

Subject Curriculum Overview for Academic Year 2022/2023

Subject: Further Mathematics		Subject Leader: Mr S Card	Year Group: 13	AUTUMN TERM
Topic	Key Learning Points		Key Vocabulary	Assessments
FP8 – Further Series	<ul style="list-style-type: none"> Express functions in terms of its partial fractions and use these within summations Find the sum of a series using the method of differences Derive the Maclaurin series for a function and find its range of validity Find the limit of a function Use L'Hopital's rule to find the limits of function written in indeterminate form 		Partial fraction Maclaurin series Limit	Weekly assignments used to assess understanding of current and previous knowledge Test in the week before Autumn half term holiday covering blocks FP7, FP8 and FP9
FP9 – Further complex numbers	<ul style="list-style-type: none"> Convert between complex numbers from Cartesian to exponential form and vice-versa Find the modulus and argument of products and quotients of complex numbers Use de Moivre's theorem to simplify powers of complex numbers Use de Moivre's theorem to prove trigonometric identities Simplify powers of trigonometric functions using a binomial expansion Calculate and solve problems involving roots of unity Calculate the nth root of a complex number 		Exponential form Complex conjugate Root of unity	
FP10 – Further calculus	<ul style="list-style-type: none"> Evaluate improper integrals where either the integrand is undefined at a value in the range of integration or the range of integration extends to infinity Integrate using partial fractions Differentiate inverse trigonometric functions Integrate functions using standard integrals and be able to choose trigonometric substitutions to integrate associated functions. Solve problems involving arc lengths and area of surface of revolution for curves expressed in Cartesian or parametric coordinates. Derivation and use of reduction formulae for integration. Find the area enclosed by a polar curve. 		Improper integral Convergent Divergent Reduction formula Surface area of revolution Arc length	Weekly assignments used to assess understanding of current and previous knowledge

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<p>FP11 – Further matrices</p>	<ul style="list-style-type: none"> • Calculate the determinant and inverse of a 3 by 3 matrix. • Use determinants as scale factors and appreciate the implications of a matrix having a negative determinant. • Use matrices to solve systems of linear equations. • Identify when a system of 3 simultaneous equations has a unique solution, many solutions and no solutions, and interpret graphically. • Understand the effect of row and column operations on the determinant of a matrix and use these to factorise. • Find the eigenvalues and eigenvectors of a 2 by 2 and 3 by 3 matrix • Understand the geometrical significance of eigenvalues and eigenvectors • Diagonalise square matrices • Use diagonal form to find the power of a matrix 	<p>Determinant Transpose Matrix of minors Row/column operation Eigenvector Eigenvalue Diagonalise</p>	<p>Weekly assignments used to assess understanding of current and previous knowledge</p> <p>Test in the week before Christmas holiday covering blocks FP10 and FP11</p>
<p>FM4 – Further circular motion</p>	<ul style="list-style-type: none"> • Use vectors to solve certain problems with circular motion • Solve problems when motion is in a horizontal plane including conical pendulums • Solve circular motion problems when the motion is in a vertical plane 	<p>Angular velocity Centripetal force Radial component Tangential component</p>	<p>Weekly assignments used to assess understanding of current and previous knowledge</p>
<p>FM5 – Centres of mass and stability</p>	<ul style="list-style-type: none"> • Find the centres of mass of systems of point masses, frameworks, laminas and solids of revolution • Solve problems involving laminas and solids being suspended • Understand the stability of objects on inclined planes • Use the conditions for an object to be in equilibrium • Find forces and couples acting upon a system 	<p>Moment Couple Centre of mass Lamina Volume of revolution Topple Equilibrium</p>	<p>Further mechanics test on completion of blocks FM4 and FM5</p>

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Topic	Key Learning Points	Key Vocabulary	Assessments	
FP12 – Differential equations	<ul style="list-style-type: none"> Solve first order differential equations using integrating factors Set up first order differential equations from models and interpret solutions in context Solve second order differential equations using auxiliary equations Set up second order differential equations from models and interpret solutions in context Understand how the motion of an object moving in simple harmonic motion can be represented using a second order differential equation Understand the different types of damping and solve associated problems Set up and solve a system of coupled equations 	First order differential equation Separation of variables Integrating factor Second order differential equation Auxiliary equation Complimentary function General solution Particular solution Simple harmonic motion Critical damping Heavy damping Light damping Coupled equations	Weekly assignments used to assess understanding of current and previous knowledge	
FP13 – Numerical methods	<ul style="list-style-type: none"> Find an approximation of the area under a graph using the mid-ordinate rule Find an approximation of the area under a graph using the Simpson's rule Find the relative error between an approximation and the accurate answer Use Euler's step-by-step first order method for equations of the form $y' = f(x,y)$ Use improved Euler methods for equations of the form $y' = f(x,y)$ 	Numerical method Ordinate Mid-ordinate rule Simpson's rule Relative error		
FP14 – Further vectors	<ul style="list-style-type: none"> Calculate the vector product of two vectors Use the vector product to calculate the size of the angle between two vectors Find a unit vector that is perpendicular to two other vectors Use the vector product to calculate areas Write the equation of lines and planes using vector form Find the intersection between a line and a plane Calculate the angle between a line and a plane or two planes Find the shortest from a point to a plane Find the shortest distance between skew lines 	Vector product Cross product		

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FS3 – Random processes	<ul style="list-style-type: none"> Calculate the cumulative distribution function and probability density function for continuous random variables Recognise and calculate the mean and variance of mixed random variables Apply rectangular and exponential probability models in different circumstances Prove and use the formulae for mean and variance of rectangular and exponential random variables 	Cumulative distribution function Exponential distribution	Weekly assignments used to assess understanding of current and previous knowledge Further statistics test on completion of blocks FS3 and FS4
FS4 – Hypothesis testing and the t-test	<ul style="list-style-type: none"> Calculate the probabilities of making type 1 and type 2 errors when conducting a hypothesis test Calculate the power of a hypothesis test Calculate the t-test statistic from a sample Identify when a t-test is an appropriate test to use and how to determine the conclusion of a t-test 	Type 1 error Type 2 error Power	
Subject: Further Mathematics		Subject Leader: Mr S Card	
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		SUMMER TERM	
Topic	Key Learning Points	Key Vocabulary	Assessments
A-level exam preparation	<ul style="list-style-type: none"> Preparation for final exams including learning of key knowledge and formulae Revision lessons on key topics and previously identified weaknesses Completion of practice and past papers 		

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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.