Topic Sequencing and Rationale

Key Stage 3 Maths

	Year	What is taught? Overview of Topics	Why this? Why then?
KS3	7	• N1 Place Value • N2 Types of Number • N3 Four Operations • N4 Associated Calculations • N5 Fractional Thinking • G1 Perimeter and Area • N6 Directed Number • A1 Algebraic Proficiency • A2 Algebraic Thinking	Year 7 is designed to link the KS2 and KS3 mathematics content, to bridge students' gaps from primary maths knowledge (across an intake from 30 feeder schools). Number topics are an initial focus to ensure that students know and understand the key mathematical structures underpinning numerical calculations in different contexts (e.g., integers, decimals and fractions). The efficiency of calculations is also a key theme, ensuring that students select appropriate methods in different problems. Algebraic notation is introduced towards the year end, to begin generalising these ideas.
	8	• G2 Geometric Notation, properties of shape & constructions • G3 Angle Reasoning • A3 Linear Equations and inequalities • R1 Proportional Reasoning • N7 FDP Equivalence and Fractions / Percentages of Amounts • P1 Probability of single and combined events • G4 Circles • S1 Data Presentation • S2 Measures of central tendency and spread	Year 8 builds on the knowledge of number and algebra from Year 7, applying these ideas in geometrical and statistical contexts. The ideas introduced form the basis for deeper level study at KS4. There is a particular focus on the use of algebraic notation, such that generalised problems can be solved in a variety of contexts. The introduction of proportional reasoning in Year 8 is also a key idea, as this appears throughout all strands of the curriculum.
	9	• A4 Developing Algebraic Skills • A5 Sequences – Linear and Non-linear • A6 Graphs of Linear & Non–linear Functions (inc. Real Life Graphs) • N8 Compound and Simple interest • A7 Developing Algebraic Skills 2 • A8 Simultaneous Equations 1 • G5 Pythagoras' Theorem and Trigonometric Ratios • G6 3D Geometry • G7 Geometrical Transformations	Year 9 continues to consolidate and build upon material studied in Years 7 and 8, as well as introducing more advanced numeric and algebraic skills, to enable students to tackle problems in more difficult contexts, including real life modelling. More advanced geometric ideas are introduced (including Pythagoras' Theorem and Trigonometry) to facilitate further in-depth study of these areas at KS4.

Topic Sequencing and Rationale

Key Stage 4 – ***year 10 correct from September 2022, year 11 correct from September 2023.***

	Year	What is taught? Overview of Topics	Why this? Why then?
KS4	**10**	• Similarity - Congruence, similarity, trigonometry. • Developing Algebra – Working with equations and inequalities, simultaneous equations. Graphs • Geometry – Angles and bearings, circles and circle theorems. Vector geometry. • Proportion & proportional change. Working with ratio and fractions, percentage and interests. Probability and tree diagrams. • Data – collecting, representing and interpreting data. • Number – Non calculator written methods, types of number and sequences, indices and roots.	Continuing with the five-year curriculum plan for all students. These topics build on Key stage 3 National Curriculum covered through our Year 7, 8 and 9. In Key stage 4 there are more formal pathways towards; Level 1, Foundation GCSE, Higher GCSE as we take a narrower setting approach. Within each topic module we will review and extend learning from Key stage 3 as well as preparing our students for their Key stage 5 pathways. For example, in the Unit: Circles and Circle Theorems the key knowledge would review KS3 building fluency and problem solving on this knowledge. There would be further key knowledge only for Higher students on the higher content of Circle theorems. The intention of Year 10 is to develop and improve our students as Mathematicians. However, assessment during and at the end of Year 10 will inform the tier of entry for GCSE in Year 11.
		• Note: Some students will access a level 1 qualification if appropriate.	Overlap with content from GCSE foundation curriculum. This standalone qualification is studied between Feb half term and Easter will allow some students the opportunity to gain to level 1 maths qualification. Another aim to improve confidence giving students success building towards taking GCSE.
	11	• Graphs – Gradients and lines, nonlinear graphs, using graphs. • Algebra – Expanding and factorising, Changing the subject, functions. • Reasoning- Multiplicative (ratio and proportion), geometric (shapes) and algebraic. • Revision, exam preparation and mock analysis.	These are the final topics of the five-year curriculum. The previous four years have been preparing our students to develop their knowledge for these topics. The Reasoning section pull together lots of the content from across the previous four years in order to solve interconnected problems. The problem-solving skills developed here can be applied in key stage 5 and the wider world beyond.

Topic Sequencing and Rationale

Key Stage 5 – Maths A Level

	Year	What is taught? Overview of Topics	Why this? Why then?
KS5 A LEVEL MATHS	**12**	**MATHS A LEVEL** **Pure** • Algebraic Methods, Expressions & Quadratics • Equations and Inequalities • Straight Line Graphs, Graphs of Circles and Transformations. • Advanced Trigonometry • Calculus • Vectors • Exponentials and Logarithms **Statistics** • Data handling, Measures and Sampling. • Representation and Correlation • Binomial Theorem • Probability • Hypothesis Testing • Large Data Set Analysis **Mechanics** • Modeling • Forces & Motion • Constant and Variable Acceleration	A LEVEL MATHS IS SUITABLE FOR STUDENTS BUILDING FROM A BASELINE OF GCSE GRADE 6/7+ Consolidation and extension from GCSE learning. E.G. In quadratics the three solution methods, Factorising, CTS, and Formula need to be mastered in the context of the discriminant. This allows the solution of non-linear problems involving curves. In conjunction with the embedding of the algebra methods, pictorial representation of problems are required which leads to a need for an appreciation of graphical solution, including transformations such as vectors. This is further developed by a study of trigonometric graphs. Many problems in the real world look at exponential growth, such as compound interest or the spread of a virus, which can be analyses with logarithms. Review and extend from GCSE, to ensure students have a good grasp of all basic statistical concepts such as measures of average and spread (mean, mode, median, range, IQR). These concepts are further developed to include the universally recognized measure of variability in a data set - standard deviation. The conversion of experimental data (relative frequency) to established theoretical models is dealt with through the further study of probability including binomial theorem and hypothesis testing. All study of this module will be done in the context of working with a large data sets common in real world analysis. Students develop their understanding of GCSE physics in a precise mathematical context (rather than analogy). This includes the study of key variables such as distance, velocity, acceleration, time, and common assumptions. Classical Mechanics is developed through the teaching of Newton's laws of motion which are applicable to all standard engineering and scientific applications. This includes F=ma and SUVAT equations. Links are made to pure maths to utilize calculus to extend SUVAT beyond constant acceleration.
	13	**Pure** • Functions and graphs • Sequences and Series (Binomial Extension) • Trigonometry in radian measure. • Parametrics • Further Calculus, Numerical Methods • 3D Vectors	We start with modulus functions and graphs. This is useful for modelling the path of a bouncing ball in real life or light reflections where the objects cannot pass below an axis. We look at developing sequences and series which can be applied to real life problems such as the amount in your savings account, the size of a population in exponential growth, e.g., bacteria growth in a Petri dish (or in your leftovers), the intensity of radioactivity after n years of a given radioactive material (with application to determining the age of artifacts.) Moving onto trigonometry we apply many of the skills from previous chapters and from Year 12 but using Radians measure which provides a different perspective of angles, this is the sole method used at higher level

			mathematics. We deepen understanding of differentiation and integration allowing students the ability to deal with more complex equations that allow modeling of real-life situations. 3D vectors extends on the work from year 12 and moves it into a 3-dimensional space, again relating to how objects move in the world, this allows for links to mechanics, physics and the motion of objects such as in 3D computer games.
		Statistics • Normal Distribution • Regression • Conditional Probability	Normal distribution builds on the Binomial distribution from year 12 and allows for modelling of problems with continuous data. Links to real life include looking at manufacturing problems, such as are coke bottles filled to an acceptable level, what is the probability of a lightbulb not meeting the manufacturers claim. Regression deals with ideas such as a business may be interested to know the relationship between advertising and sales or impact of rainfall amount on number fruits yielded. Regression features heavily in University study of economics such as the relationship between consumption and income. Conditional probability builds on the probability of year 12 and introduce the idea of dependent events. For example, what are the chances of having an accident on a road if it has been snowing compared with rain or sun.
		Mechanics • Moments • Projectiles • Friction, Equilibrium, Statics and Kinematics	We feel the effects of moments in our daily life, the force of pushing a door and having it move around its hinges. Any kid of lever can be modeled using moments. Projectiles models the path of a particle through use of trigonometry and vectors. By modelling how forces interact with particles and bodies we can model many major situations in the real world, such as the amount of energy required to tow a caravan dependent on the friction the tyres provide against a road.

Further Maths A Level

	Year	What is taught? Overview of Topics	Why this? Why then?
KS5 Further	**12**	**<u>FURTHER MATHS ALEVEL</u>** **<u>Pure</u>** Complex numbers Roots Matrices Argand diagrams Vectors Linear transformations Vectors Proof by induction Vol. Of revolution Differential equations **<u>Mechanics</u>** Momentum& impulse Work, energy & power Collisions in 1d **<u>Decision</u>** Algorithms Graphs and networks Route inspection Linear programming Critical path analysis	THIS SEPARATE A LEVEL EXTENDS A LEVEL MATHS INTO FURTHER BRANCHES. IT IS SUITABLE FOR STUDENTS BUILDING FROM A BASELINE OF GCSE GRADE 7+ Students learn to understand the meaning of solutions in the complex plane. This links to the discriminant in the quadratic formula and develops techniques to handle negative square root solutions - this includes their graphical representation on Argand diagrams. Techniques to manipulate large quantities of data are taught through the study of matrices. Applications are considered to both scientific data, engineering applications (CAD) and computer game design. Linear transformation of coordinate data is considered thorough the study of vectors. All forms of mathematical proof are considered (e.g., by contradiction) and a detailed analysis of the inductive method is undertaken and linked to series formula. Calculus is extended to practical problems such as aircraft fuel tank volume build and design through the study of volumes of revolution. The conversion of mathematical problems involving derivates to standard formula (by pseudo- integration techniques.) As an extension to the standard A-level the study of Force is developed into additional concepts and real-life applications involving Momentum, and Energy transfer. From physics different types of collisions are considered such as large objects (asteroid-planet) and energy transfer in classical particle interactions. Decision is the study of practical problems such as: Finding the shortest route from A to B on a map. Finding the most efficient delivery route for a courier company. Sorting web page data to give good matching and relevant results. Designing a workflow diagram for efficient production process.
	13	**<u>Pure</u>** Complex numbers - De Moivre's Theorem Series - Maclaurin series Vol of Revolution Inverse trig function.	De Moivre's theorem, in conjunction with series gives rise to the most dramatic equation in all mathematics. The world famous "God Equation" e^(i*Pi) + 1=0. This result can be admired not just for its mathematical beauty but can also be applied to solve Differential Equations. Students will learn how most of the top half of a scientific calculator works by using Maclaurin series. Without this technique sin/cos/tan buttons would not exist, and trigonometry would be more challenging. Trigonometry and Vol of revolution are extended to more complex modelling

		Polar Coordinates Hyperbolic functions Differential Equations	situations particularly involving the inverse and hyperbolic functions. Many position systems (such as GPS, longitude, and latitude) are better done on "circular grid" than a linear one which is the topic of polar coordinates. Differential Equations (DE) are common outcomes in advanced science when different rates are combined, e.g. acceleration, and velocity affecting the stress on a component. In the study of DE will show how advance pseudo-integration techniques can be used to solve such problems.
		Mechanics Elastic Strings and Springs Elastic Collisions in 2D	Hooke's Law and the formula for Elastic potential area are essential cross-curricular knowledge for Physics students, and they are the basis for the study of Tension in further study at university in all aspects of engineering. Energy Loss and velocity transfer during collisions between spheres or particles is key foundation knowledge for further study in field as variable as Quantum Mechanics and Road Traffic Accident Investigation.
		Decision Planarity Algorithm The Travelling Salesman Problem Simplex Algorithm CPA - Resource and Scheduling Histograms.	The TSP is a major unsolved problem in mathematics and the study of it gives students an appreciation of issues faced by delivery companies such as Amazon or Argos in meeting customer expectations to get stock to them quickly. The simplex algorithm is essential knowledge for the analysis of Logistics and Operational Research for businesses trying to maximize their efficiency. Resource scheduling is critical for the efficient completion of large-scale projects, for example the building of a housing estate or a bridge.

	Year	What is taught? Overview of Topics	Why this? Why then?
KS5 Core	**12**	**LEVEL 3 MATHEMATICAL STUDIES** Data Sampling Critical Analysis Normal Distribution Correlation and Regression Confidence Intervals	THIS COURSE IS DESIGNED FOR STUDENTS BUILDING FROM A BASELINE OF GCSE GRADE 4+ Types of data – Pupils are required to understand types of data as this is the foundational building block for being able to select calculations and representations. Once pupils understand the type of data, they can then begin to understand how to collect data whether primary or secondary etc. Pupils need to be able to calculate averages and spread in order to make conclusions about the data. Representing data diagrammatically is important in order to make conclusions about the data and be able to present it clearly to others. Understand pros and cons of each type of sampling consolidates all the previous learning into a large-scale project. Once pupils have created a large scale project, they need to be able to pick them apart to improve. Critical analysis provides them with these skills.

			Normal distribution begins a new topic block that incorporates a lot of what has been taught before for data handling. It is the start of the level 3 content and Correlation, regression, probabilities, and confidence intervals build from this.
		Percentages Fermi Estimation Interest rates Graphs Area and perimeter Inflation Currency exchange APR and AER VAT Income Tax and National Insurance Limits of Accuracy	Numerical calculations – This begins the topics for teacher 2 and focuses on the pure and financial mathematical side. Percentages builds on GCSE and is a foundational requirement for interest rates, APR, AER, and financial calculations of tax and national insurance. Fermi estimation is introduced and is then interleaved through the following topics in order to represent different ways that Fermi could be used. Interest rates builds on percentages, and Fermi. Introduces ideas of financial calculations. Financial graphs are drawn and interpreted. Also allows for a revisit of graphs before regression and correlation. Inflation, AER and APR build on the ideas from percentages and interest rates with real life applications towards saving accounts and the repayment of credit. Value added tax (VAT) start of taxation topic which covers Income tax and National Insurance. Limits of accuracy revisits several topics and combines this with critical analysis to make sure that students are making correct calculations and assumptions and provides revision.