca.org.uk and can be accessed by choosing Curriculum and Assessment, subjects, mathematics and Mathematics glossary for teachers in key stages 1 to 4.

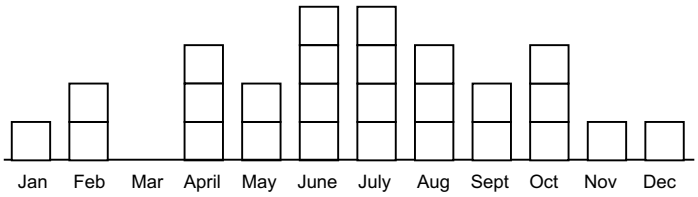
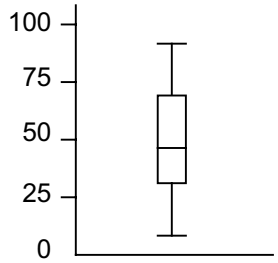
Readers are invited to suggest refinements to definitions or to offer alternative definitions. Readers may also suggest further terms that should be defined or deletions where it is felt that definitions are unnecessary. Please e-mail Pamela Wyllie, wylliep@qca.org.uk with your suggestions.

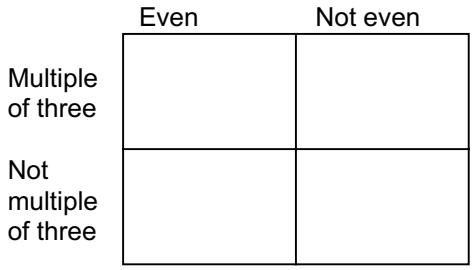
Qualifications and Curriculum Authority
Guarding standards

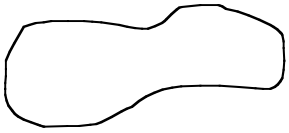
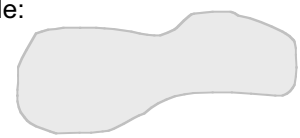
July 2001

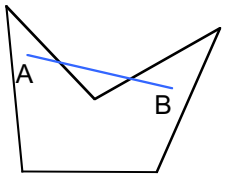
acute angle	An angle between 0° and 90°.
addition	The operation to combine two numbers or quantities to form a further number or quantity, the sum or total. Addition is the inverse operation to subtraction.
algebra	The part of mathematics that deals with generalised arithmetic. Letters are used to denote variables and unknown numbers and to state general properties. Example: a(x + y) = ax + ay exemplifies a relationship that is true for any numbers a, x and y. Adjective: algebraic. See also equation, formula, identity and expression.
alternate angles	Where two straight lines are cut by a third, as in the diagrams, the angles *d* and *f* (also *c* and *e*) are alternate. Where the two straight lines are parallel, alternate angles are equal.  
analogue clock	A clock usually with 12 equal divisions labelled 1 to 12 to represent hours. Each twelfth is subdivided into five equal parts providing sixty minor divisions to represent minutes. The clock has two hands that rotate about the centre. The minute hand completes one revolution in one hour whilst the hour hand completes one revolution in 12 hours.
angle	Where two line segments meet at a point, the term describes the measure of rotation from one of the line segments to the other. In this way, a right-angle measures 90°, an acute angle is between 0° and 90°, an obtuse angle is between 90° and 180° and a reflex angle is greater than 180°.
approximation	A number or result that is not exact. In a practical situation an approximation is sufficiently close to the actual number for it to be useful. Verb: approximate. Adverb: approximately. When two values are approximately equal, the sign ≈ is used.
arc	At an elementary level, a portion of a curve. Often used for a portion of a circle.
area	A measure of surface. Area is usually measured in square units e.g. square centimetres (cm^2), square metres (m^2).

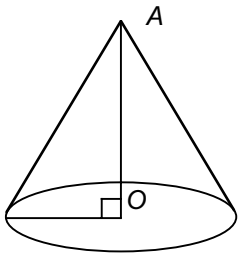
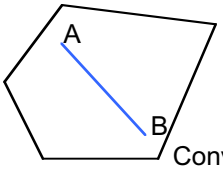
arithmetic mean	Of a set of discrete data, the sum of quantities divided by the number of quantities. Example: The arithmetic mean of 5, 6, 14, 15 and 45 is (5 + 6 + 14 + 15 + 45) ÷ 5 i.e. 17.
arithmetic sequence	A sequence of numbers in which terms are generated by adding or subtracting a constant amount to the preceding term. Examples: 3, 11, 19, 27, 35, … where 8 is added; 4, -1, -6, -11, … where 5 is subtracted.
array	At an elementary level, an ordered collection of counters, numbers etc. in rows and columns.
associative	A binary operation $*$ on a set S is associative if $a * (b * c) = (a * b) * c$ for all a, b and $c \in S$. Addition of real numbers is associative where a + (b + c) = (a + b) + c for all real numbers a, b, c. It follows that, for example, 1 + (2 + 3) = (1 + 2) + 3. Similarly multiplication is associative. Subtraction and division are not associative where, as counter examples, $1 – (2 – 3) \neq (1 – 2) – 3$ and $1 ÷ (2 ÷ 3) \neq (1 ÷ 2) ÷ 3$.
average	At an elementary level, used synonymously with ‘arithmetic mean'.
axis	A fixed, reference line along which or from which distances or angles are taken.
axis of symmetry	See reflection symmetry
bar chart	A format for representing statistical information. Bars, of equal width, represent frequencies and the lengths of the bars are proportional to the frequencies.
bar line chart	Similar to a bar chart, the width of bars is reduced so that they appear as lines. The lengths of the bar lines are proportional to the frequencies.
bearing	The direction of a line specified by the angle it makes with a North-South line. The angle is measured in degrees from north in a clockwise direction. Example:  The bearing of B from A Bearings are usually given in a three figure format.
binary operation	At an elementary level, for the set of real numbers, a rule for combining two numbers in the set to produce a third also in the set. Addition, subtraction, multiplication and division of real numbers are all binary operations.

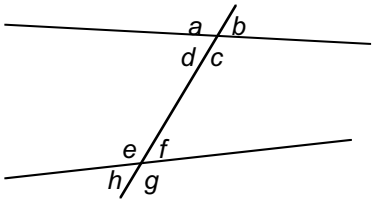
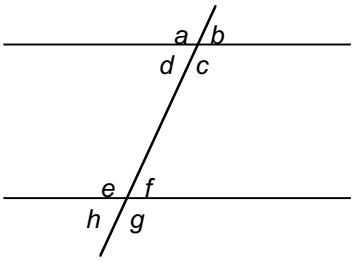
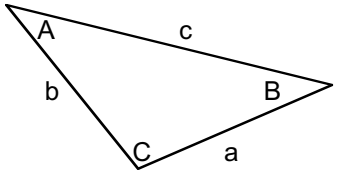
bisect	In geometry, to divide into two equal parts.
bisector	A point, line or plane that divides (a line, an angle or a solid shape) into two equal parts. A perpendicular bisector is a line at right angles to a line segment that divides it into two equal parts.
block graph	A simple format for representing statistical information. One block represents one observation. Example: A birthday graph where each child places one block, or colours one square, to represent himself / herself in the month in which he or she was born. 
box-plot	A diagram to represent a set of ranked numerical data. A box represents the interquartile range. Lines from the points representing the maximum and minimum values to the box are sometimes referred to as 'whiskers'. The median is marked on the box by a line. Example: 
brackets	Symbols used to show items that should be treated as together or as having priority. In arithmetic and algebra, operations within brackets are given priority. Example: 2 x (3 + 4) = 2 x 7 = 14 whereas 2 x 3 + 4 = 6 + 4 = 10.
cancel (a fraction)	One way to simplify a fraction. The numerator and denominator are divided by a common factor. Also to 'reduce' a fraction. Example: to simplify $^{5}/_{15}$ the fraction is cancelled when the numerator and denominator are divided by 5 to give $^{1}/_{3,}$
capacity	Volume, i.e. a measure of three-dimensional space, applied to liquids, materials that can be poured or the space within containers. Units include cubic centimetres (cm^3) and cubic metres (m^3). A litre is equivalent to 1000 cm^3.

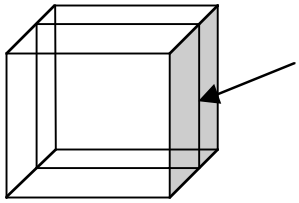
Carroll diagram	A sorting diagram named after Lewis Carroll, author and mathematician. Example: 
Cartesian coordinate system	A system used to define the position of a point in two-dimensional and three-dimensional space: 1. Two axes at right angles to each other are used to define the position of a point in a plane. The convention is to label the horizontal axis as the x-axis and the vertical axis as the y-axis. In this case, the origin is the intersection of the axes. The ordered pair of numbers (x, y) that defines the position of a point is the coordinate pair. Each of the numbers is a coordinate. The numbers are also known as Cartesian coordinates, after the French mathematician, René Descartes. 2. Three mutually perpendicular axes, conventionally labelled *x, y* and *z*, and coordinates (*x, y, z*) can be used to define the position of a point in space.
categorical data	Data arising from measurements taken on a categorical (unordered discrete) variable. Examples: pupils' favourite colours, pupils' pets.
centi –	Prefix meaning one-hundredth (of)
centilitre	Symbol: cl. A unit of volume equivalent to one-hundredth of a litre.
centimetre	Symbol: cm. A unit of linear measure, one hundredth of a metre. One inch is approximately 2.54 centimetres.
centre	At an elementary level, the middle point.
chart	As in bar chart, pie chart. Another word for graph.
chord	A straight line segment joining two points on a circle or other curve.

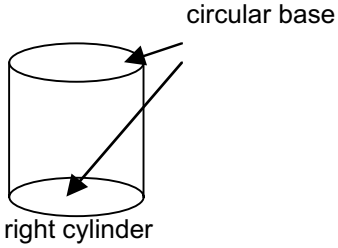
circle	A set of points in a plane at a fixed distance (the radius) from a fixed point (the centre) also in the plane; alternatively the path traced by a single point travelling in a plane at a fixed distance (the radius) from a fixed point (the centre) in the same plane. One half of a circle cut off by a diameter is a semi-circle.
circular	In the form of a circle.
circular function	A term used to describe the cosine and sine functions in trigonometry. Sometimes used for other trigonometric functions which are respectively the x and y coordinates of a rotating point on a circle of unit radius, centred on the origin of coordinates. The term circular function is also used for other trigonometric functions that can be derived from the cosine and sine functions.
circumference	The length of a circle (its perimeter). If the radius of a circle is r units, and the diameter d units, then the circumference is $2\pi r$, or πd units. For a sphere the circumference is the length of a great circle on the sphere.
clockwise	In the direction in which the hands of clock travel. Example:  Anti-clockwise or counter-clockwise are terms used for the opposite direction.
closed	Of a curve in a plane, continuous and beginning and ending at the same point. Example:  A closed region consists of a closed curve and all the points contained within it. Example: 
coefficient	Often used for the numerical coefficient. More generally, a factor of an algebraic term. Example: in the term 4xy, 4 is the numerical coefficient of xy but x is also the coefficient of 4y and y is the coefficient of 4x.
column	A vertical arrangement.
column graph	A bar graph where the bars are presented vertically.

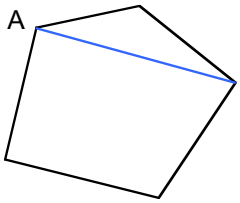
common fraction	A fraction where the numerator and denominator are both integers. Also known as simple or vulgar fraction. Contrast with a compound or complex fraction where the numerator or denominator or both contain fractions. See also decimal fraction.
commutative	A binary operation $*$ on a set S is commutative if $a * b = b * a$ for all a and b $\in$ S. Addition and multiplication of real numbers are commutative where $a + b = b + a$ and $a \times b = b \times a$ for all real numbers a and b. It follows that, for example, $2 + 3 = 3 + 2$ and $2 \times 3 = 3 \times 2$. Subtraction and division are not commutative since, as counter examples, $2 - 3 \neq 3 - 2$ and $2 \div 3 \neq 3 \div 2$.
compasses (pair of)	An instrument for constructing circles and circular arcs and for marking points at a given distance from a fixed point.
compensation (in calculation)	A mental or written calculation strategy. One number is rounded to make the calculation easier. The calculation is then adjusted by an appropriate compensatory addition or subtraction. Examples: • 56 + 38 is treated as 56 + 40 and then 2 is subtracted to compensate. • 27×19 is treated as 27×20 and then 27 (i.e. 27×1) is subtracted to compensate. • $67 - 39$ is treated as $67 - 40$ and then 1 is added to compensate.
complement (in addition)	In addition, a number and its complement have a given total. Example: When considering complements in 100, 67 has the complement 33, since 67 + 33 = 100
complementary angles	Two angles with the sum of 90°. Each is the 'complement' of the other.
compound measures	Measures with two dimensions and requiring calculation. Examples: speed calculated as distance ÷ time; and density calculated as mass ÷ volume.
concave	At an elementary level, curving inwards. A concave polygon has at least one re-entrant angle i.e. one interior angle greater than 180°. A line segment joining two points within the polygon may pass outside it. Example:  A concave pentagon. The line segment, joining points A and B within the polygon, passes outside it. Compare with convex.
concentric	Used to describe circles that have the same centre.

cone	At an elementary level, a cone consists of a base bounded by a circle, a vertex, in a different plane, and line segments joining all the points on the circle to the vertex. This defines a circular cone. If the vertex *A* lies directly above the centre *O* of the base, then the axis of the cone *AO* is perpendicular to the base and the shape is a right circular cone. 
congruent (figures)	Adjective. Describing two or more geometric figures that are the same in every way except their position in space. Example: Two figures, where one is a reflection of the other, are congruent since one can be transposed onto the other without changing any angle or edge length. Noun: congruence
consecutive	Following in order. Consecutive numbers are adjacent in a count. Examples: 5, 6, 7 are consecutive numbers. 25,30,35 are consecutive multiples of 5. In a polygon, consecutive sides share a common vertex and consecutive angles share a common side.
constant	At an elementary level, a number or quantity that does not vary. Example: in the equation y = 3x + 6, the 3 and 6 are constants, where x and y are variables.
continuous data	Data arising from measurements taken on a continuous variable (examples: lengths of caterpillars; weight of crisp packets). Continuous data may be grouped into touching but non-overlapping categories. (Example height of pupils[x cm] can be grouped into 130 ≤ x < 140; 140 ≤ x <150 etc.) Compare with discrete data.
convex	At an elementary level, curved outwards. A convex polygon has all its interior angles less than or equal to 180°. The line segment joining any two points, A and B, inside a convex polygon will lie entirely within it. Example:  Convex polygon (pentagon). For a polyhedron to be convex, it must lie completely to one side of a plane containing any face. Compare with concave
coordinate	See Cartesian coordinate system.

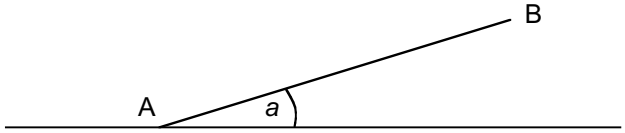
corner	In elementary geometry, a point where two or more lines or line segments meet. More correctly called *vertex, vertices (plural)*. Examples: a rectangle has four corners or vertices; and a cube has eight corners or vertices.
correlation	A measure of the strength of the association between two variables. High correlation shows a close relationship and low correlation a less close one. If an increase in one variable results in an increase in the other, then the correlation is positive. If an increase in one variable results in a decrease in the other, then the correlation is negative. The term zero correlation does not necessarily imply 'no relationship' but merely 'no linear relationship'
corresponding angles	Where two straight-line segments are intersected by a third, as in the diagrams, the angles *a* and *e* are corresponding. Similarly *b* and *f*, *c* and *g* and *d* and *h* are corresponding. Where parallel lines are cut by a straight line, corresponding angles are equal.  
cosine	See trigonometric function
cosine rule	In trigonometry, a rule used to calculate the sides and angles of a triangle: $c^2 = a^2 + b^2 - 2ab\ \cos C$ 
counter example	Where a hypothesis or general statement is offered, an example that clearly disproves it.

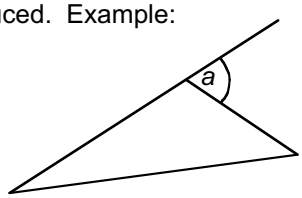
cross-section	In geometry, a section in which the plane that cuts a figure is at right angles to an axis of the figure. Example: In a cube, a square revealed when a plane cuts at right angles to a face. 
cube	1. In geometry, a three-dimensional figure with six identical, square faces. Adjoining edges and faces are at right angles. 2. In number and algebra, the result of multiplying to power three, n^3 is read as 'n cubed' or 'n to the power of three' Example: Written 2^3, the cube of 2 is (2 x 2 x 2) = 8.
cube number	A number that can be expressed as the product of three equal integers. Example: $27 = 3 \times 3 \times 3$. Consequently, 27 is a cube number.
cube root	A value or quantity whose cube is equal to a given quantity. Example: the cube root of 8 is 2 since $2^3 = 8$. This is recorded as $\sqrt[3]{8} = 2$ or $8^{1/3} = 2$
cubic centimetre	Symbol: cm^3. A unit of volume. The three-dimensional space equivalent to a cube with edge length 1cm.
cubic	A mathematical expression of degree three. Examples: a cubic polynomial is one of the type $ax^3 + bx^2 + cx + d$
cubic curve	A curve with an algebraic equation of degree three.
cubic metre	Symbol: m^3. A unit of volume. A three-dimensional space equivalent to a cube of edge length 1m.
cuboid	A three-dimensional figure with six rectangular faces.
cumulative frequency diagram	A graph for displaying cumulative frequency. At a given point on the horizontal axis the sum of the frequencies of all the values up to that point is represented by a point whose vertical coordinate is proportional to the sum.
cyclic quadrilateral	A four sided figure whose vertices lie on a circle.

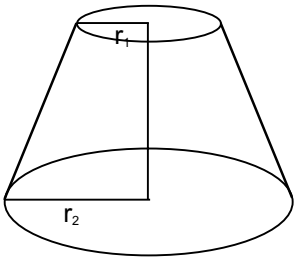
cylinder	At an elementary level, a three-dimensional object whose uniform cross-section is a circle. A right cylinder can be defined as having bases that are bound by circles with a curved surface joining them, this surface formed by line segments joining corresponding points on the circles. The centre of one base lies over the centre of the second. 
2-D, 3-D	Two-dimensional, three-dimensional. Having two or three dimensions respectively.
data	Information of a quantitative nature consisting of counts or measurements. Initially data are nearly always counts or things like percentages derived from counts. When they refer to measurements that are separate and can be counted, the data are discrete. When they refer to quantities such as length or capacity that are measured, the data are continuous. Singular: datum.
database	A means of storing sets of data.
decimal	Relating to the base ten. Most commonly used synonymously with decimal fraction where the number of tenths, hundredth, thousandths etc. are represented as digits following a decimal point. The decimal point is placed at the right of the units column. Each column after the decimal point is a decimal place. Example: The decimal fraction 0.275 is said to have three decimal places. The system of recording with a decimal point is decimal notation. Where a number is rounded to a required number of decimal places, to 2 decimal places for example, this may be recorded as 2 d.p.
decimal fraction	Tenths, hundredths, thousandths etc represented by digits following a decimal point. Example 0.125 is equivalent to $^{1}/_{10} + {}^{2}/_{100} + {}^{5}/_{1000}$ or $^{125}/_{1000}$ or $^{1}/_{8.}$ The decimal fraction representing $^{1}/_{8}$ is a terminating decimal fraction since it has a finite number of decimal places. Other fractions such as $^{1}/_{3}$ produce recurring decimal fractions. These have a digit or group of digits that is repeated indefinitely. In recording such decimal fractions a dot is written over the single digit, or the first and last digits of the group, that is repeated.
decomposition	See subtraction by decomposition
degree	Symbol: ^{o}. In the measurement of angles, a unit of turn. One whole turn is equal to 360 degrees, written 360^{o}

denominator	In the notation of common fractions, the number written below the line i.e. the divisor. Example: In the fraction $^{2}/_{3}$, the denominator is 3.
diagonal (of a polygon)	A line segment joining any two non-adjacent vertices of a polygon.  The line AB is one diagonal of this polygon.
diagram	A picture, a geometric figure or a representation.
diameter	At an elementary level, any of the chords of a circle or sphere that pass through the centre.
difference	The result of a subtraction. The amount by which one number or value is greater than another.
digit	One of the symbols of a number system most commonly the symbols 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. Examples: the number 29 is a 2-digit number; there are three digits in 2.95. The position or place of a digit in a number conveys its value.
digital clock	A clock that displays the time as hours and minutes passed, usually since midnight. Example: four thirty in the afternoon is displayed as 16:30.
dimension	At an elementary level, a property relating to geometrical figures, their length, breadth etc. A point is treated as having no dimensions, a line as having one dimension, its length, a plane shape as having two dimensions, its length and breadth, and a solid as having three dimensions, its length, breadth and height.
directed number	A numbered point on a directed line. Where one point on a line is labelled 0 and equally spaced points to one side of it are labelled +1, +2, +3 etc. these, and the numbers represented by points between them, are positive. Similar numbered points on the other side of 0 are negative and are read as 'minus one, minus two …etc.
disc	All points that lie on a circle or within it.
discrete data	Data resulting from measurements taken on a discrete variable (examples: value of coins in pupils' pockets; number of peas in a pod). Discrete data may be grouped. Example: Having collected the shoe sizes of pupils in the school, the data might be grouped into 'number of pupils with shoe sizes 3 – 5, 6 – 8, 9 – 11' etc.

distribution	For a set of data, the way in which values in the set are distributed between the minimum and maximum values. In number and algebra operations, the application of the distributive law.
distributive	One binary operation $*$ on a set S is distributive over another binary operation $\bullet$ on that set if $a * (b \bullet c) = (a * b) \bullet (a * c)$ for all a, b and c $\in$ S. For the set of real numbers, multiplication is distributive over addition and subtraction since a(b + c) = ab + ac for all a, b and c real numbers. It follows that 4(50 + 6) = (4 x 50) + (4 x 6) and 4 x (50 - 2) = (4 x 50) - (4 x 2). Addition, subtraction and division are not distributive over other number operations.
divide	Carry out the operation of division.
dividend	In division, the number that is divided.
divisibility	The property of being divisible by a given number. Example: A test of divisibility by 9 checks if a number can be divided by 9 with no remainder.
divisible (by)	A whole number is divisible by another if there is no remainder after division and the result is a whole number. Example: 63 is divisible by 7 because $63 \div 7 = 9$ remainder 0. However, 63 is not divisible by 8 because $63 \div 8 = 7.875$ or 7 remainder 7.
division	1. An operation on numbers interpreted in a number of ways. At an elementary level division can be sharing - the number to be divided is shared equally into the stated number of parts; or grouping - the number of groups of a given size is found. Division is the inverse operation to multiplication. 2. On a scale, one part. Example: Each division on a ruler might represent a millimetre.
divisor	The number by which another is divided. Example: In the calculation $30 \div 6 = 5$, the divisor is 6. In this example, 30 is the dividend and 5 is the quotient.
dodecahedron	A polyhedron with twelve faces. The faces of a regular dodecahedron are regular pentagons. A dodecahedron has 20 vertices and 30 edges.
double	1. To multiply by 2. Example: Double 13 is $(13 \times 2) = 26$. 2. The number or quantity that is twice another. Example: 26 is double 13. In this context, a 'near double' is one unit away from a double. Example: 27 is a near double of 13 and of 14.

edge	A line segment, joining two vertices of a figure. A line segment formed by the intersection of two plane surfaces. Examples: a square has four edges; and a cuboid has twelve edges.
elevation	1. The vertical height of a point above a base (line or plane). 2. The angle of elevation from one point A to another point B is the angle between the line AB and the horizontal line through A. Example: in the diagram, the angle *a* is the angle of elevation of point B from point A.  3. See projection
enlargement	A transformation of the plane in which lengths are multiplied whilst directions and angles are preserved. A centre and a positive scale factor are used to specify an enlargement. The scale factor is the ratio of the distance of any transformed point from the centre to its distance from the centre prior to the transformation. Any figure and its image under enlargement are similar.
equal	Symbol: =, read as 'is equal to' or 'equals'. Having the same value. Example: $7 - 2 = 4 + 1$ since both expressions, $7 - 2$ and $4 + 1$ have the same value, 5.
equal class interval	See grouped (discrete data)
equation	A mathematical statement showing that two expressions have equal value. The expressions are linked with the symbol =. Examples: $7 - 2 = 4 + 1$, $4x = 3$, $x^2 - 2x + 1 = 0$
equilateral	Of a polygon, having sides of equal length.
equivalent fraction	Fraction with the same value as another. Example: $^6/_{12} = {}^3/_6 = {}^1/_2$. These are equivalent fractions.
estimate	1. Verb: To arrive at a rough or approximate answer by calculating with suitable approximations for terms or, in measurement, by using previous experience. 2. Noun: A rough or approximate answer.
evaluate	Find the value of a numerical or an algebraic expression. Examples: Evaluate $28 \div 4$ by calculating, $28 \div 4 = 7$ Evaluate $x^2 - 3$ when $x = 2$ by substituting this value for x and calculating, $2^2 - 3 = (2 \times 2) - 3 = 4 - 3 = 1$
even number	A positive integer that is divisible by 2.

exchange	Change a number or expression for another of equal value. The process of exchange is used in some standard compact methods of calculation. Examples: 'carrying figures' in addition, multiplication or division; and 'decomposition' in subtraction.
exponent	Also known as index, a number, positioned above and to the right of another, indicating repeated multiplication. Example: n^2 indicates $n \times n$; and n^5 indicates $n \times n \times n \times n \times n$. The result of the multiplication is the power. Example: $2^5 = 32$ and 32 is the fifth power of 2. Exponents may be fractional or negative. Examples: $8^{1/3} = 2$, 2^{-2} is the inverse of 2^2 and has the value $^1/_4$.
exponential (function)	At an elementary level, a function having variables expressed as exponents.
expression	A mathematical form expressed symbolically. Examples: $7 + 3$; $a^2 + b^2$.
exterior angle	Of a polygon, the angle formed outside between one side and the adjacent side produced. Example:  The angle *a* is one exterior angle of this triangle.
face	At an elementary level, one of the flat surfaces of a solid shape. Example: a cube has six faces.
factor	When a number, or polynomial in algebra, can be expressed as the product of two numbers or polynomials, these are factors of the first. Examples: 1, 2, 3, 4, 6 and 12 are all factors of 12: $(x - 1)$ and $(x + 4)$ are factors of $(x^2 + 3x - 4)$ where $(x - 1)(x + 4) = (x^2 + 3x - 4)$
factorise	At an elementary level, to express a number or polynomial as the product of its factors. Example, factorising 12: $12 = 1 \times 12$ $= 1 \times 2 \times 6$ $= 1 \times 4 \times 3$ $= 1 \times 2 \times 2 \times 3$ The factors of 12 are 1, 2, 3, 4, 6 and 12.
foot	Symbol: ft. An imperial measure of length. 1 foot = 12 inches. 3 feet = 1 yard. 1 foot is approximately 30 cm.
formula	An equation linking sets of physical variables. Plural: formulae.

fraction	The result of dividing one integer by a second integer which must be non-zero. The dividend is the numerator and the non-zero divisor is the denominator. See also common fraction, decimal fraction, equivalent fraction, improper fraction, proper fraction, simple fraction, unit fraction and vulgar fraction.
frequency density	See histogram.
frequency table	A table for a set of observations showing how frequently each event or quantity occurs.
frustum of a cone	Part of a cone bounded by two parallel planes.  r_1 and r_2, the radii of the bases, are parallel.
function	A rule that relates every element x of a set X, the domain of the function, to a unique element y of another set Y, the codomain. Example: the function 'has a birthday on' could relate each person, in a set of individuals, to a unique element in the set of days in the year. If the function can be expressed algebraically, then for any particular value of x, the value of y can be calculated and y is said to have a functional relationship with x. Example: for the function $y = x^2$, when $x = 5$, then $y = 5^2$ or 25.
functional relationship	See function.
gallon	Symbol: gal. An imperial measure of volume applied to liquids or capacity, equal to the volume occupied by ten pounds of distilled water. In the imperial system, 1 gallon = 2 quarts = 8 pints. One gallon is approximately 4.546 litres.
general statement	A statement that applies correctly to all relevant cases.
generalise	To formulate a general statement or rule.
geometrical	Relating to geometry, the aspect of mathematics concerned with the properties of space and figures or shapes in space.

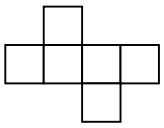
gradient	A measure of the slope of a line. On a coordinate plane, the gradient of the line through the points (x_1, y_1) and (x_2, y_2) is defined as $(y_2 – y_1) / (x_2 – x_1)$. The gradient may be positive, negative or zero depending on the values of the coordinates.
gram	Symbol: g. The unit of mass equal to one thousandth of a kilogram.
graph	A diagram showing a relationship between variables. Adjective: graphical.
grid	A lattice created with two sets of parallel lines. Lines in each set are usually equally spaced. If the sets of lines are at right angles and lines in both sets are equally spaced, a square grid is created.
grouped (discrete data)	Observed data arising from counts and grouped into non-overlapping intervals. Example: score in test / number of children obtaining the score scores 1 – 10, 11 - 20, 21 - 30, 31 - 40, 41 - 50 etc. In this example there are equal class intervals.
heptagon	A polygon with seven sides or edges.
hexagon	A polygon with six sides or edges. Adjective: hexagonal, having the form of a hexagon
highest common factor (HCF)	The common factor of two or more numbers which has the highest value. Example: 16 has factors 1, 2, 4, 8, 16. 24 has factors 1, 2, 3, 4, 6, 8, 12, 24. 56 has factors 1, 2, 4, 7, 8, 14, 28, 56. The common factors of 16, 24 and 56 are 1, 2, 4 and 8. Their highest common factor is 8.
histogram	A particular form of representation of grouped data. Segments along the x-axis are proportional to the class interval. Rectangles are drawn with the line segments as bases. The area of the rectangle is proportional to the frequency in the class. Where the class intervals are not equal, the height of each rectangle is called the frequency density of the class.
horizontal	Parallel to the horizon.
hour	A unit of time. One twenty-fourth of a day. 1 hour = 60 minutes = 3600 (60 x 60) seconds.
hundred square	A 10 by 10 square grid numbered 1 to 100. A similar grid could be numbered as a 0 - 99 grid.

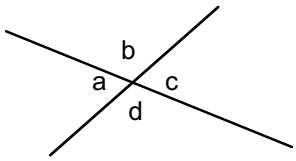
icosahedron	A polyhedron with 20 faces. In a regular icosahedron all faces are equilateral triangles.
identity	An equation that holds for all values of the variables. The symbol ≡ is used. Example: $a^2 - b^2 \equiv (a + b)(a - b)$.
imperial unit	A unit of measurement historically used in the United Kingdom and other English speaking countries. Units include inch, foot, yard, mile, acre, ounce, pound, stone, hundredweight, ton, pint, quart and gallon. Now largely replaced by metric units.
improper fraction	An improper fraction has a numerator that is greater than its denominator. Example: $^9/_4$ is improper and could be expressed as the mixed number $2^1/_4$.
inch	Symbol: in. An imperial unit of length. 12 inches = 1 foot. 36 inches = 1 yard. Unit of area is square inch, in^2. Unit of volume is cubic inch, in^3. 1 inch is approximately 2.54 cm.
index laws	Where index notation is used and powers are multiplied or divided, the rules for manipulating index numbers. Examples: $2^a \times 2^b = 2^{a+b}$ and $2^a \div 2^b = 2^{a-b}$
index notation	The notation in which a product such as $a \times a \times a \times a$ is recorded as a^4. In this example the number 4 is the index (plural indices) See also standard index form
inequality	Statements such as $a \neq b$, $a \leq b$ or $a > b$ are inequalities.
inscribed	Describing a figure enclosed by another. Examples: a polygon, whose vertices lie on the circumference of a circle, is said to be inscribed in the circle. Where a circle is drawn inside a polygon so that the sides of the polygon are tangents to the circle, the circle is inscribed in the polygon. (In this case the circle is the 'incircle' of the polygon.)
integer	Any of the positive or negative whole numbers and zero. Example: …-2, -1, 0, +1, +2 …
intercept	1. To cut a line, curve or surface with another. 2. In the Cartesian coordinate system, the positive or negative distance from the origin to the point where a line, curve or surface cuts a given axis. **OR** On a graph, the value of the non-zero coordinate of the point where a line cuts an axis.
interior angle	At a vertex of a polygon, the angle that lies within the polygon.
interquartile range	See quartile

intersect	To have a common point or points. Examples: Two intersecting lines intersect at a point; two intersecting planes intersect in a line.
inverse operations	Operations that, when they are combined, leave the entity on which they operate unchanged. Examples: addition and subtraction are inverse operations e.g. $5 + 6 - 6 = 5$. Multiplication and division are inverse operations e.g. $6 \times 10 \div 10 = 6$.
irrational number	A number that is not an integer and cannot be expressed as a common fraction with a non-zero denominator. Examples: $\sqrt{3}$ and π. Real irrational numbers, when expressed as decimals, are infinite, non-recurring decimals.
isosceles triangle	A triangle in which two sides have the same length and consequently two angles are equal.
kilo-	Prefix denoting one thousand
kilogram	Symbol: kg. The base unit of mass in the SI (Système International d'Unités). 1kg. = 1000g. One kilogram is approximately 2.2 pounds (lb.).
kilometre	Symbol: km. A unit of length in the SI (Système International d'Unités). The base unit of length in the system is the metre. 1km. = 1000m. 1 km is approximately five-eighths of a mile or 1100 yards.
kite	A quadrilateral with two equal, adjacent sides and two other sides of equal length and whose diagonals intersect at right angles.
least common multiple (LCM)	The common multiple of two or more numbers which has the least value. Example: 3 has multiples 3, 6, 9, 12, 15, 18, 21, 24 …, 4 has multiples 4, 8, 12, 16, 20, 24 … and 6 has multiples 6, 12, 18, 24, 30 …. The common multiples of 3, 4 and 6 include 12, 24 and 36. The least common multiple of 3, 4 and 6 is 12.
line	A set of adjacent points that has length but no width. A curve. A straight line is completely determined by two of its points, say A and B. The part of the line between any two of its points is a line segment.
line of best fit	At an elementary level, a line drawn on a scatter graph to represent the best estimate of an underlying linear relationship between the variables.
linear	In algebra, describing an expression or equation of degree one. Example: $2x + 3y = 7$ is a linear equation. This linear equation with its two variables, x and y, can be represented as a straight line graph.
litre	Symbol: l. A metric unit used for measuring volume or capacity. A litre is equivalent to 1000 cm^3. and is approximately 1.76 pints.

locus	The set of points that satisfy given conditions. Example: in 3-D the locus of all points that are a given distance from a fixed point is a sphere. Plural: loci.
mass	A characteristic of a body, relating to the amount of matter within it. Mass differs from weight, the force with which a body is attracted towards the earth's centre. Whereas, under certain conditions, a body can become weightless, mass is constant. In a constant gravitational field weight is proportional to mass.
maximum value	At an elementary level, the greatest value. Example: The maximum temperature in London yesterday was 18°C.
mean	Used synonymously with average. The arithmetic mean of a set of discrete data is the sum of quantities divided by the number of quantities. Example: The arithmetic mean of 5, 6, 14, 15 and 45 is (5 + 6 + 14 + 15 + 45) ÷ 5 i.e. 17.
measure	1. At an elementary level, the size in terms of an agreed unit. See also compound measure. 2. Measure is also used as a verb, to find the size.
median	The middle number or value when all values in a set of data are arranged in ascending order. Example: The median of 5, 6, 14, 15 and 45 is 14. When there is an even number of values, the arithmetic mean of the two middle values is calculated. Example: The median of 5, 6, 7, 8, 14 and 45 is (7 + 8) ÷ 2 i.e. 7.5.
mensuration	In the context of geometric figures the process of measuring or calculating angles, lengths, areas and volumes.
metre	Symbol: m. The base unit of length in SI (Système International d'Unités). 1000m. = 1km. A metre is approximately 39.37 inches.
metric unit	Unit of measurement in the metric system. Metric units include metre, centimetre, millimetre, kilometre, gram and kilogram.
mile	An imperial measure of length. 1 mile = 1760 yards. Five miles is approximately 8 kilometres.
milli-	Prefix. One-thousandth.
millilitre	Symbol: ml. One thousandth of a litre.
millimetre	Symbol: mm. One thousandth of a metre.

minimum value	At an elementary level, the least value. Example: The expected minimum temperature overnight is 6°C.
minus	The name for the symbol –, representing the operation of subtraction.
minute	Unit of time. One-sixtieth of an hour. 1 minute = 60 seconds
mixed fraction	A whole number and a fractional part expressed as a common fraction. Example: $1^2/_3$ is a mixed fraction. Also known as a mixed number.
mixed number	A whole number and a fractional part expressed as a common fraction. Example: $1^2/_3$ is a mixed number. Also known as a mixed fraction.
mode	The most commonly occurring value or class with the largest frequency.
moving average	The mean of a set of adjacent observations of fixed size is taken. The mean is calculated for successive sets of the same size to give the moving average. See time series.
multiple	For any integers *a* and *b*, *a* is a multiple of *b* if a third integer *c* exists so that *a* = *bc* Example: 14 = 7 x 2, 49 = 7 x 7 and 70 = 7 x 10. So 14, 4 9 and 70 are all multiples of 7. -21 is also a multiple of 7 since -21 = 7(-3).
multiplication	The operation of combining two numbers to give a third number, the product. Example: 12 x 3 = 36 is a multiplication. Multiplication can be seen as the process of repeated addition. Example: 3 x 5 = 3 + 3 + 3 + 3 + 3 = 15. Multiplication is the inverse operation of division, and it follows that 7 ÷ 5 x 5 = 7 Multiplication is commutative, associative and distributive over addition or subtraction.
multiplicative	Relating to multiplication. Example: the multiplicative inverse of 6 is $^1/_6$ since $6 \times {}^1/_6 = 1$
multiply	Carry out the process of multiplication.
mutually exclusive events	In probability, events that cannot both occur in one experiment. When the mutually exclusive events cover all possible outcomes the sum of their probabilities is 1.
natural number	The counting numbers 1, 2, 3, … etc. The positive integers. The set of natural numbers is usually denoted by N.

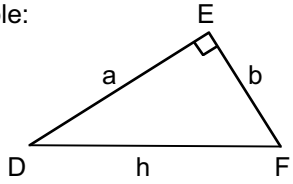
near double	See double.
negative integer	An integer less than 0. Examples: -1, -2, -3 etc.
negative number	1. At number less than zero. Example: – 0.25. Where a point on a line is labelled 0 and equally spaced points to one side of it are labelled –1, –2, –3 etc, these, and the numbers represented by points between them, are negative numbers 2. Commonly read aloud as 'minus one, minus two' etc. In some teaching approaches they are read as 'negative one, negative two' etc to distinguish the numbers from operations upon them. 3. See also directed number and positive number.
net	1. A plane figure composed of polygons which by folding and joining can form a polyhedron.  A net of a cube 2. Remaining after deductions. Examples: The net profit is the profit after deducting all operating costs. The net weight is the weight after deducting the weight of all packaging.
notation	A convention for recording mathematical ideas. Examples: Money is recorded using decimal notation e.g. £2.50 Other examples of mathematical notation include $a + a = 2a$ and $n \times n \times n = n^3$
number bond	A pair of numbers with a particular total e.g. number bonds to ten are all pairs of whole numbers with the total 10.
number line	A line where numbers are represented by points upon it.
number sentence	A mathematical sentence involving numbers. Examples: $3 + 6 = 9$ and $9 > 3$
number square	A square grid in which cells are numbered in order.
number track	A numbered track along which counters might be moved. The number in a region represents the number of single moves from the start.
numeral	A symbol used to denote a number. The Roman numerals I, V, X, L, C, D and M represent the numbers one, five, ten, fifty, one hundred, five hundred and one thousand. The Arabic numerals 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 are used in the Hindu-Arabic system giving numbers in the form that is widely used today.

numerator	In the notation of common fractions, the number written on the top - the dividend (part that is divided). In the fraction $^{2}/_{3}$, the numerator is 2.
oblong	Sometimes used to describe a non-square rectangle.
obtuse angle	An angle greater than 90° but less than 180°.
octagon	A polygon with eight sides. Adjective: octagonal, having the form of an octagon.
octahedron	A polyhedron with eight faces. A regular octahedron has faces that are equilateral triangles.
odd number	A positive integer that has a remainder of 1 when divided by 2.
operation	See binary operation
opposite	1. In a triangle, an angle is said to be opposite a side if the side is not one of those forming the angle. 2. Angles formed where two line segments intersect.  In the diagram *a* is opposite *c* and *b* is opposite *d*. Also called vertically opposite angles.
ordinal number	A term that describes a position within an ordered set. Example: first, second, third, fourth … twentieth etc.
origin	A fixed point from which measurements are taken. See also Cartesian coordinate system.
ounce	Symbol: oz. An imperial unit of mass. In the imperial system, 16 ounces = 1 pound. 1 ounce is approximately 28.35 grams.
parallel	In Euclidean geometry, always equidistant. Parallel lines, curves and planes never meet however far they are produced.

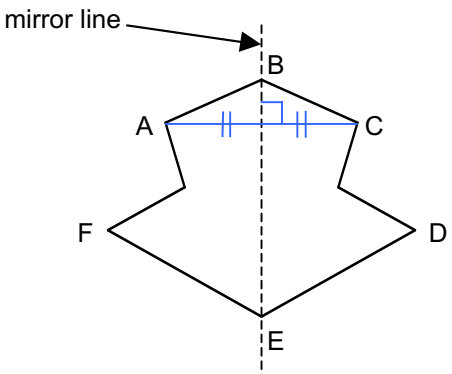
parallelogram	A quadrilateral whose opposite sides are parallel and consequently equal in length.
partition	1. To separate a set into subsets. 2. To split a number into component parts. Example: the two-digit number 38 can be partitioned into 30 + 8 or 19 + 19. 3. A model of division. Example: 21 ÷ 7 is treated as 'how many sevens in 21?'
pattern	A systematic arrangement of numbers, shapes or other elements according to a rule.
pentagon	A polygon with five sides and five interior angles. Adjective: pentagonal, having the form of a pentagon.
percentage	1. A fraction expressed as the number of parts per hundred and recorded using the notation %. Example: One half can be expressed as 50%; the whole can be expressed as 100%. 2. Percentage can also be interpreted as the operator 'a number of hundredths of'. Example: 15% of Y means $^{15}/_{100} \times Y$
perimeter	The length of the boundary of a closed figure.
perpendicular	A line or plane that is at right angles to another line or plane.
pi	Symbol: π. The length of any circle divided by the length of its diameter is a constant, π. π is an irrational number. One common approximation for π is $^{22}/_{7}$. 3.14159265 is a more accurate approximation, to 8 decimal places.
pictogram	A format for representing statistical information. Suitable pictures, symbols or icons are used to represent objects. For large numbers one symbol may represent a number of objects and a part symbol then represents a rough proportion of the number.
pie-chart	Also known as pie graph. A form of presentation of statistical information. Within a circle, sectors like 'slices of a pie' represent the quantities involved. The frequency or amount of each quantity is proportional to the angle at the centre of the circle.
pint	An imperial measure of volume applied to liquids or capacity. In the imperial system, 8 pints = 4 quarts = 1 gallon. 1 pint is approximately 0.568 litres.

place value	The value of a digit that relates to its position or place in a number. Example: in 1482 the digits represent 1 thousand, 4 hundreds, 8 tens and 2 units respectively; in 12.34 the digits represent 1 ten, 2 units, 3 tenths and 4 hundredths respectively.
plan	A 2-dimensional diagram of a 3-dimensional object, usually the view from directly above.
plane	A flat surface. A line segment joining any two points in the surface will also lie in the surface.
plot	The process of marking points. Points are usually defined by coordinates and plotted with reference to a given coordinate system.
plus	The name for the symbol +, representing the operation of addition.
point	An element, in geometry, that has position but no magnitude.
polygon	A closed plane figure bounded by straight lines. The name derives from *many angles*. If all interior angles are less than 180° the polygon is convex. If any interior angle is greater than 180°, the polygon is concave. If the sides are all of equal length and the angles are all of equal size, then the polygon is regular; otherwise it is irregular. Adjective: polygonal.
polyhedron	Plural: polyhedra. A closed solid figure bounded by surfaces (faces) that are polygonal. Its faces meet in line segments called its edges. Its edges meet at points called vertices. For a polyhedron to be convex, it must lie completely to one side of a plane containing any face. If it is not convex it is concave. A regular polyhedron has identical regular polygons forming its faces and equal angles formed by its surfaces and edges. The Platonic Solids are the five possible convex regular polyhedra: tetrahedron with four equilateral-triangular faces; cube with six square faces; octahedron with eight equilateral-triangular faces; dodecahedron with twelve regular-pentagonal faces; and icosahedron with twenty equilateral-triangular faces.
polynomial function	A function of the form $f(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \ldots + a_1 x + a_0$ Is a polynomial of order n
positive number	A number greater than zero. Where a point on a line is labelled 0 and equally spaced points to one side of it are labelled +1, +2, +3 etc., these, and the numbers represented by points between them, are positive numbers and are read 'positive one, positive two, positive three' etc. See also directed number and negative number.
pound (mass)	Symbol: lb. An imperial unit of mass. In the imperial system, 14 lb = 1 stone. 1 lb is approximately 455 grams. 1 kilogram is approximately 2.2 lb.

pound (money)	Symbol £. A unit of money. £1.00 = 100 pence.
power (of ten)	1. 100 (i.e. 10^2 or 10 x 10) is the second power of 10, 1000 (i.e.10^3 or 10 x 10 x 10) is the third power of 10 etc. Powers of other numbers are defined in the same way. Example: 2 (2^1), 4 (2^2), 8 (2^3), 16 (2^4) etc are powers of 2. 2. A fractional power represents a root. Example: $x^{1/2} = \sqrt{x}$ 3. A negative power represents the reciprocal. Example: $x^{-1} = {}^1/_x$ 4. By convention any number or variable to the power 0 equals 1. Example: $x^0 = 1$
prime factor	The factors of a number that are prime. Example: 2 and 3 are the prime factors of 12 (12 = 2 x 2 x 3). See also factor.
prime factor decomposition	The process of expressing a number as the product of factors that are prime numbers. Example: $24 = 2 \times 2 \times 2 \times 3$ or $2^3 \times 3$
prime number	A whole number greater than 1 that has exactly two factors, itself and 1. Examples: 2 (factors 2, 1), 3 (factors 3, 1). 51 is not prime (factors 51, 17, 3, 1).
prism	A solid bounded by two congruent polygons that are parallel (the bases) and parallelograms (lateral faces) formed by joining the corresponding vertices of the polygons. Prisms are named according to the base e.g. triangular prism, quadrangular prism, pentagonal prism etc. Examples:  If the lateral faces are rectangular and perpendicular to the bases, the prism is a right prism.
probability	The likelihood of an event happening. Probability is expressed on a scale from 0 to 1. Where an event cannot happen, its probability is 0 and where it is certain its probability is 1. The probability of scoring 1 with a fair dice is ${}^1/_6$. The denominator of the fraction expresses the total number of equally likely outcomes. The numerator expresses the number of outcomes that represent a 'successful' occurrence. Where events are mutually exclusive and exhaustive the total of their probabilities is 1.
product	At an elementary level, the result of multiplying one number by another. Example: The product of 2 and 3 is 6 since $2 \times 3 = 6$.
projection	At an elementary level, a mapping of points on a 3-dimensional geometric figure onto a plane according to a rule. Example: A map of the world is a projection of some type such as Mercator's projection. Plan and elevation are vertical and horizontal mappings.

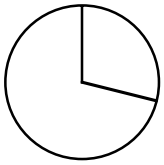
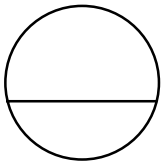
proof	A chain of reasoning that establishes in conclusion the truth of a proposition.
proper fraction	A proper fraction has a numerator that is less than its denominator. Example: $^3/_4$ is a proper fraction whereas $^4/_3$ is improper.
property	Any attribute. Example: One property of a square is that all its sides are equal.
proportion	1. At an elementary level, a part to whole comparison. Example: Where £20 is shared between two people in the ration 3 : 5, the first receives £7.50 which is $^3/_8$ of the whole £20. This is his proportion of the whole. 2. If two variables *x* and *y* are related by an equation of the form y = kx, then y is directly proportional to x; it may also be said that y varies directly as x. When y is plotted against x this produces a straight line graph through the origin. 3. If two variables *x* and *y* are related by an equation of the form y = $^k/_x$ then y is inversely proportional to x; it may be said that y varies inversely as x.
protractor	An instrument for measuring angles.
prove	To formulate a chain of reasoning that establishes in conclusion the truth of a proposition.
pyramid	A solid with a polygon as the base and one other vertex, the apex, in another plane. Each vertex of the base is joined to the apex by an edge. Other faces are triangles that meet at the apex. Pyramids are named according to the base: a triangular pyramid (which is also called a tetrahedron, having four faces), a square pyramid, a pentagonal pyramid etc.
Pythagoras' theorem	In a right-angled triangle, the square of the length of the hypotenuse is equal to the sum of the squares of the lengths of the other sides i.e. the sides that bound the right angle. Example:  When ∠DEF is a right angle, $a^2 + b^2 = h^2$
quadrant	One of the four regions into which a plane is divided by the x and y axes in the Cartesian coordinate system.
quadratic	Describing a expression of the form $ax^2 + bx + c$ where a, b and c are real numbers.

quadrilateral	A polygon with four sides.
qualitative	Relating to a quality or attribute.
quantitative	Relating to quantity or amount.
quartile	Where quantitative data is ranked in ascending order, the quartile values divide the data into four equal parts. The quartiles are the first or lower quartile, the second quartile, which is also the median value, and the third or upper quartile. The difference between the first and third quartiles, used as a measure of spread, is the interquartile range.
quotient	At an elementary level, the result of a division. Example: $46 \div 3 = 15^{1}/_{3}$ and $15^{1}/_{3}$ is the quotient of 46 by 3. Where the operation of division is applied to the set of integers, and the result expressed in integers, for example $46 \div 3 = 15$ remainder 1 then 15 is the quotient of 46 by 3 and 1 is the remainder.
radius	In relation to a circle, the distance from the centre to any point on the circle. Similarly, in relation to a sphere, the distance from the centre to any point on the sphere.
random sample	In statistics, a selection from a population where each sample of this size has an equal chance of being selected.
range	A measure of spread in statistics. The difference between the greatest value and the least value in a set of numerical data.
ratio	A part to part comparison. The ratio of *a* to *b* is usually written *a* : *b*. Example: In a recipe for pastry fat and flour are mixed in the ration 1 : 2 which means that the fat used has half the mass of the flour. In a unitary ratio a or b is 1.
rational number	A number that is an integer or that can be expressed as a fraction whose numerator and denominator are integers, and whose denominator is not zero. Examples: -1, $^{1}/_{3}$, $^{3}/_{5}$, 9, 235. Rational numbers, when expressed as decimals, are recurring decimals or finite (terminating) decimals. Numbers that are not rational are irrational. Irrational numbers include $\sqrt{5}$ and π which produce infinite, non-recurring decimals.
raw data	Data as they are collected, unprocessed.
real numbers	A number that is rational or irrational. Real numbers are those generally used in mathematics, science and everyday contexts. Numbers that are not imaginary, not connected with the square root of a negative number for instance.

reciprocal	The multiplicative inverse of any non-zero number. Example: $^1/_3$ is the reciprocal of 3. Any number multiplied by its reciprocal gives 1. Example $^1/_3$ x 3 = 1 (Division by zero is not defined and zero has no reciprocal.)
rectangle	A parallelogram with an interior angle of 90°. Opposite sides are equal. If adjacent sides are also equal the rectangle is a square. If adjacent sides are not equal, the rectangle is an oblong. Adjective: rectangular.
rectilinear	Bounded by straight lines. A closed rectilinear shape is also a polygon. A rectilinear shape can be divided into rectangles and triangles for the purpose of calculating its area.
recurring decimal	A decimal fraction with an infinitely repeating digit or group of digits. Example: The fraction $^1/_3$ is the decimal 0.33333 …, referred to as nought point three recurring and may be written as 0.3 (with a dot over the three). Where a block of numbers is repeated indefinitely, a dot is written over the first and last digit in the block e.g. $^1/_7$ = 0.˙142857˙
reduce (a fraction)	Divide the numerator and denominator by a common factor. To cancel a fraction. Example: divide the numerator and denominator by 5, to reduce $^5/_{15}$ to $^1/_3$, its simplest form.
reflection	In 2-D, a transformation of the whole plane involving a mirror line or axis of symmetry in the plane, such that the line segment joining a point to its image is perpendicular to the axis and has its midpoint on the axis. A 2-D reflection is specified by its mirror line.
reflection symmetry	At an elementary level, a 2-D shape has reflection symmetry about a line if an identical-looking object in the same position is produced by reflection in that line. Example:  In the shape ABCDEF, the mirror line runs through B and E. The part shape BCDE is a reflection of BAFE. Point A reflects onto C and F onto D. The mirror line is the perpendicular bisector of AC and of FD.
reflex angle	An angle that is greater than 180° but less than 360°.

regular	1. Describing a polygon, having all sides equal and all internal angles equal. 2. Describing a tessellation, using only one kind of regular polygon. Examples: squares, equilateral triangles and regular hexagons all produce regular tessellations.
relation, relationship	A common property of two or more items. An association between two or more items.
remainder	In the context of division requiring a whole number answer (quotient), the amount remaining after the operation. Example: 29 divided by 7 = 4 remainder 1.
repeated addition	The process of repeatedly adding the same number or amount. One model for multiplication. Example 5 + 5 + 5 + 5 = 5 x 4.
repeated subtraction	The process of repeatedly subtracting the same number or amount. One model for division. Example 35 - 5 - 5 - 5 - 5 - 5 - 5 - 5 = 0 so 35 ÷ 5 = 7 remainder 0.
resultant (of two or more vectors)	A vector that is equivalent to the vector sum of two or more vectors.
rhombus	A parallelogram with all sides equal.
RHS	Abbreviation for 'right angle, hypotenuse, side' describing one of the sets of conditions for congruence of two triangles.
right	Used as an adjective, right-angled or erect. Example: In a right cylinder the centre of one circular base lies directly over the centre of the other.
right angle	One quarter of a complete turn. An angle of 90 degrees. An acute angle is less than one right angle. An obtuse angle is greater than one right angle but less than two. A reflex angle is greater than two right angles.
rotation	In 2-D, a transformation of the whole plane which turns about a fixed point, the centre of rotation. A is specified by a centre and an (anticlockwise) angle.

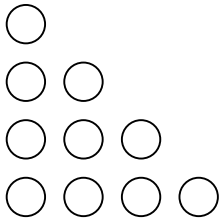
rotation symmetry	At an elementary level, a 2-D shape has rotation symmetry about a point if an identical-looking shape in the same position is produced by a rotation through some angle greater than 0° and less than 360° about that point. A 2-D shape with rotation symmetry has rotation symmetry of order *n* when *n* is the largest positive integer for which a rotation of $^{360°}/_{n}$ produces an identical-looking shape in the same position. A rotation of 360°, about any centre whatever, produces an identical-looking shape in the same position for all 2-D shapes including those without rotation symmetry. For this reason it is true, though not very informative, to say that the order of rotation symmetry is 1 for shapes that do not have rotation symmetry.
round (verb)	In the context of a number, express to a required degree of accuracy. Example: 543 rounded to the nearest 10 is 540.
row	A horizontal arrangement.
rule	Generally a procedure for carrying out a process. In the context of patterns and sequences a rule, expressed in words or algebraically, summarises the pattern or sequence and can be used to generate or extend it.
sample	A subset of a population. In handling data, a sample of observations may be made from which to draw inferences about a larger population.
scalar	When working with vectors, a quantity that is not a vector but a real number.
scalar multiple (of a vector)	The result of multiplying a non-zero vector by a scalar. The scalar multiple of vector **a** and scalar k has the direction of **a**, if k > 0, or a direction of –**a**, if k < 0. Its magnitude is $\|k\|\,\|\mathbf{a}\|$
scale	At an elementary level, a measuring device usually consisting of points on a line with equal intervals.
scale factor	For two similar geometric figures, the ratio of corresponding edge lengths.
scalene triangle	A triangle with no two sides equal and consequently no two angles equal.
scatter graph	A graph on which paired observations are plotted and which may indicate a relationship between the variables. Example: The heights of a number of people could be plotted against their arm span measurements. If height is roughly related to arm span, the points that are plotted will tend to lie along a line.

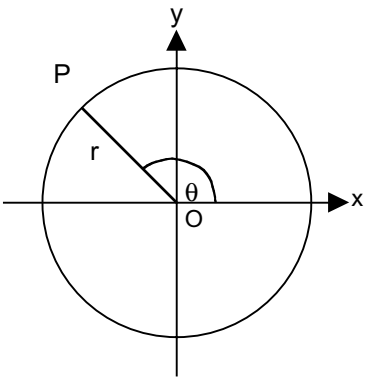
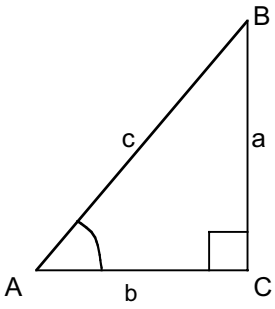
score	1. To earn points or goals in a competition. The running total of points or goals. 2. The number twenty.
second	1. A unit of time. One-sixtieth of a minute. 2. Ordinal number as in 'first, second, third, fourth …'.
section (plane section)	A plane geometrical configuration formed by cutting a solid figure with a plane. Example: A section of a cube could be a triangle, quadrilateral, pentagon or hexagon according to the direction of the plane cutting it.
sector	The region within a circle bounded by two radii and one of the arcs they cut off. Example:  The smaller of the two sectors is the minor sector and the larger one the major sector.
segment	The part of a line between two points. Within a circle, the region bound by an arc and the chord joining its two end points. Example:  The smaller of the two regions, is the minor segment and the larger is the major segment.
sequence	1. A succession of terms formed according to a rule. There is a definite relation between one term and the next and between each term and its position in the sequence. Example: 1, 4, 9, 16, 25 etc. 2. A calculation strategy.
set	A well-defined collection of objects (called members or elements).
set square	A drawing instrument for constructing parallel lines, perpendicular lines and certain angles. A set square may have angles *90°, 60°, 30°* or *90°, 45°, 45°*.
share (equally)	One model for the process of division.
short division	A compact written method of division. Example: $17\overline{)\,5\,2^{1}7}$ 3 1

side	A line segment that forms part of the boundary of a figure. Also edge.
sign	A symbol used to denote an operation. Examples: addition sign +, subtraction sign –, multiplication sign ×, division sign ÷, equals sign = etc. In the case of directed numbers, the positive + or negative – sign indicates the direction in which the number is located from the origin along the number line.
sign change key	The function key +/– of a calculator that changes a positive value to negative or vice versa.
significant figures	The run of digits in a number that are needed to specify the number to a required degree of accuracy. Additional zero digits may also be needed to indicate the number's magnitude. Examples: To the nearest thousand, the numbers 125 000, 2 376 000 and 22 000 have 3, 4 and 2 significant figures respectively; to 3 significant figures 98.765 is written 98.8
similar figures	A geometric figure is similar to another if it is congruent to an enlargement of the other. Any two squares are similar, as are any two circles.
simple fraction	A fraction where the numerator and denominator are both integers. Also known as common or vulgar fraction.
simplify (a fraction)	Reduce a fraction to its simplest form. See cancel and reduce (a fraction).
simultaneous equations	At an elementary level, two linear equations that apply simultaneously to given variables. The solution to the simultaneous equations is the pair of values for the variables that satisfies both equations. The graphical solution to simultaneous equations is a point where the lines representing the equations intersect.
sine	See trigonometric functions
sine rule	In trigonometry, a rule used to calculate the sides and angles of a triangle: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
soroban	A Japanese counting frame or abacus
sphere	A closed surface, in three-dimensional space, consisting of all the points that are a given distance from a fixed point, the centre. A hemi-sphere is a half-sphere. Adjective: spherical

square	1. A quadrilateral with four equal sides and four right angles. 2. The square of a number is the product of the number and itself. Example: the square of 5 is 25. This is written $5^2 = 25$ and read as five squared is equal to twenty-five. See also square number and square root.
square centimetre	Symbol: cm^2. A unit of area, a square measuring 1 cm by 1 cm. $10000\ cm^2 = 1\ m^2$
square metre	Symbol: m^2. A unit of area, a square measuring 1m by 1 m.
square millimetre	Symbol: mm^2. A unit of area, a square measuring 1 mm by 1 mm. One-hundredth part of a square centimetre and one-millionth part of a square metre.
square number	A number that can be expressed as the product of two equal numbers. Example 36 = 6 x 6 and so 36 is a square number. A square number can be represented by dots in a square array.
square root	A number whose square is equal to a given number. Example: one square root of 25 is 5 since $5^2 = 25$. The square root of 25 is recorded as $\sqrt{25} = 5$. However, as well as a positive square root, 25 has a negative square root, since $(-5)^2 = 25$.
standard index form	A form in which numbers are recorded as a number between 1 and 10 multiplied by a power of ten. Example: 193 in standard index form is recorded as 1.93×10^2.
standard unit	Uniform units that are agreed throughout a community. Example: the metre is a standard unit of length. Non-standard units such as the handspan are not widely agreed.
stem-and-leaf diagram	A format for displaying grouped data. Class intervals form the stem and all observations are listed in order against them, forming the leaves. Example: the numbers 29, 16, 18, 8, 4, 16, 27, 19, 13, 15 could be displayed as 0 | 4, 8 1 | 3, 5, 6, 6, 8, 9 2 | 7, 9 In this example, the class interval is the tens digit of the numbers. The diagram resembles a histogram on its side.
stratified sample	Where a population has been divided into strata based on common characteristics, a random sample drawn from each of the strata. Example: for the purposes of a school survey the pupils might be divided into age groups. The size of the sample drawn at random from each age group might be proportional to the relative sizes of the different age group for greater precision.

subtract	Carry out the process of subtraction
subtraction	The inverse operation to addition. Finding the difference when comparing magnitude. Take away.
subtraction by decomposition	A vertical method of subtraction. The number in the top line is broken down to aid calculation. Example: For 719 – 297 the calculation is written as $\begin{array}{r} {}^{6}\not{7}\,{}^{1}1\;9 \\ -\;2\;9\;7 \\ \hline 4\;2\;2 \end{array}$
sum	At an elementary level, the result of one or more additions.
surd	1. An irrational number expressed as the root of a natural number. Examples: $\sqrt[3]{2}$. 2. A numerical expression involving irrational roots. Example: $3 + 2\sqrt{7}$.
surface	A set of points defining a space in two or three dimensions.
symbol	A letter, numeral or other mark that represents a number, an operation or another mathematical idea. Example: L (Roman symbol for fifty), > (is greater than).
symmetry	A plane figure has symmetry if it is invariant under a reflection or rotation i.e. if the effect of the reflection or rotation is to produce an identical-looking figure in the same position. See also reflection symmetry, rotation symmetry. Adjective: symmetrical.
table	An orderly arrangement of information, numbers or letters usually in rows and columns.
take away	1. Subtract 2. Remove a number of items from a set.
tally	Make marks to represent objects counted.
tangent	1. A line that touches a curve at one point only. 2. See trigonometric function.

terminating decimal	A decimal fraction that has a finite number of digits. Example: 0.125 is a terminating decimal. In contrast 1/3 is a recurring decimal fraction. All terminating decimals can be expressed as fractions in which the denominator is a multiple of 2 or 5.
tetrahedron	A solid with four triangular faces. A regular tetrahedron has faces that are equilateral triangles. Plural: tetrahedra
theorem	A mathematical statement derived from premises and established by means of a proof.
time series	A set of observations, generally measurements or counts, taken over time usually at equally spaced intervals. Examples: annual birth rate for a country, mean monthly rainfall for a city. Time series are widely used in economics to predict future trends. To reduce the influence of short-term irregularities, a moving average may be used.
total	1. The aggregate. Example: the total population - all in the population. 2. The sum found by adding.
translation	A transformation in which every point of a body moves the same distance in the same direction. A transformation specified by a distance and direction (vector).
trapezium	A quadrilateral with exactly one pair of sides parallel.
tree diagram	A branching, decision diagram in which probabilities may be assigned to each branch and used to determine the probability of any outcome of combined or compound events.
triangle	A polygon with three sides. Adjective: triangular, having the form of a triangle.
triangular number	1. A number that can be represented by a triangular array of dots with the number of dots in each row from the base decreasing by one. Example:  The triangular number 10 represented as a triangular array of dots. 2. A number in the sequence 1, 1 + 2, 1 + 2 + 3, 1 + 2 + 3 + 4 etc. 55 is a triangular number since it can be expressed as, 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10.

trigonometric functions	Functions of angles. The main trigonometric functions are cosine, sine and tangent. Other functions are reciprocals of these.  The point P is taken with coordinates (x, y). The radius vector OP has length r. The angle θ is taken as the directed angle measured anticlockwise from the x – axis. The three main trigonometric functions are then defined in terms of r and the coordinates x and y. $\cos\theta = {}^{x}/_{r}$ $\sin\theta = {}^{y}/_{r}$ $\tan\theta = {}^{y}/_{x}$ The functions may be introduced as functions of angles in a right-angled triangle. Cosine, sine and tangent are defined as the ratios of sides in the triangle.  $\cos A = {}^{b}/_{c}$ $\sin A = {}^{a}/_{c}$ $\tan A = \frac{\sin A}{\cos A} = \frac{a}{b}$
uniform	Not changing. Remaining constant.
unit	One. A standard used in measuring. Example: a metre is a metric unit of length.
unit fraction	A fraction that has 1 as the numerator and whose denominator is a non-zero integer. Example: $^{1}/_{2}$, $^{1}/_{-3}$

unitary ratio	See ratio.
vector	A quantity that has magnitude and direction.
vertex	The point at which two or more lines intersect. Plural: vertices.
vertical	At right angles to the horizontal plane.
volume	A measure of three-dimensional space. Usually measured in cubes, units include cubic centimetres (cm^3) and cubic metres (m^3).
vulgar fraction	A fraction in which the numerator and denominator are both integers. Also known as common or simple fraction.
weight	The force exerted on an object possessing mass by the gravity of the earth, or any other gravitational body.
yard	Symbol: yd. An imperial measure of length. In relation to other imperial units of length, 1 yard = 3 feet = 36 inches. 1760yd. = 1 mile One yard is approximately 0.91 metres.
zero	1. Nought or nothing. 2. In a place value system, a place-holder. Example: 105. 3. The cardinal number of an empty set.