

# Maths: Phase 5 (Y12 - 13) Outcomes

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*"I know numbers are beautiful. If they aren't beautiful – nothing is." Paul Erdose*

<b>Key Knowledge</b>	<b>Key Skills</b>
<p><b>Pupils will know:</b></p> <p><b>Key Threshold Concepts</b></p> <ul style="list-style-type: none"> <li>• Maths is discovered – it doesn't just exist.</li> <li>• Maths is a tool to understand, question and criticise the world.</li> <li>• There are mathematical models that need to be applied to solve problems.</li> </ul> <p><b>Subject-specific Knowledge</b></p> <ul style="list-style-type: none"> <li>• Proof</li> <li>• Algebra and functions</li> <li>• Coordinate geometry in the (x,y) plane</li> <li>• Sequences and series</li> <li>• Trigonometry</li> <li>• Exponentials and logarithms</li> <li>• Differentiation</li> <li>• Integration</li> <li>• Vectors</li> <li>• Numerical methods</li> <li>• Statistical sampling</li> <li>• Data presentation and interpretation</li> <li>• Probability</li> <li>• Statistical distributions and hypothesis testing</li> </ul> <p><b>Cross –Curricular Knowledge (Science)</b></p> <ul style="list-style-type: none"> <li>• Quantities and units in mechanics</li> <li>• Kinematics</li> <li>• Forces and Newton's Laws</li> <li>• Moments</li> </ul>	<p><b>Pupils will be able to:</b></p> <p><b>Use and apply standard techniques</b></p> <ul style="list-style-type: none"> <li>• Use technology such as calculators and computers effectively and recognise when such use may be inappropriate</li> <li>• Comprehend and critique mathematical arguments, proofs and justifications of methods and formulae, including those relating to applications of mathematics</li> </ul> <p><b>Fluency</b></p> <ul style="list-style-type: none"> <li>• Construct and present mathematical arguments through appropriate use of diagrams; sketching graphs; logical deduction; precise statements involving correct use of symbols and connecting language, including: constant, coefficient, expression, equation, function, identity, index, term, variable</li> <li>• Use language and symbols associated with set theory, as set out in the content Apply to solutions of inequalities and probability</li> <li>• Use the definition of a function; domain and range of functions</li> </ul> <p><b>Reason, interpret and communicate mathematically</b></p> <ul style="list-style-type: none"> <li>• Recognise incorrect reasoning and reason this logically</li> <li>• Communicate a mathematical rationale clearly</li> <li>• Translate problems in context and evaluate their accuracy and limitations</li> </ul> <p><b>Problem solving</b></p> <ul style="list-style-type: none"> <li>• Recognise when mathematics can be used to analyse and solve a problem in context</li> </ul>

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# Maths: Phase 4 (Y9 - 11) Outcomes

*“When things get too complicated, it sometimes makes sense to stop and wonder: Have I asked the right question?” Enrico Bombieri*

<b>Key Knowledge</b> Pupils will know:	<b>Key Skills</b> Pupils will be able to:
<p><b>Key Threshold Concepts</b></p> <ul style="list-style-type: none"> <li>• Situations can be represented mathematically and a relationship understood between problems in context that maths can solve.</li> <li>• There are rational and irrational numbers.</li> </ul> <p><b>Subject knowledge</b></p> <ul style="list-style-type: none"> <li>• Error intervals</li> <li>• Growth/decay as a formula</li> <li>• Sine/cosine rule, area of a triangle</li> <li>• Quadratic formula</li> <li>• Trigonometric graphs and values</li> <li>• Equation of a circle and theorems</li> <li>• Constructions</li> <li>• Features of cumulative frequency graphs and histograms</li> <li>• Simplify expressions with surds, including rationalising denominators</li> <li>• Upper and lower bounds</li> <li>• Algebra’s use in constructing proofs and arguments and simplify algebraic products and quotients and fractions using the laws of indices</li> <li>• Simultaneous equations (algebraically and graphically)</li> <li>• Equations of perpendicular lines and equation of a tangent to a circle</li> <li>• Rules for congruency</li> </ul> <p><b>Cross curricular</b></p> <ul style="list-style-type: none"> <li>• Vectors</li> <li>• Standard form</li> <li>• Rearranging equations</li> <li>• Rate calculations</li> <li>• Code breaking and the world wars</li> </ul>	<p><b>Use and apply standard techniques</b></p> <ul style="list-style-type: none"> <li>• Use kinematics formulae</li> <li>• Convert compound units</li> <li>• Use calculators for inverse operations in trigonometry</li> </ul> <p><b>Fluency</b></p> <ul style="list-style-type: none"> <li>• Translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes</li> <li>• Make and use connections between different parts of mathematics</li> <li>• Interpret results in the context of the given problem</li> </ul> <p><b>Reason, interpret and communicate mathematically</b></p> <ul style="list-style-type: none"> <li>• Construct chains of reasoning to achieve a given result</li> <li>• Interpret and communicate information accurately</li> <li>• Present arguments and proofs</li> <li>• Assess the validity of an argument and critically evaluate a given way of presenting information</li> <li>• Use algebra to model complex geometric problems and trigonometric problems</li> </ul> <p><b>Problem solving</b></p> <ul style="list-style-type: none"> <li>• Select and apply mathematic techniques to solve problems</li> <li>• Make deductions and inferences and draw conclusions eg. trigonometric problems/Pythagoras and trigonometry in complex figures</li> <li>• Formulate equations and solve problems involving a quantity in direct proportion/inverse proportion to a power or root of another quantity</li> </ul>

# Maths: Phase 3 (Y6 - 9) Outcomes

*“Doing mathematics should always mean finding patterns and crafting beautiful, meaningful explanations.” Paul Lockhart*

<b>Key Knowledge</b> Pupils will know:	<b>Key Skills</b> Pupils will be able to:
<p><b>Key Threshold Concepts</b></p> <ul style="list-style-type: none"> <li>• Maths solves problems.</li> <li>• Powers and roots are inverse operations.</li> <li>• There is a constant relationship between the circumference and diameter of a circle that can be described by a number that cannot be measured, represented as a fraction, or written out completely (and yet can still be represented, calculated with, etc.).</li> <li>• Rearranging an equation and changing the subject of the formula does not change its value.</li> <li>• In a right angled triangle, for a given angle, the sine, tan and cosine of that angle have consistent values.</li> <li>• The sum of interior angles of a given polygon is directly related to its number of sides.</li> <li>• Expressions and equations can be used to model a situation.</li> <li>• A relationship between two variables can be modelled graphically.</li> </ul> <p><b>Subject-specific Knowledge</b></p> <ul style="list-style-type: none"> <li>• Fraction and decimal conversions</li> <li>• Percentage equivalences</li> <li>• Conventions of standard form</li> </ul> <p><b>Cross –Curricular Knowledge</b></p> <ul style="list-style-type: none"> <li>• Rearrange the formula for speed</li> <li>• Use the scale of a map and work with bearings</li> <li>• Construct and interpret scale drawings</li> <li>• Distance/time</li> </ul>	<p><b>Use and apply standard techniques</b></p> <ul style="list-style-type: none"> <li>• Estimate the result of a calculation</li> <li>• Use non calculator methods to calculate the sum, difference, product and quotient of positive and negative numbers</li> <li>• Know the conventional order for performing calculations involving brackets, four rules and powers, roots and reciprocals</li> </ul> <p><b>Reason, interpret and communicate mathematically</b></p> <ul style="list-style-type: none"> <li>• Understand the relationship between ratio and linear functions</li> <li>• Recognise sequences of triangular, square and cube numbers and simple arithmetic progressions</li> <li>• Interpret graphs in real world contexts</li> <li>• Prove triangles are congruent</li> <li>• Prove triangles are similar</li> <li>• Prove angle facts</li> <li>• Use relative frequency as an estimate and understand how the reliability increases as you do more trials</li> <li>• Compare data sets</li> </ul> <p><b>Problem solving</b></p> <ul style="list-style-type: none"> <li>• Select and apply mathematic techniques to solve problems</li> <li>• Make deductions and inferences and draw conclusions</li> <li>• Solve ratio and proportion problems</li> <li>• Solve problems involving direct/inverse proportion and algebraic proportions</li> </ul>

# Maths: Phase 2 (Y3 - 5) Outcomes

*“When you can measure what you are speaking about, and express it in numbers, you know something about it”. William Thomson.*

<b>Key Knowledge</b> Pupils will know:	<b>Key Skills</b> Pupils will be able to:
<p><b>Key Threshold Concepts</b></p> <ul style="list-style-type: none"> <li>• Problems are maths.</li> <li>• Negative numbers exist.</li> <li>• Numbers of equivalent value can be written in different ways (e.g. %, decimals, fraction, equivalent fraction).</li> <li>• Numbers can be represented by letters or symbols.</li> <li>• An angle is a measure of a turn.</li> <li>• Number patterns can be described using rules involving one or more operations.</li> </ul> <p><b>Subject-specific Knowledge</b></p> <ul style="list-style-type: none"> <li>• Percentage symbol</li> <li>• Know the terms points, lines, line segment</li> <li>• Use the terms acute, obtuse, right angle and reflex and use labelling conventions</li> <li>• Regular polygons and 3D shapes and the terms: face, surface, edge and vertex</li> <li>• The properties of triangles and quadrilaterals</li> <li>• Times tables 1-12 off by heart</li> <li>• Interpret expressions as functions with inputs and outputs</li> <li>• Understand and the use the terms odd, even, prime, factor, composite, multiple, common factor, common multiple, square, cube, root</li> <li>• Understand and use place value in decimals</li> <li>• Recognise and use equivalence between simple fractions and mixed numbers</li> <li>• Understand and the use the concepts and vocabulary of expressions, equations, formulae, terms and factors</li> <li>• Roman numerals to 1000 (M)</li> </ul>	<p><b>Use and apply standard techniques</b></p> <ul style="list-style-type: none"> <li>• Draw diagrams from written descriptions</li> <li>• Use a ruler to construct and measure straight lines and a protractor for angles</li> <li>• Reflect and rotate shapes accurately</li> <li>• Use and convert standard units of measurement for length, area, volume, mass, time and money</li> </ul> <p><b>Fluency</b></p> <ul style="list-style-type: none"> <li>• Calculate a fraction of a quantity</li> <li>• Add, subtract and convert decimals and fractions</li> <li>• Simplify algebraic expressions and collect like terms</li> <li>• Generate a sequence and find a rule</li> <li>• Calculate perimeter and area of shapes</li> <li>• Identify prime numbers less than 20 and express a whole number as a product</li> <li>• Calculate a percentage of a quantity</li> <li>• Round to the nearest 10, 100, 1000, 10 000 and 100 000</li> <li>• Read, write and convert time between analogue and digital 12 and 24 hour clocks</li> <li>• Interpret and present data using bar charts and time graphs</li> <li>• Read and interpret information in tables, including timetables</li> </ul> <p><b>Reason, interpret and communicate mathematically</b></p> <ul style="list-style-type: none"> <li>• Give geometric reasons to justify the properties of triangles and quadrilaterals</li> <li>• Identify reflection and rotation symmetries of regular polygons</li> <li>• Interpret plans and elevations of 3D solids</li> </ul> <p><b>Problem solving</b></p> <ul style="list-style-type: none"> <li>• Solve multi-step problems, choosing and justifying a method</li> </ul>

# Maths: Phase 1 (YN – Y2) Outcomes

*“Maths is the water. It has a lot of difficult theories but its basic logic is very simple. Just as water flows from high to low over the shortest possible distance, figures can only flow in one direction. You just have to keep your eye on them for the route to reveal itself”. Haruki Murakami.*

<b>Key Knowledge</b> Pupils will know:	<b>Key Skills</b> Pupils will be able to:
<p><b>Key Threshold Concepts</b></p> <ul style="list-style-type: none"> <li>• Mathematical symbols have meanings. (+, ÷, -, x, =, &lt;, &gt;, £, p)</li> <li>• Numbers are organised in a place value system.</li> <li>• If a number is divisible by 2 it is even.</li> <li>• 2D and 3D shapes have unique sets of properties (edges, vertices, faces, symmetry).</li> <li>• Addition and multiplication are commutative, division and subtraction are not</li> <li>• Addition and subtraction, multiplication and division are inverse operations</li> <li>• A fraction is a number which has been split into parts</li> </ul> <p><b>Subject-specific Knowledge</b></p> <ul style="list-style-type: none"> <li>• Names and properties of some common 2D and 3D shapes</li> <li>• Partition numbers</li> <li>• Recognise symmetry in simple shapes, draw lines of symmetry</li> <li>• Units of measurement used for length/height, mass, temperature and capacity</li> <li>• Mathematical vocabulary to describe position, direction and movement.</li> <li>• Some of the ways in which data is organised, i.e. tally charts and pictograms</li> <li>• 2, 5 and 10 times tables off by heart</li> <li>• Language of the 4 operations</li> <li>• Value of different denominations of coins and notes</li> <li>• Days of the week and months of the year</li> <li>• Understand and use the terms product and multiple</li> </ul>	<p><b>Use and apply standard techniques</b></p> <ul style="list-style-type: none"> <li>• Draw diagrams from written descriptions</li> <li>• Use a ruler to construct and measure straight lines</li> <li>• Reflect a shape in a mirror line</li> <li>• Rotate a shape through an angle/given centre of rotation</li> <li>• Use and convert standard units of measurement for length, area, volume, mass, time and money</li> </ul> <p><b>Fluency</b></p> <ul style="list-style-type: none"> <li>• Skip count in steps of 2, 3, 5 and 10, forwards and backwards</li> <li>• Apply number facts to 20, derive and use related facts to 100</li> <li>• Add, subtract, multiply and divide using concrete manipulatives, pictorial representations and mental and written methods</li> <li>• Solve missing number equations using the inverse</li> <li>• Round to the nearest 10</li> <li>• Read the time to the nearest 5 minutes</li> <li>• Compare and order numbers and measurements using &lt;, &gt;, and =</li> <li>• Recognise, find, name and write fractions <math>\frac{1}{2}</math>, <math>\frac{1}{3}</math>, <math>\frac{1}{4}</math>, <math>\frac{2}{4}</math>, <math>\frac{3}{4}</math> of a length, shape, set of objects or quantity</li> <li>• Interpret and record data</li> </ul> <p><b>Reason, interpret and communicate mathematically</b></p> <ul style="list-style-type: none"> <li>• Describe a mental calculation, or draw a representation of it on a blank number line</li> <li>• Explain and justify chosen method</li> <li>• Explain rules for patterns and sequences</li> <li>• Draw bar models to represent equations or</li> </ul>

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problems

- Make connections between different areas of mathematics, i.e. between the 5x tables and divisions on a clock face
- See the scales on measuring instruments as number lines

**Problem solving**

- Recognise the language of word problems
  - Solve 1 and 2-step word problems
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