P16

POST 16 SUBJECT OVERVIEW

A-level mathematics is an exciting but demanding course. This qualification requires students to demonstrate the overarching knowledge and skills contained in problem solving, modelling, language and proof. These must be applied, along with associated mathematical thinking and understanding, across the whole of the detailed content.

Name of Subject - Mathematics

Which Examination Specification is Studied for this Course?

AQA L3 Advanced GCE in Mathematics 7357
The Ofqual qualification accreditation number (QAN) is 603/1164/2.

Why should I study this course? -

You could choose this course for a number of possible reasons: You know you want to go on to Higher education studying one of the many courses for which Mathematics to A level is a required course or desirable prerequisite. This might include Mathematics, obviously, but all branches of Engineering, Sciences (including Computer Sciences, Earth Sciences and Social Sciences), Economics, Management Studies, Medicine, Dentistry, Optometry… the list goes on. You might not intend to pursue Mathematics beyond A level but relish the challenge of a topic such as this and know the value many Universities and Employers give the qualification. It may just be that Mathematics as GCSE was a favourite subject (and why wouldn't it be?), and if so you may consider combining this course with the A level in Further Mathematics.

Mathematics has two disciplines: Pure and Applied – Pure Mathematics is the abstract science of number, quantity, algebra and space. When these concepts are used in Applied Mathematics they enable understanding of complex situations in fields such as statistics, physics and engineering.

If Mathematics is a language (and some say it is), then up to GCSE you will have learnt and mastered the equivalent of spelling, constructing a sentence and grammar. At A level you will learn the equivalent of writing poetry, novels, or factual reports.

Some of the topics you will encounter you will have seen before, but will be extended or be used in different contexts. Others will be totally new. At A level we introduce the concept of Calculus, a revolutionary and, when first proposed, divisive concept in Mathematics that is now fundamental to so many aspects of our lives. The applications of Calculus in Mechanics and Statistics, the two applied topics you will study at A level, mean that problems previously inaccessible can be solved with relative ease.

At A level you will continue to explore number, algebra and geometry, linking them together in new ways. Geometry will be studied through algebra and graphs. Algebra from GCSE will become a tool to allow you to solve ever more complex equations. It will also enable you to model real life situations in Mechanics such as the motion of a projectile, or in Statistics to describe general patterns in data. Links between the graphical representation and algebraic will be investigated and you will be able to identify a variety of key features of graphs just by considering the algebra that generates them. Algebra will also allow you to unlock the power of Calculus to solve differential equations and model problems in Applied Mathematics. With Calculus you will, for example, be able to find the instantaneous speed of an object when only given a description of how far it has travelled at each point in time (or the distance travelled when given the fluctuating speed of that object). You will also be able to identify maximum or minimum values of functions without the need to plot a graph and apply this in context to solve problems. At A level you will consider proof in a more rigorous way than you have encountered it before. Using Mathematical proof to show something tells you that it must (or perhaps must not) be able to happen. For example, it is impossible to write the answer to the equation, $x^2 = 2$, as a fraction, and because we can prove it, it isn't even worth trying to!

In Mechanics you will use your Mathematics skills to investigate and describe physical situations found in "real life". Statistics will give you an insight into making generalisations about members of large groups in a more sophisticated way than studied at GCSE. You will continue to explore probability and use that to make statements about the likely truth or otherwise of claims. For example, did the drug used in this trial have the impact wanted (or claimed) by the manufacturer.

Being able to tackle a complex question and break down your thinking into logical steps is the essence of solving a maths problem. The skills required to do this will put you in good stead for embarking on further education, apprenticeships and/or entering the workforce.

Big Questions to ponder: If you know the force required to move an object upwards depends upon its weight, how do you model an object when its weight changes as it moves (for example a spacecraft loses mass as it burns fuel)? Without plotting a graph of a function, what property changes at the maximum value and how could we use that to find the coordinates of that point? How could you decide if a new drug improved the health of people, when some people would have recovered without medication anyway?

Who is suitable to study this course? -

Prospective students need to have studied and enjoyed Higher tier GCSE Mathematics.

Resilience; the ability to not be scared of getting stuck, to be able to persist, and that oftentimes the mental struggle will be worth it.

Independence; the ability to problem solve by yourself, to be proactive at looking for solutions and not needing to rely on support (but in an environment where support will be there should you need it), to think for yourself and to be looking for links between the knowledge you already have and will gain throughout the course.

Planning and organisation; you will need to plan your time and resources to ensure that you've used them effectively.

Not least, a passion for developing your knowledge and deepening your understanding in mathematics. You must be committed to your studies as this course requires dedication and a strong work ethic.

What GCSE Qualifications Support the Study of this Course?

GCSE Mathematics at Higher Tier is required.

The study of GCSE Statistics, GCSE Physics or Level 2 Further Mathematics Certificate would be supportive but not essential.

What are the Qualification Requirements for this Course?

GCSE Mathematics Grade 7

How is the Course Delivered? -

Lessons at Post 16 will continue to involve discussion and group work and provide opportunities for you to think deeply, applying your knowledge to investigate and solve problems. Review of previous learning, both from GCSE and earlier parts of A level will be regular so you can keep on top of your learning and take responsibility for it in a supportive environment.

The course will be delivered by two teachers in Year 12 and Year 13, sharing 4 hours of direct contact time. You will be expected to complete independent study for a similar amount of time and to attend additional study sessions such as after school enrichment and supervised study periods.

You will have copies of course text books to refer to and to give you access to exercise questions, your teachers will supplement this with their additional problems and notes.

In grid below outline what units / content is taught when across the two year course

Subject Overview		
Half Term	**Year 12**	**Year 13**
Autumn 1	Indices, Surds, Polynomials The Factor Theorem Simultaneous Equations Quadratics; graphs, discriminant and its meaning, completing the square, unfamiliar representations	Revision of "Summer 2" topics Modulus Function Composite functions Combinations of functions Double angle formulae

	Sketching graphs/inequalities (polynomials, reciprocals transformations of graphs) Inequalities, Inc. quadratic Trigonometry (introduction), including angles >90° Solving equations. Trig Identities (part 1) Equations of straight lines and applications Equations of circles and circle geometry Differentiation (polynomials) Including from first principles.	Proof with trigonometric functions Differentiation of trigonometric functions and logs Product Rule and Quotient Rule Chain Rule
Autumn 2	Differentiation: Stationary points, tangents, normals, Rate of change, Second Derivatives Integration and the Fundamental Theorem of Calculus Area under polynomials	Numerical Methods: Iteration Newton-Raphson Trapezium rule for integration Partial fractions Rational functions

	Exponentials and Logs: Graphs, algebra, manipulations and applications Vectors: Find magnitudes and directions (in 2D and 3D)	Parametric equations (inc. differentiation) Implicit functions (inc. differentiation) Solving differential equations (inc, in context), separating variables Use Calculus in Kinematics (2D, vectors) Vectors in Kinematics
Spring 1	Exponentials and Logs (continued) Vectors (continued): Algebra with vectors. Use in context Sampling Scatter Diagrams Interpretation of correlation coefficient Histograms and probability distributions Select / critique data presentation techniques Data Cleaning, Errors in data, Outliers Averages and Spread, Standard Deviation SI fundamental units and derived quantities Constant acceleration, motion in a straight line	Further Probability: Conditional probability Tree Diagrams, Venn Diagrams Two way Tables Modelling with Probabilities The Normal Distribution (inc. mean , standard deviation ….) Using Trigonometric Functions in context (Kinematics and Forces) Constant acceleration in 2D Motion under Gravity, Projectiles
Spring 2	Probability: Mutually Exclusive and Independent Events Discrete probability distributions Binomial Model Hypothesis Testing	Hypothesis Testing with the Normal Distribution. Addition Forces, Resultant forces Friction (motion and static, limiting friction)

	Newton's First Law Acceleration due to gravity, weight Newton's Second Law (2D) Newton's Third Law	Moments
Summer 1	The Binomial Expansion for integers Mathematical Proof Revision of learning to date. Assessments Consolidation and post assessment work	Revision (Year 12 and Year 13 topics) Exam technique Practice/Past Papers Analysis of Past Papers
Summer 2	Sequences: Recurrence relations Arithmetic Sequences Geometric Sequences Sums, (inc. to infinity) Sigma notation Binomial theorem for any rational n Further Trigonometry: (more) Identities	

	Small angle approximation Arcs, Sectors and Radians	

How is the Course Assessed?

Throughout the course you will be informally assessed with "review sheet" homework which
will be marked and you will be expected to correct any mistakes. Once you have completed a review sheet for a topic and had the opportunity to address any issues, that topic will be assessed with a "mini-test". You will be expected to repeat each test until you can demonstrate that you understand the topic.

Less frequently you will receive more formal "exam" - style" assessments as part of the Praising Stars cycle.

Formal exams are at the end of Year 13 consisting of exams, all of which permit the use of the scientific calculators used for the Post 16 Mathematics course, there is no coursework or controlled assessment element. These external assessments are undertaken by way of three 2 hour papers.. These papers cover all topics covered across the 2 year course with paper 1 being solely pure content. Paper 2 is pure and mechanics content with paper 3 being pure and statistics content. Each paper is out of 100 marks and contributes to equal weighting towards the final grade. There are a mixture of questions from one mark multiple choice to short and long answer questions.

What is our Recommended Subject Reading list to Support your Study? -

Prospective students will be given a pack of questions that they need to complete and fully understand over the course of the Summer Break. Students will continue to have access to HegartyMaths to enable them to practice or develop their mathematical skills. Revision guides such as "A Head Start to A level Mathematics" by CGP provide support for those key topics from GCSE that form the basis of the Alevel course. A good YouTube channel to support revision is ExamSolutions who provides many solutions to questions, tutorials on topics and live streams for students to work along with.

These are also a fun read:
"The Simpsons and Their Mathematical Secrets" by Simon Singh

“The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography” by Simon Singh,
“Do Dice Play God? The Mathematics of Uncertainty” by Ian Stewart
“Humble Pi: A Comedy of Maths Errors” by Matt Parker
"Can you solve my problem?" by Allex Bellos
"Alex's adventures in numberland" by Allex Bellos

The youtube channels for Numberphile, 3Blue1Brown, and Stand-up Maths are also worth looking at.