

Year 12 Further Mathematics Curriculum Rationale

In the pure strand of the curriculum students build upon their A-level mathematics studies developing both a deeper understanding of topics alongside studying more abstract skills. All students study statistics, developing probability and data handling topics covered in A-level before being introduced to additional statistical models. In mechanics students develop kinematics and forces further, beginning to apply these skills to non-particle theory. They also develop further how to use their pure skills to solve mechanics problems. All A level students are expected to practise, be resilient and persevere when approaching all areas of Mathematics.

Unit	Core knowledge/skill development	Sequence	Assessment	Literacy, numeracy, PSHE, FBV, other links	ACP and VAA development	Home learning and enrichment
Complex Numbers	Extending the number system into the complex plane. Addition/ Subtraction/ multiplication of complex numbers. Representing complex numbers geometrically	Students have the skills and facts to factorise, complete the square or use quadratic formula from GCSE. This extends into the complex plane. They will become more fluent at using these skills and in unfamiliar contexts extending to cubics and factor theorem.	Initial Assessment Integral online tests: C1, C2		Realising – Automaticity Hardworking – Practice	Review lesson notes Integral online tests / worksheets Questions from the textbook
Matrices	Introduction to matrices. Add, subtract, multiply by a scalar. They will use and understand the zero and identity matrix. This extends to matrix transformations	This is a new skill introduced at further level. The focus here is the familiarisation of working with matrices and understanding the algebraic versatility	Integral online tests: M1, M2, M3 Topic Test: Matrices 1		Linking - Connection finding Hardworking – Practice	Review lesson notes Integral online tests / worksheets Questions from the textbook

Unit:	Core knowledge/skill development:	Sequence:	Assessment:	Literacy, numeracy, PSHE, FBV, other links	ACP and VAA development:	Home learning and enrichment
	confined to reflection or rotation. This extends further to finding invariant points and lines for a linear transformation	of these for transformations				
Roots of Polynomials	Introduction to roots understanding how to use the sum and product of roots of a quadratic equation. Understand the roots of cubics and quartics and its coefficients. Use the relationships between these to form new equations. This extends into polynomials with complex roots.	This extends knowledge of roots that students learn at GCSE and they learn how to use the sum and product of roots of a quadratic equation. This extends to understanding how to calculate and use the roots of cubics, quartics and their coefficients and the relationships between these to form new equations.	Integral online tests: R1, R2 Topic Test: Further Algebra		Analysing- Complex and multi-step problem solving Linking – generalisation.	Review lesson notes Integral online tests / worksheets Questions from the textbook
Conics	Recognise the equations of parabolas, hyperbolas and ellipses. Find points of intersection with coordinate axis straight lines and	This extends on GCSE knowledge of equations of circles and parabola and	Integral online tests CS1	Vocabulary of classification of types of curves	Linking – Connection finding Analysing – Precision	Integral online tests / worksheets Questions from the textbook

Unit:	Core knowledge/skill development:	Sequence:	Assessment:	Literacy, numeracy, PSHE, FBV, other links	ACP and VAA development:	Home learning and enrichment
	curves. Find equations of asymptotes, tangents and normal.					Past exam questions written homework
Hyperbolic Functions	Introduction to Hyperbolic Functions. Defining $\sinh x$, $\cosh x$, $\tanh x$ including their domains and ranges and be able to sketch their graphs	This is a new skill introduced at further level. The focus here is the familiarisation of definitions and working with hyperbolic functions and the associated algebra	Integral online test: H1	Vocabulary of classification of types of functions and curves	Linking – generalisation	Integral online tests / worksheets Questions from the textbook Exam questions written Homework
Sequences and Series	Use and apply standard results for the sum of integers, squares and cubes. Learn method of differences and proof by induction. Find the Maclaurin series of a function including the general term. Recognise such sequences including $\ln x$, e^x $\sin x$ $\cos x$.	This extends knowledge of sequences that students learn at GCSE and they learn how to use the sum of such in sigma notation. This extends to understanding how Maclaurin series can be applied algebraically and develops the skill of proof by induction	Integral online tests: S1, S2 Topic Test: Series and Sums		Analysing – Critical or logical thinking Analysing – Precision	Integral online tests / worksheets

Unit:	Core knowledge/skill development:	Sequence:	Assessment:	Literacy, numeracy, PSHE, FBV, other links	ACP and VAA development:	Home learning and enrichment
Further Calculus	Derive formulae for and calculate volumes of revolution. Understand and evaluate the mean value of a function.	Builds on the calculus taught in A-level. Understand when a volume of revolution is formed. Be able to calculate the mean value of a function	Integral online tests: Calculus and Polar coordinates Topic Test: Calculus and Polar coordinates		Linking – Connection finding Analysing – Precision	Review lesson notes Integral online tests / worksheets Questions from the textbook
Polar co-ordinates	Understand and use polar coordinates and be able to convert between polar and Cartesian coordinates. Sketch curves with r given as a function of θ , including use of trigonometric functions	A new skill for further maths. Builds upon A-level knowledge of cartesian form equations and graphs. Students will learn the terms 'pole', 'initial line' and the convention that angles will be in radians taken as positive in the anticlockwise direction from the initial line about the pole.	Integral online tests: P1 Topic Test: Calculus and Polar coordinates	Vocabulary of classification of types of functions and curves	Analysing - Critical or logical thinking. Linking - Imagination Agile - Risk taking (the ability to demonstrate confidence speculate willingly and work in unfamiliar contexts)	Review lesson notes Integral online tests / worksheets

Unit:	Core knowledge/skill development:	Sequence:	Assessment:	Literacy, numeracy, PSHE, FBV, other links	ACP and VAA development:	Home learning and enrichment
Vectors	Calculations with vectors. Use the vector and cartesian form of an equation of a straight line in 3D. Learn scalar product and its application in calculating angle between lines. Calculate distances between two vectors.	This unit further develops the skills taught in A-level maths. Students will be able to convert between the different forms of straight line representation and apply this across a wide range of problems including intersection of two lines, angle between them and shortest distance between two skew lines	Integral online test: V1, V2 Topic Test: Further Vectors		Creating – Flexible thinking Analysing – Critical or logical thinking Analysing – Precision	Integral online tests / worksheets Exercises from the textbook
Complex Numbers and Geometry	Use and interpret Argand diagrams. Convert between the Cartesian form and the modulus / argument form of a complex number. Multiply and divide complex numbers in modulus / argument form. Construct and interpret simple loci	Students have studied complex earlier in the course. This unit builds confidence with these ideas and extends them further. Primarily students will learn the geometrical properties of complex numbers	Topic Tests: Complex Numbers 1 Integral online tests: G1, G2	Vocabulary of classification of types of functions and curves	Analysing- Complex and multi-step problem solving Linking – generalisation.	Integral online tests / worksheets

Unit:	Core knowledge/skill development:	Sequence:	Assessment:	Literacy, numeracy, PSHE, FBV, other links	ACP and VAA development:	Home learning and enrichment
	in the Argand diagrams.	on an Argand diagram.				
Graphs of Rational functions and inequalities.	Recognise and sketch different types of curves of the rational function form	Builds upon GCSE and A-level curve sketching and the work covered in the quadratic equations and polynomials units of work.	Integral online tests: RF1, RF2. Topic Test: Rational functions		Metathinking – Metacognition	Use geogebra / desmos to explore the behaviour of curves Integral online tests / worksheets
Matrices	Calculate determinants of 2×2 matrices and 3×3 matrices and interpret as scale factors. Calculate and use the inverse of non-singular 2×2 matrices and 3×3 matrices.	Students have studied complex earlier in the course. This unit builds confidence with these ideas and extends them further. Primarily students will learn the about the versatility of vectors and their applications along with vector calculations.	Integral online tests: M4 Topic Tests: Matrices 2 Past exam questions written homework.	Vocabulary of classification of types of functions.	Linking – Big picture thinking Linking - generalisation Linking – connection Finding Linking – Abstraction Analysing – Precision	Integral online tests/worksheets Exercises from the textbook Past exam questions written homework
Work, Energy and Power	Learn and apply the energy equations. Work done, Kinetic energy, Gravitational potential energy.	Builds on work taught at GCSE. Understand that total energy of a system may be	Integral online tests: E1, E2 Topic Tests: Work, energy and power	Links to Physics	Linking - Connection finding Linking - Big picture thinking	Review lesson notes Integral online tests / worksheets

Unit:	Core knowledge/skill development:	Sequence:	Assessment:	Literacy, numeracy, PSHE, FBV, other links	ACP and VAA development:	Home learning and enrichment
	Power. Students should understand that power is the rate at which a force does work	changed through work done by or against an external force. Students will interpret multi-layered energy problems and understand the links between work done and the change of energy in its different forms. Learn that power is the rate at which a force does work.			Analysing – Precision	Textbook questions
Impulse and momentum	Conservation of momentum, Newtons Experimental Law, coefficient of restitution. Impulse and its relation to momentum. Impulse for variable forces.	Understand how to calculate momentum and apply it across a range of scenarios. Learn how to calculate the coefficient of restitution. Understand that impulse can be regarded as change in momentum. Introduce calculus for variable forces.	Integral online tests: I1, I2 Topic Tests: Momentum and collisions		Analysing – Critical or logical thinking Creating – Flexible thinking	Review lesson notes Integral online tests / worksheets Textbook questions

Unit:	Core knowledge/skill development:	Sequence:	Assessment:	Literacy, numeracy, PSHE, FBV, other links	ACP and VAA development:	Home learning and enrichment
Dimensional Analysis	Finding dimensions of quantities; checking for dimensional consistency. Prediction of formulae; finding powers in potential formulae.	A new skill where students will find the dimensions of familiar quantities with compound units. Understand the concept of a dimensionless constant. Determine the power of each variable in a partially completed formula.	Integral online tests: D1 Topic Test: Impulse and dimensional analysis	Links to Physics examining formulae and modelling in scientific situations.	Linking - Generalisation Analysing – Precision Analysing – Complex and multistep problem solving	Review lesson notes Integral online tests / worksheets Textbook questions
Hooke's Law and Elastic Potential energy	Applying Hooke's law to strings and springs. Using Hooke's law with more than one spring. Learn and apply elastic potential energy formula. Modelling vertical motion involving elastic forces.	Students will understand the difference between stiffness and modulus of elasticity. They learn that the tension in a stretched elastic string or spring is proportional to the extension. Questions may be set where elastic potential energy is converted to or from kinetic energy or gravitational potential energy.	Integral online tests: H1 Topic Test: Work done by variable force, EPE and power	Vocabulary of Links to Physics	Analysing – Complex and multistep problem solving Linking – Big picture thinking	Review lesson notes Integral online tests / worksheets Textbook questions Past exam questions written homework

Unit:	Core knowledge/skill development:	Sequence:	Assessment:	Literacy, numeracy, PSHE, FBV, other links	ACP and VAA development:	Home learning and enrichment
Circular Motion	Motion of a particle moving in a circle with constant speed. Understand the definition of angular speed. Relationships between speed, angular speed, radius and acceleration.	This unit builds upon the ideas covered in Kinematics extending to circular motion. Problems will involve either horizontal circles or situations, such as a satellite describing a circular orbit, where the gravitational force is towards the centre of the circle.	<p>Integral online test: C1</p> <p>Topic Tests: Circular Motion</p> <p>Past exam questions written homework</p>		<p>Linking – Big picture thinking</p> <p>Analysing - Complex and multistep problem solving</p>	<p>Review lesson notes</p> <p>Integral online tests / worksheets</p> <p>Textbook questions</p>