Maths Department - Year 12: Pure (a) & Statistics and Mechanics (b)

Shirley High Curriculum Map

The Year 12 curriculum provides a framework within which students continue to study Mathematics beyond GCSE level. Students will see how mathematical ideas are interconnected and how mathematics can be applied to model situations mathematically using algebra, calculus and other representations. Through the study of Pure Mathematics, Statistics and Mechanics students will learn how to present robust mathematical argument, language and proof and create mathematical models in order to problem solve.

	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 expressions 1(b) Data collection 2(a) Quadratics 2(b) Measures of location and spread 3(a) Equations and inequalities	4(a) Graphs and transformations 3(b) Representations of data 5(a) Straight line graphs 4(b) Correlation 6(a) Circles	7(a) Algebraic methods 5(b) Probability 8(a) The binomial expansion 6(b) Statistical distributions	9(a) Trigonometric ratios 7(b) Hypothesis testing 10(a) Trigonometric identities and equations 8(b) Modelling in mechanics	11(a) Vectors 9(b) Constant acceleration 12(a) Differentiation 10(b) Forces and motion	13(a) Integration 11(b) Variable acceleration 14(a) Exponentials and logarithms (R) Revision (EoY) End of Year Assessment
Why Now?	1(a) This unit allows pupils to transition from GCSE to A-level. 1(b) Pupils deepen their understanding of how data is collected from their understanding at GCSE level. 2(a) Pupils deepen their understanding of quadratic equations and functions from their understanding at GCSE level. 2(b) Having a better understanding of how data is collected pupils now learn how to interpret data in new ways such as calculating variance and standard deviation. 3(a) Now with an improved understanding of functions pupils can improve their understanding of solving equations and inequalities algebraically and graphically.	4(a) Pupils build on their understanding of sketching and transforming graphs from GCSE level. 3(b) Pupils now revisit how to represent data. 5(a) Continuing the theme of graphs pupils build on their understanding of straight-line graphs from GCSE level. 4(b) Continuing the theme of representing and interpreting data, pupils revisit scatter graphs but learn about regression as opposed to a line of best fit. This unit is will also link well with the unit on straight-line graphs learnt in pure. 6(a) Again, continuing the theme of graphs pupils build on their understanding of coordinate geometry in the (x, y) plane from GCSE level.	7(a) Pupils learn how to factorise cubic expressions and different methods of algebraic proof. 5(b) Pupils revisit how to calculate probabilities using Venn diagrams and tree diagrams. 8(a) Leading on from learning more about factorising, pupils now learn how to expand any number of brackets using the binomial expansion. 6(b) Continuing the theme of probability, pupils learn about probability distributions. This unit will also link well with the unit on binomial expansion learnt in pure.	9(a) Pupils revisit trigonometry. 7(b) Pupils learn how to perform one-tailed and two-tailed hypothesis testing for the proportion of the binomial distribution. 10(a) Continuing the theme of trigonometry pupils learn how to solve more complicated trigonometric equations through using trigonometric identities. 8(b) Pupils learn how to construct a model in relation to mechanics.	11(a) Pupils build on their understanding of vectors from GCSE level as they learn about using trigonometry with vectors. This unit links with the unit on mathematical modelling in mechanics as pupils now know the difference between scalar and vector quantities. 9(b) This unit introduces constant acceleration formulae and how to use them to solve problems in mechanics. 12(a) This unit introduces differentiation to pupils. 10(b) Now equipped with the ability to use constant acceleration formulae pupils are introduced to force diagrams and Newton's laws.	13(a) Having learnt about differentiation pupils learn about its inverse operation: integration. 11(b) Having learnt about constant acceleration (and differentiation) pupils now learn about variable acceleration. 14(a) Pupils are introduced to exponentials and logarithms and can understand the relationship between them having learnt differentiation and 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. (EoY) This summarises pupils' current progress whilst providing formative data on what topics pupils must continue to develop in the following academic year. The data will also be used for teachers to reflect on their own practice in regard to the delivery of content.
Fundamental Concepts	(a) Algebra and functions (b) Statistical sampling Data presentation and interpretation	(a) Algebra and functions Coordinate geometry in the (x, y) plane (b) Data presentation and interpretation	(a) Algebra and functions Proof Sequence and series (b) Probability Statistical distributions	(a) Trigonometry (b) Statistical hypothesis testing Quantities and units in mechanics	(a) Vectors Differentiation (b) Kinematics Forces and Newton's laws	(a) Proof Algebra and functions Coordinate geometry in the (x,y) plane Sequences and series Trigonometry Exponentials and logarithms Differentiation Integration Numerical Methods Vectors (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

Students will learn about …	1(a) **Multiplying** and dividing integer powers. **Expanding** a single term over brackets and collecting like terms. **Expanding** the product of two or three expressions. **Factorising** linear, quadratic and simple cubic expressions. **Knowing** and using the laws of indices. **Simplifying** and using the rules of surds. **Rationalising** denominators. 1(b) **Understanding** 'population', 'sample' and 'census', and commenting on the advantages and disadvantages of each. **Understanding** the advantages and disadvantages of simple random sampling, systematic sampling, stratified sampling, quota sampling and opportunity sampling. **Defining** qualitative, quantitative, discrete and continuous data, and understanding grouped data. **Understanding** the large data set and how to collect data from it, identify types of data and calculate simple statistics. 2(a) **Solving** quadratic equations using factorisation, the quadratic formula and completing the square. **Reading** and using $f(x)$ notation when working with functions. **Sketching** the graph and finding the turning point of a quadratic function. **Finding** and interpreting the discriminant of a quadratic expression. **Using** and applying models that involve quadratic functions. 2(b) **Calculating** measures of central tendency such as the mean, median and mode. **Calculating** measures of location such as percentiles and deciles. **Calculating** measures of spread such as range, interquartile range and interpercentile range. **Calculating** variance and standard deviation. **Understanding** and using coding. 3(a) **Solving** linear simultaneous equations using elimination or substitution. **Solving** simultaneous equations: one linear and one quadratic. **Interpreting** algebraic solutions of equations graphically. **Solving** linear inequalities. **Solving** quadratic inequalities. **Interpreting** inequalities graphically. **Representing** linear and quadratic inequalities graphically.	4(a) **Sketching** cubic graphs. **Sketching** quartic graphs. **Sketching** reciprocal graphs of the form $y = \frac{a}{x}$ and $y = \frac{a}{x^2}$. **Using** intersection points of graphs to solve equations. **Translating** graphs. **Stretching** graphs. **Transforming** graphs of unfamiliar functions. 3(b) **Identifying** outliers in data sets. **Drawing** and interpreting box plots. **Drawing** and interpreting cumulative frequency diagrams. **Drawing** and interpreting histograms. **Comparing** two data sets. 5(a) **Calculating** the gradient of a line joining a pair of points. **Understanding** the link between the equation of a line, and its gradient and intercept. **Finding** the equation of a line given the gradient and one point on the line. **Finding** the equation of a line given two points on the line. **Finding** the point of intersection for a pair of straight lines. **Knowing** and using the rules for parallel and perpendicular gradients. **Solving** length and area problems on coordinate grids. **Using** straight line graphs to construct mathematical models. 4(b) **Drawing** and interpreting scatter diagrams for bivariate data. **Interpreting** correlation and understanding that it does not imply causation. **Interpreting** the coefficients of a regression line equation for bivariate data. **Understanding** when you can use a regression line to make predictions. 6(a) **Finding** the midpoint of a line segment. **Finding** the equation of the perpendicular bisector to a line segment. **Knowing** how to find the equation of a circle. **Solving** geometric problems involving straight lines and circles. **Using** circle properties to solve problems on coordinate grids. **Finding** the angle in a semicircle and solving other problems involving circles and triangles.	7(a) **Cancelling** factors in algebraic fractions. **Dividing** a polynomial by a linear expression. **Using** the factor theorem to factorise a cubic expression. **Constructing** mathematical proofs using algebra. **Using** proof by exhaustion and disproof by counterexample. 5(b) **Calculating** probabilities for single events. **Drawing** and interpreting Venn diagrams. **Understanding** mutually exclusive and independent events and determining whether two events are independent. **Using** and understanding tree diagrams. 8(a) **Using** Pascal's triangle to identify binomial coefficients and use them to expand simple binomial expressions. **Using** combinations and factorial notation. **Using** the binomial expansion to expand brackets. **Finding** individual coefficients in a binomial expansion. **Making** approximations using the binomial expansion. 6(b) **Understanding** and using simple discrete probability distributions including the discrete uniform distribution. **Understanding** the binomial distribution as a model and commenting on appropriateness. **Calculating** individual probabilities for the binomial distribution. **Calculating** cumulative probabilities for the binomial distribution.	9(a) **Using** the cosine rule to find a missing side or angle. **Using** the sine rule to find a missing side or angle. **Finding** the area of a triangle using an appropriate formula. **Solving** problems involving triangles. **Sketching** the graphs of the sine, cosine and tangent functions. **Sketching** simple transformations of trigonometric graphs. 7(b) **Understanding** the language and concept of hypothesis testing. **Understanding** that a sample is used to make an inference about a population. **Finding** critical values of a binomial distribution using tables. **Carrying** out a one-tailed test for the proportion of the binomial distribution and interpreting the results. **Carrying** out a two-tailed test for the proportion of the binomial distribution and interpreting the results. 10(a) **Calculating** the sine, cosine and tangent of angle. **Knowing** the exact trigonometric ratios for $30°$, $40°$ and $60°$. **Knowing** and using the relationships $\tan tan\,\theta \equiv \frac{\sin sin\,\theta}{\cos cos\,\theta}$ and $sin^2\theta + cos^2\theta \equiv 1$. **Solving** simple trigonometric equations of the forms $\sin sin\,\theta = k$, $\cos cos\,\theta = k$ and $\tan tan\,\theta = k$. **Solving** more complicated trigonometric equations of the forms $\sin sin\,n\theta = k$ and $\sin sin\,(\theta \pm \alpha) = k$ and equivalent equations involving cos and tan. **Solving** trigonometric equations that produce quadratics. 8(b) **Understanding** how the concept of a mathematical model applies to mechanics. **Understanding** and being able to apply some of the common assumptions used in mechanical models. **Knowing** International System of Units (SI units) for quantities and derived quantities used in mechanics. **Knowing** the difference between scalar and vector quantities.	11(a) **Using** vectors in two dimensions. **Using** column vectors and carrying out arithmetic operations on vectors. **Calculating** the magnitude and direction of a vector. **Understanding** and using position vectors. **Using** vectors to solve geometric problems. **Understanding** vector magnitude and using vectors in speed and distance calculations. **Using** vectors to solve problems in context. 9(b) **Understanding** and interpreting displacement-time graphs. **Understanding** and interpreting velocity-time graphs. **Deriving** the constant acceleration formulae and using them to solve problems. **Using** the constant acceleration formulae to solve problems involving vertical motion under gravity. 12(a) **Finding** the derivative, $f'(x)$ or $\frac{dy}{dx}$, of a simple function. **Using** the derivative to solve problems involving gradients, tangents and normals. **Identifying** increasing and decreasing functions. **Finding** the second order derivative, $f''(x)$ or $\frac{d^2y}{dx^2}$, of a simple function. **Finding** stationary points of functions and determining their nature. **Sketching** the gradient function of a given function. **Modelling** real-life situations with differentiation. 10(b) **Drawing** force diagrams and calculating resultant forces. **Understanding** and using Newton's second law. **Applying** Newton's second law to vector forces acceleration. **Understanding** and using Newton's third law. **Solving** problems involving connected particles.	13(a) **Finding** y given $\frac{dy}{dx}$ for x^n. **Integrating** polynomials. **Finding** $f(x)$, given $f'(x)$ and a point on the curve. **Evaluating** a definite integral. **Finding** the area bounded by a curve and the x-axis. **Finding** areas bounded by curves and straight lines. 11(b) **Understanding** that displacement, velocity and acceleration may be given as functions of time. **Using** differentiation to solve kinematics problems. **Using** calculus to solve problems involving maxima and minima. **Using** integration to solve kinematics problems. **Using** calculus to derive constant acceleration formulae. 14(a) **Sketching** graphs of the form $y = a^x$, $y = e^x$, and transformations of these graphs. **Differentiating** e^{kx} and understanding why this result is important. **Using** and interpreting models that use exponential functions. **Recognising** the relationship between exponents and logarithms. **Recalling** and applying the laws of logarithms. **Solving** equations of the form $a^x = b$. **Describing** and using the natural logarithm function. **Using** logarithms to estimate the values of constants in non-linear models. (R) **Reflecting** on prior learning in order to identify personal strengths and weaknesses. **Revising** strategically in order to make the most progress from their current level of understanding. (EoY) **What** they have learnt, mastered and are yet to fully understand from the content covered throughout the year. **How** they can improve on their current attainment by identifying topics that lost them marks under assessment.
Language for Life (Key terms/Vocabulary)	1(a) Base, index, power, exponent, simplify, indices, expand, product, gather like terms, factor, factorise, coefficient, constant, variable, unknown, difference of two squares, rational, irrational, reciprocal, surd, rationalise, denominator, numerator, rearrange. 1(b) Population, census, sample, sampling unit, sampling frame, representative, bias, random sample, lottery sample, systematic sample, stratified sample, stratum, strata, sample size, quota sampling, opportunity (convenience) sampling, variables, data, quantitative, qualitative, continuous, discrete, class, class boundaries, maximum, minimum, class width, trace, knot (kn), oktas, decametres (Dm), hectopascals (hPa), hemisphere. 2(a) Quadratic, expression, equation, coefficient, variable,	4(a) Function, cubic, root, shape of graph, point of intersection, quartic, non-zero, coefficient, reciprocal, asymptote, translation, vector, stretch, scale factor. 3(b) Outlier, lower quartile, upper quartile, anomaly, cleaning data, box plot, cumulative frequency, interquartile range, interpercentile range, histogram, frequency density, class width, frequency polygon, comparing data, measure of location, measure of spread. 5(a) Gradient m, y-intercept c, linear, parallel, perpendicular, direct proportion, linear model, assumption. 4(b) Bivariate, variable, explanatory variable (independent), response variable (dependent), correlation, positive, negative, weak, strong, causal relationship, line of best fit,	7(a) Factorise, common factor, cancel, simplify, reduce, polynomial, quotient, factor theorem, proof, conjecture, theorem, statement of proof, deduction, demonstration, identity, expression, exhaustion, disprove, counter-example. 5(b) Experiment, outcome, event, sample space, Venn diagram, intersection, union, complement, mutually exclusive, independent. 8(a) Pascal's triangle, coefficient, expansion, factorial, n choose r nC_r, binomial expansion, set of natural numbers N, binomial estimation. 6(b) Random variable, sample space, discrete, probability distribution, probability mass function, discrete uniform distribution, binomial distribution, number of trials n, index, probability of success	9(a) Cosine rule, corresponding, Sine rule, periodic function, interval, symmetry, maximum, minimum, asymptote, undefined. 7(b) Hypothesis, hypotheses, test statistic, null hypothesis, alternative hypothesis, population parameter, one-tailed test, two-tailed test, significance level, critical value, critical region, acceptance region, actual significance level, observed value, expected outcome. 10(a) Unit circle, quadrant, anticlockwise, positive x-axis, clockwise, trigonometric ratio, CAST diagram, identity, principal value, inverse, arccos cos^{-1}, arcsin sin^{-1}, arctan tan^{-1}. 8(b) Model, particle, rod, lamina, uniform body, centre of mass, light object, inextensible string, smooth	11(a) Vector, magnitude, direction, directed line segment, resultant, vector sum, triangle law, displacement, column vector, unit vector, magnitude-direction form, position vector. 9(b) Displacement s, time, velocity, gradient, stationary, acceleration, constant, distance, area, initial velocity u, final velocity v, acceleration a, time t, decelerating, gravity, time of flight, speed of projection. 12(a) Curve, tangent, gradient function, derivative, coefficient, index, normal, perpendicular, increasing, decreasing, interval, derivative, second derivative, rate of change of gradient, stationary point, zero gradient, local maximum, local minimum, point of inflection, maxima, minima, asymptote.	13(a) Integration, constant of integration, coefficient, index, indefinite, definite, limit, value, area, curve. 11(b) Acceleration, gradient, velocity-time graph, increasing, decreasing, function of time, displacement, differentiation, maxima, minima, velocity. 14(a) Exponential, function, index, power, exponent, initial value, logarithm, natural logarithm. (R) Personal learning checklist, identify, strategic, ownership, reflection, development, formative, growth mind set. (EoY) Summative, current working grade, formative reflection, development, growth mind set.

	constant, factorise, solution, root, repeated root, completing the square, function $f(x)$, domain, range, member $\in$, set of real numbers R, parabola, turning point, minimum, maximum, symmetry, discriminant, distinct real roots, model. 2(b) Measure of location, quartile, percentile, lower quartile Q_1, upper quartile Q_3, maximum, minimum, measure of central tendency, mean, median Q_2, mode, modal class, bimodal, quantitative, qualitative, discrete, continuous, interpolation, extrapolation, measure of spread, range, interquartile range (IQR), interpercentile range, variance σ^2, standard deviation σ, summary statistic, coding, original data, coded data. 3(a) Simultaneous, equation, variable, unknown, eliminate, substitute, isolate, solve, point of intersection, discriminant, inequality, set, greater than, less than, sketch, satisfy, region, inclusive, exclusive.	least squares regression line, coefficient, gradient, interpolation, extrapolation. 6(a) Midpoint, perpendicular, bisect, line segment, circumcentre, centre, radius, complete the square, point of intersection, tangent, chord, circumcircle.	p, parameter, cumulative probability function, cumulative distribution.	surface, smooth surface, rough surface, wire, smooth and light pulley, bead, peg, air resistance, gravity, International System of Units (SI), mass, length, displacement, time, derived unit, compound unit, speed, velocity, acceleration, weight, force, force diagram, normal reaction, friction, tension, thrust, compression, buoyancy, air resistance, vector, magnitude, direction, scalar.	10(b) Force diagram, Newton's second law $F = ma$, equation of motion, object, rest, constant velocity, resultant force, column vector, position vector, gravity, connected particle.	
Extended writing Opportunities	After each end of unit assessment pupils write a reflection based on the assessment.	After each end of unit assessment pupils write a reflection based on the assessment.	After each end of unit assessment pupils write a reflection based on the assessment.	After each end of unit assessment pupils write a reflection based on the assessment.	After each end of unit assessment pupils write a reflection based on the assessment.	After the end of year assessment pupils write a reflection based on the assessment.
Maths Across the Curriculum	(a) **Functions** are used in subjects such as computer science and programming. (b) **Pupils** learn about sampling methods that are used in other subjects such as Psychology. **Pupils** learn about the large data set which has links to geography.	(a) **Linear modelling** is used in subjects such as geography. (b) **Data analysis** is used in several subject such as biology, psychology, sociology and geography.	(a) **Disproving** through counterexample is also used in philosophy. **Pascal's triangle** and the binomial theorem are also used in chemistry. (b) **Binomial distributions** are used in research methodology in subjects such as biology.	(a) **Trigonometry** is used heavily in physics when calculating components of forces. (b) **Hypothesis testing** is used in subjects such as biology, sociology and psychology.	(a) **Vectors** are used in physics when working with forces. (b) **Constant acceleration formulae** is used extensively in physics.	(a) **Logarithms** are used in subjects such as biology, chemistry and physics. (b) **Pupils** learn the relationship between displacement, velocity and acceleration as a function of time which is also used in physics.
Links to careers/ aspirations	(a) **Pupils** learn the fundamental concepts of algebra that are used in careers involving astrology, architecture, computer engineering, market research analysis, finance and economy. (b) **Sampling** populations is a key statistical skill used across many fields of work such as pharmaceuticals, community management and manufacturing.	(a) **Linear modelling** is used in careers in marketing analysis, business analysis, data science and statistics. (b) **Data analysis** is used in roles such as data scientist, data analyst, business analyst, product manager and digital marketer.	(a) **Pascal's triangle** is used in careers in architecture, graphic design and finance. (b) **Probability distributions** are used in careers involving research analysis across a range of fields such as crime.	(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) **Hypothesis testing** is used in careers such as manufacturing to evaluate a manufacturing process.	(a) **Calculus** is used in careers such as aerospace engineering and software development. (b) **Pupils** learn about Newton's laws of motions that are used by engineers, astronauts and physicists.	(a) **Logarithms** are used in careers involving medicine, archaeology and actuarial science. (b) **Kinematics** is mechanical, automobile and electrical engineering.
Cultural Capital	(a) **Pupils** learn about quadratic functions that are used to model projectile motion. This provides students with a better understanding of how, in wars, armies would know how to strategically position themselves in order to attack the opposition successfully from as far away as possible. (b) **Pupils** learn about different methods of sampling and the occurrence of bias. This empowers pupils to question the validity of research claims presented across social media platforms.	(a) **Understanding graphs** can aid pupils in understanding information relayed to them from retailers or price comparison sites. Allowing them to make better informed decisions. (b) **Pupils** learn about the advantages and disadvantages of different measures of central tendency which allows pupils to identify improper use of such measures in statistics posted on social media.	(a) **Counter-examples** will enable pupils to improve their ability to debate. (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) **Pupils** are encouraged to choose the most efficient method when solving triangle problems, which helps pupils to develop their efficiency and time management skills. (b) **Mathematical modelling** teaches pupils how to simplify a problem in order to find a solution which can be used as a method for problem resolution in everyday life.	(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) **Pupils** learn about Newton's laws of motion which broadens their understanding of the physical world around them.	(a) **Pupils** learn about exponential functions and their graphs, which provides pupils with a better understanding of why exponential growth is so significant, whether it be for a company's net worth or an infection rate in a global pandemic. (b) **Pupils** learn about the difference between velocity and acceleration which are commonly confused as being the same.
Practical Application of Skills	(a) **Pupils** can use their understanding of solving simultaneous equations to identify the price of two items if two friends have both purchased varying amounts of the items but made contactless payment and did not opt for a receipt. (b) **Pupils** can decipher whether a given statistic witnessed in advertising is misleading. **Pupils** can also offer their understanding of reducing bias when performing data collection when applying for part time employment with companies looking to carry out a survey.	(a) **Pupils** can compare two separate price plans for a product, such as a mobile phone contracts and the cost for making calls by plotting the two plans as graphs. (b) **Understanding** that correlation does not imply causation gives pupils a critical eye when deciphering if claims of relationships between two variables that are made in social media are credible.	(a) **Pupils** can disregard claims made in advertising and social media if they can provide a counterexample. (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 area sine rule to find the area of triangles when they do not know the height of a triangle. For example, if a pupil were to paint a mural using a collage of equilateral triangles, they could find the total area of the triangles, and thus the amount of paint required, without taking any measurements. (b) **Planning** journeys can be overwhelming due to the various factors that must be considered; however, a pupil could make the modelling assumption that all forms of transport are not delayed in order to find the minimum journey time required. Once a minimum journey time has been calculated adding time to allow for delays is more manageable.	(a) **Pupils** can use differentiation to inform decision making regarding investments by calculating the rate of change of a stock's worth. (b) **Pupils** can save time creating displays involving two items balancing against one another by considering Newton's second and third laws of motion which will lead them to consider the weight of the items before attempting to balance.	(a) **Pupils** learn about the number e which can help them to calculate the maximum growth over a given time. This enables pupils to predict the maximum growth of stock shares of a company for a specific period. (b) **Pupils** can use constant acceleration formulae to calculate the acceleration of their car. (R) **Pupils** learn how to organise their time and prioritise tasks due to urgency and importance through revision.