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Year 12: Curriculum Implementation Plan

Knowledge and Skills – Students will be taught to…	Reading, Oracy, Literacy	Formative Assessment	Summative Assessment
Please see individual units below.	• Reading worded questions to understand the context and decide how to approach a problem • Paired/collaborative discussion of problems • Writing responses to worded questions such as “Explain why…” • Expanding vocabulary of key mathematical terms • Giving verbal responses in class question-and-answer	• Questioning in class • Self-assessment • Peer-assessment • Starter and homework questions • Weekly revision sheets, including practice exam questions • Regular mini-assessments • Show of hands and other forms of whole-class feedback • Review of student work during lessons • Practice exam papers and exam-style questions	Regular assessment of progress against exam-style questions, in line with the school assessment calendar

Mathematics – Pure Unit 1 – Algebraic Expressions	
Unit content:	By the end of the sub-unit, students should:
1.1 Index Laws 1.2 Expanding Brackets 1.3 Factorising 1.4 Negative and Fractional Indices 1.5 Surds 1.6 Rationalising denominators	• be able to perform essential algebraic manipulations, such as expanding brackets, collecting like terms, factorising etc; • understand and be able to use the laws of indices for all rational exponents; • be able to use and manipulate surds, including rationalising the denominator
Mathematics – Pure Unit 2 – Quadratics	
Unit content:	By the end of the sub-unit, students should:
2.1 Solving Quadratic Equations 2.2 Completing the Square 2.3 Functions 2.4 Quadratic Graphs 2.5 The Discriminant 2.6 Modelling with Quadratics	• be able to solve a quadratic equation by factorising; • be able to work with quadratic functions and their graphs; • know and be able to use the discriminant of a quadratic function, including the conditions for real and repeated roots; • be able to complete the square for $a \geq 1$ • be able to solve quadratic equations, including in a function of the unknown.
Mathematics – Pure Unit 3 – Equations and Inequalities	
Unit content:	By the end of the sub-unit, students should:
3.1 Linear simultaneous Equations 3.2 Quadratic Simultaneous Equations 3.3 Simultaneous Equations on a Graph 3.4 Linear inequalities 3.5 Quadratic Inequalities 3.6 Inequalities on a Graph 3.7 Regions	• be able to solve linear simultaneous equations using elimination and substitution; • be able to use substitution to solve simultaneous equations where one equation is linear and the other quadratic. • be able to solve linear and quadratic inequalities; • know how to express solutions through correct use of 'and' and 'or' or through set notation; • be able to interpret linear and quadratic inequalities graphically; • be able to represent linear and quadratic inequalities graphically.

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Mathematics – Pure Unit 4 – Graphs and Transformations	
Unit content:	By the end of the sub-unit, students should:
4.1 Cubic Graphs 4.2 Quartic Graphs 4.3 Reciprocal Graphs 4.4 Points of Intersection 4.5 Translating Graphs 4.6 Stretching Graphs 4.7 Transforming Functions	• understand and use graphs of functions; • be able to sketch curves defined by simple equations including polynomials; • be able to use intersection points of graphs to solve equations; • understand the effect of simple transformations on the graph of y=f(x) y=f(x); • be able to sketch the result of a simple transformation given the graph of any function y=f(x) y=f(x)
Mathematics – Pure Unit 5 – Straight Line Graphs	
Unit content:	By the end of the sub-unit, students should:
5.1 y = mx + c 5.2 Equations of Straight Lines 5.3 Parallel & Perpendicular Lines 5.4 Length & Area 5.5 Modelling with Straight Lines	• understand and use the equation of a straight line; • know and be able to apply the gradient conditions for two straight lines to be parallel or perpendicular; • be able to find lengths and areas using equations of straight lines; • be able to use straight-line graphs in modelling.
Mathematics – Pure Unit 6 – Circles	
Unit content:	By the end of the sub-unit, students should:
6.1 Midpoints & Perpendicular Bisectors 6.2 Equation of a Circle 6.3 Intersection of Straight Lines & Circles 6.4 Use Tangent & Chord Properties 6.5 Circles & Tangents	• be able to find the midpoint of a line segment; • understand and use the equation of a circle; • be able to find points of intersection between a circle and a line; • know and be able to use the properties of chords and tangents.

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Mathematics – Pure Unit 7 – Algebraic Methods	
Unit content:	By the end of the sub-unit, students should:
7.1 Algebraic Fractions 7.2 Dividing Polynomials 7.3 The Factor Theorem 7.4 Mathematical Proof 7.5 Methods of Proof	• be able to use algebraic division; • know and be able to apply the factor theorem; • be able to fully factorise a cubic expression; • understand and be able to use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion; • be able to use methods of proof, including proof by deduction, proof by exhaustion and disproof by counter-example.
Mathematics – Pure Unit 8 – The Binomial Expansion	
Unit content:	By the end of the sub-unit, students should:
8.1 Pascal's Triangle 8.2 Factorial Notation 8.3 The Binomial Expansion 8.4 Solving Binomial Problems 8.5 Binomial Estimation	• understand and be able to use the binomial expansion of $(a + bx)^n$ for positive integer n • be able to find an unknown coefficient of a binomial expansion.
Mathematics – Pure Unit 9 – Trigonometric Ratios	
Unit content:	By the end of the sub-unit, students should:
9.1 The Cosine Rule 9.2 The Sine Rule 9.3 Areas of Triangles 9.4 Solving Triangle Problems 9.5 Graphs of Sine, Cosine & Tangent 9.6 Transforming Trigonometric Graphs	• understand and be able to use the definitions of sine, cosine and tangent for all arguments; • understand and be able to use the sine and cosine rules; • understand and be able to use the area of a triangle in the form 12 absin$C$ 12absinC ; • understand and be able to use the sine, cosine and tangent functions; their graphs, symmetries and periodicity.

Mathematics – Pure Unit 10 – Trigonometric Identities and Equations	
Unit content:	By the end of the sub-unit, students should:
10.1 Angles in All Four Quadrants 10.2 Exact Values of Trigonometrical Ratios 10.3 Trigonometric Identities 10.4 Simple Trigonometric Equations 10.5 Harder Trigonometric Equations 10.6 Equations & Identities	• be able to solve trigonometric equations within a given interval • understand and be able to use $tan\theta = \frac{sin\theta}{cos\theta}$ • Understand and use $sin^2\theta + cos^2\theta = 1$
Mathematics – Pure Unit 11 - Vectors	
Unit content:	By the end of the sub-unit, students should:
11.1 Vectors 11.2 Representing Vectors 11.3 Magnitude & Direction 11.4 Position Vectors 11.5 Solving Geometric Problems 11.6 Modelling with Vectors	• be able to use vectors in two dimensions; • be able to calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form; • be able to add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations. • understand and be able to use position vectors; • be able to calculate the distance between two points represented by position vectors; • be able to use vectors to solve problems in pure mathematics and in context, (including forces).

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Mathematics – Pure Unit 12 - Differentiation	
Unit content:	By the end of the sub-unit, students should:
12.1 Gradients of Curves 12.2 Finding the Derivative 12.3 Differentiating x^n 12.4 Differentiating Quadratics 12.5 Differentiating Functions with Two or More Terms 12.6 Gradients, Tangents & Normals 12.7 Increasing & Decreasing Functions 12.8 Second Order Derivatives 12.9 Stationary Points 12.10 Sketching Gradient Functions 12.11 Modelling with Differentiation	• understand and be able to 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) • understand the gradient of the tangent as a limit and its interpretation as a rate of change; • be able to sketch the gradient function for a given curve; • be able to find second derivatives; • understand differentiation from first principles for small positive integer powers of x ; • be able to differentiate x^2 , for rational values of *n*, and related constant multiples, sums and differences. • be able to apply differentiation to find gradients, tangents and normals, maxima and minima and stationary points; • be able to identify where functions are increasing or decreasing.

Mathematics – Pure Unit 13 – Integration	
Unit content:	By the end of the sub-unit, students should:
13.1 Integrating x^n 13.2 Indefinite Integrals 13.3 Finding Functions 13.4 Definite Integrals 13.5 Areas Under Curves 13.6 Areas Under the x-axis 13.7 Areas Between Curves & Lines	• know and be able to use the Fundamental Theorem of Calculus; • be able to integrate $x\ n$ xn (excluding *n* = −1), and related sums, differences and constant multiples. • be able to evaluate definite integrals; • be able to use a definite integral to find the area under a curve.

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Mathematics – Pure Unit 14 – Exponentials and Curves	
Unit content:	By the end of the sub-unit, students should:
14.1 Exponential Functions 14.2 $y=e^x$ 14.3 Exponential Modelling 14.4 Logarithms 14.5 Laws of Logarithms 14.6 Solving Equations Using Logarithms 14.7 Working with Natural Logarithms 14.8 Logarithms & Non-Linear Data	• know and be able to use the function a^x and its graph, where a is positive; • know and be able to use the function e^x and its graph; • know that the gradient of e^x is equal to ke^{kx} and hence understand why the exponential model is suitable in many applications; • know and be able to use the definition of $log_a x$ as the inverse of a^x, where a is positive and $x \geq 0$; • know and be able to use the function $\ln x$ and its graph; • know and be able to use $\ln x$ as the inverse function of e^x; • understand and use the laws of logarithms: • be able to solve equations of the form $a^x = b$ • be able to use logarithmic graphs to estimate parameters in relationships of the form $y = ax^n$ and $y = kb^x$, given data for x and y; • to understand and be able to use exponential growth and decay in modelling, giving consideration to limitations and refinements of exponential models.

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Mathematics – Pure Unit 1 – Algebraic Methods	
Unit content:	By the end of the sub-unit, students should:
1.1 Proof by contradiction 1.2 Algebraic fractions 1.3 Partial fractions 1.4 Repeated factors 1.5 Algebraic Division	• understand that various types of proof can be used to give confirmation that previously learnt formulae are true, and have a sound mathematical basis; • understand that there are different types of proof and disproof (e.g. deduction and contradiction), and know when it is appropriate to use which particular method; • be able to use an appropriate proof within other areas of the specification later in the course; • be able to add, subtract, multiply and divide algebraic fractions; • know how to use the factor theorem to shown a linear expression of the form $(a+bx)$ is a factor of a polynomial; • know how to use the factor theorem for divisors of the form $(a+bx)$; • be able to simplify algebraic fractions by fully factorising polynomials up to cubic; • be able to split a proper fraction into partial fractions; • be able to split an improper fraction into partial fractions, dividing the numerator by the denominator (by polynomial long division or by inspection).

Mathematics – Pure Unit 2 – Functions and Graphs	
Unit content:	By the end of the sub-unit, students should:
2.1 The modulus function 2.2 Functions & Mappings 2.3 Composite functions 2.4 Inverse functions 2.5 y=|f(x)|and y=f(|x|) 2.6 Combining functions 2.7 Solving modulus problems	• understand what is meant by a modulus of a linear function; • be able to sketch graphs of functions involving modulus functions; • be able to solve equations and inequalities involving modulus functions; • be able to work out the domain and range of functions; • know the definition of a one-one and a many-one mappings; • be able to work out the composition of two functions; • be able to work out the inverse of a function and sketch its graph; • understand the condition for an inverse function to exist; • understand the effect of simple transformations on the graph of y=f(x) including sketching associated graphs and *combinations* of the transformations: y=af(x), y=f(x)+a, y=f(x+a), y=f(ax) • be able to transform graphs to produce other graphs; • understand the effect of composite transformations on equations of curves and be able to describe them geometrically; • Use of trigonometric functions for modelling tides, hours of sunlight, etc.; • Use of exponential functions for growth and decay Use of reciprocal function for inverse proportion (e.g. Pressure and volume).

Mathematics – Pure Unit 3 – Sequences and Series	
Unit content:	By the end of the sub-unit, students should:
3.1 Arithmetic sequences 3.2 Arithmetic series 3.3 Geometric sequences 3.4 Geometric series 3.5 Sum to infinity 3.6 Sigma notation 3.7 Recurrence relations 3.8 Modelling with series	• know what a sequence of numbers is and the meaning of finite and infinite sequences; • know what a series is; • know the difference between convergent and divergent sequences; • know what is meant by arithmetic series and sequences; • be able to use the standard formulae associated with arithmetic series and sequences; • know what is meant by geometric series and sequences; • be able to use the standard formulae associated with geometric series and sequences; • know the condition for a geometric series to be convergent and be able to find its sum to infinity; • be able to solve problems involving arithmetic and geometric series and sequences; • know the proofs and derivations of the sum formulae (for both AP and GP); • be familiar with ∑ notation and how it can be used to generate a sequence and series; • know how this notation will lead to an AP or GP and its sum; • know that $\sum 1\ n\ 1=n$ • know that a sequence can be generated using a formula for the *n*th term or a recurrence relation of the form $x\ n+1$ =f($x\ n$); • know the difference between increasing, decreasing and periodic sequences; • understand how a recurrence relation of the form $U\ n$ =f($U\ n-1$) can generate a sequence; • be able to describe increasing, decreasing and periodic sequences.

Mathematics – Pure Unit 4 – Binomial Expansion	
Unit content:	By the end of the sub-unit, students should:
4.1 Expanding $(1+x)^n$ 4.2 Expanding $(a+bx)^n$ 4.3 Using partial fractions	• be able to find the binomial expansion of $(1 \pm x)^n$ for rational values of n and $\|x\|<1$; • be able to find the binomial expansion of $(1 \pm bx)^n$ for rational values of n and $\|x\|<1\|b\|$; • be able to find the binomial expansion of $(a \pm x)^n$ for rational values of n and $\|x\|<a$; • be able to find the binomial expansion of $(a \pm bx)^n$ for rational values of n and $\|bxa\|<1$; • know how to use the binomial theorem to find approximations (including roots); • be able to use partial fractions to write a rational function as a series expansion.
Mathematics – Pure Unit 5 - Radians	
Unit content:	By the end of the sub-unit, students should:
5.1 Radian measure 5.2 Arc length 5.3 Areas of sectors and segments 5.4 Solving trigonometric equations 5.5 Small angle approximations	• understand the definition of a radian and be able to convert between radians and degrees; • know and be able to use exact values of sin, cos and tan; • be able to derive and use the formulae for arc length and area of sector; • understand and be able to use the standard small angle approximations for sine, cosine and tangent;

Mathematics – Pure Unit 6 – Trigonometric Functions	
Unit content:	By the end of the sub-unit, students should:
6.1 Secant, cosecant and cotangent 6.2 Graphs of sec x, cosec x & cot x 6.3 Using sec x, cosec x & cot x 6.4 Trigonometric identities 6.5 Inverse trigonometric functions	• understand the secant, cosecant and cotangent functions, and their relationships to sine, cosine and tangent; • be able to sketch the graphs of secant, cosecant and cotangent; • be able to simplify expressions and solve involving sec, cosec and cot; • be able to solve identities involving sec, cosec and cot; • know and be able to use the identities $1 + tan^2x = sec^2x$ and $1 + cot^2x = cosec^2x$ to prove other identities and solve equations in degrees and/or radians • be able to work with the inverse trig functions $sin^{-1}, cos^{-1}\ and\ tan^{-1}$; • be able to sketch the graphs of $sin^{-1}, cos^{-1}\ and\ tan^{-1}$

Mathematics – Pure Unit 7 – Trigonometry and Modelling	
Unit content:	By the end of the sub-unit, students should:
7.1 Addition formulae 7.2 Using the angle addition formulae 7.3 Double-angle formulae 7.4 Solving trigonometric equations 7.5 Simplifying acosx±bsinx 7.6 Proving trigonometric identities 7.7 Modelling with trigonometric functions	• be able to prove geometrically the following compound angle formulae for sin $(A\pm B)$, cos $(A\pm B)$ and tan $(A\pm B)$; • be able to use compound angle identities to rearrange expressions or prove other identities; • be able to use compound angle identities to rearrange equations into a different form and then solve; • be able to recall or work out double angle identities; • be able to use double angle identities to rearrange expressions or prove other identities; • be able to use double angle identities to rearrange equations into a different form and then solve; • be able to express $a\cos\theta+b\sin\theta$ as a single sine or cosine function; • be able to solve equations of the form $a\cos\theta+b\sin\theta=c$ in a given interval; • be able to construct proofs involving trigonometric functions and previously learnt identities; • be able to use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces.
Mathematics – Pure Unit 8 – Parametric Equations	
Unit content:	By the end of the sub-unit, students should:
8.1 Parametric equations 8.2 Using trigonometric identities 8.3 Curve sketching 8.4 Points of intersection 8.5 Modelling with parametric equations	• understand the difference between the Cartesian and parametric system of expressing coordinates; • be able to convert between parametric and Cartesian forms; • be able to plot and sketch curves given in parametric form; • be able to recognise some standard curves in parametric form and how they can be used for modelling.

Mathematics – Pure Unit	
Unit content:	By the end of the sub-unit, students should:
9.1 Differentiating sin x & cos x 9.2 Differentiating exponentials & logarithms 9.3 The chain rule 9.4 The product rule 9.5 The quotient rule 9.6 Differentiating trigonometric functions 9.7 Parametric differentiation 9.8 Implicit differentiation 9.9 Using second derivatives 9.10 Rates of change	• be able to find the derivative of $\sin x$ and $\cos x$ from first principles; • be able to differentiate functions involving e^x, $\ln x$ and related functions such as $6e^{4x}$ and $5\ln 3x$ and sketch the graphs of these functions; • be able to differentiate to find equations of tangents and normals to the curve; • be able to differentiate composite functions using the chain rule; • be able to differentiate using the product rule; • be able to differentiate using the quotient rule; • be able to differentiate parametric equations; • be able to find the gradient at a given point from parametric equations; • be able to find the equation of a tangent or normal (parametric); • be able to use implicit differentiation to differentiate an equation involving two variables; • be able to find the gradient of a curve using implicit differentiation; • be able to verify a given point is stationary (implicit); • be able to find and identify the nature of stationary points and understand rates of change of gradient; • be able to use a model to find the value after a given time; • be able to set up and use logarithms to solve an equation for an exponential growth or decay problem; • be able to use logarithms to find the base of an exponential; • know how to model the growth or decay of 2D and 3D objects using connected rates of change; • be able to set up a differential equation using given information which may include direct proportion.

Mathematics – Pure Unit 10 – Numerical Methods	
Unit content:	By the end of the sub-unit, students should:
10.1 Locating roots 10.2 Iteration 10.3 The Newton-Raphson method 10.4 Applications to modelling	• be able to locate roots of f(x)=0 by considering changes of sign of f(x); • be able to use numerical methods to find solutions of equations; • understand the principle of iteration; • appreciate the need for convergence in iteration; • be able to use iteration to find terms in a sequence; • be able to sketch cobweb and staircase diagrams; • be able to use cobweb and staircase diagrams to demonstrate convergence or divergence for equations of the form x=g(x); • be able to solve equations approximately using the Newton-Raphson method; • understand how the Newton-Raphson method works in geometrical terms; • be able to use numerical methods to solve problems in context.

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Mathematics – Pure Unit 11 – Integration	
Unit content:	By the end of the sub-unit, students should:
11.1 Integrating standard functions 11.2 Integrating f(ax+b) 11.3 Using trigonometric identities 11.4 Reverse chain rule 11.5 Integration by substitution 11.6 Integration by parts 11.7 Partial fractions 11.8 Finding areas 11.9 The Trapezium rule 11.10 Solving differential equations 11.11 Modelling with differential equations	• be able to integrate expressions by inspection using the reverse of differentiation; • be able to integrate x^n for all values of n and understand that the integral of $\frac{1}{x}$ is $\ln\|x\|$; • be able to integrate expressions by inspection using the reverse of the chain rule (or function of a function); • be able to integrate trigonometric expression and expressions involving e^x; • be able to integrate a function expressed parametrically; • recognise integrals of the form $\int \frac{f'(x)}{f(x)} dx = ln(f(x)) + c$; • be able to use trigonometric identities to manipulate and simplify expressions to a form which can be integrated directly; • be able to integrate expressions using an appropriate substitution; • be able to select the correct substitution and justify their choices; • be able to integrate an expression using integration by parts; • be able to select the correct method for integration and justify their choices; • be able to integrate rational expressions by using partial fractions with linear denominators; • be able to simplify the expression using laws of logarithms; • understand and be able to use integration as the limit of a sum; • understand the difference between an indefinite and definite integral and when we need + c; • be able to integrate polynomials and other functions to find definite integrals, and use these to find the areas of regions bounded by curves and/or lines; • be able to use a definite integral to find the area under a curve and between two curves; • be able to find an area under a curve defined by a pair of parametric equations; • be able to use the trapezium rule to find an approximation to the area under a curve; • appreciate the trapezium rule is an approximation and realise when it gives an overestimate or underestimate; • be able to write a differential equation from a worded problem; • be able to use a differential equation as a model to solve a problem; • be able to solve a differential equation; • be able to substitute the initial conditions or otherwise into the equation to find + c and the general solution.

Mathematics – Pure Unit 12 – Vectors	
Unit content:	By the end of the sub-unit, students should:
12.1 3D coordinates 12.2 Vectors in 3D 12.3 Solving geometric problems 12.4 Applications to mechanics	• be able to extend the work on vectors from AS Pure Mathematics to 3D with column vectors and with the use of **i**, **j** and **k** unit vectors; • be able to calculate the magnitude of a 3D vector; • know the definition of a unit vector in 3D; • be able to add 3D vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations; • understand and use position vectors, and calculate the distance between two 3D points represented by position vectors; • be able to use vectors to solve problems in pure mathematics and in contexts (e.g. mechanics).