Maths Department - Year 13 Pure (a) & Statistics and Mechanics (b)

Shirley High Curriculum Map

The Year 13 curriculum builds upon Year 12, with more complex areas within pure Mathematics, Statistics and Mechanics covered. Students will be expected to accurately assess the reliability of their Mathematical models. Students are regularly assessed according to their ability to: use and apply standard techniques; reason, interpret and communicate mathematically and solve problems within Mathematics and other contexts.

	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
	Theme/Topic/Skill:	Theme/Topic/Skill:	Theme/Topic/Skill:	Theme/Topic/Skill:	Theme/Topic/Skill:	Theme/Topic/Skill:
	1(a) Algebraic methods 1(b) Regression, correlation and hypothesis testing 2(a) Functions and graphs 2(b) Conditional probability 3(a) Sequences and series	4(a) Binomial expansion 3(b) Moments 5(a) Radians 4(b) Forces and Friction 6(a) Trigonometric functions	7(a) Trigonometry and modelling 5(b) Projectiles 8(a) Parametric equations 6(b) The normal distribution	9(a) Differentiation 7(b) Applications of forces 10(a) Numerical methods 8(b) Further Kinematics	11(a) Integration 12(a) Vectors Revision and Exam Practice	Public Examination
Why Now?	1(a) This unit ensures pupils have the algebraic manipulation tools that are required in latter units. Pupils also build on their ability to prove from unit 7 of the previous year. 1(b) Pupils revisit and build upon content covered in unit 4 and unit 7 of previous year. 2(a) The theme of algebra is continued by exploring functions which will be used in the following unit. 2(b) Pupils revisit and build upon content covered in unit 5 of previous year. 3(a) The theme of algebra is continued into exploring sequences and series.	4(a) Continuing the theme of algebra, pupils build on their understanding from unit 8 of the previous year. 3(b) Pupils now revisit mechanics, by learning how to take moments when considering rigid bodies as opposed to only particles in the previous year. 5(a) Pupils learn that degrees is not the only unit of measure for angles as they are introduced to radians. 4(b) Pupils apply their understanding of moments to calculate components of forces to solve problems. 6(a) The theme of trigonometry is continued as pupils learn about the reciprocal trigonometric functions.	7(a) The theme of trigonometry is continued as pupils build upon their understanding of trigonometric identities from unit 10 of the previous year. 5(b) Pupils learn how to find components of velocity to solve problems involving projectiles. 8(a) This unit links well with the previous unit as pupils learn that parametric equations can be converted into Cartesian form before learning how to use trigonometric identities to perform the conversion if the parametric equations are trigonometric. 6(b) Pupils' attention is returned to statistics where they learn about the normal distribution and practice their hypothesis testing abilities, learnt in unit 1 of this year and unit 7 of the previous year, using the normal distribution.	9(a) Pupils revisit differentiation from unit 12 of the previous year building on their understanding by learning how to differentiate trigonometric functions, exponentials and logarithms. 7(b) Pupils' attention is returned to mechanics as they build upon their understanding from unit 4 in order to solve a variety of problems involving forces. 10(a) Continuing the theme of differentiation, pupils learn how to solve equations using iterative methods that involve differentiation. 8(b) Pupils learn how to work with vectors for displacement, velocity and acceleration by using the vector equations of motion. This unit ties in well with what is being taught in pure as pupils have been differentiating and will move on to integration.	11(a) Having been using integration in mechanics, pupils build on their understanding of integration from unit 13 of the previous year. 12(a) With the content of statistics and mechanics covered, this unit – which is heavily linked to the last unit from mechanics – can be delivered during timetabled mechanics lessons to allow pupils more practice with integration. (R) Having taught all content pupils now need time to improve their understanding of topics that they have identified as a weakness through assessment and reflection. This is also an opportunity to consolidate the mentality of a pupil taking ownership of their learning in such a way that maximises productivity in time spent revising.	N/A
Fundamental Concepts	(a) Proof Algebra and functions Sequence and series (b) Data presentation and interpretation Statistical hypothesis testing Probability	(a) Sequence and series Trigonometry (b) Moments Forces and Newton's laws	(a) Trigonometry Coordinate geometry in the (x,y) plane (b) Kinematics Moments Forces and Newton's laws Statistical distributions Statistical hypothesis testing	(a) Differentiation Numerical methods (b) Forces and Newton's laws Moments Kinematics	(a) Integration Vectors Revision (a) Proof Algebra and functions Coordinate geometry in the (x,y) plane Sequences and series Trigonometry Exponentials and logarithms Differentiation Integration Numerical Methods Vectors Revision (b) Statistical sampling Data presentation and interpretation Probability Statistical distributions Statistical hypothesis testing Quantities and units in mechanics Kinematics Forces and Newton's laws Moments	N/A
Students will learn about …	1(a) **Using** proof by contradiction to prove true statements. **Multiplying** and dividing two or more algebraic fractions. **Adding** or subtracting two or more algebraic fractions. **Converting** an expression with linear factors in the denominator into partial fractions. **Converting** an expression with repeated linear factors in the denominator into partial fractions. **Dividing** algebraic expressions. **Converting** an improper fraction into partial fraction form. 1(b) **Understanding** exponential models in bivariate data. **Using** a change of variable to estimate coefficients in an exponential model. **Understanding** and calculating the product moment correlation coefficient. **Carrying** out a hypothesis test for zero correlation. 2(a) **Understanding** and using the modulus function.	4(a) **Expanding** $(1 + x)^n$ for any rational constant n and determining the range of values of x for which the expansion is valid. **Expanding** $(a + bx)^n$ for any rational constant n and determining the range of values of x for which the expansion is valid. **Using** partial fractions to expand fractional expressions. 3(b) **Calculating** the turning effect of a force applied to a rigid body. **Calculating** the resultant moment of a set of forces acting on a rigid body. **Solving** problems involving uniform rods in equilibrium. **Solving** problems involving non-uniform rods. **Solving** problems involving rods on the point of tilting. 5(a) **Converting** between degrees and radians and applying this to trigonometric graphs and their transformations.	7(a) **Proving** and using the addition formulae. **Understanding** and using the double-angle formulae. **Solving** trigonometric equations using the double-angle and addition formulae. **Writing** expressions of the form $\theta \pm \theta$ in the forms $R\cos cos\ (\theta \pm \alpha)$ or $R\sin sin\ (\theta \pm \alpha)$. **Proving** trigonometric identities using a variety of identities. **Using** trigonometric functions to model real-life situations. 5(b) **Modelling** motion under gravity for an object projected horizontally. **Resolving** velocity into components. **Solving** problems involving particles projected at an angle. **Deriving** the formulae for time of flight, range and greatest height, and the equation of the path of a projectile. 8(a)	9(a) **Differentiating** trigonometric functions. **Differentiating** exponentials and logarithms. **Differentiating** functions using the chain, product and quotient rules. **Differentiating** parametric equations. **Differentiating** functions which are defined implicitly. **Using** the second derivative to describe the behaviour of a function. **Solving** problems involving connected rates of change and constructing simple differential equations. 7(b) **Finding** an unknown force when a system is in equilibrium. **Solving** statics problems involving weight, tension and pulleys. **Understanding** and solving problems involving limiting equilibrium. **Solving** problems involving motion on rough or smooth inclined planes. **Solving** problems involving connected particles that	11(a) **Integrating** standard mathematical functions including trigonometric and exponential functions and using the reverse of the chain rule to integrate functions of the form $f(ax + b)$. **Using** trigonometric identities in integration. **Using** the reverse of the chain rule to integrate more complex functions. **Integrating** functions by making a substitution, using integration by parts and using partial fractions. **Using** integration to find the area under a curve. **Using** the trapezium rule to approximate the area under a curve. **Solving** simple differential equations and modelling real-life situations with differential equations. 12(a) **Understanding** 3D Cartesian coordinates. **Using** vectors in three dimensions. **Using** vectors to solve geometric problems. **Modelling** 3D motion in mechanics with vectors.	N/A

	Understanding mappings and functions and using domain and range. **Combining** two or more functions to make a composite function. **Knowing** how to find the inverse of a function graphically and algebraically. **Sketching** the graphs of the modulus functions $y = \|f(x)\|$ and $y = f(\|x\|)$. **Applying** a combination of two (or more) transformations to the same curve. **Transforming** the modulus function. 2(b) **Understanding** set notation in probability. **Understanding** conditional probability. **Solving** conditional probability problems using two-way tables and Venn diagrams. **Using** probability formulae to solve problems. **Solving** conditional probability using tree diagrams. 3(a) **Finding** the *n*th term of an arithmetic sequence. **Proving** and using the formula for the sum of the first *n* terms of an arithmetic series. **Finding** the *n*th term of a geometric sequence. **Proving** and using the formula for the sum of a finite geometric series. **Proving** and using the formula for the sum to infinity of a convergent geometric series. **Using** sigma notation to describe series. **Generating** sequences from recurrence relations. **Modelling** real-life situations with sequences and series.	**Knowing** exact values of angles measured in radians. **Finding** an arc length using radians. **Finding** areas of sectors and segments using radians. **Solving** trigonometric equations in radians. **Using** approximate trigonometric values when θ is small. 4(b) **Resolving** forces into components. **Using** the triangle law to find a resultant force. **Solving** problems involving smooth or rough inclined planes. **Understanding** friction and the coefficient of friction. **Using** $F \leq \mu R$. 6(a) **Understanding** the definitions of secant, cosecant and cotangent and their relationship to cosine, sine and tangent. **Understanding** the graphs of secant, cosecant and cotangent and their domain and range. **Simplifying** expressions, proving simple identities and solving equations involving secant, cosecant and cotangent. **Proving** and using $sec^2 x \equiv 1 + tan^2 x$ and $cosec^2 x \equiv 1 + cot^2 x$. **Understanding** and using inverse trigonometric functions and their domain and ranges.	**Converting** parametric equations into Cartesian form by substitution. **Converting** parametric equations into Cartesian form using trigonometric identities. **Understanding** and using parametric equations of curves and sketching parametric curves. **Solving** coordinate geometry problems involving parametric equations. **Using** parametric equations in modelling in a variety of contexts. 6(b) **Understanding** the normal distribution and the characteristics of a normal distribution curve. **Finding** percentage points on a standard normal curve. **Calculating** values on a standard normal curve. **Finding** unknown means and/or standard deviations for a normal distribution. **Approximating** a binomial distribution using a normal distribution. **Selecting** appropriate distributions and solving real-life problems in context. **Carrying** out a hypothesis test for the mean of a normal distribution.	require the resolution of forces. 10(a) **Locating** roots of $f(x) = 0$ by considering changes of sign. **Using** iteration to find an approximation to the root of the equation $f(x) = 0$. **Using** the Newton-Raphson procedure to find approximations to the solutions of equations of the form $f(x) = 0$. **Using** numerical methods to solve problems in context. 8(b) **Working** with vectors for displacement, velocity and acceleration when using the vector equations of motion. **Using** calculus with harder functions of time involving variable acceleration. **Differentiating** and integrating vectors with respect to time.	(R) **Reflecting** on prior learning to identify personal strengths and weaknesses. **Revising** strategically to make the most progress from their current level of understanding.	
Language for Life (Key terms/Vocabulary)	1(a) Contradiction, proof, rational, irrational, common factor, cancel, reduce, reciprocal, common denominator, equating coefficients, substitution, linear factor, degree, improper, divisor. 1(b) Linear relationship, logarithm, constant, product moment correlation coefficient, regression, sample, population, hypothesis, hypotheses, one-tailed, two-tailed, significance level, critical value, critical region. 2(a) Modulus, sketch, argument, function, mapping, input, output, domain, range, one-to-one, one-to-many, many-to-one, piecewise-defined, composite function, inverse, translation, refection, stretch, vector, scale factor. 2(b) Sample space, set, intersection, union, complement, conditional, independent, event, restricted sample space, mutually exclusive. 3(a) Arithmetic, sequence, progression, increasing, decreasing, first term, common difference, last term, series, sum, geometric, common ratio, geometric, limit, alternating, divergent, convergent, sum to infinity, sigma $\sum$, recurrence relation, periodic, period, cycle.	4(a) Term, index, coefficient, finite, infinite, convergent. 3(b) Moment, clockwise, anticlockwise, perpendicular distance, rigid body, resultant, coplanar, equilibrium, uniform, non-uniform, centre of mass, point of tilting. 5(a) Radian, angle unit, pi, CAST diagram, arc length, minor, major, segment, sector, approximation. 4(b) Direction of motion, component, angle, resolve, triangle law, maximum, limiting value, coefficient of friction, normal reaction, gravity. 6(a) Reciprocal, function, secant, cosecant, cotangent, symmetry, period, asymptote, domain, range, identity, inverse, arcsin, arccos, arctan, principal value.	7(a) Compound-angle, identity, simplify, reduce, cancel, coefficient. 5(b) Horizontal, vertical, initial velocity, final velocity, displacement, acceleration, time, time of flight, angle of projection, component, resolve, greatest height, range, trajectory, parabola, constant velocity. 8(a) Parametric, Cartesian, parameter, time, substitute, eliminate, domain, range, point of intersection. 6(b) Continuous random variable, continuous probability distribution, parameter, mean μ, variance σ^2, standard deviation σ, probability, area, symmetrical, asymptote, point of inflection, cumulative distribution, inverse normal distribution, standardise, normal random variable, coefficient, approximate, n large, p close to 0.5, continuity correction, sample size, population, hypothesis, hypotheses, sample mean, critical region, critical value, one-tailed, two-tailed, significance level, observed value.	9(a) Limit, first principles, function, with respect to, chain rule, product rule, quotient rule, implicit, explicit, second derivative, concave, convex, point of inflection, change of sign. 7(b) Static particle, equilibrium, at rest, resultant force, resultant moment, component, weight, tension, pulley, smooth, limiting equilibrium, maximum, coefficient of friction, rigid body, direction of motion, rough plane, connected particles. 10(a) Function, continuous, interval, root, iteration, iterative method, converge, root, staircase diagram, cobweb diagram, diverge, convergent, divergent, Newton-Raphson method. 8(b) Vector equations of motion, position vector, displacement, velocity, acceleration, time, constant, variable, differentiate, initial condition, boundary condition, magnitude, distance.	11(a) Integral, derivative, inverse, identity, reverse chain rule, integration by substitution, integration by parts, limit, partial fraction, bounded, curve, area, trapezium rule, differential equations, separating variables, function, general solution, particular solution, boundary condition, family of solutions. 12(a) Distance, points, unit vector, column vector, scalar, compare coefficients, coplanar vectors. (R) Personal learning checklist, identify, strategic, ownership, reflection, development, formative, growth mind set.	N/A
Extended writing Opportunities	After each end of unit assessment pupils write a reflection based on the assessment.	After an end of unit assessment or PPEs pupils write a reflection based on the assessment/PPEs.	After an end of unit assessment or PPEs pupils write a reflection based on the assessment/PPEs.	After an end of unit assessment or PPEs pupils write a reflection based on the assessment/PPEs.	After an end of unit assessment or PPEs pupils write a reflection based on the assessment/PPEs.	N/A
Maths Across the Curriculum	(a) **Functions** are used in subjects such as computer science and programming. (b) **Regression** and correlation are used in subjects such as geography, psychology and sociology.	(a) **Radians** are used in computer science. (b) **Moments** are used heavily in physics.	(a) **Parametric equations** are used in chemistry and physics. (b) **The normal distribution** is used in subjects such as geography, psychology and sociology.	(a) **Differentiation** is used in chemistry (not to be confused with formation of derivative products from a chemical species) as well as physics. (b) **Kinematics** is an essential component of the physics course.	(a) **Vectors** are used in physics when working with forces.	N/A

Links to careers/ aspirations	(a) **Sequences** and series are used in careers in finance, banking and investments. (b) **Hypothesis testing** is used in careers such as manufacturing to evaluate a manufacturing process.	(a) **Radians** is the main unit of measurement using in game development. (b) **Forces** and motion are used in careers involving game development and game technology development. [Video]	(a) **Trigonometry** is used in oceanography in calculating the height of tides in oceans. The sine and cosine functions are fundamental to the theory of periodic functions, those that describe the sound and light waves. (b) **The normal distribution** is used in careers that involve quality control, cost management and business operations.	(a) **Calculus** is used in careers such as aerospace engineering and software development. (b) **Kinematics** is mechanical, automobile and electrical engineering.	(a) **Integration** is used in careers involving civil engineering, computer animation and game development and economics.	N/A
Cultural Capital	(a) **Series** can be used to make calculations over time such as calculating the interest made over n years if x amount of money was invested into a savings account. (b) **Venn diagrams** are often used in decision making where there is a need to see a visual comparison of the advantages, or disadvantages or multiple options.	(a) **Radians** can be used to simplify the method of finding an arc length, this teaches pupils to consider different methods and approaches to increase efficiency instead of using the most common method by default. (b) **Pupils** solve problems using Newton's laws of motion which broadens their understanding of the physical world around them.	(a) **Pupils** learn how trigonometry can be used to model many real-life situations from the temperature of an oven or the electric field strength of a microwave to the price of stock within a training window. (b) **The normal distribution** teaches pupils to pay more attention to values grouped around a central value rather than extreme values. This can be adopted by pupils in every-day life as they can identify areas of required development more efficiently.	(a) **Rates of change** are crucial in forecasting. Being able to calculate the rate of change from real life graphs allows pupils to better understand the references to the rate of infection (r) in the global pandemic and the subsequent decisions made because of its value. (b) **Mathematical modelling** teaches pupils how to simplify a problem to find a solution which can be used as a method for problem resolution in everyday life.	(a) **Position vectors** are a measurement from the origin, this concept can be adopted by pupils to measure improvement or development by comparing their current progress with their starting point.	N/A
Practical Application of Skills	(a) **Pupils** can use their understanding of composite functions to calculate the discount in pounds of an item on sale in a country with a different currency. (b) **Pupils** can use their understanding of Venn diagrams to help in decision making, such as which university should be a first choice.	(a) **Pupils** can use the binomial coefficient to quickly identify how many outcomes will lead to them winning in a game. (b) **Moments** can be used by pupils to loosen tight nuts when performing DIY as they will be able to identify the need for a longer tool to increase the turning effect.	(a) **Pupils** can use a trigonometric model for the price of a stock within a trading window to help inform a decision to buy stock. (b) **Pupils** can use a normal distribution to test whether they are improving on their times running 5km whilst exercising.	(a) **Pupils** can use differentiation to inform decision making regarding investments by calculating the rate of change of a stock's worth. (b) **Pupils** could use a mathematical model to calculate the tension in a wire or rope that they have tied between two trees to ensure the wire/rope is strong enough to safely hold their weight.	(a) **Pupils** can use integration to find the volume of an irregular shaped swimming pool to work out how long is needed to fill it with water. (R) **Pupils** learn how to organise their time and prioritise tasks due to urgency and importance through revision.	N/A