Year 9 Maths Scheme of Work

Edexcel Units 1-5 GCSE Textbook

Term	*Lessons*	*Key Areas*	
Autumn 1	20	• Apply the four operations with negative numbers • Convert numbers into standard form and vice versa • Apply the multiplication, division and power laws of indices • Convert between terminating decimals and fractions • Find a relevant multiplier when solving problems involving proportion • Solve problems involving percentage change, including original value problems • Factorise an expression by taking out common factors • Change the subject of a formula when two steps are required • Find and use the nth term for a linear sequence • Solve linear and quadratic equations with unknowns on both sides • Venn diagrams & Set notation • Ratio & Proportion • Charts & Sampling	
Autumn 2	18		
Spring 1	18		
Spring 2	15		
Summer 1	15		
Summer 2	15		
Total:	101		

Autumn 1: UNIT 1 – NUMBER	GCSE EDEXCEL HIGHER TEXTBOOK	10 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Probability progression map

- apply systematic listing strategies including use of the product rule for counting
- calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams.

Return to overview

Possible themes

- Understand and use the product rule for counting
- Use Venn diagrams to represent probability situations
- Use two-way tables to represent probability situations
- Solve probability problems involving combined events

Possible key learning points

- Apply the product rule for counting
- Use a Venn diagram to sort information in a probability problem
- Use a two-way table to sort information in a probability problem
- Use a Venn diagram to calculate theoretical probabilities
- Use a two-way table to calculate theoretical probabilities
- Calculate conditional probabilities using different representations

Prerequisites

- Know when to add two or more probabilities
- Know when to multiply two or more probabilities
- Convert between fractions, decimals and percentages
- Use a tree diagram to calculate probabilities of dependent and independent combined events

Mathematical language

Outение, equally likely outcomes
Event, independent event, dependent event
Tree diagrams
Theoretical probability, experimental probability
Random
Bias, unbiased, fair
Enumerate
Set
Conditional probability
Venn diagram

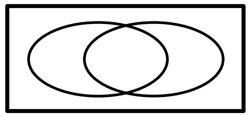
Notation
P(A) for the probability of event A
Probabilities are expressed as fractions, decimals or percentages. They should not be expressed as ratios (which represent odds) or as words

Pedagogical notes

In Stage 9, pupils calculate the probability of independent and dependent combined events using tree diagrams and enumerate sets and combinations of sets systematically, using tree diagrams. This unit has a strong emphasis on the use of Venn diagrams and two-way tables to solve probability problems.
Note: A Venn diagram has regions for all possible combinations of groups whether there are elements in those regions or not.
An Euler diagram only shows a region if things exist in that region.

NCETM: Glossary
NCETM: Department Workshops: Sets and Venn Diagrams
FMSP: Set Notation Poster

Common approaches
Pupils are taught to draw the border around the Venn 'regions' to highlight the elements that are not included in the regions.



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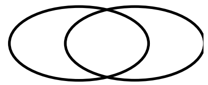


Reasoning opportunities and probing questions

- Show me an example of a Venn diagram. And another. And another
- Show me an example of a two-way table. And another. And another
- Always / Sometimes / Never: All the regions of a Venn diagram must be populated

Suggested activities

CIMT: Venn Diagrams
OCR: Check In: Combined Events and Probability Diagrams
AQA: Bridging Unit: Set notation, number lines and Venn diagrams

Learning review
GLOWMaths/JustMaths: Sample Questions Both Tiers
GLOWMaths/JustMaths: Sample Questions Higher Tiers

Possible misconceptions

- When constructing a Venn diagrams for a given situation, some pupils may struggle to distinguish between elements that are included in the intersection of both regions or only in one of the regions
- Some pupils may muddle the conditions for adding and multiplying probabilities
- Some pupils may add the denominators when adding fractions

Autumn 1: UNIT 1 - NUMBER	GCSE EDEXCEL HIGHER TEXTBOOK	10 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Calculation progression map

- calculate with roots, and with integer indices
- calculate with standard form $A \times 10^n$, where $1 \le A < 10$ and n is an integer
- use inequality notation to specify simple error intervals due to truncation or rounding
- apply and interpret limits of accuracy

Return to overview

Possible themes	Possible key learning points
• Calculate with powers and roots • Explore the use of standard form • Explore the effects of rounding	• Calculate with positive indices • Calculate with roots • Calculate with negative indices in the context of standard form • Use a calculator to evaluate numerical expressions involving powers • Use a calculator to evaluate numerical expressions involving roots • Add numbers written in standard form • Subtract numbers written in standard form • Multiply numbers written in standard form • Divide numbers written in standard form • Use standard form on a scientific calculator including interpreting the standard form display of a scientific calculator • Understand the difference between truncating and rounding • Identify the minimum and maximum values of an amount that has been rounded (to nearest x, x d.p., x s.f.) • Use inequalities to describe the range of values for a rounded value • Solve problems involving the maximum and minimum values of an amount that has been rounded

Prerequisites	Mathematical language	Pedagogical notes
• Know the meaning of powers • Know the meaning of roots • Know the multiplication and division laws of indices • Understand and use standard form to write numbers • Interpret a number written in standard form • Round to a given number of decimal places or significant figures • Know the meaning of the symbols <, >, ≤, ≥ KM: Calculating powers recap	Power Root Index, Indices Standard form Inequality Truncate Round Minimum, Maximum Interval Decimal place Significant figure **Notation** Standard form: $A \times 10^n$, where $1 \le A < 10$ and n is an integer Inequalities: e.g. $x > 3$, $-2 < x \le 5$	Liaise with the science department to establish when students first meet the use of standard form, and in what contexts they will be expected to interpret it. NCETM: Departmental workshops: Index Numbers NCETM: Glossary **Common approaches** *The description 'standard form' is always used instead of 'scientific notation' or 'standard index form'.* *Standard form is used to introduce the concept of calculating with negative indices. The link between 10^{-n} and $1/10^n$ can be established.* *The language 'negative number' is used instead of 'minus number'.*

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
• Kenny thinks this number is written in standard form: 23×10^7. Do you agree with Kenny? Explain your answer. • When a number 'x' is rounded to 2 significant figures the result is 70. Jenny writes '65 < x < 75'. What is wrong with Jenny's statement? How would you correct it? • Convince me that $4.5 \times 10^7 \times 3 \times 10^5 = 1.35 \times 10^{13}$	KM: Maths to Infinity: Standard form KM: Maths to Infinity: Indices KM: Investigate 'Narcissistic Numbers' **NRICH**: Power mad! **NRICH**: A question of scale The scale of the universe animation (external site) **Learning review** KM: 9M1 BAM Task	• Some students may think that any number multiplied by a power of ten qualifies as a number written in standard form • When rounding to significant figures some students may think, for example, that 6729 rounded to one significant figure is 7 • Some students may struggle to understand why the maximum value of a rounded number is actually a value which would not round to that number; i.e. if given the fact that a number 'x' is rounded to 1 significant figure the result is 70, they might write '65 < x < 74.99'

Autumn 2: UNIT 1 – NUMBER	GCSE EDEXCEL HIGHER TEXTBOOK	9 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Calculation progression map

- estimate powers and roots of any given positive number
- calculate with roots, and with integer and fractional indices
- calculate exactly with surds
- apply and interpret limits of accuracy, including upper and lower bounds

Return to overview

Possible themes

- Estimate with powers and roots
- Calculate with powers and roots
- Explore the impact of rounding

Possible key learning points

- Estimate squares and cubes of numbers up to 100
- Estimate powers of numbers up to 10
- Estimate square roots of numbers up to 150 and cube roots of numbers up to 20
- Know and use the fact that $a^{-n} = 1/a^n$
- Know and use the fact that $a^{1/n} = \sqrt[n]{a}$
- Calculate exactly with surds
- Choose the required minimum and maximum values when solving a problem involving upper and lower bounds
- Calculate the upper and lower bounds in a given situation

Prerequisites

- Calculate with positive indices using written methods and negative indices in the context of standard form
- Know the multiplication and division laws of indices
- Round to a given number of decimal places or significant figures
- Identify the minimum and maximum values of an amount that has been rounded (to nearest x, x d.p., x s.f.)

Mathematical language

Power, Root
Index, Indices
Standard form
Inequality
Truncate, Round
Minimum bound, Maximum bound
Interval
Decimal place, Significant figure
Surd
Limit

Notation
Inequalities: e.g. $x > 3$, $-2 < x \le 5$

Pedagogical notes

Surd is derived from the Latin 'surdus' ('deaf' or 'mute'). A surd is therefore a number that cannot be expressed ('spoken') as a rational number.
Calculating with surds includes establishing the rules:

$\sqrt{a \pm b} \neq \sqrt{a} \pm \sqrt{b}$, $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ and $\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$

If $a^{1/n}$ and *n* is even, then $a^{1/n}$ denotes the principle root - the positive *n*th root.

NCETM: Departmental workshops: Index Numbers
NCETM: Departmental workshops: Surds
NCETM: Glossary

Common approaches
Pattern sniffing is encouraged to establish the result $a^0 = 1$, $a^{-n} = 1/a^n$, i.e.
$2^3 = 2 \times 2 \times 2 = 8$, $2^2 = 2 \times 2 = 4$, $2^1 = 2$, $2^0 = 1$, $2^{-1} = \frac{1}{2}$

Reasoning opportunities and probing questions

- Show me a surd. And another. And another …
- When a number 'x' is rounded to 1 decimal place the result is 2.5. Jenny writes '$2.45 < x < 2.55$'. What is wrong with Jenny's statement? How would you correct it?
- Always/ Sometimes/ Never: $\sqrt{a+b} = \sqrt{a} + \sqrt{b}$
- Convince me that $2^{-3} = \frac{1}{8}$

Suggested activities

KM: Maths to Infinity: Standard form, Maths to Infinity: Indices
KM: Bounding about and PowerPoint
KM: Calculating bounds: a summary
NRICH: Powers and Roots – Short Problems
NRICH: Power Countdown
Hwb: Fibonacci Rectangles 1, Fibonacci Rectangles 2
Hwb: Motorway roadworks
Hwb: Rhayader has moved
Hwb: Manipulating surds
Powers of 10 (external website)

Learning review
GLOWMaths/JustMaths: Sample Questions Both Tiers
GLOWMaths/JustMaths: Sample Questions Higher Tiers
KM: 10M1 BAM Task

Possible misconceptions

- Some students may think that negative indices change the sign of a number, for example $2^{-1} = -2$ rather than $2^{-1} = \frac{1}{2}$
- Some students may think $\sqrt{a \pm b} = \sqrt{a} \pm \sqrt{b}$
- Some students may struggle to understand why the maximum bound of a rounded number is actually a value which would not round to that number; i.e. if given the fact that a number 'x' is rounded to 1 decimal place the result is 2.5, they might write '$2.45 < x < 2.55$'

Autumn 2: UNIT 1 – NUMBER	GCSE EDEXCEL HIGHER TEXTBOOK	6 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Calculation progression map

- simplify surd expressions involving squares (e.g. √12 = √(4 × 3) = √4 × √3 = 2√3) and rationalise denominators

Return to overview

Possible themes	Possible key learning points
• Manipulate expressions by simplifying surds **Bring on the Maths: GCSE Higher Number** Investigating numbers: #4, #5	• Know and use $\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$ • Simplify surds • Solve problems involving the simplification of surds • Multiply two binomials involving surds • Rationalise the denominator of a simple surd expression • Rationalise the denominator of a more complex surd expression

Prerequisites	Mathematical language	Pedagogical notes
• Calculate exactly with surds • Use the functionality of a scientific calculator when calculating with roots and powers	Power, Root Index, Indices Surd Simplify Rationalise **Notation** $\sqrt{a}$ represents the 'positive square root of', and the bar should be used to enclose contents correctly	Surd is derived from the Latin 'surdus' ('deaf' or 'mute'). A surd is therefore a number that cannot be expressed ('spoken') as a rational number. Students should already have established the following facts: $\sqrt{a \pm b} \neq \sqrt{a} \pm \sqrt{b}$, $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ and $\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$ NCETM: Departmental workshops: Surds NCETM: Glossary **Common approaches** *All students carry out the Standard Unit activity referenced below*

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
• Always/Sometimes/Never: tan 45° = $\frac{1}{\sqrt{2}}$ • What's the same and what is different: $(\sqrt{3} + \sqrt{5})^2$ and $(\sqrt{3} + \sqrt{5})(\sqrt{3} - \sqrt{5})$? • Show me an expression, of the form $a\sqrt{b}$, that is equivalent to $24\sqrt{3}$. And another, and another …	Hwb: Q3 Manipulating surds Standards Unit: N11 Manipulating surds NRICH: Surds **Learning review** KM: 11M1 BAM Task GLOWMaths/JustMaths: Sample Questions Higher Tiers	• Some students may think that $\sqrt{a \pm b} = \sqrt{a} \pm \sqrt{b}$ • Some students may think that $(\sqrt{a} + \sqrt{b})^2 = a + b$ • Some students may write √4 × 3 when they should write $\sqrt{4 \times 3}$ (or √(4 × 3))

Autumn 2 – Assessment	3 lessons

- 1.5 hours non calculator Foundation Paper
- Self-assessment sheets completed
- Review and self-assessment of performance stuck into books

Spring 1: UNIT 2 – ALGEBRA & SEQUENCES	GCSE EDEXCEL HIGHER TEXTBOOK	5 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Algebra progression map

- understand and use the concepts and vocabulary of identities
- know the difference between an equation and an identity
- simplify and manipulate algebraic expressions by expanding products of two binomials and factorising quadratic expressions of the form $x^2 + bx + c$
- argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments
- translate simple situations or procedures into algebraic expressions or formulae

Return to overview

Possible themes

- Understand equations and identities
- Manipulate algebraic expressions
- Construct algebraic statements

Possible key learning points

- Understand the meaning of an identity
- Multiply two linear expressions of the form $(x + a)(x + b)$
- Multiply two linear expressions of the form $(ax + b)(cx + d)$
- Expand the expression $(x + a)^2$
- Factorise a quadratic expression of the form $x^2 + bx$
- Factorise a quadratic expression of the form $x^2 + bx + c$
- Work out why two algebraic expressions are equivalent
- Create a mathematical argument to show that two algebraic expressions are equivalent
- Distinguish between situations that can be modelled by an expression or a formula
- Create an expression or a formula to describe a situation

Prerequisites

- Manipulate expressions by collecting like terms
- Know that $x \times x = x^2$
- Calculate with negative numbers
- Know the grid method for multiplying two two-digit numbers
- Know the difference between an expression, an equation and a formula

Mathematical language

Inequality
Identity
Equivalent
Equation
Formula, Formulae
Expression
Expand
Linear
Quadratic

Notation
The equals symbol '=' and the equivalency symbol '≡'

Pedagogical notes

In the above KLPs for factorising and expanding, a, b, c and d are positive or negative.
Students should be taught to use the equivalency symbol '≡' when working with identities.
During this unit students could construct (and solve) equations in addition to expressions and formulae.
See former coursework task, opposite corners
NCETM: Algebra
NCETM: Departmental workshops: Deriving and Rearranging Formulae
NCETM: Glossary

Common approaches
All students are taught to use the grid method to multiply two linear expressions. They then use the same approach in reverse to factorise a quadratic.

Reasoning opportunities and probing questions

- The answer is $x^2 + 10x + c$. Show me a possible question. And another. And another … (Factorising a quadratic expression of the form $x^2 + bx + c$ can be introduced as a reasoning activity: once students are fluent at multiplying two linear expressions they can be asked 'if this is the answer, what is the question?')
- Convince me that $(x + 3)(x + 4)$ does not equal $x^2 + 7$.
- What is wrong with this statement? How can you correct it? $(x + 3)(x + 4) \equiv x^2 + 12x + 7$.
- Jenny thinks that $(x – 2)^2 = x^2 – 4$. Do you agree with Jenny? Explain your answer.

Suggested activities

KM: Stick on the Maths: Multiplying linear expressions
KM: Maths to Infinity: Brackets
KM: Maths to Infinity: Quadratics
NRICH: Pair Products
NRICH: Multiplication Square
NRICH: Why 24?

Learning review
KM: 9M2 BAM Task, 9M3 BAM Task

Possible misconceptions

- Once students know how to factorise a quadratic expression of the form $x^2 + bx + c$ they might overcomplicate the simpler case of factorising an expression such as $x^2 + 2x$ ($\equiv (x + 0)(x + 2)$)
- Many students may think that $(x + a)^2 \equiv x^2 + a^2$
- Some students may think that, for example, $-2 \times -3 = -6$
- Some students may think that $x^2 + 12 + 7x$ is not equivalent to $x^2 + 7x + 12$, and therefore think that they are wrong if the answer is given as $x^2 + 7x + 12$

Spring 1: UNIT 2 – ALGEBRA & SEQUENCES	GCSE EDEXCEL HIGHER TEXTBOOK	3 lessons
Key concepts (GCSE subject content statements) • recognise and use Fibonacci type sequences, quadratic sequences		**The Big Picture**: Algebra progression map

Return to overview

Possible themes	Possible key learning points
• Investigate Fibonacci numbers • Investigate Fibonacci type sequences • Explore quadratic sequences	• Recognise and use the Fibonacci sequence • Generate Fibonacci type sequences • Solve problems involving Fibonacci type sequences • Explore growing patterns and other problems involving quadratic sequences • Generate terms of a quadratic sequence from a written rule • Find the next terms of a quadratic sequence using first and second differences • Generate terms of a quadratic sequence from its nth term

Prerequisites	Mathematical language	Pedagogical notes
• Generate a linear sequence from its nth term • Substitute positive numbers into quadratic expressions • Find the nth term for an increasing linear sequence • Find the nth term for a decreasing linear sequence	Term Term-to-term rule Position-to-term rule nth term Generate Linear Quadratic First (second) difference Fibonacci number Fibonacci sequence **Notation** T(n) is often used to indicate the 'nth term'	The Fibonacci sequence consists of the Fibonacci numbers (1, 1, 2, 3, 5, …), while a Fibonacci type sequence is any sequence formed by adding the two previous terms to get the next term. In terms of quadratic sequences, the focus of this unit is to generate from a rule which could be in algebraic form. Find the nth term of such a sequence is in Stage 10. NCETM: Departmental workshops: Sequences NCETM: Glossary **Common approaches** *All students should use a spreadsheet to explore aspects of sequences during this unit. For example, this could be using formulae to continue a given sequence, to generate the first few terms of a sequence from an nth term as entered, or to find the missing terms in a Fibonacci sequence as in 'Fibonacci solver'.*

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
• A sequence has the first two terms 1, 2, … Show me a way to continue this sequence. And another. And another … • A sequence has nth term $3n^2 + 2n – 4$. Jenny writes down the first three terms as 1, 12, 29. Kenny writes down the first three terms as 1, 36, 83. Who do agree with? Why? What mistake has been made? • What is the same and what is different: 1, 1, 2, 3, 5, 8, … and 4, 7, 11, 18, 29, …	KM: Forming Fibonacci equations KM: Mathematician of the Month: Fibonacci KM: Leonardo de Pisa KM: Fibonacci solver. Students can be challenged to create one of these. KM: Sequence plotting. A grid for plotting nth term against term. KM: Maths to Infinity: Sequences NRICH: Fibs	• Some students may think that it is possible to find an nth term for any sequence. A Fibonacci type sequence would require a recurrence relation instead. • Some students may think that the word 'quadratic' involves fours. • Some students may substitute into ax^2 incorrectly, working out $(ax)^2$ instead.

Spring 1: UNIT 2 – ALGEBRA & SEQUENCES	GCSE EDEXCEL HIGHER TEXTBOOK	3 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Algebra progression map

- deduce expressions to calculate the nth term of quadratic sequences
- recognise and use simple geometric progressions (r^n where n is an integer, and r is a rational number > 0)

Return to overview

Possible themes	Possible key learning points
• Explore quadratic sequences • Investigate geometric progressions	• Find the nth term of a sequence of the form $ax^2 + b$ • Find the nth term of a sequence of the form $ax^2 + bx + c$ • Recognise and describe a simple geometric progression (of the form r^n) • Find the next three terms, or a given term, in a geometric progression

Prerequisites	Mathematical language	Pedagogical notes
• Find the nth term for an increasing linear sequence • Find the nth term for an decreasing linear sequence • Identify quadratic sequences • Establish the first and second differences of a quadratic sequence • Find the next three terms in a quadratic sequence	Term nth term Generate Quadratic First (second) difference Geometric Progression **Notation** T(n) is often used to indicate the ‘nth term’	In Stage 9, pupils recognised and used quadratic sequences. The focus in this stage is finding the nth term for a quadratic sequence and introducing pupils to geometric sequences (r>0). NCETM: Departmental workshops: Sequences NCETM: Glossary **Common approaches** *All students should use a spreadsheet to explore aspects of sequences during this unit. For example, this could be using formulae to continue a given sequence, to generate the first few terms of a sequence from an nth term as entered, or to find the missing terms in sequence.* *Ask pupils to repeatedly fold a piece of paper in half as many times as possible as an introduction to geometric sequences.*

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
• Show me a geometric progression. And another. And another…. • Show me a quadratic sequence with n^{th} term $3x^2 + bx + c$. And another. And another…. • Convince me the n^{th} term of 19, 16, 11, 4, … is $20 – x^2$. • Kenny thinks 1, 1, 1, 1, 1, … is an arithmetic sequence. Jenny thinks 1, 1, 1, 1, 1, … is a geometric sequence. Who is correct? Explain your answer.	KM: Sequence plotting. A grid for plotting nth term against term. KM: Maths to Infinity: Sequences KM: Stick on the Maths: Quadratic sequences Hwb: Linear and quadratic sequences NRICH: Growing Surprises **Learning review** GLOWMaths/JustMaths: Sample Questions Both Tiers GLOWMaths/JustMaths: Sample Questions Higher Tiers	• Some students may think that it is possible to find an nth term for any sequence. • Some students may think that the second difference (of a quadratic sequence) is equivalent to the coefficient of x^2. • Some students may substitute into ax^2 incorrectly, working out $(ax)^2$ instead.

Key concepts (GCSE subject content statements)

The Big Picture: Algebra progression map

- 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

Return to overview

Possible themes	Possible key learning points
• investigate geometric progressions	• Recognise and use geometric progressions, ar^n, when r is a fraction > 0 • Recognise and use geometric progressions, ar^n, when r is a surd • Solve problems involving geometric sequences • Recognise and use non-standard sequences

Prerequisites	Mathematical language	Pedagogical notes
• Understand the difference between an arithmetic progression, a quadratic sequence and a geometric progression • Recognise a simple geometric progression • Find the next three terms in a geometric progression • Find a given term in a simple geometric progression • Describe a geometric progression	Term nth term First (second) difference Geometric Progression Surd **Notation** T(n) is often used to indicate the 'nth term' r^n	In Stage 10, pupils have learnt about recognising and using simple geometric progressions where n is an integer, and r is a rational number > 0. In this unit, the common ratio (r) could be a **surd**. Pupils are also introduced to non-standard sequences such as $\frac{1}{1\times2}, \frac{1}{2\times3}, \frac{1}{3\times4}, \frac{1}{4\times5}, \ldots$ NCETM: Glossary **Common approaches** *All pupils are introduced to geometric sequences with r as a rational number using the 'Kangaroo Problem'*

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
• Show me a geometric progression. And another, and another, … • Convince Kenny that 1, 0.5, 0.25, 0.125 is a geometric sequence. • Convince Jenny that 3, $3\sqrt{2}$, 6, $6\sqrt{2}$, 12, … is a geometric sequence. • Always/Sometimes/Never: The ratio (r) of terms in a geometric sequence is greater than 1	KM: Kangaroo Problem NRICH: Summing Geometric Progressions AQA Maths: Sequences Resourceaholic: Sequences **Learning review** GLOWMaths/JustMaths: Sample Questions Higher Tiers	• Some pupils may have difficulty with sequences when r is a surd • Some pupils think the ratio (r) of terms in a geometric sequence has to be greater than 1 • Some pupils may have difficulty spotting the position-to-term relationship for 'non-standard' sequences such as: $\frac{1}{1\times2}, \frac{1}{2\times3}, \frac{1}{3\times4}, \frac{1}{4\times5}, \ldots$

Spring 1: UNIT 2 – ALGEBRA & SEQUENCES | GCSE EDEXCEL HIGHER TEXTBOOK | 2 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Algebra progression map

- understand and use the concepts and vocabulary of inequalities
- solve linear inequalities in one variable
- represent the solution set to an inequality on a number line

Return to overview

Possible themes	Possible key learning points
• Explore the meaning of an inequality • Solve linear inequalities	• Find the set of integers that are solutions to an inequality, including the use of set notation • Know how to show a range of values that solve an inequality on a number line • Solve a simple linear inequality in one variable with unknowns on one side • Solve a complex linear inequality in one variable with unknowns on one side • Solve a linear inequality in one variable with unknowns on both sides • Solve a linear inequality in one variable involving brackets • Solve a linear inequality in one variable involving negative terms • Solve problems by constructing and solving linear inequalities in one variable

Prerequisites	Mathematical language	Pedagogical notes
• Understand the meaning of the four inequality symbols • Solve linear equations including those with unknowns on both sides	(Linear) inequality Unknown Manipulate Solve Solution set Integer **Notation** The inequality symbols: < (less than), > (greater than), ≤ (less than or equal to), ≥ (more than or equal to) The number line to represent solutions to inequalities. An open circle represents a boundary that is not included. A filled circle represents a boundary that is included. Set notation; e.g. {-2, -1, 0, 1, 2, 3, 4}	The mathematical process of solving a linear inequality is identical to that of solving linear equations. The only exception is knowing how to deal with situations when multiplication or division by a negative number is a possibility. Therefore, take time to ensure students understand the concept and vocabulary of inequalities. NCETM: Departmental workshops: Inequalities NCETM: Glossary **Common approaches** *Students are taught to manipulate algebraically rather than be taught 'tricks'. For example, in the case of -2x > 8, students should not be taught to flip the inequality when dividing by -2. They should be taught to add 2x to both sides. Many students will later generalise themselves. Care should be taken with examples such as 5 < 1 – 4x < 21 (see reasoning opportunities).*

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
• Show me an inequality (with unknowns on both sides) with the solution x ≥ 5. And another. And another … • Convince me that there are only 5 common integer solutions to the inequalities 4x < 28 and 2x + 3 ≥ 7. • What is wrong with this statement? How can you correct it? 1 – 5x ≥ 8x – 15 so 1 ≥ 3x – 15. • How can we solve 5 < 1 – 4x < 21 ? For example, subtracting 1 from all three parts, and then adding 4x, results in 4 + 4x < 0 < 20 + 4x. This could be broken down into two inequalities to discover that x < -1 and x > -5, so -5 < x < -1. The 'trick' (see common approaches) results in the more unconventional solution -1 > x > -5.	KM: Stick on the Maths: Inequalities KM: Convinced?: Inequalities in one variable NRICH: Inequalities	• Some students may think that it is possible to multiply or divide both sides of an inequality by a negative number with no impact on the inequality (e.g. if -2x > 12 then x > -6) • Some students may think that a negative x term can be eliminated by subtracting that term (e.g. if 2 – 3x ≥ 5x + 7, then 2 ≥ 2x + 7) • Some students may know that a useful strategy is to multiply out any brackets, but apply incorrect thinking to this process (e.g. if 2(3x – 3) < 4x + 5, then 6x – 3 < 4x + 5)

Key concepts (GCSE subject content statements)

The Big Picture: Algebra progression map

- solve linear inequalities in two variables
- represent the solution set to an inequality using set notation and on a graph

Return to overview

Possible themes

- Understand and use set notation
- Solve inequalities
- Represent inequalities on a graph

Possible key learning points

- State the (simple) inequality represented by a shaded region on a graph
- Construct and shade a graph to show a linear inequality of the form $y > ax + b$, $y < ax + b$, $y \geq ax + b$ or $y \leq ax + b$
- Construct and shade a graph to show a linear inequality in two variables stated implicitly
- Construct and shade a graph to represent a set of linear inequalities in two variables
- Find the set of integer coordinates that are solutions to a set of inequalities in two variables
- Use set notation to represent the solution set to an inequality

Prerequisites

- Understand the meaning of the four inequality symbols
- Find the set of integers that are solutions to an inequality
- Use set notation to list a set of integers
- Use a formal method to solve an inequality in one variable
- Plot graphs of linear functions stated explicitly
- Plot graphs of linear functions stated implicitly

Mathematical language

(Linear) inequality
Variable
Manipulate
Solve
Solution set
Integer
Set notation
Region

Notation
The inequality symbols: < (less than), > (greater than), ≤ (less than or equal to), ≥ (more than or equal to)
A graph to represent solutions to inequalities in two variables. A dotted line represents a boundary that is not included. A solid line represents a boundary that is included.
Set notation; e.g. {-2, -1, 0, 1, 2, 3, 4}

Pedagogical notes

Pupils have explored the meaning of an inequality and solved linear inequalities in one variable in Stage 9. This unit focuses on solving linear equalities in two variables, representing the solution set using set notation and on a graph Therefore, it is important that pupils can plot the graphs of linear functions, including $x = a$ and $y = b$.
NCETM: Departmental workshops: Inequalities
NCETM: Glossary

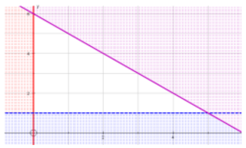
Common approaches
All students experience the use of dynamic graphing software, such as Autograph, to represent the solution sets of inequalities in two variables.
Students are taught to manipulate algebraically rather than be taught 'tricks'. For example, in the case of $-2x > 8$, students should not be taught to flip the inequality when dividing by -2. They should be taught to add 2x to both sides. Many students will later generalise themselves. Note that with examples such as $5 < 1 – 4x < 21$, subtracting 1 from all three parts, and then adding 4x, results in $4 + 4x < 0 < 20 + 4x$. This could be broken down into two inequalities to discover that $x < -1$ and $x > -5$, so $-5 < x < -1$. The 'trick' results in the more unconventional solution $-1 > x > -5$.

Reasoning opportunities and probing questions

- Show me a pair of integers that satisfy $x + 2y < 6$. And another. And another …
- Convince me that the set of inequalities $x > 0$, $y > 0$ and $x + y < 2$ has no positive integer solutions.
- Convince me that the set of inequalities $x \geq 0$, $y > 0$ and $x + 2y < 6$ has 6 pairs of positive integer solutions.
- What is wrong with this statement? How can you correct it?

The unshaded region represents the solution set for the inequalities:

$x < 1$, $y \geq 0$ and $x + y > 6$



Suggested activities

KM: Linear programming with Lego
KM: Linear programming (Autograph)
KM: Stick on the Maths 8: Inequalities
KM: Convinced?: Inequalities in two variables
NRICH: Which is bigger?
Hwb: How do we know?
MAP: Defining regions using inequalities
CIMT: Inequalities

Learning review
GLOWMaths/JustMaths: Sample Questions Both Tiers
GLOWMaths/JustMaths: Sample Questions Higher Tiers

Possible misconceptions

- Some pupils may think that it is possible to multiply or divide both sides of an inequality by a negative number with no impact on the inequality (e.g. if $-2x > 12$ then $x > -6$)
- Some pupils may think that strict inequalities, such as $y < 2x + 3$, are represented by a solid, rather than dashed, line on a graph
- Some pupils may shade the incorrect region

Spring 2: UNIT 2 – ALGEBRA & SEQUENCES	GCSE EDEXCEL HIGHER TEXTBOOK	3 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Algebra progression map

- solve quadratic equations algebraically by factorising
- solve quadratic equations (including those that require rearrangement) algebraically by factorising
- find approximate solutions to quadratic equations using a graph
- deduce roots of quadratic functions algebraically

Return to overview

Possible themes	Possible key learning points
• Solve quadratic equations • Use graphs to solve equations	• Solve a quadratic equation of the form $x^2 + bx + c = 0$ by factorising • Solve a quadratic equation by rearranging and factorising • Make connections between graphs and quadratic equations of the form $ax^2 + bx + c = 0$ • Make connections between graphs and quadratic equations of the form $ax^2 + bx + c = dx + e$ • Find approximate solutions to quadratic equations using a graph • Deduce roots of quadratic functions algebraically • Solve problems that involve solving a quadratic equation in context

Prerequisites	Mathematical language	Pedagogical notes
• Manipulate linear equations • Factorise a quadratic expression of the form $x^2 + bx + c$ • Factorise a quadratic expression of the form $ax^2 + bx + c$ • Make connections between a linear equation and a graph	(Quadratic) equation Factorise Rearrange Variable Unknown Manipulate Solve Deduce x-intercept Root	Pupils factorise quadratic expressions of the form $ax^2 + bx + c$ in Stage 9 ($a = 1$) and Stage 10. If $A \times B = 0$ then either $A = 0$ or $B = 0$ is a fundamental underlying concept to solving quadratic equations when $b \neq 0$ and $c \neq 0$ by factorising. Pupils should experience solving quadratics with $b \neq 0$ and $c = 0$, such as $x^2 + 6x = 0$, and quadratics with $b \neq 0$ and $c \neq 0$, such as $x^2 + 6x + 8 = 0$. Pupils may wish to 'divide both sides by 'x' when solving quadratics such as $x^2 + 6x = 0$ without appreciating that x could equal zero. NCETM: Glossary **Common approaches** *Pupils are taught how to solve quadratics of the form $ax^2 + bx + c = 0$ when:* - $b = 0$, $b \neq 0$ and $c = 0$, $b \neq 0$ and $c \neq 0$ *Pupils are encouraged, whenever possible, to divide a quadratic equation by a common factor to make the factorising process easier, such as $2x^2 + 6x + 8 = 0$*

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
• Show me a quadratic equation that can be solved by factorising. And another, and another … • Show me a quadratic equation with one solution $x = 3$. And another, and another … • Always/Sometimes/Never: A quadratic equation can be solved by factorising. • Convince me why you can't '*divide both sides by x*' when solving $x^2 + 8x = 0$ • Kenny is solving $x^2 + 6x + 8 = 2$ as follows: *$(x + 4)(x + 2) = 2$ so $x + 4 = 2$ or $x + 2 = 1$.* *Therefore, $x = -2$ and $x = -1$.* • Do you agree with Kenny? Explain your answer.	NRICH: How old am I? NRICH: Golden thoughts Hwb: Algebra Fails **Learning review** GLOWMaths/JustMaths: Sample Questions Both Tiers GLOWMaths/JustMaths: Sample Questions Higher Tiers KM: 10M6 BAM Task, 10M7 BAM Task	• Some pupils may not appreciate that a quadratic equation must equal zero when solving by factorising • Some pupils may solve $x^2 + 8x = 0$ by dividing both sides by x to get $x + 8 = 0$, $x = -8$. • Some pupils may forget to divide by the coefficient of x when solving quadratics such as $2x^2 + 5x + 2 = 0$, i.e. $(2x + 1)(x + 2) = 0$ so $2x + 1 = 0$ or $x + 2 = 0$ and therefore $x = -1$ (rather than $-½$ or $x = -2$) • Some pupils may not divide a quadratic equation by a common factor to make the factorising process easier, such as $2x^2 + 6x + 8 = 0$

Spring 2: UNIT 2 – ALGEBRA & SEQUENCES	GCSE EDEXCEL HIGHER TEXTBOOK	3 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Algebra progression map

- simplify and manipulate algebraic expressions involving algebraic fractions
- manipulate algebraic expressions by expanding products of more than two binomials
- simplify and manipulate algebraic expressions (including those involving surds) by expanding products of two binomials and factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of two squares
- manipulate algebraic expressions by factorising quadratic expressions of the form $ax^2 + bx + c$

Return to overview

Possible themes

- Manipulate algebraic fractions
- Manipulate algebraic expressions

Possible key learning points

- Add and subtract algebraic fractions
- Multiply and divide algebraic fractions
- Simplify an algebraic fraction
- Expand the product of three binomials
- Expand the product of two binomials involving surds
- Factorise an expression involving the difference of two squares
- Factorise a quadratic expression of the form $ax^2 + bx + c$ (a is prime)
- Factorise a quadratic expression of the form $ax^2 + bx + c$ (a is composite)
- Identify when factorisation of the numerator and/or denominator is needed to simplify an algebraic fraction
- Simplify an algebraic fraction that involves factorisation
- Change the subject of a formula when more than two steps are required
- Change the subject of a formula when the required subject appears twice

Prerequisites

- Calculate with negative numbers
- Multiply two linear expressions of the form $(x \pm a)(x \pm b)$
- Factorise a quadratic expression of the form $x^2 + bx + c$
- Add, subtract, multiply and divide proper fractions
- Change the subject of a formula when two steps are required

Mathematical language

Equivalent
Equation
Expression
Expand
Linear
Quadratic
Algebraic Fraction
Difference of two squares
Binomial
Factorise

Notation

Pedagogical notes

Pupils have applied the four operations to proper, and improper, fractions in Stage 7 and factorised quadratics of the form $x^2 + bx + c$ in Stage 9. Pupils should build on the experiences of using the grid method in Stage 9 to expand products of more than two binomials.

Eg $(x + 2)(x + 3)(x – 4) = (x^2 + 5x + 6)(x – 4) = x^3 + x^2 – 14x – 24$

	x^2	$+5x$	$+6$
x	x^3	$+5x^2$	$+6x$
$– 4$	$–4x^2$	$–20x$	$–24$

Teachers also need to help pupils 'see' the difference of two squares by using pictorial representations

NCETM: Algebra

NCETM: Glossary

Common approaches

Students are taught to use the grid method in reverse to factorise a quadratic
Students manipulate algebra tiles to explore factoring quadratics
The difference of two squares is explained using visual representation

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
• The answer is $2x^2 + 10x + c$. Show me a possible question. And another. • Kenny simplifies $\frac{3x^2+x}{x}$ as $3x^2 + 1$. Do you agree with Kenny? Explain. • Convince me that $103^2 – 97^2 = 1200$ without a calculator. • Convince me that $4x^2 – 9 \equiv (3x – 2)(3x + 2)$. • Jenny thinks that $(3x – 2)^2 = 3x^2 + 12x + 4$. Do you agree with Jenny? Explain your answer. • Convince me that $\frac{2x^2+5x+2}{2x+1} = x + 2$	KM: Simplifying algebraic fractions KM: Maths to Infinity: Brackets and Quadratics KM: Stick on the Maths: Quadratic sequences NRICH: What's possible? NRICH: Finding Factors Algebra Tiles (external site) **Learning review** GLOWMaths/JustMaths: Sample Questions Higher Tiers KM: 10M5 BAM Task	• Once pupils know how to factorise a quadratic expression of the form $x^2 + bx + c$ they might overcomplicate the simpler case of factorising an expression such as $3x^2 + 6x$ ($\equiv (3x + 0)(x + 2)$) • Some pupils may think that $(x + a)^2 \equiv x^2 + a^2$ • Some pupils may apply the 'rules of factorising' quadratics of the form $x^2 + bx + c$ to quadratics of the form $ax^2 + bx + c$; e.g. $2x^2 + 7x + 10 \equiv (2x + 5)(x + 2)$ because $2 \times 5 = 10$ and $2 + 5 = 7$.

Spring 2: UNIT 3 – REPRESENTING DATA	GCSE EDEXCEL HIGHER TEXTBOOK	9 lessons

Key concepts (GCSE subject content statements)

The Big Picture: [Statistics progression map]

- interpret and construct tables, charts and diagrams, including tables and line graphs for time series data and know their appropriate use
- draw estimated lines of best fit; make predictions
- know correlation does not indicate causation; interpolate and extrapolate apparent trends whilst knowing the dangers of so doing

Return to overview

Possible themes	Possible key learning points
• Construct and interpret graphs of time series • Interpret a range of charts and graphs • Interpret scatter diagrams • Explore correlation	• Construct graphs of time series • Interpret graphs of time series • Construct and interpret compound bar charts • Construct and interpret frequency polygons • Construct and interpret stem and leaf diagrams • Interpret a scatter diagram using understanding of correlation • Construct a line of best fit on a scatter diagram and use the line of best fit to estimate values • Understand that correlation does not indicate causation

Prerequisites	Mathematical language	Pedagogical notes
• Know the meaning of discrete and continuous data • Interpret and construct frequency tables • Construct and interpret pictograms, bar charts, pie charts, tables, vertical line charts, histograms (equal class widths) and scatter diagrams	Categorical data, Discrete data Continuous data, Grouped data Axis, axes Time series Compound bar chart Scatter graph (scatter diagram, scattergram, scatter plot) Bivariate data (Linear) Correlation Positive correlation, Negative correlation Line of best fit Interpolate Extrapolate Trend **Notation** Correct use of inequality symbols when labeling groups in a frequency table	Lines of best fit on scatter diagrams are first introduced in Stage 9, although students may well have encountered both lines and curves of best fit in science by this time. William Playfair, a Scottish engineer and economist, introduced the line graph for time series data in 1786. NCETM: [Glossary] **Common approaches** *As a way of recording their thinking, all students construct the appropriate horizontal and vertical line when using a line of best fit to make estimates.* *In simple cases, students plot the 'mean of x' against the 'mean of y' to help locate a line of best fit.*

Reasoning opportunities and probing questions	Suggested activities	Possible misconceptions
• Show me a compound bar chart. And another. And another. • What's the same and what's different: correlation, causation? • What's the same and what's different: scatter diagram, time series, line graph, compound bar chart? • Convince me how to construct a line of best fit. • Always/Sometimes/Never: A line of best fit passes through the origin	KM: [Stick on the Maths HD2: Frequency polygons and scatter diagrams]	• Some students may think that correlation implies causation • Some students may think that a line of best fit always has to pass through the origin • Some students may misuse the inequality symbols when working with a grouped frequency table

Spring 2 – Assessment	*3 lessons*
• 1.5 hours calculator Foundation Paper • Self-assessment sheets completed • Review and self-assessment of performance stuck into books	

Summer1: UNIT 4 – FDP	GCSE EDEXCEL HIGHER TEXTBOOK	15 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Fractions, decimals and percentages progression map

- Solving ratio problems
- Fraction and decimal equivalence
- Percentages and percentage change
- change recurring decimals into their corresponding fractions and vice versa
- set up, solve and interpret the answers in growth and decay problems, including compound interest

Return to overview

Possible themes

- Explore the links between recurring decimals and fractions
- Solve problems involving repeated percentage change
- Solve problems involving exponential growth and decay

Possible key learning points

- Convert a fraction to a recurring decimal
- Convert a recurring decimal of the form $0.\dot{x}$, $0.\dot{x}\dot{y}$, $0.\dot{x}y\dot{z}$ to a fraction
- Convert a recurring decimal of the form $0.0\dot{x}$, $0.0\dot{x}\dot{y}$, to a fraction
- Recognise when a situation involves compound interest
- Calculate the result of a repeated percentage change, including compound interest
- Solve problems involving growth and decay

Prerequisites

- Identify if a fraction is terminating or recurring
- Move freely between terminating fractions, decimals and percentages
- Use a multiplier to calculate the result of percentage changes

Mathematical language

Fraction
Mixed number
Top-heavy fraction
Percentage change, percentage increase, percentage increase
Compound interest, Simple interest
Terminating decimal, Recurring decimal
(Exponential) growth, decay

Notation
Dot notation for recurring decimals; e.g. $0.\dot{x}y\dot{z} = 0.xyzxyzxyz$ … and $0.x\dot{y} = 0.xyyy$ …
Note that other notations for recurring decimals are used, for example the vinculum, $0.\dot{x}y\dot{z} = 0.\overline{xyz}$ (USA); parentheses, $0.\dot{x}y\dot{z} = 0.(xyz)$ (parts of Europe); the letter 'R', $0.x^R$ (upper or lower case)

Pedagogical notes

The diagonal fraction bar (solidus) was first used by Thomas Twining (1718) when recorded quantities of tea. The division symbol (÷) is called an obelus, but there is no name for a horizontal fraction bar.
It is useful to start with 1/3 (a fraction and recurring decimal pupils are familiar with) to explain the method:
x = 0.33333… ⇒ 10x = 3.33333… ⇒ 9x = 3 and therefore x = $^3/_9$ = $^1/_3$
NRICH: History of fractions
NRICH: Teaching fractions with understanding
NCETM: Glossary

Common approaches
All pupils use the horizontal fraction bar to avoid confusion when fractions are coefficients in algebraic situations
All pupils use dot notation for recurring decimals
All pupils know the recurring decimal for 1/9, 1/90, 1/900 …

Reasoning opportunities and probing questions

- Show me a fraction that can be expressed as a recurring decimal. And another. And another …
- Always/Sometime/Never: If the denominator is odd, the fraction can ve expressed as a recurring decimal
- Convince me $^1/_7$ can be expressed as a recurring decimal
- Convince me 0.9999999999 … = 1
- Kenny thinks that the interest gained when £100 is increased 20% per annum for 4 years can be calculated by multiplying £100 by 2.0736. Do you agree with Kenny? Explain your answer.

Suggested activities

KM: Investigate fractions connected to cyclic numbers; e.g. the decimal equivalents of sevenths, nineteenths, etc.
KM: Stick on the Maths 8: Recurring decimals and fractions
KM: Stick on the Maths 8: Repeated Proportional Change
KM: Convinced?: Recurring decimals and fractions
KM: Convinced?: Repeated Proportional Change
NRICH: Repetitiously
Hwb: Borrowing money: APR, Too good to be true!, Double your money! and Comparing interest
Learning review
GLOWMaths/JustMaths: Sample Questions Both Tiers
GLOWMaths/JustMaths: Sample Questions Higher Tiers
KM: 10M3 BAM Task

Possible misconceptions

- Some pupils may incorrectly think 0.111111… = $^1/_{11}$
- Some pupils may think that an the amount created by increasing a quantity by 5% repeated four times is the same as increasing the quantity by 5% and multiplying that amount by 4.
- Some pupils may think the percentage multiplier for a 20% increase (or decrease) is 0.2

Summer 2: UNIT 5 – ANGLES & BASIC TRIG | GCSE EDEXCEL HIGHER TEXTBOOK | 12 lessons

Key concepts (GCSE subject content statements)

The Big Picture: Properties of Shape progression map

- make links to similarity (including trigonometric ratios) and scale factors
- know the exact values of sinθ and cosθ for θ = 0°, 30°, 45°, 60° and 90°; know the exact value of tanθ for θ = 0°, 30°, 45° and 60°
- know the trigonometric ratios, sinθ = opposite/hypotenuse, cosθ = adjacent/hypotenuse, tanθ = opposite/adjacent
- apply it to find angles and lengths in right-angled triangles in two dimensional figures

Return to overview

Possible themes

- Investigate similar triangles
- Explore trigonometry in right-angled triangles
- Set up and solve trigonometric equations
- Use trigonometry to solve practical problems

Bring on the Maths: GCSE Higher Shape

Investigating angles: #5, #6, #7, #8, #9

Possible key learning points

- Appreciate that the ratio of corresponding sides in similar triangles is constant
- Choose an appropriate trigonometric ratio that can be used in a given situation
- Understand that sine, cosine and tangent are functions of an angle
- Establish the exact values of sinθ and cosθ for θ = 0°, 30°, 45°, 60° and 90°
- Establish the exact value of tanθ for θ = 0°, 30°, 45° and 60°
- Use a calculator to find the sine, cosine and tangent of an angle
- Know the trigonometric ratios, sinθ = opp/hyp, cosθ = adj/hyp, tanθ = opp/adj
- Set up and solve a trigonometric equation to find a missing side in a right-angled triangle
- Set up and solve a trigonometric equation when the unknown is in the denominator of a fraction
- Set up and solve a trigonometric equation to find a missing angle in a right-angled triangle
- Use trigonometry to solve problems involving bearings
- Use trigonometry to solve problems involving an angle of depression or an angle of elevation

Prerequisites

- Understand and work with similar shapes
- Solve linear equations, including those with the unknown in the denominator of a fraction
- Understand and use Pythagoras' theorem

Mathematical language

Similar
Opposite
Adjacent
Hypotenuse
Trigonometry
Function
Ratio
Sine
Cosine
Tangent
Angle of elevation, angle of depression

Notation

sinθ stands for the 'sine of θ'
$\sin^{-1}$ is the inverse sine function, and not 1÷ sin

Pedagogical notes

Ensure that all students are aware of the importance of their scientific calculator being in degrees mode.
Ensure that students do not round until the end of a multi-step calculation
This unit of trigonometry should focus only on right-angled triangles in two dimensions. The sine rule, cosine rule, and applications in three dimensions are covered in Stage 11.
Note that inverse functions are explored in Stage 11.
NRICH: History of Trigonometry
NCETM: Glossary

Common approaches

All students explore sets of similar triangles with angles of (at least) 30°, 45° and 60° as an introduction to the three trigonometric ratios
The mnemonic 'Some Of Harry's Cats Are Heavier Than Other Animals' is used to help students remember the trigonometric ratios

Reasoning opportunities and probing questions

Suggested activities

Possible misconceptions

• Show me an angle and its exact sine (cosine / tangent). And another … • Convince me that you have chosen the correct trigonometric function • (When exploring sets of similar triangles and working out ratios in corresponding cases) why do you think that the results are all similar, but not the same? Could we do anything differently to get results that are closer? How could we make a final conclusion for each ratio?	KM: From set squares to trigonometry KM: Trigonometry flowchart NRICH: Trigonometric protractor NRICH: Sine and cosine Hwb: Greenhouse **Learning review** GLOWMaths/JustMaths: Sample Questions Both Tiers GLOWMaths/JustMaths: Sample Questions Higher Tiers KM: 10M10 BAM Task	• Some students may not appreciate the fact that adjacent and opposite labels are not fixed, and are only relevant to a particular acute angle. In situations where both angles are given this can cause difficulties. • Some students may not balance an equation such as sin35 = 4/x correctly, believing that the next step is (sin35)/4 = x • Some students may think that $\sin^{-1}\theta = 1 \div \sin\theta$ • Some students may think that sinθ means sin × θ

Summer 2 – Assessment	***3 lessons***
• Two papers - 1.5 hours each non calc and calculator Foundation Papers • Self-assessment sheets completed • Review and self-assessment of performance stuck into books	