A-level Further Mathematics
Curriculum Map

TRINITY SIXTH FORM ACADEMY

A-level Further Mathematics						
Term	**Content**	**Knowledge / Skills**	**Assessment**	**Rationale**	**Spaced Repetition**	**Civic Virtues / Industry**
1 and 2	Core Pure AS Unit 1: Complex Numbers Core Pure AS Unit 4: Series Core Pure AS Unit 5: Algebra and Functions Core Pure AS Unit 6: Proof by Induction Core Pure Unit 2 a - c: Matrices Core Pure AS Unit 2d: Matrices Further Statistics 1 unit 3: Geometric Progression	• Introduction of complex numbers, basic manipulation; • Complex conjugate, division and solving polynomial equations; • Argand diagrams; • Modulus and argument; • Loci; • Sums of series; • Roots of polynomial equations; • Formation of polynomial equations; • Proof by mathematical induction; • Matrix addition, subtraction and multiplication; • Inverse of 2 × 2 and 3 × 3 matrices; • Simultaneous Equations • Linear transformations. • Geometric Progression • Hypothesis Testing • Finding Critical Values	Progress Checks: PC1 PC2	Starting with complex numbers straight after GCSE sets the standard for the high level of maths required in the course. It is a good test of students' skills in algebra, geometry, graphing and numeric manipulation for which we have high expectations at this level. The graphical work complements the work on graphs in Mathematics in Terms ½. As algebraic manipulation becomes a focus in year 12 Mathematics, roots of polynomials and sums of series makes use of the same skills and shows links between the two A levels. Both of these concepts are familiar to students already, but have not been formalised in mathematical notation. Notation will remain a key focus throughout FM. Proof by induction is taught just before students look at proof in year 12. It links back to sums of series and forwards to Matrices, so is an ideal standalone topic at this point, to be revisited in Y13. Matrices moves from 2x2 to 3x3, creating a link to 3D vectors in term 3. As students are being taught Statistics (probability) at this point in year 12, in FM we move on to Geometric Probability and introduce them to Hypothesis Testing and Critical Values	Spaced Repetition: Paper 1 Paper 2 Paper 3 Weekly Fluency Check	Complex numbers reignite students' curiosity in mathematics and shows how creative it can be. Students practise efficiency and learn to choose routes that will minimise effort for the same results. Probabilty broaches dangers of gambling, drug testing and safe sex through mathematic methods of testing safety and consistency.
3 and 4	Core Pure AS Unit 7: Vectors Further Mechanics 1 Unit 1: Momentum and Impulse (Part 1) Further Mechanics 1 Unit 4: Momentum and Impulse (Part 2) Further Mechanics 1 Unit 2: Work, Energy and Power	• Vector and Cartesian equations of a line and a plane • Scalar product; • Problems involving points, lines and planes. • Volumes of revolution. • Momentum and impulse; impulse-momentum principle; • conservation of momentum applied to collisions; jerking string problems. • Momentum as a vector (i, j problems) Impulse-momentum principle in vector form.	Progress Checks: PC3 PC4	Vectors build on straight line graph work from Term 1 Maths, and Matrix work from Term 1 Further Mathematics. The modelling element is rich in this unit, and is a good springboard for the upcoming mechanics module. Vectors play an important role in impulse and momentum, so students will already have a good grasp of the notation to help them here. Students have a familiarity with Work, Energy and Power from Physics lessons, but here they will understand the mathematical roots of the equations, using direct proportion and differentiation. The accumulation of understanding around impulse and energy means students now have the bank of knowledge required for kinematics involving elasticity.	Spaced Repetition: Paper 4 Paper 5 Paper 6 Weekly Fluency Check	Students visualise in 3D, a skill useful in architecture, product design and computer graphics. Students will appreciate how mathematics can be used to make predictions and model movement. History around the discovery of Hooke's law is a good example of the law of multiple

	Further Mechanics 1 Unit 5: Elastic Strings and Springs and Elastic Energy	• Work, kinetic energy; derivation of units and formulae; • Potential energy, work-energy principle, conservation of mechanical energy, problem solving; • Power; derivation of units and formula. • Hooke's law and definition of modulus of elasticity; • Derivation of elastic potential energy formula; • Problem solving: equilibrium and using the work-energy principle.		Underlying all of the above are graphical representations of movement and energy, solving polynomials and mathematical modelling, all of which are revisited frequently throughout the entire course.		discoveries- what multiple discoveries have happened in our lifetime?
5 and 6	Further Statistics 1 Unit 2: Discrete Probability Distributions Further Statistics 1 Unit 1 & 3: Poisson and Binomial Distribution Further Statistics 1 Unit 4 & 8: Chi Squared Tests Core Pure Unit 8: Calculus	• Mean and Variance of Discrete Probability distributions • The Poisson Distribution • Mean and Variance of binomial and poisson distribution • Poisson as an approximation to binomial • Chi Squared Tests • Volumes of Revolution		Students will be picking up Statistics in Mathematics lessons, and will have familiarity with some probability distributions and hypothesis testing. All there is a strong link between all of the probability distributions at this point in the course and students will spent a large amount of time distinguishing between the new distributions, making links between them and evaluating the potential and appropriate uses of each in turn. Volumes of revolution has been saved until students have covered integration in Mathematics lessons and contains many of the key algebraic and geometric reasoning skills that were taught the previous term to revisit following a heavy statistical period.		This part of the course will include debate on the trustworthiness of number in statistics. Students will be referred to the podcast More or Less where statistics in national and global news is analysed and doubted.

Year 2 A-Level Mathematics						
Term	**Content**	**Knowledge / Skills**	**Assessment**	**Rationale**	**Spaced Repetition**	**Civic Virtues / Industry**
6 (Year1)	Core Pure Unit 1: Complex Numbers (Part 1) Core Pure Unit 2: Hyperbolic Functions sin*h x*, cos*h x*, tan*h x* and their inverses.	• Know and use $z = re^{i\theta} = r(\cos\theta + i\sin\theta)$; • De Moivre's theorem; • The nth roots of $z = re^{i\theta}$ and complex roots of unity.	Progress Checks: N/A	As with year 12, this starting topic contains almost every element of pure mathematics studied up until now. Links between number, geometry and algebra are at their strongest here so students will have the opportunity to practise old skills at the same time as learning new ones.	Spaced Repetition: Weekly Fluency Check	Exploration and creativity are the mothers of this complex number. Students are encouraged to use multiple methods, appreciating alternative routes to solutions and evaluating their efficiency and beauty
1 and 2	Core Pure Unit 2: Hyperbolic Functions (continued) Core Pure Unit 4: Further Algebra and Functions (Series) Core Pure Unit 3: Polar Coordinates Core Pure Unit 5a – c: Further Calculus Core Pure Unit 5d – e: Further Calculus Core Pure Unit 6: Differential Equations	• Logarithmic forms of the inverse hyperbolic functions and integrate functions of the form $1/\sqrt{(x^2 \pm a^2)}$; • Method of differences; • Maclaurin series; • Convert between Cartesian and polar and sketch r(θ); • Area enclosed by a polar curve. • Improper integrals; • Mean value of a function; • Integrate using partial fractions; • Differentiate inverse trigonometric functions and integrate using trigonometric substitutions; • Volumes of revolution; • Integrating factors to solve first order differential equations; • Second order differential equations of the form $y'' + ay' + by = f(x)$; • Modelling.		Following the (r, θ) format of complex numbers, a natural extension is to graphs that use that format, as opposed to the familiar Cartesian axes that have been used across all branches of mathematics until now. Students' knowledge of integration is ever growing and this part of the course contains the highest level calculus they will do in school. They are encouraged to create their own taxonomy surrounding different types of integration, so that they are used to the formula book in the run up to the examination period In the lead up to Oxbridge interviews, there will be an increased focus towards graph sketching and vocalising thought to explain reasoning. First and Second order differentials are the zenith of all student understanding up to this point and a good topic to study at the time of interviews/university preparation as the modelling element is far reaching into many subject areas.	Progress Checks: PC5	A Problem Solving course for Year 13 students starts at this time, allowing an opportunity for students to go to Halifax Library and meet like-minded students in a tutorial style learning environment. This is good preparation for university style tests, and to partake in high level conversations in unfamiliar circumstances, hoping to build confidence for our students for when they leave school.
3 and 4	Further Statistics 1 Unit 7: The Central Limit Theorem Further Statistics 1 Unit 9: Probability Generating Functions Further Statistics 1 Unit 10: Quality of Tests and Estimators	• The Central Limit Theorem • Applications to other distributions • Definitions, derivations, applications and use to find the mean and variance • Use of Probability Generating Functions for negative binomial, geometric, binomial and Poisson distribution • Probability generating function of the sum of independent random variables • Type 1 and 11 errors.	Progress Checks: PC4 (Trial Examination)	As differential equations encompassed all the previous pure topics, Probability Generating Functions will pick up the many probability distributions studied throughout the course. It also picks up summations (geometric, binomial and Power series), highlighting the unsuspected highly algebraic nature of probability functions. As this is less rigorous than the pure elements, there is time at this stage to consolidate any gaps in knowledge through homework or extra sessions.	Spaced Repetition: Paper 5 Paper 6 Paper 7 Weekly Fluency Check	Quality of Tests generates further opportunity for students to consider the authenticity of statistics, they will discuss how the same data can be used to argue conflicting hypotheses. This can be applied to data in the news, as well as experimental data collected in other classes such as psychology, biology or chemistry.
5	CHAPTER 5 2020				Spaced Repetition: Paper 8 Paper 9	
External Examinations						