Stage 9

Thinking and Working Mathematically

- **TWM.01** Specialising

- **TWM.02** Generalising

- **TWM.03** Conjecturing

- **TWM.04** Convincing

- **TWM.05** Characterising

- **TWM.06** Classifying

- **TWM.07** Critiquing

- **TWM.08** Improving

Number

Integers, powers and roots

- **9Ni.01** Understand the difference between rational and irrational numbers.

- **9Ni.02** Use positive, negative and zero indices, and the index laws for multiplication and division.

- **9Ni.03** Understand the standard form for representing large and small numbers.

- **9Ni.04** Use knowledge of square and cube roots to estimate surds.

Place value, ordering and rounding

- **9Np.01** Multiply and divide integers and decimals by 10 to the power of any positive or negative number.

- **9Np.02** Understand that when a number is rounded there are upper and lower limits for the original number.

Fractions, decimals, percentages, ratio and proportion

- **9Nf.01** Deduce whether fractions will have recurring or terminating decimal equivalents.

- **9Nf.02** Estimate, add and subtract proper and improper fractions, and mixed numbers, using the order of operations.

- **9Nf.03** Estimate, multiply and divide fractions, interpret division as a multiplicative inverse, and cancel common factors before multiplying or dividing.

- **9Nf.04** Use knowledge of the laws of arithmetic, inverse operations, equivalence and order of operations (brackets and indices) to simplify calculations containing decimals and fractions.

- **9Nf.05** Understand compound percentages.

- **9Nf.06** Estimate, multiply and divide decimals by integers and decimals.

- **9Nf.07** Understand the relationship between two quantities when they are in direct or inverse proportion.

- **9Nf.08** Use knowledge of ratios and equivalence for a range of contexts.

Algebra

Expressions, equations and formulae

- **9Ae.01** Understand that the laws of arithmetic and order of operations apply to algebraic terms and expressions (four operations and integer powers).

- **9Ae.02** Understand how to manipulate algebraic expressions including:
  - expanding the product of two algebraic expressions
  - applying the laws of indices
  - simplifying algebraic fractions.

- **9Ae.03** Understand that a situation can be represented either in words or as an algebraic expression, and move between the two representations (including squares, cubes and roots).

- **9Ae.04** Understand that a situation can be represented either in words or as a formula (including squares and cubes), and manipulate using knowledge of inverse operations to change the subject of a formula.

- **9Ae.05** Understand that a situation can be represented either in words or as an equation. Move between the two representations and solve the equation (including those with an unknown in the denominator).

- **9Ae.06** Understand that the solution of simultaneous linear equations:
  - is the pair of values that satisfy both equations
  - can be found algebraically (eliminating one variable)
  - can be found graphically (point of intersection).

- **9Ae.07** Understand that a situation can be represented either in words or as an inequality. Move between the two representations and solve linear inequalities.

Sequences, functions and graphs

- **9As.01** Generate linear and quadratic sequences from numerical patterns and from a given term-to-term rule (any indices).

- **9As.02** Understand and describe nth term rules algebraically (in the form $an \pm b$, where a and b are positive or negative integers or fractions, and in the form $\frac{n}{a}$, n^2, n^3 or $n^2 \pm a$, where a is a whole number).

- **9As.03** Understand that a function is a relationship where each input has a single output. Generate outputs from a given function and identify inputs from a given output by considering inverse operations (including indices).

- **9As.04** Understand that a situation can be represented either in words or as a linear function in two variables (of the form $y = mx + c$ or $ax + by = c$), and move between the two representations.

- **9As.05** Use knowledge of coordinate pairs to construct tables of values and plot the graphs of linear functions, including where y is given implicitly in terms of x ($ax + by = c$), and quadratic functions of the form $y = x^2 \pm a$.

- **9As.06** Understand that straight-line graphs can be represented by equations. Find the equation in the form $y = mx + c$ or where y is given implicitly in terms of x (fractional, positive and negative gradients).

- **9As.07** Read, draw and interpret graphs and use compound measures to compare graphs.

Geometry and Measure

Geometrical reasoning, shapes and measurements

- **9Gg.01** Know and use the formulae for the area and circumference of a circle.

- **9Gg.02** Know and recognise very small or very large units of length, capacity and mass.

- **9Gg.03** Estimate and calculate areas of compound 2D shapes made from rectangles, triangles and circles.

- **9Gg.04** Use knowledge of area and volume to derive the formula for the volume of prisms and cylinders. Use the formula to calculate the volume of prisms and cylinders.

- **9Gg.05** Use knowledge of area, and properties of cubes, cuboids, triangular prisms, pyramids and cylinders to calculate their surface area.

- **9Gg.06** Identify reflective symmetry in 3D shapes.

- **9Gg.07** Derive and use the formula for the sum of the interior angles of any polygon.

- **9Gg.08** Know that the sum of the exterior angles of any polygon is 360°.

- **9Gg.09** Use properties of angles, parallel and intersecting lines, triangles and quadrilaterals to calculate missing angles.

- **9Gg.10** Know and use Pythagoras' theorem.

- **9Gg.11** Construct 60°, 45° and 30° angles and regular polygons.

Position and transformation

- **9Gp.01** Use knowledge of bearings and scaling to interpret position on maps and plans.

- **9Gp.02** Use knowledge of coordinates to find points on a line segment.

- **9Gp.03** Transform points and 2D shapes by combinations of reflections, translations and rotations.

- **9Gp.04** Identify and describe a transformation (reflections, translations, rotations and combinations of these) given an object and its image.

- **9Gp.05** Recognise and explain that after any combination of reflections, translations and rotations the image is congruent to the object.

- **9Gp.06** Enlarge 2D shapes, from a centre of enlargement (outside, on or inside the shape) with a positive integer scale factor. Identify an enlargement, centre of enlargement and scale factor.

- **9Gp.07** Analyse and describe changes in perimeter and area of squares and rectangles when side lengths are enlarged by a positive integer scale factor.

Statistics and Probability

Statistics

- **9Ss.01** Select, trial and justify data collection and sampling methods to investigate predictions for a set of related statistical questions, considering what data to collect, and the appropriateness of each type (qualitative or quantitative; categorical, discrete or continuous).

- **9Ss.02** Explain potential issues and sources of bias with data collection and sampling methods, identifying further questions to ask.

- **9Ss.03** Record, organise and represent categorical, discrete and continuous data. Choose and explain which representation to use in a given situation:
  - Venn and Carroll diagrams
  - tally charts, frequency tables and two-way tables
  - dual and compound bar charts
  - pie charts
  - line graphs, time series graphs and frequency polygons
  - scatter graphs
  - stem-and-leaf and back-to-back stem-and-leaf diagrams
  - infographics.

- **9Ss.04** Use mode, median, mean and range to compare two distributions, including grouped data.

- **9Ss.05** Interpret data, identifying patterns, trends and relationships, within and between data sets, to answer statistical questions. Make informal inferences and generalisations, identifying wrong or misleading information.

Probability

- **9Sp.01** Understand that the probability of multiple mutually exclusive events can be found by summation and all mutually exclusive events have a total probability of 1.

- **9Sp.02** Identify when successive and combined events are independent and when they are not.

- **9Sp.03** Understand how to find the theoretical probabilities of combined events.

- **9Sp.04** Design and conduct chance experiments or simulations, using small and large numbers of trials. Calculate the expected frequency of occurrences and compare with observed outcomes.