

Royale Tutors Year 10 Mathematics Curriculum

Number

- **Place value & ordering** : Order and compare positive/negative integers, decimals and simple fractions; use inequality symbols (e.g. $=$, \neq , $<$, \geq).

Objective: Students should read, write and order numbers of any size and use place value to compare magnitudes.

- **Arithmetic operations** : Perform addition, subtraction, multiplication and division on integers, decimals and common fractions (including mixed numbers and negatives) with and without a calculator.

Objective: Fluency with the four operations in context, using formal written methods where appropriate.

- **Factors, multiples and primes**: Identify factors, multiples, prime numbers; find highest common factor and lowest common multiple; use prime factorization (foundation) and unique factor theorem.

Objective: Understand the vocabulary (factor, multiple, prime, prime factor) and use it to simplify problems (e.g. simplify fractions, solve factor puzzles).

- **Indices and roots** : Work with powers and roots. Foundation-tier covers positive integer powers (squares, cubes) and corresponding roots. Higher tier extends to fractional and negative indices and exact calculation of roots.

Objective: Calculate powers by repeated multiplication and roots; recognise and use index laws.

- **Standard form**: Express large or small numbers in the form $A \times 10^n$.

Objective: Convert between ordinary notation and standard form to handle very large/small quantities (e.g. scientific data).

- **Fractions, decimals & percentages** : Convert between fractions, decimals and percentages; interpret percentages as operators (e.g. 30% of xxx); calculate percentage increase/decrease. Foundation-tier works with simple percentage problems, while Higher-tier includes compound interest and growth/decay problems.

Objective: Use percentages in context (discounts, interest), and understand percentage as “parts per hundred.”

- **Ratio and proportion** : Solve sharing and division problems in a given ratio; work with proportion as an equivalence. Foundation covers basic ratio use and scale factors, while Higher-tier includes inverse proportion and more complex proportional reasoning (e.g. recipes, maps).

Objective: Relate ratios to actual values and use proportion to solve real problems (like map scales or scaling recipes).

- **Rates:** Interpret and compare rates such as speed, density or unit pricing (foundation). Higher tier includes compound rates (e.g. reverse percentages, financial rates).

Objective: Relate different quantities via rates (e.g. metres per second, cost per litre) and convert between compound units.

- **Accuracy & bounds:** Round numbers and measurements to a given degree of accuracy; interpret simple error intervals (higher tier: upper/lower bounds).

Objective: Apply rounding/estimation to check work and solve bounds problems (e.g. “to 2 d.p.” implies error ± 0.005).

- **Units and simple finance:** Convert between units (length, time, mass, currency); understand basic financial terms (profit/loss, VAT, interest).

Objective: Confidently switch units (e.g. hours to minutes, £ to pence) and perform simple money calculations.

Algebra

- **Notation & manipulation** : Use letters to generalise numbers; understand $3y$ as $y+y+y$, and a^2 as $a \times a$. Simplify algebraic expressions by collecting like terms, multiplying out brackets, taking out common factors. Higher tier covers algebraic surds and rationalising denominators.

Objective: Work fluently with expressions (e.g. expand $(x+2)(x-3)$, factorise quadratics).

- **Equations & inequalities:** Solve linear equations in one variable including those with the unknown on both sides. Solve quadratic equations by factorising; use the quadratic formula for all solutions. Solve simultaneous equations (two linear equations) algebraically; extend to one linear + one quadratic. Solve and graph linear inequalities

Objective: Find unknown values from equations and inequalities, using algebraic methods (e.g. rearranging, substitution).

- **Functions & formulas** : Substitute values into formulas, including scientific formulas ; understand a function as an input–output rule (e.g. $y=f(x)=2x+1$). Higher tier includes inverse and composite functions notation.

Objective: Apply given formulas (e.g. area of circle) and treat simple formulae as functions.

- **Graphs of functions** : Plot and interpret graphs on the coordinate plane. graph linear functions $y=mx+c$, identify gradients and intercepts. Sketch/interpret quadratics ($y=ax^2+bx+c$), cubics, reciprocal graphs ($y=1/x$), and non-standard graphs in context (e.g. distance–time).

Objective: Translate between linear equations and straight-line graphs, and understand the shape of basic nonlinear graphs.

- **Sequences**: Generate number sequences using term-to-term or n-th-term rules. Arithmetic progressions; Geometric sequences.

Objective: Find patterns (e.g. “add 3 each time”) and express them algebraically (e.g. $T_n=3n+2$).

Ratio & Proportion (and Rates)

- **Ratio**: Simplify ratios and solve problems like splitting a quantity in a given ratio. Dividing into more than two parts and working algebraically.

Objective: Relate two quantities multiplicatively (e.g. recipe ingredients, mixing solutions).

- **Direct and inverse proportion** : Understand that if y is directly proportional to x , then $y=kx$; and inversely proportional if $y=k/x$. Apply to simple problems (e.g. trip cost with distance).

Objective: Solve problems like scaling quantities up/down by a constant factor.

- **Percentages** : Express one quantity as a percentage of another; calculate percentage increase/decrease.

Objective: Use percent to compare and change quantities (e.g. calculate a new price after a 15% rise).

- **Rates of change**: Interpret gradients as rates. For example, understand the gradient of a linear graph as a constant rate (e.g. speed) and the gradient of a curve as an instantaneous rate.

Objective: Link algebraic graphs to real rates (distance–time, velocity–time).

- **Scales and maps** : Use scale factors and scale drawings (e.g. map scales).

Objective: Convert actual distances using given scales.

- **Compound measures** : Work comfortably with compound units (e.g. metres per second, £ per kg).

Objective: Convert between compound units and solve related problems (e.g. “miles per hour to metres per second” or “grams per cm³ to kg per m³”).

Geometry and Measures

- **Geometric terminology** : Learn standard vocabulary for points, lines, planes, angles, polygons, etc. Draw diagrams from descriptions.

Objective: Visualise and label figures correctly (e.g. naming angles in a triangle, identifying parallel lines).

- **Angle facts** : Use angle properties: angles on a straight line sum to 180°, around a point sum to 360°, vertically opposite angles equal, alternate & corresponding angles with parallel lines. Derive and use the interior angle sum of a triangle (180°) and of polygons.

Objective: Solve unknown angles in diagrams using known angle rules.

- **Polygons and symmetries** : Understand properties of special quadrilaterals (square, rectangle, parallelogram, kite, trapezium). Recognise and draw lines of symmetry and rotational symmetries of shapes.

Objective: Classify shapes and use their properties (e.g. opposite sides equal, base angles in isosceles triangle equal).

- **Constructions** : Use ruler-and-compass methods: construct perpendicular bisector of a segment, perpendicular line through a point, bisect an angle.

Objective: Perform basic constructions to build or analyze figures.

- **Congruence & similarity** : Recognise congruent triangles (using SSS, SAS, ASA, RHS) and use similarity of shapes, including enlargement by integer (and fractional) scale factors.

Objective: Identify when two shapes are the same size/shape or proportional, and apply scale factors.

- **Transformations**: Perform translations, rotations, reflections and enlargements including fractional or negative scale factors .

Objective: Map figures under transformations and recognise invariants (e.g. orientation).

- **Coordinates** : Work on Cartesian coordinates: plot points, lines, and solve simple coordinate geometry problems.

Objective: Move between algebraic equations and coordinate plots (e.g. graph a triangle given coordinates).

- **Mensuration:** Calculate perimeter, area and volume. Lengths, perimeters of polygons, areas of triangles, parallelograms and trapezia, and volumes of prisms (including cylinders). Area/circumference of circles, areas of sectors and composite 2D shapes, surface area and volume of cones, pyramids, spheres.

Objective: Apply geometric formulas (given in formula booklets) correctly.

- **Pythagoras & Trigonometry** : Pythagoras' theorem in right triangles. Trigonometric ratios (sin, cos, tan) for right-angled triangles, including exact values for key angles. use Sine and Cosine rules and area of triangle formula .

Objective: Solve side/angle problems in right triangles using Pythagoras or trig ratios.

- **Circle geometry** : Know circle definitions (radius, chord, tangent, sector) and apply circle theorems: e.g. angle in a semicircle = 90° , opposite angles in cyclic quadrilateral sum to 180° , tangent \perp radius.

Objective: Deduce unknown angles involving circles using theorems.

- **Vectors**): Understand 2D vectors, additions, scalar multiplication, diagrammatic/column form.

Objective: Solve problems involving translations and vector sums (e.g. displacement problems).

Probability

- **Basic probability** : Define probability on a 0–1 scale; record outcomes of simple experiments. Use equally likely outcomes to calculate theoretical probability; compare with experimental (relative frequency) probabilities.

Objective: Assign and compute probabilities for single events (e.g. “What is the probability of rolling a 3?” or estimating from data).

- **Combined events** : Use probability rules for combined events. Foundation tier covers independent events using tree diagrams or tables; use $P(A \text{ or } B) = P(A) + P(B)$ for mutually

exclusive events and sum-to-one for exhaustive outcomes. Dependent events and conditional probability (often via tree diagrams).

Objective: Calculate probabilities of events like “two dice both even” or “drawing two cards without replacement.”

- **Venn diagrams and sample spaces** : Represent events and their probabilities using Venn diagrams or complete sample space diagrams.

Objective: Visualise events and apply formulas (e.g. $P(A \cup B) = P(A) + P(B) - P(A \cap B)$).

- **Expected outcomes and fair games** : Use ideas of randomness/fairness to predict expected counts in multiple trials.

Objective: Estimate how often an event should occur in many trials (e.g. the expected heads in 100 coin flips).

- **Statistical language**: Understand terms like independent, mutually exclusive, exhaustive.

Objective: Describe experiments precisely (e.g. “A and B are independent events”).

Statistics

- **Data collection** : Understand sampling methods. Foundation covers surveys and sampling limitations (e.g. bias).

Objective: Recognise good vs poor data collection (e.g. random vs biased samples).

- **Data representation** : Construct and interpret frequency tables, bar charts, pie charts and pictograms for categorical data; vertical line charts (eg. histograms for grouped or continuous data). frequency polygons and cumulative frequency graphs.

Objective: Choose and draw charts/graphs to summarise data sets.

- **Measures of average & spread** : Calculate mean, median, mode and range from data (ungrouped data given or from frequency tables).

Objective: Summarise typical values (median/mean) and dispersion (range,

- **Comparison of distributions**: Analyse and compare two data sets using appropriate charts and measures. Understand outliers.

Objective: Comment on differences (e.g. “Class A has a higher median and less spread than Class B”).

Year 11 Mathematics

Number

- **Place value and arithmetic:** Ordering positive and negative integers, decimals and fractions; using symbols ($=$, \neq , $<$, $>$, \leq , \geq). All students apply the four operations (including formal written methods) to integers, decimals and simple fractions (proper, improper, mixed) – both positive and negative – and use place value in calculations. *Skills:* fluency with calculations, use of a number line and order of operations.
- **Factors, multiples, primes:** Understanding divisors, multiples, prime numbers, HCF/LCM and prime factor decomposition. Common to both tiers.
- **Powers and roots:** Using integer exponents and their associated real roots (squares, cubes, etc.), recognising small powers (2^2 , 2^3 , 2^4 , 2^5), and estimating powers and roots. These are assessed in Foundation and Higher.
- **Fractional indices :** candidates also learn to calculate with fractional indices (e.g. cube roots, higher roots).
- **Standard form:** Writing very large/small numbers in standard form $A \times 10^n$ ($1 \leq A < 10$).
- **Exact arithmetic with fractions, surds and π :** Higher tier adds exact calculations with fractions, surds and multiples of π ; simplifying surd expressions (e.g. $\sqrt{12} = 2\sqrt{3}$) and rationalising denominators.
- **Decimals and percentages:** Converting between fractions, decimals and percentages; working interchangeably with terminating decimals and their fractions (e.g. $3.5 = 7/2$), and converting recurring decimals to fractions and vice versa. Expressing one quantity as a percentage of another, and solving percentage increase/decrease and simple interest problems (including in financial contexts). These are common to both tiers.
- **Ratio in Number:** Identifying and working with fractions in ratio contexts (e.g. $3/8$ of 0.375).
- **Estimation and accuracy:** Rounding numbers/measures to a given number of decimal places or significant figures, and using inequality notation to specify simple error intervals. Interpreting upper and lower bounds of accuracy. These “limits of accuracy” topics are taught in both tiers, but Higher may focus on more precise error-interval reasoning.
- **Compound units:** Using units in calculations (e.g. compound units like speed, density). Converting related units freely (time, length, area, volume, mass, currency). Covered in both tiers.

Algebra

- **Algebraic notation & manipulation:** Using standard algebraic notation (ab for $a \times b$, a^2 for $a \times a$, a/b , coefficients, brackets). Writing expressions and formulas correctly. Substituting numbers into expressions and formulae (including scientific formulae).
- **Expressions, identities, factors:** Understanding terms like expressions, equations, identities, formulas, factors. Simplifying and expanding algebraic expressions by collecting like terms, multiplying into brackets, factorising quadratics of the form $x^2 + bx + c$ (including difference of squares)
- **Algebraic fractions and surds:** simplify algebraic fractions and manipulate expressions involving surds.
- **Formulas and change of subject:** Using and rearranging standard mathematical formulae (e.g. area, volume, compound interest) to make any letter the subject.
- **Equations vs identities:** *know the difference* between an equation and an identity, and can use algebraic arguments to show expressions are equivalent, constructing simple proofs.
- **Functions:** Interpreting simple expressions as functions with inputs and outputs. linear and basic quadratic functions (finding roots, intercepts graphically); composite and inverse functions, formal function notation, and recognizing exponential and trigonometric functions
- **Graphs:** Plotting and interpreting graphs is in both tiers, but content differs in depth:
 - *Linear graphs:* Plotting straight lines, using $y = mx + c$; identifying gradients and intercepts graphically and algebraically.
 - *Quadratic and other curves:* Foundation: sketching simple quadratic curves, reading off roots, plotting graphs to estimate solutions. Higher tier: recognizing and sketching cubic, reciprocal ($y=1/x$), and simple exponential functions; completing the square to find turning points.
 - *Circle graph:* plotting the equation of a circle centred at the origin, and finding the tangent at a point on a circle.
 - *Advanced graphs:* plotting and interpreting graphs of non-standard real-world functions (including kinematic distance/time and velocity/time graphs), calculating gradients at a point on a curve (instantaneous rates).
- **Solving equations/inequalities:**

- *Linear equations:* Solve linear equations in one variable (including with the unknown on both sides).
- *Quadratic equations:* solve simple quadratics by factorising or using a graph. solve general quadratics by completing the square and using the quadratic formula.
- *Simultaneous equations:* solve two linear equations in two unknowns (graphically and algebraically). *mixed* simultaneous systems (linear/quadratic).
- *Inequalities:* Solve linear inequalities in one variable, showing solution sets on a number line. solving two simultaneous inequalities and quadratic inequalities
- **Sequences:** Generating sequences: cover arithmetic (constant difference) and simple sequences.geometric progressions, Fibonacci-type and quadratic sequences, and finding the nth term of linear or quadratic sequences.

Geometry (Shape, Space & Measures)

- **Basic geometry vocabulary:** Use terms and notation for points, lines, vertices, planes, parallel/perpendicular lines, angles (acute, obtuse, right), and standard conventions for naming shapes.
- **Angle facts:** Apply angle rules: angles at a point and on a line, vertically opposite angles, alternate and corresponding angles with parallel lines, and angle-sum in triangles or polygons.
- **2D shapes:** Recognize and use properties of special quadrilaterals (square, rectangle, parallelogram, trapezium, kite, rhombus) and triangle types; use congruence criteria (SSS, SAS, ASA, RHS).
- **Similar shapes:** Recognize and construct similar shapes using scale factors (including fractional). identify scale relationships; use similarity to solve problems.
- **Circle definitions:** Know circle parts (centre, radius, chord, diameter, circumference, tangent, arc, sector, segment).
- **Circle theorems :** use/ prove circle theorems (angles in the same segment, angles at centre, tangent–radius, etc.).
- **Constructions:** use ruler-and-compass for basic constructions: perpendicular bisector, constructing perpendiculars and angle bisectors. using constructions to solve loci problems.

- **Transformations:** Working with translations, reflections, rotations and enlargements. Cover basic angle rotations ($90^\circ, 180^\circ, 270^\circ$) and simple enlargements; negative/fractional scale factors and combinations of transformations.
- **Coordinates (2D):** Plotting and solving problems on coordinate axes (straight lines, midpoints, distance)..
- **Perimeter, area and volume:**
 - *Areas of 2D shapes:* Using formulae for area of triangles, parallelograms, trapezia; circumference and area of circles.
 - *Composite shapes:* Calculating perimeters and areas of composite figures, circle sectors and segments.
 - *Volumes:* Computing volumes of prisms, cylinders; surface area and volume of pyramids, cones, spheres and composite solids
 - *Mensuration skills:* Using standard units (mm, cm, m, km, l, ml, £ etc) and compound measures; interpreting scale drawings and bearings.
- **Pythagoras and Trigonometry:**
 - Use Pythagoras' theorem ($a^2+b^2=c^2$) to find lengths in right triangles.
 - use sine, cosine, tangent ratios for right triangles to find missing sides/angles.
 - trig values for special angles ($0^\circ, 30^\circ, 45^\circ, 60^\circ, 90^\circ$), and solve non-right triangles using trigonometric methods (Sine/Cosine rule).
- **3D geometry:** Identifying and working with 3D shapes (cubes, prisms, cylinders, cones, pyramids, spheres) – faces, edges, vertices; drawing 3D nets; calculating volumes and surface areas.
- **Vectors:** Representing translations as 2D vectors, and adding/subtracting vectors graphically and algebraically.

Ratio, Proportion & Rates of Change

- **Simple ratios:** Expressing one quantity as a ratio of another; using ratio notation and reducing ratios to simplest form. Dividing quantities in given ratios .
- **Fractions and proportions:** Working interchangeably with fractions and ratios; understanding “fraction of” a quantity and proportion as equality of ratios ($a:b = c:d$).

- **Linear proportion:** Solving direct and inverse proportion problems (including graphically and algebraically).
- **Scale factors:** Using scale factors, scale diagrams and maps (scaling lengths, areas, volumes by given factor) .
- **Units and rates:** Converting units (including compound rates: speed, density, unit pricing, etc.). H interpreting gradient as rate of change (e.g. speed as $\Delta \text{distance} / \Delta \text{time}$).
- **Percentages:** Defining percentage as “number of parts per hundred”; converting between fractions, decimals, percentages. Expressing one quantity as a % of another; solving percentage increase/decrease problems; percentages over 100%.
- **Compound proportion:** Using compound measures (e.g. compound interest, repeated growth/decay). learns to set up/solve compound growth and decay problems (e.g. annual interest) and general iterative processes.

Probability

- **Experimental & theoretical probability:** Recording and analyzing frequencies of outcomes (using tables and frequency trees). Relating relative frequencies to theoretical probabilities on the 0–1 scale.
- **Equally likely events:** Applying fairness/equiprobability to calculate expected outcomes; constructing theoretical sample spaces for single or combined events (using lists, tables, Venn diagrams, grids).
- **Probability rules:** Using the fact that probabilities of an exhaustive set sum to 1, and probabilities of mutually exclusive events sum; calculating combined event probabilities via tree diagrams.
- **Dependent & independent events:** Calculating probabilities of independent and dependent (conditional) combined events.
- **Randomness & large samples:** Understanding that random/unbiased large samples tend towards the theoretical distribution (law of large numbers).

Statistics

- **Data collection and samples:** Understanding populations and samples; recognizing limitations of sampling.
- **Charts and diagrams:** Constructing and interpreting tables, charts and diagrams: bar charts, pie charts, pictograms (categorical data); vertical line graphs (discrete numerical); tables and line graphs (time series).

- **Measures of center and spread:** Calculating and interpreting measures of central tendency (mean, median, mode, modal class) and range (considering outliers) for univariate data.
- **Distributions:** Describing and comparing distributions of data sets (shape, center, spread) through appropriate graphs and statistics.
- **Cumulative frequency and histograms:** Construction and interpretation of histograms (for grouped continuous data) and cumulative frequency graphs..
- **Correlation and scatter plots:** Drawing and interpreting scatter graphs of bivariate data; identifying correlation; understanding that correlation \neq causation; estimating lines of best fit to make predictions.
- **Statistical inference :** Recognizing that samples may not perfectly reflect population; interpreting differences between samples and theoretical models.
- **Statistics in context:** Applying statistics to describe or compare populations; making predictions from trends, while noting limitations

