KS5 Curriculum Map – Mathematics:

Topic	Substantive Knowledge This is the specific, factual content for the topic, which should be connected into a careful sequence of learning.	Disciplinary Knowledge (Skills) This is the action taken within a particular topic in order to gain substantive knowledge.	Assessment Opportunities What assessments will be used to measure student progress?
Algebra and functions	• Surds and Indices • Expanding and Factorising • Quadratics • Simultaneous Equations • Inequalities • Graph transformations	• Use the laws of indices for all rational exponents. • Use and manipulate surds, including rationalising the denominator. • Work with quadratic functions and their graphs. • Apply knowledge of the discriminant of a quadratic function, including the conditions for real and repeated roots. • Extend completing the square to more complicated expressions. • Solve quadratic equations (including solving quadratic equations in a function of the unknown) by factorisation, use of the formula, use of a calculator or completing the square. • Solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation. • Solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions.	• Controlled Homework • Baseline 1 (October) • Baseline Assessment 2 (February) • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13) • CQ1 (January) • CQ2 (Easter) • CQ3 (November Y13) • CQ4 (March Y13)

		• Express solutions through correct use of 'and' and 'or', or through set notation. • Represent linear and quadratic inequalities on number lines and graphs. • Manipulate polynomials algebraically, including expanding brackets and collecting like terms, factorisation and simple algebraic division; use of the factor theorem • Recall and use graphs of functions; sketch curves defined by simple equations including polynomials • Interpret algebraic solution of equations graphically; use intersection points of graphs to solve equations • Recalland use proportional relationships and their graphs. • Derive and sketch he effect of simple transformations on the graph of y = f(x), including stretches, reflections and translations. Apply this to general curves with points given algebraically.	
Coordinate geometry in the (x,y) plane	• Straight line Graphs • Equation of a Circle	• Derive and use the equation of a straight line, including the forms $y - y_1 = m(x - x_1)$ and ax + by + c = 0. • Find the equation of a line in the following cases: • two given points • parallel/perpendicular to a given line through a given point. • Apply gradient conditions for two straight lines to be parallel or perpendicular. • Use straight line models in a variety of contexts. • Derive and use the coordinate geometry of the circle including using the equation of a circle.	• Controlled Homework • Baseline Assessment 2 (February) • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13) • CQ1 (January) • CQ2 (Easter) • CQ3 (November Y13) • CQ4 (March Y13)

		• Find the radius and the coordinates of the centre of the circle given the equation of the circle, and vice versa. • Complete the square to find the centre and radius of a circle; make 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.	
Sequences and series	• The binomial theorem • The binomial series	• Derive and use the binomial expansion of (a + bx)^n for positive integer n. • Explore the notation n! and nCr • Extend the binomial expansion to any rational n, including its use for approximation together with expansion validity	• Controlled Homework • Baseline Assessment 2 (February) • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13) • CQ1 (January) • CQ3 (November Y13) • CQ4 (March Y13)
Trigonometry	• Sine, cosine and tangent of any angle • Cosine rule, sine rule and area of a triangle • Solve problems involving triangles • Trigonometric graphs and transformations • Use exact trigonometric ratios for $30°$, $45°$ and $60°$ • Simple trigonometric identities • Solve trigonometric equations, including quadratics	• Use of x and y coordinates of points on the unit circle to give cosine and sine respectively. • Derive from first principles, and use, the definitions of sine, cosine and tangent for all arguments • Use the sine/cosine rules and formula for the area of a triangle to solve complicated problems, including the ambiguous case of the sine rule. • Draw and use the sine, cosine and tangent functions; their graphs, symmetries and periodicity.	• Controlled Homework • Baseline Assessment 2 (February) • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13) • CQ1 (January) • CQ3 (November Y13)

		• Apply transformations of graphs to sine, cosine and tangent functions. • Derive and use $\sin^2\theta + \cos^2\theta = 1$ and $\tan\theta = \frac{\sin\theta}{\cos\theta}$ • Solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle. • Solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle.	
Data Collection	• Populations and samples • Sampling • Non-random sampling • Types of data • Introduction to the large data set	• Recall the terms 'population', 'sample' and 'census', interpret them in context and comment on the advantages and disadvantages of each. • Explain the implementation, advantages and disadvantages of simple random sampling, systematic sampling, stratified sampling, quota sampling and opportunity sampling. • Use samples to make informal inferences about the population • Define qualitative, quantitative, discrete and continuous data, and understand grouped data • Become fluent in the large data set and how to collect data from it, identify types of data and calculate simple statistics. • Select or critique sampling techniques in the context of solving a statistical problem and understand that different samples can lead to different conclusions about the population.	• Controlled Homework • Baseline Assessment 2 (February) • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)

Measures of location and spread	• Measures of central tendency • Other measures of location • Measures of spread • Variance and standard deviation • Coding	• Calculate and interpret measures of central tendency such as the mean, median and mode • Calculate and interpret measures of location such as percentiles and deciles, using linear interpolation • Calculate and interpret measures of spread such as range, interquartile range and interpercentile range • Calculate and interpret variance and standard deviation, including from summary statistics • Use coding to find mean, variance and standard deviation	• Controlled Homework • Baseline Assessment 2 (February) • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)
Representations of data	• Outliers • Box plots • Cumulative frequency • Histograms • Comparing data	• Identify and interpret outliers in data sets • Clean data, including dealing with missing data, errors and outliers. • Draw and interpret box plots • Draw and interpret cumulative frequency diagrams • Draw and interpret histograms • Compare two data sets	• Controlled Homework • Baseline Assessment 2 (February) • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)
Correlation	• Introduction to correlation and the PMCC • Linear regression	• Draw and interpret scatter diagrams for bivariate data • Interpret correlation and understand that it does not imply causation • Interpret the coefficients of a regression line equation for bivariate data • Derive and use a regression line to make predictions	• Controlled Homework • Baseline Assessment 2 (February) • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)

Differentiation	• Find the derivative of a simple function • Use the derivative to solve problems involving gradients, tangents and normal • Increasing and decreasing functions • Second derivatives • Stationary points • Sketch the gradient function of a given function • Model real life situations with differentiation • Derive a derivative from first principles	• 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 • Given the graph of y = f (x), sketch the graph of y = f ′(x)using given axes and scale. This could relate speed and acceleration for example. • Differentiate from first principles for small positive integer powers of x • Use the second derivative as the rate of change of gradient • Differentiate x^n, for rational values of n, and related constant multiples, sums and differences. • Apply differentiation to find gradients, tangents and normals, maxima and minima and stationary points. • Use differentiation to find equations of tangents and normals at specific points on a curve. • Identify where functions are increasing or decreasing.	• Controlled Homework • Baseline Assessment 2 (February) • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)
Integration	• Integrating x^n • Indefinite integrals • Finding functions • Definite integrals • Areas under curves • Areas under the x-axis • Areas between curves and lines	• Use the Fundamental Theorem of Calculus Integration as the reverse process of differentiation. Apply the constant of integration as required • Evaluate definite integrals; use a definite integral to find the area under a curve and the area between two curves • Evaluate the area of a region bounded by a curve and given straight lines, or between two curves.	• Controlled Homework • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13) • CQ2 (Easter)

Exponentials and logarithms	• Exponential functions • Exponential modelling • Logarithms • Laws of Logarithms • Solving equations using logarithms • Working with natural logarithms • Logarithms and non-linear data	• Use the function a^x and its graph, where a is positive. • Use the function e^x and its graph • Recognise that the gradient of e^{kx} is equal to ke^{kx} and apply the exponential model when appropriate. • Use the definition of $\log_a x$as the inverse of a^x where a is positive and x≥ 0. • Define and use the function $\ln x$ and its graph. • Use $\ln x$ as the inverse function of e^x • Solve equations of the form $e^{ax+b} = p$ and $\ln(ax + b) = q$ is expected. • Derive and use the laws of logarithms: • $\log_a x + \log_a y = \log_a(xy)$ • $\log_a x - \log_a y = \log_a\left(\frac{x}{y}\right)$ • $k \log_a x = \log_a x^k$ • Solve equations of the form $a^x = b$ • Use logarithmic graphs to estimate parameters in relationships of the form $y = ax^n$ and $y = kb^x$, given data for x and y • Use exponential growth and decay in modelling • Consider limitations of, and refine, exponential models.	• Controlled Homework • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13) • CQ4(March)
Vectors	• Representing vectors • Magnitude and direction • Position vectors • Solving geometric problems • Modelling with Vectors	• Use vectors in 2D • Use column vectors and carry out arithmetic operations on vectors • Calculate the magnitude and direction of a vector • Define and use position vectors • Use vectors in speed and distance calculations • Use vector to solve problems in context. • Apply knowledge of vectors to 3 dimensions.	• Controlled Homework • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)

		• Use vectors to solve geometric problems • Model 3D motion in mechanics with vectors	
Probability and conditional probability	• Sample spaces • Venn diagrams • Mutually exclusive and independent events • Tree diagrams • Set notation • Conditional probability • Conditional probability in Venn diagrams • Probability formulae • Conditional probability in tree diagrams	• Calculate probabilities for single events • Draw and interpret Venn diagrams • Use definitions of mutually exclusive and independent events, and determine whether two events are independent • Use tree diagrams to solve problems • Use set notation in probability • Explore the concept of conditional probability • Solve conditional probability problems using two-way tables and Venn diagrams • Use probability formulae to solve problems • Solve conditional probability problems using tree diagrams • Explore simple modelling with probability, including critiquing assumptions made and the likely effect of more realistic assumptions.	• Controlled Homework • Baseline Assessment 3 (Summer exams) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)
Discrete probability distributions and the Binomial distribution	• Probability distributions • The Binomial distribution • Cumulative probabilities	• Define and use simple discrete probability distributions including the discrete uniform distribution • Explore the binomial distribution as a model and comment on its appropriateness • Calculate individual probabilities for the binomial distribution • Calculate cumulative probabilities for the binomial distribution	• Controlled Homework • Baseline Assessment 3 (Summer exams) • September test (Y13) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)
The Normal distribution	• Introduction to the normal distribution • Finding probabilities for the normal distribution • The inverse normal function	• Explore the normal distribution and the characteristics of a normal distribution curve	• Controlled Homework • Baseline Assessment 3 (Summer exams) • September test (Y13)

	• The standard normal distribution • Finding unknown parameters • Approximating a binomial distribution	• Find percentage points on a standard normal curve • Calculate values on a standard normal curve • Find unknown means and/or standard deviations for a normal distribution • Approximate a binomial distribution using a normal distribution and understand when it is appropriate to do so. • Select appropriate distributions and solve real-life problems in context	• Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)
Hypothesis testing	• Introduction to hypothesis testing • Hypothesis testing with the binomial distribution • Hypothesis testing with the normal distribution • Extend correlation to include exponential models and the PMCC • Hypothesis testing for zero correlation	• Explore the language and concept of hypothesis testing • Use sample data to make an inference about a population • Find critical values of a binomial distribution • Carry out and interpret a one-tail test and a two-tail test for the proportion in the binomial distribution and interpret the results in context. • Carry out a hypothesis test for the mean of a normal distribution and interpret the results in context • Extend correlation to include exponential models and the PMCC • Carry out a hypothesis test for zero correlation, as a measure of how close data points lie to a straight line and interpret the results in context.	• Controlled Homework • Baseline Assessment 3 (Summer exams) • September test (Y13) • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)
Sequences and Series	• Arithmetic sequences and series • Geometric sequences and series • Geometric sum to infinity • Sigma notation • Recurrence relations • Modelling with Series	• Work with sequences including those given by a formula for the nth term and those generated by a simple relation; increasing sequences; decreasing sequences; periodic sequences. • Derive and work with arithmetic sequences and series, including the formulae for nth term and the sum to n terms	• Controlled homework • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)

		• Derive the proof of the sum formula for an arithmetic series, including the formula for the sum of the first n natural numbers • Derive and work with geometric sequences and series, including the formulae for the nth term, sum of a finite geometric series; sum to infinity of a convergent geometric series • Derive the proof of the sum formula for a geometric series • Given the sum of a series, use logs to find the value of n. • Use sequences and series in modelling.	
Proof	• Proof by deduction • Proof by counterexample • Proof by contradiction	• 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 counterexample • Proof by contradiction (including proof of the irrationality of 2 and the infinity of primes, and application to unfamiliar proofs).	• Controlled homework • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)
Algebra and functions 2	• Algebraic Fractions • Partial fractions • Repeated factors • Algebraic division • Modulus function • Functions and mappings • Composite functions. • Inverse functions • Combining graph transformations • Solving modulus problems	• Simplify rational expressions, including by factorising and cancelling, and algebraic division (by linear expressions only). • Explore the modulus function and use it to sketch graphs and solve equations • Calculate composite functions, inverse functions and their graphs. • Identify the domain and range of functions and their inverse. • Sketch combinations of transformations of graphs. • Decompose rational functions into partial fractions	• Controlled homework • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13) • CQ4 (March)

		• Apply knowledge of partial fractions to series expansions. • Use functions in modelling, including consideration of limitations and refinements of the models	
Trigonometry 2	• Radians • Small angle approximations • Reciprocal trig functions and their graphs • Inverse trig functions and their graphs • Trigonometric identities	• Convert between degrees and radians and apply this to trigonometric graphs and their transformations • Use exact values of angles measured in radians • Find the arc length using radians • Find area of sectors and segments using radians • Explore and use the standard small angle approximations of sine, cosine and tangent • Solve trigonometric equations in radians • Define secant, cosecant and cotangent and of arcsin, arccos and arctan, and their relationships to sine, cosine and tangent; sketch the graphs and identify their ranges and domains. • Prove the identities and • Use and to solve problems. • Simplify expressions, prove simple identities and solve equations involving secant, cosecant and cotangent • Derive and use the addition and double angle formulae • Use knowledge of addition formulae to derive expressions for $a\cos\theta + b\sin\theta$ in the equivalent forms of $r\cos(\theta \pm \alpha)$ or $r\sin(\theta \pm \alpha)$ • Construct proofs involving trigonometric functions and identities. • Use trigonometric functions to solve problems in context, using degrees or radians.	• Controlled homework • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13) • CQ3 (November)

Coordinate geometry in the (x,y) plane	• Parametric Equations • Modelling with parametric equations	• Convert between Cartesian and parametric forms • Sketch curves given in parametric form • Find points of intersection in parametric form • Use parametric equations in modelling in a variety of contexts.	• Controlled homework • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13) • CQ4 (March)
Modelling in Mechanics	• Constructing a model • Modelling assumptions • Quantities and units • Working with vectors	• Explore the concept of mathematical modelling as applied to Mechanics. • Identify and apply some of the common assumptions used in mechanics models. • Use fundamental quantities and units in the S.I. system: length, time, mass. • Convert quantities into S.I units e.g. km/h to m/s • Define and use velocity, acceleration, force, weight, moment • Identify scalar and vector quantities	• Controlled homework • Baseline 4 mock exams (January of Y13) • Baseline 5 mock exams (Post-Easter of Y13)

Kinematics	• Displacement – Time Graphs
	• Velocity – Time Graphs
	• Constant Acceleration Formulae
	  ○ Horizontal motion
	  ○ Vertical motion under gravity
	• Variable acceleration as a function of time
	• Using calculus to solve kinematics problems and problems involving maxima and minima
	• Vectors in kinematics
	• Projectiles
	  ○ Horizontal projections
	  ○ Horizontal and vertical components
	  ○ Projection at any angle
	  ○ Projectile motion formulae
		• Use the language of kinematics
		• Draw and interpret displacement-time graphs
		• Draw and interpret velocity-time graphs
		• Derive the constant acceleration formulae and use them to solve problems for horizontal motion.
		• Use the constant acceleration formulae to solve problems involving vertical motion under gravity.
		• Use displacement, velocity and acceleration as functions of time.
		• Use differentiation and integration to solve kinematics problems.
		• Use calculus to derive the constant acceleration formulae, making links with earlier work.
		• Extend earlier work to 2-D using vectors.
			• Controlled homework
			• Baseline 4 mock exams (January of Y13)
			• Baseline 5 mock exams (Post-Easter of Y13)

		• Work with vectors for displacement, velocity and acceleration when using the vector equations of motion. • Use calculus with harder functions of time involving variable acceleration. • Differentiate and Integrate vectors with respect to time. • Model motion under gravity for an object projected horizontally • Resolve velocity into components • Solve problems involving particles projected at an angle • Derive and use the formulae for time of flight, range and greatest height, and the equation of the path of a projectile.	

Differentiation 2	• Know how to differentiate
	  ○ trigonometric functions
	  ○ exponentials and logarithms
	  ○ using chain rule, quotient rule and product rule
	  ○ parametric equations
	  ○ implicit functions
	• Use the second derivative to describe the behaviour of a functions
	• Solve problems involving connected rates of change
	• Construct simple differential equations
		• Use the second derivative as the rate of change of gradient, connecting to convex and concave sections of curves and points of inflection.
		• Differentiate $e^{kx}$and a^x, sinkx, coskx, tankx and related sums, differences and constant multiples. Prove the derivative of ln x is 1/x.
		• Differentiate sinx and cosx from first principles
		• Differentiate using the product rule, the quotient rule and the chain rule, including problems involving connected rates of change and inverse functions.
		• Differentiate simple functions and relations defined implicitly or parametrically, for first derivative only.
		• Find equations of tangents and normals to curves given parametrically or implicitly.
		• Construct simple differential equations in pure mathematics and in context
			• Controlled homework
			• Baseline 5 mock exams (Post-Easter of Y13)

Numerical Methods	• Locating roots • Iteration • The Newton-Raphson Method • Applications to modelling	• Locate roots of f (x) = 0 by considering changes of sign of f (x) in an interval of x on which f (x) is sufficiently well behaved. • Explore and use the limitations of change of sign method. • Solve equations approximately using simple iterative methods; be able to draw associated cobweb and staircase diagrams. • Use iteration to find a root and show understanding of the convergence in geometrical terms by drawing cobweb and staircase diagrams. • Solve equations using the Newton-Raphson method and other recurrence relations of the form $x_{n+1} = \mathrm{g}(x_n)$ and explain how such methods can fail. • Use numerical methods to solve problems in context.	• Controlled homework • Baseline 5 mock exams (Post-Easter of Y13)
Integration 2	• Integrating standard functions • Integrating f(ax + b) • Using trigonometric identities • Reverse chain rule • Integration by substitution • Integration by parts • Partial fractions • Finding areas • The trapezium rule • Solving differential equations • Modelling with differential equations • Integration as a limit of a sum	• Integrate standard mathematical functions including trigonometric and exponential functions and use the reverse of the chain rule to integrate functions of the form f(ax+b). • Use trigonometric identities in integration • Use the reverse chain rule to integrate more complicate functions • Integrate functions by making a substitution, using integration by parts, and using partial fractions. • Use integration to find the area under a curve. • Use the trapezium rule to approximate the area under a curve, identifying limitations of this method. • Solve simple differential equations and model real-life situations with differential equations.	• Controlled homework • Baseline 5 mock exams (Post-Easter of Y13)

Forces and Newton's law	• Forces and motion
	  ○ Newton's 1st Law
	  ○ Force diagrams
	  ○ Forces as vectors
	  ○ Forces and acceleration (Newton's 2nd Law)
	  ○ Motion in 2 dimensions
	  ○ Connected particles and Newton's 3rd Law
	  ○ Pulleys
	• Forces and friction
	  ○ Resolving forces
	  ○ Inclined planes
	  ○ Friction
	• Applications of forces
	  ○ Static particles
	  ○ Modelling with statics
	  ○ Friction and static particles
	  ○ Static rigid bodies
	  ○ Dynamics and inclined planes
	  ○ Connected particles 2
		• Draw force diagrams and calculate resultant forces
		• Explore and use Newton's First Law
		• Calculate resultant forces by adding vectors
		• Explore and use Newton's Second Law,
		• F = ma
		• Apply Newton's Second Law to vector forces and acceleration
		• Explore and use Newton's Third Law
		• Solve problems involving connected particles
		• Resolve forces into components
		• Use the triangle law to find a result force
		• Understand friction and the coefficient of friction.
		• Use $F \leq \mu R$
		• Solve problems involving smooth or rough inclined planes
		• Find an unknown force when a system is in equilibrium
		• Solve statics problems involving weight, tension and pulleys
		• Solve problems involving limiting equilibrium
		• Solve problems involving motion on rough or smooth inclined planes
		• Solve problems involving connected particles that require the resolution of forces.
			• Controlled homework
			• Baseline 5 mock exams (Post-Easter of Y13)

Moments	• Moments and resulting moments • Equilibrium • Centres of mass • Tilting • Moments in 2D	• Calculate the turning effect of a force applied to a rigid body. • Calculate the resultant moment of a set of forces acting on a rigid body • Solve problems involving uniform rods in equilibrium Solve problems involving non-uniform rods	• Controlled homework • Baseline 5 mock exams (Post-Easter of Y13)

		• Solve problems involving rods on the point of tilting. • Solve problems involving moments of objects in 2D, including ladder and hinge problems.	