

Key Stage 3

The purpose of our KS3 Maths curriculum is to inspire pupils, secure strong academic outcomes and to drive learners to think and work independently and with a powerful sense of curiosity. Pupils develop mathematical fluency and confidence because they are supported by a challenging curriculum that gives abundant opportunities to master their knowledge and understanding so that they can analyse, evaluate, make judgements and justify their reasoning.

Throughout Key Stage 3 pupils explore and extend their understanding of:

- our number system, and parts of wholes;
- number operations and calculation methods;
- relationships between sets of numbers, using algebra and graphs;
- the properties and measurements of 2-D and 3-D shapes;
- using and analysing data to inform us about our world.

Key Stage 4

During Key Stage 4 pupils extend the knowledge, skills and understanding developed in earlier Key Stages. A fundamental aim is to enable pupils to apply their knowledge logically and creatively. They see more challenging questions related to a wide variety of contexts and mature in their ability to reason mathematically, make deductions and inferences and draw conclusions. They are also taught to check and evaluate their methods and answers, assessing whether they are reasonable and make sense.

Key Stage 5

Studying Mathematics at KS5 invites pupils to enhance the breadth and depth of their mathematical knowledge covering pure maths, mechanics and statistics with a deeper emphasis on developing and assessing reasoning, problem-solving skills and modelling. A Level Mathematics challenges pupils to gain mastery in their subject in order to fully develop the skills required to study Mathematics, in any sense, at higher education.

KS5 is split into Mathematics and Further Mathematics, both of which are further split into Core and Applied topics.

The complexity of study increases and students engage with new mathematical concepts and methods, such as the binomial theorem.

KS3	Topics	Skills	Understanding	Assessment
Year 7	Analysing & displaying data	Tables & pictograms, bar charts, grouped data, mode & modal class, Range & median, Mean	Pupils will create or use a variety of frequency diagrams and measures of average to analyse simple data sets	<p>Each KPI is assessed either through an end of topic assessment</p> <p>KPI 1 Analysing and Displaying Data: Calculating averages and spread and using them to describe features of a variety of data types. Constructing and interpreting a range of graphs and understanding when they are appropriate to use.</p> <p>KPI 2 Number Skills: Knowing and using priority of operations. Using written methods for multiplication and division of numbers. Performing operations with positive and negative numbers. Understanding square numbers.</p> <p>KPI 3 Expressions, functions and formulae: Understanding functions as a relationship mapping input to output. Using letters to represent unknown numbers and recognising the different ways they can be manipulated. Applying inverse</p>
	Calculating / number skills	strategies for using the four operations, working with powers of 10, directed numbers	Pupils will be able to call upon various strategies to tackle various calculations. They will know how to work with large or small numbers and both positive and negative numbers	
	Expressions, functions and formulae	Functions, simplify expressions, Formulae	Pupils will be able to simplify simple expressions, understand how functions and formulae turn an input into an output and use some basic real-life formulae	
	Graphs and sequences	Real life graphs, co-ordinates, graphs of functions and sequences	Pupils will be able to produce and use a set of axes and plot co-ordinates in all four quadrants. They will plot sequences and the outputs of functions. They will interpret graphs of real-life situations.	
	Factors and multiples	Multiplying & dividing, factors, primes, HCF, LCM	Pupils will be able to identify factors and multiples of an integer, find the highest common factor and lowest common multiple of two or three integers. They will recognise prime numbers between 0 and 100 and be able to describe an integer in terms of its prime factors	

KS3	Topics	Skills	Understanding	Assessment
	Fractions	comparing & simplifying fractions, 4 operations with fractions, mixed numbers	Pupils will be able to order and simplify fractions, add/subtract fractions with common or differing denominators, multiply fractions by initially simplifying, dividing fractions, converting between mixed numbers and improper fractions	operations to solve equations and using substitution to evaluate formulae. KPI 4 Decimals and measure: Understanding the decimal system, including measuring, rounding and calculations. Understanding area and perimeter and associated formulae.
	Probability	language, probability scale, calculating probability, experimental probability	Pupils will use the language associated with probability, understand the probability scale, calculate the probability of single events and understand how theoretical and experimental probabilities may differ	KPI 5 Fractions: Comparing, simplifying and working with fractions. Converting between fractions, decimals and percentages. Understanding percentages and finding percentages of amounts.
	Angles, lines and shapes	measuring/drawing/estimating angles, angles: on a line/around a point/in a triangle/parallel lines/quadrilateral, constructing triangles	pupils will be able to measure, draw and estimate angles, as well as being able to calculate angles in a range of simple situations.	KPI 6 Probability: Understanding and comparing probabilities. Calculating theoretical probabilities and experimental probability.
	Equations	one & two step equations, trial & improvement	Pupils will be able to reverse functions in order to find unknown inputs. They will extend this concept to encompass the balance method in order to solve simple 1- or 2- step equations.	KPI 7 Ratio and Proportion: Understanding direct proportion and solving direct proportion problems. Using ratio, percentages and fractions to compare proportions.
	Multiplicative reasoning	direct proportion, ratio, fractions of quantities	Pupils will use the unitary method for calculating different quantities from known comparisons. This will be applied to proportion, equivalent ratios, fractions of quantities.	KPI 8 Angles and Shapes: Accurately constructing 2D shapes involving angles. Calculating angles in triangles and quadrilaterals.
	Perimeter, area and volume	Perimeter/area of simple shapes/compound shapes, Volume of prisms, surface area of prisms	Pupils will find the perimeter of simple shapes, begin to use formulae to calculate areas and volumes of simple shapes and solids, use correct units to describe Perimeter, area, volume.	

KS3	Topics	Skills	Understanding	Assessment
	Fractions, decimals and percentages	equivalence and converting, rounding, 4 operations, scales	Pupils will know common equivalences between fractions, decimals & percentages and be able to calculate the equivalences if not known. They will be able to round to the nearest integer/10/100 etc or to round to a given number of decimal places or significant figures. Pupils will be able to perform calculations involving fractions, decimals & percentages.	<p>KPI 9 Sequences and Graphs: Recognising, describing and generating number sequences. Working with coordinates on a grid and understanding the equation of a line as a function.</p> <p>KPI 10 Transformations: Enlarging, reflecting, rotating and translating 2D shapes on a coordinate grid.</p> <p>Each KPI is assessed either through an end of topic assessment</p> <p>KPI 1 Number: Choosing strategies for calculations by developing understanding of relationships between numbers. Understanding of prime factor decomposition and its applications.</p> <p>KPI 2 Area and Volume: Calculating the area and volume of a variety of simple and compound rectilinear shapes by use of the associated formulae.</p> <p>KPI 3 Statistics, Graphs and Charts: Calculating averages from tabulated</p>
	Transformations	symmetry, rotation, reflection, translation, enlargement, congruency, combinations	Pupils will be able to describe transformations, understand congruency and carry out simple transformations	
Year 8	Powers, Number properties and calculations	directed numbers, laws of indices, prime factor decomposition, powers of 10, estimation	Pupils will improve their knowledge of primes, factors, multiples, prime factors, LCM, HCF and the use of indices. They will round numbers in order to estimate calculations	
	2D Shapes and 3D solids	Nets of solids, surface area, volume, plans and elevations, construction, Pythagoras theorem	Pupils will understand how nets relate to their solids and consider them when calculating surface area. They will have an understanding of plans and elevations, constructions and will begin to use Pythagoras' theorem.	
	Statistics, graphs and charts	data collection, simple charts including bar- & stem and leaf, comparing data sets, scatter graphs	Pupils will create or use a variety of frequency diagrams and measures of average to analyse simple data sets	
	Expressions and equations	simplifying expressions, solving simple equations, factorising and expanding, algebraic powers, substitution	Pupils will be able to simplify expressions, solve one- or two-step equations, multiply across a bracket and factorise $ax+ab$ type	

KS3	Topics	Skills	Understanding	Assessment
			expressions. They will substitute positive and negative integers into simple formulae.	data. Understanding and interpreting a variety of graphs and charts used to represent and analyse data.
	Decimal calculations	ordering, rounding, 4 operations, place value, multiplicative reasoning, recurring decimals	Pupils will be able to put decimals (including recurring) in order, perform all four operations with decimals and solve proportion problems that include decimals.	KPI 4 Expressions and Equations: Manipulating algebraic identities and solving algebraic equations.
	Angles	angles in polygons, angles in parallel lines, bearings	Pupils will find missing angles in triangles and quadrilaterals, find angles in parallel lines and describe their reasoning, measure and draw bearings and back-bearings.	KPI 5 Real Life Graphs: Constructing and interpreting a variety of graphs in context.
	Sequences	generating, extending, recognising special sequences, position-to-term / term-to-term rules,	pupils will be able to continue a sequence, fill gaps in a sequence and describe in words the term-to-term and position-to-term rules for a sequence. They will be able to generate a sequence from a given rule and reason whether a number is a term of a sequence.	KPI 6 Decimals and Ratio: Deepening understanding of the decimal system and the variety of applications calculating with decimals. KPI 7 Lines and Angles: Understanding the properties of polygons and associated angle rules.
	Fractions, decimals and percentages	equivalence and converting, rounding, 4 operations, scales	Pupils will be able to recognise or calculate equivalent fractions and convert between fractions, decimals & percentages. They will perform calculations involving fractions, decimals & percentages and will round to a given number of decimal places or significant figures.	KPI 8 Calculating with Fractions: Using appropriate methods when calculating with fractions.
	Probability	language, probability scale, calculating probability, experimental probability, mutual exclusivity, tree diagrams	Pupils will use the language associated with probability and be able to relate these words to locations on the probability scale. They will describe the probability of single events and compare theoretical and experimental probabilities. They will be able to display the	KPI 9 Linear Graphs: Understanding the relationship between two quantities in direct proportion and its associated graph. Understanding the properties of linear graphs.

KS3	Topics	Skills	Understanding	Assessment
			probability of two events using a table or tree diagram.	<p>KPI 10 Percentages, decimals and Fractions: Understanding the equivalence of fractions, decimals and percentages and their uses to represent proportions of a whole.</p> <p>KPI 11 Probability: Understanding and comparing probabilities. Calculating theoretical probabilities and experimental probability.</p> <p>KPI 12 Transformations: Enlarging, reflecting, rotating and translating 2D shapes on a coordinate grid.</p> <p>KPI 13 Construction and Loci: Constructing accurate scale diagrams of a variety of 2D Shapes.</p>
	Area and volume	area & circumference of a circle	Pupils will recognise and understand the significance of Pi and be able to use it to find the area and circumference of circles.	
	Algebraic and real-life graphs	distance-time graphs, misleading graphs, interpreting financial graphs, $y=mx+c$	Pupils will be able to interpret and complete distance time graphs, describe what makes a misleading graph so, be able to describe trends. They will be able to describe linear graphs in terms of gradient and intercept and be able to relate that to the equation of a line. They will be able to use the equation of a line to create a linear graph.	
	Decimals and ratio	maps and scale, ratio & proportion with decimals	Pupils will be able to use scale in a drawing or map, including the use of decimals.	
	Calculating with Fractions	reciprocals, 4 operations with fractions & mixed numbers	pupils will be able to identify the reciprocal of an integer or fraction, be able to use the four operations with fractions and mixed numbers - including combinations thereof.	
	constructions and loci	Accurate drawings, constructing shapes, Loci	Pupils will be able to use compass and protractor to construct loci, triangles and angles. They will identify regions in a diagram that satisfy criteria involving Loci, Scale and inequalities.	

KS3	Topics	Skills	Understanding	Assessment
	Transformations	Reflection, rotation, translation, enlargement, combinations, 2D&3D applications	Pupils will recognise, describe and draw all four transformations in isolation and in combination.	
Year 9	Number Calculations	directed numbers, laws of indices, prime factor decomposition, powers of 10, estimation, bounds	Pupils will perform calculations with positive & negative numbers, work with indices, express numbers as a product of prime factors, consider place value/ order of magnitude when making calculations round numbers in order to estimate calculations and consider bounds.	Each KPI is assessed either through an end of topic assessment KPI 1 Indices and Standard Form: Understanding indices; manipulation and associated conventional notation.
	Sequences, graphs, inequalities and equations, real-life graphs	Reading/Plotting graphs, midpoints, intercepts and gradients, arithmetic/non-linear/geometric sequences, position-to-term/term-to-term rules, $y=mx+c$, quadratic and other non-linear functions, rates of change, solving inequations	Pupils will plot sequences as graphs and the relate the inputs and outputs of functions. They will interpret graphs of real-life situations. They will extend their experience in solving equations to encompass solutions to inequalities.	KPI 2 Expressions and Formulae: Manipulating algebraic identities and solving algebraic equations. KPI 3 Dealing with Data: Performing all stages of the Data Handling Cycle form planning an enquiry through to presenting findings and conclusions.
	Statistics	data collection, simple charts including bar-pi- & stem and leaf, comparing data sets, scatter graphs, averages, comparing data, estimating, cumulative frequency & box plots, histograms	Pupils will consider methods of data collection and presentation in order to compare data sets, identify trends and make predictions. This will include the use of cumulative frequency, box plots & histograms.	KPI 4 Multiplicative Reasoning: Deepening understanding of proportional variation in a range of contexts.
	Fractions, decimals and percentages	equivalence and converting, rounding, 4 operations, scales, recurring decimals, percentage change	Pupils will be able to recognise or calculate equivalent fractions and convert between fractions, decimals & percentages. They will perform calculations involving fractions, decimals & percentages and will round to a given number of decimal places or significant figures.	KPI 5 Constructions: Constructing accurate scale diagrams of a variety of 2D Shapes.

KS3	Topics	Skills	Understanding	Assessment
	Geometry in 2D Shapes and 3D solids	Angles & constructions, Pythagoras' theorem, geometric formulae, compound shapes/circles, congruency, loci	Pupils will be able to use geometry equipment to construct angles, shapes and loci. They will use Pythagoras' theorem in 2D & 3D. They will calculate angles in polygons, areas and perimeters of compound shapes. They will present arguments for congruency.	<p>KPI 6 Sequences, inequalities, Equations and proportion: Understanding nth term of linear and non-linear sequences. Understanding differences and similarities between solving equations and inequalities.</p> <p>KPI 7 Circles, Pythagoras and Prisms: Calculating lengths and areas of triangles and circles using the associated formulas involving Pythagoras and Pi.</p> <p>KPI 8 Graphs: Drawing and interpreting linear graphs presented in a variety of ways.</p> <p>KPI 9 Probability: Identifying mutually exclusive events and using the associated notation. Using a variety of diagrams to visualise and solve probability problems.</p> <p>KPI 10 Comparing Shapes: Understanding congruency and similarity. Solving geometrical problems using Trigonometry.</p> <p>KPI 11 Percentages, decimals and Fractions: Understanding the equivalence of fractions, decimals and</p>
	Multiplicative reasoning	direct proportion, rates of change, scales & ratio, similarity, non-linear proportion, arcs & sectors of circles	Pupils will use algebra to find a constant of proportionality, hence using algebra to solve problems involving proportion. They will work with compound measures such as speed, density and pressure. They will calculate missing sides on similar shapes and will find arc lengths and sector areas.	
	Algebraic and geometric formulae	using & finding nth term, changing the subject, substitution,	Pupils will find the n th term of arithmetic linear and quadratic sequences. They will describe the progression of geometric sequences. Pupils will rearrange simple formulae and substitute into formulae.	
	Probability	language, probability scale, calculating probability, experimental probability, mutual exclusivity, tree diagrams, sample space, 2-way tables, independent events	Pupils will describe the probability of single and combined events and compare theoretical and experimental probabilities. They will be able to display the probability of two events using a table or tree diagram, taking into account mutual exclusivity and independence.	
	Indices and standard form	standard form, fractional/negatives indices, surds	Pupils will be able to convert between large and small numbers written normally and in standard form, as well as doing basic calculations within standard form. They will simplify expressions involving positive and	

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			negative indices and be able to simplify surds.	percentages and their uses to represent proportions of a whole.
	Quadratics	graphs of quadratics, solving quadratic equations	Pupils will be able to sketch or plot graphs of quadratics and recognise various features of the graph. Pupils will solve quadratics graphically, by factorising and by using the quadratic formula.	
	Trigonometry	sin/cos/tan in right angled triangles, graphs of functions	Pupils will use and understand trigonometry as it applies to right angled triangles. They will be familiar with and be able to make use of the graphs of the 3 trigonometrical ratios.	
	Mathematical reasoning	proof	Pupils will be able to demonstrate rudimentary mathematical proofs, using common algebraic conventions and/or by referring to established geometrical principals.	

KS4	Topics	Skills	Understanding	Assessment
	Number and Place value	4 operations of number, Rounding and Estimation. BIDMAS and place	pupils will be able to apply 4 Operations and Estimation to wordy questions in context	Summative assessments after every topic based on the scheme of work.

KS4	Topics	Skills	Understanding	Assessment
			and be able to justify if it is an over or under estimate.	Covering all content from that topic. Year 10 exam week: 2x 1h45m exams covering all content. Year 11 mock exam week: 3x 1h45min exams covering all content Year 11 2 nd mock: 2x 1h45m exams covering all content. Foundation Only: KPI: Real Life and linear Graphs (F) KPI: Algebra, Manipulation, Solving and Sequences (F) KPI: Quadratic equations and Graphs (F) Foundation Only: Foundation Only: Foundation and Higher: KPI: Integers, Indices, Factors, Multiples, Primes, Standard Form and Surds (F/H)
	Indices, Roots, Reciprocals , Surds and BIDMAS	Rules of indices including fractional and negative indices, Standard form, Surds,	Pupils will be able to apply Standard Form and Surds in context.	
	Number properties - Factors, Multiples, Primes	HCF, LCM, Prime factor decompositions,	Solve problems using HCF, LCM and Prime Factors	
	Expressions	Manipulate and Simplify Algebraic Expressions, Expand and Simplify Brackets, Factories Brackets, Difference of Two Squares. Simplify Algebraic Fractions.	Pupils will be able to form an Algebraic Expression, show that Mathematical Expressions are equivalent.	
	Solving equations.	Solve Linear Equations with; unknowns on both sides, brackets and Fractional Coefficients. Rearranging equations. Simultaneous Equations, Solving Quadratics by Factorizing, Quadratic Formula and Completing the Square. Iteration. Inequalities	Pupils will be able to form and solve an equation. Identify an appropriate method to solve a quadratic equation. Use algebra to solve a problem in context.	
	Fractions	4 Operations, Equivalence, Converting Fractions to Decimals and back again. Fraction Amounts.	Pupils will be able to apply fraction skills to questions in context.	
	Linear Graph	Distance time graphs. Drawing linear graphs, $y=mx+c$, identifying perpendicular/parallel graphs.	Pupils will be able to draw a graph using a variety of methods including Intercept Gradient method and Cover Up method. Be able to interpret a Distance Time graph and identify Direct Proportion from a graph. Pupils will be able to use graphs to solve Simultaneous Equations.	
	Sequences	linear Sequences, Quadratic Sequences and Geometric Sequences. Fibonacci Sequence and Substitution.	Pupils will be able to generate a Linear or Quadratic sequence. Pupils will be able to find the nth term of a Linear or Quadratic	

KS4	Topics	Skills	Understanding	Assessment
			sequence and use the nth term to solve a problem. Pupils will be able to understand the difference between a GP and an AP.	KPI: Collecting and Processing Data (F/H)
	Percentages	Percentage Amounts, Percentage Increase/Decrease. Percentage Change, Compound Interest and Depreciation, Reverse Percentages	Pupils will be able to solve a variety of problems, including finance problems, using different percentage calculations.	KPI: Fractions, Percentages, Ratios and proportion (F/H)
	Ratio and Proportions & Similarity	Simplifying Ratio, Ratio Amounts, 3 Part Ratios, Scales, Compound Measures, Direct and Inverse Proportion, Capture Recapture. Similar Shapes.	Pupils will be able to tackle a variety of contextual problems using Ratio and Proportion. They will be able to apply Capture Recapture appropriately and solve problems using Direct and Inverse proportion. Pupils will be able to use the principals of Similarity to find missing lengths/area and volumes.	KPI: Angles Polygons and Pythagoras and Trigonometry (F/H)
	Polygons and Angles	Angles in Polygon, Angles and Parallel lines, Properties of Shape, Bearings, Constructing angles. Simple Circle Theorems.	Pupils will be able to use all the different properties of Angles to solve multistep problems, in a range of problems. The angle rules will be applied to bearings. Pupils will start to use circle theorems to solve problems.	KPI: Perimeter, Area and Volume (F/H)
	Pythagoras and Trigonometry	Pythagoras, Trigonometry in right and triangles, Sine Rule and Cosine Rule.	Pupils will be able to identify the appropriate skill to use when solving a problem that uses Pythagoras and Trigonometry and then apply it to the problem.	KPI: Transformations and Construction (F/H)
	Perimeter, Area and Volume, Bounds	Area of Squares, Rectangles, Triangles, Trapezium and Circles. Volume of Prisms, Cylinders and Cones and Spheres. Perimeter and Area of Sectors. Upper and Lower bounds.	Pupils will be able to use areas and volumes to work out questions in a range of contexts. Pupils will be able analyse critically the validity of their results.	KPI: Probability (F/H)
				KPI: Multiplicative Reasoning (F/H)
				KPI: Similarity, Congruence and Vectors (F/H)
				Higher only: KPI: Graphs - Linear, Real life, Quadratic, cubic and other Graphs (H)
				KPI: Rearranging, Solving Equations and sequences (H)

KS4	Topics	Skills	Understanding	Assessment
	Probability	Sample Space Diagrams, Venn Diagrams, Frequency Trees, Two Way Tables and Tree Diagrams. AND Rule and the OR Rule to work out Probability.	Pupils will be able to calculate the probability of an Event happening by using Tree Diagrams, AND/OR Rule and Two-Way Tables. Pupils will able to analyse the reliability of their results and justify the probability of events happening or not happening. Pupils will understand the importance of working systematically to find all outcomes.	KPI: Algebra - Further Manipulation, Algebraic Fractions, Proof and Rationalising Surds (H) KPI: Sketching Graphs, Graphs of Circles, Cubes and Quadratics (H)
	Direct and inverse proportion	Direct and Inverse Proportion, Graphically and Algebraically.	Pupils will recognize when values are in Direct Proportion Algebraically and Graphically. Pupils will be able to set up and use equations to solve problems on Proportion.	KPI: Circle Theorems (H) KPI: Further Trig and Trig Graphs (H)
	Averages and Range	Pupils will be able to interpret a scatter graphs considering outliers and one the line of best fit to interpolate results. Pupils will understand the difference between causation and correlation. Compare and interpret box plots and understand the advantages of interquartile range over range. Pupils will be able to interpret Histograms.	Pupils will be able interpret, compare and comment on different distributions and consider outliers. They will recognize the advantages and disadvantages of different measures of Averages.	KPI: Reciprocal and Exponential Graphs, Direct and Inverse Proportion (H)
	Representing and Interpreting Data and Scatter Graphs	Scatter graphs, time-series graphs histograms and cumulative frequency graphs.	Pupils will be able to interpret a scatter graphs considering outliers and one the line of best fit to interpolate results. Pupils will understand the difference between causation and correlation. Compare and interpret box plots and understand the advantages of interquartile range over range. Pupils will be able to interpret Histograms.	

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	Sampling and Questionnaires	Questionnaires, Sampling Techniques and Stratified Sampling.	Pupils will be able to construct and critically analyse a Questionnaire/Survey. They will understand the limitations of their data and be able to comment how a sample size and collection method will lead to possible bias.	
	Circle Theorems	Circle Theorems, parts of a Circle.	Pupils will be able to apply Circle Theorems to Geometric Problems.	
	Transformations	Rotation, Reflection, Enlargement and Transformation.	Pupils will be able to use a variety of Scale Factors including Negative and Fractional. They will be able to describe fully a Transformation using correct subject specific language. Pupils will be able to apply a Combination of Transformations.	
	Non-Linear Graphs -	Quadratic, Cubic and other Graphs. Transformation of Graphs	Pupils will be able to plot and sketch a variety of nonlinear graphs. Pupils will be able to apply transformations to a variety of functions.	
	Plans, Elevations, Constructions, Loci, Similarity and Bearings	Construct Triangles, Construct Loci, Similarity Problems and Congruency. Draw Bearings	Pupils will be able Construct Bearings and find Return Bearings, understand that triangles satisfy SSS, SAS, ASA and RHS to solve problems including proofs with Congruency and Similarity. Pupils will be able to draw a shape in 3D from its Plan and Elevations.	
	Vectors and Geometric Proof	Vectors and Geometric Proof	Pupils will understand and use Vector notation, including Column Notation. They will be able to represent combination of Vectors pictorially. Pupils will be able to calculate the resultant of two Vectors and	

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			produce proofs to prove points are Collinear and lines are Parallel	
	Reciprocal and Exponential Graphs; Gradient and Area under Graphs	Reciprocal and Exponential Graphs; Gradient and Area under Graphs	Pupils will be able to sketch and interpret graphs of the Reciprocal and Exponential Function, Estimate the Area Under a Quadratic Graph using the Trapezium Rule. Interpret the rate of change demonstrated on a graph. To be able to find and interpret the Gradient of a Non- Linear Graph.	
	Proof	proof	Pupils will be able to use and apply a variety of Algebraic and Geometric proofs using known facts.	

KS5	Topics	Skills	Understanding	Assessments
Year 12 Core	Algebraic Expressions	Index laws, expanding brackets, factorising, negative and fractional indices, surds, rationalising denominators.	Pupils will multiply and divide integer powers, expand a single term over brackets and collect like terms, expand the product of two or three expressions, factorise linear, quadratic and simple cubic expressions, know and use the laws of indices, simplify and use the rules of surds, rationalise denominators.	Summative assessments after every topic based on the scheme of work. Covering all content from that topic. Mathematics A-Level <u>Year 12 mock week:</u> 1x 2h Pure Maths exam covering all content.
	Quadratics	Solving quadratic equations, completing the square, functions,	Pupils will solve quadratic equations using factorisation, the quadratic formula and	

KS5	Topics	Skills	Understanding	Assessments
		quadratic graphs, the discriminant, modelling with quadratics.	completing the square, read and use $f(x)$ notation when working with functions, sketch the graph and find the turning point of a quadratic expression, use and apply models that involve quadratic functions.	1x 1h30min Applied Maths exam covering all content <u>Year 13 mock exam week:</u> 2x 2h Pure Maths exams covering all content.
	Equations and inequalities	Linear simultaneous equations, quadratic simultaneous equations, linear inequalities, quadratic inequalities, inequalities on graphs, regions.	Pupils will solve linear simultaneous equations using elimination or substitution, solve simultaneous equations: one linear and one quadratic, interpret algebraic solutions of equations graphically, solve linear inequalities, solve quadratic inequalities, interpret inequalities graphically, represent linear and quadratic inequalities graphically.	1x 2h Applied Maths exam covering all content Further Mathematics A-Level <u>Year 12 mock week:</u>
	Graphs and transformations	Cubic graphs, quartic graphs, reciprocal graphs, points of intersection, translating graphs, stretching graphs, transforming functions.	Pupils will sketch cubic, quartic and reciprocal graphs, use intersection points of graphs to solve equations, translate graphs, sketch graphs, transform graphs of unfamiliar graphs.	1x 2h Pure Maths exam covering all content. 1x 1h40min Applied Maths exam covering all content
	Straight line graphs	$y=mx+c$, equations of straight lines, parallel and perpendicular lines, length and area, modelling with straight lines.	Pupils will calculate the gradient of a line joining a pair of points, understand the link between the equation of a line and its gradient and intercept, find the equation of a line given either the gradient and one point or two points on the line, find the point of intersection for a pair of straight lines, know and use the rules for parallel and perpendicular gradients, solve length and area problems on coordinate grids, use straight line graphs to construct mathematical models.	<u>Year 13 mock exam week:</u> 1 x 2h Pure Maths exams covering all content. 2 x 1.5h Applied Maths exam covering all content

KS5	Topics	Skills	Understanding	Assessments
	Circles	Midpoints and perpendicular bisectors, equation of a circle, intersections of straight lines and circles, use tangent and chord properties, circles and triangles.	Pupils will find the midpoint of a line segment, find the equation of the perpendicular bisector to a line segment, know how to find the equation of a circle, solve geometric problems involving straight lines and circles, use circle properties to solve problems on coordinate grids, find the angle in a semicircle and solve other problems involving circles and triangles.	
	Algebraic Methods	Algebraic fractions, dividing polynomials the factor theorem, mathematical proof, methods of proof.	Pupils will cancel factors in algebraic fractions, divide a polynomial by a linear expression, use the factor theorem to factorise a cubic expression, construct mathematical proofs using algebra, use proof by exhaustion and disproof by counter-example.	
	The binomial expansion	Pascal's triangle, factorial notation, the binomial expansion, solving binomial problems, binomial estimation.	Pupils will use Pascal's triangle to identify binomial coefficients and use them to expand simple binomial expressions, use combinations and factorial notation, use the binomial expansion to expand brackets, find individual coefficients in a binomial expansion, make approximations using the binomial expansion.	
	Trigonometric ratios	The cosine rule, the sine rule, area of triangles, solving triangle problems, graphs of sine cosine and tangent, transforming trigonometric graphs.	Pupils will use the cosine rule to find a missing side or angle, use the sine rule to find a missing side or angle, find the area of a triangle using an appropriate formula. Solve problems involving triangles, sketch the graphs of the sine, cosine, tangent functions and simple transformations of these functions.	

KS5	Topics	Skills	Understanding	Assessments
	Trigonometric identities and equations	Angles in all four quadrants, exact values of trigonometric ratios, trigonometric identities, simple trigonometric equations, harder trigonometric equations, equations and identities.	Pupils will calculate the sine, cosine and tangent of any angle, know the exact trigonometric ratios for 30,45 and 60 degrees, know and use the relationships between $\tan = \sin/\cos$ and $\sin^2 + \cos^2 = 1$, solve simple trigonometric equations, solve more complicated trigonometric equations, some of which produce quadratics.	
	Vectors	Vectors, representing vectors, magnitude and direction, position vectors, solving geometric problems, modelling with vectors.	Pupils will use vectors in two dimensions, use column vectors and carry out arithmetic operations on vectors, calculate the magnitude and direction of a vector, understand and use position vectors, use vectors to solve geometric problems, understand vector and magnitude and use vectors in speed and distance calculations, use vectors to solve problems in context.	
	Differentiation	Gradients of curves, finding the derivative, differentiating simple, differentiating quadratics, differentiation functions with two or more terms, gradients tangents and normal, increasing and decreasing functions, second order derivatives, stationary points, sketching gradient functions, modelling with differentiation.	Pupils will find the derivative of simple functions, solve problems involving gradients, tangents, and normals, identify increasing and decreasing functions, find second order derivatives of simple functions, find stationary points of functions and determine their nature, sketch the gradient function of a given function, model real-life situations with differentiation.	
	Integration	Simple integration, indefinite integrals, finding functions, definite integrals, areas under curves, areas under the x-axis, areas between curves and lines.	Pupils will find y given dy/dx , integrate polynomials, find $f(x)$ given $f'(x)$ and a point on the curve, evaluate definite integrals, find the area bounded by a curve and the x-axis,	

KS5	Topics	Skills	Understanding	Assessments
			find areas bounded by curves and straight lines.	
	Exponentials and logarithms	Exponential functions, e , exponential modelling, logarithms, solving equations using logarithms, working with natural logarithms, logarithms and non-linear data.	Pupils will sketch exponential graphs and be able to transform them, differentiate e^{kx} and understand its importance, use and interpret models that use exponential functions, recognise the relationships between exponents and logarithms, recall and apply the laws of logarithms, solve exponential equations, describe and use the natural log function, use logarithms to estimate the values of constants in non-linear models.	
Year 12 Statistics	Data collection	Populations and samples, sampling, non-random sampling, types of data, the large data set.	Pupils will understand 'population', 'sample' and 'census' and comment on the advantages and disadvantages of each, understand the pros and cons of simple random sampling, systematic sampling, stratified sampling, quota sampling, and opportunity sampling, define qualitative quantitative, discrete and continuous data and understand grouped data, understand the large data set and how to collect data from it, identify types of data and calculate simple statistics.	
	Measures of location and spread	Measures of central tendency, other measures of location, measures of spread, variance and standard deviation, coding.	Pupils will calculate measures of central tendency such as the mean, median and mode, calculate measures of location such as percentiles and deciles, calculate measures of spread such as range, interquartile range and interpercentile range, calculate variance and standard deviation, understand and use coding.	

KS5	Topics	Skills	Understanding	Assessments
	Representations of data	Outliers, box plots, cumulative frequency, histograms, comparing data.	Pupils will identify outliers in data sets, draw and interpret box plots, draw and interpret cumulative frequency diagrams and histograms, compare two data sets.	
	Correlation	Correlation, linear regression.	Pupils will draw and interpret scatter diagrams for bivariate data, interpret correlation and understand that it does not imply causation, interpret the coefficients of a regression line equation for bivariate data, understand when you can use a regression line to make predictions.	
	Probability	Calculating probabilities, Venn diagrams, mutually exclusive and independent events, tree diagrams.	Pupils will calculate probabilities for single events, draw and interpret Venn diagrams, understand mutually exclusive and independent events, and determine whether two events are independent, use and understand tree diagrams.	
	Statistical distributions	Probability distributions, the binomial distribution, cumulative probabilities.	Pupils will understand and use simple discrete probability distributions including the discrete uniform distribution, understand the binomial distribution as a model and comment on appropriateness, calculate individual probabilities for the binomial distribution, calculate cumulative probabilities for the binomial distribution.	
	Hypothesis testing	Hypothesis testing, finding critical values, one-tailed tests, two-tailed tests.	Pupils will understand the language and concept of hypothesis testing, understand that a sample used to make an inference about a population, find critical values of a binomial distribution using tables, carry out one and two-tailed tests for the proportion	

KS5	Topics	Skills	Understanding	Assessments
			of the binomial distribution and interpret the results.	
Year 12 Mechanics	Modelling in mechanics	Constructing a model, modelling assumptions, quantities and units, working with vectors.	Pupils will understand how the concept of a mathematical model applies to mechanics, understand and be able to apply some of the common assumptions used in mechanical models, know SI units for quantities and derived quantities used in mechanics, know the difference between scalar and vector quantities.	
	Constant acceleration	Displacement-time graphs, velocity-time graphs, constant acceleration formulae 1, constant acceleration formulae 2, vertical motion under gravity.	Pupils will understand and interpret displacement-time and velocity-time graphs, derive the constant acceleration formulae and use them to solve problems, use the constant acceleration formulae to solve problems involving vertical motion under gravity.	
	Forces and motion	Force diagrams, forces as vectors, forces and acceleration, motion in 2 dimensions, connected particles, pulleys.	Pupils will draw force diagrams and calculate resultant forces by adding vectors, understand and use Newton's first law, understand and use Newton's second law $F=ma$, apply Newton's second law to vector forces and acceleration, understand and use Newton's third law, solve problems involving connected particles.	

KS5	Topics	Skills	Understanding	Assessments
	Variable acceleration	Functions of time, using differentiation, maxima and minima problems.	Pupils will understand that displacement, velocity and acceleration may be given as functions of time, use differentiation to solve kinematics problems, use calculus to solve problems involving maxima and minima, use integration to solve kinematics problems, use calculus to derive constant acceleration formulae.	
Year 13 Core	Algebraic methods	Proof by contradiction, algebraic fractions, partial fractions, repeated factors, algebraic division.	Pupils will use proof by contradiction to prove true statements, multiply and divide two or more algebraic fractions, add or subtract two or more algebraic fractions, convert an expression with linear factors into the denominator into partial fractions, convert an expression with repeated linear factors in the denominator into partial fractions, divide algebraic expressions, convert an improper fraction into partial fraction form.	
	Functions and graphs	The modulus function, functions and mappings, composite functions, inverse functions, $y=f(x)$ and $y=f(x)$, combining transformations, solving modulus problems.	Pupils will understand and use the modulus function, understand mappings and functions and use domain and range, combine two or more functions to make a composite function, know how to find the inverse of a function graphically and algebraically, sketch the graphs of the modulus functions $y= f(x) $ and $y=f(x)$, apply a combination of two or more transformations to the same curve, transform the modulus function.	

KS5	Topics	Skills	Understanding	Assessments
	Sequences and series	Arithmetic sequences, arithmetic series, geometric sequences, geometric series, sum to infinity, sigma notation, recurrence relations, modelling with series.	Pupils will find the nth term of an arithmetic sequence, prove and use the formula for the sum of the first n terms of an arithmetic series, find the nth term of a geometric sequence, prove and use the formula for the sum of a finite geometric series, prove and use the formula for the sum to infinity of a convergent geometric series, use sigma notation to describe series, generate sequences from recurrence relations, model real-life situations with sequences and series.	
	Binomial expansion	Expanding $(1+x)^n$, expanding $(a+bx)^n$, using partial fractions.	Pupils will expand $(1+x)^n$ for any rational constant n and determine the range of values of x for which the expansion is valid, expand $(a+bx)^n$ for any rational constant n and determine the range of values for which the expansion is valid. Use partial fractions to expand fractional expressions.	
	Radians	Radian measure, arc length, areas of sectors and segments, solving trigonometric equations, small angle approximations.	Pupils will convert between degrees and radians and apply this to trigonometric graphs and their transformations, know exact values of angles measured in radians, find an arc length using radians, find area of sectors and segments using radians, solve trigonometric equations in radians, use approximate equations in radians, use approximate trigonometric values when theta is small.	

KS5	Topics	Skills	Understanding	Assessments
	Trigonometric functions	Secant cosecant and cotangent, graphs of $\sec x$, $\operatorname{cosec} x$ and $\cot x$, using $\sec x$, $\operatorname{cosec} x$ and $\cot x$, trigonometric identities, inverse trigonometric functions.	Pupils will understand the definitions of secant, cosecant and cotangent and their relationship to cosine sine and tangent, understand the graphs of each of these and their domain and range, simplify expressions, prove simple identities and solve equations involving secant cosecant and cotangent, prove and use $\sec^2 = 1 + \tan^2 x$ and $\operatorname{cosec}^2 = 1 + \cot^2$, understand and use inverse trigonometric functions and their domain and ranges.	
	Trigonometry and modelling	Addition formulae, using the angle addition formulae, double-angle formulae, solving trigonometric equations, simplifying $a \cos x + b \sin x$, proving trigonometric identities, modelling with trigonometric functions.	Pupils will prove and use the addition formulae, understand and use the double-angle formulae, solve trigonometric equations using these formulae, write expressions of the form $a \cos x + b \sin x$ in the forms $R \cos$ or $R \sin$, prove trigonometric identities using a variety of identities, use trigonometric functions to model real-life situations.	
	Parametric equations	Parametric equations, using trigonometric identities, curve sketching, points of intersection, modelling with parametric equations.	Pupils will convert parametric equations into Cartesian form by substitution and trigonometric identities, understand and use parametric equations of curves and sketch parametric curves, solve coordinate geometry problems involving parametric equations and use parametric equations in modelling in a variety of contexts.	
	Differentiation	Differentiating $\sin x$ and $\cos x$, differentiating exponentials and logarithms, the chain rule, the product rule, the quotient rule, differentiating trigonometric	Pupils will differentiate trigonometric functions, exponentials and logarithms, functions using the chain, product and quotient rules, parametric equations, functions which are defined implicitly, use	

KS5	Topics	Skills	Understanding	Assessments
		functions, parametric differentiation, implicit differentiation, using second derivatives, rates of change.	the second derivative to describe the behaviour of a function, solve problems involving connected rates of change and construct simple differential equations.	
	Numerical methods	Locating roots, iteration, the Newton-Raphson method, applications to modelling.	Pupils will locate roots of $f(x)=0$ by considering changes of sign, use iteration to find an approximation to the root of the equation $f(x)=0$, use the Newton-Raphson procedure to find approximations to the solutions of equations of the form $f(x)=0$, use numerical methods to solve problems in context.	
	Integration	Integrating standard functions, integrating $f(ax+b)$, using trigonometric identities, reverse chain rule, integration by substitution, integration by parts, partial fractions, finding areas, the trapezium rule, solving differential equations, modelling with differential equations.	Pupils will integrate standard mathematical functions including trigonometric and exponential functions and use the reverse of the chain rule to integrate functions of the form $f(ax+b)$, use trigonometric identities in integration, use the reverse of the chain rule to integrate more complex functions, integrate functions by making a substitution, using integration by parts and using partial fractions, use the trapezium rule to approximate the area under a curve, use integration to find the exact area under a curve, solve simple differential equations and model real-life situations with differential equations.	
	Vectors	3D coordinates, vectors in 3D, solving geometric problems, application to mechanics.	Pupils will understand 3D Cartesian coordinates, use vectors in three dimensions, use vectors to solve geometric problems, model 3D motion in mechanics with vectors.	

KS5	Topics	Skills	Understanding	Assessments
Year 13 Statistics	Regression, correlation and hypothesis testing.	Exponential models, measuring correlation, hypothesis testing for zero correlation.	Pupils will understand exponential models in bivariate data, use a change of variable to estimate coefficients in an exponential model, understand and calculate the product moment correlation coefficient, carry out a hypothesis test for zero correlation.	
	Conditional probability	Set notation, conditional probability, conditional probabilities in Venn diagrams, probability formulae, tree diagrams.	Pupils will understand set notation in probability, understand conditional probability, solve 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.	
	The normal distribution	The normal distribution, finding probabilities of normal distributions, the inverse normal distribution function, the standard normal distribution, finding mu and sigma, approximating a binomial distribution, hypothesis testing with the normal distribution.	Pupils will understand the normal distribution and the characteristics of a normal distribution curve, calculate values on a standard normal curve, find percentage points 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, carry out a hypothesis test for the mean of a normal distribution.	
Year 13 Mechanics	Moments	Moments, resultant moments, equilibrium, centres of mass, tilting.	Pupils will calculate the turning effect of a force applied to a rigid body, calculate the resultant moment of a set of forces acting on a rigid body, solve problems involving uniform rods in equilibrium, solve problems involving non-uniform rods and rods on the point of tilting.	

KS5	Topics	Skills	Understanding	Assessments
	Forces and friction	Resolving forces, inclined planes, friction.	Pupils will resolve forces into components, use the triangle law to find a resultant force, solve problems involving smooth or rough inclined planes, understand friction and the coefficient of friction.	
	Projectiles	Horizontal projection, horizontal and vertical components, projection at any angle, projectile motion formulae.	Pupils will 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.	
	Applications of forces	Static particles, modelling with statics, friction and static particles, static rigid bodies, dynamics and inclined planes, connected particles.	Pupils will 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 rough or smooth inclined planes and connected particles that require the resultant force.	
	Further kinematics	Vectors in kinematics, vector methods with projectiles, variable acceleration in one dimension, differentiating vectors, integrating vectors.	Pupils will work with vectors for displacement, velocity and acceleration when using the vector equations of motion, use calculus with harder functions of time involving variable acceleration, differentiate and integrate vectors with respect to time.	
Year 12 Further Core	Complex numbers	Imaginary and complex numbers, multiplying complex numbers, complex conjugation, roots of quadratic equations, solving cubic and quartic equations.	Pupils will understand and use the definitions of imaginary and complex numbers, add and subtract complex numbers, multiply complex numbers, understand the definition of a complex conjugate, divide complex numbers, solve	

KS5	Topics	Skills	Understanding	Assessments
			quadratic equations that have complex roots, solve cubic or quartic equations that have complex roots.	
	Argand diagrams	Argand diagrams, modulus and argument, modulus-argument form of complex numbers, loci in the argand diagram, regions in the argand diagram.	Pupils will show complex numbers on an Argand diagram, find the modulus and argument of a complex number, write a complex number in modulus-argument form, represent loci on an Argand diagram, represent regions on an Argand diagram.	
	Series	Sums of natural numbers, sums of squares and cubes.	Pupils will use standard results for summation of series in $1, r, r^2$ and r^3 . Pupils will evaluate and simplify the summation of series in the form $f(r)$ where $f(r)$ is linear, quadratic or cubic.	
	Roots of polynomials	Roots of a quadratic equation, roots of a cubic equation, roots of a quartic equation, expressions relating to the roots of a polynomial, linear transformations of roots.	Pupils will derive and use the relationships between the roots of quadratic, cubic, and quartic equations, evaluate expressions relating to the roots of polynomials, find the equation of a polynomial whose roots are a linear transformation of the roots of a given polynomial.	
	Volumes of revolution	Volumes of revolution around the x-axis, Volumes of revolution around the y-axis, adding and subtracting volumes, modelling with volumes of revolution.	Pupils will find the volume of revolution when a curve is rotated around the x or y-axis, find more complicated volumes of revolution, model real-life objects using volumes of revolution.	
	Matrices	Introduction to matrices, matrix multiplication, determinants, inverting a 2×2 matrix, inverting a 3×3	Pupils will understand the concept of a matrix, define the zero and identity matrices, multiply a matrix by a scalar, multiply	

KS5	Topics	Skills	Understanding	Assessments
		matrix, solving systems of equations using matrices.	matrices, calculate the determinant of a matrix, find the inverse of a matrix, use matrices to solve systems of equations, interpret simultaneous equations geometrically.	
	Linear transformations	Linear transformations in two dimensions, reflections and rotations, enlargements and stretches, successive transformations, linear transformations in three dimensions, the inverse of a linear transformation.	Pupils will understand the properties of linear transformations and represent them using matrices, perform reflections and rotations using matrices, carry out enlargements and stretches using matrices, find the coordinates of invariant points and the equations of invariant lines, carry out successive transformations using matrix products, understand linear transformations in three dimensions, use inverse matrices to reverse linear transformations.	
	Proof by induction	Proof by mathematical induction, proving divisibility results, proving statements involving matrices.	Pupils will understand the principle of proof by mathematical induction and prove results about sums of series, prove results about divisibility using induction, prove results about matrices using induction.	
	Vectors	Equation of a line in three dimensions, equation of a plane in three dimensions, scalar product, calculating angles between lines and planes, points of intersection, finding perpendiculars.	Pupils will understand and use the vector and Cartesian forms of the equation of a straight line in three dimensions and the equation of a plane, calculate the scalar product for two 3D vectors, calculate the angle between: two vectors, two lines, a line and a plane, or two planes. They will understand and use the scalar product form of the equation of a plane, determine whether two lines meet and determine the point of intersection, calculate the	

KS5	Topics	Skills	Understanding	Assessments
			perpendicular distance between: two lines, a point and a line, or a point and a plane.	
Year 13 Futher Core	Complex numbers	Exponential form of complex numbers, multiplying and dividing complex numbers, De Moivre's theorem, trigonometric identities, sums of series, nth roots of a complex number, solving geometric problems.	Pupils will express a complex number in exponential form, multiply and divide complex numbers in exponential form, understand de Moivre's theorem, use de Moivre's theorem to derive trigonometric identities and to find sums of series, know how to solve completely equations of the form $Z^n - a - ib = 0$, use complex roots of unity to solve geometric problems.	
	Series	The method of differences, higher derivatives, Maclaurin series, series expansions of compound functions.	Pupils will understand and use the method of differences to sum finite series, find and use higher derivatives of functions, know how to express functions as an infinite series in ascending powers using Maclaurin series expansion, be able to find the series expansions of compound functions.	
	Methods in calculus	Improper integrals, the mean value of a function, differentiating inverse trigonometric functions, integrating with inverse trigonometric functions, integrating using partial fractions.	Pupils will evaluate improper integrals, understand and evaluate the mean value of a function, integrate rational functions using trigonometric substitutions, integrate using partial fractions.	
	Volumes of revolution	Volumes of revolution around the x-axis, Volumes of revolution around the y-axis, volumes of revolution of	Pupils will find the volume of revolution around the x and y-axis, for curves defined	

KS5	Topics	Skills	Understanding	Assessments
		parametrically defined curves, modelling with volumes of revolution.	parametrically and model real-life applications of volumes of revolution.	
	Polar coordinates	Polar coordinates and equations, sketching curves, area enclosed by a polar curve, tangents to polar curves.	Pupils will understand and use polar coordinates, convert between polar and Cartesian coordinates, sketch curves with r given as a function of θ , find the area enclosed by a polar curve, find tangents parallel to, or at right angles to, the initial line.	
	Hyperbolic functions	Introduction to hyperbolic functions, inverse hyperbolic functions, identities and equations, differentiating hyperbolic functions, integrating hyperbolic functions.	Pupils will understand the definitions of hyperbolic functions, sketch the graphs of hyperbolic functions, understand and use the inverse hyperbolic functions, prove identities and solve equations using hyperbolic functions, differentiate and integrate hyperbolic functions.	
	Methods in differential equations	First-order differential equations, second-order homogeneous differential equations, second-order non-homogeneous differential equations, using boundary conditions.	Pupils will solve first-order differential equations using an integrating factor, solve second-order differential equations using the auxiliary equation, solve second-order non-homogeneous differential equations using the complimentary function and the particular integral, find particular solutions to differential equations using given boundary conditions.	
	Modelling with differential equations	Modelling with first-order differential equations, simple harmonic motion, damped and forced harmonic motion, coupled first-order simultaneous differential equations.	Pupils will model real-life situations with first-order differential equations, use differential equations to model simple harmonic motion, model damped and forced oscillations using differential equations, model real-life situations using coupled first-order differential equations.	

KS5	Topics	Skills	Understanding	Assessments
Further Statistics	Discrete random variables	Expected value of a discrete random variables, variables of a discrete random variable, expected value and variance of a function of X, solving problems involving random variables.	Pupils will find the expected value of a discrete random variable X, find the expected value of X^2 , find the variance of a discrete random variable, use the expected value and variance of a function of X, solve problems involving random variables.	
	Poisson distributions	The Poisson distribution, modelling with the Poisson distribution, adding Poisson distributions, mean and variance of a Poisson distribution, mean and variance of the binomial distribution, using the Poisson distribution to approximate the binomial distribution.	Pupils will use the Poisson distribution to model real-world situations, use the additive property of the Poisson distribution, understand and use the mean and variance of the Poisson and binomial distributions, use the Poisson distribution as an approximation to the binomial distribution.	
	Geometric and negative binomial distributions	The geometric distribution, mean and variance of a geometric distribution, the negative binomial distribution, mean and variance of the negative binomial.	Pupils will understand and use the geometric distribution, calculate and use the mean and variance of the geometric distribution, understand and use the negative binomial distribution, calculate and use the mean and variance of the negative binomial distribution.	
	Hypothesis testing	Testing for the mean of a Poisson distribution, finding critical regions for a Poisson distribution, hypothesis testing for the parameter p of a geometric distribution.	Pupils will use hypothesis tests to test for the mean of a Poisson distribution, find critical regions of a Poisson distribution using tables, use hypothesis tests to test for the parameter p in a geometric distribution, find critical regions of a geometric distribution.	
	Central Limit Theorem	The central limit theorem, applying the central limit theorem to other distributions.	Pupils will understand and apply the central limit theorem to approximate the sample mean of a random variable, apply the central limit theorem to other distributions.	

KS5	Topics	Skills	Understanding	Assessments
	Chi-squared tests	Goodness of fit, degrees of freedom and the chi-squared family of distributions, testing a hypothesis, testing the goodness of fit with discrete data, using contingency tables, apply goodness-of-fit tests to geometric distributions.	Pupils will form hypotheses about how well a distribution fits as a model for an observed frequency distribution and measure goodness of fit of a model to observed data, understand degrees of freedom and use the chi-squared family of distributions, be able to test a hypothesis, apply goodness-of-fit tests to discrete data and geometric distributions, use contingency tables.	
	Probability generating functions	Probability generating functions, probability generating functions of standard distributions, mean and variance of a distribution, sums of independent random variables.	Pupils will understand the use of probability generating functions, use them for standard deviation, mean and variance and know the probability generating function of the sum of independent random variables.	
	Quality of tests	Type 1 and type 2 errors, finding type 1 and type 2 errors using the normal distribution, calculate the size and power of a test, the power function.	Pupils will know about type 1 and type 2 errors, find type 1 and type 2 using the normal distribution, calculate the size and power of a test, draw a graph of the power function for a test.	
Further Decision	Algorithms	Using and understanding algorithms, flow charts, bubble sort, quick sort, Bin-packing algorithms, order of an algorithm.	Pupils will use and understand an algorithm given in words, understand how flow charts can be used to describe algorithms, carry out a bubble sort and a quick sort, carry out the three bin-packing algorithms and understand their strengths and weaknesses, determine the order of an algorithm.	
	Graphs and networks	Modelling with graphs, graph theory, special types of graph, representing graphs and networks using matrices, the planarity algorithm.	Pupils will know how graphs and networks can be used to create mathematical models, be familiar with basic terminology used in graph theory, know some special types of graph, understand how graphs and networks can be represented using matrices, use the	

KS5	Topics	Skills	Understanding	Assessments
			planarity algorithm to determine whether or not a given graph is planar.	
	Algorithms on graphs	Kruskal's algorithm, Prim's algorithm, applying Prim's algorithm to a distance matrix, using Dijkstra's algorithm to find the shortest path, Floyd's algorithm.	Pupils will use Kruskal's algorithm to find a minimum spanning tree, use Prim's algorithm on a network to find a minimum spanning tree, apply Prim's algorithm to a distance matrix, use Dijkstra's algorithm to find the shortest path between two vertices in a network, use Floyd's algorithm.	
	Route inspection	Eulerian graphs, using the route inspection algorithm, networks with more than four odd nodes.	Pupils will use the orders of nodes to determine whether a graph is Eulerian semi-Eulerian or neither, use the route inspection algorithm to find the shortest route in a network and in networks with more than four odd nodes.	
	The travelling salesman problem	The classical and practical travelling salesman problems, using a minimum spanning tree method to find an upper bound, using a minimum spanning tree method to find a lower bound, using the nearest neighbour algorithm to find an upper bound.	Pupils will explain the differences between the classical and practical problems, use minimum spanning tree method to find an upper and lower bound, use the nearest neighbour algorithm to find an upper bound.	
	Linear programming	Linear programming problems, graphical methods, locating the optimal point, solutions with integer values.	Pupils will formulate a problem as a linear programming problem, illustrate two-variable linear programming problems graphically, locate the optimal point in a feasible region using the objective line method, use the vertex testing method to	

KS5	Topics	Skills	Understanding	Assessments
			locate the optimal point, determine solutions that need integer values.	
	This simplex algorithm	Formulating linear programming problems, the simplex method, problems requiring integer solutions, two-stage simplex method, the Big-M method.	Pupils will understand and use slack and surplus variables, solve maximising and minimising linear programming problems, use the simplex tableaux method to solve linear programming problems requiring integer solutions, understand and use the two-stage simplex method for maximising and minimising problems which may include inequality constraints, understand and use the Big-M method for maximising and minimising problems which may include inequality constraints.	
	Critical path analysis	Modelling a project, dummy activities, early and late event times, critical activities, the float of an activity, Gantt charts, resource histograms, scheduling diagrams.	Pupils will model a project by an activity network using a precedence table, use dummy activities, identify and calculate early and late event times in activity networks, identify the critical activities, calculate the total float on an activity, calculate and use Gantt charts, construct resource histograms and scheduling diagrams.	

