University of Birmingham School Curriculum Outline: MATHEMATICS

Term ➔ Year ↓	Term 1a	Term 1b	Term 2a	Term 2b	Term 3a	Term 3b
Y12 Teacher 1	**Pure** **GCSE Recap** **Chapter 1 – Algebraic Expressions** Recap and build upon techniques learnt from GCSE on ways to manipulate algebraic expressions. This includes expanding and factorising quadratics, index laws and surds. **Graphs and Coordinate Geometry** **Chapter 5 – Straight Line Graphs** Formalise different ideas explored in GCSE on equations of straight lines. We will then delve deeper into coordinate geometry and the use of linear functions in modelling problems. **Chapter 6 – Circles** Further develop our knowledge of circles, now including when the centre is not the origin. This is then combined with knowledge from previous chapters to solve coordinate geometry problems. **Calculus** **Chapter 12 – Differentiation** Introduce the topic of calculus, focusing specifically on differentiating polynomials and other powers of x. We will explore the uses of different order derivatives and their use in real life modelling, particularly in the process of 'optimisation'. **Chapter 13 – Integration** In this chapter, we will explore the partial inverse of differentiation; integration. We will learn how to integrate polynomials and other powers of x. We will also look at how to use integration to calculate areas bounded by curves.		**Exponentials and Logarithms** **Chapter 14 – Exponentials and Logarithms** Explore the meaning and use of exponents and logarithms. We will interpret models that use exponential functions, learn and apply the laws of logarithms, and solve equations in the form ax=b. **Statistics** **Statistical Sampling** **Chapter 1 - Data Collection** Consider the advantages and disadvantages of different forms of sampling. We shall also consider different types of real- world statistical data. **Data Representation and Interpretation** **Chapter 2 - Measures of location and spread** Build upon GCSE work on analysing data. Calculate measures of central tendency, such as the mean, median and mode, and other measures of location, such as quartiles and deciles. Students will extend their knowledge of measures of spread to include inter-percentile range, variance and standard deviation. **Chapter 3 - Representations of data** Extend knowledge gained at GCSE about boxplots, cumulative frequency graphs and histograms. Use knowledge gained in this unit to analyse and compare two data sets and make conclusions based on inferences. **Chapter 4 - Correlation** Consider the correlation of bivariate data and explore the use of linear regression models. **Probability** **Chapter 5 - Probability** Consider different methods for calculating probability, such as sample space, Venn and tree diagrams. Also determine whether two events are independent or mutually exclusive.	**Statistical Distributions** **Chapter 6 - Statistical distributions** Introduce discrete probability distributions and become familiar with different representations for them. Also learn how to calculate probabilities of single values from a binomial distribution using a calculator. We will then extend our understanding of binomial distributions and learn to calculate cumulative probabilities. **Statistical Hypothesis Testing** **Chapter 7 - Hypothesis testing** Learn to formulate a hypothesis about an event occurring within a population, using technical language, based upon assumptions made about that population. We will then use our knowledge of binomial distribution to test our hypotheses against a sample of the population by considering multiple methods such as finding critical regions and calculating the probability of a test statistic. We will then use these findings to draw conclusions in real-world contexts. **Slack for revision and end of year exams** **Further Algebra** **Chapter 1 (A2) – Algebraic methods** Recap arithmetic involving algebraic fractions and look at splitting algebraic fractions into partial fractions. We also look at a new method of proving that statements are true; proof by contradiction **Chapter 2 (A2) – Functions** Build upon prior knowledge of function notation, and inverse and composite functions from GCSE. We extend this to modulus functions and explore the graphs of these functions.

Y12 Teacher 2	**CCSE Recap** **Chapter 2 – Quadratics** Recap solving quadratic equations from GSCE. We will use this knowledge to learn about sketching a quadratic function and the importance of the discriminant. **Chapter 3 – Equations and Inequalities** Recap knowledge from GCSE on solving both linear and quadratic equations and inequalities, as well as simultaneous equations. **Graphs and Coordinate Geometry** **Chapter 4 – Graphs and Transformation** Expand upon knowledge of graphs from GSCE, exploring the graphs of polynomials of different degrees. Afterwards, we will look at the result of graphs after a transformation, now including stretching parallel to each axis. **Further Algebra** **Chapter 7 – Algebraic Methods** Practice new methods of manipulating algebraic expressions, including using the factor theorem with cubic expressions. We will use these methods to help construct mathematical proofs. **Chapter 8 – Binomial Expansion** Explore the different components of the Binominal Expansion, such as Pascal's triangle and factorial notation. We will use this knowledge to make approximations of complicated functions.	**AS Trigonometry** **Chapter 9 – Trigonometric ratios** Recap the trigonometric formulas used in GCSE and how we can apply them when problem solving. We will then explore the different trigonometric functions, sketching their graphs and applying transformations. **Chapter 10 –Trigonometric Identities and Equations** Develop our understanding of different trigonometric relationships, before moving onto using these to solve various trigonometric equations, including quadratics. **Vectors** **Pure Chapter 11 – Vectors** Build upon work studied at GCSE on vectors. Calculate the magnitude and direction of a vector and use this to solve problems. Use vectors to solve geometric problems, producing universal results and apply these results to real-world contexts. **Quantities and units in Mechanics** **Chapter 8 - Modelling in mechanics** Learn about assumptions used in Mathematical modelling. Apply knowledge of vectors from GCSE to real-life scenarios. **Kinematics 1** **Chapter 9 - Constant acceleration** Build upon GCSE knowledge of speed, distance and time to interpret velocity and displacement-time graphs and solve problems relating to both. Also learn how to derive formulae based on constant acceleration and apply these in different contexts including both horizontal and vertical motion. Also solve multi-stage problems, including those where objects are falling freely due to gravity.	**Forces and Newton's Laws** **Chapter 10 - Forces and motion** Draw complete force diagrams to consider all forces acting on an object. Use knowledge of vectors to apply them in the context of forces and use Newton's three laws of motions to calculate an object's acceleration and solve problems using these results. Apply knowledge of Newton's three laws to solve problems with connected particles, such as pulleys. **Kinematics 2** **Chapter 11 - Variable acceleration** Draw upon knowledge from various topics of the year 1 pure mathematics course and apply them to real-world contexts. We will use differentiation and integration to solve kinematic problems and we will derive constant acceleration formulae. **Slack for revision and end of year exams** **Sequences and Series (A2)** **Chapter 3 - Sequences and Series** Build upon GCSE knowledge of linear and geometric sequences, and learn to calculate the sum of a series. We will then progress onto application of arithmetic and geometric series to real- life problems. **Further Algebra (A2)** **Chapter 4 - Binomial Expansion** Build upon binomial expansion from AS. Explore non-integer and negative indices and link it to series and partial fractions.
Y13 Teacher 1	**Pure** **A2 Calculus** **Chapter 9 - Differentiation** Explore differentiating a wider range of functions (trigonometric, logarithms, exponentials etc.) as well as products, quotients and composites of these functions. Also look at differentiating functions written as parametric equations. We also begin to explore rates of changes and how we can form differential equations. **Chapter 11 - Integration** Explore integrating a wider range of functions (trigonometric, logarithms, exponentials etc.). Look at different integration techniques such as integration by parts and integration by substitution. We also apply these different techniques to solving first order **Chapter 8 - Parametric Equations** Explore a new class of equations where we express 2 variables in terms of a third variable called a 'parameter'.	**Numerical Methods** **Pure Chapter 10 - Numerical methods** We shall consider different methods for finding or approximating the roots of functions. We will learn how to use change of sign, iteration and the Newton-Raphson procedure **Statistics** **Regression and Correlation** **Chapter 1 - Regression, correlation and hypothesis testing** Bivariate (paired) data can show a strong relationship that is not linear. We shall use logarithms to examine trends in non-linear data. We shall also consider correlation in bivariate data and carry out hypothesis tests for possible correlation. **Conditional Probability** **Chapter 2 Conditional probability** Extend on work studied in AS probability. Use set notation and explore conditional probability using multiple representations, including Venn diagrams and two way tables. Also use probability formulae and solve problems using conditional probability. **The Normal Distribution** **Chapter 3 - The normal distribution** Learn the characteristics of the normal distribution curve and use it to calculate values and probabilities using a calculator. Building upon work done in Year 12, find means and standard deviations for normally distributed, continuous random variables and also use this distribution as an approximation to the binomial distribution. Finally, we shall apply everything learned last year regarding hypothesis testing to continuous random variables and the normal distribution.	**Revision and Exams**

Y13 Teacher 2	**Pure** **A2 Trigonometry** **Chapter 5 - Radians** Introduce a new measure for angles and explore how it affects calculations involving circles. This is an important bridging topic in preparation for A2 calculus. **Chapter 6 - Trigonometric Functions** Here we explore reciprocal and inverse trigonometric functions and form new identities involving these functions. We then use these to solve a wider range of trigonometric equations. **Chapter 7 - Trigonometry and Modelling** Introduce compound angle formulae and harmonic form and use these to model real-life situations. These will also be used in A2 Mechanics. **Vectors 2** **Pure Chapter 12 - Vectors (3D)** This topic extends the work on vectors in two dimensions that was done at GCSE and in Year 12. We will begin by understanding Cartesian coordinates in three dimensions (x, y, z). We will then learn to use vectors to describe positions in relation to the three dimensions before using these vectors to solve geometric and mechanical problems. **Mechanics** **Forces at any angle** **Chapter 5 - Forces and friction** Consider the role friction has in kinematic systems and be able to understand and calculate the magnitude of friction in each situation. Work with forces on inclined planes and explore how the change of the angle of incline of the slope affects the forces acting on an object. We will use knowledge gained in year 1 to solve more complex problems involving constant acceleration.	**Moments** **Chapter 4 - Moments** Calculate the turning effect of a force applied to a rigid body, consider all turning forces acting on a body to calculate the overall force and examine what this means in a real-world context. Students will calculate moments on rods, both uniform and non-uniform, and solve problems with objects at the point of tilting. **Applications of Kinematics** **Chapter 6 - Projectiles** Analyse the motion of a projectile by considering its horizontal and vertical motion separately. Learn that the horizontal motion can be modelled as having constant velocity, but that they will have to include acceleration due to gravity in the vertical motion. Both of these will draw heavily upon the 'SUVAT' work done in Year 12. We will also derive the equation of the path of a projectile and formulae for time of flight, range and greatest height. **Applications of Forces** **Chapter 7 – Application of forces (Statics)** When the forces acting upon a body are balanced, it is static or in equilibrium. We will use this to find unknown forces involving pulleys, strings, rough surfaces and inclined planes. **(Dynamics)** As more force is applied to an object, forces become unbalanced and we reach a dynamic situation where the object starts moving. We will learn that, in this situation, we not only need to consider unknown forces involving pulleys, strings, rough surfaces and inclined planes, but also Newton's laws of motion. **Further Kinematics** **Chapter 8 - Further kinematics** Combine previous work on vectors with that on motion to produce vector equations for displacement, velocity and acceleration. We will also use calculus from Pure studies and learn to differentiate and integrate equations of motion with respect to time. This will enable us to now consider variable acceleration in addition to the constant acceleration of 'SUVAT'.	**Revision and Exams**