

Learning Objectives

Section 1: Working with integers

- To identify the correct operations required and use written calculations to solve worded problems
- To calculate with all four operations of arithmetic using positive and negative numbers
- To apply the hierarchy of operations to accurately work out calculations involving two or more operations
- To identify and write the inverses for operations and apply these to check the results of calculations and develop the skills required to solve equations

Section 2: Properties of integers

- To recall and understand key definitions
- To consolidate their understanding of basic place value
- To apply their knowledge of factors and primes to express a number as a product of its prime factors
- To simplify a collection of numbers that have been multiplied together by writing them in index form
- To use the 'listing method' to find the highest common factor and lowest common multiple of a set of numbers
- To use a prime factor tree to find the highest common factor and lowest common multiple of a set of numbers

Section 3: Working with fractions

- To apply knowledge of factors and multiples to simplify fractions and identify equivalent fractions
- To apply and explain an algorithm to find the median fraction
- To apply the four operations to fractions
- To apply knowledge of the four operations to solving problems involving fractions
- To calculate fractions of amounts
- To express one number as a fraction of another

Section 4: Working with decimals

- To apply knowledge of place value to convert decimals to fractions and order fractions
- To be able to add, subtract, multiply and divide decimals
- To use a calculator to complete more complicated calculations that involve decimals
- To be able to add, subtract, multiply and divide decimals without using a calculator
- To convert recurring decimals to fractions

Learning Objectives

Section 1: Basic Algebra

- To interpret and work with algebraic notation including an understanding of correct, formal language and notation
- To form algebraic expressions from worded instructions and geometric problems
- To simplify products and quotients and apply the index laws to simplify
- To simplify algebraic expressions by collecting like terms
- To simplify products and quotients
- To expand the product of a single term and binomial
- To factorise out common factors and recognise that the HCF must be factored out for an expression to be fully factorised
- To form expressions from word problems and use algebra to solve problems in different contexts including number problems

Section 2: Further algebra

- To know what a quadratic expression is
- To be able to expand the product of two binomials
- To be able to factorise expressions of the form $ax^2 + bx + c$
- To complete the square on a quadratic expression
- To simplify and manipulate algebraic fractions

Section 3: Equations

- To solve linear equations
- To understand that identities are equations for which there are an infinite number of solutions as they are true for all values x can take
- To form and solve quadratic equations
- To understand that different types of equations have a different possible number of solutions
- To solve linear simultaneous equations
- To solve linear and quadratic simultaneous equations
- To know how to read and interpret graphs in various contexts
- To be able to use graphs to find approximate solutions to equations
- To use iterative methods to find approximate solutions to equations
- To use equations and graphs to solve problems

Learning Objectives

Section 1: Properties of polygons and 3D objects

- To know the names and features of common polygons and polyhedrals
- To know how to describe and label common features (congruent, parallel, etc.) of plane figures
- To identify and describe line and rotational symmetry in plane figures
- To know and use properties of triangles, including their interior angle sum
- To know and use properties of quadrilaterals, including their interior angle sum
- To know and use properties of 3D solids

Section 2: Angles

- To recall knowledge of basic angle facts including: vertically opposite angles, angles on a line and angles around a point
- To apply basic and parallel angle facts to find the size of angles in various scenarios
- To recall knowledge of parallel line angle facts including: corresponding angles, alternate angles and co-interior angles
- To apply basic and parallel angle facts to find the size of angles in various scenarios
- To understand a proof for the sum of the interior angles of a triangle being 180 degrees
- To understand a proof for the exterior angle of a triangle being equal to the sum of the opposite interior angles
- To calculate the sum of the interior angles of any polygon
- To calculate the size of a single interior angle of a regular polygon
- To calculate the size of a single exterior angle of a regular polygon

Section 3: Perimeter

- To calculate the perimeter of a given simple shape, including the use of properties of triangles, quadrilaterals and regular polygons
- To understand that the perimeter of a shape is its boundary and what a boundary is for a composite shape where a smaller shape has been removed from the centre of a larger shape
- To calculate the perimeter of composite shapes
- To form expressions and equations for the perimeter of a given shape and solve these equations to find unknown lengths
- To know and use a formula (either $C = \pi D$ or $C = 2\pi r$) for the circumference of a circle to find the value of one variable given any other, e.g. D given C
- To be able to find the arc length of a given sector and hence the perimeter of this shape

Section 4: Area

- To know and use the formulae for calculating the area of rectangles, triangles, parallelograms and trapeziums
- To identify how composite shapes have been formed using these four shapes and use the formulae to calculate the total area of the composite shape

- To form algebraic expressions for the area of a shape given expressions for lengths of the shape
- To know and use the formula for calculating the area of a circle
- To adapt this formula to find the area of a sector given the angle formed at the centre between the radii using fractions of the whole
- To split composite shapes into the sum of known shapes from sections 1 and 2
- To recognise that the area of some composite shapes can be found by subtracting known areas from a larger shape
- To use known perimeter formulae from section 1 and 2 to solve contextual problems

Number 2

Estimated teaching time: 24 lessons

Learning Objectives

Section 1: Rounding and estimation

- To be able to round to the nearest positive integer power of ten and apply this to some real-life examples
- To round values to a specified number of decimal places
- To round values to a specified number of significant figures
- To truncate values and understand when this is useful to apply in context
- To apply the ability to round to one significant figure in order to estimate answers to more complex calculations without using a calculator
- To use inequalities and identify the lower and upper bounds for measurements and use these within calculations to find maximum and minimum solutions
- To calculate the upper and lower bounds of a calculation (for discrete and continuous quantities)

Section 2: Percentages

- To be able to convert between fractions, decimals and percentages
- To use fractions, multipliers or calculators to work out percentages of amounts
- To be able to express a quantity as a percentage of another
- To calculate percentage increase or decrease
- To calculate the original amount given the value after an increase or decrease

Section 3: Powers and roots

- To write a series of numbers multiplied together in index form
- To write an exponent on a calculator
- To understand zero and negative indices
- To apply the laws of indices for multiplying and dividing, and for powers of indices
- To work with fractional indices and understand the link to surds
- To estimate powers and roots of a number
- To solve problems involving powers and roots

Section 4: Standard Form

- To apply understanding of multiplying and dividing by powers of ten to convert numbers to and from standard form
- To use a scientific calculator efficiently for standard form calculations
- To apply the laws of indices to multiply and divide numbers in standard form without the use of a calculator
- To apply understanding of place value, and previously learned conversion between standard form and ordinary numbers, to add and subtract numbers in standard form
- To solve problems, including contextualised ones, involving standard form

Section 5: Surds

- To use a calculator to approximate the values of numbers involving surds
- To calculate exact solutions to problems using surds
- To simplify expressions containing surds
- To manipulate surds when multiplying and dividing
- To rationalise the denominator of a fraction
- To apply an understanding of surds to solve more complex problems

Algebra 2

Estimated teaching time: 21 lessons

Learning Objectives

Section 1: Functions and sequences

- To generate terms of a sequence from a term-to-term rule, a function and a position-to-term rule
- To generate terms of a sequence from a position-to-term rule
- To find the n th term of a linear sequence
- To use correct notation to write rules to find any term in a sequence
- To generate terms of a sequence from a function rule
- To interpret expressions as functions with inputs and outputs
- To find the inverse of a function
- To identify special sequences
- To find the n th term of linear sequences
- To find the n th term of quadratic sequences

Section 2: Formulae

- To write formulae to represent real life contexts
- To substitute numerical values into formulae
- To use formulae from the topic of kinematics
- To rearrange formulae to change the subject
- To work with formulae in a variety of contexts

Section 3: Inequalities

- To understand and interpret inequalities and use the correct symbols to express inequalities
- To use a number line and set notation to represent an inequality
- To solve linear inequalities in one variable and represent the solution set on a number line and in set notation
- To solve quadratic inequalities
- To solve (several) linear inequalities in two variables and represent the solution set on a graph

Geometry 2

Estimated teaching time: 13 lessons

Learning Objectives

Section 1: 3D objects

- To apply what you already know about the properties of 3D objects
- To work with 2D representations of 3D objects
- To construct and interpret plans and elevations of 3D objects

Section 2: Units and measure

- To convert metric units for capacity, mass and length
- To convert metric units of area and volume
- To understand units of time are not metric
- To convert units of time and solve related problems
- To convert currencies using scale factors
- To convert compound measurements
- To use formulae: $\text{speed} = \text{distance}/\text{time}$, $\text{density} = \text{mass}/\text{volume}$, $\text{pressure} = \text{force}/\text{area}$, to find any one of the variables given values for the other two
- To read and use scales on maps including both line/bar scales and ratio scales
- To form scales to construct scale drawings to fit a given dimension
- To read and use bearings in scale drawings
- To understand the connection between a bearing of B from A and A from B on a given line segment

Section 3: Volume and surface area

- To calculate the volume of prisms (including cylinders)
- To calculate the surface area of prisms (including cylinders)
- To calculate the volume and surface area of a cone
- To calculate the volume and surface area of a sphere
- To calculate the volume and surface area of composite 3D shapes
- To find the volume and surface area of a pyramid

Probability

Estimated teaching time: 7 lessons

Learning Objectives

Section 1: Basic probability

- To understand and use the vocabulary of probability
- To express probabilities as a number between 0 (impossible) and 1 (certain), either as a decimal, fraction or percentage
- To relate relative frequency to theoretical probability
- To represent and analyse outcomes of probability experiments
- To calculate the probability of an event NOT happening
- To understand that the probabilities of mutually exclusive events sum to 1
- To use tables and frequency trees to organise outcomes, understanding that a frequency tree is not the same as a probability tree
- To calculate probabilities in different contexts

Section 2: Further probability

- To construct and use representations (tables, tree diagrams and Venn diagrams)
- To use the language and notation of basic set theory
- To use the addition rule, including an understanding of mutually exclusive events
- To use the multiplication rule, including an understanding of independent events
- Calculate numbers of possible outcomes using the product rule for counting
- To use methods of conditional probability, including questions phrased in the form 'given that'

Statistics

Estimated teaching time: 12 lessons

Learning Objectives

Section 1: Collecting, interpreting and representing data

- To be able to infer properties of populations or distributions from a sample, while knowing the limitations of sampling

- To be able to interpret and construct tables, charts and diagrams, including frequency tables and bar charts
- To be able to draw and interpret pie charts and pictograms for categorical data and vertical line charts for ungrouped, discrete numerical data
- To be able to draw and interpret histograms and cumulative frequency diagrams for continuous data and know their appropriate use
- To use tables and line graphs for time series data

Section 2: Analysing data

- To calculate summary statistics from raw and grouped data
- To compare two or more sets of data
- To estimate quartiles from a cumulative frequency diagram
- To identify why a graph may be misleading
- To construct scatter diagrams
- To describe correlation
- To draw a line of best fit
- To identify outliers

Ratio and Proportion

Estimated teaching time: 13 lessons

Learning Objectives

Section 1: Ratio

- To use ratio notation to write ratios for diagrams and word statements and to simplify ratios
- To divide a quantity into two or more parts given a specified ratio and to write the division of quantities into parts as a ratio
- To use a unitary method to solve ratio and proportion problems and relate ratios to fractions and linear functions in order to solve problems, including real-life ones such as conversions and scaling

Section 2: Proportion

- To use direct proportion to solve problems
- To use the unitary method to solve proportion problems
- To solve direct proportion questions graphically
- To solve direct proportion questions using algebraic manipulation
- To solve direct proportion problems involving the square or square root of a variable
- To solve inverse proportion questions, based on $y = 1/x$

Section 3: Growth and decay

- To calculate with simple growth, such as simple interest rates

- To calculate with compound growth, such as compound interest rates
- To solve word problems using simple and/or compound growth
- To use the formula $y = a(1 + r)^n$ for compound growth
- To calculate with simple decay
- To calculate with compound decay, such as depreciation
- To solve word problems using simple and/or compound decay
- To use the formula $y = a(1 - r)^n$ for compound decay

Algebra 3

Estimated teaching time: 28 lessons

Learning Objectives

Section 1: Graphs of linear functions

- To use a table of values to plot graphs of linear functions
- To identify the main features of straight-line graphs and use them to sketch graphs
- To sketch graphs from linear equations in the form of $y = mx + c$
- To find the equation of a straight line using gradient and points on the line
- To find the equation of a tangent that touches a circle centred on the origin
- To solve problems involving straight-line graphs

Section 2: Interpreting graphs

- To use a table of values to plot graphs of linear functions
- To identify the main features of straight-line graphs and use them to sketch graphs
- To sketch graphs from linear equations in the form of $y = mx + c$
- To find the equation of a straight line using gradient and points on the line
- To find the equation of a tangent that touches a circle centred on the origin
- To solve problems involving straight-line graphs

Section 3: Graphs of other functions and equations

- To work fluently with equations of straight-line graphs
- To identify and plot graphs of quadratic functions i.e. parabolas
- To find roots of quadratic equations from the x-intercept of the parabola of the quadratic equation that defines the graph
- To know the features of graphs of quadratic equations
- To sketch parabolas
- To work fluently with cubic polynomials and their graphs

- To sketch cubic graphs
- To work fluently to calculate reciprocals of numbers and plot functions involving reciprocals
- To identify hyperbolas and match them to their equations
- To plot and sketch graphs from given functions
- To recognise linear, quadratic and reciprocal graphs
- To identify and plot exponential graphs
- To identify and plot trigonometric graphs
- To represent a circle given its centre on the origin and radius r by a function
- To identify equations of circles from their graphs

Section 4: Transformations of curves

- To know the features of a quadratic function (parabola): axis of symmetry, roots and vertex, and identify these features from the sketch of a quadratic
- To sketch vertical translations of quadratic functions
- To sketch horizontal translations of quadratic functions
- To sketch quadratic functions that have been translated in both the horizontal and vertical directions
- To know the effect translations have on the axis of symmetry and vertex of a quadratic
- To use graph sketching to identify the effect of multiplying $f(x)$ by -1
- To use algebraic manipulation skills to identify the features above and sketch any quadratic of the form $y = ax^2 + bx + c$
- To identify reflections and translations in the graphical representations of trigonometric functions
- To sketch a transformed trigonometric curve for a given domain
- To sketch translations and reflections of cubic, reciprocal and exponential functions
- To apply transformations learnt in this chapter to a variety of problems including identifying the effect of a transformation on a feature of a graph and finding the equation of a function once a transformation has been applied

Circles

Estimated teaching time: 9 lessons

Learning Objectives

Section 1: Circles

- To review the names of parts of a circle
- To label angles correctly and refer to angles in a diagram involving a circle
- To learn how to prove the following circle theorems:
 - Angles subtended at the centre and at the circumference
 - Angles in a semicircle
 - Angles in the same segment

- Angle between a radius and a chord
- Angle between a radius and a tangent
- Two tangent theorem
- Alternate segment theorem
- Angles in a cyclic quadrilateral
- To use the circle theorem
- To construct geometric 'proofs' using the circle theorems

Geometry 3 (32, 33, 34, 35, 36) Estimated teaching time: 30 lessons

Learning Objectives

Section 1: Vector geometry

- To represent vectors as a diagram or a column vector
- To add and subtract vectors
- To multiply vectors by a scalar
- To recognise parallel vectors
- To use vectors to construct geometric arguments and proofs

Section 2: Transformations in a plane

- To carry out, identify and describe reflections
- To carry out, identify and describe translations using 2D vectors
- To carry out, identify and describe rotations
- To find the centre of rotation by construction
- To carry out, identify and describe combined transformations

Section 3: Construction and loci

- To use ruler, protractor and pair of compasses to accurately construct angles and shapes
- To accurately copy diagrams using rulers and a pair of compasses only
- To construct the perpendicular bisector of a line
- To construct the perpendicular at a given point on a line
- To construct a perpendicular from a given point to a line
- To bisect an angle
- To use constructions to solve loci problems
- To apply appropriate constructions and loci knowledge to a variety of problems including those set in context

Section 4: Similarity

- To know what is meant by the phrase 'mathematically similar'
- To determine when two objects are mathematically similar
- To know what is meant by a 'mathematical enlargement'
- To enlarge a shape given a positive rational scale factor
- To know what the centre of enlargement is
- To enlarge a shape given a scale factor and centre of enlargement
- To determine a given centre of enlargement and scale factor from a diagram
- To enlarge a shape given a negative rational scale factor
- To determine similar polygons
- To determine similar 3D shapes
- To know the relationship between lengths, areas and volumes of similar shapes

Section 5: Congruence

- To know what it means for two objects to be congruent
- To know the conditions for which congruence for a pair of triangle is then implied:
 - o SSS – three sides are the same in both triangles
 - o ASA – two angles and one side length are the same in both triangles
 - o SAS – two sides and the angle between them are the same in both triangle
 - o RHS – the hypotenuse and another side of a right-angled triangle are the same in both triangles
- To apply the conditions for congruency to a variety of situations

Geometry 4

Estimated teaching time: 19 lessons

Learning Objectives

Section 1: Pythagoras' theorem

- To know and use Pythagoras' theorem to find any missing length in a right-angled triangle
- To use Pythagoras' theorem to show whether a triangle is right-angled or not
- To apply Pythagoras' theorem to 2D problems
- To apply Pythagoras' theorem to 3D problems
- To link Pythagoras' theorem to real-life skills for industry

Section 2: Trigonometry

- To use the trigonometric ratios given by the sine, cosine and tangent functions to find unknown lengths and angles in 2D right-angled triangles
- To know the exact ratios given by sine and cosine of 0, 30, 45, 60 and 90 degrees and the exact ratios given by the tangent function for 0, 30, 45 and 60 degrees
- To use the sine, cosine and area rules to solve problems relating to unknown sides, angles and areas in non-right-angled triangles
- To know the difference between an angle of depression and an angle of elevation
- To identify when the trigonometric ratios must be used instead of Pythagoras' theorem to solve 2D problems relating to right-angled triangles, including contextual problems