Curriculum Map: A Level Mathematics

YEAR 12

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
Content Declarative knowledge 'I Know'	<u>Quadratics</u> What a quadratic function is What a quadratic graph looks like What the quadratic formula and the discriminant is <u>Indices and surds</u> The laws of indices The laws of surds <u>Inequalities</u> What an inequality is <u>Simultaneous equations</u> What simultaneous equations are <u>Trigonometry</u> The definitions and graphs of sine, cosine and tangent The sine and cosine rules The trigonometric identities $\tan\theta = \frac{\sin\theta}{\cos\theta}$ and $sin^2\theta + cos^2\theta = 1$ <u>Polynomials and graphs</u> What a polynomial is	<u>Exponentials and Logarithms</u> What the function a^x is for $a > 0$ What the graph of $y = a^x$ looks like What the function e^x is What the graph of $y = e^x$ looks like The gradient of $y = e^{kx}$ is proportional to the value of the function The equivalence of the statements $y = a^x$ and $\log_a y = x$. Likewise $y = e^x$ and $\ln y = x$. Know that the function $\log_a x$ is the inverse of a^x for $a > 0$ and $x \geq 0$. Know that the function $\ln x$ is the inverse of e^x. $\log_a x$ is the inverse of a^x for $a > 0$ and $x \geq 0$. The laws of logarithms Know that $\log_a a = 1$ and $\log_a 1 = 0$.	<u>Differentiation</u> The derivative of $f(x)$ is the gradient of the tangent to the graph of $y = f(x)$ What a gradient graph is What the second derivative is At a stationary point $\frac{dy}{dx} = 0$. At a local maximum, $\frac{dy}{dx} = 0$ and $\frac{d^2y}{dx^2} < 0$. At a local minimum, $\frac{dy}{dx} = 0$ and $\frac{d^2y}{dx^2} > 0$. <u>Coordinate Geometry</u> The equation of a straight line The gradient conditions for two straight lines to be parallel or perpendicular The equation of a circle <u>Vectors</u> What a vector quantity is What component form is, both in column vectors and with ***i*** and ***j*** notation	<u>Kinematics</u> The fundamental quantities length, mass and time and their S.I. units The derived quantities velocity, acceleration and force including weight (and their S.I. units) The terms position, displacement, distance travelled and speed Recall and understand the (SUVAT) formulae for constant acceleration for motion in a straight line What *g* (acceleration due to gravity) is The relationship between the vector quantities displacement and velocity and their associated scalar quantities distance and speed Average speed and average velocity Kinematics graphs may have negative displacements or velocities Make assumptions made when modelling projectiles	<u>Forces, Newton's Laws, Statics and Dynamics</u> What a force is The distinction between mass and weight Understand normal reaction forces, the tension in a string or a rod, the thrust in a rod and friction Understand that objects can be modelled as particles. Newton's three Laws of Motion What equilibrium is and what limiting equilibrium is What static friction and dynamic friction mean What a coefficient of friction is The $F \leq \mu R$ model for friction <u>Statistical Hypothesis Testing</u> The language of statistical hypothesis testing: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail	<u>Revision and PPEs</u> *Then…* <u>Trigonometry and Circular Measure</u> Radian measure and conversions to and from degrees The formulae for arc length and the areas of a sector and a segment The standard small angle approximations for $\sin\theta$, $\cos\theta$ and $\tan\theta$ Exact trigonometric values The definitions of secant, cosecant and cotangent; their graphs, ranges and domains <u>Functions and Transformations</u> What the modulus function is What a graph of the modulus function looks like The definition of a function and the domain and range

	What polynomial and reciprocal graphs look like The effect of various graphical transformations The factor theorem	<u>Proof</u> The concept of mathematical proof The terms: Proof by exhaustion Proof by deduction Disproof by counterexample <u>Binomial Expansion</u> What a binomial is Pascal's triangle The formulae for nCr and n!	What magnitude/direction form means What a position vector is What the resultant is What parallel means What collinear means <u>Statistical sampling</u> What a 'population' and a 'sample' are The following sampling techniques: simple random sampling, opportunity sampling, stratified sampling, systematic sampling, quota sampling and cluster sampling. That different samples can lead to different conclusions about the population	<u>Data Presentation and Interpretation</u> That data can be presented in a number of different ways such as histograms (single variable data) and scatter diagrams (bivariate data) The definition of a probability distribution The following measures of central tendency: mean, mode and median The following measures of spread: range, interquartile range, variation and standard deviation The product moment correlation coefficient <u>Probability and Probability distributions</u> The definitions of mutually exclusive events and independent events The conditions for the Binomial distribution	test, 2-tail test, critical value, critical region, acceptance region, *p*-value That the significance level is the probability of incorrectly rejecting the null hypothesis	What a composite function is When functions have inverses The relationship between functions and their inverses and their graphs
Skills Procedural Knowledge 'I know how to'	<u>Quadratics</u> Sketch quadratic graphs Solve quadratic equations Factorise quadratics Use the quadratic formula	<u>Exponentials and Logarithms</u> Sketch exponential graphs $y = a^x$ for $a > 0$ and $y = e^x$ and simple transformations of these functions	<u>Differentiation</u> Use the derivative of $f(x)$ to find the equation of a tangent Differentiate polynomials from first principles	<u>Kinematics</u> Convert between commonly used S.I. units Convert from non-standard units	<u>Forces, Newton's Laws, Statics and Dynamics</u> Model forces as vectors Draw force diagrams for bodies that are at rest or moving with constant	<u>Revision and PPEs</u> *Then…* <u>Trigonometry and Circular Measure</u> Use exact trigonometric values.

	Complete the square Determine the number of solutions a quadratic has <u>Indices and surds</u> Use the laws of indices Manipulate, use and simplify surds <u>Inequalities</u> Solve linear and quadratic inequalities. Represent linear and quadratic inequalities graphically. Express solutions of inequalities using set notation. <u>Simultaneous equations</u> Solve simultaneous equations by substitution. Solve simultaneous equations by elimination. Represent and solve simultaneous equations graphically. <u>Trigonometry</u> Sketch graphs of sine, cosine and tangent and related functions Use the sine and cosine rules to find missing angles and sides	Use $\log_a x$ as the inverse of a^x is for $a > 0$ and $x \geq 0$ Use $\ln x$ as the inverse of e^x Simplify expressions involving logarithms Solve equations of the form $a^x = b$, including $e^x = b$. Reduce a non-linear relation to linear form. Estimate parameters in the relationships of the form $y = ax^n$ and $y = kb^x$ by plotting graphs, drawing lines of best fit and calculating and interpreting gradients and intercepts. Perform simple transformations of $y = e^x$ and $y = \ln x$. Identify and describe single transformations of the functions a^x and e^x. Use given conditions to determine the values of unknown constants in $y = Ae^{bx} + C$ or in $P = Ak^t + C$. Translate a situation in context into a mathematical model.	Find the second derivative Sketch gradient graphs Interpret gradients as rates of change Differentiate x^n (for rational values of n) and related constant multiples, sums and differences Apply differentiation to find gradients, tangents and normal Apply differentiation to find stationary points. Identify where functions are increasing or decreasing. <u>Coordinate Geometry</u> Use the equation of a straight line, including the forms $y - y_1 = m(x - x_1)$ and $ax + by + c = 0$. Use the coordinate geometry of the circle including using the equation of a circle in the form $(x - a)^2 + (y - b)^2 = r^2$ Complete the square to find the centre and radius of a circle. <u>Vectors</u>	Use and interpret kinematics graphs, including the gradient of a displacement-time graph and the gradient of, or area under, a velocity-time graph Use and derive the SUVAT formulae. Use calculus in kinematics for motion in a straight line: $v = \frac{dr}{dt} \quad a = \frac{dv}{dt} = \frac{d^2r}{dt^2}$ $r = \int v\,dt \quad v = \int a\,dt$ Sketch either a displacement-time or velocity-time graph for a given scenario. Derive the SUVAT formulae, for instance from a velocity-time graph. <u>Data Presentation and Interpretation</u> Interpret diagrams for single-variable data, including understanding that area in a histogram represents frequency. Connect to probability distributions. Interpret scatter diagrams and regression lines for bivariate data, including	velocity or constant acceleration Find the resultant of several forces acting at a point including by use of a vector diagram or resolving into perpendicular components Use Newton's three Laws of Motion to find unknown values Work with weight and motion in a straight line under gravity Identify action and reaction forces <u>Statistical Hypothesis Testing</u> Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context Calculate p-values and critical regions	Calculate arc lengths and areas of sectors and segments Use small angle approximations Sketch graphs of reciprocal trigonometric functions <u>Functions and Transformations</u> Find the modulus of a function and sketch its graph. Solve equations involve the modulus function Find the maximum domain and range of a function Find composite functions. Find inverse functions and sketch their graphs Describe combinations of graph transformations and sketch associated graphs

	Solve trigonometric equations in a given interval Find the area of a triangle <u>Polynomials and graphs</u> Manipulate polynomials algebraically Use the factor theorem to factorise and divide polynomials Sketch curves defined by polynomials Describe graph transformations and sketch associated graphs Sketch graphs of the form $y = \frac{a}{x}$ and $y = \frac{a}{x^2}$ and find their asymptotes	<u>Proof</u> Use and interpret logical symbols and implication symbols. Use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion. Use different methods of proof including: • Proof by exhaustion • Proof by deduction • Disproof by counterexample <u>Binomial Expansion</u> Use the Binomial formula to expand binomials of the form $(a + b)^n$ and $(1 + x)^n$ Use Pascal's triangle, the formula for nCr and the choose function on the calculator to find Binomial coefficients	For 2 D vectors, convert between component form and magnitude/direction form Add vectors diagrammatically Perform algebraically the addition of vectors and multiplication by a scalar Calculate the distance between two points defined by position vectors Identify parallel vectors Demonstrate collinearity <u>Statistical Sampling</u> Use samples to make informal inferences about the population Use a variety of different sampling techniques Select or critique sampling techniques in the context of solving a statistical problem	recognition of scatter diagrams Interpret correlation and understand that correlation does not imply causation Calculate and interpret measures of central tendency and variation, both from raw data and 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 <u>Probability and Probability distributions</u> Use mutually exclusive and independent events when calculating probabilities Calculate probabilities using the binomial distribution		
Strategies Conditional Knowledge 'I know when to'	<u>Quadratics</u> Factorise, apply the quadratic formula or complete the square to solve a quadratic equation Put a quadratic in factorised form or completed square form to sketch a quadratic	<u>Exponentials and Logarithms</u> Apply an exponential model Form and use exponential equations to make predictions	<u>Differentiation</u> Apply the limiting process during differentiation by first principles Use the laws of indices to assist differentiation	<u>Kinematics</u> Use SUVAT formulae (for constant acceleration) Use calculus in kinematics (for variable acceleration) Give a final answer to a particular degree of	<u>Forces, Newton's Laws, Statics and Dynamics</u> Apply Newton's Laws of Motion as appropriate to solve problems, for instance involving connected particles	<u>AS Revision and AS PPEs</u> *Then…* <u>Trigonometry and Circular Measure</u> When to evaluate a result and when to show it with relevant steps

	Apply the discriminant Apply the techniques for quadratics to disguised quadratics and related functions <u>Indices and surds</u> Apply the laws of indices Leave answers in surd form <u>Inequalities</u> Use graphical and algebraic techniques to solve inequalities <u>Simultaneous equations</u> Solve simultaneous equations using a substitution, elimination or graphical technique Model problems by forming and solving simultaneous equations <u>Trigonometry</u> Use the symmetries of the graphs of sine, cosine and tangent to find multiple solutions to trigonometric equations Apply the sine and cosine rules to geometrical problems	Apply the laws of logarithms to simplify expressions and solve equations Use logarithmic graphs to estimate parameters Use exponential growth and decay in modelling Consider limitations and refinements in exponential models Manipulate logarithms and exponentials if required within the solution to a problem <u>Proof</u> Apply different methods of proof including: • Proof by exhaustion • Proof by deduction • Disproof by counterexample and combinations of these to prove a variety of different theorems and identities <u>Binomial Expansion</u> Apply the different forms of the Binomial formula to expand Binomials Use Pascal's triangle, the formula for nCr or the choose function	Use the second derivative to determine the nature of a stationary point <u>Coordinate Geometry</u> Use straight line models in a variety of contexts 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 <u>Vectors</u> Interpret algebraic outcomes geometrically Use vectors to solve problems in pure mathematics and in mechanics, for instance with velocities or forces Select appropriate methods when solving a vector problem Use a vector diagram to consider resultants	accuracy, dependent on the information given in the question <u>Data Presentation and Interpretation</u> Use scatter diagrams to assess correlation Use histograms to represent single variable data Choose appropriate measures of central tendency and spread to analyse data effectively and apply to large data sets Use regression lines to estimate values from data and comment on the reliability of these estimates Clean data, including dealing with missing data, errors and outliers <u>Probability and Probability distributions</u> Link to discrete and continuous distributions Use simple, discrete probability distributions, including the binomial distribution, as models.	Apply SUVAT formulae in contexts involving forces Use gravitational acceleration *g* to varying degrees of accuracy Assume during motion under gravity that *g* remains constant, that objects can be treated as particles and that resistance forces are negligible Make modelling assumptions as appropriate <u>Statistical Hypothesis Testing</u> Use a sample to make an inference about the population Apply the Binomial model in hypothesis testing Construct a one tailed or two tailed test. Find the critical region instead of the p-value and vice versa Accept or reject the null hypothesis.	<u>Functions and Transformations</u> Apply graph transformations Apply functions to different contexts

	Use trigonometric identities to solve equations and prove other identities Use the formula $\frac{1}{2}ab\sin c$ to find the area of a triangle <u>Polynomials and graphs</u> Apply the factor theorem to a range of problems Apply graph transformations Use proportional relationships and their graphs	Use Binomial expansions in approximations	<u>Statistical Sampling</u> Apply sampling techniques in the context of solving a statistical problem Use a sample to draw conclusions about the population			
Key Questions	Questions will use the following question stems to assess the understanding of the content above: Evaluate… Find… Simplify… Express in the form… Solve… Sketch… Justify… Prove that…	Questions will use the following question stems to assess the understanding of the content above: Evaluate… Find… Simplify… Express in the form… Solve… Sketch… Justify… Prove that… State your modelling assumptions.	Questions will use the following question stems to assess the understanding of the content above: Evaluate… Find… Simplify… Express in the form… Solve… Sketch… Justify… Prove that…	Questions will use the following question stems to assess the understanding of the content above: Evaluate… Find… Simplify… Express in the form… Solve… Sketch… Justify… Prove that… Critique… State your modelling assumptions.	Questions will use the following question stems to assess the understanding of the content above: Evaluate… Find… Simplify… Express in the form… Solve… Sketch… Justify… Prove that… Critique… State your modelling assumptions.	Questions will use the following question stems to assess the understanding of the content above: Evaluate… Find… Simplify… Express in the form… Solve… Sketch… Justify… Prove that…
Assessment topics	Baseline test (GCSE algebraic skills revisited through use of GCSE-AS transition material) Topic testing ('10th lesson testing') each fortnight	Topic testing ('10th lesson testing') each fortnight	Topic testing ('10th lesson testing') each fortnight	Topic testing ('10th lesson testing') each fortnight	Topic testing ('10th lesson testing') each fortnight	June PPEs (at AS standard in Pure Mathematics, Statistics and Mechanics)

Cross curricular links/ Character Education	Links to Science (indices and solving equations) Aspiration and Challenge, Persistence and Resilience, Initiative and Confidence, Communication and Mutual Support	Links to Economics, Geography and Science (exponential growth) and Science (use of logarithms) Understand the difference between scientific and mathematical proof Aspiration and Challenge, Persistence and Resilience, Initiative and Confidence, Communication and Mutual Support	Links to Geography, History Psychology and Science (Statistical sampling) Links to Science (gradients and vector quantities) Aspiration and Challenge, Persistence and Resilience, Initiative and Confidence, Communication and Mutual Support	Links to Science (S.I. units, kinematics, vector quantities) Links to Geography, History Psychology and Science (Data presentation and interpretation) Aspiration and Challenge, Persistence and Resilience, Initiative and Confidence, Communication and Mutual Support	Links to Science (forces, Newton's Laws of Motion, friction, equilibrium, resultant force) Links to Geography, Psychology and Science (Statistical hypothesis testing) Aspiration and Challenge, Persistence and Resilience, Initiative and Confidence, Communication and Mutual Support	Links to Science (radian measure) Aspiration and Challenge, Persistence and Resilience, Initiative and Confidence, Communication and Mutual Support