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Learning Cycle Year 1	Knowledge and Skills	Vocabulary & Reading	Checking of understanding	Rationale
Autumn Term	Pure - Algebra and Functions • Algebraic Expressions – basic manipulation with indices and surds; • Quadratic Functions – factorising, solving, graphs and discriminants; • Linear and quadratic simultaneous equations; • Linear and quadratic inequalities; • Cubic, quartic and reciprocal graphs; Transformations of graphs – f(x) notation. Pure - Coordinate Geometry in the (x, y) plane • Straight Line Graphs. Statistics - Data Representation • Interpret diagrams for single-variable data. Mechanics - Quantities and Units in Mechanics • Introduction to mathematical modelling and standard S.I. units of length, time and mass; • Definitions of force, velocity, speed, acceleration and weight and displacement; • Vector and scalar quantities Pure - Trigonometry • Sine rule Cosine rule and Area of a triangle Statistics - Statistical Sampling and Measures of location and spread • Measures of central tendency, other location and spread;	Surd Rational or Irrational number Rationalising the denominator Index; Indices; Base Discriminant Real roots/solutions Repeated root Completing the Square Mathematical Modelling Inequality Graphs; Axes; Asymptote Cubic; Quartic and Reciprocal graphs Gradient Y-intercept Parallel and Perpendicular Linear model Model Particle; Rod; Uniform Body Light Object; Inextensible String; Smooth Surface Smooth and Light Pulley Bead; Air resistance; Gravity;	Throughout the year there will be • Weekly homework from both teachers – by topic and mixed questions including problem-solving. Self-assessment using purple pen. • Classroom strategies will include: Question and Answer, both open questioning and closed questioning, differentiated as appropriate • Use of mini-whiteboards to aid Q and A • Teacher scrutiny of work and exercises, performed in real time. • Folder scrutiny Diagnostic Test in Week 1	We will teach this section first, since these skills are fundamental to the students' ability to progress with the course. These components and basic skills form the foundations of knowledge for the remainder of the course. We also see a link with Key Stage 4, since the topics under scrutiny in the first term will have been encountered previously by the students at GCSE. The mathematical skills developed in this first term reference previous work therefore, thus enabling the students to commence the A-level course with some confidence. These considerations are applicable to both the Pure Mathematics and Statistics that are to be taught at this stage. The Mechanics work will also build upon GCSE knowledge in Science and complement

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	• Coding Statistics - Correlation and Regression Mechanics - Kinematics continued • Motion in a straight line under constant acceleration; SUVAT formulae; Vertical motion under gravity. Pure AS - Vectors • Definitions, magnitude/direction, addition and scalar multiplication Pure - Proof • Proof by Exhaustion • Algebraic Proof/Deduction • Disproof by Counter-example	Force; weight; Normal reaction; Friction; Thrust Compression Measures of Location and Spread; Central Tendency Quartiles; Outliers Standard deviation; Variance Interpolation Interpercentile range Coding Displacement – Distance Velocity – Speed Acceleration/Deceleration Gradient; Rate of Change Kinematics formulae (SUVAT); Time of flight Speed of Projection Vector and Scalar quantity Magnitude; direction Proof Statement/Conjecture Identity Deduction; Exhaustion Counter-example Rigour	Concept and skill check opportunities (Integral Maths): Pure S1 – Surds S2 – Indices Q1 – Quadratic graphs and equations Q2 – The quadratic formulae C1 – Points and straight lines E1 – Simultaneous equations E2 – Inequalities T3 – Sine and Cosine rules Mechanics K1 – Displacement and distance K2 - Speed and velocity Summative tests TEST 1 to include: • Algebra/Surds/Indices • Quadratics • Coordinate Geometry • Simultaneous Equations TEST 2 to include: • Descriptive Statistics • Modelling in Mechanics • Constant Acceleration • Correlation and Regression • Trigonometry • Recall from T1	contemporaneous work done in A-level Physics, which many of our students take as well. The selection of Pure Mathematics, interweaved with Statistics and Mechanics throughout this term is to give the students a flavour of the whole course and the various concepts and skills which will be required for the different strands. It is also to ensure that the importance of all aspects of the course is emphasised at the outset. The teaching of Correlation and Regression gives the opportunity to analyse a large data set using sampling techniques and the use of spreadsheets. The introduction of Vectors will inform this aspect of the Pure course as well as providing an introduction for the vectors which will be encountered in Mechanics and for Further Mathematics students to more readily access the vectors section of the course (later in Year 12). The concept of Proof is crucial to a genuine

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				understanding of the purpose of Mathematics and links to our intent.
Spring Term	Pure - Differentiation • Gradients of curves • Differentiating x^n and functions with two or more terms • Gradients, Tangents and Normals Pure – Graph Sketching • Points of Intersection • Transforming Graphs by translation, reflection and stretching • Transforming Functions Statistics - Probability • Calculating Probabilities • Venn Diagrams and Tree Diagrams • Mutually exclusive and independent events Statistics – Histograms and Cumulative Frequency • Cumulative frequency diagrams • Histograms Pure – Binomial Expansion • Pascal's Triangle • Factorial Notation • The Binomial Expansion • Problem Solving and Estimation Pure – Indefinite Integration • Indefinite Integrals • Finding Functions Statistics – Discrete Distributions • Probability distributions • Binomial distribution	Translation; Vector; Vertical or Horizontal; Stretch; Scale Factor; Reflection Function notation Experiment; Outcome; Event; Sample Space; Venn Diagram; Tree Diagram Mutually exclusive and independent events Frequency density Factorial Binomial Integration (Indefinite) Constant	Concept and skill check opportunities (Integral Maths): Pure V1 – Working with vectors G1 – Graph sketching I1 – Introduction to Integration B1 – Binomial Expansion P1 – Polynomial functions and graphs C1 – Points and straight lines D1 – Differentiation Statistics D1 – Collecting data D2 – Single variable data D3 – Bivariate data P1 – Working with probability B1 – The Binomial Distribution Mechanics K3 – Constant acceleration formulae Summative tests TEST 3 to include: • Differentiation • Vectors • Probability • Graph Sketching • Binomial Expansion • Indefinite Integration • Recall from T1 and T2	Differentiation occurs at both ends of this term; separated to allow some of the new concepts to embed and allow for recall towards the end of the term. Graph Sketching – Points of Intersection allows for recall and to give meaning to simultaneous equations introduced in term 1. A good understanding of Probability is fundamental for a good understanding of much of the subsequent statistics course and is an interesting topic in itself. Histograms and Cumulative frequency are graphical representations of single-variable data, which builds upon knowledge gained at GCSE. Both the Binomial Expansion and Algebraic Methods topics studied this term are nice algebraic topics, good for improving algebraic skills and problem-solving. The Binomial Expansion points

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	Pure – Algebraic Methods • Algebraic fractions • Dividing Polynomials • Factor Theorem Mechanics – Forces and Newton's Laws • Force diagrams • Forces as Vectors • Forces and Acceleration • Motion in 2-dimensions • Connected particles and Pulleys Pure - Differentiation • Increasing and Decreasing functions • 2nd order derivatives • Stationary points • Modelling with differentiation	Probability distribution Random variable; Discrete Probability (mass) function Uniform distribution Binomial distribution Denominator; Numerator Polynomial Factor; Solution Resultant force: F=ma (Newton's 2nd law) Weight vs Mass Scale pan; Smooth pulley Newton's 1st and 3rd laws Increasing and decreasing functions 1st and 2nd derivative Stationary point; Turning point; (local) Maximum;Minimum: Rate of Change; Point of Inflection	TEST 4 to include: • Discrete distributions • Binomial Distribution • Forces and Newton's Laws • Factor Theorem • Further Differentiation • Recall from T1, T2, T3	towards a development of this topic in year 13. Integration has been separated into two sections, to allow time for consolidation and embedding of the key ideas prior to definite integration to be taught later (during term 3). Work with indices (term 1) and differentiation (term 2) are pre-requisites for this aspect of the course. Discrete probability distributions will inform understanding of continuous distributions (the Normal distribution in year 13). The Binomial distribution resides in the curriculum at this juncture, since pre-requisite knowledge is the Binomial Expansion (above). The Forces mechanics topic builds upon concepts and skills developed during term 1 and utilizes skills learned previously in Vectors (term 1)
Summer Term	Statistics – Hypothesis Testing • One and Two tailed tests for a Binomial Distribution • Finding critical values and critical regions	Null Hypothesis; Alternative hypothesis; Population parameter; Test statistic Significance level; Actual significance level; Critical value and Critical region	Concept and skill check opportunities (Integral Maths): Pure P2 – Dividing and factorising polynomials	Several of the components of the course learned in the summer term are beginning to be quite challenging and removed from GCSE learning; they also require a good

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	Pure - Circles • Equation of a Circle • Intersections of lines and circles • Tangents, chords and normals Pure - Trigonometry • Solving trigonometric equations • Identities • Sketching trigonometric graphs Pure – Definite Integration • Definite Integrals to find areas • Areas between curves and lines (including axes) • Disproof by Counter-example Pure – Exponentials and Logarithms • Exponential functions including $y=e^x$ • Laws of Logarithms • Logarithms and the natural logarithm • Solving Equations using logarithms and exponentials as the inverses of one another • Exponential and Logarithmic modelling including non-linear data Mechanics – Variable Acceleration • Functions of time • Use of Differentiation and Integration	Perpendicular bisector Chord; Tangent; Normal Circumcentre Circumcircle Principal value; Identity or Equation; Acute, obtuse or reflex angle Limits; Bounded Fundamental theorem of Calculus Logarithm; Base; Natural Logarithm "Logs to both sides"	D2 – Maximum and minimum points D3 – Differentiation: Extending the rule I2 – Area under the curve I3 – Further Integration C2 – Circles Statistics H1 – Introduction to hypothesis testing Mechanics F1 – Force diagrams and equilibrium F2 – Newton's 2nd Law F3 – Connected objects V1 – Variable Acceleration Summative tests Year 12 Exam - Exam paper to include Pure, Statistics and Mechanics End of year test – Recall of year's work	breadth of knowledge and skills learned to date in the A-level course, which is why we have introduced them towards the end of the academic year. This is particularly true of Trigonometry, Exponentials and Logarithms and Variable Acceleration Circles is taught at this stage to recall Coordinate Geometry (term 1) and develop these skills further. Also, we feel that students' problem-solving skills will have developed sufficiently to make the most of this topic at this latter stage. Hypothesis testing is a powerful tool, which gives a good reason for studying Statistics. To what extent are our empirical predictions true? Do we have sufficient statistical evidence to draw such-and-such a conclusion? These are the questions addressed in this topic. Variable acceleration builds upon concepts introduced in Kinematics (term 1) and requires knowledge of (year 12) Differentiation and Integration.

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Learning Cycle Year 2	Knowledge and Skills	Vocabulary & Reading	Checking of understanding	Rationale
Autumn Term	Pure – Functions and Graphs • Modulus Functions and Solving modulus problems • Functions and Mappings • Domain and Range • Composite Functions • Inverse Functions • Combining Transformations Pure – Trigonometric Functions • Small Angles • Radians • Secx; Cosecx; Cotx and their graphs • Solving Equations • Identities • Inverse trigonometric functions • Arcs and Sectors Pure – Algebraic and Partial Fractions • Algebraic Fractions • Partial Fractions • Algebraic Division Pure - Differentiation • Chain, Product and Quotient Rules • Differentiation of Trig functions	Modulus of a function Mapping vs Function Domain Range Real Numbers Secx, Cosecx, Cotx Arcsinx, Arccosx etc. Arc; Minor or Major Arc Sector Segment Equate coefficients Degree of a polynomial Chain, Product and Quotient Rules Implicit Differentiation	Throughout the year there will be • Weekly homework from both teachers – by topic and mixed questions including problem-solving. Self-assessment using purple pen. • Classroom strategies will include: Question and Answer, both open questioning and closed questioning, differentiated as appropriate • Use of mini-whiteboards to aid Q and A • Teacher scrutiny of work and exercises, performed in real time. • Folder scrutiny	A good understanding of functions is required for sound progress during year 13. A good understanding of trigonometry is required for sound progress during year 13 as it forms background knowledge for the further calculus and other topics to come. It also builds upon the work on trigonometry which was done towards the end of year 12. Trigonometry presents opportunity for problem solving. Algebraic and Partial Fractions is a good introductory topic for year 13 since it does not require much previous knowledge, but does help students to further build

	• Differentiation of the natural log function and exponentials • Implicit Differentiation • Use of second order derivatives Mechanics - Forces and Friction • Resolving Forces • Inclined Planes • Friction Pure - Vectors • 3D Coordinates and Vectors in 3D • Application to Mechanics • Geometric Problems Statistics - Probability • Set Notation • Conditional Probability • Probability formulae • Venn diagrams and Tree diagrams Pure - Integration • Integrating standard functions • Integrating f(ax+b) • Integration using partial Fractions Statistics – Normal Distribution • Finding Probabilities • Inverse normal distribution function • The standard normal distribution • Finding μ and σ	Concave Convex Point of Inflection Component of a force Resolving Coefficient of Friction F_{max} Limiting Equilibrium Unit Vectors Position vector Direction vector Coplanar/Non-coplanar Intersection; Union Complement Conditional Probability Continuous random variable Standard Deviation vs Variance Population parameter Standardise/Standard Normal z-values	Consolidation Opportunities: Integral Maths (Year 12 Pure) L1-3 – Exponentials and Logarithms T1-2 – Trigonometry P1-2 – Problem Solving D4 – Further differentiation Revision Booklets Coordinate Geometry Functions Descriptive Statistics and Sampling Year 12 Mechanics Concept and skill check opportunities (Integral Maths): Pure F1-3 – Functions A2 – Rational Expressions A3 – Partial Fractions T1 – Working with radians TF1 – Reciprocal and Inverse trig functions D2 – Chain Rule C1 – Product and Quotient Rules Statistics P1 – Conditional probability D1 – Normal distribution Summative tests TEST 1 • Functions and graphs	their algebraic manipulation skills. It is highly desirable to teach Differentiation prior to Integration because of the Fundamental Theorem of Calculus. It is also more accessible than Integration. Another reason is that there is a lot of calculus in Further Mathematics in Year 13, so FM students will benefit (although they would have learned some of the more important principles already – end of Year 12). Knowledge of trigonometry is needed, hence the differentiation component being taught after trigonometry. The Mechanics sections have been staggered throughout Year 13 to encourage recall. Resolving is a concept, which recurs throughout the year so is to be emphasised. Vectors builds upon year 12 knowledge and informs some later Mechanics.

			• Algebraic and partial fractions TEST 2 • Forces and Friction • Trigonometry • Moments (easy) • Differentiation • Recall from T1	Revisit, Recall and further development of knowledge of Probability. Integration is a big topic, so we feel that it would be easier for the students to learn if it is broken up into sections, requiring recall and revision of techniques throughout year 13. The Normal Distribution complements learning in other statistics learning across the curriculum – Biology in particular. It enables students to clarify the meaning of a continuous vs a discrete random variable. Problem Solving is inherent in this component.
Spring Term	Pure – Trigonometry 2 • Addition formulae • Double-angle formulae • Solving Equations and Identities • acosx ± bsinx • Modelling using trig. Pure – Numerical Methods • Location of roots • Iteration • Newton-Raphson Method	Addition formulae Double-angle formulae A numerical method vs algebraic solution Continuous function Iteration; Converge; Diverge; Cobweb diagram; staircase diagram	Consolidation Opportunities: Revision Booklets Differentiation1 Exponential and Logs Arcs and Sectors Numerical Methods Trigonometry Integration 1 Probability Distributions and Hypothesis testing Binomial Expansion	Lots of problem-solving opportunity in trigonometry. The separation from the previous work on trigonometry in term 1 and previously, in year 12 allows for the recall and consolidation of concepts. The idea of a numerical method to find solutions to equations stands in opposition to the idea of finding solutions

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	Statistics – Regression and Correlation • Exponential models • Measuring correlation • Hypothesis testing for zero correlation Pure – Sequences and Series • Geometric Series and the Sum to Infinity • Use of Sigma notation • recurrence relations • Increasing, Decreasing or Periodic sequences Pure – Integration • Using trigonometric identities • Integration by parts • Integration by Substitution • Reverse chain rule • Integration as the limit of a sum • Trapezium Rule Mechanics – Applications of Forces • Modelling with Statics • Friction and static particles • Dynamics and inclined planes • Connected particles • Static rigid bodies Pure – Binomial Expansion • Expanding $(1 + ax)^n$ • Expanding $(a + bx)^n$ • Using partial fractions Mechanics – Projectiles • Horizontal and Vertical components of projection • Projection at any angle	Extrapolation Product moment correlation coefficient Sample vs Population Sequence vs Series Geometric; Common ratio Divergent; Convergent Recurrence Periodic Smooth pulley Hinge Validity Convergent Time of flight; Range of projection; Trajectory Horizontal component	Concept and skill check opportunities (Integral Maths): Pure T2 – Circular measure and small angles S1-3 – Series TI1-2 Trig Identities FD1-3 – Further Differentiation I1-4 - Integration V1 – Vectors in 3 dimensions Summative tests TEST 3 - Mock Exam All content taught to date.	algebraically. It is worth emphasising this point. There are some links to calculus and differentiation and opportunities for modelling and problem solving. The regression and correlation section is well placed here, since it reviews and gives further context to exponential models and hypothesis testing, both encountered in the summer term of year 12. Sequences and Series – Arithmetic series has been self-taught during the Christmas holidays, so some checking of this will take place. Sequences and Series allows for problem solving and modelling interpretations. Integration is becoming more complex at this point and requires good knowledge of differentiation and trigonometry. The Trapezium Rule will have been learned during the Christmas holidays.

	Pure – Proof by Contradiction • Proof that √2 is irrational • Proof of infinite primes Pure – Differential Equations • Rates of Change (Differentiation) • Differential Equations (Integration) • Modelling with differential equations	Vertical component Conjecture Assumption; Contradiction Separate the Variables General Solution; Boundary conditions; Particular solution		The Applications of Forces and Projectiles sections conclude much of the Mechanics work covered to date. "Interleaved" as alluded to above. The Binomial expansion offers the opportunity to reinforce good algebraic processing with some problem solving. Not too onerous to learn to provide some balance against some of the more difficult topics studied towards the end of the course. The concept of Proof is crucial to a genuine understanding of the purpose of Mathematics and links to our intent. Proof by contradiction is used a lot at university level mathematics. Differential Equations is a very synoptic topic, so requires knowledge from many other aspects of the course. But it is a powerful tool for modelling situations and provides a good reason for the study of this and higher level mathematics.

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Summer Term	Statistics – Normal Distribution 2 • Approximating a Binomial Distribution • Hypothesis testing with the normal distribution Pure – Parametric Equations • Parametric equations • Domain and Range • Using trigonometric identities • Points of intersection • Modelling with parametric equations • Differentiating parametric equations • Integrating parametric equations Mechanics – Further Kinematics • Vectors in kinematics • Vector methods with projectiles • Variable acceleration • Differentiating and Integrating vectors	Continuity correction Continuous vs Discrete random variable Sample Mean Inverse normal distribution Parameter Parametric vs Cartesian equation In Mechanics – the parameter is time r as displacement Variable acceleration Dot notation for derivatives wrt time Initial/Boundary condition	Consolidation Opportunities: Revision Booklets Harder Calculus Parametrics Pearson Topic Tests Summative tests TEST 4 – post mock content • Proof • Binomial Expansion • Differential Equations • Sequences and Series • Projectiles • Normal Distribution	The students are now familiar with the binomial distribution and have encountered hypothesis testing in two prior contexts (Binomial distribution and Correlation). Parametric equations is a largely synoptic year 13 topic, so is better to be taught at this later point in the course. It links to the Mechanics topics taught at the later stages too. The Mechanics section here is synoptic in nature, so needs to be taught late on in the course. It requires good knowledge of prior mechanics topics and in pure maths – calculus techniques.