On – Line Programme of Learning for Year 12 – Further Mathematics

Autumn (1st term)	Autumn (2nd term)	Spring (1st term)	Spring (2nd term)	Summer (1st term)	Summer (2nd term)
From: September To: October	From: November To: December	From: January To: February	From: March To: April	From: May To: June	From: June To: July
Topic: - Core Pure 1 (AS) Complex numbers Argand diagrams Matrices Linear Transformations	**Topic: - Core Pure 1 (AS)** Series Roots of Polynomials Proof by Induction Vectors	**Topic – Further Pure 1 (AS)** Vectors Conic Sections **Topic – Further Mechanics 1 (AS)** Momentum and Impulse Work, energy and power	**Topic – Further Pure 1 (AS)** Inequalities The t-formulae Numerical Methods **Topic – Further Mechanics 1 (AS)** Elastic collisions in one dimension **Topic: - Core Pure 1 (AS)** Volumes of Revolution	**Revision for exams** **External exams will be sat this term.** **Topic – A2 Pure Maths*** Trigonometry Differentiation *For those continuing into year 13 only	**Internal Exams** **Topic – A2 Pure Maths*** Trigonometry Differentiation Integration** *For those continuing into year 13 only **If time allows due to exams and work experience
Key Skills – CP1 Understand and use the definitions of imaginary and complex numbers. Add, subtract, multiply and divide complex numbers. Understand the definition of a complex conjugate. Solve quadratic, cubic and quartic equations that have complex roots. Show complex numbers on an Argand diagram. Find the modulus and argument of a complex number. Be able to write a complex number in modulus-argument form. Represent loci and regions on an Argand diagram. Understand the concept of a matrix and define the zero and identity matrices. Add, subtract and multiply matrices. Calculate the determinant of a matrix.	**Key Skills – CP1** Understand that the Greek letter sigma, ∑, is used in mathematics to represent a sum. Use standard formulae for series summations to prove algebraic results. Evaluate and simplify series summations for linear, quadratic and cubic summations. Derive and use the relationships between the roots of quadratic, cubic and quartic equations. Evaluate expressions relating to the roots of polynomials. Find the equation of a polynomial whose roots are a linear transformation of the roots of a given polynomial. Understand the principle of proof by mathematical induction. Prove results about sums of series, divisibility and	**Key Skills – FP1** Find the vector product of two vectors. Be able to interpret the modulus of the vector product as an area. Find the scale triple product of three vectors and be able to interpret it as a volume. Plot and sketch a curve expressed parametrically. Work with the Cartesian equation and parametric equations of a parabola and a rectangular hyperbola. Find the equation of tangents and normal to parabolas and rectangular hyperbolas Understand the focus-directrix property of a parabola. Solve locus problems involving the parabola and rectangular parabola.	**Key Skills – CP1** Find the volume of revolution when a curve is rotated about either the x-axis or the y-axis. Model real-life objects using volumes of revolution. **Key Skills – FP1** Manipulate inequalities involving algebraic fractions. Use graphs to find solutions to inequalities. State the t-formulae Apply the t-formulae to trigonometric identities. Use the t-formulae to solve trigonometric equations. Find numerical solutions to first-order differential equations using Euler's method and the midpoint method. Extend Euler's method to find numerical solutions to second-order differential equations.	**Key Skills – A2 Pure** Use approximate trigonometric values for small angles. Understand the definitions of the reciprocal functions - secant, cosecant and cotangent and their relationship to cosine, sine and tangent. Simplify expressions, prove simple identities and solve equations involving secant, cosecant and cotangent. Differentiate trigonometric functions – sin x and cos x. Differentiate exponentials and logarithms.	**Skills / Key Questions – Pure** Prove and use the addition formulae. Understand and use the double-angle formulae. Solve trigonometric equations using the double angle and addition formulae. Differentiate functions using the chain, product and quotient rules. Differentiate parametric equations. Differentiate functions which are defined implicitly. Integrate standard mathematical functions including trigonometric and exponential functions and use the reverse of the chain rule to integrate functions of the form f(ax+b). Use trigonometric identities in integration. Use the reverse of the chain rule to integrate more complex functions.

Find the inverse of a matrix. Use matrices to solve systems of equations. Interpret simultaneous equations geometrically. Understand the properties of linear transformations and represent them using matrices. Perform reflections, rotations, enlargements and stretches using matrices. Find the coordinates of invariant points and the equations of invariant lines. Carry out successive transformations using matrix products. Understand linear transformations in three dimensions. Use inverse matrices to reverse linear transformations.	matrices using mathematical induction. Understand and use the vector and Cartesian forms of the equation of a straight line in three dimensions and of a plane. Calculate the scalar product of two 3D vectors. Calculate the angle between two vectors, two lines, a line and a plane, or two planes. Understand and use the scalar product form of the equation of a plane. Determine whether two lines meet and determine the point of intersection. Calculate the perpendicular distance between two lines; a pint and a line, or a point and a plane.	Key Skills – FM1 Calculate the momentum of a particle and the impulse of a force. Solve problems involving collisions using the principle of conservation of momentum. Calculate the work done by a force when its point of application moves. Calculate the kinetic energy of a moving particle and the potential energy of a particle. Use the principle of conservation of mechanical energy and the work-energy principle. Calculate the power developed by an engine.	Key Skills – FM1 Solve problems involving the direct impact of two particles by using the principle of conservation of momentum and Newton's law of restitution. Apply Newton's law of restitution to problems involving the direct collision of a particle with a smooth plane surface. Find the change in energy due to an impact or the application of an impulse. Solve problems involving successive direct impacts.		
Assessments: At AS students will be assessed on their ability to A01 (60%): Use and apply standard techniques – i.e. be able to (i) select and carry out routine procedures; (ii) accurately recall facts, terminology and definitions A02 (at least 10%): Reason, interpret and communicate mathematically – i.e. be able to (i) construct rigorous mathematical arguments (including proofs); (ii) make deductions and inferences; (iii) assess the validity or mathematical arguments; (iv) explain their reasoning; (v) use mathematical language and notation correctly A03 (at least 10%): Solve problems within mathematics and in other contexts – i.e. be able to (i) translate problems in mathematical and non-mathematical contexts into mathematical processes; (ii) interpret solutions to problems in their original context, and, where appropriate, evaluate their accuracy and limitations; (iii) translate situations in context into mathematical models; (iv) use mathematical models; (v) evaluate the outcome of modelling in context. Recognise the limitations of models and, where appropriate, explain how to refine them.					
End of term 1 assessment to cover: All content taught in Autumn 1 will be assessed in November		End of term 2 assessment to cover: All content taught in Autumn 1, Autumn 2 and Spring 1 will be assessed in March		End of year assessment to cover: Students who are not continuing with further mathematics in Year 13 will sit the External AS papers. Students who are continuing with further mathematics in year 13 will sit internal exams consisting of the three AS papers.	
Building understanding: Rationale / breakdown for your sequence of lessons: The two teachers split so that one teaches the matrices content and the other the	Building understanding: Rationale / breakdown for your sequence of lessons: These are stand-alone topics which can be taught alongside each other. The	Building understanding: Rationale / breakdown for your sequence of lessons: FP1 Vectors follows on from CP1 vectors, introducing some practical applications.	Building understanding: Rationale / breakdown for your sequence of lessons: CP1 volumes of revolution depends on AS integration and extends the idea of	Building understanding: Rationale / breakdown for your sequence of lessons: The vast majority of the A2 content for pure further mathematics cannot be taught until the A2 trigonometry and calculus from the mathematics a level has been taught, therefore as much as possible is covered this term.	

complex numbers. Both topics provide a good introduction to further maths and build on GCSE knowledge.	algebra content is taught by one teacher and build on students' algebra skills. Vectors is taught by the second teacher and extends the concepts of Cartesian equations of lines taught in AS mathematics to introduce vector equations of lines and planes.	The first half of the topic of conic sections is covered at AS and is a prerequisite for the A2 content. The prerequisite for this topic is AS differentiation. FM1 extends AS mechanics skills to include momentum and collisions. Some A2 mechanics content has to be introduced before students can access the topic of work, energy and power.	finding areas under curves to finding volumes created when curves are rotated. FP1 t-formulae depends on AS trigonometry and is an extension to these concepts. FP1 numerical methods serves as an introduction to the topic of differential equations which features heavily at A2. In FM1, students finish by looking at elastic collisions in 1 dimension – this is a perquisite for collisions in 2-dimensions at A2.	Students need to be fluent in A2 calculus skills to access the CP2 and FP1 content, so it is beneficial to cover as much of this content as possible before the summer to give time for consolidation before year 13. If all students are continuing into year 13, then we will start this content earlier and cover numerical methods in year 13.	
Calendared Centrally Planned Extended Home – Learning Tasks: End of chapter assessments	**Calendared Centrally Planned Extended Home – Learning Tasks:** End of chapter assessments	**Calendared Centrally Planned Extended Home – Learning Tasks:** End of chapter assessments	**Calendared Centrally Planned Extended Home – Learning Tasks:** End of chapter assessments	**Calendared Centrally Planned Extended Home – Learning Tasks:** End of chapter assessments	**Calendared Centrally Planned Extended Home – Learning Tasks:** End of chapter assessments

Reading / literacy / Oracy:
For reading in mathematics, see the links under enrichment.
For literacy, students will learn how to break down long worded problems to extract the mathematics involved. This will be modelled in the classroom.
Students should get used to reading all parts of the textbook / exam questions and challenging words they don't understand.

Numeracy:
Students should be numerate in terms of knowing what a sensible answer looks like for any question they answer and not simply relying on the calculator.

Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC):

Plus Magazine https://plus.maths.org/content/– an online magazine that provides articles and podcasts for all aspects of mathematics, often discussing aspects of mathematics underlying recent news stories. They regularly interview people in maths-based careers and so this is a great source of inspiration for real world mathematics.

Imperial College run an on-line programme (including masterclasses and MOOCs) in the spring and summer term for students in year 12 who are considering mathematics at university and aiming for an A* - https://www.imperial.ac.uk/be-inspired/schools-outreach/secondary-schools/mentoring-and-tutoring/maths-online-programme/

The practice materials for university admissions provide enrichment and challenge on AS topics for students aspiring to the top grades. TMUA is the most accessible. https://www.admissionstesting.org/for-test-takers/test-of-mathematics-for-university-admission/preparation/ ; whilst the Oxford MAT papers are more challenging https://www.maths.ox.ac.uk/study-here/undergraduate-study/maths-admissions-test/mat-past-papers

A padlet of resources for enrichment and revision for Featherstone students is kept here https://padlet.com/lemerson3/KS5maths