Mathematics KS3 Curriculum Overview

By the end of Key Stage 3, students should:

KNOW	Students to become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
DO	Students can **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language. Students can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions. Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas. Students should build on Key Stage 2 and connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems. They should also apply their mathematical knowledge in science, geography, computing and other subjects.
APPRECIATE	Students to appreciate that Mathematics is a creative and highly inter-connected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment. A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.

Curriculum coverage:

	Topic	Sub topic	Coverage
Year 7	**Algebraic Thinking**	Sequences	Exploring sequences in detail using both diagrams and lists of numbers.
		Understanding and using algebraic notation	Developing a deep understanding of the basic algebraic forms.
		Equality and equivalence	Forming and solving one-step linear equations building on the study of inverse operations.
	Place Value and Proportion	Place value, ordering integers and decimals	Explore integers up to one billion and decimals to hundredths.
		Fractions, decimal and percentage equivalence	Developing a deeper understanding of the link between fractions, decimals and percentages.
	Applications of Number	Solving problems with addition and subtraction	Building on the formal methods od addition and subtraction developed in Key Stage 2.
		Solving problems with multiplication and division.	Building on the formal methods od multiplication and division developed in Key Stage 2.
		Fractions and percentages of amounts	Calculating fractions and percentages of quantities and the link between the two.
	Directed Number	Operations and equations with directed number	Extend and deepen the understanding of direct numbers.
	Fractional thinking	Addition and subtraction of fractions	Build the experience of equivalence of fractions with any denominators and introduce the addition and subtraction of fractions.
	Lines and Angles	Constructing, measuring and using geometric notation	Build on their KS2 geometry skills to construct and measure increasingly complex diagrams using the correct mathematical notation.
		Developing geometric reasoning	Angle rules will be introduced and used to form chains of reasoning.
	Reasoning with Number	Developing number sense	Extend their mental strategies with a focus on using known facts to find other facts.
		Sets and probability	Explore probability and learn about sets, set notation and systematic listing strategies.
		Prime numbers and proof	Introduce the concept of prime numbers, form and test conjectures, and use counter-examples in proof.

	Topic	Sub topic	Coverage
Year 8	Proportional reasoning	Ratio & scale	Develop the understanding of ratio and the various models that can be used to represent ratios.
		Multiplicative change	Build the link between ratio and scaling, including the idea of direct proportion.
		Multiplying and dividing fractions	Deepen the understanding of multiply and dividing fractions by looking at multiple representations.
	Representations	Working in the Cartesian plane	Build on the knowledge of co-ordinates from Key Stage2 by examining the algebraic rules for straight lines
		Representing data	Work with bi-variant data and develop an understanding of linear correlation.
		Tables & Probability	Build on the work in Year 7 and explore sample spaces and the use of tables to represent probabilities.
	Algebraic techniques	Brackets, equations & inequalities	Build on the knowledge of equivalence from Year 7 and explore expanding over a single bracket and factorising.
		Sequences	Extend the knowledge of sequences with more complex algebraic rules.
		Indices	Manipulate expressions involving powers and learn the addition and subtraction laws of indices.
	Developing Number	Fractions & percentages	Using the relationship between fractions and percentages, including decimal equivalents, calculate percentage increase or decrease.
		Standard index form	Build on the knowledge of indices and explore standard form notation and its uses.
		Number sense	Explore the role of estimation in mental calculations and develop the skills of converting metric units.
	Developing geometry	Angles in parallel lines & polygons	Build on the knowledge of angle notation and relationships in Year 7 by exploring angles in parallel lines and polygons.
		Area of trapezia & circles	Develop the understanding of formulae for the area of trapezia and the formula for the are of a circle.
		Line symmetry & reflection	Deepen the understanding of symmetry and reflection, and explore shapes and lines in different orientations.
	Reasoning with data	The data handling cycle	Focus on using familiar charts to compare different distributions of data and explore why graphs may be misleading.
		Measures of location	Explore why and when a different average should be used and use them along with range to compare distributions.
Year 9	**Reasoning with algebra**	Straight line graphs	Building on the knowledge in Year 8, explore the general form of the equation of a straight line.
		Forming & solving equations	Extend the knowledge of forming and solving linear equations and inequalities, and explore its link to re-arranging formulae.
		Testing conjectures	Develop the skills of reasoning through making and testing conjectures.
	Constructing in 2 and 3 dimensions	Three dimensional shapes	Develop the knowledge of surface area and volume of 3D shapes, and explore plans and elevations.
		Constructions & congruency	Build upon construction skills by exploring the idea of a locus and standard constructions using ruler and a pair of compasses.
	Reasoning with number	Numbers	Develop knowledge of the number system to include rational and real numbers.
		Using percentages	Extend Year 8 skills by exploring reverse and repeated percentage.
		Maths & money	Apply number skills to financial mathematics within areas of interest, taxation and wages.
	Reasoning with geometry	Deduction	Extend their knowledge of angle rules and properties of geometric shapes, and deduction in a geometric contexts.
		Rotation & translation	Build upon the Year 8 skills of symmetry and rotation through exploring rotational symmetry, rotation and translations.
		Pythagoras' theorem	Through the investigation of the relationship between the sides of a right angled triangle, build the understanding of the theorem.
	Reasoning with proportion	Enlargement & similarity	Develop the knowledge of enlargement, scale factor and its link to similar shapes.
		Solving ratio & proportion problems	Building on previous ratio skills to solve more complex problems and make links with direct / inverse proportion and graphs.
		Rates	Explore the links between compound measures e.g. speed, distance and time, and mass density and volume.
	Representations and revision	Probability	Extend previous skills by examining probabilities of single and combined events, and using diagrams to support the calculations.
		Algebraic Representation	Enhance their knowledge of graphs through the interpretation and creation of non-linear curves and the representation of inequalities

Wider Key Stage 3 Curriculum

Competitions - Termly Mathematics Challenge and the International Mathematics Day competition.
Homework expectations: work is set online weekly using Dr Frost Maths allow students time to consolidate on skills they have already covered in detail in lessons and so boosting the impact on their long term memory.

Mathematics KS4 Curriculum Overview

By the end of Key Stage 4, students should:

KNOW	Students to become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
DO	Students can **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language. Students can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions. Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas. Students should build on Key Stage 3 to further develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems. They should also apply their mathematical knowledge in other subjects and in financial contexts.
APPRECIATE	Students to appreciate that Mathematics is a creative and highly inter-connected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment. A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.

Curriculum coverage: Edexcel GCSE specification

	Topic	Sub topic	Coverage
Year 10	**Similarity**	Congruence, similarity & enlargement	Build on the previous skills of similarity by looking at similar triangles and congruency.
		Trigonometry	Introduce trigonometry in relation to right angled triangles and build awareness of the trigonometric functions.
	Developing algebra	Representing solutions of equations & inequalities	Deepen the understanding of solving equations and inequalities covered in KS3 and explore how number lines and graphs can be used to represent solutions to inequalities.
		Simultaneous equations	Apply existing algebra skills to simultaneous equations by solving them using algebraic and graphical methods.
	Geometry	Angles & bearings	Extend knowledge of angles from KS3 by exploring Bearings and solving problems using Pythagoras' Theorem and Trigonometry skills.
		Working with circles	Develop knowledge of circles through arc length and area of sectors, and volume of surface area of spheres and cones.
		Vectors	Build on prior knowledge of vectors by working with vector notation and applying the four key operations to vector problems.
	Proportions & proportional change	Ratios & fractions	Build on the work on ratio and fractions in KS3, develop reasoning skills and solve more complex problems.
		Percentages & Interest	Further explore percentages with repeated percentage change, growth and decay, and the financial literacy used in the outside world.
		Probability	Apply existing probability knowledge further with the use of tree diagrams and explore the concept of conditional probability.
	Delving into data	Collecting, representing & interpreting data	Deepen existing knowledge of interpretation and evaluation of results, and be able to critique statistical methods and diagrams.
	Using number	Non-calculator methods	Explore accuracy and enhance the calculation methods used in KS3 through solving more complex problems using mental methods.
		Types of number & sequences	Using prime factorisation identify the Highest Common Factors and Lowest Common Multiples, and introduce Surds.
		Indices & roots	Review negative and fractional indices, and link them to prior knowledge of powers and standard form.
	Expressions	Manipulating expressions	Revise fractional arithmetic and apply skills to algebraic fractions and examine algebraic argument and proof.

	Topic	Sub topic	Coverage
Year 11	**Graphs**	Gradients & lines	Build on the earlier studies of straight line graphs by plotting graphs from a given equation, and finding and interpreting the equation of a straight line.
		Non-linear graphs	Explore on-linear graphs such as quadratic, cubic and reciprocal graphs and finding the roots of and turning points of quadratic equations graphically.
		Using graphs	Examine through constructing and interpreting conversion graphs and other real life graphs, including speed/distance/time graphs.
	Algebra	Expanding & factorising	Become familiar with expanding and factorising with single brackets and quadratic expressions.
		Changing the subject	Consolidate the work in Year 9 on changing the subject of an equation with rearranging familiar and non-familiar formulae.
		Functions	Introduce the formal function notation and re-visit quadratic functions and graphs and trigonometric functions.
	Reasoning	Multiplicative reasoning	Develop multiplicative reasoning in a variety of contexts from simple scale factors through to complex equations involving direct and inverse proportion.
		Geometric reasoning	Develop increasing complex chains of reasoning to solve geometric problems and explore circle theorems in greater depth.
		Algebraic reasoning	Develop algebraic reasoning skills to explore more complex situations, make inferences and explore algebraic proof.
	Revision & communication	Transforming & Constructing	Extend knowledge of transformations from KS3, exploring all transformations and constructions, and describing them using the language that promotes deeper thinking and understanding.
		Listing & describing	Review the organisation of information, the use of the product rule for counting and describing and comparing data distributions.
		Show that...	Stress the requirement of 'Show that …' questions to communicate in a clear mathematical fashion when writing solutions to any type of problem.
	Revision and examinations		Target gaps in knowledge, or remaining development areas, identified via assessments in preparation for the formal GCSE examination.

Wider Key Stage 4 Curriculum

Competitions- Termly Mathematics Challenge and the International Mathematics Day competition.
Trips – Year 10 Maths Feast
Homework expectations - work is set online weekly using Dr Frost Maths allow students time to consolidate on skills they have already covered in detail in lessons and so boosting the impact on their long term memory.

Mathematics KS5 Curriculum Overview

By the end of Key Stage 5, students should:

KNOW	A level mathematics builds from GCSE level mathematics and introduces calculus and its applications. It emphasises how mathematical ideas are interconnected and how mathematics can be applied to model situations mathematically using algebra and other representations, to help make sense of data, to understand the physical world and to solve problems in a variety of contexts, including social sciences and business
DO	• use their mathematical knowledge to make logical and reasoned decisions in solving problems both within pure mathematics and in a variety of contexts, and communicate the mathematical rationale for these decisions clearly • reason logically and recognise incorrect reasoning, generalise mathematically and construct mathematical proofs • make deductions and inferences and draw conclusions by using mathematical reasoning
APPRECIATE	A level mathematics provides a framework within which a large number of young people continue the subject beyond GCSE level. It supports their mathematical needs across a broad range of other subjects at this level and provides a basis for subsequent quantitative work in a very wide range of higher education courses and in employment

Curriculum coverage: Edexcel Exam Board

	Topic	Sub topic	Coverage	Topic	Sub topic	Coverage
Year 12	**Pure**	Algebraic Expressions	Expanding and factorising up to three brackets, using understanding of surds and indices.	**Mechanics**	Modelling in mechanics	Understand standard conventions used in mechanics (e.g. SI units, scalar & vector quantities, modelling conventions, etc.)
		Quadratics	Work with quadratic functions and their graphs.		Constant acceleration	Use and interpret displacement-time/velocity-time graphs. Derive and use constant acceleration formulae (suvat equations).
		Equations and Inequalities	Solve simultaneous equations and inequalities graphically, through elimination or substitution.		Forces & motion	Draw force diagrams, and apply Newton's Laws of motion. Solve problems involving connected particles.
		Graphs & Transformations	Sketch and translate up to quartic graphs, and understand unfamiliar graphs (reciprocal, exponential, quintic, etc.)		Variable acceleration	Solve problems with variable acceleration, using understanding of differentiation and integration.
		Circles	Understand the equation of a circle, and solve for intersecting lines.			
		Algebraic Methods	Rearrange algebraic fractions, use algebraic long division for polynomials. Construct proofs with algebra.	**Statistics**	Data collection	Understand terminology of data. Understand different types of sampling and types of data Analyse the large data set.
		Binomial Expansion	Understand and use the binomial expansion of $(a + bx)^n$ for positive integer n.		Measures of location and spread	Calculate measures of central tendency, location, spread, variance and standard deviation. Understand and use coding.
		Trigonometric Ratios	Apply sine & cosine rules, solve problems involving triangles and sketch transformations of each trigonometric graph.		Representations of data	Identify outliers. Draw and interpret box plots, cumulative frequency diagrams and histograms. Compare two data sets.
		Trigonometric Identities & Equations	Understand how to manipulate expressions using trigonometric identities and solve within given regions.		Correlation	Draw and interpret scatter graphs and coefficients of regression. Understand that correlation does not imply causation. Understand when to use regression to make predictions.
		Vectors	Apply understanding of vectors in two dimensions to solve geometric problems, and problems in given contexts.		Probability	Understand and use mutually exclusive and independent events, tree diagrams and Venn diagrams.
		Differentiation	Understand differentiation from first principles, and use to find rates of change of any polynomial. Apply understanding to real-life models.		Statistical distributions	Understand and use simple, discrete probability distributions including the binomial distribution, as a model. Know the limitations of Binomial distributions. Calculate probabilities from binomial distributions
		Integration	Understand that this is the inverse of differentiation. Evaluate indefinite and definite integrals involving any polynomial and apply to contextual problems.		Hypothesis testing	Understand and apply the language of statistical hypothesis testing (1 and 2 tailed), developed through a binomial model. Find critical regions and values.
		Exponentials & Logarithms	Sketch and transform exponential graphs. Understand and apply [natural] logarithms using logarithmic laws.			

	Topic	Sub topic	Coverage	Topic	Sub topic	Coverage
Year 13	**Pure**	Algebraic Methods	Proof by contradiction. Write a single fraction as partial fractions.	**Mechanics**	Moments	Calculate the turning effects of forces on rigid bodies (and solve problems involving rods in [limiting] equilibrium).
		Functions & Graphs	Understand and use the modulus function, mappings, domain, range, composite functions and apply transformations.		Forces & Friction	Resolve forces involving smooth and rough surfaces. Understand and use the coefficient of friction to solve problems.
		Sequences & Series	Understand arithmetic and geometric sequences, find the sum of n terms and the sum to infinity.		Projectiles	Model motion under gravity for objects projected either horizontally or at an angle. Resolve components of velocity and derive formulae for the paths of projectiles.
		Binomial Expansion	Expand $(a + bx)^n$ where n is negative or a fraction.			
		Radians	Know exact values, calculate arc length and sector area. Solve equations and use small angle approximations.		Applications of Forces	Finding unknown forces for systems in equilibrium. Resolve forces involving rough/smooth surfaces and connected particles.
		Trigonometric Functions	Using secant, cosecant and cotangent , prove identities and solve equations.			
		Trigonometric Identities	Know and use the addition formulae, double-angle formulae Express $a\sin x \pm b\cos x$ in the form $R\sin(x \pm \alpha)$ and $a\cos x \pm b\sin x$ in the form $R\cos(x \pm \alpha)$		Further Kinematics	Work with vectors for displacement/velocity/acceleration. Apply understanding of differentiation and integration to solve complex problems with variable acceleration.
		Parametric Equations	Convert parametric equations into Cartesian form. Solve problems and use to model problems.	**Statistics**	Regression, Correlation & Hypothesis Testing	Understand exponential models of bivariate data. Use change of variables to estimate coefficients. Understand and use PMCC. Carry out hypothesis testing for correlations
		Differentiation	Differentiate trigonometric, exponentials, logarithmic functions and parametric equations. Use second derivative.		Conditional Probability	Understand and use, probability formulae, set notation and conditional probability. Solve conditional probability problems using Venn diagrams, 2-way tables and tree diagrams.
		Numerical Methods	Locate roots, use iteration, use Newton-Raphson method. Solve problems in context.			
		Integration	Reverse chain rule, use substitution, by parts and using partial fractions. Use the trapezium rule.		The Normal Distribution	Understand and use the normal distribution curve. Find percentage points and critical values of the standard normal curve. Find unknown means and standard deviations of normal distributions. Carry out hypothesis testing for mean of a normal distribution.
		Vectors	Use vectors in 3-dimensios to solve geometric problems.			

Wider Key Stage 5 Curriculum

Homework expectations – *students are issued with independent learning tasks linked with their lessons and completion is required as a foundation for their next lesson. They may also be given prior learning tasks, e.g. watching videos or completing some research, that are needed before commencing their next lesson.*
Trips – University of Lincoln Maths Inspiration Day