

## Key Stage 4 Higher Tier Skills Map

### Module 1: Number

Unit	Key Learning	
<b>1: Powers and roots</b>	<ul style="list-style-type: none"> <li>Understand the meaning of higher powers and know how to find these</li> <li>Understand the meaning of roots and how to find these, including through approximation</li> </ul>	<ul style="list-style-type: none"> <li>Efficient use of a calculator, when appropriate</li> </ul>
<b>2: Surds and irrational numbers</b>	<ul style="list-style-type: none"> <li>Understand the difference between rational and irrational numbers</li> <li>Change recurring decimals into their corresponding fractions and vice versa</li> </ul>	<ul style="list-style-type: none"> <li>Rationalise denominators</li> </ul>
<b>3: Indices</b>	<ul style="list-style-type: none"> <li>Understand the meaning of higher powers and know how to find these</li> <li>Understand, derive and use the rules of indices with integer values</li> <li>Multiplying numbers in index form</li> <li>Dividing numbers in index form</li> <li>Raising a power by a power</li> </ul>	<ul style="list-style-type: none"> <li>Negative powers</li> <li>The power of zero</li> <li>The power of 1</li> <li>Calculate with fractional indices</li> </ul>
<b>4: Standard form</b>	<ul style="list-style-type: none"> <li>Multiply and divide numbers by any power of 10</li> <li>Convert numbers to and from standard form</li> </ul>	<ul style="list-style-type: none"> <li>Perform calculations involving standard form</li> <li>Efficient use of a calculator, when appropriate</li> </ul>
<b>5: Sequences</b>	<ul style="list-style-type: none"> <li>Recognise and describe arithmetic and geometric sequences</li> <li>Arithmetic sequences: find a formula for the <math>n^{\text{th}}</math> term</li> <li>Geometric sequences: find a formula for the <math>n^{\text{th}}</math> term</li> </ul>	<ul style="list-style-type: none"> <li>Find the formula for the <math>n^{\text{th}}</math> term of a quadratic sequence</li> <li>Find missing terms in and find the formula for the <math>n^{\text{th}}</math> term of, geometric sequences with ratios that are surds</li> </ul>

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## Key Stage 4 Higher Tier Skills Map Module 2: Applications of algebra

Unit	Key Learning	
<b>6: Quadratics</b>	<ul style="list-style-type: none"> <li>Expand products of two binomials</li> <li>Factorise quadratic expressions of the form <math>x^2 + bx + c</math> and difference of two squares</li> <li>Factorise quadratic expressions of the form <math>ax^2 + bx + c</math>, when <math>a &gt; 1</math></li> <li>Complete the square of a quadratic expression</li> </ul>	<ul style="list-style-type: none"> <li>Solve quadratic equations of the form <math>x^2 + bx + c</math> by factorising</li> <li>Introducing the quadratic formula</li> <li>Rearrange and solve quadratic equations by factorisation, completing the square or the use of the quadratic formula</li> </ul>
<b>7: Quadratic graphs</b>	<ul style="list-style-type: none"> <li>Draw and recognise quadratic graphs</li> <li>Use quadratic graphs to find the approximate solution to quadratic equations</li> </ul>	<ul style="list-style-type: none"> <li>Identify intercepts, and using symmetry, the turning points of graphs of quadratic functions</li> <li>Sketch graphs of quadratic functions, finding the turning point by completing the square</li> </ul>
<b>8: Algebraic fractions</b>	<ul style="list-style-type: none"> <li>Simplify algebraic fractions</li> </ul>	<ul style="list-style-type: none"> <li>Manipulate algebraic fractions</li> </ul>
<b>9: Simultaneous equations</b>	<ul style="list-style-type: none"> <li>Solving simultaneous equations graphically</li> <li>Solving simultaneous equations algebraically</li> <li>Writing and solving simultaneous equations to solve problems</li> </ul>	<ul style="list-style-type: none"> <li>Set up and solve two simultaneous equations where one is linear and one is quadratic</li> </ul>

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### Module 3: Percentages and probability

Unit	Key Learning	
<b>10: Fractions, percentages and decimals</b>	<ul style="list-style-type: none"> <li>Understand fraction notation, recognising when fractions are equivalent</li> <li>Convert between improper fractions and mixed numbers</li> <li>Apply the four rules of number to fractions</li> </ul>	<ul style="list-style-type: none"> <li>Find fractions of a quantity</li> <li>Appreciate the equivalence of fractions, decimals and percentage and convert between them</li> </ul>
<b>11: Percentages</b>	<ul style="list-style-type: none"> <li>Increase and decrease by a given percentage</li> <li>Express one number as a percentage of another, including percentage changes</li> <li>Know the difference between simple and compound interest</li> </ul>	<ul style="list-style-type: none"> <li>Solve problems involving compound interest</li> <li>Solve other problems involving repeated change, such as depreciation</li> <li>Solve problems involving growth and decay</li> </ul>
<b>12: Probability</b>	<ul style="list-style-type: none"> <li>Use the language associated with probability</li> <li>Find the probability of a single event when there are equally likely events</li> <li>Convert between different forms of probability fractions, decimals and percentages</li> <li>Know that <math>P(\text{Not } A) = 1 - P(A)</math></li> <li>Solve equations from probability problems</li> <li>Understand what is meant by relative frequency</li> <li>Understand why relative frequency is sometimes used as an estimate for probability</li> <li>Compare theoretical probability with result obtained by experiments</li> <li>Use Venn diagrams and two way tables to solve probability problems</li> </ul>	<ul style="list-style-type: none"> <li>Construct Venn diagrams and two way tables to solve probability problems</li> <li>Use the addition law for probability, understanding when events are mutually exclusive</li> <li>Systematically list sample spaces</li> <li>Understand the multiplication rule for independent and dependent events</li> <li>Use tree diagrams to solve probability problems</li> <li>Construct tree diagrams to solve probability problems</li> <li>Understand what is meant by conditional probability</li> <li>Calculate conditional probabilities</li> <li>Extend their work on Venn diagrams to include those with three regions</li> <li>Solve more complex problems involving tree diagrams</li> </ul>

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### Module 4: Geometry

Unit	Key Learning	
<b>13: Transformations</b>	<ul style="list-style-type: none"> <li>Reflect a shape in a given line, including on a coordinate grid using e.g. <math>x = \pm a</math></li> <li>Rotate a shape by a <math>90^\circ</math>, <math>180^\circ</math> and <math>270^\circ</math> about a given centre</li> <li>Translate a shape by a given vector</li> <li>Understand that these transformations do not affect the area of the shape and that the distance between pairs of points is the same in the image as in the original shape</li> </ul>	<ul style="list-style-type: none"> <li>Describe a single transformation using correct mathematical language</li> <li>Enlarge shapes, with or without a coordinate grid, from a given centre, using positive integer and fractional scale factors</li> <li>Find the centre of enlargement given a shape and its image</li> <li>Enlarge shapes from a given centre, using negative integer and fractional scale factors</li> <li>Consider the effects of combining reflections, rotations and translations</li> </ul>
<b>14: Upper and lower bounds</b>	<ul style="list-style-type: none"> <li>Find the upper and lower bounds of a calculation using numbers that have been rounded to a given degree of accuracy</li> </ul>	<ul style="list-style-type: none"> <li>Understand the difference between the bounds of discrete and continuous quantities</li> </ul>
<b>15: 2D shape and circle geometry</b>	<ul style="list-style-type: none"> <li>Round numbers to a given number of decimal places</li> <li>Calculate the area of triangles, parallelograms, trapezia, circles and composite 2D shapes</li> <li>Find the circumference of a circle</li> <li>Find the perimeter of composite 2D shapes</li> </ul>	<ul style="list-style-type: none"> <li>Identify and use the terms centre, radius, chord, diameter, circumference, tangent, arc, sector and segment</li> <li>Calculate the length of an arc of a circle</li> <li>Calculate the area of a sector of a circle</li> <li>Recognise and use the equation of a circle, centre the origin</li> <li>Find the equation of a tangent to a circle at a given point</li> </ul>
<b>16: 3D shape</b>	<ul style="list-style-type: none"> <li>Recognise the vocabulary associated with 3D solids</li> <li>Interpret plans and elevations of 3D solids</li> </ul>	<ul style="list-style-type: none"> <li>Construct plans and elevations of 3D solids</li> </ul>
<b>17: Volume and surface area</b>	<ul style="list-style-type: none"> <li>Calculate the surface area and volume of: cuboids, spheres, cones, pyramids, simple composite solids</li> <li>Compare the surface area and volume of solid shapes, using ratios where appropriate</li> <li>Form and solve equations related to 3D shapes</li> </ul>	<ul style="list-style-type: none"> <li>Give answers in terms of pi if appropriate</li> <li>Understand the limits of accuracy, using inequality notation to show error intervals</li> <li>Convert between area and volume units</li> </ul>

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### Module 5: Similarity

Unit	Key Learning	
<b>18: Ratio review</b>	<ul style="list-style-type: none"> <li>Recognise and use ratio notation, simplify ratios, compare ratios to fractions, decimals and percentages</li> </ul>	<ul style="list-style-type: none"> <li>Share a quantity in a given ratio</li> <li>Solve simple ratio and proportion problems</li> </ul>
<b>19: Direct and inverse proportion</b>	<ul style="list-style-type: none"> <li>Use and apply compound units such as density and pressure</li> <li>Know and apply <math>\text{Density} = \text{Mass} \div \text{Volume}</math></li> <li>Use and apply compound units in algebraic contexts</li> <li>Solve problems using unitary method</li> <li>Recognise the link between gradient and proportion</li> <li>Solve problems involving direct proportion in numerical and algebraic contexts</li> </ul>	<ul style="list-style-type: none"> <li>Solve formal problems involving direct proportion where <math>y \propto x</math></li> <li>Solve problems involving inverse proportion in contexts such as speed, distance and time</li> <li>Solve formal problems involving inverse proportion where <math>y \propto \frac{1}{x}</math></li> <li>Solve problems involving a quantity directly or inversely proportional to a power or a root of another quantity</li> </ul>
<b>20: Pythagoras theorem</b>	<ul style="list-style-type: none"> <li>Apply Pythagoras' theorem to problems in three dimensions, including repeated use of the theorem e.g. in finding the length of the diagonal of a cuboid</li> </ul>	<ul style="list-style-type: none"> <li>Identify right angled triangles in three dimensional shapes and use trigonometry to find missing sides and angles</li> </ul>
<b>21: Similarity and trigonometry</b>	<ul style="list-style-type: none"> <li>Find missing sides in right angled triangles given the other two sides</li> <li>Model practical situations with right angled triangles and so find missing lengths</li> </ul>	<ul style="list-style-type: none"> <li>Identify whether a triangle is right angled by considering the lengths of its sides</li> </ul>
<b>22: 3D triangles</b>	<ul style="list-style-type: none"> <li>Understand the meaning of similarity</li> <li>Find missing sides in pairs of similar shapes, including similar triangles</li> <li>Understand and use the relationship between lengths, areas and volumes of similar shapes</li> <li>Understand and use the trigonometric ratios sin, cos and tan</li> <li>Understand the link between similar triangles and trigonometry</li> </ul>	<ul style="list-style-type: none"> <li>Derive and use the exact values of <math>\sin \theta</math> and <math>\cos \theta</math> for <math>\theta = 0^\circ, 30^\circ, 45^\circ, 60^\circ</math> and <math>90^\circ</math>; know the exact value of <math>\tan \theta</math> for <math>\theta = 0^\circ, 30^\circ, 45^\circ</math> and <math>60^\circ</math></li> <li>Solve problems involving right angled triangles</li> <li>Use the sine rule to find missing sides and angles in any triangle</li> <li>Use the cosine rule to find missing sides and angles in any triangle</li> <li>Find the area of a triangle using the formula <math>\text{Area} = \frac{1}{2}ab\sin C</math></li> </ul>

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### Module 6: Data handling

Unit	Key Learning	
<b>23: Average and range review</b>	<ul style="list-style-type: none"> <li>Calculate the mean, median and mode and range of ungrouped data</li> <li>Find the modal class of grouped data</li> <li>Find estimates of the mean, median and range of grouped data</li> <li>Make comparisons between sets of data using summary statistics</li> </ul>	<ul style="list-style-type: none"> <li>Design tables to classify data</li> <li>Discuss the advantages and disadvantages of different measures used in statistics</li> </ul>
<b>24: Data collection and sampling</b>	<ul style="list-style-type: none"> <li>Appreciate the difference between quantitative, qualitative, discrete and continuous data</li> <li>Explore methods of data collection including surveys, questionnaires and the use of secondary data</li> </ul>	<ul style="list-style-type: none"> <li>Classify and tabulate data</li> <li>Know the difference between a sample and a population</li> <li>Understand different types of sampling and discuss the reliability of different types of sample</li> </ul>
<b>25: Presenting data including scatter diagrams</b>	<ul style="list-style-type: none"> <li>Interpret and construct: bar charts, pie charts and line graphs for time series data</li> <li>Identify trends within time series</li> <li>Recognise when graphs and charts can be misleading</li> <li>Identify outliers</li> </ul>	<ul style="list-style-type: none"> <li>Scatter graphs                             <ul style="list-style-type: none"> <li>Plot to identify correlation</li> <li>Understand that correlation does not imply causality</li> <li>Draw (by eye) lines of best fit</li> <li>Interpret the graphs to make estimates, knowing the limitations of this</li> <li>Spot outliers on a scatter graph</li> </ul> </li> </ul>
<b>26: Further statistical diagrams</b>	<ul style="list-style-type: none"> <li>Construct and interpret histograms with equal and unequal class intervals</li> <li>Plot and interpret cumulative frequency diagrams</li> <li>Calculate estimates of statistical measures from graphical representations of grouped data</li> </ul>	<ul style="list-style-type: none"> <li>Draw and interpret box plots</li> <li>Use the median and interquartile range to compare distributions</li> </ul>

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### Module 7: Reasoning and proof

Unit	Key Learning	
<b>27: Vectors</b>	<ul style="list-style-type: none"> <li>Represent a two dimensional vector as a column vector</li> <li>Add and subtract vectors</li> </ul>	<ul style="list-style-type: none"> <li>Multiply a vector by a scalar</li> <li>Use vectors to prove geometric arguments</li> </ul>
<b>28: Geometric reasoning</b>	<ul style="list-style-type: none"> <li>Know and use: alternate angles are equal</li> <li>Know and use: corresponding angles are equal</li> <li>Know and use: vertically opposite angles are equal</li> <li>Identify and know the properties of special quadrilaterals</li> <li>Find the sum of the interior angles of a polygon</li> <li>Find the interior angle of a regular polygon</li> </ul>	<ul style="list-style-type: none"> <li>Derive and use the sum of the exterior angles of a polygon</li> <li>Use angle facts to find missing angles in increasingly complex situations</li> <li>Use angle facts to justify results in simple proofs</li> <li>Use the known properties of triangles and quadrilaterals to follow and to derive simple proofs in rectilinear figures, including key angle and area facts</li> </ul>
<b>29: Circle theorems</b>	<ul style="list-style-type: none"> <li>Prove and use:                             <ul style="list-style-type: none"> <li>The angle subtended by an arc at the centre of a circle is twice that at the circumference</li> <li>The angle in a semi circle is a right angle</li> <li>Angles in the same segment are equal</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Opposite angles of a cyclic quadrilateral sum to 1800</li> <li>A radius bisects a chord if and only if it is perpendicular to the chord</li> <li>The angle between a tangent and a radius is a right angle</li> <li>The alternate segment theorem</li> </ul>
<b>30: Bearings</b>	<ul style="list-style-type: none"> <li>Understand and use bearings</li> </ul>	
<b>31: Congruence and proof</b>	<ul style="list-style-type: none"> <li>Construct triangles and quadrilaterals from given information</li> <li>Recognise congruent triangles</li> </ul>	<ul style="list-style-type: none"> <li>Be aware of the conditions for congruency</li> <li>Prove pairs of triangles are congruent using SSS, ASA, AAS and RHS</li> </ul>
<b>32: Construction and loci</b>	<ul style="list-style-type: none"> <li>Use rulers, protractors and pairs of compasses accurately</li> <li>Use the standard ruler and compass constructions for: perpendicular bisector of a line segment, constructing a perpendicular to a given line from/at a given point and bisecting a given angle</li> <li>Understand and use the perpendicular distance from a point to a line as the shortest distance to the line</li> </ul>	<ul style="list-style-type: none"> <li>Construct triangles and quadrilaterals from given information</li> <li>Apply ruler and compass constructions to construct figures</li> <li>Understand the term equidistant</li> <li>Identify the loci of points and use these to solve real world problems</li> </ul>

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## Key Stage 4 Higher Tier Skills Map Module 8: Inequalities and graphs

Unit	Key Learning	
<b>33: Inequalities</b>	<ul style="list-style-type: none"> <li>Form and solve linear equations in one variable (review)</li> <li>Form and solve inequalities in one variable, including representing solutions on a number line</li> <li>Express solutions to inequalities using set notation</li> </ul>	<ul style="list-style-type: none"> <li>Solve several inequalities in two variables, representing the solution set on a graph</li> <li>Solve quadratic inequalities</li> </ul>
<b>34: Linear graphs</b>	<ul style="list-style-type: none"> <li>Solve problems involving coordinates and midpoints of line segments</li> <li>Plot straight line graphs</li> <li>Understand input and output</li> <li>Understand the equation of a straight line, interpreting the gradient and intercept</li> </ul>	<ul style="list-style-type: none"> <li>Rearrange formulae where the subject appears only once</li> <li>Find the equation of a straight line given sufficient information</li> <li>Prove whether two straight lines are parallel by considering their equations, rearranging where necessary</li> </ul>
<b>35: Non-linear graphs</b>	<ul style="list-style-type: none"> <li>Construct and interpret graphs of real life contexts such as:                             <ul style="list-style-type: none"> <li>Currency conversion</li> <li>Temperature conversion</li> <li>Distance time graphs</li> </ul> </li> <li>Use tables of values to plot polynomial graphs</li> </ul>	<ul style="list-style-type: none"> <li>Use tables of values to plot reciprocal graphs</li> <li>Recognise and sketch graphs of cubic and reciprocal functions</li> <li>Plot graphs of the form <math>y = k^x</math> from a table of values</li> <li>Recognise and sketch the graphs of exponential functions</li> </ul>
<b>36: Trigonometric graphs</b>	<ul style="list-style-type: none"> <li>Evaluate the sine, cosine and tangent of angles greater than <math>90^\circ</math></li> <li>Recognise and sketch the graphs of <math>y = \sin \theta</math>, <math>y = \cos \theta</math> and <math>y = \tan \theta</math></li> </ul>	<ul style="list-style-type: none"> <li>Solve simple trigonometric equations using graphs</li> </ul>

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## Key Stage 4 Higher Tier Skills Map Module 9: Algebra and graphs

Unit	Key Learning	
<b>37: Algebraic proof and reasoning</b>	<ul style="list-style-type: none"> <li>Use algebraic notation, understanding input and output</li> <li>Formulate simple formulae from real world situations</li> <li>Simplify more complex algebraic expressions, including using powers multiplied over a single bracket</li> <li>Use reasoning to show whether two expressions are equivalent, so developing their understanding of an identity</li> </ul>	<ul style="list-style-type: none"> <li>Develop/critique simple mathematical arguments</li> <li>Rearrange formulae where the subject appears twice</li> <li>Use algebra to construct proofs of arguments</li> <li>Verify whether two straight lines are perpendicular</li> </ul>
<b>38: Recurrence relations</b>	<ul style="list-style-type: none"> <li>Understand the meaning of iteration and use iterative processes</li> </ul>	<ul style="list-style-type: none"> <li>Use recurrence formulae</li> </ul>
<b>39: Functions</b>	<ul style="list-style-type: none"> <li>Understand and use function notation</li> <li>Find the inverse of a function</li> </ul>	<ul style="list-style-type: none"> <li>Interpret the succession of two functions as a composite function</li> </ul>
<b>41: Transformation of graphs</b>	<ul style="list-style-type: none"> <li>Identify and sketch the graphs of translations and reflections of a given graph</li> </ul>	<ul style="list-style-type: none"> <li>Identify and sketch the graphs of translations and reflections of the graph of a given equation</li> </ul>
<b>42: Further graphs</b>	<ul style="list-style-type: none"> <li>Find approximate solutions to equations by using:                             <ul style="list-style-type: none"> <li>Trial and improvement/decimal search</li> <li>Sign change methods</li> <li>Calculate estimates of gradients of graphs using gradients of tangents</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Interpret gradients of real world graphs</li> <li>Calculate estimates areas under graphs</li> <li>Interpret areas under real world graphs</li> </ul>

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