

Key stage 3 - Introduction

Through the mathematics content, pupils should be taught to:

Develop fluency
consolidate their numerical and mathematical capability from key stage 2
apply appropriate calculation strategies and degrees of accuracy to increasingly complex problems
extend their understanding of the number system to include all fractions and surds calculate with fractions and surds as exact numbers
use algebra to generalise arithmetic and to formulate mathematical relationships
substitute values in expressions, rearrange and simplify expressions, and solve equations
move fluently between different representations such as algebra, graphs and diagrams
develop algebraic and graphical fluency and understand linear and quadratic functions
interpret relations algebraically and graphically
use language and properties precisely, such as with 2D and 3D shapes, algebraic expressions, probability and statistics
Reason mathematically
extend their understanding of the number system, make connections between number relationships, and their algebraic and graphical representations
extend and formalise their knowledge of ratio and proportion in working with measures and geometry, and in formulating proportional relations algebraically
identify variables and express relations between them algebraically and graphically
establish when to use additive, multiplicative or proportional reasoning from the underlying structure of a problem when working numerically
begin to reason deductively in geometry
develop reasoning in different areas of mathematics and begin to express their arguments formally
Solve problems
develop their mathematical knowledge, in part through solving problems and evaluating the outcomes
develop their use of formal mathematical knowledge to solve and devise problems, including in financial mathematics
begin to model situations mathematically and express the results using a range of formal mathematical representations
apply elementary knowledge to multi-step and increasingly sophisticated problems
select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems.

Subject content

	R	A	G
Number			
Pupils should be taught to:			
use place value, including for decimals, measures and for any size of integers; the language of larger and smaller numbers; and ordering numbers, including the correct use of =, ≠, <, >, ≤, ≥			
use the four operations, including formal written methods, applied to integers, decimal fractions, simple fractions (proper and improper) and mixed numbers, all both positive and negative			
understand and use conventional notation for the priority of operations, including brackets, powers, roots and reciprocals			
understand the relation between operations and their inverses and identify the inverse of a given operation where this exists			
know and use integer powers and associated roots (square, cube and higher), including the use of surd notation (e.g. $\sqrt{8}$), and distinguish between exact representations of surds and their decimal approximations			
interpret and compare numbers in standard form $A \times 10^n$ $1 \leq A < 10$, where n is a positive or negative integer			
compare, order and convert between fractions and decimals			
interpret percentages and percentage changes as a fraction or a decimal, and calculate these multiplicatively			
use mass, length, time, money and other measures, including with decimal quantities			
use a calculator and other technologies to calculate results accurately and then interpret them appropriately			
estimate number, measures and approximate answers, including using these to check other calculation methods			
round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures), including simple error intervals, using standard interval and inequality notation $a < x \leq b$, and standard notation for open and closed intervals $x \in (a, b]$			
use prime numbers, common factors and common multiples for whole numbers with two and three digits, including highest common factor and lowest common multiple, understanding these as the intersection and union of the prime factors, and other classifications of number, including product notation			
understand the infinite nature of the sets of integers, real and rational numbers			
interpret the number line as a model of the structure of the real number system, including such ideas as infinite divisibility.			

	R	A	G
Algebra: expressing relationships			
Pupils should be taught to:			
read and interpret algebraic notation			
understand and use the concepts and vocabulary of terms, expressions and factors			
express known relations, including spatial generalisations, algebraically using accurate notation, including prioritisation of operations			
manipulate algebraic expressions to maintain equivalence, including expanding products of binomials, factorising by taking out a common factor, collecting like terms and simplifying expressions			
recognise an arithmetic progression, and find the nth term			
make and test conjectures about recursive and long-term behaviour of geometric and other sequences that arise within and outside mathematics			
recognise, sketch and produce graphs of linear and quadratic functions of one variable with appropriate scaling, using equations in x and y and the cartesian plane			
interpret mathematical relationships both algebraically and graphically.			
	R	A	G
Algebra: using equations and functions			
Pupils should be taught to:			
use formulae by substitution to calculate the value of a variable, including for scientific formulae			
begin to model simple contextual and subject-based problems algebraically			
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calculate and interpret gradients and intercepts of linear functions numerically, graphically and algebraically, using $y=mx+c$.			
use linear and quadratic graphs to estimate values of y for given values of x and vice versa and approximate solutions of simultaneous equations			
use given graphs of a variety of functions, including piece-wise linear, exponential and reciprocal graphs, to find approximate solutions to contextual problems.			
	R	A	G
Ratio, proportion and rates of change			
Pupils should be taught to:			
use ratio and scale factor notation and methods involving conversion, mixing, measuring, scaling, comparing quantities and concentrations			
calculate missing quantities and totals using given ratios, including reduction to simplest form			
solve problems involving percentage change, including: percentage increase and decrease and original value problems, simple interest in financial mathematics and repeated growth			
use multiplicative reasoning where two quantities have a fixed product or fixed ratio including graphical, and algebraic representations			
use compound units such as speed, unit pricing and density to solve problems			
solve kinematic problems involving constant speed.			

	R	A	G
Geometry and measures			
Pupils should be taught to:			
solve problems involving perimeter and area of triangles, circles and composite shapes; and cross-sectional areas, surface area and volume of cubes, cuboids, prisms, cylinders and composite solids			
use concrete and digital instruments to measure line segments and angles in geometric figures, including interpreting scale drawings			
describe, sketch and draw using conventional terms and notations: points; lines; parallel lines; perpendicular lines; right angles; regular polygons; reflectively and rotationally symmetric polygons; and irregular polygons			
derive and illustrate properties of triangles, quadrilaterals, circles, and other plane figures (e.g. equal lengths and angles) using appropriate language and technologies			
identify and construct congruent triangles, and construct similar shapes by enlargement, including on coordinate grids			
solve problems involving spatial properties on coordinate grids			
know and use angle relations in parallel lines to deduce unknown angles			
apply angle facts, triangle congruence, similarity and properties of named quadrilaterals to conjecture and derive results about angles and sides, using transformational, axiomatic and property-based deductive reasoning			
use Pythagoras' Theorem and side ratios in similar triangles to solve problems in right-angled triangles			
identify properties of the faces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres			
interpret mathematical relationships both algebraically and geometrically.			
	R	A	G
Probability			
Pupils should be taught to:			
record and describe the frequency of outcomes of simple probability experiments involving randomness, fairness, equally and unequally likely outcomes, using appropriate language and the 0-1 scale			
enumerate sets and combinations of sets systematically, using tables, grids and Venn diagrams			
generate theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes; use these to calculate theoretical probabilities; and know that the probabilities of an exhaustive set of mutually exclusive outcomes sum to one.			
	R	A	G
Statistics			
Pupils should be taught to:			
describe and compare univariate empirical distributions through: appropriate graphical representation involving discrete, continuous and grouped data; and appropriate measures of central tendency and spread			
describe simple mathematical relationships between two variables in observational and experimental contexts.			