

## Further Maths

	Year 12 (Full Maths A Level)	Year 13 (Full Further Maths A Level)
A u t u m n 1	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Algebraic manipulation (expanding and factorising)</li> <li>● Surds and Laws of Indices</li> <li>● Trigonometry in right-angled triangles and solving simple trigonometric equations</li> <li>● Coordinate Geometry and the equation of a straight line</li> <li>● Introduction to differentiation, including from first principles</li> <li>● Introduction to integration as the reverse of differentiation</li> <li>● Introduction to Numerical Methods (using Trial and Improvement)</li> <li>● Working with exponentials and solving simple exponential equations</li> <li>● Binomial expansions involving positive integer powers</li> </ul> <p>Applied Maths:</p> <ul style="list-style-type: none"> <li>● Sampling techniques and measures of central tendency/dispersion</li> <li>● Vectors in 2 dimensions</li> <li>● Basic probability and probability notation</li> </ul>	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Introduction to Complex Numbers and the use of an Argand diagram to represent them visually. Calculations involving complex numbers are also covered here</li> <li>● Working with roots of polynomial equations and solving polynomial inequalities</li> <li>● Summation of series</li> <li>● Recognition that certain functions (exponential, logarithmic and trigonometric) can be represented as an infinite series (Maclaurin expansions)</li> <li>● Working with rational functions, including sketching graphs and solving inequalities</li> </ul> <p>Applied Maths:</p> <ul style="list-style-type: none"> <li>● Development of the concept of discrete random variables as probability distributions, including finding the expectation and variance</li> <li>● Introduction to specific discrete random variables, such as the discrete uniform distribution and the Poisson distribution, and using them to model real life scenarios</li> <li>● Performing hypothesis tests for data modelled by a Poisson distribution, and an introduction to Type I and Type II errors</li> <li>● Development of the concept of continuous random variables, and the use of calculus to work out averages and probabilities</li> <li>● Understand the concept of association between variables and the use of the chi-squared distribution in tests for association</li> <li>● Construction and use of confidence intervals for the mean of a population</li> </ul>
A u t u m n 2	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Solving linear simultaneous equations</li> <li>● Quadratic functions and solving quadratic equations</li> <li>● Trigonometry in non-right-angled triangles, an introduction to the radian measure and applications to arcs and sectors of circles</li> <li>● Curve sketching techniques</li> <li>● Applications of differentiation to finding stationary points, tangents and normals</li> <li>● Definite integration and integration as the area under a curve</li> <li>● Locating roots of an equation using the 'change of sign' method</li> </ul>	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Deriving the vector equation of a line, calculation of the scalar (or 'dot') product of two vectors, and finding angles/distances between lines in 3 dimensions</li> <li>● An introduction to polar coordinates, sketching graphs of functions given in polar form, and converting between polar coordinates/cartesian coordinates</li> <li>● Using integration to calculate volumes of revolution and to evaluate the mean value of a function</li> </ul>

	<ul style="list-style-type: none"> <li>● Introducing logarithms, including the natural logarithm</li> <li>● Using 'sigma notation' to represent a sum</li> </ul> <p>Applied Maths:</p> <ul style="list-style-type: none"> <li>● Probability distributions, discrete random variables and the Binomial Distribution</li> <li>● Newton's Laws and objects in equilibrium</li> <li>● Hypothesis testing involving the Binomial Distribution</li> </ul>	<ul style="list-style-type: none"> <li>● An introduction to hyperbolic functions and the inverse hyperbolic functions, including sketching graphs and solving equations</li> <li>● Proving a variety of results using the method of mathematical induction</li> </ul> <p>Applied Maths:</p> <ul style="list-style-type: none"> <li>● An introduction to the principles of impulse and momentum, and using the law of conservation of momentum to solve problems involving collisions</li> <li>● Further work on collisions, taking into account the concept of the elasticity of a collision and the coefficient of restitution</li> <li>● Introducing the concepts of work, energy and power before looking at specific forms of energy such as kinetic energy, gravitational potential energy and elastic potential energy (Hooke's Law is also covered)</li> <li>● An introduction to motion in a circle, but where the object is moving in a horizontal circle only</li> </ul>
S p r i n g 1	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● A formal introduction to functions, including domain, range and composite functions</li> <li>● Solving linear and quadratic inequalities</li> <li>● Using basic trigonometric identities to solve more advanced trigonometric equations</li> <li>● Transformations of graphs, including translations, reflections and stretches</li> <li>● Differentiation using the Chain Rule, and differentiating trigonometric, exponential and logarithmic functions</li> <li>● Integration by substitution</li> <li>● Solving equations using iterative methods</li> <li>● Introducing and using the laws of logarithms</li> <li>● Solving problems involving arithmetic sequences and series</li> </ul> <p>Applied Maths:</p> <ul style="list-style-type: none"> <li>● Kinematics involving motion under constant and non-constant acceleration in one dimension</li> <li>● Development of Newton's Laws to solve problems involving accelerating objects and objects that are connected.</li> </ul>	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Further work with complex numbers, including using de Moivre's Theorem and finding all roots of any complex number</li> <li>● Development of matrices work to include finding the inverse of a 3x3 matrix and its associated applications (e.g. solving 3 linear equations in 3 unknowns)</li> <li>● Finding eigenvalues and eigenvectors, and using them to diagonalise a matrix</li> <li>● Further summations of series</li> <li>● Using Maclaurin expansions to represent functions as infinite series, and to find limits (l'Hopital's Rule may also be used)</li> <li>● Further development of the modulus function, including sketching graphs and solving inequalities</li> <li>● Development of earlier work with rational functions to be able to sketch graphs with oblique asymptotes</li> <li>● Understanding and working with the equations of a parabola, a hyperbola and an ellipse.</li> </ul> <p>Applied Maths:</p> <ul style="list-style-type: none"> <li>● Calculating the probability of a Type I or a Type II error occurring</li> <li>● The expectation and variance of functions of random variables are introduced, and the concept of a Cumulative Distribution Function is also covered here</li> <li>● Understanding and using the Exponential Distribution as a model for the time between random events.</li> </ul>

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S p r i n g 2	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Algebraic manipulation involving fractions</li> <li>● Division of polynomials and using the Factor Theorem</li> <li>● Working with the reciprocal trigonometric functions, including further identities and solving equations</li> <li>● Coordinate Geometry and the equation of a circle</li> <li>● Differentiation involving the Product and Quotient Rules</li> <li>● Integration by Parts</li> <li>● Solving equations using the Newton-Raphson method</li> <li>● Modelling real-life situations involving exponential growth or decay</li> <li>● Developing the concept of a recurrence relation to describe/generate sequences</li> </ul> <p>Applied Maths:</p> <ul style="list-style-type: none"> <li>● Use and interpret visual representations, including histograms, box plots and scatter diagrams</li> <li>● Vectors in 3 dimensions</li> <li>● Extending probability to cover the concept of conditional probability</li> <li>● Introduction to the Normal probability distribution</li> </ul>	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Working with the coordinate geometry of a plane, including finding both Cartesian and vector equations of a plane</li> <li>● Calculating and using the vector (or 'cross') product of two vectors</li> <li>● Development of Polar Coordinates to be able to find the area enclosed by a curve given in Polar form</li> <li>● Further applications of calculus including: <ul style="list-style-type: none"> <li>- evaluating improper integrals</li> <li>- integration using Partial Fractions where the denominator contains a quadratic factor</li> <li>- integration of more difficult rational functions using appropriate trigonometric substitutions</li> <li>- calculating arc lengths/surface areas of revolution</li> <li>- derivation and use of reduction formulae in integration</li> </ul> </li> <li>● Further work with Hyperbolic Functions that includes the introduction of the reciprocal hyperbolic functions, calculus, solving further equations and proving a variety of results using identities</li> <li>● Further integration of rational functions using appropriate hyperbolic substitutions</li> </ul> <p>Applied Maths:</p> <ul style="list-style-type: none"> <li>● Using dimensional analysis to check the consistency of a formula</li> <li>● Developing the work on collisions to include collisions in 2 dimensions, introducing the use of vectors where appropriate</li> <li>● Previous work on circular motion is developed to include motion in a vertical circle</li> <li>● Work on centres of mass is developed to include finding the centres of mass of lamina and certain 3D shapes</li> </ul>
S u m m e	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Developing work on functions to include inverse functions</li> <li>● Decomposition of rational functions into Partial Fractions</li> <li>● Using the Compound and Double Angle Formulae to solve trigonometric equations and to prove more advanced trigonometric identities</li> </ul>	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Solving first order and second order differential equations, including applications in real life scenarios (e.g. simple harmonic motion, damped harmonic motion and predator-prey models)</li> </ul>

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S u m m e r 2	<p>Pure Maths:</p> <ul style="list-style-type: none"> <li>● Solving trigonometric equations of the form <math>a\cos x + b\sin x = c</math></li> <li>● Drawing graphs and solving equations involving the modulus function</li> <li>● Using differentiation to solve problems involving rates of change and connected rates of change</li> <li>● Forming and solving differential equations</li> <li>● Plotting and using logarithmic graphs</li> <li>● Binomial Expansions involving rational and negative powers</li> <li>● Introduction to matrices, including calculations involving matrices and using matrices to represent transformations (Further Maths)</li> </ul> <p>Applied Maths:</p> <ul style="list-style-type: none"> <li>● Further development of Newton's Laws to incorporate the effects of friction on objects (including connected objects) moving on horizontal or sloped surfaces</li> <li>● Forming and solving differential equations to represent scenarios involving variable forces/acceleration</li> </ul>	EXAMS