Stanborough

Curriculum Intent and vision for Mathematics

The vision of the maths team at Stanborough is to ensure that students gain a deeper understanding of the Curriculum through a variety of effective pedagogical approaches and resources. Whilst providing students with a solid understanding and an enjoyable experience of mathematical concepts, teachers will communicate how maths is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment.

Along with supporting students in fulfilling their potential in the classroom, the maths team will continue to provide students with the opportunity to appreciate the beauty of maths and ignite students' passion to extend their learning outside the classroom through a range of enrichment programmes.

Key Stage 3

What is your Curriculum intent for Key Stage 3?

The KS3 Curriculum aims to deliver continuity and progression in the learning process of maths from KS2 to KS3. Teachers' awareness of T&L methods employed in KS2 and that of the KS2 Curriculum itself, coupled with teaching and learning of sophisticated written methods, careful sequencing of topics and application of topics to real life situations will support a successful transition from one year to another. Students will experience a KS3 Curriculum that puts huge emphasis on depth and not just breadth, and a Curriculum that will support students with development of reasoning and analytical skills. The Curriculum also aims to enable students to recall and apply key knowledge and apply a structured and logical approach to problem solving effectively. This, in turn, will provide students the ability and confidence to access the KS4 Curriculum more effectively and in being successful in the maths GCSE. The 'stretch and challenge' ethos of the Curriculum aims to prepare as many students as possible to study the Higher GCSE course. Teaching and learning will also provide opportunities to carry out independent research and study, and to make cross-curricular links.

What have students been taught at Key Stage 2 to prepare them for Key Stage 3?

The principal focus of mathematics teaching in upper KS2 is to ensure that pupils extend their understanding of the number system and place value to include larger integers. This should develop the connections that pupils make between multiplication and division with fractions, decimals, percentages and ratio. Along with calculating simple percentages, simplifying fractions, ordering fractions and adding and subtracting fractions with different denominators and mixed numbers, multiplying pairs of proper fractions and divide proper fractions by whole numbers, students are also expected to use percentages for comparison and solve problems involving unequal sharing and grouping using the knowledge of fractions and multiples. With this foundation in arithmetic, algebra is introduced as a means for solving a variety of problems. In algebra, students are expected to generate and describe linear number sequences, express missing number problems, find pairs of numbers that satisfy an equation with two unknowns and use simple formulae.

Students should be able to round to the nearest 10, 100, 1000, 10000 and 100000 and to one decimal place, and use rounding to check answers.

Teaching of geometry and measures at KS2 aims to develop students' ability to classify shapes with increasingly complex geometric properties and learn the vocabulary necessary to describe them, and solve problems on calculating the value of missing angles where they meet at a point, are on a straight line or are vertically opposite. Students should also be able to solve simple problems involving unit conversion, calculate area of rectangles, parallelograms and triangles, and volume of cubes and cuboids. Regarding position and direction, students should be able to describe positions in all four quadrants, draw and translate simple shapes on a coordinate plane, and reflect them in the axes.

In statistics, students should be able to solve problems involving information presented on a line graph and tables, including timetables. Students should also be able to interpret and construct pie charts and line graphs and use these to solve problems and calculate and interpret 'mean' as an average.

Pupils should also read, spell and pronounce mathematical vocabulary correctly.

How are any gaps in student knowledge addressed to enable them to access the Curriculum at Key Stage 3?

A formative baseline test at the start of year 7 will inform about gaps in understanding of any concepts from KS2, 'common errors' and how students demonstrate reasoning in problem solving. This exercise will also support with streaming students.

Carefully planned lesson starters will provide students with the opportunity to recall and revise key facts and teachers to monitor and address errors and misconceptions.

RAG rated (Question Level Analysis) reports highlight areas for development at the end of every key assessment. Online maths websites like MathsWatch are frequently used by students to address the areas for development from previous learning. This will also support them in becoming independent learners.

What do students cover in Key Stage 3? When do they study it?

Year 7	Year 8	Year 9
Number		
Whole and Decimal Numbers (recap of number system and place value, factors, multiples and primes, round to a number of decimal places, introduction to significant figures, solve word problems) Basic Financial Mathematics (use of arithmetic, negative numbers in real life)	**Further Number Skills** (work out prime factors, work out LCM and HCF using listing method, prime factor decomposition and Venn Diagrams, multiply and divide negative numbers, introduction to cubes and cube roots and powers of negative numbers, round to a number of significant figures)	**Recall of work done in year 7 and year 8** to ensure successful application of these concepts in a variety of topics
Order of Operations (BIDMAS) **Powers and roots** (confined to squares and square roots)	**Powers and roots** (extend to cubes and cube roots, laws of indices, introduction to Standard Form)	**Powers and roots** (calculate with roots and integer indices, including use of a calculator to solve problems involving roots and indices, convert between ordinary numbers and numbers in standard form as well as performing a variety of calculations involving numbers in standard form)
Fractions (revision from KS2 – reduce fractions to simplest form and equivalent fractions, adding and subtracting fractions/mixed numbers, solving word problems)	**Fractions** (extend to multiplying and dividing fractions, including working with mixed numbers)	**Exact numbers** (calculate exactly with fractions and multiples of π – applications in Geometry)
Percentages (revision from KS2 + calculate percentages with a scientific calculator, percentage increase and decrease problems, application in real life situations)	**Percentages** (use multipliers to calculate percentage increase and decrease, work out the value of multipliers in percentage change problems, application in real life situations)	**Percentages** (recap of year 8 work, original value problems (reverse percentages), simple and compound interest)
Ratio (ratio notation, including writing in 1 : n and n : 1 notation, equivalent ratios, sharing amounts in a ratio, introduce connection between fractions and ratios)	**Ratio and Proportion** (recap of year 7 work, apply ratios to lengths, areas and volumes, apply ratios to enlargement of shapes and map scales, solve ratio and direct proportion problems with real life context, introduction to inverse proportion)	**Ratio and Proportion** (recap of year 8 work, solve problems using ratio and direct proportion e.g. “Best Buy”, recipes, currency conversion, solve problems related to inverse proportion) Compound units (such as speed, density and pressure, including rates of pay and unit pricing)

Geometry		
Unit conversion (use standard units of measure and related concepts – length, area, volume/capacity, mass, time, money, etc.)	**Unit conversion – recall as necessary**	**Unit conversion – recall as necessary**
Perimeter, Area and Volume (revision from KS2, 2D shapes confined to rectangles, parallelograms and trapezia and compound shapes made from these, volume and surface area confined to cubes and cuboids, solve problems with real life context)	**Perimeter, Area and Volume** (extend to area and circumference of circles, area of 'complex compound shapes', volume of triangular prisms, solve problems with real life context, calculate surface area of cuboids and triangular prisms)	**Perimeter, Area and Volume** (recap of year 8 work, volume and surface area of cylinders)
Angles (recap of basic angle properties on a straight line and at a point, angles in triangles and quadrilaterals, extend to angles in parallel lines)	**Angles** (angle facts in parallel lines, interior and exterior angles in polygons, calculating number of sides in polygons) **Congruency** (use congruent triangles to solve problems)	**Angles** (introduction to Circle Theorems) **Congruency** (use the basic congruence criteria for triangles – SSS, SAS, ASA, RHS)
Transformations (reflections and rotations, reflection in a line of symmetry expressed as an equation, tessellations)	**Transformations** (enlargements of 2D shapes) **Compass and ruler constructions** (use the standard ruler and compass constructions – perpendicular bisector of a line segment, constructing a perpendicular to a given line from/at a given point, bisecting a given angle, know that the perpendicular distance from a point to a line is the shortest distance to the line)	**Transformations** (identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement) <u>Describe translations as 2D vectors</u> **Compass and ruler constructions** (solve problems related to loci)
3D Shapes (identify common 3D shapes, construct nets, investigation leading to relationships between edges, faces and vertices)	**3D Shapes** (recap of work done in year 7)	**3D shapes** (plans and elevations of 3D shapes)
		Pythagoras' Theorem and Trigonometry (introduction to Pythagoras' Theorem to work out the size of unknown lengths in right angles triangles, introduction to Trigonometry to calculate size of unknown lengths and angles in right angled triangles)
Algebra		
Algebraic expressions (introduce simplifying expressions by adding and multiplying terms, substitution, use of simple formulae, word	**Algebraic expressions** (extend to complex expressions with fractions and variables with powers, expand brackets, introduce	**Algebraic expressions** (recap from year 8, introduce factorisation of quadratic expressions where a = 1)

problems involving simple formulae)	factorisation, apply algebra to Geometry and Number)	
Sequences (term to term rule in linear sequences, introduce generalisations – nth term)	**Sequences** (nth term of linear sequences, 'practical' number sequences, exploring other types of sequences, including Special Sequences e.g. Fibonacci)	**Sequences** (work out the nth term of quadratic sequences)
Equations (introduce sophisticated methods to solve equations, including setting up and solving simple equations)	**Equations** (solve equations with variable on both sides, equations involving brackets and fractional coefficients, solve unstructured problems by setting up and solving equations in a variety of contexts, introduction to rearranging simple formulae)	**Equations** (solve a pair of equations simultaneously, rearrange simple equations and formulae in a variety of contexts) **Linear inequalities** (solve linear inequalities in one variable, represent the solution set on a number line)
Coordinates and Graphs (simple relationships between x and y coordinates resulting in straight lines)	**Coordinates and Graphs** (recognize and draw graphs of more complex linear equations, calculate gradient of straight lines, introduction to quadratic graphs)	**Coordinates and Graphs** (exploring meaning of gradient in straight line graphs, working out equations of straight line graphs graphically and algebraically, exploring quadratic graphs, plot and interpret graphs of non-standard functions in real contexts, involving distance, time & speed, know how gradients in non-linear graphs vary along the curves as opposed to the constant value of gradient in linear graphs)
Statistics and Probability		
Representing data (construct simple statistical diagrams e.g. Pie Charts, introduce discrete and continuous data and grouped frequency)	**Representing Data** (construct grouped frequency tables for discrete and continuous data, construct frequency diagrams)	**Representing Data** (recap of work done previously, introduction to cumulative frequency graphs)
Interpreting and Comparing Data (conduct statistical survey, use statistical charts and diagrams to compare data, understand and calculate averages and range)	**Interpreting and Comparing Data** (compare data from two separate Pie Charts, introduction to Scatter Graphs and correlation, calculate averages from grouped frequency tables, interpret and compare averages, compare data from frequency diagrams, interpret misleading data/graphs)	**Interpreting and Comparing Data** (interpret, analyse and compare distributions through appropriate graphical representations, involving discrete, continuous and grouped data; through appropriate measures of averages and range, including use of cumulative frequency graphs and box plots) **Scatter Graphs and Correlation** (use and interpret scatter graphs of

		bivariate data; recognise correlation)
Probability (probability scales, introduce combined events, understand the difference between theoretical and experimental probability)	**Probability** (mutually exclusive and exhaustive outcomes, use of Venn diagrams to illustrate outcomes and work out probabilities, use of sample space diagrams to illustrate outcomes and work out probabilities in combined events, use relative frequency to estimate probabilities)	**Probability** (recap of work done previously, record, describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees, relate relative expected frequencies to theoretical probability, introduce tree diagrams to calculate probabilities of combined events)

The table above shows progression and extension of teaching and learning from KS2 to KS3 (KS2 -> Y7 -> Y8 -> Y9)

Why do they study it in that order?

Some examples:

Year 7 will begin study of maths with Number skills. The teaching aims at recall of key concepts and clearing gaps from previous learning in Primary School along with extension through word problems and problems which require application of sophisticated reasoning and written skills. This will also provide students with the confidence and accuracy to solve problems in other modules/topics requiring application of Number skills.

An example of careful sequencing of topics: A strong foundation in arithmetic, will support with better understanding of Algebra in year 7. Teaching of equations in year 8 will also involve setting up of simple equations using angle facts learnt in year 7 and setting up and solving equation in 'number' problems. Later on in year 9, students will extend learning to solving more complex linear equations as well as solving a pair of equations simultaneously.

Extending the teaching of 'sequences' from working with generalisations and nth term of linear sequences in years 7 and 8 to working out the nth term of quadratic sequences in year 9 will provide an opportunity to teachers to introduce, and students to learn about 'proof', along with linking maths to careers (encryption).

A strong foundation in arithmetic, along with use of rounding and use of rounding to check answers will support accuracy and efficiency in solving problems related to area and volume throughout KS3. This will support students with understanding 'error intervals' (bounds) in year 9 and later in KS4 – a concept used in the manufacturing industry.

Interpretation and comparison of data sets can be carried out efficiently using more sophisticated methods in year 9 with knowledge of the different types of data, representation of data through simple charts and diagrams and the pros and cons of the various averages learnt in years 7 and 8.

The Curriculum also takes into consideration the fact that certain topics need to be introduced when students are capable of understanding and appreciating the underlying concepts e.g. gradients of straight lines. This will enable students to engage better.

Does the Key Stage 3 coverage reflect the content in the national Curriculum?

Yes. All the topics covered reflect at least the statutory requirements mentioned in the National Curriculum.

How do you ensure students embed knowledge? What do you revisit? When do you revisit it?

Knowledge is embedded through a variety of means, such as lesson starters, probing questions and practice exercises, including investigative discussions/activities during lesson time. This is also done through homework which is generally related to classwork and through RAG rated performance sheets which are designed to reflect on areas of development following key assessments. An area of discussion during many departmental meetings relates to 'common errors' and 'misconceptions', which are then addressed in classwork and homework, and are also communicated during meetings with parents/carers. Schemes of work also include time allocated to revisit areas which require further practice/reinforcement. KS4 Curriculum also includes topics from KS3 which have been flagged up as 'tricky' and the ones which require frequent practice/revisiting. Careful analysis of GCSE results provides useful information about depth of students' understanding of concepts learnt in KS3 and also supports key stage leaders with making an informed decision with regards to updating SOW and measuring impact of T&L.

How do your Curriculum choices contribute to the student's cultural capital?

Teaching/lesson planning will incorporate problem solving with real life context/application of the maths learnt in class to real life. This will also support students with awareness of careers (jobs) which involve application of maths or related skills. Schemes of work incorporate short video clips which link the learning of maths in class to the various disciplines of work. These are consistently shared with students. 'Why this', 'Why now' and 'what next' also helps teachers with communicating the applications of maths in real life.

Students regularly get opportunities to explore the subject and further opportunities that maths provides through trips to universities, webinars on careers related to maths, an enrichment club (which includes activities like code breaking) and by participating in UKMT challenges.

Key Stage 4

What is your Curriculum intent for Key Stage 4?

The aim of the Curriculum is to ensure that every student is provided with an opportunity to achieve their target or better and that the outcome of the maths GCSE supports their post 16 aspiration, including an effective transition into study of maths at A Level. Our Key Stage 4 maths Curriculum is designed to build upon skills learnt at Key Stage 3. Careful sequencing, use of retrieval activities, practice exercises and the ethos of 'stretch and challenge' will enable students to make continuous progress/extend learning. In year 10 and year 11, students work through a Foundation or a Higher tier depending on their strengths and abilities.

The KS4 programme of study continues to aim to improve the depth and breadth of student understanding, including communicating the application of maths in real life. The Curriculum fosters a supportive bridge for a large proportion of students to pursue maths at A-level and beyond through alternative qualifications and enrichment programmes.

How does Key Stage 3 prepare students for Key Stage 4?

Throughout Key Stage 3 students will develop knowledge and skills which will support students with creating a solid foundation in relation to accessing the GCSE course. The emphasis on depth in understanding of the various topics will enable students with recall of key concepts and in turn this will support with extending their learning at KS4 effectively. Consistent and systematic use of effective online resources will also create an ethos among students to be independent and resilient learners.

Students will understand that maths is not an isolated discipline and that they will adopt and apply appropriate mathematical knowledge confidently in other subjects such as Science. The design of the Curriculum encourages students to be more experienced in working systematically towards solving complex, multistep mathematical problems through critical and analytical methods. It also urges students to develop and significantly improve their skills to

communicate their findings and correct solutions in clear and sophisticated mathematical language verbally and on paper.	
What do students cover in Key Stage 4? When do they study it?	
Year 10	**Year 11**
Number	
Whole numbers and decimals Work interchangeably with terminating decimals and their corresponding fractions Apply and interpret limits of accuracy and error intervals, including upper and lower bounds Solve complex problems on LCM and HCF, including problems with real life context	**Whole numbers and decimals** Convert recurring decimals to fractions (Use inequality notation to specify) bounds for error interval Calculate the upper and lowers bounds to varying degrees of accuracy – relate to real life formulae and context
Surds Calculate exactly with surds Simplify surd expressions involving squares	**Surds** Rationalise denominators
Laws of Indices Use conventional notation for priority of operations, particularly when calculating with roots and indices, applying the laws of indices Estimate powers and roots of any given positive number	**Laws of Indices** Calculate with roots, integers and fractional indices Use index laws to simplify and calculate the value of numerical expressions and solve equations Use calculator functions for all calculations
Standard Form Perform calculations with numbers in standard form, with and without a calculator Solve problems with real life context/by manipulating formulae used in science.	**Standard Form** Revision of previous content
Ratio, Proportion and Rates of Change	
Direct and Inverse Proportion Relate ratios to fractions and linear functions Introduce notation of proportionality, including graphical and algebraic representations Recognise and interpret graphs showing direct and indirect proportion	**Direct and Inverse Proportion** Form and interpret equations describing Direct and Inverse Proportions and solve Understand the concept of 'constant of proportionality'. Solve complex problems on Direct and Inverse proportion.
Compound units Complex problems, including problems with real life context, on compound units: Reasoning problems related to speed, links with standard form, solving increasingly unstructured problems	**Compound units** Revision of previous content
Further Percentages Solve problems related to percentage change, reverse percentages and simple and compound interest using multipliers	**Further Percentages** Solve and interpret the answer in exponential growth and decay problems
Scale Factors Compare lengths, areas and volumes using ratio notation; make links to similarity (including trigonometric ratios) and scale factors	**Scale Factors** Revision of previous content

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Algebra	
Algebraic Expressions Expand a product of three binomials Factorise quadratic expressions	**Algebraic Expressions** Simplify and manipulate algebraic fractions by canceling common factors
Rearranging equations/formulae Rearrange formulae, where the subject appears on both sides, including introduction of fractions in expressions Link to real life formulae as well as formulae used in geometry	**Rearranging equations/formulae** Extend to rearrange complex formulae to change the subject
Equations of straight lines Find the equation of a line through two given points or through one point with a given gradient Identify and work out equations of parallel and perpendicular lines Identify & interpret gradients & intercepts of linear functions algebraically	**Equations of straight lines** Find the equation of a tangent to a circle at a given point
Simultaneous equations Solve two linear simultaneous equations algebraically, introduction algebraic solution to non linear simultaneous equations	**Simultaneous equations** Solve linear & non-linear simultaneous equations algebraically
Non linear sequences Deduce expressions to calculate the nth term of quadratic sequences	**Non linear sequences** Recognise & use simple geometric progressions of the form r^n
Linear inequalities Solve linear inequalities in one variable Represent the solution set on a number line Solve linear inequalities in two variables Represent the solution set using set notation on a graph	**Linear inequalities** Solve quadratic inequalities in one variable
Non linear graphs Draw graphs of complex quadratic functions using a table of values, understand how roots relate to quadratic factorisation Solve simple quadratic equations algebraically by factorising (link to quadratic graphs/intercepts) Recognise, sketch & interpret graphs of simple cubic & reciprocal functions	**Non linear graphs** Identify & interpret roots, intercepts, turning points of quadratic functions graphically & algebraically Solve quadratic equations algebraically by factorising, completing the square and using the quadratic formula Recognise, sketch and interpret trigonometric functions Sketch translations and reflections of a given function
Not directly related to topics learnt in KS3	
Functions Where appropriate, interpret simple expressions as functions with inputs and outputs; interpret the reverse process as the 'inverse function'; interpret the succession of two functions as a 'composite function'	Revision of previous content
Iterative process Work out approximate solutions to equations numerically using iterative formulae	Revision of previous content
	Non linear graphs – pre calculus Calculate or estimate gradients of non-linear graphs & areas under graphs Interpret results of distance-time & velocity-time graphs

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Geometry	
Angles Solve complex angles problems involving parallel lines and polygons giving clear reasons for answers Use circle theorems and other angle properties/rules to identify missing angles giving clear reasons for answers	**Angles** Prove circle theorem rules
Similarity and Congruency Apply the concepts of congruence and similarity, including the relationships between lengths, areas and volumes in similar figures	**Similarity and Congruency** Revision of previous content
Transformations Revision of previous content, plus enlargement using fractional and negative scale factors	**Transformations** Describe the changes and invariance achieved by combinations of rotations, reflections and translations
Perimeter, Area and Volume Calculate arc lengths, angles and areas of sectors of circles Calculate surface area and volume of spheres, pyramids and cones and composite solids	**Perimeter, Area and Volume** Revision of previous content
Pythagoras' Theorem and Trigonometry Apply Pythagoras' theorem and Trigonometry to solve complex unstructured problems in 2D Extend application of the above in 3D shapes Know and apply the Sine rule and Cosine rule to find lengths and angles Know and apply Area = ½ *ab* sin *C* to calculate the area, sides or angles of any triangle	**Pythagoras' Theorem and Trigonometry** Know the exact values of sin θ and cos θ for θ = 0°, 30°, 45°, 60° and 90°; know the exact value of tan θ for θ = 0°, 30°, 45° and 60° Solve problems by manipulating surds/leaving answer in surd form
Vectors Apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors Use vectors to construct geometric arguments and proofs	**Vectors** Revision of previous content
Statistics and Probability	
Sampling techniques and Representation of data Know different sampling techniques and their limitations Construct and interpret diagrams for grouped discrete data and continuous data, i.e. histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use	**Sampling techniques and Representation of data** Revision of previous content
Interpreting and Comparing data Interpret, analyse and compare distributions by considering outliers; by working out quartiles and interquartile range from box plots	**Interpreting and Comparing data** Revision of previous content
Scatter Graphs - Correlation Know that correlation does not indicate causation; draw estimated lines of best fit; make predictions; interpolate and extrapolate apparent trends while knowing the dangers of so doing	**Scatter Graphs – Correlation** Revision of previous content
Probability	**Probability** Solve problems containing algebraic expressions combined with ratio and

Enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams and tree diagrams Calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions	percentages

Why do they study it in that order?

Students study a variety of topics over the course of KS3 and KS4, each topic is broken down over the program of study to ensure incremental progress each year. Pace and content are varied to meet the student/class's ability. This also allows for opportunities to revisit and overlap content where required ensuring that students make appropriate progress whilst consolidating previously learnt skills and knowledge. There are also several topics that are interlinked and require knowledge from previous topics thus the order in which they are taught. In addition, regardless of the student ability or class, topics are taught where possible parallel to allow students to discuss and support each other outside of the classroom.

How do you ensure students embed knowledge? What do you revisit? When do you revisit it?

This is done through well planned lessons, deploying highly qualified maths teachers and support specialists. The progress of all students is closely monitored and follow up interventions are embedded in the SOW.

- Well planned lessons
- Incorporation of Rich and Engaging activities
- HW set on regular basis (1 piece of homework a week to consolidate knowledge)
- In year 11, students complete one past GCSE paper each week
- Recall activities
- Revision guides available from the maths dept.
- Online resources to consolidate knowledge outside the classrooms
- Weekly maths club
- Intervention classes (y11-period 6)
- Key Assessments/Mock exams
- Addressing misconceptions in lessons
- QLA (question level analysis) - students obtain a RAG sheet based on their performance in KA or EOY exams
- Revisiting/reteaching topics where majority of the class scored low marks
- Key topics are incorporated in SOW more than once in KS4
- Revision time embedded in the SOW
- Key topics/skills e.g. fractions, equations are embedded more than once
- Wide variety of AFL techniques (e.g. use of mini-white boards)
- Contact with parents/carers to support students' learning at home
- Maths stretch and challenge in Stanborough times

How do your Curriculum choices contribute to the student's cultural capital?

Mathematics is often thought of as memorisation of facts and algorithms. Many mathematics textbooks, workbooks, and resources reinforces this traditional memorisation methodology. While this type of mathematical instruction may have had its place in the past, we believe that contemporary mathematical teaching should reflect society's growing need for advanced problem-solving skills to deal with current and future economic, humanitarian, and environmental challenges. The problem solving required to address these challenges requires solutions that have never been thought of before. In order to tackle these problems, teachers challenge the traditional problem-solving methodologies used in mathematics classes and encourage new problem-solving strategies through the incorporation of the arts and facilitating of creative problem solving and real-life applications. The maths Curriculum has been designed to contribute to the student's cultural capital through the accumulation of mathematical knowledge and skills that a student can draw upon and so be prepared for their future success.

Students continue to get opportunities to explore the subject through trips, webinars, an enrichment club (which includes activities like code breaking) and by participating in UKMT challenges.

Key Stage 5

What is your Curriculum intent for Key Stage 5?

The purpose of mathematics at Key Stage 5 is to provide students with an appropriate pathway to develop their skills from GCSE to support other subjects and to prepare them for higher education, training, employment and citizenship. The available pathways range from the Level 3 certificate in Core Maths to A level Mathematics to A level Mathematics with AS or A level Further Mathematics. All students with a standard pass at mathematics GCSE are eligible to study mathematics at Key Stage 5 and could benefit from doing so. Alongside the practical benefits of studying maths post-16, we aim to engender a deeper enjoyment and affection for the subject as well as skills of reasoning, problem-solving and modelling.

A level Mathematics

A level Maths is available to all students who have achieved at least grade 7 at GCSE and is a qualification that is well-respected by both universities and employers. It is the most popular A level subject nationally and is required or encouraged for many university degree courses. We encourage all students who are eligible to study A level maths to do so, especially if they have an interest in STEM subjects.

Further Mathematics

Students who enjoy maths and excel at the subject (having achieved grade 8 or 9 at GCSE) may additionally study Further Mathematics at either AS or A level, which provides excellent preparation for mathematically rich degrees such as physics, engineering, computer science and mathematics itself. Once again, all those who are eligible to study Further Maths are encouraged to do so.

Core Mathematics

Students with a grade 4 or above at GCSE who either do not qualify for A level mathematics or who choose not to study it may choose Core Maths as an alternative mathematical pathway. This qualification takes mathematical skills from GCSE and applies them to real-life situations and other academic subjects as well as extending knowledge of statistical and financial mathematics.

How does Key Stage 4 prepare students for Key Stage 5?

Core Mathematics

Core Maths builds on topics from Key Stage 4 such as percentages, estimation, probability and statistics. The techniques learned at GCSE are consolidated, extended and applied.

A level Mathematics

A level Maths builds especially on the algebra learned at GCSE, but also extends trigonometry, some aspects of geometry, probability and statistics and ideas surrounding rates of change. The mechanics strand of A level mathematics also links to the content of physics at GCSE and A level.

Further Mathematics

Further Maths Pure Core depends largely on A level Mathematics, but also extends GCSE knowledge of quadratic and cubic equations, simultaneous equations, transformations and loci. Further Mechanics depends on basic algebra and knowledge of Key Stage 4 physics as well as linking to the mechanics in A level maths. Discrete maths does not have specific prerequisites in Key Stage 4 but builds on ideas such as the product rule for counting, proportionality relationships and graphical solution of inequalities.

Core Maths content is organised over two years which are interchangeable so that Year 12 and Year 13 students can learn together in a single class.

What do students cover in Key Stage 5? When do they study it?

Year 12/13	Year 13/12
Risk	Introduction to estimation
Probability	Fermi estimates
Medical screening	Upper and lower bounds
Scams	Foreign exchange
Statistics Intro	Product prices
Valid arguments	Comparing and deciding
Normal distribution	Costing and financial problem solving
Guessing the answers	Algebra
Approximately normal	Graphs and gradients
Percentages	Standard form
Appreciation and depreciation	Measures and scaling
Business and risk	Exponentials and logarithmic scales
Making decisions with risk	Modelling
Regression to the mean	Voting and decision making systems (after exams both years)
Randomised controlled trials	
Voting and decision making systems	

Why do they study it in that order?

The chosen order allows each year of the course to stand alone so that new Year 12s can join at the beginning of either year and Year 13s can be confident that they have covered the course by the time of the exams. Related topics which are split between the two modules of the qualification are taught together to improve comprehension and retention.

How do you ensure students embed knowledge? What do you revisit? When do you revisit it?

Topics are regularly revisited as they appear in students' other subjects and current events. Revision occurs at the end of each academic year as Year 13s prepare for the final exams and Year 12s consolidate the first half of the course. Certain topics link across the years, such as appreciation and depreciation with exponential growth, and business and risk with costing and financial problem solving.

How do your Curriculum choices contribute to the student's cultural capital?

The content of Core Maths and the contexts in which it is taught are designed to equip students as educated citizens able to make informed decisions. Students are taught to appreciate the power, limitations and potential pitfalls of statistics so that they can be critical of information presented in the media, but also to reason in areas such as medical screening, legal evidence, investment and borrowing. They learn the modelling process and some basic modelling techniques to allow a deeper understanding of the process of scientists, social scientists and policy-makers.

How do you prepare students for learning beyond Key Stage 5?

Core Maths prepares students with statistical, financial and quantitative skills which support further study in a range of fields with quantitative elements, such as business, economics, biology, geography, psychology, sociology and sports science. Because Core Maths supports a number of degree subjects, it is recognized by universities as useful preparation and may result in a lower offer to reflect this.

A level Maths content is organised so that all of the AS content is taught in Year 12 before teaching of the additional A level content begins. This is largely because the hierarchical nature of mathematics makes this the most logical order, but also so that students are prepared for any university entrance exams they may face in the autumn of Year 13 and so that students may take just the AS exam on occasions when this is appropriate.

What do students cover in Key Stage 5? When do they study it?

Year 12	Year 13
Proof and Problem Solving	Modelling with Trigonometry
Coordinate Geometry	Further Trig Functions and Identities
Surds and Indices	Calculus of Trig and Exponentials
Quadratic Functions	Transformations and Modulus
Vectors	Rational Expressions
Kinematics	Extended Binomial Expansion
Differentiation	Further Differentiation
Data Collection	Further Integration
Data Presentation	Applications of Vectors
Trigonometry	Further Applications of Calculus
Equations and Inequalities	Differential Equations
Polynomials	Conditional Probability
Probability	Normal Distribution
Binomial Expansion	Further Hypothesis Testing
Binomial Distribution	Projectiles
Circles	Moments
Graphs and Transformations	Forces in Context
Integration	Numerical Integration
Kinematics with Calculus	Numerical Solution of Equations
Hypothesis Testing	
Forces and Motion	
Logarithms	
Exponential Models	
Large Data Sets	
Functions	
Sequences and Series	
Radian Measure	
Methods of Proof	
Combined Transformations	

Why do they study it in that order?

Topics are ordered so that new information builds on prior learning, ensuring that prerequisites precede the topics which rely on them. Topics from different strands which are related are grouped together, such as kinematics with differentiation and the binomial distribution with the binomial expansion. Consideration also has to be given to those students studying Further Maths alongside A level maths, ensuring that prerequisite topics from the single A level are completed before their dependent topics in Further Maths.

How do you ensure students embed knowledge? What do you revisit? When do you revisit it?

Because of the way topics in mathematics build on previous knowledge, much of the content is naturally revisited as ideas are extended. For example, introducing radians as a measure of angle involves revision of prior work on trigonometry. Topics such as the binomial expansion, differentiation, integration, proof, probability, hypothesis testing, kinematics and forces are expanded in the Year 13 content so that revision of Year 12 content is inevitable. In addition, all assessments include (or potentially include) all topics up to that point, so that students are encouraged to continue to improve on any weaknesses or difficulties earlier in the course. Dedicated revision time occurs at the end of each academic year as Year 13s prepare for the final exams and Year 12s consolidate the first half of the course. Year 12 students are also encouraged to improve on their end of year exam results through summer work between Year 12 and Year 13.

How do your Curriculum choices contribute to the student's cultural capital?

Advanced mathematics is one of the crowning achievements of human civilization and students are made aware of the significance of the topics they learn, both historically and in modern applications. Calculus, which forms the backbone of the pure mathematics studied

at A level, is integral to mathematical modelling in every numerate discipline. Students are exposed to some of its important applications to topics such as kinematics and differential equations. The historical development of topics like calculus and coordinate geometry is linked to much of the notation that students learn. Students also learn statistics, applied to a large data set, and hypothesis testing which are used in extensively in social and biological sciences and in a multitude of careers. In addition, students are given the opportunity to attend public lectures and exhibitions which explore historical and modern mathematical developments in venues such as the Royal Society, the Royal Institution and the universities of Cambridge and Oxford.

How do you prepare students for learning beyond Key Stage 5?

A level mathematics is encouraged or required as preparation for a number of degrees and is particularly recognized by prestigious universities such as those in the Russell Group. Reference is made to the importance of topics in areas of further study as they are taught, such as the centrality of proof in further study of mathematics and the application of calculus and, in particular, differential equations to fields such as biology, economics, chemistry, physics and engineering. Furthermore, the importance of statistics, especially hypothesis testing, to further study of psychology, sociology, geography, biology and many other fields is highlighted. Students are also encouraged to take responsibility for their learning by marking and correcting their independent work in advance of lessons, seeking help between lessons and utilizing a range of resources to consolidate past learning and prepare new topics. The independence and resilience which they develop is vital to success in higher education and to lifelong learning.

A level Further Maths content is organised so that all of the AS content is taught in Year 12 before teaching of the additional A level content begins. This is largely because the hierarchical nature of mathematics makes this the most logical order, but also so that students are prepared for any university entrance exams they may face in the autumn of Year 13 and so that students may take just the AS exam on occasions when this is appropriate.

What do students cover in Key Stage 5? When do they study it?

Year 12	Year 13
Complex Numbers	Further Vectors
Dimensional Analysis	Graphs and Networks
Graphs	Linear Momentum in 2-D
Work and Energy	Summation of Series
Matrices and Transformations	Oblique Impact
Network Algorithms	Induction on Series
Resolving Forces	Travelling Salesman Problem
Power	Route Inspection Problem
Matrices and their Inverse	Exponential Form of Complex Numbers
Principles of Algorithms	Centres of Mass 1
Roots of Equations	Hyperbolic Functions
Momentum and Restitution	More Arrangement Problems
Graphical Linear Programing	Solids of Revolution
More Complex Numbers	Work and Energy in 2-D
Impulse	Inverse Hyperbolic Functions
Game Theory	Efficiency and Complexity
Circular Motion	More Motion in a Vertical Circle
Vectors	Polar Coordinates
Types of Problem	Sorting and Packing
Arrangement and Selection Problems	Centres of Mass 2
Proof by Induction	Further Integration
Motion in a Vertical Circle	Rigid Bodies
Order of an Algorithm	More Linear Programming
Systems of Simultaneous Equations	Further Calculus
Lines and Planes in 3-D	Differential Equations
Hooke's Law	Linear Motion Under a Variable Force
	More Game Theory

Why do they study it in that order?

The three strands of Further Maths, Further Pure, Mechanics and Discrete Maths are taught over both years to aid consolidation and retention for the end of the course and to align with the strengths of different teachers. Topics are ordered to follow prerequisite topics in Further Maths itself and also in the single Maths A level. Some of these dependencies cut across strands such as Motion under a Variable Force from Mechanics which depends on Differential Equations from Further Pure. An effort has also been made to tie together topics from Further Maths with Maths A level to emphasise the development of the topic, such as linking Complex Numbers at the beginning of the Further Pure course with the related topics of Coordinate Geometry, Surds and Quadratics in the single Maths A level.

How do you ensure students embed knowledge? What do you revisit? When do you revisit it?

As with A level Maths, the hierarchical nature of the subject means that new topics build on previous learning leading to a natural revision of earlier topics as they develop. Complex numbers recur at various points through the Further Pure strand, as do topics like momentum and work, power and energy in Mechanics. The Discrete Maths strand is set up so that every topic is introduced in Year 12 and developed further in Year 13. Again like A level Maths, all assessments include (or potentially include) all topics up to that point, so that students are encouraged to continue to improve on any weaknesses or difficulties earlier in the course. Dedicated revision time occurs at the end of each academic year as Year 13s prepare for the final exams and Year 12s consolidate the first half of the course. Year 12 students who are continuing with the course are also encouraged to improve on their end of year exam results through summer work between Year 12 and Year 13.

How do your Curriculum choices contribute to the student's cultural capital?

Further Maths at AS or A level adds both breadth and depth to students' mathematical background. In Further Pure, students get a closer look at how mathematics as a discipline has developed through expansion of the number system and additional methods of proof. They learn that topics which were initially studied as purely academic pursuits have developed important practical applications in modern society, such as complex numbers in electronic and aeronautical engineering. The study of mechanics demonstrates the importance of mathematics in STEM applications all the more forcefully. Discrete Mathematics helps students to see mathematics as a dynamic discipline which continues to evolve and links powerfully to computer science, at the heart of modern society. Further Maths students have all of the opportunities afforded to Maths A level students to attend lectures and exhibitions and are also encouraged to explore the subject independently through further trips, enrichment activities and reading.

How do you prepare students for learning beyond Key Stage 5?

Further Mathematics extends students' knowledge of mathematics to prepare them especially for university degrees and careers in mathematics, physics, engineering and computer science. It also prepares them for advanced study in less obviously mathematical fields where matrices may be used to transform data in social sciences or a wider range of differential equations may be used in economic or population models, for example. Further Maths also requires a higher degree of independence on the part of students which prepares them for higher education as it is a very challenging subject but taught on a reduced timetable. Clear links can be drawn between the Further Maths course and university study, both in terms of the topics covered and the style of study.