ARNOLD LODGE
4 - 18 yrs Co-educational Independent Day School

Key Stage 5 Mathematics: Curriculum Map

Year 12: Cycle of Topics Per Year

1. Algebraic Expressions, Quadratics, Equations & Inequalities

2. Graphs & Transformations, Data Collection, Measure of location & spread, Straight Line Graphs, Modelling in Mechanics

3. Constant Acceleration, Circles, Algebraic Methods, Trigonometic Ratios, Representations of Data

4. Correlation, Binomial Expansion, Trigonometic Identities & Equations, Probability

5. Conditional Probability, Differentiation, Vectors, Forces & Motion, Statistical Distributions

6. Integration, Hypothesis Testing, Exponentials & Logorithins, Variable Acceleration

Year 12 Mathematics

Pupils will be working towards the Edexcel A Level Maths qualification. Pupils will continue to build on the fundamental mathematical skills developed in KS4, focusing on their depth of mathematical knowledge and their ability to prove and accurately demonstrate their mathematical skills. The Edexcel GCSE specification focuses on six core sub-topics of mathematics: Number, Algebra, Ratio, Geometry, Probability and Statistics, in varying proportions. The amount of time dedicated to each sub-topic in class is proportional to the percentage incorporated into the examination. Pupils will have continual exposure to exam-style questions with consistent modelling and reference to the mark schemes to ensure that pupils are aware of the requirements of each question.

	Topic of Learning	Half-Termly Overview: Knowledge and Skills
HT1	**Unit 1: Algebraic Expressions**	**By the end of the unit, pupils should be able to:** ● Construct and present mathematical arguments through appropriate use of diagrams; sketch graphs; logical deduction; precise statements involving correct use of symbols and connecting language including: constant, coefficient, expression, equation, function, identity, index, term, variable. ● Comprehend and critique mathematical arguments, proofs and justifications of methods and formulae, including those relating to applications of mathematics. ● Understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion and use methods of proof, including proof by deduction, proof by exhaustion and disproof by counter example proof by contradiction (including proof of the irrationality of $\sqrt{2}$ and the infinity of

		primes, and application to unfamiliar proofs).
	Unit 2: Quadratics	**By the end of the unit, pupils should be able to:** • Work with quadratic functions and their graphs; the discriminant of a quadratic function, including the conditions for real and repeated roots; completing the square; solution of quadratic equations including solving quadratic equations in a function of the unknown. • Understand the effect of simple transformations on the graph of y = f(x) including sketching associated graphs: y = af(x), y = f(x) + a, y = f (x + a), y = f (ax) and combinations of these transformations.
	Unit 3: Equations and inequalities	**By the end of the unit, pupils should be able to:** ● Construct and present mathematical arguments through appropriate use of diagrams; sketching graphs; logical deduction; precise statements involving correct use of symbols and connecting language, including: constant, coefficient, expression, equation, function, identity, index, term, variable. ● Understand and use language and symbols associated with set theory, as set out in the glossary. Apply to solutions of inequalities (see B5 [g]) ● Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. ● Solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions. Express solutions through correct use of 'and' and 'or', or through set notation. Represent linear and quadratic inequalities such as y > x + 1 and y = ax2 + bx + c graphically.

HT2	**Unit 4: Graphs and transformations**	**By the end of the unit, pupils should be able to:** ● Construct and present mathematical arguments through appropriate use of diagrams; sketching graphs; logical deduction; precise statements involving correct use of symbols and connecting language, including: constant, coefficient, expression, equation, function, identity, index, term, variable. ● Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. ● Understand and use graphs of functions; sketch curves defined by simple equations including polynomials, the modulus of a linear function y = a/x and y = a/x2 and (including their vertical and horizontal asymptotes); interpret algebraic solution of equations graphically; use intersection points of graphs to solve equations Understand and use proportional relationships and their graphs. ● Understand the effect of simple transformations on the graph of y = f(x) including sketching associated graphs: y = af(x), y = f(x) + a, y = f (x + a), y = f (ax), and combinations of these transformations.
	Unit 5: Data collection	**By the end of the unit, pupils should be able to:** ● Evaluate, including by making reasoned estimates, the accuracy or limitations of solutions, including those obtained using numerical methods. ● Understand and use the terms 'population' and 'sample'. Use samples to make informal inferences about the population. Understand and use sampling techniques, including simple random sampling and opportunity sampling. Select or critique sampling techniques in the context of solving a statistical problem, including understanding that different samples can lead to different conclusions about the population.

	Unit 6: Measure of location and spread	**By the end of the unit, pupils should be able to:** ● Understand and use mathematical language and syntax as set out in the glossary. ● Interpret measures of central tendency and variation, extending to standard deviation. Be able to calculate standard deviation, including from summary statistics. ● Recognise and interpret possible outliers in data sets and statistical diagrams. Select or critique data presentation techniques in the context of a statistical problem. Be able to clean data, including dealing with missing data, errors and outliers.
	Unit 7: Straight line graphs	**By the end of the unit, pupils should be able to:** ● Understand and use graphs of functions; sketch curves defined by simple equations including polynomials, y = a/x and y = a/x2 and (including their vertical and horizontal asymptotes); interpret algebraic solution of equations graphically; use intersection points of graphs to solve equations. Understand and use proportional relationships and their graphs. ● Understand and use the equation of a straight line, including the forms y – y1 = m(x – x1) and ax + by + c = 0; gradient conditions for two straight lines to be parallel or perpendicular. ● Be able to use straight line models in a variety of contexts.
	Unit 8: Modelling in mechanics	**By the end of the unit, pupils should be able to:** ● Understand and use mathematical language and syntax as set out in the glossary. ● Understand and use fundamental quantities and units in the S.I. system: length, time, mass. Understand and use derived quantities and units: velocity, acceleration, force, weight, moment.
HT3	**Unit 9: Constant acceleration**	**By the end of the unit, pupils should be able to:** ● Evaluate, including by making reasoned estimates, the accuracy or limitations of solutions, including those obtained using numerical methods. ● Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model

		constructed or selected by the student). ● Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). ● Understand that a mathematical model can be refined by considering its outputs and simplifying assumptions; evaluate whether the model is appropriate. ● Understand, use and derive the formulae for constant acceleration for motion in a straight line; extend to 2 dimensions using vectors.
	Unit 10: Circles	**By the end of the unit, pupils should be able to:** ● Understand and use the coordinate geometry of the circle including using the equation of a circle in the form (x – a)2 + (y – b)2 = r2; completing the square to find the centre and radius of a circle; use of the following properties: ○ the angle in a semicircle is a right angle ○ the perpendicular from the centre to a chord bisects the chord ○ the radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point.
	Unit 11: Algebraic methods	**By the end of the unit, pupils should be able to:** ● Construct and present mathematical arguments through appropriate use of diagrams; sketching graphs; logical deduction; precise statements involving correct use of symbols and connecting language, including: constant, coefficient, expression, equation, function, identity, index, term, variable. ● Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. ● Solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation. ● Understand and use graphs of functions; sketch curves defined by simple equations including polynomials, the modulus of a linear function, y = a/x and y = a/x2 and (including their vertical and horizontal asymptotes); interpret algebraic solution of equations graphically; use intersection points of graphs to solve equations Understand and use proportional relationships and their graphs.

	Unit 12: Trigonometric ratios	**By the end of the unit, pupils should be able to:** ● Understand and use mathematical language and syntax as set out in the glossary. ● Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. • Understand the effect of simple transformations on the graph of y = f(x) including sketching associated graphs: y = af(x), y = f(x) + a, y = f (x + a), y = f (ax), and combinations of these transformations. ● Use of functions in modelling, including consideration of limitations and refinements of the models. ● Understand and use the definitions of sine, cosine and tangent for all arguments; the sine and cosine rules; the area of a triangle in the form 1/2 ab sinC. Work with radian measure, including use for arc length and area of sector. ● Understand and use the sine, cosine and tangent functions; their graphs, symmetries and periodicity. Know and use exact values of sin and cos for 0, π/6, π/4, π/3, π/2 and π and multiples thereof, and exact values of tan for 0, π/6, π/4, π/3 and π and multiples thereof. ● Understand and use tan θ = sin θ/cos θ, Understand and use sin2θ + cos2θ = 1. sec2θ = 1 + tan2θ and cosec2θ = 1 + cot2θ. ● Solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle.
	Unit 13: Representations of data	**By the end of the unit, pupils should be able to:** ● Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. ● Interpret diagrams for single-variable data, including understanding that area in a histogram represents frequency. ● Connect to probability distributions. ● Recognise and interpret possible outliers in data sets and statistical diagrams. Select or critique data presentation techniques in the context of a statistical problem. Be able to clean data, including dealing with missing data, errors and outliers.
HT4	**Unit 14: Correlation**	**By the end of the unit, pupils should be able to:** ● Evaluate, including by making reasoned estimates, the accuracy or limitations of solutions, including those obtained using numerical methods. ● Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems,

		including in mechanics. ● Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student). ● Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). ● Interpret scatter diagrams and regression lines for bivariate data, including recognition of scatter diagrams which include distinct sections of the population (calculations involving regression lines are excluded). Understand informal interpretation of correlation. Understand that correlation does not imply causation. ● Recognise and interpret possible outliers in data sets and statistical diagrams. Select or critique data presentation techniques in the context of a statistical problem. Be able to clean data, including dealing with missing data, errors and outliers.
	Unit 15: Binomial expansion	**By the end of the unit, pupils should be able to:** ● Evaluate, including by making reasoned estimates, the accuracy or limitations of solutions, including those obtained using numerical methods. ● Understand and use the binomial expansion of (a + bx)n for positive integer n; the notations n! and nCr; link to binomial probabilities. Extend to any rational n, including its use for approximation; be aware that the expansion is valid for $\|bx/a\|<1$. (Proof not required).
	Unit 16: Trigonometric identities and equations	**By the end of the unit, pupils should be able to:** ● Understand and use $\tan\theta = \sin\theta/\cos\theta$. ● Understand and use $\sin^2\theta + \cos^2\theta = 1$; $\sec^2\theta = 1 + \tan^2\theta$ and $\text{cosec}^2\theta = 1 + \cot^2\theta$.
	Unit 17: Probability	**By the end of the unit, pupils should be able to:** ● Understand and use mathematical language and syntax as set out in the glossary. ● Understand and use language and symbols associated with set theory, as set out in the glossary. Apply to solutions of inequalities. (see B5 [g]) ● Understand and use mutually exclusive and independent events when calculating probabilities. Link to discrete and continuous distributions. ● Interpret diagrams for single-variable data, including understanding that area in a histogram represents frequency.

		Connect to probability distributions. ● Understand and use simple, discrete probability distributions (calculation of mean and variance of discrete random variables is excluded), including the binomial distribution, as a model; calculate probabilities using the binomial distribution.
HT5	**Unit 18: Conditional probability**	**By the end of the unit, pupils should be able to:** ● Construct and present mathematical arguments through appropriate use of diagrams; sketching graphs; logical deduction; precise statements involving correct use of symbols and connecting language, including: constant, coefficient, expression, equation, function, identity, index, term, variable. ● Understand and use mathematical language and syntax as set out in the glossary. ● Understand and use language and symbols associated with set theory, as set out in the glossary. Apply to solutions of inequalities. (see B5 [g]) ● Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. ● Understand a situation in context into a mathematical model, making simplifying assumptions. ● Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). ● Understand and use conditional probability, including the use of tree diagrams, Venn diagrams, two-way tables. ● Understand and use the conditional probability formula $P(A\|B) = P(A \cap B) \div P(B)$.
	Unit 19: Differentiation	**By the end of the unit, pupils should be able to:** ● Recognise the underlying mathematical structure in a situation and simplify and abstract appropriately to enable problems to be solved. ● Translate a situation in context into a mathematical model, making simplifying assumptions. ● Understand and use the derivative of f(x) as the gradient of the tangent to the graph of y = f(x) at a general point (x, y); the gradient of the tangent as a limit; interpretation as a rate of change; sketching the gradient function for a given curve; second derivatives; differentiation from first principles for small positive integer powers of x and for sin x and cos x. ● 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. ● Apply differentiation to find gradients, tangents and normals, maxima and minima and stationary points, points of inflexion. Identify where functions are increasing or decreasing.

	Unit 20: Vectors	**By the end of the unit, pupils should be able to:** ● Construct and present mathematical arguments through appropriate use of diagrams; sketching graphs; logical deduction; precise statements involving correct use of symbols and connecting language, including: constant, coefficient, expression, equation, function, identity, index, term, variable. ● Use vectors in two dimensions and three dimensions. ● Calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form. ● Add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations. ● Understand and use position vectors; calculate the distance between two points represented by position vectors. ● Use vectors to solve problems in pure mathematics and in context, including forces and kinematics.
	Unit 21: Forces & Motion	**By the end of the unit, pupils should be able to:** ● Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. ● Translate a situation in context into a mathematical model, making simplifying assumptions. ● Understand that a mathematical model can be refined by considering its outputs and simplifying assumptions; evaluate whether the model is appropriate. ● Understand and use modelling assumptions. ● Understand and use the language of kinematics: position; displacement; distance travelled; velocity; speed; acceleration. ● Understand, use and interpret graphs in kinematics for motion in a straight line: displacement against time and interpretation of gradient; velocity against time and interpretation of gradient and area under the graph.
	Unit 22: Statistical distributions	**By the end of the unit, pupils should be able to:** ● Recognise the underlying mathematical structure in a situation and simplify and abstract appropriately to enable problems to be solved. ● Translate a situation in context into a mathematical model, making simplifying assumptions. ● Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student). ● Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student).

		• Understand that a mathematical model can be refined by considering its outputs and simplifying assumptions; evaluate whether the model is appropriate. • Understand and use modelling assumptions. • Use of functions in modelling, including consideration of limitations and refinements of the models. • Understand and use simple, discrete probability distributions (calculation of mean and variance of discrete random variables is excluded), including the binomial distribution, as a model; calculate probabilities using the binomial distribution.
HT6	**Unit 23: Integration**	**By the end of the unit, pupils should be able to:** • Understand and use mathematical language and syntax as set out in the glossary. • Know and use the Fundamental Theorem of Calculus. • Integrate xn (excluding n = –1), and related sums, differences and constant multiples. Integrate ekx, 1/x, sin kx & cos kx and related sums, differences and constant multiples.
	Unit 24: Hypothesis Testing	**By the end of the unit, pupils should be able to:** • Understand and use mathematical language and syntax as set out in the glossary. • Understand and apply the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, p-value; 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).
	Unit 25: Exponentials & Logarithms	**By the end of the unit, pupils should be able to:** • Recognise the underlying mathematical structure in a situation and simplify and abstract appropriately to enable problems to be solved. • Translate a situation in context into a mathematical model, making simplifying assumptions. • Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student). • Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student).

		• Understand that a mathematical model can be refined by considering its outputs and simplifying assumptions; evaluate whether the model is appropriate. • Understand and use modelling assumptions. • Use of functions in modelling, including consideration of limitations and refinements of the models. • Understand and use exponential growth and decay; use in modelling (examples may include the use of e in continuous compound interest, radioactive decay, drug concentration decay, exponential growth as a model for population growth); consideration of limitations and refinements of exponential models.
	Unit 26 : Variable Acceleration	**By the end of the unit, pupils should be able to:** • Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student). • Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). • Use calculus in kinematics for motion in a straight line: $v = dr/dt$, $a = dv/dt$, $r = \int v\,dt$, $a = \int v\,dt$; extend to 2 dimensions using vectors.
		Exam Practice

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Key Stage 5 Mathematics: Curriculum Map

Year 13: Cycle of Topics Per Year

1. Proof, Algebraic Methods, Functions & Graphs,	2. Regression, Correlation & Hypothesis Testing, Sequences and Series, Moments, Radians	3. Large Data Set, Binomial Expansion, Trigonometric Functions, Forces & Friction,	4. Trigonometry & Modelling, Projectiles, Differentiation, Normal Distribution, Integration	5. Applications of Force, Further Kinematics, Parametric Equations, Vectors, Numerical Methods	6. Application to Exam Questions and Revision

Year 13 Mathematics

Pupils will be working towards the Edexcel A Level Maths qualification. Pupils will continue to build on the fundamental mathematical skills developed in KS4, focusing on their depth of mathematical knowledge and their ability to prove and accurately demonstrate their mathematical skills. The Edexcel GCSE specification focuses on six core sub-topics of mathematics: Number, Algebra, Ratio, Geometry, Probability and Statistics, in varying proportions. The amount of time dedicated to each sub-topic in class is proportional to the percentage incorporated into the examination. Pupils will have continual exposure to exam-style questions with consistent modelling and reference to the mark schemes to ensure that pupils are aware of the requirements of each question.

HT1	**Unit 1: Proof**	**By the end of the unit, pupils should be able to:** • Construct and present mathematical arguments through appropriate use of diagrams; sketching graphs; logical deduction; precise statements involving correct use of symbols and connecting language, including: constant, coefficient, expression, equation, function, identity, index, term, variable. • Comprehend and critique mathematical arguments, proofs and justifications of methods and formulae, including those relating to applications of mathematics use methods of proof. • Understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion; use methods of proof, including proof by deduction, proof by exhaustion. Disproof by counter example. Proof by contradiction (including proof of the irrationality of $\sqrt{2}$ and the infinity of primes, and application to unfamiliar proofs).

	Unit 2: Algebraic Methods	**By the end of the unit, pupils should be able to:** • Manipulate polynomials algebraically, including expanding brackets and collecting like terms, factorisation and simple algebraic division; use of the factor theorem. Simplify rational expressions including by factorising and cancelling, and algebraic division (by linear expressions only).
	Unit 3: Functions & Graphs	**By the end of the unit, pupils should be able to:** • Construct and present mathematical arguments through appropriate use of diagrams; sketching graphs; logical deduction; precise statements involving correct use of symbols and connecting language, including: constant, coefficient, expression, equation, function, identity, index, term, variable. • Understand and use mathematical language and syntax as set out in the glossary. • Understand and use the definition of a function; domain and range of functions. • Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. • Understand and use graphs of functions; sketch curves defined by simple equations including polynomials, the modulus of a linear function, y = a/x and y = a/x2 and (including their vertical and horizontal asymptotes); interpret algebraic solution of equations graphically; use intersection points of graphs to solve equations. Understand and use proportional relationships and their graphs. • Understand and use composite functions; inverse functions andtheir graphs. • Understand the effect of simple transformations on the graph of y = f(x) including sketching associated graphs: y = af(x), y = f(x) + a, y = f (x + a), y = f (ax), and combinations of these transformations.

HT2	**Unit 4: Regression, correlation and hypothesis testing**	**By the end of the unit, pupils should be able to:** • Understand and apply the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, p-value; 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).
	Unit 5: Sequences and series	**By the end of the unit, pupils should be able to:** • Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student). • Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). • 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. • Use sequences and series in modelling.

	Unit 6: Moments	**By the end of the unit, pupils should be able to:** • Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. • Translate a situation in context into a mathematical model, making simplifying assumptions. • Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student). • Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). • Understand and use fundamental quantities and units in the S.I. system: length, time, mass. Understand and use derived quantities and units: velocity, acceleration, force, weight, moment. • Understand and use moments in simple static contexts.
	Unit 7: Radians	**By the end of the unit, pupils should be able to:** • Understand and use mathematical language and syntax as set out in the glossary. • Evaluate, including by making reasoned estimates, the accuracy or limitations of solutions, including those obtained using numerical methods. • Understand and use the definitions of sine, cosine and tangent for all arguments; the sine and cosine rules; the area of a triangle in the form 1/2 ab sinC. Work with radian measure, including use for arc length and area of sector. • Understand and use the standard small angle approximations of sine, cosine and tangent: $\sin\theta \approx \theta$; $\cos\theta \approx 1 - \theta 2/2$; $\tan\theta \approx \theta$ where θ is in radians. • Understand and use the sine, cosine and tangent functions; their graphs, symmetries and periodicity. Know and use exact values of sin and cos for 0, $\pi/6$, $\pi/4$, $\pi/3$, $\pi/2$ and π and multiples thereof, and exact values of tan for 0, $\pi/6$, $\pi/4$, $\pi/3$ and π and multiples thereof.

HT3	**Unit 8: Large Data Set**	By the end of the unit, pupils should be able to: • Understand and use the data given by Edexcel
	Unit 9: Binomial Expansion	**By the end of the unit, pupils should be able to:** • Evaluate, including by making reasoned estimates, the accuracy or limitations of solutions, including those obtained using numerical methods. • Understand and use the binomial expansion of (a + bx)n for positive integer n; the notations n! and nCr; link to binomial probabilities. Extend to any rational n, including its use for approximation; be aware that the expansion is valid for |bx/a|<1. (Proof not required). • Understand and use sigma notation for sums of series. • 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.
	Unit 10: Trigonometric functions	**By the end of the unit, pupils should be able to:** • Understand and use double angle formulae; use of formulae for sin(A ± B), cos(A ± B) and tan (A ± B); understand geometrical proofs of these formulae. Understand and use expressions for acos θ + bsin θ in the equivalent forms of rcos (θ ± α) or rsin (θ ± α).

	Unit 11: Forces & Friction	**By the end of the unit, pupils should be able to:** • Recognise the underlying mathematical structure in a situation and simplify and abstract appropriately to enable problems to be solved. • Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. • Translate a situation in context into a mathematical model, making simplifying assumptions. • Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student). • Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). • Use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces. • 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 2-D vectors); extend to situations where forces need to be resolved (restricted to 2 dimensions). • Understand and use addition of forces; resultant forces; dynamics for motion in a plane. • 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 statics.
HT4	**Unit 12: Trigonometry & Modelling**	**By the end of the unit, pupils should be able to:** • Understand and use the derivative of f(x) as the gradient of the tangent to the graph of y = f(x) at a general point (x, y); the gradient of the tangent as a limit; interpretation as a rate of change; sketching the gradient function for a given curve; second derivatives; differentiation from first principles for small positive integer powers of x and for sin x and cos x. 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. • Differentiate xn, for rational values of n, and related constant multiples, sums and differences. Differentiate ekx and akx, sin kx, cos kx, tan kx and related sums, differences and constant multiples. Understand and use the derivative of ln x.

	Unit 13: Projectiles	**By the end of the unit, pupils should be able to:** • Recognise the underlying mathematical structure in a situation and simplify and abstract appropriately to enable problems to be solved. • Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. • Translate a situation in context into a mathematical model, making simplifying assumptions. • Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student). • Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). • Understand and use modelling assumptions. • Use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces. • Use vectors to solve problems in pure mathematics and in context, including forces and kinematics. • Model motion under gravity in a vertical plane using vectors; projectiles.
	Unit 14: Differentiation	**By the end of the unit, pupils should be able to:** • Construct and present mathematical arguments through appropriate use of diagrams; sketching graphs; logical deduction; precise statements involving correct use of symbols and connecting language, including: constant, coefficient, expression, equation, function, identity, index, term, variable. • Understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics. • Understand and use the derivative of f(x) as the gradient of the tangent to the graph of y = f(x) at a general point (x, y); the gradient of the tangent as a limit; interpretation as a rate of change; sketching the gradient function for a given curve; second derivatives; differentiation from first principles for small positive integer powers of x and for sin x and cos x. 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. • Apply differentiation to find gradients, tangents and normals, maxima and minima and stationary points, points of inflexion. Identify where functions are increasing or decreasing. • 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.

	Unit 15: Normal Distribution	**By the end of the unit, pupils should be able to:** • Understand and use mathematical language and syntax as set out in the glossary. • Translate a situation in context into a mathematical model, making simplifying assumptions. • Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). • 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.
	Unit 16: Integration	**By the end of the unit, pupils should be able to:** • Integrate xn (excluding n = –1), and related sums, differences and constant multiples. Integrate ekx and related sums, differences and constant multiples. Integrate 1/x and related sums, differences and constant multiples. Integrate sin kx & cos kx and related sums, differences and constant multiples. • Evaluate definite integrals; use a definite integral to find the area under a curve and the area between two curves. • Understand and use integration as the limit of a sum. • Carry out simple cases of integration by substitution and (Integration by substitution includes finding a suitable substitution and is limited to cases where one substitution will lead to a function which can be integrated) integration by parts; (integration by parts includes more than one application of the method but excludes reduction formulae) understand these methods as the inverse processes of the chain and product rules respectively.

HT5	**Unit 17: Applications of force**	**By the end of the unit, pupils should be able to:** • Translate a situation in context into a mathematical model, making simplifying assumptions. • Use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student). • Interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student). • Use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces. • Use vectors to solve problems in pure mathematics and in context, including forces and kinematics. • 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 2-D vectors); extend to situations where forces need to be resolved (restricted to 2 dimensions).
	Unit 18: Further Kinematics	**By the end of the unit, pupils should be able to:** • Use vectors to solve problems in pure mathematics and in context, including forces and kinematics. • Use calculus in kinematics for motion in a straight line: $v = dr/dt$, $a = dv/dt$, $r = \int v\,dt$, $a = \int v\,dt$; extend to 2 dimensions using vectors.

	Unit 19: Parametric Equations	**By the end of the unit, pupils should be able to:** • Understand and use the parametric equations of curves and conversion between Cartesian and parametric forms. • Use parametric equations in modelling in a variety of contexts.
	Unit 20: Vectors	**By the end of the unit, pupils should be able to:** • Understand and use mathematical language and syntax as set out in the glossary. • Understand, use and derive the formulae for constant acceleration for motion in a straight line; extend to 2 dimensions using vectors.

	Unit 21: Numerical Methods	**By the end of the unit, pupils should be able to:** • Evaluate, including by making reasoned estimates, the accuracy or limitations of solutions, including those obtained using numerical methods. • 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 xn + 1 = g(xn). Understand how such methods can fail. • Use numerical methods to solve problems in context.
	Application to Exam Questions	

ARNOLD LODGE
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Key Stage 5 Mathematics: Curriculum Map

HT6	Application to Exam Questions and Revision