

Principles of a mastery curriculum in mathematics

The KS4 curriculum builds on the KS3 mastery model. The aim of the mastery approach is that, over time, all students develop secure and connected factual knowledge, procedural fluency and conceptual understanding.

The KS4 SOW has been adapted from the Edexcel SOW to suit our school. The students are taught the SOW over 2 years and use the *Edexcel GCSE* textbooks. These focus on developing key skills along with reasoning and problem-solving techniques.

Students are able to solve problems because they have developed knowledge regarding the, 'that', 'how' and 'why' related to that topic.

- Factual knowledge – knowledge 'that'
- Procedural fluency – knowledge 'how'
- Conceptual understanding – knowledge 'why'

Essential Lesson Components are:

- Thinking Mathematically – *helping the students to decide what to do when they are not sure about how to start*
- Key Concepts – *key concept/objective identified and required prior knowledge, interleaving and misconceptions built into lesson*
- Motivating Students' Learning – *the why we are learning this and how does it relate to other concepts*
- Supporting Reasoning – *use of activities and discussion to sharpen students' reasoning and the links between other topics (interleaving)*
- Intelligent Practice – *time spent on a sequence of lessons to ensure factual knowledge, procedural fluency and conceptual understanding are achieved by the end of the topic*
- Concrete-Pictorial-Abstract – *multiple representations of concepts should be used to both support and extend understanding*
- Mathematical Language - *precise language and vocabulary is introduced, used and reinforced throughout so students are able to express themselves clearly and accurately.*
- Differentiation – *teach to the top with the same outcome for all but consider how to scaffold to support those who need it.*
- Assessment – *Quick starts, class tests and Examinations based on GCSE graded questions.*

Y10 Autumn 1

Content/Skills

*Procedural
Knowledge –
'Know What'*

Unit 1 – Calculations 1

Pupils are taught to

- Order positive and negative integers and decimals
- Round to a number of decimal places or significant figures.
- Use mental and written methods to add, subtract, multiply and divide with positive and negative integers and decimals.
- Use BIDMAS to complete calculations in the correct order

Unit 5 – Fractions, Decimals and Percentages

Pupils are taught to

- Find fractions and percentages of amounts.
- Add, subtract, multiply and divide with fractions and mixed numbers.
- Convert between fractions, decimals (including recurring decimals), and percentages.
- Order fractions, decimals and percentages.

Unit 3 – Angles and Polygons

Pupils are taught to

- Use angle facts including at a point, on a line, at an intersection and for parallel lines.
- Use bearings to specify directions.
- Identify types of triangles and quadrilaterals and use their properties.
- Identify congruent shapes and use congruence to prove geometric results.
- Identify similar shapes and use similarity to find lengths and areas.
- Calculate the properties of polygons including interior and exterior angles for regular polygons.

Unit 6 – Formulae and Functions

Pupils are taught to

- Substitute values into formulae and rearrange formulae to change their subject.
- Write an equation to represent a functions and find inputs and outputs. Find the inverse of a function and construct and use composite functions.
- Use the terms expression, equation, formula, identity, inequality, term, and factor.
- Construct proofs of simple statements using algebra.
- Expand brackets to get a quadratic expression and factorise quadratics into brackets.

Y10 Autumn 2

Content/Skills

*Procedural
Knowledge –
'Know What'*

Unit 7 – Working in 2D

Pupils are taught to

- Measure line segments and angles accurately.
- Use scale drawings and bearings.
- Calculate the area of triangles, parallelograms, trapezia and composite shapes.
- Describe and transform shapes using reflections, rotations, translations (described as 2D vectors), and enlargements (including fractional and negative scale factors).
- Identify what changes and what is invariant under a combination of transformations.

Unit 9 – Measures and Accuracy

Pupils are taught to

- Use approximate values to estimate calculations.
- Use an estimate to check an answer obtained using a calculator.
- Solve problems involving speed and density.
- Look at a value that has been rounded and work out upper and lower bounds for the original value.

Y10 Spring 1

Content/Skills

*Procedural
Knowledge –
'Know What'*

Unit 13 – Factors, Powers and Roots

Pupils are taught to

- Know and use the language of factors, multiples, and primes.
- Write a number as a product of its prime factors.
- Find the HCF and LCM of a pair of integers.
- Estimate the square or cube root of an integer.
- Find square and cube roots of numbers and apply the laws of indices.
- Simplify expressions involving surds including rationalising fractions.

Unit 10a – Linear & Quadratic Equations

Pupils are taught to

- Solve linear equations with unknowns on both sides
- Derive and solve linear equations (with unknowns both sides and brackets and fractions anywhere)
- Solve quadratic equations by factorising
- Solve quadratic equations by completing the square and using the quadratic formula
- Derive and solve quadratic equations

Y10 Spring 2

Content/Skills

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Knowledge –
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Unit 14a – Linear & Quadratic Functions

Pupils are taught to

- Plot straight line graphs – vertical, horizontal and diagonal
- Decide whether a given point lies on a graph
- Draw a quadratic graph
- Identify and interpret roots, intercepts and turning points of a quadratic graph
- Complete the square to be able to sketch a quadratic curve

Unit 8 – Probability

Pupils are taught to

- Use experimental data to estimate probabilities of future events.
- Calculate theoretical probabilities using the idea of equally likely events.
- Compare theoretical probabilities with experimental probabilities.
- Recognise mutually exclusive events and exhaustive events and know that the probabilities of mutually exclusive exhaustive events sum to 1.

Unit 10b & 14b - Simultaneous Equations, Iteration & Inequalities, and Solving Graphically

Pupils are taught to

- Derive and solve two linear simultaneous equations in two variables (by elimination)
- Solve simultaneous equations graphically (find approximate solutions)
- Use iterative processes to find approximate solutions to equations
- Solve linear inequalities in one variable and represent the solution on a number line

	Y10 Summer 1
Content/Skills <i>Procedural Knowledge – ‘Know What’</i>	<p><u>Unit 11 – Circles and Construction</u> Pupils are taught to</p> <ul style="list-style-type: none"> • Find the area and circumference of a circle and composite shapes involving circles. • Calculate arc lengths, angles, and areas of sectors. • Prove and apply circle theorems. • Use standard ruler and compass constructions and solve problems involving loci. <p><u>Unit 14c – Equation of a Straight Line, and Kinematics</u> Pupils are taught to</p> <ul style="list-style-type: none"> • Understand and identify gradient and intercept ($y = mx + c$), interpret the gradient as rate of change and use graphs to solve real life problems • Identify parallel and perpendicular lines • Use one point and gradient to find equation of a line • Use two points to find the gradient, and the equation of a line • Find the midpoint of a line segment • Plot and interpret kinematic graphs (ST or DT) • Calculate the gradient of kinematic graphs to find speed/acceleration • Find the area under speed-time graphs to find the distance travelled <p><u>Unit 12 – Proportion, Ratio and Percentage Change</u> Pupils are taught to</p> <ul style="list-style-type: none"> • Express proportions of amounts as fractions and percentages. • Divide a quantity in a given ratio. • Use scale factors to convert between lengths on maps and scale diagrams and the distances they represent. • Calculate percentage increases and decreases using multiplication. • Find the original value of a quantity that has undergone a percentage increase or decrease.
	Y10 Summer 2
Content/Skills <i>Procedural Knowledge – ‘Know What’</i>	<p><u>Unit 17 – Calculations with Roots and Indices</u> Pupils are taught to</p> <ul style="list-style-type: none"> • Perform calculations involving roots and indices, including negative and fractional indices. • Perform exact calculations involving fractions, surds and π. • Work with numbers in standard form.

Y11 Autumn 1

Content/Skills

*Procedural
Knowledge –
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Unit 19 – Pythagoras and Trigonometry

Pupils are taught to

- Use the formulae for Pythagoras' theorem to find a missing side in a right-angled triangle.
- Use the trigonometric ratios to find missing angles and lengths in triangles.
- Find the exact values of $\sin\theta$, $\cos\theta$ and $\tan\theta$ for key angles.
- Use the sine and cosine rules to find missing lengths and angles.
- Express vectors in terms of simple base vectors.

Unit 22 – Units and Proportionality

Pupils are taught to

- Convert between standard and compound units.
- Use compound measures.
- Compare lengths, areas, and volumes of similar shapes.
- Solve direct and inverse proportion problems.
- Describe direct and inverse proportion relationships using equations.
- Recognise graphs showing direct and inverse proportion and interpret the gradient of a straight-line graph.
- Find the instantaneous and average rate of change from a graph.
- Solve repeated proportional change problems.

Y11 Autumn 2

Content/Skills

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Unit 18b – Graphs 2

Pupils are taught to

- Recognise and draw graphs of cubic and reciprocal functions.
- Recognise and draw graphs of exponential functions.
- Recognise and sketch the graphs of trigonometric functions.
- Recognise and sketch translations and reflections of graphs.
- Draw and interpret graphs of non-standard functions and use them in real-life problems.
- Approximate the gradient of a curve at a given point and the area under a graph. Interpret these values in real-life problems including kinematic graphs.
- Recognise and use simple equations of circles and find the tangent to a circle at a point.

Unit 16 – Groups and Bivariate Data

Pupils are taught to

- Use frequency tables to represent grouped data.
- Construct histograms with equal or unequal class widths.
- Calculate summary statistics from a grouped frequency table.
- Plot scatter graphs and recognise correlation.
- Draw lines of best fit and use them to make predictions.

	Y11 Spring 1					
Content/Skills <i>Procedural Knowledge – ‘Know What’</i>	<p><u>Unit 15 - Working in 3D</u> Pupils are taught to</p> <ul style="list-style-type: none"> • Construct and interpret plans and elevations of 3D shapes. • Calculate the volume of cuboids and right prisms. • Calculate the volume and surface area of spheres, pyramids, cones, and composite solids. • Know and apply the relationship between lengths, areas and volumes of similar shapes. 					
	Y11 Spring 2					
Content/Skills <i>Procedural Knowledge – ‘Know What’</i>	<p><u>Unit 20 - Combined Events</u> Pupils are taught to</p> <ul style="list-style-type: none"> • Use Venn diagrams to represent sets. • Use a possibility space to represent the outcomes of two experiments and to calculate probabilities. • Use a tree diagram to show the outcomes of two experiments. • Calculate conditional probabilities. <p><u>Unit 21 - Sequences</u> Pupils are taught to</p> <ul style="list-style-type: none"> • Find terms of a linear sequence using a term-to-term or position-to-term rule. • Recognise special types of sequence and find terms using either a term-to-term or position-to-term rule. • Find terms of a quadratic sequence using a term-to-term or position-to-term rule. 					
Term	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2

Assessment			Year 10 Exam 1			Year 10 Exam 2
		Year 11 Exam 1	Year 11 Exam 2			
Literacy/Numeracy/ SMSC/Character	<p>Throughout our mathematics curriculum students are expected to show the character trait of resilience when problem solving. When problem solving teachers will know when to give hints and when to encourage that extra bit of struggle to get to an answer. When this is done well the students achieve an amazing sense of accomplishment and they develop their problem-solving resilience which is not only needed in their maths exams but also in the wider world of work, later on.</p> <p>We have an expectation that our students will communicate their mathematics well, both orally and in written form. It isn't enough to be "good at working stuff out" in the modern world, solutions to problems must be well communicated.</p> <p>We also expect that students will display the character trait of empathy in lessons. Students often find contributing to maths lessons daunting if they are not sure of their answer or method and other students need to respect all contributions, even if they are incorrect. Often progress is made by understanding another person's incorrect answer.</p>					