

## Mathematics overview: Stage 9 Star

| Unit                                 | Hours | KNOWLEDGE  |
|--------------------------------------|-------|--|
| Calculating                          | 16    | <ul style="list-style-type: none"> <li>apply and interpret limits of accuracy including upper and lower bounds (9*)</li> <li>use standard ruler and compass constructions to solve loci (keep) problems; know that the perpendicular distance from a point to a line is the shortest distance to the line (9*)</li> </ul>  |
| Visualising and constructing         | 12    | <ul style="list-style-type: none"> <li>rearrange formulae to change the subject (8*, 9*)</li> <li>solve problems involving direct and inverse proportion including graphical and algebraic representations (9*)</li> <li>apply the concepts of congruence and similarity, including the relationships between lengths in similar figures (9*)</li> <li>change freely between (and use) compound units (e.g. density) in numerical and algebraic contexts (9*)</li> <li>recognise and interpret graphs that illustrate direct and inverse proportion (9*)</li> <li>express the division of a quantity into two parts as a ratio; apply ratio to real contexts and problems (such as those involving conversion, comparison, scaling, mixing, concentrations) (7*, 8*, 9*)</li> </ul>  |
| Algebraic proficiency: tinkering     | 12    | <ul style="list-style-type: none"> <li>recognise and use simple geometric progressions (<math>r^n</math> where <math>n</math> is an integer, and <math>r</math> is a rational number <math>&gt; 0</math> or a surd) and other sequences (9*)</li> <li>know the formulae for: Pythagoras' theorem, <math>a^2 + b^2 = c^2</math>, and apply it to find lengths in right-angled triangles in two dimensional figures (8*, 9*)</li> <li>know the formulae for: Pythagoras' theorem, <math>a^2 + b^2 = c^2</math>, and apply it to find lengths in right-angled triangles and, where possible, general triangles and in three dimensional figures (8*, 9*)</li> <li>know the trigonometric ratios, <math>\sin\theta = \text{opposite/hypotenuse}</math>, <math>\cos\theta = \text{adjacent/hypotenuse}</math>, <math>\tan\theta = \text{opposite/adjacent}</math> (9*)</li> <li>apply them to find angles and lengths in right-angled triangles and, where possible, general triangles in three dimensional figures (9*)</li> </ul> |
| Proportional reasoning               | 12    | <ul style="list-style-type: none"> <li>apply it to find angles and lengths in right-angled triangles in two dimensional figures (9*)</li> <li>apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive results about angles and sides, including Pythagoras' Theorem and the fact that the base angles of an isosceles triangle are equal, and use known results to obtain simple proofs (9*)</li> <li>recognise, sketch and interpret graphs of quadratic functions (8*, 9*)</li> </ul>   |
| Pattern sniffing                     | 9     | <ul style="list-style-type: none"> <li>recognise, sketch and interpret graphs of simple cubic functions and the reciprocal function <math>y = 1/x</math> with <math>x \neq 0</math> (9*)</li> <li>plot and interpret graphs (including reciprocal graphs) and graphs of non-standard functions in real contexts, to find approximate solutions to problems such as</li> <li>find approximate solutions to simultaneous equations using a graph (9*)</li> <li>interpret and construct tables, charts and diagrams, including tables and line and know their appropriate use (7*, 9*)</li> </ul>   |
| Solving equations and inequalities I | 8     | <p><b>Key Stage 4</b></p> <ul style="list-style-type: none"> <li>calculate with fractional indices (KS4)</li> <li>calculate with standard form <math>A \times 10^n</math>, where <math>1 \leq A &lt; 10</math> and <math>n</math> is an integer (KS4 (8*))</li> <li>calculate exactly with surds (KS4)</li> <li>change recurring decimals into their corresponding fractions and vice versa (KS4)</li> <li>set up, solve and interpret the answers in growth and decay problems, including compound interest (KS4)</li> <li>apply systematic listing strategies including use of the product rule for counting (KS4)</li> </ul>  |
| Calculating space                    | 16    | <ul style="list-style-type: none"> <li>identify, describe and construct similar shapes, including on coordinate axes, by considering enlargement (including fractional scale factors and negative scale factors) (KS4)</li> <li>simplify and manipulate algebraic expressions by expanding products of two binomials and factorising quadratic expressions of the form <math>x^2 + bx + c</math> (KS4 (8*))</li> <li>simplify and manipulate algebraic expressions BY USING THE DIFFERENCE OF TWO SQUARES (KS4)</li> <li>manipulate algebraic expressions by factorising quadratic expressions of the form <math>ax^2 + bx + c</math> (KS4)</li> </ul>   |
| Conjecturing                         | 8     | <ul style="list-style-type: none"> <li>simplify and manipulate algebraic expressions (including those involving surds and algebraic fractions) by expanding products of two or more binomials (KS4)</li> <li>using pressure (KS4 (8*))</li> </ul>  |
| Algebraic proficiency: visualising   | 16    | <ul style="list-style-type: none"> <li>solving three part ratio problems in the form <math>a:b:c</math> where a common ratio needs establishing (KS4)</li> <li>deduce expressions to calculate the <math>n</math>th term of quadratic sequences (KS4, 8*)</li> <li>understand and use the concepts and vocabulary of inequalities (KS4)</li> <li>solve linear inequalities in two variables (KS4)</li> <li>represent the solution set to an inequality on a number line (KS4)</li> </ul>   |

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|---------------------------------------|----|--|
| Solving equations and inequalities II | 12 | <ul style="list-style-type: none"> <li>• calculate arc lengths, angles and areas of sectors of circles (KS4)</li> <li>• calculate surface area of right prisms (including cylinders) (KS4)</li> <li>• use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS) (KS4)</li> <li>• apply the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results (KS4)</li> <li>• use the form <math>y = mx + c</math> to identify perpendicular lines (KS4)</li> <li>• find the equation of the line through two given points, or through one point with a given gradient (KS4)</li> <li>• simple kinematic problems involving distance, speed and acceleration (KS4)</li> <li>• solve, in simple cases, two linear simultaneous equations in two variables algebraically (KS4)</li> <li>• solve quadratic equations (including those that require rearrangement) algebraically by factorising (KS4)</li> <li>• calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions (KS4 (8*))</li> </ul> |
| Understanding risk                    | 8  | <ul style="list-style-type: none"> <li>• enumerate sets and combinations of sets systematically, using tree diagrams (KS4 (8*))</li> <li>• calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams (KS4)</li> <li>• construct and interpret diagrams for grouped discrete data and continuous data, i.e. cumulative frequency graphs, and know their appropriate use (KS4)</li> <li>• interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate graphical representation involving discrete, continuous and grouped data, including box plots (KS4)</li> </ul>  |
| Presentation of data                  | 8  | <ul style="list-style-type: none"> <li>• interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency including quartiles and inter-quartile range (KS4)</li> </ul>  |
|                                       |    |  |

## Calculating

### KNOWLEDGE

- calculate with fractional indices (KS4)
- calculate with standard form  $A \times 10^n$ , where  $1 \leq A < 10$  and  $n$  is an integer (KS4 (8\*))
- apply and interpret limits of accuracy including upper and lower bounds (9\*)
- calculate exactly with surds (KS4)
- change recurring decimals into their corresponding fractions and vice versa (KS4)
- set up, solve and interpret the answers in growth and decay problems, including compound interest (KS4)
- apply systematic listing strategies including use of the product rule for counting (KS4)

## Visualising and constructing

### KNOWLEDGE

- identify, describe and construct similar shapes, including on coordinate axes, by considering enlargement (including fractional scale factors and negative scale factors) (KS4)
- use standard ruler and compass constructions to solve loci (keep) problems; know that the perpendicular distance from a point to a line is the shortest distance to the line (9\*)

## Algebraic proficiency - Tinkering

### KNOWLEDGE

- simplify and manipulate algebraic expressions by expanding products of two binomials and factorising quadratic expressions of the form  $x^2 + bx + c$  (KS4 (8\*))
- simplify and manipulate algebraic expressions BY USING THE DIFFERENCE OF TWO SQUARES (KS4)
- manipulate algebraic expressions by factorising quadratic expressions of the form  $ax^2 + bx + c$  (KS4)
- simplify and manipulate algebraic expressions (including those involving surds and algebraic fractions) by expanding products of two or more binomials (KS4)
- rearrange formulae to change the subject (8\*, 9\*)

## Proportional reasoning

### KNOWLEDGE

- solve problems involving direct and inverse proportion including graphical and algebraic representations (9\*)
- apply the concepts of congruence and similarity, including the relationships between lengths in similar figures (not including rules of congruency (ASA etc.)) (9\*)
- change freely between (and use) compound units (e.g. density) in numerical and algebraic contexts (9\*)
- using pressure (KS4 (8\*))
- recognise and interpret graphs that illustrate direct and inverse proportion (9\*)
- solving three part ratio problems in the form  $a:b:c$  where a common ratio needs establishing (KS4)
- express the division of a quantity into two parts as a ratio; apply ratio to real contexts and problems (such as those involving conversion, comparison, scaling, mixing, concentrations) (7\*,8\*,9\*)

## Pattern sniffing

### KNOWLEDGE

- deduce expressions to calculate the  $n$ th term of quadratic sequences (KS4, 8\*)
- recognise and use simple geometric progressions ( $r^n$  where  $n$  is an integer, and  $r$  is a rational number  $> 0$  or a surd) and other sequences (9\*)

## Solving equations and inequalities

### KNOWLEDGE

- understand and use the concepts and vocabulary of inequalities (KS4)
- solve linear inequalities in two variables (KS4)
- represent the solution set to an inequality on a number line (KS4)

## Calculating space

### KNOWLEDGE

- calculate arc lengths, angles and areas of sectors of circles (KS4)
- calculate surface area of right prisms (including cylinders) (KS4)
- know the formulae for: Pythagoras' theorem,  $a^2 + b^2 = c^2$ , and apply it to find lengths in right-angled triangles in two dimensional figures (8\*,9\*)
- know the formulae for: Pythagoras' theorem,  $a^2 + b^2 = c^2$ , and apply it to find lengths in right-angled triangles and, where possible, general triangles and in three dimensional figures (8\*,9\*)
- know the trigonometric ratios,  $\sin\theta = \text{opposite/hypotenuse}$ ,  $\cos\theta = \text{adjacent/hypotenuse}$ ,  $\tan\theta = \text{opposite/adjacent}$  (9\*)
- apply them to find angles and lengths in right-angled triangles and, where possible, general triangles in three dimensional figures (9\*)
- apply it to find angles and lengths in right-angled triangles in two dimensional figures (9\*)

## Conjecturing

### KNOWLEDGE

- use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS) (KS4)
- apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive results about angles and sides, including Pythagoras' Theorem and the fact that the base angles of an isosceles triangle are equal, and use known results to obtain simple proofs (9\*)
- apply the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results (KS4)

## Algebraic proficiency – Visualising

### KNOWLEDGE

- find the equation of the line through two given points, or through one point with a given gradient (KS4)
- use the form  $y = mx + c$  to identify perpendicular lines (KS4)
- recognise, sketch and interpret graphs of quadratic functions (8\*,9\*)
- recognise, sketch and interpret graphs of simple cubic functions and the reciprocal function  $y = 1/x$  with  $x \neq 0$  (9\*)
- plot and interpret graphs (including reciprocal graphs) and graphs of non-standard functions in real contexts, to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration (KS4)

## Solving equations and inequalities

### KNOWLEDGE

- solve, in simple cases, two linear simultaneous equations in two variables algebraically (KS4)
- find approximate solutions to simultaneous equations using a graph (9\*)
- solve quadratic equations (including those that require rearrangement) algebraically by factorising (KS4)

## Understanding risk

### KNOWLEDGE

- calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions (KS4 (8\*))
- enumerate sets and combinations of sets systematically, using Venn diagrams (KS4 (8\*))
- calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams (KS4)

## Presentation of data

### KNOWLEDGE

- interpret and construct tables, charts and diagrams, including tables and line and know their appropriate use (7\*,9\*)
- construct and interpret diagrams for grouped discrete data and continuous data, i.e. cumulative frequency graphs, and know their appropriate use (KS4)
- interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate graphical representation involving discrete, continuous and grouped data, including box plots (KS4)
- interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency including quartiles and inter-quartile range (KS4)