CURRICULUM INTENT

MATHS

At Trinity our aim is to help students understand the universal language of Mathematics so they can feel empowered to make informed choices in their futures. Our teachers believe numerical fluency will not only help students to succeed in gaining fantastic Mathematics qualification but will help them to achieve in all their academic studies as well as in their workplace. Students are challenged to think in both real life and theoretical scenarios, to analyse and to create numerical arguments with both rigor and efficiency. When students leave Trinity, we want them to be able to use their knowledge to solve problems as well as navigate the world of statistics and beyond.

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CURRICULUM INTENT OVERVIEW

HEAD
KNOWLEDGE-RICH

Students will:

- learn Maths through big themes in the curriculum. At GCSE, these themes are Number, Algebra, Ratio & Proportion, Geometry and Statistics & Probability. At A level the big themes are; Algebra, Calculus, Geometry & Trigonometry, Statistics & Probability and Mechanics.
- learn about number properties, arithmetic operations and the relationship between fractions, decimals, percentages and ratio
- learn how to use and manipulate algebraic notation and how to use algebra to problem solve through writing and solving equations and inequalities moving to making generalisations and working with proofs at A level.
- learn about proportional relationships, in particular their application to real life problems.
- learn the properties of shapes, angles, lines, transformations, measurements, area, perimeter, volume and coordinate geometry, including trigonometric functions at A level.
- learn about the world of statistics, how to draw and interpret charts, analyse and draw conclusions from data. At A level, students deepen their understanding of statistical enquiry, hypothesis testing, statistical distributions and correlation & regression analysis.
- understand the language and concept of probability, applying knowledge to both theoretical and experimental scenarios, including probability theory at A level.
- be taught many facts and concepts in KS3 with deliberate practice to build automaticity over time. This leads to students being able to reason and problem solve. Factual knowledge is also taught in KS4 and KS5 but with an emphasis on reasoning and problem solving and the construction of mathematical arguments and proofs.
- be taught to communicate mathematical arguments with efficiency and rigor through clear explanations and logical presentation of the solutions.

HEART
FAITH, LOVE AND RESPECT

Students will:

- be encouraged to be brave and share their mistakes to create a respectful class discussion. Teachers encourage students to question any models or answers and demonstrate a positive attitude when they make a mistake. This helps students to see both experts and notices make mistakes.
- be encouraged to take responsibility for their own learning in the classroom. Students know their work could be shown under the visualiser and are responsible for achieving 100% on homework each week and to actively seek help if they are struggling.
- be encouraged to do the right things as teachers uphold the school behaviour policy.
- understand their teacher has high expectations and wants them to be the best they can be.
- be exposed to their teachers love of working with a difficult problem and being able to prove their answer is correct. This is particularly prevalent when teaching A level where the beauty of the subject can be marvelled at.
- have the opportunity to take part in National Maths Challenges which give students the opportunity to problem solve using both the specific knowledge they have been taught as well as pure logical thinking.

HANDS

APPLICATION OF KNOWLEDGE

Students will:

- feel empowered to make informed decisions about their future.
- be able to speak the universal language of number and understand the world around them.
- be able to construct a logical argument with rigor.
- be able to solve real-life problems by recalling number arithmetic, formulae, etc.
- know what knowledge to apply to solve a mathematical problem.
- know how to break down a problem and what strategy to employ to solve a mathematical problem.
- be able to interpret data and understand it limitations.
- understand that data can be manipulated to create a particular narrative.
- be able to make generalisations.
- have the skills needed for a life-time of varying career paths, such as engineering, science, business, architecture, finance, technology and beyond.

CURRICULUM TO CLASSROOM

HEAD KNOWLEDGE-RICH	KNOWLEDGE FOCUSED	Maths lessons are well sequenced episodes of learning linking to bigger themes which build over time to interleave prior knowledge. Increasingly, students have access to key knowledge through knowledge organisers and/or knowledge booklets. Most lessons are focused on the acquisition of knowledge rather than being activity led to keep the main thing the main thing. Where there is a natural link, real life situations are used to add context to key knowledge and help deepen understanding. Teachers use rigorous mathematical language and have ambition for students to speak like a mathematician when asking and answering questions. Students are challenged to improve their verbal reasoning and teachers avoid 'rounding up answers'. Live modelling via a visualiser or whiteboard is seen in most lessons continually emphasises the correct presentation of solutions.
	EXPERT TEACHERS (EXPLANATIONS)	Examples are carefully chosen. Initially, these may include simple numbers or allow use of a calculator to minimise cognitive load, before building complexity back in. Increasingly, the presentation of teaching materials is decluttered to minimise cognitive load.
	TAUGHT TO BE REMEMBERED	Lessons generally start with a spaced retrieval 'Do Now' task which focuses on recently acquired knowledge as well as retrieval from students' long-term memories. These tasks can also activate prior learning needed to access the new learning in the lesson. Interleaving new learning into prior topics starts to build as students become more fluent with their newly acquired skills. Mini-whiteboards are used to encourage the participation of all students and to help guide the pace of the lesson. Show call is increasingly visible in lessons with student responses being shown under a visualiser. A combination of 'hands up' and 'cold calling' are regularly used to check both engagement and understanding. Students fluency skills are regularly assessed via low-stakes testing within lessons through the use of mini-whiteboards, quick quizzes and exit tickets. Teachers model rigorous mathematical language and challenge students to speak like a mathematician by employing 'right is right' when students are answering questions. Homework is set to test knowledge after it has been taught in lesson. KS3 and KS4 students use the homework platform Sparx. It is intelligent and slowly increases the level of challenge, starting with fluency and then interleaving. Students must achieve 100% on their homework. The platform offers support in the form of videos.

HEART **FAITH, LOVE AND RESPECT**	**ENCOURAGING CLASSROOMS BASED ON FAITH, LOVE & RESPECT**	When students arrive to their Maths lessons they are greeted at the door and in most lessons, a Do Now task is ready for them to begin. Teachers have high expectations of students. They are expected to be on time, correctly dressed, fully equipped and to complete weekly homework. Those who fail to meet these high expectations are challenged and the school behaviour and sanctions policy is followed. During modelling, students are increasingly encouraged to focus on the teacher in various ways with prompts such as 'pens down, eyes on me' whilst teachers live model examples via a visualiser or whiteboard. Students are expected to participate in lessons with mini-whiteboards, and through questioning. Students are expected to respond to verbal and written feedback. In Maths lessons students know there is no-opt out when questioned. Teachers may re-phase the question or ask another student to help and use bounce back. Silence may be expected for independent deliberate practice to help reduce cognitive load and give a defined start to independent work. Our Maths teachers believe a culture of error is an opportunity for deeper learning. Students are encouraged to be brave and share their mistakes to create a respectful class discussion. Teachers encourage students to question any models or answers and demonstrate a positive attitude when they make a mistake. This helps students to see both experts and notices make mistakes.
HANDS **APPLICATION OF KNOWLEDGE**	**EXPERT TEACHERS (MODELLING)**	Modelling is teacher led, not student led. Expert teachers use visualisers and whiteboards to live model with the emphasis on the correct notation and presentation of a solution. Teachers also share what they are thinking at each step of a process. When solving complex problems, teachers may model how they have arrived at the strategy they will use to start a solution. Teachers subject specific knowledge ensures that the chosen examples give a natural opportunity to address common misconceptions before they arise. Increasingly knowledge books are used to minimise cognitive load which employ an 'I do, we do, you do' modelling approach.

	DELIBERATE PRACTICE	Do now tasks give students the opportunity to practice the retrieval of recent knowledge as well as knowledge from their long-term memory. This may activate prior learning needed for the lesson. Formal assessments provide students with a focal point to encourage revision. These are teacher marked, followed up with teacher feedback and the opportunity to improve by attempting similar questions in purple pen. In KS3, students are assessed using White Rose end of unit assessments with fluency and reasoning as the focus. When students enter their GCSE and A level courses, past exam paper questions as used in their formal assessments which build over the course to include questions from past topics, essentially building towards an actual past exam paper and so include fluency, reasoning and problem solving throughout our KS4 assessment plan. In addition, KS5 assessments test the communication of mathematical arguments and proof. Teachers circulate classrooms during independent work and identify if there are any individual or class wide misconceptions. Teachers may address the whole class with a widely found misconception asking students to respond with mini-whiteboard question(s). Some teachers also mark work whilst they circulate. Mini-whiteboards are regularly used throughout large parts of a lesson to help assess students understanding and guide the pace at which increasingly more difficult questions are posed. Exit tickets are sometimes used.

LEARNING SEQUENCE – YEAR 7

OUTCOMES	Our Year 7 curriculum builds on the knowledge and skills acquired in KS2 and seeks to begin to use these skills in context to solve problems. Students are introduced to Algebra early on as this form the foundation for many topics to come and it is interleaved into the topics that follow. A key theme in Year 7 is Equality and Equivalence this being revisited several times throughout the year.
Sequences	This introductory topic is designed to be accessed by all students. Students will learn how to: • Describe and continue a sequence given diagrammatically • Represent sequences in tabular and graphical forms • Recognise the difference between linear and non-linear sequences • Continue numerical linear and non-linear sequences • Explain the term-to-term rule of numerical sequences in words
Algebraic notation	Algebra and generalisation as well as formal algebraic notation are introduced for the first time. Students will learn how to: • Find the output of a single and double function machine • Use inverse operations to find the input given the output • Use diagrams and letters to generalise number operations • Use diagrams and letters with single and double function machines • Find the function machine given a one step and expression and two step expression • Substitute values into one step and two step expressions • Generate sequences given an algebraic rule
Equivalence	Here students will build on their knowledge of algebra from the previous unit Students will: • Understand the meaning of equality • Understand and use fact families; numerically and algebraically • Solve one-step linear equations involving addition and subtraction using inverse operations with function machines • Understand the meaning of like and unlike terms • Understand the meaning of equivalence • Simplify algebraic expressions by collecting like terms using the ≡ symbol
Place Value & Ordering	Students consolidate Key Stage 2 learning here and extend it further. Student will: • Recognise the place value of any digit in an integer up to one billion • Understand and write integers up to one billion in words and figures • Work out intervals on a number line • Position integers and decimals on a number line • Compare two numbers using =, ≠, <, >, ≤ and ≥ • Compare and order any number up to one billion • Round integers to the nearest power of 10 • Round a number to 1 significant figure
Fractions and Percentages of amounts	This topic focuses on the key concepts of finding fractions of amounts and percentages of amounts. Visual representations such as bar models are used linking back to Equality and Equivalence. Students will learn how to: • Find a fraction of a given amount • Use a given fraction to find the whole and/or other fractions • Find a percentage of a given amount using mental methods as well as a calculator

Addition and Subtraction	Formal methods of addition and subtraction from Key Stage 2 knowledge are built upon with the introduction of a variety of contexts including money. Students will learn how to: • Use the properties of addition and subtraction • Use mental strategies and formal written methods for addition and subtraction of integers and decimals • Choose the most appropriate method: mental strategies, formal written or calculator • Solve financial maths problems • Solve problems involving tables, time and timetables • Solve addition and subtraction problems in context of perimeter and frequency trees
Multiplication and Division	Formal methods of multiplication and division from Key Stage 2 knowledge are built on here. Students will develop fluency in converting between different units of measure using known facts. Students will learn how to: • Identify factors and multiplies • Multiply and divide integers and decimals by powers of 10 • Use formal methods to multiply and divide integers and decimals • Use order of operations • Find the area of basic shapes • Find the mean of a set of data
Fractions, Decimals & Percentages Equivalence	Students will develop a deeper understanding of the links between fractions, decimals and percentages and be able to fluently convert between them, building on their knowledge of equivalence. Students will learn how to: • Represent division as a fraction • Fully simplify fractions • Represent fractions, decimals and percentages on grids and number lines • Interchange between fractions, decimals and percentages
Adding and Subtracting Fractions	Adding and Subtraction fractions builds on the previous topic. Students now start to work with fractions of any denominator as well as mixed numbers. Bar models continue to be used as a visual representation of the problem, helping students to add and subtract any fraction or mixed number. Students will learn how to: • Convert between improper fractions and mixed numbers • Add and subtract any improper fractions and mixed numbers • Use equivalence to solve problems involving decimals and fractions and choosing the appropriate conversion
Negative Numbers	Students build on prior knowledge from previous topics of work with negative numbers. Students will learn how to: • Create visual representations of negative numbers • Order and compare negative numbers using mathematical symbols • Add, subtract, multiply and divide negative numbers • Use order of operations with negative numbers • Use negative numbers with a calculator • Evaluate algebraic expressions with negative numbers • Solve one and two step equations with negative numbers uing the balance method
Primes and Proof	Students build on prior knowledge of multiples and factors from previous topics of work. Students will learn how to: • Identify multiples and factors in algebraic expressions • Identify prime numbers • Write numbers as a product of prime factors • Find the highest common factor and lowest common multiple of 2 numbers

Construction & Measuring	Students learn the basics of geometric language used for lines, angles and shapes, as well as their properties. Time is spent learning how to construct angles. Here students apply their knowledge of Fractions, Equivalence and angle construction to the real-life context of pie charts. Students will learn how to: • Use letter and labelling conventions including those for geometric figures • Classify and Measure angles • Identify parallel and perpendicular lines • Recognise different types of triangles and quadrilaterals • Name polygons of up to 10 sides • Draw and interpret pie charts

LEARNING SEQUENCE – YEAR 8

OUTCOMES	The Year 8 curriculum builds on the content taught in Year 7 and begins to deepen and develop students' understanding. Students learn about how to use bar models to understand proportional relationships. Many more algebraic concepts are introduced to enable links to be established between geometry and algebraic manipulation. Calculator use is encouraged in Year 8 alongside regular opportunities for students to practise their mental Maths when appropriate.
Tables and Probability	Students will use knowledge of fractions, decimals and percentages in the new context of probability in this new topic. Students will learn how to: • Use the language of probability • Place events on a number line • Write simple probabilities • Know probabilities add to 1 • Construct sample spaces for 1 or more events • Find probabilities from sample space • Represent and find probabilities from two-way tables • Find probabilities from Venn diagrams
Averages and Range	Students will build on prior knowledge of the mean from prior units of work. Students will learn how to: • Find and use the mode and median • Find and use the range • Use the mean and median • Choose the most appropriate average to represent a set of data • Identify outliers in a set of data and their effect on the average and range • Compare distributions using averages and range
Representing Data	In this topic, students will build on knowledge of outliers from their prior topic of Averages and Range. Students will learn to: • Draw and interpret scatter graphs • Describe and interpret correlation • Draw a line of best fit • Read and interpret tables of grouped and ungrouped frequency tables • Represent discrete and continuous data in tables and graphs
Brackets, Equations and Inequalities	Here, students will build on their understanding of equivalence from Year 7. This topic will build on solving one and two step equations. Student will learn how to: • Identify and use formulae, expressions, identities and equations • Form algebraic expressions • Use negative numbers with algebra • Expand a single bracket • Expand multiple single brackets and simplify • Factorise into a single bracket • Solve equations, including equations with brackets • Form and solve equations with brackets • Understand and solve simple inequalities • Form and solve positive inequalities

Indices	In this topic students are building on prior knowledge of collecting like terms and creating the building blocks needed for the next topic; Standard Form. Students will learn how to: • Add and subtract expressions with indices • Simplify algebraic expressions by multiplying indices and use the addition law • Simplify algebraic expressions by dividing indices and use the subtraction law
Standard Form	Here, students build on their knowledge of simple powers such as squares and cubes studied in Year 7 where they learn to represent very small and large numbers using powers of 10. Students will learn how to: • Work with numbers greater than 1 in standard form • Work with numbers between 0 and 1 in standard form • Compare and order numbers in standard form • Mentally calculate with numbers in standard form • Multiply and divide numbers in standard form • Use a calculator to work with numbers in standard form
Geometric Reasoning	Building on letter and labelling conversions studied in Year 7, students will develop an understanding of basic angle facts to solve problems. Students will learn how to: • Use the sum of angles around a point and on a straight line • Use the equality of vertically opposite angles • Apply the sum of angles in triangles and quadrilaterals • Solve angle problems using properties of triangles and quadrilaterals • Solve complex angle problems
Sets and Probability	Students us their understanding of the language of probability studied earlier in the year to solve probabilities problems. Students will learn how to: • Identify and represent sets • Interpret and create Venn diagrams • Understand and use the intersection of sets • Understand and use the union of sets • Find probabilities from Venn diagrams
Angles in Parallel Lines and Polygons	This topic builds on Year 7 understanding on angle notation as well as Year 8 understanding of basic angle facts. Students will learn to: • Identify and calculate with alternate, corresponding and co-interior angles • Solve complex problems with parallel line angles • Identify and calculate with sides and angles in special quadrilaterals • Understand and use the sum of exterior angles of any polygon • Understand and use the sum of interior angles of any polygon • Calculate missing interior angles in regular polygons
Multiplying and Dividing Fractions	Students will have some basic understanding of multiplying and dividing fractions from primary and so this topic deepens understanding of how the rules of multiplying and dividing fractions work. Students will learn how to: • Represent multiplication of fractions as diagrams • Multiply integers, fractions and mixed numbers to find the product • Use the reciprocal when dividing by a fraction • Divide integers, fractions and mixed numbers

Tables and Probability	Students will use knowledge of fractions, decimals and percentages in the new context of probability in this new topic. Students will learn how to: • Use the language of probability • Place events on a number line • Write simple probabilities • Know probabilities add to 1 • Construct sample spaces for 1 or more events • Find probabilities from sample space • Represent and find probabilities from two-way tables • Find probabilities from Venn diagrams
Averages and Range	Students will build on prior knowledge of the mean from prior units of work. Students will learn how to: • Find and use the mode and median • Find and use the range • Use the mean and median • Choose the most appropriate average to represent a set of data • Identify outliers in a set of data and their effect on the average and range • Compare distributions using averages and range
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	• Compare and order numbers in standard form • Mentally calculate with numbers in standard form • Multiply and divide numbers in standard form • Use a calculator to work with numbers in standard form
Geometric Reasoning	Building on letter and labelling conversions studied in Year 7, students will develop an understanding of basic angle facts to solve problems. Students will learn how to: • Use the sum of angles around a point and on a straight line • Use the equality of vertically opposite angles • Apply the sum of angles in triangles and quadrilaterals • Solve angle problems using properties of triangles and quadrilaterals • Solve complex angle problems
Sets and Probability	Students us their understanding of the language of probability studied earlier in the year to solve probabilities problems. Students will learn how to: • Identify and represent sets • Interpret and create Venn diagrams • Understand and use the intersection of sets • Understand and use the union of sets • Find probabilities from Venn diagrams
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Multiplying and Dividing Fractions	Students will have some basic understanding of multiplying and dividing fractions from primary and so this topic deepens understanding of how the rules of multiplying and dividing fractions work. Students will learn how to: • Represent multiplication of fractions as diagrams • Multiply integers, fractions and mixed numbers to find the product • Use the reciprocal when dividing by a fraction • Divide integers, fractions and mixed numbers

LEARNING SEQUENCE – YEAR 9

OUTCOMES	The Year 9 curriculum builds on the content taught in Year 7 and Year 8 and further deepens and develops students' understanding. Year 9 helps to lay the foundations for more complex topics which will be studied at GCSE. Students will work with more algebraic concepts, be introduced to Pythagoras, Trigonometry and Quadratics. Also, students will have the opportunity to understand key concepts related to money such as wages, tax and interest.
Sequences	This topic reinforces students' learning from the start of Year 7 and further extends students algebraic fluency. Students will learn how to: • Generate sequences given a simple and complex algebraic rule • Find the nth term • Prove algebraically if a term is in the sequence
Fractions & Percentages	Students now develop knowledge of finding fractions and percentages of amounts into money-based problems. Students will learn how to: • Decrease and increase by a percentage using a multiplier • Express one number as a fraction or a percentage of another without a calculator and using another number • Work with percentage change as well as profit and loss • Solve percentage problems • Solve reverse percentage problems
Number	Here students will extend their understanding of the number system as well as revisit basic number knowledge in a problem-solving context where prior knowledge is applied to a new context. Students will learn how to: • Solve problems with integers and decimals in new contexts • Solve highest common factor and lowest common multiple problems using prime factorisation and Venn diagrams • Solving problems with fractions
Probability	In this topic students build on their learning in Year 8 to calculate the probabilities. Students bring together their knowledge of multiplication of fractions to solve probability questions. Students will learn how to: • Find the relative frequency of an event • Calculate expected outcomes of an event • Calculate theoretical probabilities of an event • Identify independent events • Use tree diagrams to work out probabilities of 2 or more independent events
Maths and Money	Students practice their number skills in various financial contexts in this topic. The language of financial mathematics, already introduced in Year 7 and 8, is further developed. Simple ideas of tax and wages are introduced, and the percentages studied earlier in Year 9 are applied in various contexts including simple and compound interest. Students will learn how to:

	• Calculate simple and compound interest • Solve problems with VAT • Calculate wages and taxes • Solve problems with exchange rates • Solve unit pricing problems
Forming and Solving Equations	Students revisit and extend their knowledge of forming and solving linear equations and inequalities, including those related to different parts of the mathematics curriculum. Students will learn how to: • Solve equations and inequalities with unknowns on both sides • Solving equations and inequalities in context • Substitute into formulae and equations • Rearrange one step and two step formulae
Straight Line Graphs	This topic builds on Year 8 content where students plotted simple straight-line graphs. Students will learn how to: • Use a table of values • Interpret gradients and intercepts • Use the equation y = mx + c • Find the equation of a line from a graph • Find approximate values of y for given values of x and vice versa
3D Shapes	This is the first-time students have studied 3D shapes formally at Key Stage 3. Students will learn how to: • Identify 2-D and 3-D shapes including prisms • Sketch and recognise nets of cubes, cuboids and other 3-D shapes • Draw and interpret plans and elevations • Find the surface area of cubes, cuboids and triangular prisms • Find the volume of cubes, cuboids, prisms, cylinders and other 3D shapes
Constructions and Congruency	This unit builds on the constructions studied in Year 7 and 8 with an introduction to using compasses and protractors. Students will learn how to: • Construct the locus of distance from a point, two lines and a shape • Construct the locus of points equidistant from two points • Construct a perpendicular bisector of a line and from a given point • Recognise and use the perpendicular distance from a point to a line as the shortest distance to the line • Construct an angle bisector • Recognise and construct congruent triangles • Identify congruent shapes
Transformations	This units builds on prior knowledge of straight-line graphs as well as understanding properties of 2D shapes. Students will learn how to: • Identify the order of rotational symmetry of a shape • Identity line symmetry • Rotate a shape about a point • Translate points and shapes by a given vector • Draw and describe reflections • Recognise enlargements and similarity • Work out missing sides and angles in a pair of given similar shapes • Enlarge a shape by a positive integer scale factor

Ratio & Proportion	Building on students experience in previous years, here they solve all types of ratio problems and make the links with direct proportion graphs. Students will learn how to: • Solve 'best-buy' problems • Solve problems with direct and inverse proportion
Compound Measures	Students build on knowledge of inverse proportion from the prior unit and explore the relationships between different variables. Students will learn how to: • Solve speed, distance and time problems with and without a calculator • Use distance-time graphs • Solve flow problems and their graphs • Understand rates of change and their units
Pythagoras	This is an introduction to the topic of Pythagoras which will be studied in greater depth at GCSE. Students will learn how to: • Identify the hypotenuse of a right-angled triangle • Determine whether a triangle is right angled • Calculate the hypotenuse of a right-angled triangle • Calculate missing sides in right-angled triangles • Use Pythagoras' theorem on a coordinate grid
Quadratics	This is an introduction to the topic of Quadratics which will be studied in greater depth at GCSE. Students will learn how to: • Draw and interpret quadratic graphs • Find approximate estimate values of y for given values of x and vice versa to find approximate solutions • Expand a pair of binomials • Factorise quadratics with a coefficient of 1 • Recognise the 'Difference of 2 squares'
Trigonometry	This is an introduction to the topic of Trigonometry which will be studied in greater depth at GCSE. Students will learn how to: • Correctly label the hypotenuse, opposite and adjacent sides of a right-angled triangle • Find missing sides and angles of right-angled triangles using trigonometry

LEARNING SEQUENCE – YEAR 10

Foundation

Number This topic builds on Key Stage 3 Knowledge. Mental methods are encouraged as well as formal methods for all four operations with integers, fractions and decimals. Here students will develop their ability to apply the correct operations to solve multi-step problems. Time is dedicated to identifying different types of number as well as prime factorisation, highest common factor and lowest common multiple. This knowledge is required to deepen understanding and allow students to access word-based problems.
Algebra Students revisit the basics of algebra and build on skills developed in Key Stage 3. This prior knowledge is used throughout the Year 10 & 11. Students extend their knowledge of other key areas of maths by being able to generalise using algebra and so this is a fundamental building block for GCSE.
Graphs Tables & Charts In this topic students build on Key Stage 3 work on collection, representation and use of summary statistics to describe data. Much of the content will be familiar from other students e.g. Science and Geography with the use of everyday life examples. Students will both construct tables and charts as well as interpret the data shown by the tables and charts. Students will develop their skills in being able to decide on the most appropriate way to display data and have an understanding of the limitations each table or chart may have. Students will develop skills in being able to criticise tables and charts which are misleading.
Fractions & Percentages Students revisit fractions and develop their ability to apply fluency skills to more reasoning and problem-solving style questions. Percentages features heavily in GCSE examinations and this topic builds on existing Key Stage 3 knowledge. Calculator and non-calculator methods are used throughout. Students deepen their understanding of real-life percentages e.g. using different types of interest. Student vocabulary builds quickly in this unit with lots of real-life problems being used.
Equations, Inequalities & Sequences Students build, extend and deepen their knowledge of equations, inequalities and sequences from Key Stage 3. Key vocabulary is developed here which helps students to access questions which look mathematically similar but require different approaches. Students look at solving equations and inequalities as well as forming. Sequences is revisited and extended from Key Stage 3 to start to formalise sequences with algebraic rules.
Angles In this topic students revisit accurate drawing and measuring as well as basic angles rules including angles in parallel lines covered in Key Stage 3. Students start to move from knowing individual angle facts to developing reasoning skills to solve problems. Here students develop the ability to solve geometric problems with increasingly complex chains of reasoning.
Averages & range This topic builds on Key Stage 3 work. The block consolidates existing learning but also extends and deepens. Students start to appreciate the advantages and limitations of using average and range to describe a set of data. There is more emphasis on interpretation of the results and being able to make accurate and relevant comparisons between 2 or more sets of data. Students also explore the methodology of surveys.

Perimeter, Area & Volume
This topic introduces new content as well as extending prior knowledge. Students will complete a unit of work focused on Circles in Year 11. All other 2D and 3D shapes are explored in this unit with reference to perimeter, area and volume where appropriate. Students are introduced to new formula and encouraged to find any links e.g. volume of a cube and square based pyramid.

Graphs
This topic builds on earlier study of straight line graphs in Year 9. Students plot straight lines from given equations and find and interpret the equation of a straight line from a variety of situations. Students learn to interpret real life graphs and appreciate what the gradient and y-intercept represent in real life situations that they may come across e.g. mobile phone tariffs and taxi journeys.

Transformations
Students revisit and extend their learning from Key Stage 3, exploring all the transformations and constructions, relating these to symmetry and properties of shapes. There is an emphasis on describing as well as performing the transformations.

Ratio & Proportion
In this topic students build on Key Stage 3 work on ratio, highlighting similarities and differences and links to other areas of maths including both algebra and geometry. The focus is on reasoning and understanding notation to support solutions when problem solving.

Higher

Number
This topic builds on Key Stage 3 content. Mental methods are encouraged as well as formal methods for all four operations with integers, fractions and decimals. Here students will develop their ability to apply the correct operations to solve multi-step problems. Time is dedicated to identifying different types of number as well as prime factorisation, highest common factor and lowest common multiple. This knowledge is required to deepen understanding and allow students to access word-based problems. Students also develop an understanding of surds.

Algebra
Students revisit the basics of algebra and build on skills developed in Key Stage 3. This consolidation unit is used throughout Year 10 & 11. Students extend their knowledge of other key area of maths by being able to generalise using algebra and so this is a fundamental building block for GCSE.

Interpreting and Representing Data
In this topic students build on Key Stage 3 work on collection, representation and use of summary statistics to describe data. Much of the content will be familiar from other students e.g. Science and Geography with the use of everyday life examples. Students will both construct tables and charts as well as interpret the data shown by the tables and charts. Students will develop their skills in being able to decide on the most appropriate way to display data and have an understanding of the limitations each table or chart may have. Students will develop skills in being able to criticise tables and charts which are misleading. Students start to appreciate the advantages and limitations of using average and range to describe a set of data. There is more emphasis on interpretation of the results and being able to make accurate and relevant comparisons between 2 or more sets of data. Students also explore the methodology of surveys.

Fractions, Ratios & Percentages

Students revisit fractions and develop their ability to apply fluency skills to more reasoning and problem-solving style questions. Percentages and Ratios feature heavily in GCSE examinations and this block builds on existing Key Stage 3 knowledge. Calculator and non-calculator methods are used throughout. Students deepen their understanding of real-life percentages e.g. using different types of interest. Student vocabulary builds quickly in this unit with lots of real-life problems being used.

Angles & Trigonometry

In this topic students revisit accurate drawing and measuring as well as basic angles rules including angles in parallel lines covered in Key Stage 3. Students start to move from knowing individual angle facts to developing reasoning skills to solve problems. Here students develop the ability to solve geometric problems with increasingly complex chains of reasoning. Students revisit Pythagoras and Trigonometry here and develop the application of their understanding to solve problems in both right-angled triangles and other shapes. Emphasis is placed on linking the trigonometric functions to ratios.

Graphs

This topic builds on earlier study of straight link graphs in Year 9. Students plot straight lines from given equations and find and interpret the equation of a straight line from a variety of situations. Students learn to interpret real life graphs and appreciate what the gradient and y-intercept represent in real life situations that they may come across e.g. mobile phone tariffs and taxi journeys.

Area & Volume

This topic introduces new content as well as extending prior knowledge. All other 2D and 3D shapes are explored in this unit with reference to perimeter, area and volume where appropriate. Students are introduced to new formula and encouraged to find any links e.g. volume of a cube and square based pyramid. Here students work extensively with circles. Students also explore different levels of accuracy and work with the limitations of bounds.

Transformations & Constructions

Students revisit and extend their learning from Key Stage 3, exploring all the transformations and constructions, relating these to symmetry and properties of shapes. There is an emphasis on describing as well as performing the transformations.

Equations 7 Inequalities

Students build, extend and deepen their knowledge of equations, inequalities and sequences from Key Stage 3. Key vocabulary is developed here which helps students to access questions which look mathematically similar but require different approaches. Students look at solving equations and inequalities as well as forming. Sequences if revisited and extended from Key Stage 3 to start to formalise sequences with algebraic rules.

LEARNING SEQUENCE – YEAR 11

Foundation

Right-angled Triangles Students revisit Pythagoras and Trigonometry here and develop the application of their understanding to solve problems in both right-angled triangles and other shapes. Emphasis is placed on linking the trigonometric functions to ratios.
Probability This topic builds on Key Stage 3 and provides good context in which to revisit fraction arithmetic and conversion between fractions, decimals & percentages. Tables and Venn diagrams are revisited and understanding and use of tree diagrams is developed here.
Constructions, Loci & Bearings Students revisit and extend their learning from Key Stage 3, exploring all transformations, relating these to symmetry and properties of shapes where appropriate. There is an emphasis on describing as well as performing transformations. Using the correct mathematical language here promote deep thinking and understanding.
Multiplicative Reasoning Students develop their multiplicative reasoning in a variety of contexts, from simple scale factors through to complex equations. Students are exposed to many real-life applications of compound measures and the different equations that can be created to solve problems. This unit further develops the Fractions and Percentages unit studied in Year 10 by moving students on to solving problems like reverse percentages.
Quadratic Equations & Graphs Students develop their knowledge of non-linear graphs in this unit, looking at quadratic graphs. Students develop an understanding of how a quadratic equation can be represented as a graph, how they can manipulate a quadratic equation to identify key parts of a quadratic graph and how they can read a graph to help them identify the associated graphical representation.
Perimeter Area & Volume (2) Here students build on their Key Stage 3 basic knowledge of circumference and area of a circle. The formula for areas of sectors and arc lengths are derived by working with fractions of circles rather than simply being shown how to use a given formula.
Fractions, Indices & Standard Form Much of the content for this unit builds in Key Stage 3 required skills. Here students move from being able to process a skill to be being able to apply the appropriate operation to a posed worded-problem.
Congruency, Similarity & Vectors Building on their experience of enlargement and similarity in previous years, this unit extends students' experiences and looks for more formality in dealing with congruent and similar triangles. Congruency is introduced through considering what information is needed to produce congruent and similar triangles. Students will build on existing knowledge of vectors from Key Stage 3. Again, this unit will look to formalise prior knowledge with an emphasis on correct notation, understanding the difference between positive and negative vectors and develop a sense of vector arithmetic.
More Algebra Students develop their algebra skills further by forming and solving simultaneous equations in context as well as developing algebraic proof skills.

Revision
Students have now been exposed all the fluency skills, reasoning discussion and applications of their skills throughout Year 10 & 11. Students now enter the revision stage in class which predominantly takes the form of students practicing exam questions with teacher feedback. Students must be given time to get used to how the exam papers will be set, how to approach the exam papers and what is expected, to gain all the marks available for each question.

Higher

Probability
This topic builds on Key Stage 3 and provides good context in which to revisit fraction arithmetic and conversion between fractions, decimals & percentages. Tables and Venn diagrams are revisited and student understanding of tree diagrams is developed here. Students work with both independent events as well as conditional probability. The topic extends students algebraic fluency when solving complex probability problems.

Multiplicative Reasoning
Students develop their multiplicative reasoning in a variety of contexts, from simple scale factors through to complex equations. Students are exposed to many real-life applications of compound measures and the different equations that can be created to solve problems. This unit further develops the Fractions and Percentages unit studied in Year 10 by moving students on to solving problems like reverse percentages.

Similarity & Congruency
Building on their experience of enlargement and similarity in previous years, this unit extends students' experiences and looks for more formality in dealing with congruent and similar triangles. Congruency is introduced through considering what information is needed to produce congruent and similar triangles. Students develop skills of comprehensively writing proofs and develop.
Students will build on existing knowledge of vectors from Key Stage 3. Again, this unit will look to formalise prior knowledge with an emphasis on correct notation, understanding the difference between positive and negative vectors and develop a sense of vector arithmetic.

More Trigonometry
Students trigonometry knowledge is developed further in this unit by linking it to similar triangles. Here the emphasis is on non-right-angled triangles and the application of fluency skills to complex problems requiring students to draw their own sketches and apply bearing rules.

Further Statistics
Students will both construct charts as well as interpret the data shown by the charts. Students will develop their skills in being able to decide on the most appropriate way to display data and have an understanding of the limitations each table or chart may have. Students also investigate how to select appropriate samples. There is further emphasis on interpretation of the results and being able to make accurate and relevant comparisons between 2 or more sets of data. Students also explore the methodology of surveys.

Equations & Graphs
Students will be able to expand and factorise double brackets. They will be able sketch and plot quadratic and cubic equations and circles of the form $x^2 + y^2 = r^2$. Students will also use these graphs to find solutions of equations, to find intersection points with axis and linear equations, and to find approximate solutions to simultaneous equations. Students will sketch regions on a graph to represent inequalities.

Circle Theorems
Students will use and prove circle theorems. They will recognise the equation of a circles with centre, origin and find the equation of a tangent to the circle.

More Algebra
Here students build on their algebraic fluency by solving and changing the subject of equations with algebraic fractions, use algebra in proofs and learn to work with functions.

Vectors & Geometric Proof Students will build on existing knowledge of vectors from Key Stage 3. Again, this unit will look to formalise prior knowledge with an emphasis on correct notation, understanding the difference between positive and negative vectors and develop a sense of vector arithmetic. Students combine knowledge of 2D shapes and vectors to form mathematically sound vector proofs.
Proportion & Graphs Here students will learn to recognise, draw and sketch graphs of specific functions as well graph transformations. Real life graphs are also studied further here where students have an appreciation for what the features of the graph means in a real-life context e.g. acceleration.
Revision Students have now been exposed all the fluency skills, reasoning discussion and applications of their skills throughout Year 10 & 11. Students now enter the revision stage in class which predominantly takes the form of students practicing exam questions with teacher feedback. Students must be given time to get used to how the exam papers will be set, how to approach the exam papers and what is expected, to gain all the marks available for each question.

LEARNING SEQUENCE – YEAR 12

Maths A level is taught in 2 strands by 2 different teachers;

Strand A – Pure Mathematics and Mechanics

Strand B – Pure Mathematics and Statistics

A level lessons follow a textbook and each unit of work is linked to a given chapter which is highlighted below.

Strand A – Pure mathematics and Mechanics	Strand B – Pure Mathematics and Statistics
Algebraic Expressions – Pure 1 Chapter 1 Students will build on GCSE algebra skills to: • Be able to perform essential algebraic manipulations, such as expanding brackets, collecting like terms, factorising etc. • Understand and be able to use the laws of indices for all rational exponents. • Be able to use and manipulate surds, including rationalising the denominator.	**Algebraic Methods – Pure 1 Chapter 7** Students will build on GCSE algebra skills to: • Be able to fully factorise a cubic expression • Be able to use algebraic division • Know and be able to apply the factor theorem • Understand and be able to use the structure of mathematical proof, proceeding from given assumption through a series of logical steps to a conclusion • Be able to use methods of proof, including proof by deduction, proof by exhaustion and disproof by counter-example
Quadratics – Pure 1 Chapter 2 Students will build on GCSE algebra skills to: • Be able to work with quadratic functions and their graphs. (The notation f(x) may be used.). • Know and be able to use the discriminant of a quadratic function, including the conditions for real and repeated roots. • Be able to complete the square. (Including cases where a > 1and a<0 (This also includes a proof of the quadratic formula). • Solution of quadratic equations by factorisation, use of the formula, use of a calculator and completing the square. • Including solving quadratic equations in a function of the unknown. (These functions could include powers of x, trigonometrical functions of x, exponential and logarithmic functions of x.).	**Graphs and Transformations – Pure 1 Chapter 4** Students will build on their knowledge of graphs from GCSE to: • Understand and use graphs of functions. • Be able to sketch curves defined by simple equations including polynomials. This includes simple cubic and quartic functions. • Be able to sketch $y = a/x$ and $y = a/x^2$ (including their horizonal and vertical asymptotes) • Interpret algebraic solution of equations graphically and be able to use intersection points of graphs to solve equations. • Understand and use proportional relationships and their graphs (Direct proportion between two variables.) • Understand the effect of simple transformations on the graph of y = f(x), including sketching

	associated graphs: y = af(x), y = f(x) + a, y = f(ax) and y = f(x + a) and combinations of these transformations. • Students should be able to apply a combination of these transformations to any of the functions in the a-level specification (quadratics, cubics, quartics, reciprocals, a/x², mod x, sinx, cosx, tanx, e^x and a^x) and sketch the resulting graph.
Equations and Inequalities – Pure 1 Chapter 3 Students will build on GCSE algebra skills to: • Be able to solve linear simultaneous equations using elimination and substitution. • Be able to use substitution to solve simultaneous equations where one equation is linear and the other quadratic. The quadratic may involve powers of 2 in one unknown or in both unknowns. • Solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions. (These would be reducible to linear or quadratic inequalities). • Express solutions through correct use of 'and' and 'or' or through set notation. • Represent linear and quadratic inequalities graphically. (Shading and use of dotted and solid lines convention is required).	**The Binomial Expansion – Pure 1 Chapter 8** Students will develop knew skills in binomial expansion so they can: • Understand and use the binomial expansion of $(a + bx)^n$ for positive integer n; the notations n! and nCr, link to binomial probabilities. • Use of Pascal's triangle • Relation between binomial coefficients • Be aware of alternative notations for nCr.
Straight Line Graph – Pure 1 Chapter 5 Students will build on GCSE algebra skills to: • Understand and use the equation of a straight line. (This includes the equation of a line through two given points, and the equation of a line parallel (or perpendicular) to a given line through a given point.). • Gradient conditions for two straight lines to be parallel or perpendicular. • Be able to use straight-line models in a variety of contexts, e.g. the line for converting degrees Celsius to degrees Fahrenheit, distance against time for constant speed, etc.	
Circles – Pure 1 Chapter 6 Students will begin to develop further geometry skills from GCSE to:	**Trigonometric Ratios – Pure 1 Chapter 9** Students will build on their knowledge of trigonometry from GCSE to: • Understand and be able to use the definitions of sine, cosine and tangent for all arguments

• Understand and use the co-ordinate geometry of the circle including using the equation of a circle in the form $(x - a)^2 + (y - b)^2 = r^2$
• Students should be able to find the radius and the coordinates of the centre of the circle given the equation of the circle, and vice versa.
• Students should also be familiar with the equation $x^2 + y^2 + 2fx + 2gx + c = 0$."
• Completing the square to find the centre and radius 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
  ○ the radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point.
• Students should be able to find the equation of a circumcircle of a triangle with given vertices using these properties.
• Students should be able to find the equation of a tangent at a specified point, using the perpendicular property of tangent and radius.
	• Use of x and y coordinates of points on the unit circle to give cosine and sine respectively.
	• Understand and be able to use the sine and cosine rules, including the ambiguous case of the sine rule.
	• Understand and be able to use the area of a triangle in the form $\frac{1}{2}ab\sin C$.
	• Understand and be able to use the sine, cosine and tangent functions; their graphs, symmetries and periodicity.
	• Knowledge of graphs of curves with equations such as y = sinx, y = cos(x + 30), y = tan2x is expected.

Differentiation – Pure 1 Chapter 12 Students will begin to develop their understanding of differentiation in order to: • Understand and use the derivative of f(x) as the gradient of the tangent to the graph of y = f(x) at a general point (x,y); the gradient of the tangent as a limit; interpretation as a rate of change. • Know that dy/dx is the rate of change of y with respect to x. (The notation f'(x) may be used for the first derivative and f''(x) may be used for the second derivative.) • Be able to sketch the gradient function for a given curve. This could relate speed and acceleration for example. • Be able to find second derivatives • Understand differentiation from first principles for small positive integer powers of x (powers of 2 and 3) • Understand and use the second derivative as the rate of change of the gradient.	**Trigonometric identities and equations - Pure 1 Chapter 10** Students will continue to develop their trigonometry to: • Understand and be able to use tanx = sin x/cos x. • Understand and use sin $\sin^2\theta+\cos^2\theta = 1$ • Both of the above identities may be used to solve trigonometric equations and angles will be in degrees. • They may also be used to prove further identities. • Be able to solve trigonometric equations within a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle.

• Be able to differentiate x^n, for rational values of n, and related constant multiples, sums and differences.	
Integration - Pure 1 Chapter 13 Students will begin to develop their understanding of integration in order to: • Know and be able to use the Fundamental Theorem of Calculus. Integration as the reverse process of differentiation. Students should know that for indefinite integrals a constant of integration is required. • Be able to integrate x^n (excluding n = −1), and related sums, differences and constant multiples. • Given f'(x) and a point on the curve students should be able to find an equation of the curve in the form y = f(x). • Be able to evaluate definite integrals. • Be able to use a definite integral to find the area under a curve.	
Vectors – Pure 1 Chapter 11 Students will build on basic knowledge of vectors from GCSE in order to: • Be able to use vectors in two dimensions. Students should be familiar with column vectors and with the use of i and j unit vectors in two dimensions. • Be able to calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form. Students should be able to find a unit vector in the direction of a, and be familiar with the notation for mod a. • Be able to add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations. This is the triangle and parallelogram laws of addition. Students must have an understanding of parallel vectors. • Understand and be able to use position vectors, ($\overrightarrow{AB}$ = b – a) • Be able to calculate the distance between two points represented by position vectors. • Be able to use vectors to solve problems in pure mathematics and in context, (including forces).	**Data Collection – Statistics 1 Chapter 1** Students will begin to develop their statistic skills building on GCSE knowledge to: • Understand and be able to use the terms 'population' and 'sample' • Be able to describe advantages and disadvantages of sampling compared to census • Know how to use samples to make informal inferences about the population • Understand and be able to use sampling techniques, including simple random sampling, stratified sampling, systematic sampling, quota sampling and opportunity (or convenience) sampling. • Be able to select or critique sampling techniques in the context of solving a statistical problem • Understand that different samples can lead to different conclusions about the population.

Exponentials and Logarithms – Pure 1 Chapter 14

Students will build on their knowledge of index laws to begin their understanding of exponents and logarithms in order to:

- Know and be able to use the function a^x and its graph, where a is positive. (Understand the difference in shape between a < 1 and a > 1).
- Know and be able to use the function e ^x and its graph.
- Know and be able to use the definition of log(ax) as the inverse of a^x, where a is positive and x ≥0
- Know and be able to use the function ln(x) and its graph.
- Know and be able to use ln(x) as the inverse function of e^x.
- "Understand and use the laws of logarithms:
  - Log(x) + log(y) = log(xy)
  - Log(x) – log(y) = log(x/y)
  - klogax = log_ax^k (including, for example k=−1 and k=−½)
  - log_aa = 1
- Be able to solve equations of the form a^x=b. Students may use the change of base formula.
- Be able to use logarithmic graphs to estimate parameters in relationships of the form y=$ax^n$and y=kb^n, given data for x and y.
- Plot log y against log x and obtain a straight line where the intercept is log a and the gradient is n.
- Plot log y against x and obtain a straight line where the intercept is log k and the gradient is log b.

Measures of Location and Spread - Statistics 1 Chapter 2

Students will build on GCSE knowledge of measures of location and spread to:

- Be able to interpret measures of location: mean, median and mode. Data may be discrete, continuous, grouped or ungrouped.
- Be able to interpret measures of variation: standard deviation, variance, range and interpercentile range.
- Be able to use linear interpolation to calculate percentiles from grouped data.
- Be able to calculate standard deviation, including from summary statistics.

Representations of Data - Statistics 1 Chapter 3

Students will continue to build on GCSE knowledge of statistics to:

- Recognise and interpret possible outliers in data sets and statistical diagrams. Any rule needed to identify outliers will be specified in the question.
- Be able to select or critique data presentation techniques in the context of a statistical problem. Students will be expected to draw simple inferences and give interpretations to measures of central tendency and variation. Significance tests,

	other than those mentioned in chapter 7, will not be expected. • Be able to clean data, including dealing with missing data, errors and outliers. For example, students may be asked to identify possible outliers on a box plot or scatter diagram.
Modelling in Mechanics – Mechanics 1 Chapter 8 Students will build on GCSE knowledge to: • Understand and use fundamental quantities and units in the S.I. system: Length (displacement, distance travelled), time, mass. • Understand and use derived quantities and units: velocity, acceleration, force, weight.	**Probability – Statistics 1 Chapter 5** Students will further their knowledge of probability from GCSE to: • Understand and be able to use mutually exclusive and independent events when calculating probabilities. Venn diagrams or tree diagrams may be used. • Be able to make links to discrete and continuous distributions. No formal knowledge of probability density functions is required but students should understand that area under the curve represents probability in the case of a continuous distribution.
Constant Acceleration – Mechanics 1 Chapter 9 Students will begin to use knowledge from physics and maths to deepen and further their mechanics skill in order to: • Understand and use the language of kinematics: position; displacement; distance travelled; velocity; speed; acceleration. • Understand, use and interpret graphs in kinematics for motion in a straight line: displacement against time and interpretation of gradient; velocity against time and interpretation of gradient and area under the graph. Graphical solutions to problems may be required. • Understand, use and derive the formulae for constant acceleration for motion in a straight line. (Understand and use suvat formulae for constant acceleration in 2-D**).**	**Correlation – Statistics 1 Chapter 4** Students will build on GCSE knowledge of graphs in order to: • Interpret scatter diagrams and regression lines for bivariate data, including recognition of scatter diagram which include distinct sections of the population (calculations involving regression lines are excluded). This includes the use of interpolation and the dangers of extrapolation. Variables other than x and y may be used. • Students should be familiar with the terms explanatory (independent) and response (dependent) variables. • Understand informal interpretation of correlation. Use of terms such as positive, negative, zero, strong and weak are expected. • Understand that correlation does not imply causation
Forces and Motion – Mechanics 1 Chapter 10 Students will deepen their mechanics skills so they can: • Understand the concept of a force; understand and use Newton's first law. (Normal reaction, tension, thrust or compression, resistance) • Understand and use Newton's second law for motion in a straight line (restricted to forces in	**Statistical Distributions – Statistics 1 Chapter 6** Students will develop their knowledge from this topic in order to: • Understand and use simple, discrete probability distributions (calculation of mean and variance of discrete random variables is excluded), including the binomial distribution, as a model; calculate probabilities using the binomial distribution.

two perpendicular directions or simple cases of forces given as 2D (i, j) vectors). • Problems will involve motion in a straight line with constant acceleration in scalar form, where the forces act either in parallel or perpendicular to the motion. • Problems may involve motion in a straight line with constant acceleration in vector form, where the forces are given in i-j form or as a column vector. • Understand and 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. • The default value of g will be 9.8ms² but some questions may specify another value e.g. g = 10ms². • The inverse square law for gravitation is not required and g may be assumed to be constant, but students should be aware that g is not a universal constant but depends on location. • Understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line; application to problems involving smooth pulleys and connected particles. • Problems may be set where forces need to be resolved (restricted to forces in two perpendicular directions or simple cases of forces given as 2D vectors). • Connected particle problems could include problems with particles in contact e.g. lift problems.	• Students will be expected to use distributions to model a real-world situation and to comment critically on the appropriateness. • Students should know and be able to identify the discrete uniform distribution. • The notation X~B(n, p) may be used. • Use of a calculator to find individual or cumulative binomial probabilities.
Forces and Friction – Mechanics 2 Chapter 5 This is a Y13 topic but leads on nicely from the previous chapter: • Understand and use Newton's second law for motion in a straight line; extend to situations where forces need to be resolved (restricted to 2 dimensions). • Resolve forces in 2 dimensions; equilibrium of a particle under coplanar forces. • Understand and use addition of forces; resultant forces; dynamics for motion in a plane. Understand friction and the coefficient of friction and use $F \leq \mu R$	
Variable Acceleration - Mechanics 1 Chapter 11	**Hypothesis Testing – Statistics 1 Chapter 7**

• Use calculus in kinematics for motion in a straight line. (The level of calculus required will be consistent with that in Paper 1) • V = $\frac{dr}{dt}$, $a = \frac{dv}{dt} = \frac{d^2r}{dt^2}$ r = $\int v\,.dt$, $v = \int a\,.dt$	Students will put their new skills into practise to be able to: • Understand and apply 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. • An informal appreciation that the expected value of a binomial distribution is given by np may be required for a 2-tail test. • Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context. • Understand that a sample is being used to make an inference about the population. • Hypotheses should be expressed in terms of the population parameter p. • Appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis. • A formal understanding of Type 1 errors is not expected.
Differentiation - Pure 2 Chapter 9 Part 1 Students will build on their Y12 knowledge to begin the Y13 content to: • Be able to differentiate $e^{kx}$and a^{kx}, sin kx, cos kx, tan kx and related sums, differences and constant multiples. • Understand and use the derivative of ln x • Differentiate using the product rule, the quotient rule and the chain rule.	**Radians – Pure 2 Chapter** Students will begin to develop knowledge of radians to: • Be able to work with radian measure, including use for arc length and area of a sector. This includes use of the formulae for arc length and areas of sectors. • Know and use the exact values of sin, cos and tan for 0, $\frac{\pi}{6}$, $\frac{\pi}{4}$, $\frac{\pi}{3}$, $\frac{\pi}{2}$, π and multiples thereof. • Understand and use the standard small angle approximations of sine, cosine and tangent.
Trigonometric Functions – Pure 2 Chapter 6 Students will build on trigonometric skills from Y12 in order to: • Understand and use the definitions of secant, cosecant, and cotangent and of arcsin, arccos and arctan; their relationships to sine, cosine and tangent; understanding of their graphs; their ranges and domains. (For both degrees and radians). • Understand and use trigonometric identities for sec squared and cosec squared.	**Functions and Graphs – Pure 2 Chapter** Students will build on Y12 knowledge of graphs for Y13 content in order to: • Understand the modules of a linear function and be able to sketch its graph. • Understand and use composite functions, inverse functions and their graphs.

Trigonometry and Modelling – Pure 2 Chapter 7 Students will continue to develop their trigonometry skills to: • Understand and use double angle formulae; use of formulae for sin (A+B), sin (A-B), cos (A+B), cos (A-B), tan (A+B), tan (A-B). • Understand geometrical proofs of these formulae. • Understand and use expressions for a cos x + b sin x in the equivalent forms of r cos (x + a) or r sin (x + a).	

LEARNING SEQUENCE – YEAR 13

Strand A – Pure mathematics and Mechanics	Strand B – Pure Mathematics and Statistics
Trigonometric Functions – Pure 2 Chapter 6 Students will build on their knowledge on trigonometry from Y12 to: • Understand and use the definitions of secant, cosecant, and cotangent and of arcsin, arccos and arctan; their relationships to sine, cosine and tangent; understanding of their graphs; their ranges and domains. (For both degrees and radians). • Understand and use trigonometric identities for sec squared and cosec squared.	**Algebraic Methods – Pure 2 Chapter 1** Students build on their knowledge of proof and algebraic fractions to: • Understand and use proof by contradiction (including proof of the irrationality of root 2 and the infinity of primes, and application to unfamiliar proofs). • Be able to simplify rational expressions, including by factorising and cancelling, and algebraic division (by linear expressions only). • Be able to decompose rational functions into partial fractions (denominators not more complicated than squared linear terms and with no more than 3 terms, numerators constant or linear).
Trigonometry and Modelling – Pure 2 Chapter 7 Students will continue to develop their trigonometry skills to: • Understand and use double angle formulae; use of formulae for sin (A+B), sin (A-B), cos (A+B), cos (A-B), tan (A+B), tan (A-B). • Understand geometrical proofs of these formulae. Understand and use expressions for a cos x + b sin x in the equivalent forms of r cos (x + a) or r sin (x + a).	**Parametric Equations – Pure 2 Chapter 8** Students will begin to develop their knowledge on parametric equations in order to: • Understand and use the parametric equations of curves and conversion between Cartesian form and parametric form. • Be able to use parametric equations in modelling in a variety of contexts.
Differentiation - Pure 2 Chapter 9 Part 2 Students will build on their knowledge of differentiation from Y12 to: • Be able to differentiate sin x and cos x from first principles. • Differentiate simple functions and relations defined implicitly or parametrically, for the first derivative only. • Understand and use the second derivative in connection to concave and convex sections of curves and points of inflection.	**Numerical Methods – Pure 2 Chapter 10** Building on Y12 knowledge students will learn to: • Be able to locate roots of f(x) = 0 by considering changes of sign of f(x) in an interval of x on which f(x) is sufficiently well behaved. • Understand how change of sign methods can fail. • Solve equations approximately using simple iterative methods, be able to draw cobweb and staircase diagrams.

• Construct simple differential equations in pure mathematics and in context, (contexts may include kinematics, population growth and modelling the relationship between price and demand).	• Be able to solve equations using the Newton-Raphson method and other recurrence relations. • Understand how such methods can fail. • Be able to use numerical methods to solve problems in context.
Integration – Pure 2 Chapter 11 Students will build on their knowledge of integration from Y12 to: • Be able to integrate e^{kx}, $\frac{1}{x}$, sin kx, cos kx and related sums, differences and constant multiples. (This includes integration of standard functions such as sin 3x, sec2 2x, tan x, e^{5x}, $\frac{1}{2x}$. Students are expected to be able to use trigonometric identities to integrate, for example sin2 x, tan2 x, cos2 3x). • Be able to use definite integration to find the area between 2 curves. (This is an extension of the work already taught in year 12) This includes curves defined parametrically. • Understand and use integration as the limit of a sum. • Be able to carry out simple cases of integration by substitution and integration by parts; understand these methods as the inverse processes of the chain and product rule respectively. (Integration by substitution includes finding a suitable substitution and is limited to cases where one substitution will lead to a function which can be integrated) (Integration by parts includes more than one application of the method but excludes reduction formulae). • Be able to integrate using partial fractions that are linear in the denominator. • Be able to evaluate the analytical solution of simple first order differential equations with separate variables, including finding particular solutions. (Separation of variables may require factorisation involving a common factor). • Interpret the solution of a differential equation in the context of solving a problem, including identifying limitations of the solution; includes links to kinematics.	**Vectors – Pure 2 Chapter 12** Students will build on Y11 knowledge of vectors in order to: • Be able to use vectors in 2 and 3 dimensions.
Moments – Mechanics 2 Chapter 4 Students will begin to build on their schema in order to: • Calculate the turning effect of a force applied to a rigid body.	**Sequences and Series – Pure 2 Chapter 3** Students will build on knowledge of sequences in order to: • Be able to work with sequences including those given by a formula for the nth term and those

• Calculate the resultant moment of a set of forces acting on a rigid body. • Solve problems involving uniform rods in equilibrium, non-uniform rods and rods on the point of tilting.	generated by a simple term to term relationship. This includes increasing sequences, decreasing sequences and periodic sequences. • Understand and use sigma notation for the sums of series. • Understand and work with arithmetic sequences and series, including the formulae for nth term and the sum to n terms. The proof of the sum formula for an arithmetic sequence should be known including the formula for the sum of the first n natural numbers. • Understand and work with geometric sequences and series, including the formulae for the nth term and the sum of a finite geometric series; the sum to infinity of a convergent series, including the use of mod r < 1; modulus notation. • Be able to use sequences and series in modelling.
Applications of Forces – Mechanics 2 Chapter 7 Students will begin to use their knowledge to apply it so they can: • Find an unknown force when a system is in equilibrium. • Solve statics problems involving weight, tension and pulleys. • Understand and solve problems involving limiting equilibrium. • Solve problems involving motion on a rough or smooth inclined plane. • Solve problems involving connected particles that require the resolution of forces.	**Binomial Expansion – Pure 2 Chapter 4** Students will build on what they have learnt about binomial in Y12 to: • Understand and use the Binomial expansion of $(a+bx)^n$ for any rational n, including its use for approximation; be aware that the expansion is valid for mod $(\frac{bx}{a})$ <1.
Projectiles – Mechanics 2 Chapter 6 Students will continue to apply mechanics principles to: • Model motion under gravity for an object projected horizontally • Resolve velocity into components • Solve problems involving particles projected at an angle • Derive the formulae for time of flight, range and greatest height, and the equation of the path of a projectile	**Regression, Correlation and Hypothesis – Statistics 2 Chapter 1** Students will build on Y12 Stas to: • Understand exponential models in bivariate data • Use a change of variable to estimate coefficient in an exponential model • Understand and calculate the product moment correlation coefficient • Carry out a hypothesis test for zero correlation
Further Kinematics – Mechanics 2 Chapter 8 Students will use build on previous knowledge in order to:	**Conditional Probability – Statistics 2 Chapter 2** Students will use their knowledge of probability to learn to:

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- Work with vectors for displacement, velocity and acceleration when suing the vector equations of motion.
- Use calculus with harder functions of time involving variable acceleration.
- Differentiate and integrate vectors with respect to time.

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- Understand set notation in probability
- Understand conditional probability
- Solve conditional probability problems using two-way tables and Venn diagrams
- Use probability formulae to solve problems
- Solve conditional probability using tree diagrams

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Normal Distribution – Statistics 2 Chapter 3

Students will learn to:

- Understand the normal distribution and the characteristics of a normal distribution curve.
- Find percentage points on a standard normal curve.
- Calculate values on a standard normal curve
- Find unknown means and/or standard deviations for a normal distribution.
- Approximate a binomial distribution using a normal distribution.
- Select appropriate distributions and solve real-life problems in context.
- Solve conditional probability using tree diagrams.

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Revision

Students have now been exposed all content from Pure, Statistics and Mechanics. Students now enter the revision stage in class which predominantly takes the form of students practicing exam questions with teacher feedback. Students must be given time to get used to how the exam papers will be set, how to approach the exam papers and what is expected to gain all the marks available for each question.

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ENRICHMENT, SUPPORT, EXTRA-CURRICULAR

- Maths club
- National Maths Challenge
- Direct Instruction
- Functional Skills