Year 12

Subject Name:	Mathematics

Key Stage 5 (A Level Mathematics)

Curriculum Intent Statement

Our curriculum will encourage pupils to be efficient, resilient problems solvers, able to apply their mathematical skills to any real life context they encounter after leaving the academy.
Through learning mathematics, our pupils will develop the logical thinking skills to break problems in a wide range of contexts into manageable steps.
Pupils will embrace the interconnected nature of the concepts within mathematics and how mathematics can be applied to contexts within everyday life, academia and careers. Their mathematical skills and knowledge will open doors for our pupils to select whichever future path they choose.

Autumn Term 1

Algebra and functions

- Algebraic expressions – basic algebraic manipulation, indices and surds
- Quadratic functions – factorising, solving, graphs and the discriminants
- Equations – quadratic/linear simultaneous
- Inequalities – linear and quadratic (including graphical solutions)
- Graphs – cubic, quartic and reciprocal
- Transformations – transforming graphs – f(x) notation

Coordinate geometry in the (x, y) plane

- Straight-line graphs, parallel/perpendicular, length and area problems
- Circles – equation of a circle, geometric problems on a grid

Further algebra

- Algebraic division, factor theorem and proof
- The binomial expansion

Autumn Term 2

Trigonometry

- Trigonometric ratios and graphs
- Trigonometric identities and equations

Vectors (2D)

- Definitions, magnitude/direction, addition and scalar multiplication
- Position vectors, distance between two points, geometric problems

Spring Term 1

Differentiation

- Definition, differentiating polynomials, second derivatives
- Gradients, tangents, normals, maxima and minima

Integration

- Definition as opposite of differentiation, indefinite integrals of xn
- Definite integrals and areas under curves

Exponentials and logarithms

- Exponential functions and natural logarithms

Statistical sampling

- Introduction to sampling terminology; Advantages and disadvantages of sampling
- Understand and use sampling techniques; Compare sampling techniques in context

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

Spring Term 2

Data presentation and interpretation

- Calculation and interpretation of measures of location; Calculation and interpretation of measures of variation; Understand and use coding
- Interpret diagrams for single-variable data; Interpret scatter diagrams and regression lines; Recognise and interpret outliers; Draw simple conclusions from statistical problems

Probability:

- Mutually exclusive events; Independent events

Statistical distributions:

- Use discrete distributions to model real-world situations; Identify the discrete uniform distribution; Calculate probabilities using the binomial distribution (calculator use expected)

Statistical hypothesis testing

- Language of hypothesis testing; Significance levels
- Carry out hypothesis tests involving the binomial distribution

Kinematics 1 (constant acceleration)

- Graphical representation of velocity, acceleration and displacement
- Motion in a straight line under constant acceleration; suvat formulae for constant acceleration; Vertical motion under gravity

Forces & Newton's laws

- Newton's first law, force diagrams, equilibrium, introduction to i, j system Newton's second law, 'F = ma', connected particles (no resolving forces or use of F = μR); Newton's third law: equilibrium, problems involving smooth pulleys

Summer Term 1
<u>Kinematics 2 (variable acceleration)</u> • Variable force; Calculus to determine rates of change for kinematics • Use of integration for kinematics problems i.e. $r = \int v \, \mathrm{d}t$, $v = \int a \, \mathrm{d}t$ **Revision**
Summer Term 2
Exams and Revision

Year 13

Subject Name:	Mathematics

Key Stage 5 (A Level)

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Autumn Term 1

Proof: Examples including proof by deduction* and proof by contradiction

Algebraic and partial fractions

- Simplifying algebraic fractions
- Partial fractions

Functions and modelling

- Modulus function
- Composite and inverse functions
- Transformations
- Modelling with functions*

Regression and correlation

- Change of variable
- Correlation coefficients
- Statistical hypothesis testing for zero correlation

Series and sequences

- Arithmetic and geometric progressions (proofs of 'sum formulae')
  Sigma notation
- Recurrence and iterations

The binomial theorem

- Expanding (a + bx)n for rational n; knowledge of range of validity Expansion of functions by first using partial fractions

Autumn Term 2

Trigonometry

- Radians (exact values), arcs and sectors
- Small angles
- Secant, cosecant and cotangent (definitions, identities and graphs);
- Inverse trigonometrical functions; Inverse trigonometrical functions
- Compound* and double (and half) angle formulae
- *geometric proofs expected
- $R\cos(x \pm \alpha)$ or $R\sin(x \pm \alpha)$
- Proving trigonometric identities
- Solving problems in context (e.g. mechanics)

Parametric equations

- Definition and converting between parametric and Cartesian forms
- Curve sketching and modelling

Differentiation

- Differentiating $\sin x$ and $\cos x$ from first principles
- Differentiating exponentials and logarithms
- Differentiating products, quotients, implicit and parametric functions.
- Second derivatives (rates of change of gradient, inflections)
- Rates of change problems* (including growth and kinematics)
- Differential equations

Probability

- Using set notation for probability
- Conditional probability
- Questioning assumptions in probability

The Normal distribution

- Understand and use the Normal distribution
- Use the Normal distribution as an approximation to the binomial distribution
- Selecting the appropriate distribution
- Statistical hypothesis testing for the mean of the Normal distribution

Spring Term 1

Numerical methods

- Location of roots
- Solving by iterative methods (knowledge of 'staircase and cobweb' diagrams)
- Newton-Raphson method
- Problem solving

Integration (part 1)

- Integrating x^n (including when $n = -1$), exponentials and trigonometric functions.
- Integrating functions defined parametrically.
- Using the reverse of differentiation, and using trigonometric identities to manipulate integrals

Statistics Revision

Spring Term 2

Integration (part 2)

- Integration by substitution
- Integration by parts
- Use of partial fractions
- Areas under graphs or between two curves, including understanding the area is the limit of a sum (using sigma notation).
- Areas under curves expressed parametrically
- The trapezium rule
- Differential equations (including knowledge of the family of solution curves)

Vectors (3D)

- Use of vectors in three dimensions; knowledge of column vectors and i, j and k unit vectors

Moments

- Forces' turning effect

Forces at any angle

- Resolving forces
- Friction forces (including coefficient of friction μ)

Applications of kinematics

- Projectiles

Applications of forces

- Equilibrium and statics of a particle (including ladder problems)
- Dynamics of a particle

Further kinematics

- Constant acceleration (equations of motion in 2D; the i, j system)
- Variable acceleration (use of calculus and finding vectors $\dot{\mathbf{r}}$ and $\ddot{\mathbf{r}}$ at a given time)

Summer Term 1

Revision

Summer Term 2

Revision and Exams