Stage 9

N Number

Ni Integers, powers and roots

- **9Ni1** Add, subtract, multiply and divide directed numbers
- **9Ni2** Estimate square roots and cube roots
- **9Ni3** Use positive, negative and zero indices and the index laws for multiplication and division of positive integer powers

Np Place value, ordering and rounding

- **9Np1** Recognise the equivalence of 0.1, $\frac{1}{10}$ and 10^{-1}; multiply and divide whole numbers and decimals by 10 to the power of any positive or negative integer
- **9Np2** Round numbers to a given number of decimal places or significant figures; use to give solutions to problems with an appropriate degree of accuracy
- **9Np3** Use the order of operations, including brackets and powers

Nf Fractions, decimals, percentages, ratio and proportion

- **9Nf1** Consolidate writing a fraction in its simplest form by cancelling common factors
- **9Nf2** Add, subtract, multiply and divide fractions, interpreting division as a multiplicative inverse, and cancelling common factors before multiplying or dividing
- **9Nf3** Solve problems involving percentage changes, choosing the correct numbers to take as 100% or as a whole, including simple problems involving personal or household finance, e.g. simple interest, discount, profit, loss and tax
- **9Nf4** Recognise when fractions or percentages are needed to compare different quantities
- **9Nf5** Compare two ratios; interpret and use ratio in a range of contexts
- **9Nf6** Recognise when two quantities are directly proportional; solve problems involving proportionality, e.g. converting between different currencies

Nc Calculation

Mental strategies

- **9Nc1** Extend mental methods of calculation, working with decimals, fractions, percentages and factors, using jottings where appropriate
- **9Nc2** Solve word problems mentally
- **9Nc3** Consolidate use of the rules of arithmetic and inverse operations to simplify calculations

Multiplication and division

- **9Nc4** Multiply by decimals, understanding where to position the decimal point by considering equivalent calculations; divide by decimals by transforming to division by an integer
- **9Nc5** Recognise the effects of multiplying and dividing by numbers between 0 and 1

A Algebra

Ae Expressions, equations and formulae

- **9Ae1** Know the origins of the word *algebra* and its links to the work of the Arab mathematician Al'Khwarizmi
- **9Ae2** Use index notation for positive integer powers; apply the index laws for multiplication and division to simple algebraic expressions
- **9Ae3** Construct algebraic expressions
- **9Ae4** Simplify or transform algebraic expressions by taking out single-term common factors
- **9Ae5** Add and subtract simple algebraic fractions
- **9Ae6** Derive formulae and, in simple cases, change the subject; use formulae from mathematics and other subjects
- **9Ae7** Substitute positive and negative numbers into expressions and formulae
- **9Ae8** Construct and solve linear equations with integer coefficients (with and without brackets, negative signs anywhere in the equation, positive or negative solution); solve a number problem by constructing and solving a linear equation
- **9Ae9** Solve a simple pair of simultaneous linear equations by eliminating one variable
- **9Ae10** Expand the product of two linear expressions of the form $x \pm n$ and simplify the corresponding quadratic expression
- **9Ae11** Understand and use inequality signs ($<$, $>$, $\leqslant$, $\geqslant$); construct and solve linear inequalities in one variable; represent the solution set on a number line

As Sequences, functions and graphs

- **9As1** Generate terms of a sequence using term-to-term and position-to-term rules
- **9As2** Derive an expression to describe the nth term of an arithmetic sequence
- **9As3** Find the inverse of a linear function
- **9As4** Construct tables of values and plot the graphs of linear functions, where y is given implicitly in terms of x, rearranging the equation into the form $y = mx + c$; know the significance of m and find the gradient of a straight line graph
- **9As5** Find the approximate solutions of a simple pair of simultaneous linear equations by finding the point of intersection of their graphs
- **9As6** Use systematic trial and improvement methods to find approximate solutions of equations such as $x^2 + 2x = 20$ (1, 2 and 7)
- **9As7** Construct functions arising from real-life problems; draw and interpret their graphs
- **9As8** Use algebraic methods to solve problems involving direct proportion, relating solutions to graphs of the equations

G Geometry

Gs Shapes and geometric reasoning

- **9Gs1** Calculate the interior or exterior angle of any regular polygon; prove and use the formula for the sum of the interior angles of any polygon; prove that the sum of the exterior angles of any polygon is 360°
- **9Gs2** Solve problems using properties of angles, of parallel and intersecting lines, and of triangles, other polygons and circles, justifying inferences and explaining reasoning with diagrams and text
- **9Gs3** Draw 3D shapes on isometric paper
- **9Gs4** Analyse 3D shapes through plans and elevations
- **9Gs5** Identify reflection symmetry in 3D shapes
- **9Gs6** Use a straight edge and compasses to:
  - construct the perpendicular from a point to a line and the perpendicular from a point on a line
  - inscribe squares, equilateral triangles, and regular hexagons and octagons by constructing equal divisions of a circle
- **9Gs7** Know and use Pythagoras' theorem to solve two-dimensional problems involving right-angled triangles

Gp Position and movement

- **9Gp1** Tessellate triangles and quadrilaterals and relate to angle sums and half-turn rotations; know which regular polygons tessellate, and explain why others will not
- **9Gp2** Use the coordinate grid to solve problems involving translations, rotations, reflections and enlargements
- **9Gp3** Transform 2D shapes by combinations of rotations, reflections and translations; describe the transformation that maps an object onto its image
- **9Gp4** Enlarge 2D shapes, given a centre and positive integer scale factor; identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments
- **9Gp5** Recognise that translations, rotations and reflections preserve length and angle, and map objects on to congruent images, and that enlargements preserve angle but not length
- **9Gp6** Know what is needed to give a precise description of a reflection, rotation, translation or enlargement
- **9Gp7** Use bearings (angles measured clockwise from the north) to solve problems involving distance and direction
- **9Gp8** Make and use scale drawings and interpret maps
- **9Gp9** Find by reasoning the locus of a point that moves at a given distance from a fixed point, or at a given distance from a fixed straight line

G Measure

Gl Length, mass and capacity

9Gl1
- **9Ml1** Solve problems involving measurements in a variety of contexts

Gt Time and rates of change

9Gt1
- **9Mt1** Solve problems involving average speed

9Gt2
- **9Mt2** Use compound measures to make comparisons in real-life contexts, e.g. travel graphs and value for money

Ga Area, perimeter and volume

9Ga1
- **9Ma1** Convert between metric units of area, e.g. mm^2 and cm^2, cm^2 and m^2 and volume, e.g. mm^3 and cm^3, cm^3 and m^3; know and use the relationship 1 cm^3 = 1 ml

9Ga2
- **9Ma2** Know that land area is measured in hectares (ha), and that 1 hectare = 10 000 m^2; convert between hectares and square metres

9Ga3
- **9Ma3** Solve problems involving the circumference and area of circles, including by using the π key of a calculator

9Ga4
- **9Ma4** Calculate lengths, surface areas and volumes in right-angled prisms and cylinders

D Handling data

Dc Planning and collecting data

- **9Dc1** Suggest a question to explore using statistical methods; identify the sets of data needed, how to collect them, sample sizes and degree of accuracy
- **9Dc2** Identify primary or secondary sources of suitable data
- **9Dc3** Design, trial and refine data collection sheets
- **9Dc4** Collect and tabulate discrete and continuous data, choosing suitable equal class intervals where appropriate

Dp Processing and presenting data

- **9Dp1** Calculate statistics and select those most appropriate to the problem
- **9Dp2** Select, draw, and interpret diagrams and graphs, including:
  - frequency diagrams for discrete and continuous data
  - line graphs for time series
  - scatter graphs to develop understanding of correlation
  - back to back stem-and-leaf diagrams

Di Interpreting and discussing results

- **9Di1** Interpret tables, graphs and diagrams and make inferences to support or cast doubt on initial conjectures; have a basic understanding of correlation
- **9Di2** Compare two or more distributions; make inferences, using the shape of the distributions and appropriate statistics
- **9Di3** Relate results and conclusions to the original question

Db Probability

- **9Db1** Know that the sum of probabilities of all mutually exclusive outcomes is 1 and use this when solving probability problems
- **9Db2** Find and record all outcomes for two successive events in a sample space diagram
- **9Db3** Understand relative frequency as an estimate of probability and use this to compare outcomes of experiments in a range of contexts

Problem solving

Using techniques and skills in solving mathematical problems

- **9Pt1** Calculate accurately, choosing operations and mental or written methods appropriate to the numbers and context
- **9Pt2** Manipulate numbers, algebraic expressions and equations, and apply routine algorithms
- **9Pt3** Understand everyday systems of measurement and use them to estimate, measure and calculate
- **9Pt4** Recognise and use spatial relationships in two dimensions and three dimensions
- **9Pt5** Draw accurate mathematical diagrams, graphs and constructions
- **9Pt6** Decide how to check results, by:
  - using rounding to estimate numbers to one significant figure and calculating mentally then comparing with the estimate
  - considering whether an answer is reasonable in the context of the problem
  - using inverse operations
- **9Pt7** Estimate, approximate and check their working. Solve a range of word problems involving single or multi-step calculations

Using understanding and strategies in solving problems

- **9Ps1** Identify, organise, represent and interpret information accurately in written, tabular, graphical and diagrammatic forms
- **9Ps2** Explore the effect of varying values in order to generalise
- **9Ps3** Find a counter-example to show that a conjecture is not true
- **9Ps4** Present concise, reasoned arguments to justify solutions or generalisations using symbols, diagrams or graphs and related explanations
- **9Ps5** Recognise the impact of constraints or assumptions
- **9Ps6** Recognise connections with similar situations and outcomes
- **9Ps7** Consider and evaluate the efficiency of alternative strategies and approaches and refine solutions in the light of these

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