Subject overview: (KS5 Maths)

Subject Rationale (Intent) linked to whole school curriculum mission
In brief (no more than four sentences) *The aim of the Mathematics Department is to encourage and develop mathematical independence, providing all pupils with the functional skills essential for everyday life. We believe in promoting an understanding of mathematical concepts, employing a problem solving approach to develop transferable skills and fostering an appreciation of mathematics as a creative and beautiful subject.* Maths at St Edmund's develops a love for the subject through all students knowing the satisfaction of solving mathematical problems. We enable students to think for themselves, giving them the mathematical knowledge and skills to confidently justify their answers to today and tomorrow's, abstract and real life problems. Students will be able to apply their skills across the curriculum and beyond; they will understand that mathematics is a universal language that underpins everything. **Additional details**

YEAR 12			
TERM	**Topic sequence** **(What are you teaching?)**	**Topic sequence rationale** **(Why are you teaching this? How does it link to prior learning? Any notable links to St Edmund's curriculum mission** [St Edmund's curriculum mission]	**Main method of assessment?**
Term 1:1	<u>Pure</u> **Algebraic expressions** ● Index laws ● Expanding brackets ● Factorising ● Negative and fractional indices ● Surds ● Rationalising denominators **Quadratics** ● Solving quadratic equations ● Completing the square ● Functions ● Quadratic graphs ● The discriminant ● Modelling with quadratics	<u>Algebraic expressions</u> **Why Taught?** This is taught so that students understand and use the laws of indices for all rational exponents. They should be able to simplify algebraic surds and manipulate algebraic surds (including rationalising the denominator). $a^m \times a^n = a^{m+n}, a^m \div a^n = a^{m-n}, (a^m)^n = a^{mn}$ **Prior Learning** Students should already know the three laws of indices, processed for expanding and factorising brackets and how to simplify surds. <u>Quadratics</u> **Why Taught?** This is taught to help students identify the discriminant of a quadratic function, including the conditions for real and repeated roots.They should be able to complete the square and find the solutions of a quadratic equation. Different approaches can be used to solve an equation e.g. by factorisation, using the formula, using the calculator or completing the square. **Prior Learning** Students should be familiar with factorising into double brackets, completing the square and use of quadratic formula. <u>Equations and Inequalities</u>	**unit tests, weekly homework and past paper tests**

	Equations and Inequalities • Linear simultaneous equations • Quadratic simultaneous equations • Simultaneous equations on graphs • Linear inequalities • Quadratic inequalities • Inequalities on graphs	**Why Taught?** This helps students to solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically - this also includes inequalities with brackets and fractions. Students are taught to express solutions through the correct use of "and" and "or", or through set notation. **Prior Learning** Students should be familiar with solving linear simultaneous equations,sketching straight lines, shading regions and sketching quadratics.	
	<u>Applied</u> **Measures of location and spread** • Central location • Spread • Variance and Standard deviation • Coding	<u>Measures of location and spread</u> **Why Taught?** Students are taught to interpret measures of central tendency and variation, extending to standard deviation. Students should understand and use coding. They should recognise that data can be discrete, continuous, grouped or ungrouped and that measures of tendency include mean, mode and median. Measures of variation include variance, standard deviation, range as well as interpercentile range. Students should be able to use the statistic : $S_{xx} = \sum (x-\bar{x})^2 = \sum x^2 - \frac{(\sum x)^2}{n}$ **Prior Learning** Students should already be able to find the mean from a frequency table and using grouped data.	
	Representing data • Outliers • Box-plots • Cumulative frequency	<u>Representing data</u> **Why Taught?** This is taught in order to help students recognise and interpret	

	- Histograms - Comparing data **Data collection** - Populations and samples - Sampling - Types of data - The large data set	possible outliers in data sets and statistical diagrams.Students will be expected to draw simple inferences and give interpretations to measures of central tendency and variation. Being able to clean data, including dealing with missing data, errors and outliers is a skill that is involved in this topic. Students should interpret diagrams for single-variable data, including understanding that area in a histogram represents frequency. **Prior Learning** They should already be familiar with histograms, frequency polygons, box and whisker plots (including outliers) and cumulative frequency diagrams. <u>Data collection</u> **Why Taught?** Students are taught to use samples to make informal inferences about the population. The skill they develop during this topic is being able to 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. They should understand and use sampling techniques, including simple random sampling and opportunity sampling. **Prior Learning** From GCSE level, students should already understand and use the terms "population" and "sample". Students will be expected to comment on the advantages and disadvantages associated with a census and a sample.	
Term 1:2	<u>**Pure**</u> **Graphs and transformations** - Cubic graphs - Quartic graphs - Reciprocal graphs - Points of Intersection - Translating graphs - Stretching graphs - Transforming functions	<u>Graphs and transformations</u> **Why Taught?** Students should be able to understand and use graphs of functions; sketch curves defined by simple equations including polynomials, including their vertical and horizontal asymptotes. They should be able to interpret algebraic solutions of equations graphically; use intersection points of graphs to solve equations. Also, they should understand the effect of simple transformations on the graph of $y = f(x)$, including sketching associated graphs : $y = af(x)$, $y = f(x) + a$,	**unit tests, weekly homework and past paper tests**

		y = f(x + a), y = f(ax) Students should be able to apply one of these transformations to any of the functions listed: quadratics, cubics, quartics, reciprocal, sin x, cos x and tan x) and sketch the resulting graph. **Prior Learning** Students should be familiar with the shape of quadratic, cubic and reciprocal graphs. They should understand the basic rules of transformation.	
	Straight line graphs ● Y = mx + c ● Equations of straight lines ● Parallel and perpendicular lines ● Length and area ● Modelling with straight lines	<u>Straight line graphs</u> **Why Taught?** Students should be taught the gradient conditions for two straight lines to be parallel or perpendicular i.e. m′ = m for parallel lines and m′ = -1/m for perpendicular lines. They are taught so that they can use straight line models in a variety of contexts. **Prior Learning** Students should be familiar with the idea of gradient and intercept and know how to sketch a straight line graph.	
	Circles ● Midpoints and perpendicular bisectors ● Equation of a circle ● Intersections of straight lines and circles ● Use tangent and chord properties ● Circles and triangles	<u>Circles</u> **Why Taught?** Students should be able to find the radius and the coordinates of the centre of the circle given the equation of the circle, and vice versa. Students should be able to find the equation of a circumcircle of a triangle with given vertices using these properties and find the equation of a tangent at a specified point, using the perpendicular property of tangent and radius. **Prior Learning** Should be familiar with sketching straight line graphs and how to find a perpendicular gradient.	
	Algebraic methods ● Algebraic fractions ● Dividing polynomials ● The factor theorem ● Mathematical proof ● Methods of proof	<u>Algebraic methods</u> **Why Taught?** Under algebraic methods, methods of proof such as proof by deduction, exhaustion and by counterexample is taught. Students	

	The binomial expansion ● Pascal's triangle ● Factorial notation ● The binomial expansion ● Solving binomial problems ● Binomial estimation **<u>Applied</u>** **Correlation** ● Correlation ● Linear regression **Probability** ● Calculation ● Venn diagrams	should be able to use and understand the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion. Students are taught to manipulate polynomials algebraically, including expanding brackets and collecting like terms, factorisation and simple algebraic division; use of the factor theorem. Only division by (ax + b) or (ax – b) will be required. Students should know that if f(x) = 0 when x = a, then (x – a) is a factor of f(x). **Prior Learning** Students should know the four rules of fractions (numerical and algebraic). They are already able to factorise quadratic expressions. <u>The binomial expansion</u> **Why taught?** The use of Pascal's triangle helps students to identify the relation between binomial coefficients. This helps students to understand and use the binomial expansion of (a+ bx) n for positive integer n. **Prior Learning** They should be able to expand double and triple brackets and be familiar with Pascal's triangle. <u>Correlation</u> **Why Taught?** Students are taught to interpret scatter diagrams and regression lines for bivariate data, including recognition of scatter diagrams that include distinct sections of the population. They should understand that correlation does not imply causation. Students should be familiar with the terms 'explanatory (independent)' and 'response (dependent)' variables. When describing the correlation on a graph, terms such as positive, negative, strong and weak are expected to be used. **Prior Learning** <u>Probability</u> **Why Taught?** To help students understand and use mutually exclusive and independent events when calculating probabilities. Venn diagrams	

	• Mutually exclusive and independent events • Tree diagrams **Statistical distributions** • Probability distributions • Binomial distributions • Cumulative probabilities	and tree diagrams are also taught to help calculate probabilities. No formal knowledge of probability density functions is required but students should understand that the area under the curve represents probability in the case of a continuous distribution. **Prior Learning** <u>Statistical distributions</u> **Why Taught?** Students should 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. Students will be expected to use distributions to model a real-world situation and to comment critically on the appropriateness. In addition, they should also be able to identify the discrete uniform distribution. **Prior Learning**	
Term 2:1	<u>**Pure**</u> **Trigonometric ratios** • The cosine rule • The sine rule • Areas of triangles • Solving triangle problems • Graphs of sine, ,cosine and tangent • Transforming trigonometric graphs **Trigonometric identities and equations** • Angles in all four quadrants • Exact values of trigonometric ratios • Trigonometric identities • Simple trigonometric equations • Harder trigonometric equations • Equations and identities	<u>Trigonometric ratios</u> **Why Taught?** Students are taught to use the definitions of sine, cosine and tangent for all arguments; the sine and cosine rules; the area of a triangle in the form 1/2absinC. Students should use the sine, cosine and tangent functions; their graphs, symmetries and periodicity. **Prior Learning** <u>Trigonometric identities and equations</u> $\tan\theta = \frac{\sin\theta}{\cos\theta}$ $\sin^2\theta + \cos^2\theta = 1$ These identities may be used to solve trigonometric equations or to prove further identities. From this, they should be able to 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 tests, weekly homework and past paper tests**

		Prior learning	
	Vectors • Vectors • Representing vectors • Magnitude and direction • Position vectors • Solving geometric problems • Modelling with vectors	<u>Vectors</u> **Why taught?** The students are taught to calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form. In addition, they should add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations. They should be able to understand and use position vectors; calculate the distance between two points represented by position vectors. A combination of these skills will allow students to use vectors to solve problems in pure mathematics and in context, including forces. **Prior Learning**	
	<u>Applied</u> **Hypothesis testing** • Testing • Finding critical values • 1-Tail tests • 2-Tailed tests	<u>Hypothesis testing</u> **Why taught?** Students are taught to apply the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tailed test, critical value, critical region, acceptance region, p-value. They should understand that the expected value of a binomial distribution is given by np may be required for a 2-tailed test. From this topic, they should understand that a sample is being used to make an inference about the population and appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis. **Prior Learning**	

	Modelling in Mechanics • Forming a model • Modelling assumptions • Quantities and Units • Working with vectors **Constant Acceleration** • Displacement-time graphs • Velocity-time graphs • Constant acceleration formulae • Vertical motion under gravity	Modelling in Mechanics **Why Taught?** Students are taught to use fundamental quantities and units in the S.I. system: length, time, mass. They can use derived quantities and units: velocity, acceleration, force, weight. They should develop the ability to 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 **Prior Learning** Constant acceleration **Why Taught?** This is taught so that students can understand, use and derive the formula for constant acceleration for motion in a straight line. Also, they are taught to understand and use SUVAT formulae for constant acceleration in 2D. **Prior Learning**	
Term 2:2	**Pure** **Differentiation** • Gradients of curves • Finding the derivative • Differentiating x^n • Differentiating quadratics • Differentiating functions with two or more terms • Gradients, tangents and normal • Increasing and decreasing functions • Second order derivatives • Stationary points • Sketching gradient functions	Differentiation **Why taught?** Students should 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. They should differentiate x^n , for rational values of n, and related constant multiples, sums and differences. This helps students to apply differentiation to find gradients, tangents and normals, maxima and minima and stationary points. This then aids students to identify whether functions are increasing or decreasing. **Prior Learning**	**unit tests, weekly homework and past paper tests**

	● Modelling with differentiation **Integration** ● Integrating x^n ● Indefinite triangles ● Finding functions ● Definite integrals ● Areas under curves ● Areas under the x-axis ● Areas between curves and lines **Exponentials and Logarithms** ● Exponential functions ● $Y = e^x$ ● Exponential modelling ● Logarithms ● Laws of logarithms ● Solving equations using logarithms ● Working with natural logarithms ● Logarithms and non-linear data	<u>Integration</u> **Why Taught?** Students should see integration as the reverse process of differentiation. Students should know that for indefinite integrals a constant of integration is required.They should practise evaluating definite integrals; use a definite integral to find the area under a curve. Given f ′(x) and a point on the curve, Students should be able to find an equation of the curve in the form y = f(x). **Prior Learning** <u>Exponentials and Logarithms</u> **Why Taught?** Students should know and use the function a^x and e^x as well as its graph. They should know that the gradient of e^{kx} is equal to ke^{kx} and hence understand why the exponential model is suitable in many applications. It is important that they realise that when the rate of change is proportional to the y value, an exponential model should be used. $\log_a x + \log_a y = \log_a(xy)$ $\log_a x - \log_a y = \log_a\left(\frac{x}{y}\right)$ $k\log_a x = \log_a x^k$ **Prior Learning**	

	<u>Applied</u>		
	Forces and motion ● Force Diagrams ● Forces as vectors ● Forces and acceleration ● Motion in 2-D ● Connected particles ● Pulleys	<u>Forces and motion</u> **Why Taught?** This is taught so that students understand the concept of a force; understand and use Newton's first law. Problems will involve motion in a straight line with constant acceleration in scalar form, where the forces act either parallel or perpendicular to the motion. Moreover, further problems will involve motion in a straight line with constant acceleration in vector form, where the forces are given in i − j form or as column vectors.Students should understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line; application to problems involving smooth pulleys and connected particles. **Prior Learning**	
	Variable acceleration ● Functions of time ● Differentiation ● MAX/MIN problems ● Integration	<u>Variable acceleration</u> **Why Taught?** Techniques such as differentiation and integration are developed when solving problems involving motion in a straight line. $v = \frac{dr}{dt}$, $a = \frac{dv}{dt} = \frac{d^2r}{dt^2}$ $r = \int v \, dt$, $v = \int a \, dt$	

Term 3:1			
Term 3:2	**<u>Pure</u>** • **Algebraic methods** **<u>Applied</u>** **Resolving forces** • In equilibrium • For dynamics F=ma • Connected particles on inclined planes **Projectiles** • Finding position using components • Finding speed, velocity and direction of motion • Finding the initial speed and angle of projection	<u>Algebraic methods</u> **Why Taught?** Under algebraic methods, methods of proof such as proof by deduction, exhaustion and by counterexample is taught. Students should be able to use and understand the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion. Students are taught to manipulate polynomials algebraically, including expanding brackets and collecting like terms, factorisation and simple algebraic division; use of the factor theorem. Only division by (ax + b) or (ax – b) will be required. Students should know that if f(x) = 0 when x = a, then (x – a) is a factor of f(x). <u>Projectiles</u> **Why taught?** Students should be able to model motion under gravity in a vertical plane using vectors. They should understand the derivation of formulae for time of flight, range and greatest height and the derivation of the equation of the path of a projectile.	**unit tests, weekly homework and past paper tests**

YEAR 13			
TERM	**Topic sequence** **(What are you teaching?)**	**Topic sequence rationale** **(Why are you teaching this? How does it link to prior learning? Any notable links to [St Edmund's curriculum mission]**	**Main method of assessment?**
Term 1:1	**Pure** **Functions and graphs** ● The modulus function ● Functions and mappings ● Composite functions ● Inverse functions ● y = | f(x) | and y = f(|x|) ● Combining transformations ● Solving modulus problems **sequences and series** ● Arithmetic sequences ● Arithmetic series ● Geometric sequences ● Geometric series ● Sum to infinity ● Sigma notation ● Recurrence relations ● Modelling with series **Applied** **Regression, correlation and hypothesis testing** ● Exponential Models ● Measuring Correlation ● Hypothesis Testing for Correlation	Functions and graphs **Why Taught?** Students are taught how to solve linear and quadratic inequalities in a single variable and interpret inequalities graphically, including inequalities with brackets and fractions. Students should be able to understand and use graphs of functions; sketch curves defined by simple equations including polynomials. Students should have the ability to interpret algebraic solutions of equations graphically; use intersection points of graphs to solve equations. This topic is taught to help students express relationship between two variables using proportion "∝" symbol or using equation involving constant. **Prior Learning** Sequence and series **Why Taught?** This topic is taught so that students are able to understand and work with arithmetic sequences and series, including the formulae for nth term and the sum to n terms. This topic also allows them to 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 and modulus notation. **Prior Learning** Regression, correlation and hypothesis testing **Why Taught?** In Year 2, where the topic correlation is taught, students learn how to make predictions within the range of values of the explanatory variable. For hypothesis testing, students should see correlation coefficients as measures of how close data points lie to a straight line	**unit tests, weekly homework and past paper tests**

		and be able to interpret a given correlation coefficient using a given p-value or critical value. Students should be able to conduct a statistical hypothesis test for the mean of a Normal distribution with known, given or assumed variance and interpret the results in context **Prior Learning** At AS level, students are taught to interpret scatter diagrams and regression lines for bivariate data, including recognition of scatter diagrams that include distinct sections of the population. They should have a clear understanding of the idea that correlation does not imply causation. Students should be familiar with the terms ‘explanatory (independent)’ and ‘response (dependent)’ variables. When describing the correlation on a graph, terms such as positive, negative, strong and weak are expected to be used. From Year 1, students should already understand that a sample is being used to make an inference about the population and appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis.	
	Conditional probability ● Set Notation ● Conditional probability ● With venn diagrams ● Probability formulae ● Tree diagrams	<u>Conditional probability</u> **Why taught?** It is important for students to understand and use conditional probability, including the use of tree diagrams, Venn diagrams, and two-way tables. A skill they should develop from this topic is being able to model with probability, where they can critique assumptions made and comment on the likely effect of more realistic assumptions. They should be able to understand and use the conditional probability formula. $P(A\|B) = \frac{P(A \cap B)}{P(B)}$ **Prior Learning**	
	Moments ● Resultant moments ● Equilibrium ● Centres of mass ● Tilting	<u>Moments</u> **Why taught?** It is important for students to understand and use moments in simple static contexts. Students should be able to solve problems involving parallel and nonparallel coplanar forces, e.g. ladder problems.	

		Prior Learning	
Term 1:2	<u>Pure</u> **Binomial expansion** ● Expanding $(1 + x)^n$ ● Expanding $(a + bx)^n$ ● Using partial fractions **Radians** ● Radian measure ● Arc length ● Areas of sectors and segments ● Solving trigonometric equations ● Small angle approximations **Trigonometric functions** ● Secant, cosecant and cotangent ● Graphs of sec x, cosec x and cot x ● Using sec x, cosec x and cot x ● Trigonometric identities ● Inverse trigonometric functions **Trigonometry and modelling** ● Addition formulae ● Using the angle addition formulae	<u>Binomial expansion</u> **Why Taught?** Students are taught how to use the Pascal's triangle to help understand the relation between binomial coefficients. Understand and use the binomial expansion of $(a + bx)^n$ for positive integer n; the notations n! and ${}^rC_n$ link to binomial probabilities. **Prior Learning** <u>Radians</u> **Why taught?** Radians are taught to help students understand radian measure where it is used for calculating arc length and area of sector. Students should Understand and use the standard small angle approximations of sine, cosine and tangent where the angle is in radians. Knowledge of graphs of curves with equations such as y = sin x, y = cos(x + 30°), y = tan 2x is expected. **Prior Learning** <u>Trigonometric functions</u> **Why taught?** Students should understand and use the definitions of secant, cosecant and cotangent and of arcsin, arccos and arctan; their relationships to sine, cosine and tangent whilst understanding of their graphs, their ranges and domains. The trigonometric identities may be used to solve trigonometric equations and angles may be in degrees or radians. They may also be used to prove further identities. **Prior Learning** <u>Trigonometry and modelling</u> **Why taught?** Students should understand and use double angle formulae - they	**unit tests, weekly homework and past paper tests**

	• Solving trigonometric equations • Simplifying a cos x ± b sin x • Proving trigonometric identities • Modelling with trigonometric functions	should be familiar with the use of formulae for sin (A ± B), cos (A ± B), and tan (A ± B) and understand geometrical proofs of these formulae.They should be capable of solving simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle. Students are expected to construct proofs involving trigonometric functions and identities. For example, students need to be able to prove identities such as cos x cos 2x + sin x sin 2x = cos x. Students can use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces. Problems could involve wave motion, the height of a point on a vertical circular wheel, or the hours of sunlight throughout the year etc. **Prior Learning**	
	<u>Applied</u> **Forces and friction** • Resolving • Inclined planes • Friction	<u>Forces and friction</u> **Why taught?** At A level stage, students should resolve forces in 2 dimensions and have an understanding of the equilibrium of a particle under coplanar forces. Connected particle problems could include problems with particles in contact e.g. lift problems. Problems may be set where forces need to be resolved, e.g. at least one of the particles is moving on an inclined plane. **Prior Learning** From AS level, they should understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line and be able to apply to problems involving smooth pulleys and connected particles	
	Normal distribution part 1 • Finding probabilities • Inverse Normal function • Standard Normal function • Finding μ and σ	<u>Normal distribution part 1</u> **Why taught?** This is taught to help students understand and use the Normal distribution as a model and find probabilities using the Normal distribution. Knowledge of the shape and the symmetry of the distribution is required. Students will be expected to use their calculator to find probabilities connected with the normal distribution; they should know that the points of inflection on the normal curve are at x = μ ± σ.	

Term 2:1	<u>**Pure**</u> **Parametric equations** ● Parametric equations ● Using trigonometric identities ● Curve sketching ● Points of Intersection ● Modelling with parametric equations **Differentiation** ● Differentiating sin x and cos x ● Differentiating exponentials and logarithms ● The chain rule ● The product rule ● The quotient rule ● Differentiating trigonometric functions ● Parametric differentiation ● Implicit differentiation ● Using second derivatives ● Rates of change **Numerical methods** ● Locating roots ● Iteration ● The Newton-Raphson method ● Applications to modelling	<u>Parametric equations</u> **Why taught?** Students should be able to understand and use the parametric equations of curves and conversion between Cartesian and parametric forms.Students should pay particular attention to the domain of the parameter t, as a specific section of a curve may be described. Moreover, students need to be able to use parametric equations in modelling in a variety of contexts. **Prior Learning** <u>Differentiation</u> **Why taught?** At A level stage, students are expected to differentiate using the product rule, the quotient rule and the chain rule, including problems involving connected rates of change and inverse functions. Construct simple differential equations in pure mathematics and in context, (contexts may include kinematics, population growth and modelling the relationship between price and demand). The finding of equations of tangents and normals to curves given parametrically or implicitly is required. **Prior Learning** From previous learning, students need to be able to use differentiation to find equations of tangents and normals at specific points on a curve. They should already be able to apply differentiation to find gradients, tangents, normals, maxima, minima and stationary points. <u>Numerical methods</u> **Why taught?** Teaching numerical methods helps students to understand that many mathematical problems cannot be solved analytically, but numerical methods permit solutions to a required level of accuracy. Students are expected to evaluate the analytical solution of simple first order differential equations with separable variables, including finding particular solutions. For the Newton-Raphson method,	**unit tests, weekly homework and past paper tests**

	<u>Applied</u> **Projectiles** ● Horizontal projection ● Components ● Any Angle ● Formulae for Motion **Further Kinematics** ● Vectors in kinematics ● Vectors for projectiles ● Variable acceleration in 1-D ● Differentiating vectors ● Integrating vectors	students should understand its working in geometrical terms, so that they understand its failure near to points where the gradient is small. Also, in these topics, students are taught the trapezium rule and how to estimate the approximate area under a curve and limits that it must lie between. <u>Projectiles</u> **Why taught?** Students should be able to model motion under gravity in a vertical plane using vectors. They should understand the derivation of formulae for time of flight, range and greatest height and the derivation of the equation of the path of a projectile. <u>Further kinematics</u> **Why taught?** Students are taught differentiation and integration of a vector with respect to time. **Prior Learning** From previous learning, students should 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.	
Term 2:2	**<u>Pure</u>** **Integration** ● 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	<u>Integration</u> **Why taught?** A level students should be able to carry out simple cases of integration by substitution and integration by parts; they should understand these methods as the inverse processes of the chain and product rules respectively. They learn to integrate using partial fractions that are linear in the denominator. 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 includes more than one application of the method but excludes reduction formulae.	**unit tests, weekly homework and past paper tests**

	● Modelling with differential equations **Vectors** ● 3D Coordinates ● Vectors in 3D ● Solving geometric problems ● Application to mechanics	<u>Vectors</u> **Why taught?** The students are taught to calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form. In addition, they should add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations. They should be able to understand and use position vectors; calculate the distance between two points represented by position vectors. A combination of these skills will allow students to use vectors to solve problems in pure mathematics and in context, including forces. At a level stage, students are expected to use vectors in two dimensions and in three dimensions.	
	<u>Applied</u> **Normal distribution part 2** ● Approximating a Binomial Distribution ● Hypothesis testing with the Normal Distribution	<u>Normal distribution part 2</u> **Why taught?** Students should know that when n is large and p is close to 0.5 the distribution B(n, p) can be approximated by N(np, np[1 – p]). Students should know under what conditions a binomial distribution or a Normal distribution might be a suitable model. They should be capable of selecting an appropriate probability distribution for a context, with appropriate reasoning, including recognising when the binomial or Normal model may not be appropriate. Also, they should conduct a statistical hypothesis test for the mean of a Normal distribution with known, given or assumed variance and interpret the results in context. **Prior Learning** Prior learning includes being able to conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context. Understanding that a sample is being used to make an inference about the population and appreciating that the significance level is the probability of incorrectly rejecting the null	

	Applications of Forces ● Modelling with statics ● Friction with static particles ● Static Rigid Bodies ● Dynamics and inclined planes ● Connected particles	hypothesis is taught prior to learning part 2 of normal distribution. Applications of Forces **Why taught?** Students should understand and use addition of forces, resultant forces, dynamics for motion in a plane.Students may be required to resolve a vector into two components or use a vector diagram, e.g. problems involving two or more forces, given in magnitude-direction form. They should have an understanding of $F = \mu R$ when a particle is moving ; an understanding of $F \leq \mu R$ in a situation of equilibrium. **Prior Learning** Students should already have an understanding of the concept of force and Newton's first law. They should understand motion in a straight line with constant acceleration in vector form, where the forces are given in $i - j$ form or as column vectors.Students should already understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line; application to problems involving smooth pulleys and connected particles.	
Term 3:1	**Applied** ● **Statistic Review** ● **Mechanics Review**		**unit tests, weekly homework and past paper tests**
Term 3:2			