

Mathematics

The aims and objectives of this qualification are to enable students to:

- understand mathematics and mathematical processes in a way that promotes confidence, fosters enjoyment and provides a strong foundation for progress to further study
- extend their range of mathematical skills and techniques
- understand coherence and progression in mathematics and how different areas of mathematics are connected
- apply mathematics in other fields of study and be aware of the relevance of mathematics to the world of work and to situations in society in general
- use their mathematical knowledge to make logical and reasoned decisions in solving problems both within pure mathematics and in a variety of contexts, and communicate the mathematical rationale for these decisions clearly
- reason logically and recognise incorrect reasoning
- generalise mathematically
- construct mathematical proofs
- use their mathematical skills and techniques to solve challenging problems that require them to decide on the solution strategy
- recognise when mathematics can be used to analyse and solve a problem in context
- represent situations mathematically and understand the relationship between problems in context and mathematical models that may be applied to solve them
- draw diagrams and sketch graphs to help explore mathematical situations and interpret solutions
- make deductions and inferences and draw conclusions by using mathematical reasoning
- interpret solutions and communicate their interpretation effectively in the context of the problem
- read and comprehend mathematical arguments, including justifications of methods and formulae, and communicate their understanding
- read and comprehend articles concerning applications of mathematics and communicate their understanding
- use technology such as calculators and computers effectively and recognise when their use may be inappropriate
- take increasing responsibility for their own learning and the evaluation of their own mathematical development.

Year 13 A Level Mathematics

Term One

Content of study

Pure:

- Unit 3 – Functions and Modelling
- Unit 4 – Series and Sequences
- Unit 5 – The binomial theorem

Statistics:

- Unit 1 – Regression and correlation

Mechanics:

- Unit 4 – Moments

What are the aims and objectives of this term?	Pure Unit 3 – Functions and Modelling: • <i>Modulus function</i> • <i>Composite and inverse functions</i> • <i>Transformations</i> • <i>Modelling with functions (trigonometric, exponential, reciprocal etc.)</i> Pure Unit 4 – Series and Sequences: • <i>Arithmetic and geometric progressions (proof of ‘sum formulae’)</i> • <i>Sigma notation</i> • <i>Recurrence and iterations</i> Pure Unit 5 – The binomial theorem: • Expanding $(a + bx)^n$ for rational n knowledge of range of validity • Expansion of functions by first using partial fractions Statistics Unit 1 – Regression and correlation: • <i>Change of variable</i> • <i>Correlation coefficients. Statistical hypothesis for zero correlation</i> Mechanics Unit 4 – Moments: • <i>Forces’ turning effect</i>
What previous knowledge is required?	Pure Unit 3 – Functions and Modelling: GCSE (9-1) in Mathematics at Higher Tier A7 • Vocabulary and notation for functions A13 • Composite, inverse and transformations of polynomial functions A12 • Knowledge of polynomial, trigonometric, exponential and logarithmic functions, including their graphs AS Mathematics - Pure Mathematics content 2.9 • Transforming graphs Pure Unit 4 – Series and Sequences: GCSE (9-1) in Mathematics at Higher Tier A23 • Generate terms of a sequence from either a term-to-term or a position-to-term rule A24 • Use simple arithmetic and geometric progression and geometric sequence A25 • Finding expressions for the nth term of linear and quadratic sequences Pure Unit 5 – The binomial theorem: GCSE (9-1) in Mathematics at Higher Tier A4 • Algebraic fractions AS Mathematics - Pure Mathematics content 2.6

	- Algebraic division, factor theorem 4.1 - Binomial expansion of the form $(1+x)^n$, where n is a positive integer Statistics Unit 1 – Regression and correlation: AS Mathematics - Statistics content 2.2 - Understanding of regression - Understanding of correlation AS Mathematics - Statistics content 5.1 - Use appropriate language of statistical hypothesis testing 5.2 - Be able to apply a hypothesis test to the binomial distribution AS Mathematics - Pure Mathematics content 6.3, 6.4 - Knowledge of logarithms Mechanics Unit 4 – Moments: <i>Types of forces and force diagrams</i> <i>Assumptions made throughout this course (e.g. particle, rigid, light, etc.)</i> <i>Weight = mass $\times$ gravity ($= mg$)</i> <i>S.I. units</i> GCSE (9-1) in Mathematics at Higher Tier A19 <i>Solving linear and simultaneous equations</i> AS Mathematics - Mechanics content 8.4 <i>Basic equilibrium</i>
How will this term's content help with future learning?	Pure: - Unit 9 – Numerical Methods Mechanics: - Unit 7 – Application of Forces
Resources	- Tutorial videos for all topics and interactive questions available at www.hegartymaths.com. All students provided with an account - Tutorial videos and practice exam questions available at https://www.mathsgenie.co.uk/newalevel.html - Tutorial videos, practice questions and practice exam questions available at https://www.drfrstmaths.com/course.php?coid=29 - Additional revision resources available at www.bbc.co.uk/bitesize/
Links to the national curriculum/specific ation	https://qualifications.pearson.com/content/dam/pdf/A%20Level/Mathematics/2017/specification-and-sample-assesment/a-level-l3-mathematics-specification-issue4.pdf Pure Unit 3 – Functions and Modelling: 2.7

	- The modulus of a linear function 2.8 - Understand and use composite functions; inverse functions and their graphs 2.9 - Understand the effect of simple transformations on the graph of $y = f(x)$ including sketching associated graphs: $y = af(x)$, $y = f(ax)$, $y = f(x) + a$, $y = f(x - a)$, $y = f(x + a)$, $y = f(ax)$ and combinations of these transformations 2.11 - Use of functions in modelling, including consideration of limitations and refinements of the models Pure Unit 4 – Series and Sequences: 4.2 - Work with sequences including those given by a formula for the nth term and those generated by a simple relation of the form $x_{n+1} = f(x_n)$; increasing sequences; decreasing sequences; periodic sequences 4.3 - Understand and use sigma notation for sums of series 4.4 - Understand and work with arithmetic sequences and series, including the formulae for nth term and the sum to n terms 4.5 - Understand and work with geometric sequences and series including the formulae for the nth term and the sum of a finite geometric series; the sum to infinity of a convergent geometric series, including the use of $r < 1$; modulus notation 4.6 - Use sequences and series in modelling Pure Unit 5 – The binomial theorem: 4.1 - Understand and use the binomial expansion of $(a + bx)^n$ for rational n, including its use for approximation; be aware that the expansion is valid for $bx < 1$ (proof not required) Statistics Unit 1 – Regression and correlation: 2.2 - Change of variable may be required e.g. using knowledge of logarithms to reduce a relationship of the form $y = ax^ny = ax^n$ or $y = kbxy = kbx$ into linear form to estimate a and n or k and b 5.1 - Understand and apply the language of statistical hypothesis testing, ..., extend to correlation coefficients as measures of how close data points lie to a straight line and be able to interpret a given correlation coefficient using a given p-value or critical value (calculation of correlation coefficients is excluded) Mechanics Unit 4 – Moments:
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	9.1 Understand and use moments in simple static contexts	
Assessments	Pure Mathematics Year 2 (A Level) Unit Test 3: Functions and Modelling Pure Mathematics Year 2 (A Level) Unit Test 4: Sequences and Series Pure Mathematics Year 2 (A Level) Unit Test 5: The Binomial Theorem	
Term Two		
Content of study	Pure Unit 6: Trigonometry Unit 7: Parametric Equations	Applied Unit 3: Normal Distribution Unit 5: Forces and Friction
What are the aims and objectives of this term?	Pure See above	Applied See above
What previous knowledge is required?	GCSE (9-1) in Mathematics at Higher Tier G22 Sine and cosine function G18 Length of arc and area of sector AS Mathematics - Pure Mathematics content 2.6 Algebraic division, factor theorem (See Unit 3a of the SoW) 5.7 Solving trigonometric equations (See Unit 4 of the SoW) 5.5 $\sin 2x + \cos 2x = 1$ and $\sin x \cos x = \tan x \sin x \cos x = \tan x$ (See Unit 4 of the SoW) 5.3 Properties of graphs of $y = \sin x$, $y = \cos x$, $y = \sin x$, $y = \cos x$ and $y = \tan x$ (See Unit 4 of the SoW) Covered so far - Trigonometric identities - Knowledge of a variety of functions involving powers, roots, trigonometric functions, exponentials and logarithms GCSE (9-1) in Mathematics at Higher Tier G11 Coordinate geometry A2, A5 Changing the subject of the formula, and substitution A12 Graphs of linear, quadratic and trigonometric functions AS Mathematics - Pure Mathematics content 2.7, 3.1, 3.2 Coordinate geometry (See Unit 2 of SoW) 5.5, 5.7 Trigonometric identities (See Unit 4b of SoW)	GCSE (9-1) in Mathematics at Higher Tier A19 Solve two simultaneous equations in two variables (linear/linear or linear/quadratic) algebraically AS Mathematics - Statistics content 3.1 Probability calculations, independent events (See Unit 3 of the SoW) AS Mathematics - Statistics content Unit 4 4.1 Properties of the binomial distribution (See Unit 4 of the SoW) 3.1 Probability is the area under a curve (See Unit 4 of the SoW) AS Mathematics - Statistics content Unit 5 5.1 Use appropriate language of statistical hypothesis testing (See Unit 5a of the SoW) 5.2 Be able to apply a hypothesis test to the binomial distribution (See Unit 5b of the SoW) 2D trigonometry - Cosine and sine rules $\sin x \cos x = \tan x \sin x \cos x = \tan x$ (to find the angle of the resultant) - Basic vectors, magnitude and direction (kinematics) ii, jj vectors - Force diagrams and assumptions

How will this term's content help with future learning?	<i>All learning from this period of time will be called on during exam preparation revision in Term 5.</i>
Resources	- Tutorial videos for all topics and interactive questions available at www.hegartymaths.com. All students provided with an account <i>Students are provided with Exam style questions in their assessment folders.</i> <i>All classroom resources are published onto teams</i>
Links to the national curriculum/specific ation	<i>Pure:</i> 5.1 Work with radian measure, including use for arc length and area of sector 5.2 Understand and use the standard small angle approximations of sine, cosine and tangent i.e. $\sin\theta \approx \theta$, $\cos\theta \approx 1 - \frac{\theta^2}{2}$, $\tan\theta \approx \theta$ where θ is in radians 5.3 Know and use exact values of sin and cos for $0, \frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}, \pi$ and multiples thereof, and exact values of tan for $0, \frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}, \pi$ and multiples thereof 5.4 Understand and use the definitions of secant, cosecant and cotangent and of arcsin, arccos and arctan; their relationships to sine, cosine and tangent; understanding of their graphs; their ranges and domains 5.5 Understand and use $\sec 2\theta = 1 + \tan^2\theta$ and $\operatorname{cosec} 2\theta = 1 + \cot^2\theta$ 5.6a Understand and use double angle formulae; use of formulae for $\sin(A \pm B)$, $\cos(A \pm B)$ and $\tan(A \pm B)$; understand geometrical proofs of these formulae 5.6b Understand and use expressions for $a\cos\theta + b\sin\theta$ in the equivalent forms of $R\cos(\theta \pm \alpha)$ or $R\sin(\theta \pm \alpha)$. 5.8 Construct proofs involving trigonometric functions and identities 5.9

	Use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces 3.3 Understand and use the parametric equations of curves and conversion between Cartesian and parametric forms 3.4 Use parametric equations in modelling in a variety of contexts <i>Applied</i> 4.2 Understand and use the Normal distribution as a model; find probabilities using the Normal distribution Link to histograms, mean, standard deviation, points of inflection and the binomial distribution 4.3 Select an appropriate probability distribution for a context, with appropriate reasoning, including recognising when the binomial or the Normal model may not be appropriate 5.3 Conduct a statistical hypothesis test for the mean of the Normal distribution with known, given or assumed variance and interpret the results in context 8.4 Resolving forces in 2 dimensions. Problems may be set where forces need to be resolved. 8.6 Understand and use the $F \leq \mu R$ model for friction; coefficient of friction; motion of a body on a rough surface; limiting friction and limiting equilibrium.
Assessments	Pure: <i>Trigonometry assessment</i> <i>Parametric equations assessment</i> <i>Applied:</i> <i>The Normal distribution assessment</i>

<i>Forces at any angle assessment</i>		
Term Three		
Content of study	Pure <i>Unit 8: Differentiation</i> <i>Unit 9: Numerical Methods</i>	Applied <i>Unit 6: Projectiles</i> <i>Unit 7: Application of forces</i>
What are the aims and objectives of this term?	Pure See above	Applied See above
What previous knowledge is required?	Covered so far - Functional notation including $f'(x)$ and $f''(x)$ GCSE (9-1) in Mathematics at Higher Tier G11 Coordinate geometry A2, A6 Changing the subject of the formula, and substitution A12 Graphs of linear, quadratic and trigonometric functions AS Mathematics - Pure Mathematics content 2.7, 3.1, 3.2 Coordinate geometry (See Unit 2 of SoW) 5.5, 5.7 Trigonometric identities (See Unit 4b of SoW) 7 Differentiation (See Unit 6 of SoW) Covered so far - Series, sequences and recurrence relations (Unit 4) - Graphs, roots and functions - Differentiation GCSE (9-1) in Mathematics at Higher Tier A15, A20 Iterations and approximate areas under curves A15 Kinematics (velocity-time graphs) AS Mathematics - Pure Mathematics content 2.7, 2.8 Graphs, roots and functions 7, 8 Differentiation and integration (See Units 6 & 7 of SoW) AS Mathematics - Mechanics content 7.2 Kinematics (velocity-time graphs) (See Unit 7 of SoW)	GCSE (9-1) in Mathematics at Higher Tier G20 Trigonometry AS Mathematics - Mechanics content 7.3 <i>suvat</i> formulae (See Unit 7b of the SoW) 8.3 Vertical motion under gravity (See Unit 7b of the SoW) 8.2 i, j (2D) vectors (See Unit 8a of the SoW) AS Mathematics - Pure Mathematics content 10.1 i, j (2D) vectors (See Unit 5 of the SoW) 10.2 Magnitude and direction of a vector 5 Trigonometry (See Unit 4 of the SoW) A level Mathematics - Pure Mathematics content 5.5 $\sec^2 x = 1 + \tan^2 x$ identity and solving trigonometric equations (See Unit 6 of the SoW) - Types of forces and force diagrams - Assumptions made throughout this course (e.g. particle, rigid, light, etc.) - S.I. units - Moments and frictional forces - Resolving forces AS Mathematics - Mechanics content 7 Kinematics (constant acceleration) (See Unit 7 of the SoW) 8.1, 8.2, 8.4 Newton's laws of motion (See Unit 8 of the SoW) 8.4 Basic equilibrium (See Unit 8 of the SoW)
How will this term's content help with future learning?	Pure: <i>Year 13 Unit 10: Integration</i>	

	<i>All learning from this period of time will be called on during exam preparation revision in Term 5.</i>
Resources	• Tutorial videos for all topics and interactive questions available at www.hegartymaths.com. All students provided with an account • <i>Students are provided with Exam style questions in their assessment folders.</i> • <i>All classroom resources are published onto teams</i>
Links to the national curriculum/specification	<i>Pure:</i> 7.1c Differentiation from first principles for $\sin x \sin x$ and $\cos x \cos x$ 7.1b Understand and use the second derivative as the rate of change of gradient; connection to convex and concave sections of curves and points of inflection 7.2 Differentiate $e^k x e^k x$, $a^k x a^k x$, $\sin k x \sin k x$, $\cos k x \cos k x$, $\tan k x \tan k x$ and related sums, differences and constant multiples. Understand and use the derivative of $\ln \ln x x$ 7.4 Differentiate using the product rule, the quotient rule and the chain rule, including problems involving connected rates of change and inverse functions 7.5 Differentiate simple functions and relations defined implicitly or parametrically, for first derivative only 7.6 Construct simple differential equations in pure mathematics and in context, (contexts may include kinematics, population growth and modelling the relationship between price and demand) 9.1 Locate roots of $f(x)=0$ by considering changes of sign of $f(x)$ in an interval of x on which $f(x)$ is sufficiently well-behaved Understand how change of sign methods can fail 9.2

	Solve equations approximately using simple iterative methods; be able to draw associated cobweb and staircase diagrams Solve equations using the Newton-Raphson method and other recurrence relations of the form $x_{n+1} = g(x_n)$ Understand how such methods can fail 9.4 Use numerical methods to solve problems in context <i>Applied:</i> 7.5 Model motion under gravity in a vertical plane using vectors; projectiles. 8.2 Understand and use Newton's second law for motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2D vectors); extend to situations where forces need to be resolved (restricted to 2 dimensions). 8.4 Understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line; application to problems involving smooth pulleys and connected particles; resolving forces in 2 dimensions; equilibrium of a particle under coplanar forces. 8.5 Understand and use addition of forces; resultant forces; dynamics for motion of a particle in a plane. 8.6 An understanding of $F \leq \mu R$ in a situation of equilibrium. 9.1 Moments: problems involving parallel and non-parallel coplanar forces e.g. ladder problems.
Assessments	Pure: <i>Differentiation assessment</i> <i>Numerical methods assessment</i> <i>Applied:</i>

	<i>Forces at any angle (projectiles) assessment</i> <i>Application of forces assessment</i>	
Term Four		
Content of study	Pure <i>Unit 10: Integration</i>	Applied <i>Unit 8: Further Kinematics</i> <i>Unit 11: Vectors 3D</i>
What are the aims and objectives of this term?	Pure See above	Applied See above
What previous knowledge is required?	Pure: Covered so far - Knowledge of e^x and $\ln x$ - Laws of logarithms - Trigonometry - Differentiation - Parametric Equations AS Mathematics - Pure Mathematics content 6.1, 6.3 Knowledge of e^x and $\ln x$ (See Unit 8 of SoW) 6.4 Laws of logarithms (See Unit 8 of SoW) 5.1 Trigonometry (See Unit 4 of SoW) 7, 8 Differentiation and integration (See Units 6 & 7 of SoW)	Applied - Basic trigonometry, Pythagoras and vectors - Find the magnitude and direction of vectors AS Mathematics - Mechanics content 7 Kinematics 1 and equations of motion (See Unit 7b of the SoW) 7 Kinematics 2 (variable force) (See Unit 9 of the SoW) AS Mathematics - Pure Mathematics content 10.1 2D vectors - $\hat{i}$, $\hat{j}$ system (See Unit 5 of the SoW) GCSE (9-1) in Mathematics at Higher Tier G24, G25 Vectors AS Mathematics - Pure Mathematics content 10 Vectors (See Unit 5 of SoW)
How will this term's content help with future learning?	<i>All learning from this period of time will be called on during exam preparation revision in Term 5.</i>	
Resources	- Tutorial videos for all topics and interactive questions available at www.hegartymaths.com. All students provided with an account <i>Students are provided with Exam style questions in their assessment folders.</i> <i>All classroom resources are published onto teams</i>	
Links to the national curriculum/specification	Pure: 8.2 Integrate $\sin x$, (including $\cos x$) and integrate e^{kx} , $\sin kx$, $\cos kx$ and related sums, differences and constant multiples To include integration of standard functions such as $\sin^3 x$, $\sec^2 x$, $\tan x$, e^{5x} , $\ln x$. Students are expected to be able to use trigonometric identities to integrate, for example, $\sin^2 x$, $\tan^2 x$, $\cos^2 x$. Integration to include integrating functions defined parametrically. 8.5 Students should recognise integrals of the form $\int f'(x)f(x)dx = \ln f(x) + c$ Applied: 7.3 Extend the constant acceleration formulae of motion to 2 dimensions using vectors. 7.4 Use calculus in kinematics for (variable acceleration) motion in a straight line. Extend to 2 dimensions using vectors.	

	10.1 Use vectors in three dimensions Knowledge of column vectors and i , j and k unit vectors in three dimensions	
Assessments	<i>Pure:</i> <i>Integration assessment</i> <i>Applied:</i> <i>Further Kinematics assessment</i> <i>Vectors 3D assessment</i>	
Term Five		
Content of study	Pure <i>Revision for external exams</i>	Applied <i>Revision for external exams</i>
What are the aims and objectives of this term?	Pure See above	Applied See above
What previous knowledge is required?	All topics which have been covered over the course	
How will this term's content help with future learning?	<i>All learning from this period of time will be called on during exam in Term 5.</i>	
Resources	• Tutorial videos for all topics and interactive questions available at www.hegartymaths.com. All students provided with an account • <i>Students are provided with Exam style questions in their assessment folders.</i> • <i>All classroom resources are published onto teams</i>	
Links to the national curriculum/specification		
Assessments	<i>Formal External exams</i>	