	Dallam School Mathematics Curriculum Overview	**Department: A Level Mathematics** **Year Group: 12**

Pure Mathematics					
AUTUMN		**SPRING**		**SUMMER**	
Half term 1	**Half term 2**	**Half term 3**	**Half term 4**	**Half term 5**	**Half term 6**
Theme / Topic **Algebra and functions**	**Theme / Topic** **Co-ordinate geometry and Further algebra**	**Theme / Topic** **Trigonometry and Vectors**	**Theme / Topic** **Differentiation and Integration**	**Theme / Topic** **Exponentials and Logarithms**	**Theme / Topic** **Proof and partial fractions**
By the end of this half term pupils will know *(key knowledge, including tier 3 vocabulary)*					
➢ Use and manipulate surds ➢ Make connections between quadratic functions and their graphs ➢ Interpret inequalities graphically ➢ The use of 'and' and 'or', in set notation such ➢ The effect of simple transformations on the graph of y=f(x) ***Tier 3 vocabulary*** *Expression, function, constant, variable, term, coefficient, index, linear, identity, simultaneous, elimination, substitution, factorise, completing the square, intersection, change the subject, cross-multiply, power, exponent, base, rational, irrational, reciprocal, root, standard form, surd, rationalise, exact, manipulate, sketch, plot, quadratic,*	➢ Proportional relationships and their graphs ➢ Equation of a straight line ➢ The gradient conditions for two straight lines to be parallel or perpendicular ***Tier 3 vocabulary*** *Binomial, coefficient, probability, proof, assumptions, deduction, exhaustion, disproof, counter-example, polynomials, factorisation, quadratic, cubic, quartic, conjecture, prediction, rational number, implies, necessary, sufficient, converse, fully factorise, factor, expand, therefore, conclusion. Equation, bisect, centre, chord, circle, circumcircle, coefficient, constant, diameter, gradient, hypotenuse, intercept,*	➢ The definition of sine, cosine and tangent ➢ The magnitude and the direction of a vector ***Tier 3 vocabulary*** *Sine, cosine, tangent, interval, period, amplitude, function, inverse, angle of elevation, angle of depression, bearing, degree, identity, special angles, unit circle, symmetry, hypotenuse, opposite, adjacent, intercept. Vector, scalar, magnitude, direction, component, parallel, perpendicular, modulus, dimension, ratio, collinear, scalar product, position vectors.*	➢ The derivative as the gradient of the tangent of the function ➢ Know and understand the use the Fundamental Theorem of Calculus ➢ Students should be able to explain the need for the +c in indefinite integration ***Tier 3 vocabulary*** *Differentiation, derivative, first principles, rate of change, rational, constant, tangent, normal, increasing, decreasing, stationary point, maximum, minimum, integer, calculus, function, parallel, perpendicular*	➢ Know and use the definition of log$_a$ x as the inverse of a^x is positive and $x > 0$ ➢ $y = e^x$ and $y = \ln x$ as the one being the inverse of the other ***Tier 3 vocabulary*** *Exponential, exponent, power, logarithm, base, initial, rate of change, compound interest*	➢ Identify assumptions through a series of logical steps to a conclusion ➢ ***Tier 3 vocabulary*** *Proof, verify, deduction, contradict, rational, irrational, square, root, prime, infinity, square number, quadratic, expansion, trigonometry, Pythagoras.*

maximum, minimum, turning point, transformation, translation, polynomial, discriminant, real roots, repeated roots, factor theorem, quotient, intercepts, inequality, asymptote	*isosceles, linear, midpoint, parallel, perpendicular, proportion, Pythagoras, radius, right angle, segment, semicircle, simultaneous, tangent*				
They will understand *(key concepts)*					
➢ Understand and use the laws of indices ➢ Understand factor theorem ➢ Understand and use graphs of functions; ➢ Understand the discriminant of a quadratic function	➢ Understand the coordinate geometry of the circle including using the equation of a circle ➢ Understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion ➢ Understand and use the binomial expansion	➢ Understand and use sine, cosine and tangent as functions ➢ Understand simple trig identities ➢ Understand parallel vectors ➢ Understand position vectors, adding and subtracting vectors ➢ Understand and interpret properties of vectors	➢ Understand the gradient as the rate of change ➢ Understand the significance of the sign and the value of the derivative ➢ Understand the use of Riemann integral as a sum of the areas of rectangles ➢ Understand the implication of a negative answer to encourage students reasoning skills	➢ Understand the graph of $y = ax$ and its transformations for $0 < a \neq 1$ ➢ Understand and use the graph of $y = \log_a x$ for $0 < a \neq 1$ ➢ Understand the derivatives of $y = ke^{mx}$ and $y = \ln(mx)$ ➢ Understand and use the laws of logarithms ➢ Understand and use exponential growth and decay; use in modelling ➢ Understand the asymptotes of the graphs	➢ Understand the structure of mathematical proof Identify appropriate methods of proof, including proof by deduction. proof by contradiction (including proof of the irrationality of $2-\sqrt{2}$ and the infinity of primes, and application to unfamiliar proofs ➢ Understand algebraic division
They will know how to *(key skills)*					
➢ Work with quadratic functions and their graphs ➢ Being able to complete a square ➢ Solve quadratic equations ➢ 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 ➢ Represent linear and quadratic inequalities	➢ Be able to use straight line models ➢ Use the coordinate geometry of the circle including using the equation of a circle ➢ Find the tangent of a circle ➢ Use of the following properties: • the angle in a semicircle is a right angle • the perpendicular from the centre to a chord bisects the chord	➢ Use sine, cosine and tangent as functions and translate their graphs ➢ Prove trig identities ➢ Solve simple trig equations ➢ Rearrange trig equations or expressions in order to hold only one trig ratio ➢ Use vectors in 2D ➢ Calculate the magnitude and the direction of a vector ➢ Use vectors to solve geometrical problems	➢ Differentiate from first principles ➢ Use the derivative as the gradient of the function ➢ Find the equation of tangents and normals ➢ Use the derivative (1st and 2nd) to find maxima and minima ➢ Problem solve real life examples about maxima and minima ➢ Find stationary points and create diagrams to see how a function is changing	➢ Use the laws of logarithms ➢ Solve equations of the form $a^x = b$ ➢ Solve equations of the form $k a^{2x} + m a^x + n = 0$ ➢ Solve equations including multiple logarithms by creating single logarithms on each side ➢ Use exponential models ➢ Explain why an exponential may or may not be an appropriate model	➢ Use the structure of mathematical proof ➢ Identify mistakes in a series of logical steps to a conclusion ➢ Use appropriate methods of proof, including proof by deduction. proof by contradiction ➢ Know how to prove that $\sqrt{2}$ is an irrational number ➢ Be able to prove the infinity of primes ➢ Be able to separate cases n being even (n

➢ Manipulate polynomials algebraically ➢ Divide polynomials ➢ Sketch curves defined by simple equations	• the radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point ➢ Manipulate polynomials algebraically use of the factor theorem use methods of proof, including: proof by deduction, proof by exhaustion, disproof by counter-example		➢ Be able to integrate xn (excluding n = −1), and related sums, differences and constant multiples. ➢ Be able to find areas under a curve or areas among lines (not all straight) by using definite integrals		= 2k) or n being odd (n = 2k +1) ➢ Decompose partial fractions ➢ Simplify algebraic fractions

Applied Mathematics					
AUTUMN		**SPRING**		**SUMMER**	
Half term 1	**Half term 2**	**Half term 3**	**Half term 4**	**Half term 5**	**Half term 6**
Theme / Topic **Statistical sampling, Data presentation and Probability**	**Theme / Topic** **Statistical distributions and hypothesis testing**		**Theme / Topic** **Quantities and units in mechanics and Kinematics (constant acceleration)**	**Theme / Topic** **Forces and Newton's laws**	**Theme / Topic** **Kinematics (variable acceleration)**
By the end of this half term pupils will know *(key knowledge, including tier 3 vocabulary)*					
➢ Know the terms 'population' and 'sample' ➢ 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 recognition of scatter diagrams which include distinct sections of the population ➢ Know that correlation does not imply causation ➢ Interpret measures of central tendency and variation, extending to standard deviation ➢ Recognise and interpret possible outliers in data sets and statistical diagrams ➢ 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 recognition of scatter diagrams which include distinct sections of the population ➢ Interpret measures of central tendency and variation, extending to standard deviation ➢ Recognise and interpret possible outliers in data sets and statistical diagrams	➢ Know the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, p-value ➢ Know 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 ***Tier 3 vocabulary*** *Binomial, probability, discrete distribution, discrete random variable, uniform, cumulative probabilities Hypotheses, significance level, one-tailed test, two-tailed test, test statistic, null hypothesis, alternative hypothesis, critical value, critical region, acceptance region, p-value, binomial model, accept, reject, sample, inference*		➢ The fundamental quantities and units in the S.I. system: length, time, mass. ➢ Know the language used to describe simplifying assumptions; understand the particle model. ➢ Know the difference between position, displacement and distance; ➢ Know the difference between velocity and speed, and between acceleration and magnitude of acceleration; ➢ Know the difference between mass and weight (including gravity); ***Tier 3 vocabulary*** *Modelling, smooth, rough, light, inelastic, inextensible, particle, rigid body, mass, weight, rod, plane, lamina, length, distance (m), displacement (m), velocity (m s^{-1}), speed (m s^{-1}), acceleration (m s^{-2}), force (N), retardation (m s^{-2}), newtons (N), scalar, vector, direction, magnitude, (normal) reaction, friction, tension, thrust, compression*	➢ Know and understand the concept of a force; ***Tier 3 vocabulary*** *Force, newtons, mass, weight, gravity, tension, thrust, compression, air resistance, reaction, driving force, braking force, resultant, force diagram, equilibrium, inextensible, light, negligible, particle, smooth, uniform, pulley, string, retardation, free particle.*	➢ Know that calculus (differentiation) in kinematics can be used to model motion in a straight line for a particle moving with variable acceleration; ➢ Know how to find max and min velocities by considering zero gradients. ➢ Know how to use initial conditions to calculate the constant of integration and refer back to the problem. ***Tier 3 vocabulary*** *Distance, displacement, velocity, speed, constant acceleration, variable acceleration, retardation, deceleration, gradient, area, differentiate, integrate, rate of change, straight-line motion, with respect to time, constant of integration, initial conditions.*

Tier 3 vocabulary *Population, census, sample, sampling unit, sampling frame, simple random sampling, stratified, systematic, quota, opportunity (convenience) sampling Histogram, box plot, probability density function, cumulative distribution function, continuous random variable, scatter diagram, linear regression, explanatory (independent) variables, response (dependent) variables interpolation, extrapolation, product moment correlation coefficient (PMCC), mean, median, mode, variance, standard deviation, range, interquartile range, interpercentile range, outlier, skewness, symmetrical, positive skew, negative skew, sample space, exclusive event, complementary event, discrete random variable, continuous random variable, mathematical modelling, independent, mutually exclusive, Venn diagram, tree diagram.*				
They will understand *(key concepts)*				
➢ Understand simple random sampling and opportunity sampling. ➢ Understand that different samples can lead to different conclusions about the population ➢ Understand informal interpretation of correlation ➢ Understand that different samples can lead to different conclusions about the population ➢ Understand informal interpretation of correlation ➢ Understand that correlation does not imply causation ➢ Understand mutually exclusive and independent events when calculating probabilities ➢ Link to discrete and continuous distributions ➢ Understand the definition of independence	➢ Understand simple, discrete probability distributions ➢ Understand and use the binomial distribution, as a model; ➢ Understand the real significance level as the probability of falsely rejecting the null hypothesis	➢ Understand derived quantities and units: velocity, acceleration, force, weight. ➢ Understand that there are different types of forces. ➢ Understand 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. ➢ Understand and derive the formulae for constant acceleration for motion in a straight line. ➢ Understand weight and motion in a straight line under gravity	➢ Understand and use Newton's second law for motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2D (i, j) vectors). ➢ Understand 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.	➢ Understand that gradients of the relevant graphs link to rates of change; ➢ Understand how to use calculus (integration) in kinematics to model motion in a straight line for a particle moving under the action of a variable force; ➢ Understand that the area under a graph is the integral, which leads to a physical quantity;

They will know how to *(key skills)*				
➢ Use samples to make informal inferences about the population ➢ Use sampling techniques ➢ Select or critique sampling techniques in the context of solving a statistical problem ➢ Apply statistics to describe a population ➢ Being able to calculate the mean and standard deviation ➢ Being able to calculate or estimate the 3 quartiles ➢ Select or critique data presentation techniques in the context of a statistical problem ➢ Be able to clean data, including dealing with missing data, errors and outliers ➢ Apply statistics to describe a population ➢ Being able to calculate the mean and standard deviation ➢ Being able to calculate or estimate the 3 quartiles ➢ Select or critique data presentation techniques in the context of a statistical problem ➢ Be able to clean data, including dealing with missing data, errors and outliers ➢ Use mutually exclusive and independent events when calculating probabilities ➢ Link to discrete and continuous distributions ➢ Use tree diagrams and Venn Diagrams to calculate probabilities ➢ Use independent events	➢ Use simple, discrete probability distributions ➢ Complete distribution tables or functions ➢ Be able to calculate probabilities using the binomial distribution ➢ Apply the language of statistical hypothesis testing, developed through a binomial model ➢ Identify null hypothesis and alternative hypothesis ➢ Carry out hypothesis testing given a significance level ➢ Identify the test statistic ➢ Carry out 1-tail test or 2-tail test ➢ Find critical values and critical regions ➢ Find acceptance region, p-value Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context	➢ Use derived quantities and units: velocity, acceleration, force, weight, be able to analyse the model appropriately, and interpret and communicate the implications of the analysis in terms of the situation being modelled; ➢ Use 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. ➢ Use and derive the formulae for constant acceleration for motion in a straight line. ➢ Use weight and motion in a straight line under gravity; gravitational acceleration, g, and its value in S.I. units to varying degrees of accuracy ➢ Use compound units such as speed, rates of pay, unit pricing, density and pressure. ➢ Plot and interpret graphs (including reciprocal graphs and exponential graphs) and graphs of non-standard functions in real contexts to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration. ➢ Calculate or estimate gradients of graphs and area under graphs (including quadratic and non-linear graphs), and interpret results in cases	➢ Use Newton's first law. Use Newton's second law for motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2D (i, j) vectors). ➢ Understand 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	➢ Be able to use calculus (differentiation) in kinematics to model motion in a straight line for a particle moving with variable acceleration; ➢ Understand that gradients of the relevant graphs link to rates of change; ➢ Know how to find max and min velocities by considering zero gradients and understand how this links with the actual motion (i.e. acceleration = 0). Be able to use calculus (integration) in kinematics to model motion in a straight line for a particle moving under the action of a variable force. ➢ Know how to use initial conditions to calculate the constant of integration and refer back to the problem.

		such as distance-time graphs, velocity-time graphs and graphs in financial contexts.		

Dallam School

Mathematics Curriculum Overview

Department: A-level Mathematics
Year Group: 13

Pure Mathematics

AUTUMN		SPRING		SUMMER	
Half term 1	**Half term 2**	**Half term 3**	**Half term 4**	**Half term 5**	**Half term 6**
Theme / Topic **Functions and modelling, sequences and series, the binomial theorem**	**Theme / Topic** **Trigonometry and parametric equations**	**Theme / Topic** **Differentiation, numerical methods and integration** **Theme / Topic**		**Theme / Topic** **Integration and Vectors**	**End of course**
By the end of this half term pupils will know *(key knowledge, including tier 3 vocabulary)*					
➢ Recognise the Modulus function and its graph ➢ Know sigma notation for sums of series ***Tier 3 vocabulary*** *Function, mapping, domain, range, modulus, transformation, composite, inverse, one to one, many to one mappings, f(x), fg(x), f-1(x), reflect, translate, stretch. Sequence, series, finite, infinite, summation notation, Σ(sigma), periodicity, convergent, divergent, natural numbers, arithmetic series, arithmetic progression (AP), common difference, geometric series, geometric progression (GP), common ratio, $n$nth term, sum to nn terms, sum to infinity (S∞), limit Binomial, expansion, theorem, integer, rational, power, index, coefficient, validity, modulus, factorial, ^nC_r combinations, Pascal's triangle, partial fractions, approximation, converges, diverges, root.*	➢ Know the definitions of secant, cosecant and cotangent and of arcsin, arccos and arctan; their relationships to sine, cosine and tangent; knowledge of their graphs; their ranges and domains, ➢ Know that the expressions for $a\cos\theta+b\sin\theta$ in the equivalent forms of $R\cos(\theta\pm\alpha)$ or $R\sin(\theta\pm\alpha)$. ***Tier 3 vocabulary*** *Parametric, Cartesian, convert, parameter t, identity, eliminate, substitute, circle, hyperbola, parabola, ellipse, domain, modelling*	➢ Know the product rule, quotient rule and chain rule ➢ Know the notation used throughout implicit differentiation to differentiate an equation involving two variables ***Tier 3 vocabulary*** *Derivative, tangent, normal, turning point, stationary point, maximum, minimum, inflexion, parametric, implicit, differential equation, rate of change, product, quotient, first derivative, second derivative, increasing function, decreasing function, Integral, inverse, differential, coefficient, index, power, negative, reciprocal, natural logarithm, ln|x|, coefficient, exponential, identity, sin, cos, tan, sec, cosec, cot, e^x, parametric.*		➢ Appreciate the trapezium rule is an approximation and realise when it gives an overestimate or underestimate ➢ Know the definition of a unit vector in 3D; understand and use position vectors. ***Tier 3 vocabulary*** *Integral, definite integral, integrand, limit, indefinite integral, constant of integration, trapezium, substitution, by parts, area, differential equation, first order, separating variables, initial conditions, general solution, parametric, Vector, scalar, column, 3D coordinates, vertices, Cartesian, i, j, k, magnitude, origin, distance, direction, angle, position vector, unit vector, orthogonal, vector addition/subtraction.*	**END OF COURSE**

They will understand *(key concepts)*				
➢ Understand composite and inverse functions ➢ Understand arithmetic sequences and series, including the formulae for nth term and the sum to n terms ➢ Understand 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 understanding of $\|r\|>1$ ➢ Understand the binomial expansion of $(a+bx)^n$ for rational n, including its use for approximation; be aware that the expansion is valid for $\|bx / a\| < 1$ (proof not required)	➢ Understand use the standard small angle approximations of sine, cosine and tangent ➢ Understand and prove $\sec 2\theta = 1+\tan 2\theta$ and $\operatorname{cosec} 2\theta = 1+\cot 2\theta$, ➢ Understand double angle formulae; use of formulae for $\sin(A\pm B)$, $\cos(A\pm B)$ and $\tan(A\pm B)$ ➢ Understand geometrical proofs of these formulae ➢ Understand the parametric equations of curves and conversion between Cartesian and parametric forms, ➢ Understand the difference between the Cartesian and parametric system of expressing coordinates	➢ Understand and use differentiation by first principles ➢ Understand the principle of iteration; appreciate the need for convergence in iteration ➢ Understand how the Newton-Raphson method works in geometrical terms	➢ Understand and select the correct substitution and justify their choices ➢ Understand and be able to use integration as the limit of a sum ➢ Understand the difference between an indefinite and definite integral and why we do not need + c	**END OF COURSE**
They will know how to *(key skills)*				
➢ Use the modulus of a function ➢ Use composite and inverse functions ➢ Create the graph of an inverse function ➢ Use modelling for ➢ real life problems, ➢ Criticise and improve models ➢ Work with arithmetic sequences and series ➢ Work with sigma notation including the formulae for nth term and the sum to n terms, ➢ Work with geometric sequences and series including the formulae for the $n$nth term and the sum of a finite geometric series; the sum to infinity of a convergent geometric series, including the use of $\|r\|>1$	➢ Work with radian measure, including use for arc length and area of sector ➢ Know and use exact values of sin and cos and tan ➢ Use the identities $\sec 2\theta = 1+\tan 2\theta$, $\operatorname{cosec} 2\theta = 1+\cot 2\theta$ ➢ Use double angle formulae; ➢ Use of formulae for $\sin(A\pm B)$, $\cos(A\pm B)$ and $\tan(A\pm B)$ ➢ Use 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 ➢ Use the parametric equations of curves and conversion	➢ Be able to differentiate using the product rule, chain rule and 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 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 ➢ Be able to use iteration to find terms in a sequence;	➢ 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 that are linear in the denominator; ➢ Be able to simplify the expression using laws of logarithms ➢ Be able to find an area under a curve defined by a pair of parametric equations	**END OF COURSE**

➢ Use sequences and series in modelling ➢ Use the binomial expansion of $(a+bx)^n$ for rational n, including its use for approximation; ➢ Be able to expand fractions using binomial expansion	between Cartesian and parametric forms ➢ Use parametric equations in modelling in a variety of contexts ➢ Be able to convert between parametric and Cartesian forms, ➢ Be able to plot and sketch curves given in parametric form	➢ 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; ➢ Be able to use numerical methods to solve problems in context ➢ 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 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 expressions; ➢ Be able to integrate expressions involving e^x; ➢ Be able to integrate a function expressed parametrically;	➢ Be able to use the trapezium rule to find an approximation to the area under a curve ➢ 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 extend the work on vectors from Year 12 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; ➢ Be able to add 3D vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations; 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).	

Applied Mathematics					
AUTUMN		**SPRING**		**SUMMER**	
Half term 1	**Half term 2**	**Half term 3**	**Half term 4**	**Half term 5**	**Half term 6**
Theme / Topic **Regression, correlation and conditional probability**	**Theme / Topic** **Normal distribution**	**Theme / Topic** **Moments**	**Theme / Topic** **Forces, friction, Newton's third law**	**Theme / Topic** **Further kinematics**	**Theme / Topic** **End of course**
By the end of this half term pupils will know *(key knowledge, including tier 3 vocabulary)*					
➢ Know that exponential graphs can be transformed to linear graphs using logarithms ➢ Know the conditions for strong correlation with the PMCC ***Tier 3 vocabulary*** *Correlation coefficients, product moment correlation coefficient, population coefficient, sample, inference, mean, normal distribution, variance, assumed variance, linear regression, interpolation, extrapolation, coded data, Sample space, exclusive event, complementary event, discrete random variable, continuous random variable, mathematical modelling, independent, mutually exclusive, Venn diagram, tree diagram, set notation, conditional probability, two-way tables, critiquing assumptions*	➢ Know that the Normal distribution can be used as a model, ➢ Recognise when the binomial or the Normal model may not be appropriate ***Tier 3 vocabulary*** *Hypotheses, significance level, one-tailed test, two-tailed test, test statistic, null hypothesis, alternative hypothesis, critical value, critical region, acceptance region, p-value*	➢ Realise that a force can produce a turning effect, ➢ Know that a moment of a force is given by the formula force × distance giving Nm ➢ Know what the sense of a moment is ➢ Realise what conditions are needed for a system to remain in equilibrium, ➢ Know the language relating to forces ***Tier 3 vocabulary*** *Moment, turning effect, sense, newton metre (N m), equilibrium, reaction, tension, rod, uniform, non-uniform, centre of mass, resolve, tilting, 'on the point', concurrent, force, weight, tension, thrust, friction, coefficient of friction, μ, limiting, reaction, resultant, magnitude, direction, bearing, force diagram, equilibrium, inextensible, light, negligible, particle, smooth, rough, uniform, perpendicular.*	➢ Know that a rough plane will have an associated frictional force, which opposes relative motion ➢ Know that the 'roughness' of two surfaces is represented by a value called the coefficient of friction represented by μ; ➢ Know that $0 \leq \mu$ but that there is no theoretical upper limit for μ although for most surfaces it tends to be less than 1 and that a 'smooth' surface has a value of μ=0; ➢ Know the formula $F \leq \mu R$ ***Tier 3 vocabulary*** *Force, newtons, mass, weight, gravity, tension, thrust, compression, air resistance, reaction, driving force, braking force, resultant, force diagram, equilibrium, inextensible, light, negligible, particle, smooth, uniform, pulley, string, retardation, free particle.*	➢ Recognise when the use of constant acceleration formulae is appropriate, ➢ Know the language of kinematics appropriate to motion in 2 dimensions ➢ Know the language and notation of kinematics appropriate to variable motion in 2 dimensions, i.e. knowing the notation $\dot{r}$ and $\ddot{r}$ for variable acceleration in terms of time. ***Tier 3 vocabulary*** *Distance, displacement, speed, velocity, constant acceleration, constant force, variable force, variable acceleration, retardation, deceleration, initial ($t = 0$), stationary (speed = 0), at rest (speed = 0), instantaneously, differentiate, integrate, turning point.*	**END OF COURSE**
They will understand *(key concepts)*					
➢ Understand exponential models ➢ Understand correlation coefficients	➢ Understand the link with histograms, mean, standard deviation, points of inflection and the binomial distribution	➢ Understand moments in simple static contexts ➢ Understand that the force and distance must be	➢ Understand the concept of a force; understand and use Newton's first law,	➢ Extend techniques for motion in 1 dimension to 2 dimensions by using vectors;	**END OF COURSE**

➢ Understand and use mutually exclusive and independent events when calculating probabilities ➢ Link to discrete and continuous distributions, ➢ Understand conditional probability, including the use of tree diagrams, Venn diagrams, two-way tables, understand the conditional probability formula P(A|B)=P(A∩B)/P(B)	➢ Understand the continuity correction	perpendicular to one another ➢ Understand the $F \leq \mu R$ model for friction; ➢ Understand how to find the resultant force (magnitude and direction)	➢ Understand and use Newton's second law for motion in a straight line ➢ Understand 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. ➢ Understand Newton's second law for motion in a straight line ➢ Understand 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	➢ Understand suvat formulae for constant acceleration in 2D	
They will know how to *(key skills)*					
➢ Be able to change the variable in a regression line ➢ Be able to estimate values from regression line ➢ Be able to calculate the PMCC (calculator only) ➢ Be able to conduct a hypothesis test for a correlation coefficient ➢ Use conditional probability, including the use of tree diagrams, Venn diagrams, two-way tables ➢ Use the conditional probability formula P(A|B)=P(A∩B)/P(B)	➢ Use the Normal distribution as a model; ➢ Find probabilities using the Normal distribution ➢ Select an appropriate probability distribution for a context, with appropriate reasoning, ➢ Conduct a statistical hypothesis test for the mean of the Normal distribution with known, given or assumed variance and interpret the results in context, ➢ Be able to find the mean and variance of a binomial distribution ➢ Be able to apply a continuity correction; ➢ Be able to use the Normal distribution as an approximation to the binomial distribution,	➢ Use moments in simple static contexts ➢ Be able to draw mathematical models to represent horizontal rod problems ➢ Be able to solve problems when a bar is on the point of tilting ➢ Resolving forces in 2 dimensions ➢ Use the $F \leq \mu R$ model for friction; coefficient of friction; motion of a body on a rough surface; limiting friction and limiting equilibrium, ➢ Be able to identify the forces acting on a particle and represent them in a force diagram ➢ Be able to find the resultant of several concurrent forces by vector addition	➢ 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, ➢ Be able to use Newton's second law for motion in a straight line ➢ 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	➢ Be able to write positions, velocities and accelerations in vector form ➢ Use suvat formulae for constant acceleration in 2D; ➢ Know how to apply the equations of motion to **i**, **j** vector problems; ➢ Be able to use v = u + at, ➢ Be able to use r = ut + 1/2at^2 etc. with vectors given in i , j or column vector form	**END OF COURSE**

	➢ Be able to conduct a statistical hypothesis test for the mean of the Normal distribution	➢ Be able to resolve a force into components ➢ Be able to select suitable directions for resolution			