Subject Curriculum Overview

Subject: A Level Further Mathematics		Year Group: 12	AUTUMN TERM
Topic	**Key Learning Points**	**Key Vocabulary**	**Assessments**
FP1 – Complex numbers	• Solve any quadratic equations with real coefficients • Solve cubic or quartic equations with real coefficients (given sufficient information to deduce at least one root for cubics or at least one complex root or quadratic factor for quartics). • Add, subtract, multiply and divide complex numbers in the form x + iy with x and y real; understand and use the terms 'real part' and 'imaginary part' • Understand and use the complex conjugate • Know that non-real roots of polynomial equations with real coefficients occur in conjugate pairs. • 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 in the Argand diagram such as $\|z - a\| > r$ and $\arg(z - a) = \theta$	Imaginary number Complex number Complex conjugate Argand diagram Real axis Imaginary axis Modulus Argument Modulus argument form Half line	Weekly assignments used to assess understanding of current and previous knowledge Test in the week before Autumn half term holiday covering blocks FP1 and FP2
FP2 – Algebraic series	• Understand and use the relationship between roots and coefficients of polynomial equations up to quartic equations. • Form a polynomial equation whose roots are a linear transformation of the roots of a given polynomial equation (of at least cubic degree). • Solve inequalities involving polynomials (up to quartics) • Understand and use formulae for the sums of integers, squares and cubes and use these to sum other series. • Understand and use the method of differences for summation of series. • Construct proofs using mathematical induction; contexts include sums of series, divisibility, and powers of matrices.	Method of differences Proof by induction	

FP3 – Rational functions	• Draw graphs of rational functions formed from linear functions, including cases when some of these coefficients are zero • Draw graphs of rational functions formed from quadratic functions, including cases when some of these coefficients are zero • Identify asymptotes parallel to coordinate axes and oblique asymptotes. • Solve inequalities involving rational functions • Using quadratic theory (not calculus) to find the possible values of the function and coordinates of the stationary points of the graph for rational functions • Convert between Cartesian and polar coordinates • Convert between Cartesian and polar equations • Sketch polar curves and find points of intersection • Sketch graphs of conic curves including intercepts with axes and equations of asymptotes of hyperbolas • Know the definitions of sinhx, coshx and tanhx in terms of exponentials • Calculate exact values and solve equations involving hyperbolic functions • Know and use the identity $\cosh^2 x - \sinh^2 x \equiv 1$ • Derive the logarithmic form of inverse hyperbolic functions and calculate exact values	Rational function Asymptote Polar graph Polar coordinate Parabola Ellipse Hyperbola Rectangular hyperbola Hyperbolic function	Weekly assignments used to assess understanding of current and previous knowledge
FP4 – Matrices	• Understand the language associated with matrices • Add, subtract and multiply conformable matrices • Multiply a matrix by a scalar. • Understand and use zero and identity matrices. • Use matrices to represent linear transformations in 2D; successive transformations; single transformations in 3D (3D transformations confined to reflection in one of x = 0, y = 0, z = 0 or rotation about one of the coordinate axes) • Find invariant points and lines of invariance for a linear transformation. • Calculate determinants of 2 × matrices and interpret as scale factors	Matrix Element Zero matrix Identity matrix Conformable Order of matrix Transpose Transformation matrix Invariant points Line of invariance Determinant Singular matrix Inverse matrix	Test in the week before Christmas holiday covering blocks FP3 and FP4

Subject Curriculum Overview

Subject: A Level Further Mathematics		Year Group: 12	SPRING TERM
Topic	**Key Learning Points**	**Key Vocabulary**	**Assessments**
FP5 – Further integration	• Understand and evaluate the mean value of a function • Derive formulae for and calculate volumes of revolution when an area is rotated about the x-axis • Derive formulae for and calculate volumes of revolution when an area is rotated about the x-axis • Calculate more complicated volumes of revolution by adding or subtracting volumes	Mean value Volume of revolution	Weekly assignments used to assess understanding of current and previous knowledge Test in the week before Autumn half term holiday covering blocks FP5 and FP6
FP6 – Further vectors	• Understand and use the vector and Cartesian forms of an equation of a straight line in 3D • Understand and use the vector and Cartesian forms of the equation of a plane • Check whether vectors are perpendicular by using the scalar product • Find the intersection of two lines • Calculate the angle at which two intersecting vectors meet • Calculate the perpendicular distance a point to a line	Scalar product Skew	
FS1 – Discrete and continuous random variables	• Understand discrete random variables with distributions given in the form of a table or function. • Evaluate probabilities for a discrete random variable • Evaluate measures of average and spread for a DRV to include mean, variance, standard deviation, mode and median • Know the discrete uniform distribution defined on the set 1,2, …, n • Understand conditions for a Poisson distribution to model a situation • Know the Poisson formula and calculate Poisson probabilities using the formula or equivalent calculator function • Know mean, variance and standard deviation of a Poisson distribution • Use the result that in a Poisson distribution the mean and variance of X are equal • Understand the distribution of the sum of independent Poisson distributions • Evaluate probabilities for a continuous random variable • Evaluate measures of average and spread for a CRV to include mean, variance, standard deviation, mode and median	Discrete random variable Expectation Variance Discrete uniform distribution Poison distribution Poison probability Continuous random variable	Weekly assignments used to assess understanding of current and previous knowledge

Subject Curriculum Overview

FM1 – Work energy and power	• Solve problems involving work done by a force acting in the direction of motion or directly opposing the motion • Use gravitational potential and kinetic energy in conservation of energy problems • Know Hooke's Law including using modulus of elasticity • Solve problems involving work done by a variable force • Solve problems involving elastic potential energy using modulus of elasticity and apply in conservation of energy problems • Check equations using dimensional analysis	Work done Kinetic energy Gravitational potential energy Elastic potential energy Modulus of elasticity Dimensional analysis	Weekly assignments used to assess understanding of current and previous knowledge
FM2 – Momentum and collisions	• Solve problems involving conservation of momentum for linear motion and cases where velocities are given as one- or two-dimensional vectors • Look at the coefficient of restitution and Newton's Experimental Law • Use coefficient of restitution in direct collisions and impacts with a fixed smooth surface • Understand impulse and its relation to momentum • Find the size of an impulse for constant and variable forces	Momentum Impulse Conservation of momentum Coefficient of restitution	

Subject Curriculum Overview

Subject: A Level Further Mathematics		Year Group: 12	SUMMER TERM
Topic	**Key Learning Points**	**Key Vocabulary**	**Assessments**
FS2 – Hypothesis testing and contingency tables	• Perform a hypothesis test for data which follows a Poisson distribution • Use a contingency table to calculate expected frequencies and Chi squared contributions • Calculate the number of degrees of freedom, and the critical value or the p-value of the test statistic • Perform a test for association • Interpret the result of a test for association in context and describe the association • Use Yate's correction appropriately	Hypothesis test Null hypothesis Alternate hypothesis Critical value p-value Critical region Acceptance region Contingency table Degrees of freedom Association	Further statistics test on completion of blocks FS1 and FS2
FM3 – Circular motion	• Motion of a particle moving in a circle with constant speed Understand the definition of angular speed using both radians and revolutions per unit time. • Study the relationships between speed, angular speed, radius and acceleration • Look at conical pendulum, with one or two strings • Study circular motion in a vertical plane Including the conditions to complete vertical circles. Use of conservation of energy in this context	Angular velocity Revolutions per minute Centripetal force	Further mechanics test on completion of blocks FM1, FM2 and FM3

FP7 – Curve sketching	• Use graphical and algebraic methods to find and sketch reciprocal and modulus functions • Use graphical and algebraic methods to solve inequalities involving reciprocal and modulus functions • Enlarge and rotate graphs of conic sections • Combine transformations of conic sections • Sketch graphs of inverse hyperbolic functions and state each domain and range • Sketch the graphs of reciprocal hyperbolic functions and state each domain and range • Know, prove and use identities involving hyperbolic functions • Solve equations involving hyperbolic functions • Understand and use the concept of an oblique asymptote, including finding the equation of an oblique asymptote	Reciprocal function Modulus function Asymptote Oblique asymptote Parabola Ellipse Hyperbola Rectangular hyperbola Hyperbolic function	Weekly assignments used to assess understanding of current and previous knowledge
Preparation, analysis and review of Year 12 exams	• Preparation for Year 12 exams including learning of key knowledge and formulae • Completion of practice and past papers • Students sit a full set of AS level exam papers • Feedback and evaluation		

Subject Curriculum Overview

How parents can support learning in the subject this academic year

Practice of mathematical skills is an essential part of students developing confidence, building fluency and improving problem-solving skills.
Students are expected to complete at least 6 hours of independent work per week:

- 4 hours of tutorial work (one hour after each lesson). Students are expected to self-mark this work and seek help when experiencing difficulties.
- 1 hour of revision work. Students will be set a revision task each week which will help them to remember key knowledge and practice previously taught skills.
- 1 hour of assessed work. Students will be given a weekly assignment focusing on the skills that they have recently been taught in lessons. This will be used to assess their understanding of a topic and may result in follow up work requiring to be completed.

Due to the hierarchical structure of Mathematics, it is vital that students catch up on any work missed through absences. Students should copy up notes and examples from lessons into their notebooks and attempt any tutorial work set. If they need support with the work then please encourage them to speak to their teacher or attend Maths Club where staff will be there to help and support.

Recommended Reading

Why do Buses Come in Threes? - Rob Eastaway/Jeremy Wyndham
How to Cut a Cake? - Ian Stewart
The Number Mysteries - (Marcus Du Sautoy
Thinking in Numbers - Daniel Tammet
Closing the Gap: The Quest to Understand Prime Numbers - Vicky Neale
50 Mathematical Ideas You Really Need to Know - Tony Crilly
The Hidden Mathematics of Sport - Rob Eastaway/John Haigh
Fermat's Last Theorem - Simon Singh
The Music of the Primes - Marcus du Sautoy

Points to note

Students are expected to bring a graphical calculator to every maths lesson. The model we currently recommend is the Casio FX CG50S. This calculator can be purchased through the school via parentpay at a significant discount to what is available commercially.