Cornwallis Academy
Ambitions for All

SMILE
SUCCESSFUL | MOTIVATED | INSPIRED | LEARNING | EXCITED & ENGAGED

Year 9 Mathematics

Number

Learning Objectives

- Apply systematic listing strategies
- Use priority of operations with positive and negative numbers
- Simplify calculations by cancelling
- Use inverse operations
- Round to a given number of decimal places
- Multiply and divide decimal numbers
- Convert metric measures
- Write decimal numbers of millions
- Round to a given number of significant figures
- Estimate answers to calculations
- Use one calculation to find the answer to another
- Recognise 2-digit prime numbers
- Find factors and multiples of numbers
- Find common factors ad common multiples of two numbers
- Find the HCF and LCM of two numbers by listing
- Find square roots and cube roots
- Recognise powers of 2, 3, 4 and 5
- Understand surd notation on a calculator
- Use index notation for powers of 10
- Use index notation in calculations
- Use the laws of indices
- Write a number as the product of its prime factors
- Use prime factor decomposition to find the HCF and LCM

What previous knowledge is required?

- Understand place value for whole numbers and decimals.
- Read, write and compare positive and negative numbers.
- Use the four operations (addition, subtraction, multiplication and division) with whole numbers.
- Recall multiplication tables and basic number facts.
- Understand and apply BIDMAS/BODMAS in simple calculations.
- Recognise common metric units of measure:
    - mm
    - cm
    - m
    - km
    - g
    - kg
    - ml
    - l
- Round whole numbers to the nearest 10, 100 and 1000.
- Perform calculations with decimal numbers.
- Understand the concepts of factors and multiples.
- Recognise square numbers and simple cube numbers.
- Understand the meaning of powers and exponents in simple cases.
- Use a calculator accurately.

- Follow systematic methods when solving simple problems.
- Understand inverse operations in arithmetic contexts.

How will this term's content help with future learning?

- Provides the numerical foundation for all GCSE Mathematics topics.
- Develops fluency and confidence with calculations involving integers, decimals and powers.
- Supports future work in:
    - algebra
    - ratio and proportion
    - probability
    - statistics
    - geometry and measures
- Strengthens estimation and checking strategies used throughout GCSE Mathematics.
- Builds understanding of standard form through powers of 10 and index notation.
- Develops number sense and reasoning skills required for problem-solving.
- Supports efficient calculator use and interpretation of calculator displays.
- Provides the basis for algebraic index laws studied later in the course.
- Develops understanding of prime factorisation, which supports:
    - fractions
    - algebraic manipulation
    - HCF and LCM calculations
- Supports work with scientific calculations in mathematics and science.
- Strengthens logical thinking through systematic listing and structured problem-solving.

Common Misconceptions

Systematic Listing

- Missing possible outcomes due to unsystematic working.
- Repeating outcomes and counting them twice.
- Assuming a list is complete without checking.

Order of Operations

- Working strictly from left to right without applying BIDMAS/BODMAS.
- Multiplying before completing brackets.
- Confusing subtraction signs with negative numbers.

Cancelling

- Cancelling across addition or subtraction incorrectly.
- Cancelling numbers that are not common factors.
- Cancelling before completing required calculations.

Inverse Operations

- Using the wrong inverse operation.
- Applying inverse operations in the wrong order.
- Confusing subtraction and division inverses.

Decimal Places

- Counting digits incorrectly after the decimal point.
- Rounding based on the wrong digit.
- Confusing decimal places with significant figures.

Multiplying and Dividing Decimals

- Misplacing the decimal point.
- Ignoring place value.
- Believing multiplication always makes a number larger.
- Believing division always makes a number smaller.

Metric Conversions

- Multiplying instead of dividing (or vice versa).

- Confusing units such as:
  - cm and mm
  - kg and g
  - ml and l
- Forgetting conversion factors.

Large Decimal Numbers

- Misreading place value in millions.
- Incorrectly placing commas.
- Confusing millions with thousands.

Significant Figures

- Starting counting from the decimal point rather than the first non-zero digit.
- Counting leading zeros as significant.
- Confusing significant figures with decimal places.

Estimation

- Rounding values inconsistently.
- Forgetting estimation is approximate.
- Using exact values instead of rounded values.

Factors and Multiples

- Confusing factors with multiples.
- Assuming all even numbers are factors of each other.
- Missing factor pairs.

HCF and LCM

- Confusing highest common factor with lowest common multiple.
- Listing multiples inaccurately.
- Stopping lists too early.

Square Roots and Cube Roots

- Confusing:
  - $\sqrt{25}$with 25^2
  - cube roots with square roots.
- Believing all roots produce whole-number answers.

Powers and Indices

- Thinking:
  - $2^3 = 2 \times 3$
    instead of
  - $2 \times 2 \times 2.$
- Confusing powers with multiplication by the exponent.
- Misapplying index laws.

Laws of Indices

- Adding indices when powers are added rather than multiplied.
- Multiplying indices instead of adding them when multiplying powers.
- Confusing the rules for multiplication and division.

Prime Numbers

- Believing 1 is a prime number.
- Forgetting that 2 is the only even prime number.
- Missing factors when testing for primality.

Prime Factor Decomposition

- Stopping factor trees too early.
- Including non-prime numbers in the final answer.
- Forgetting to write prime factors in index form.

Surds on a Calculator

- Assuming calculator surd notation represents an exact decimal value.
- Confusing exact and approximate answers.
- Misinterpreting square root symbols displayed on calculators.

National Curriculum / Specification

Number

- **N1** – Understand and use place value for integers, decimals and powers of 10.
- **N2** – Use the four operations, including formal written methods, applied to integers and decimals.
- **N3** – Use integer powers and associated real roots.
- **N4** – Recognise and use multiples, factors, primes and prime factor decomposition.
- **N5** – Use the concepts and vocabulary of:
  - prime numbers
  - factors
  - multiples
  - common factors
  - common multiples.
- **N6** – Use positive integer powers and roots.
- **N7** – Understand and use mathematical notation correctly.
- **N8** – Calculate accurately with integers, fractions and decimals.
- **N9** – Round numbers and measures to an appropriate degree of accuracy.
- **N10** – Use approximation through rounding to estimate answers.
- **N11** – Use a calculator appropriately and interpret calculator displays.

Ratio, Proportion and Rates of Change

- **R1** – Change freely between related standard units.
- **R2** – Use scale factors and proportional reasoning where appropriate.
- **R9** – Apply proportional reasoning to numerical problems.

Algebra

- **A1** – Use algebraic notation, including index notation.
- **A4** – Apply and manipulate powers and index laws.

Algebra

Learning Objectives

- Use correct algebraic notation
- Write and simplify expressions
- Use the index laws
- Multiply and divide expressions
- Substitute numbers into expressions
- Write more complex expressions
- Recognise the difference between a formula and an expression
- Write and use formula
- Expand brackets
- Simplify expressions with brackets
- Write and use formulae with brackets
- Factorise algebraic expressions
- Use the identity and the not equal to symbols
- Write expressions and simple formulae
- Use formulae

What previous knowledge is required?

- Use the four operations (addition, subtraction, multiplication and division) confidently.
- Apply the order of operations (BIDMAS/BODMAS).

- Understand positive and negative numbers.
- Recognise and use mathematical symbols correctly:
  - $=$
  - $+$
  - $-$
  - $\times$
  - $\div$
  - brackets.
- Understand basic index notation, such as:
  - 2^3
  - 5^2.
- Simplify numerical calculations.
- Substitute numbers into simple number patterns.
- Recognise that letters can represent unknown values.
- Understand simple number sequences and patterns.
- Use basic mathematical vocabulary including:
  - term
  - factor
  - variable
  - coefficient.
- Rearrange simple numerical calculations using inverse operations.
- Interpret and follow algebraic rules written in words.

How will this term's content help with future learning?

- Provides the foundation for all future algebra topics at GCSE.
- Develops fluency in algebraic manipulation and notation.
- Supports future work on:
  - equations
  - inequalities
  - sequences
  - graphs
  - simultaneous equations
  - quadratic expressions
  - functions.
- Builds understanding of mathematical relationships and generalisation.
- Strengthens problem-solving skills by moving from arithmetic to algebraic thinking.
- Develops the use of formulae in mathematics, science and other subjects.
- Supports future work involving:
  - rearranging formulae
  - substitution into complex formulae
  - mathematical modelling.
- Provides a foundation for coordinate geometry through the use of variables and expressions.
- Develops reasoning skills through identities and algebraic proofs.

Common Misconceptions

Algebraic Notation

- Writing $3 \times a$ as $3 \times a$ rather than $3a$.
- Using inconsistent notation for variables.

Simplifying Expressions

- Adding unlike terms, e.g.
  - $3a + 2b = 5ab$.
- Combining coefficients and variables incorrectly.

- Treating variables as if they are always numbers.

Index Laws

- Thinking:
  - $a^2 + a^3 = a^5$.
- Confusing multiplication and addition rules.
- Believing:
  - $a^2 \times a^3 = a^6$ instead of a^5.
- Ignoring powers when multiplying or dividing expressions.

Multiplying and Dividing Expressions

- Multiplying coefficients but not variables.
- Cancelling terms incorrectly across addition or subtraction.
- Dividing only part of an expression.

Substitution

- Replacing only one occurrence of a variable.
- Forgetting to use brackets when substituting negative numbers.
- Confusing variables with coefficients.

Writing Expressions

- Reversing operations from word descriptions.
- Misinterpreting phrases such as:
  - "three more than a number"
  - "three times a number".

Formulae

- Confusing a formula with an expression.
- Substituting values into the wrong variable.
- Forgetting the order of operations when evaluating a formula.

Expanding Brackets

- Multiplying only the first term inside the bracket.
- Forgetting negative signs.
- Adding instead of multiplying when removing brackets.

Simplifying Expressions with Brackets

- Removing brackets without changing signs appropriately.
- Collecting unlike terms.
- Missing opportunities to simplify fully.

Factorising

- Thinking factorising means dividing every term separately.
- Forgetting to identify the highest common factor.
- Confusing factorising with expanding.

Identity and Not Equal To Symbols

- Thinking:
  - $\equiv$ means exactly the same as $=$.
- Using:
  - $\neq$ incorrectly to mean greater than or less than.
- Confusing identities with equations to be solved.

Expressions, Formulae and Equations

Students often confuse:

- **Expression:** $3x + 4$
- **Equation:** $3x + 4 = 10$
- **Formula:** $A = lw$
- **Identity:** $2(x + 3) \equiv 2x + 6$

Common misconception:

- Believing all algebraic statements are equations.

National Curriculum / Specification

Algebra

- **A1 –** Use and interpret algebraic notation.
- **A2** – Substitute numerical values into formulae and expressions.
- **A3** – Understand and use the concepts and vocabulary of:
  - expressions
  - equations
  - formulae
  - identities.
- **A4** – Simplify and manipulate algebraic expressions by:
  - collecting like terms
  - multiplying a single term over a bracket
  - factorising expressions.
- **A5** – Understand and use standard mathematical formulae.
- **A6** – Model situations mathematically using algebraic expressions and formulae.
- **A7** – Use algebraic methods to solve problems.
- **A12** – Generalise patterns and relationships algebraically.

Number

- **N3 –** Use integer powers and associated notation.
- **N7** – Understand and use mathematical notation correctly.
- **N8** – Use index laws and powers in calculations.

Ratio, Proportion and Rates of Change

- **R6 –** Express relationships algebraically and solve associated problems.

3. Graphs, Tables and Charts

Learning Objectives

- Designing tables and data collection sheets
- Reading data from tables
- Use data from tables
- Design and use two-way tables
- Draw and interpret comparative and composite bar charts
- Interpret and compare data shown in bar charts, line graphs and histograms
- Plot and interpret time series graphs
- Use trends to predict what might happen in the future
- Construct and interpret stem and leaf and back-to-back stem and leaf diagrams
- Draw and interpret pie charts
- Plot and interpret scatter graphs
- Determine whether there is a relationship between sets of data
- Draw a line of best fit on scatter graphs
- Use the line of best fit to predict values

What previous knowledge is required?

- Understand how to collect and record simple data.
- Read information from basic tables and charts.
- Count frequencies accurately and organise data systematically.
- Use scales on number lines and axes.
- Plot coordinates in the first quadrant.
- Calculate simple totals and frequencies.
- Understand the meanings of terms such as:
  - data

    - frequency
    - category
    - variable
    - axis
    - scale
- Recognise common chart types from Key Stage 2 and Key Stage 3:
    - pictograms
    - bar charts
    - line graphs
    - tally charts
- Understand basic fractions, percentages and angles (particularly for pie charts).
- Interpret information presented in everyday contexts such as timetables, surveys and weather charts.
- Draw straight lines accurately using a ruler.

How will this term's content help with future learning?

- Develops statistical literacy needed throughout GCSE Mathematics.
- Builds skills for interpreting and analysing real-world data.
- Provides foundations for more advanced statistics topics, including:
    - averages
    - range
    - grouped data
    - cumulative frequency
    - box plots
    - histograms
- Supports probability by helping students organise and interpret data.
- Develops graphical skills required for coordinate geometry and graph work.
- Strengthens understanding of correlation and relationships between variables.
- Introduces prediction and trend analysis used in:
    - statistics
    - science
    - geography
    - economics

Develops critical thinking when evaluating data presented in the media.
Builds confidence in selecting appropriate methods to display data.

Common Misconceptions

Tables and Data Collection

- Missing categories when designing tables.
- Counting frequencies incorrectly.
- Recording data inconsistently.
- Confusing frequency with total frequency.

Two-Way Tables

- Adding rows and columns incorrectly.
- Confusing row totals with column totals.
- Forgetting that the grand total should equal all frequencies combined.
- Reading values from the wrong row or column.

Bar Charts and Composite Bar Charts

- Using uneven scales on axes.
- Drawing bars with unequal widths.
- Confusing composite and comparative bar charts.
- Comparing bar heights without considering the scale.

Histograms
- Assuming frequency is represented by bar height alone.
- Confusing histograms with bar charts.
- Ignoring frequency density.

Time Series Graphs
- Joining points incorrectly.
- Assuming trends always continue indefinitely.
- Reading values between plotted points inaccurately.

Stem-and-Leaf Diagrams
- Confusing stems and leaves.
- Forgetting to include a key.
- Ordering leaves incorrectly.
- Misreading values in back-to-back stem-and-leaf diagrams.

Pie Charts
- Forgetting that the total angle must equal 360°.
- Confusing percentages with angles.
- Measuring sectors inaccurately.
- Comparing sector sizes visually rather than mathematically.

Scatter Graphs
- Assuming correlation means causation.
- Believing all scatter graphs must show a relationship.
- Confusing positive and negative correlation.
- Drawing a line of best fit through every point.
- Drawing a line of best fit that is not balanced around the data.
- Using a line of best fit to make unrealistic extrapolations far beyond the data range.

General Data Interpretation
- Reading scales incorrectly.
- Ignoring units.
- Making conclusions that are not supported by the data.
- Selecting information without considering the context.

National Curriculum / Specification

Statistics
- **S1** – Interpret and construct tables and line graphs for time series data.
- **S2** – Interpret and construct appropriate tables and diagrams to represent data.
- **S3** – Interpret and construct bar charts and pie charts.
- **S4** – Interpret and construct stem-and-leaf diagrams.
- **S5** – Understand and use scatter graphs.
- **S6** – Interpret observations, recognise patterns and identify relationships.
- **S7** – Draw appropriate conclusions from data.
- **S8** – Use lines of best fit and make predictions.
- **S9** – Understand that correlation does not imply causation.

Number
- **N9** – Use approximation and estimation when interpreting graphs and predicting values.
- **N10** – Interpret data presented in different numerical forms, including percentages and fractions.

Ratio, Proportion and Rates of Change
- **R4** – Use scale factors, fractions, percentages and ratio in interpreting statistical diagrams.
- **R8** – Interpret and compare data represented in different forms.

Geometry and Measures
- **G1** – Use angles in pie charts and other graphical representations.
- **G7** – Use coordinates and axes accurately when plotting graphs.

4. Fractions and Percentages

Learning Objectives

- Compare fractions
- Add and subtract fractions
- Use fractions to solve problems
- Find a fraction of a quantity or measurement
- Use fractions to solve problems
- Multiply whole numbers, fractions and mixed numbers
- Simplify calculations by cancelling
- Divide a whole number by a fraction
- Divide a fraction by a whole number or a fraction
- Convert fractions to decimals and vice versa
- Use decimals to find quantities
- Work out divisions with decimal answers
- Write one number as a fraction of another
- Convert percentages to fractions and vice versa
- Write one number as a percentage of another
- Convert percentages to decimals and vice versa
- Find a percentage of a quantity
- Use percentages to solve problems
- Calculate simple interest
- Calculate percentage increases and decreases
- Use percentages in real life situations
- Calculate VAT

What previous knowledge is required?

- Understand place value in whole numbers and decimals.
- Recall multiplication tables and basic number facts.
- Use the four operations (addition, subtraction, multiplication and division) with whole numbers.
- Recognise and write simple fractions, decimals and percentages.
- Identify equivalent fractions.
- Simplify fractions using common factors.
- Find common multiples and common denominators.
- Compare and order whole numbers and simple fractions.
- Understand the relationship between fractions, decimals and percentages in simple cases (e.g. ½ = 0.5 = 50%).
- Use factors and multiples to simplify calculations.
- Perform calculations involving decimal numbers.
- Calculate simple proportions and parts of quantities.
- Understand basic percentage language such as:
    - increase
    - decrease
    - discount
    - profit
    - interest
- Use calculator and non-calculator methods accurately.

How will this term's content help with future learning?

- Provides essential numerical fluency required throughout GCSE Mathematics.
- Supports work on:

    - ratio and proportion
    - probability
    - algebraic fractions
    - standard form
    - compound measures
    - statistics
- Develops proportional reasoning skills needed for:
    - scale drawings
    - maps
    - recipes
    - financial mathematics
- Forms the basis of percentage change calculations used in:
    - business studies
    - economics
    - science
- Supports understanding of growth and decay models studied later in GCSE.
- Provides a foundation for compound interest calculations at Higher Tier.
- Strengthens problem-solving skills involving multi-step calculations.
- Develops confidence in converting between fractions, decimals and percentages.
- Supports interpretation of statistical information expressed as percentages.
- Builds financial literacy through VAT, discounts, interest and real-life percentage problems.

Common Misconceptions

Comparing Fractions

- Assuming the fraction with the largest denominator is always larger.
- Comparing denominators instead of the value of the fractions.
- Forgetting to find common denominators when comparing fractions.

Adding and Subtracting Fractions

- Adding numerators and denominators separately, e.g. $\frac{1}{2}+\frac{1}{3}=\frac{2}{5}$.
-
- Forgetting to convert to equivalent fractions first.
- Not simplifying the final answer.

Finding Fractions of Quantities

- Multiplying by the denominator instead of dividing first.
- Confusing "of" with addition rather than multiplication.

Multiplying Fractions

- Adding fractions instead of multiplying.
- Forgetting to convert mixed numbers into improper fractions.
- Missing opportunities to cancel before multiplying.

Dividing Fractions

- Forgetting to invert the second fraction.
- Inverting both fractions instead of only the divisor.
- Confusing multiplication and division rules.

Fractions, Decimals and Percentages

- Believing all fractions convert to terminating decimals.
- Confusing decimal place value when converting.
- Forgetting that percentages are always "out of 100".

Writing One Number as a Fraction or Percentage of Another

- Reversing the numerator and denominator.

- Dividing in the wrong order.
- Confusing percentage difference with percentage of a quantity.

Percentage Calculations

- Finding 10% incorrectly by dividing by 100.
- Multiplying by the percentage rather than its decimal equivalent.
- Treating percentages as whole numbers during calculations.

Percentage Increase and Decrease

- Adding or subtracting the percentage directly from the original value.
- Using the wrong multiplier.
- Confusing percentage increase with percentage points.

Simple Interest

- Recalculating interest on an increasing amount rather than the original amount each year.
- Confusing simple interest with compound interest.

VAT and Real-Life Percentages

- Adding VAT incorrectly by calculating the percentage on the VAT amount itself.
- Subtracting VAT by simply reversing the addition process.
- Forgetting whether VAT should be included or excluded in the final answer.

National Curriculum / Specification

Number

- **N1** – Use place value and the ordering of integers, decimals and fractions.
- **N2** – Use the four operations, including formal written methods, applied to integers, decimals and simple fractions.
- **N3** – Understand and use place value for decimals and fractions.
- **N4** – Use factors, multiples and prime factorisation to support calculations.
- **N8** – Calculate accurately with fractions, decimals and percentages.
- **N9** – Round numbers and measures to an appropriate degree of accuracy.
- **N10** – Use approximation through rounding to estimate answers.

Ratio, Proportion and Rates of Change

- **R1** – Change freely between related standard units and compound units.
- **R2** – Use scale factors, scale diagrams and maps.
- **R3** – Express one quantity as a fraction of another.
- **R4** – Use ratio notation and simplify ratios.
- **R5** – Divide quantities into given ratios.
- **R6** – Express relationships between quantities proportionally.
- **R7** – Understand and use percentage change.
- **R8** – Solve problems involving percentage change, including financial mathematics.
- **R9** – Apply proportional reasoning in contexts involving percentages and fractions.

Algebra

- **A2** – Substitute numerical values into formulae and expressions, including those involving fractions and percentages.
- **A6** – Solve problems involving proportional relationships.

Statistics

- **S2** – Interpret and compare data represented as fractions, decimals and percentages.

Equations, Inequalities and Sequences

Learning Objectives

- Understand and use inverse operations
- Solve simple linear equations
- Solve two step equations

- Solve linear equations with brackets
- Solve equations with unknowns on both sides
- Use correct notation to show inclusive and exclusive inequalities
- Show inequalities on a number line
- Write down integers that satisfy an inequality
- Solve simple linear inequalities
- Solve two sided inequalities
- Substitute values into formulae and solve equations
- Change the subject of a formula
- Know the difference between an expression, an equation and a formula
- Recognise and extend sequences
- Use the nth term to generate terms of a sequence
- Find the nth term of an arithmetic sequence

What previous knowledge is required?

- Understand and use the four operations (addition, subtraction, multiplication and division).
- Apply inverse operations in arithmetic calculations.
- Use BIDMAS/BODMAS correctly.
- Understand basic algebraic notation.
- Simplify algebraic expressions by collecting like terms.
- Substitute numbers into simple expressions.
- Expand and factorise simple algebraic expressions.
- Understand the meaning of mathematical symbols:
  - $=$
  - $<$
  - $>$
  - $\leq$
  - $\geq$
  - $\neq$
- Use positive and negative numbers confidently.
- Plot and read values from a number line.
- Recognise simple number patterns and sequences.
- Generate terms in a sequence by following a rule.
- Understand the difference between:
  - a variable
  - a coefficient
  - a term
- Use simple formulae in mathematical and real-life contexts.

How will this term's content help with future learning?

- Provides the foundation for all future algebra topics at GCSE.
- Develops logical problem-solving and mathematical reasoning skills.
- Supports solving more complex equations, including:
  - simultaneous equations
  - quadratic equations
  - algebraic fractions (Higher Tier)
- Builds understanding of rearranging formulae used extensively in:
  - geometry
  - science
  - financial mathematics
- Develops understanding of inequalities needed for:
  - graphing regions

  - linear programming (Higher Tier)
  - interpreting constraints in real-life problems
- Strengthens algebraic manipulation skills required throughout GCSE Mathematics.
- Introduces sequences as a bridge between algebra and graphs.
- Supports future learning on:
  - coordinate graphs
  - straight-line graphs
  - functions
  - rates of change
- Develops pattern recognition skills that underpin mathematical modelling.
- Helps students understand relationships between variables.

Common Misconceptions

Solving Equations

- Performing different operations on each side of the equation.
- Forgetting that equations must remain balanced.
- Applying inverse operations in the wrong order.
- Making sign errors when moving terms across the equals sign.
- Believing terms can simply "cross the equals sign and change sign" without understanding the balancing process.

Two-Step Equations

- Adding/subtracting before removing multiplication or division.
- Completing only one stage of the solution process.

Equations with Brackets

- Expanding brackets incorrectly.
- Multiplying only the first term inside the bracket.
- Forgetting negative signs when expanding.

Equations with Unknowns on Both Sides

- Moving variables incorrectly.
- Collecting terms on the wrong side.
- Losing track of negative values.

Inequalities

- Treating inequalities exactly like equations without considering the inequality symbol.
- Confusing:
  - $<$ and $\leq$
  - $>$ and $\geq$
- Using an open circle instead of a closed circle (or vice versa) on number lines.
- Including values that do not satisfy the inequality.

Two-Sided Inequalities

- Solving only one part of the inequality.
- Treating the inequality as two separate unrelated statements.

Formulae

- Substituting values into the wrong variable.
- Mixing up formulae and equations.
- Forgetting to use brackets when substituting negative numbers.
- Rearranging formulae without performing the same operation on both sides.

Expression, Equation and Formula

Students often confuse:

- Expression: $3x + 2$
- Equation: $3x + 2 = 11$
- Formula: $A = lw$

Common misconception:

- Believing every algebraic statement containing letters is a formula.

Sequences

- Assuming all sequences increase.
- Finding the common difference incorrectly.
- Confusing the term number with the term value.
- Using the wrong pattern to generate future terms.

Nth Term

- Using the common difference as the entire nth-term rule.
- Forgetting to adjust for the starting value.
- Confusing the position number (n) with the actual sequence values.
- Believing the nth term only generates terms already listed rather than any term in the sequence.

National Curriculum / Specification

Algebra

- **A1** – Use and interpret algebraic notation.
- **A2** – Substitute numerical values into formulae and expressions.
- **A3** – Understand and use the concepts and vocabulary of expressions, equations, inequalities, terms and factors.
- **A4** – Simplify and manipulate algebraic expressions.
- **A5** – Understand and use standard mathematical formulae.
- **A6** – Model situations mathematically and express results using algebra.
- **A7** – Use algebraic methods to solve linear equations.
- **A8** – Solve linear inequalities in one variable.
- **A9** – Generate terms of a sequence from a rule.
- **A10** – Recognise arithmetic sequences and find the nth term.
- **A11** – Plot and interpret graphs arising from real situations and sequences.

Number

- **N2** – Use the four operations, including inverse operations.
- **N7** – Understand and use mathematical notation correctly.
- **N9** – Use approximation and estimation to check solutions where appropriate.

Ratio, Proportion and Rates of Change

- **R6** – Express relationships algebraically and solve associated problems.

Angles

Learning Objectives

- Solve geometric problems using side and angle properties of quadrilaterals
- Identify congruent shapes
- Understand and use angle properties of parallel lines
- Find missing angles using corresponding and alternate angles
- Solve angle problems in triangles
- Understand angle proofs about triangles
- Calculate the interior and exterior angles of regular polygons
- Calculate the interior and exterior angles of polygons
- Explain why some polygons fit together and others do not
- Solve angle problems using equations
- Solve geometrical problems showing reasoning
- Use x for the unknown to help you to solve problems

What previous knowledge is required?

- Recognise and name common 2D shapes, including:

  - triangles
  - quadrilaterals
  - pentagons
  - hexagons
- Understand that angles are measured in degrees (°).
- Use a protractor to measure and draw angles.
- Know basic angle facts:
  - angles on a straight line sum to 180°
  - angles around a point sum to 360°
  - vertically opposite angles are equal
  - right angles measure 90°
- Classify angles as:
  - acute
  - right
  - obtuse
  - reflex
- Understand properties of common quadrilaterals:
  - square
  - rectangle
  - parallelogram
  - rhombus
  - trapezium
  - kite
- Understand the properties of triangles:
  - equilateral
  - isosceles
  - scalene
- Solve simple one-step algebraic equations.
- Substitute values into simple expressions.
- Use basic algebraic notation confidently.
- Understand symmetry and basic shape properties.

How will this term's content help with future learning?

- Provides a foundation for all geometry topics at GCSE.
- Develops deductive reasoning and mathematical proof skills.
- Supports future work on:
  - congruence
  - similarity
  - transformations
  - constructions
  - loci
- Forms the basis for understanding:
  - Pythagoras' theorem
  - trigonometry
  - circle theorems
  - coordinate geometry
- Strengthens algebra skills through solving angle problems using equations.
- Develops logical reasoning needed for geometric proofs.
- Supports problem-solving involving shape properties and spatial reasoning.
- Helps students understand tessellations and geometric patterns.
- Prepares students for multi-step geometrical reasoning questions in GCSE examinations.

- Develops communication skills by requiring mathematical justification and explanations.

Common Misconceptions

Quadrilaterals

- Believing all quadrilaterals have equal sides.
- Confusing the properties of parallelograms, rhombuses and rectangles.
- Assuming opposite angles are always equal in every quadrilateral.
- Forgetting which quadrilaterals have parallel sides.

Congruent Shapes

- Thinking congruent shapes must have the same orientation.
- Confusing congruence with similarity.
- Believing enlarged shapes can be congruent.

Parallel Lines

- Mixing up corresponding and alternate angles.
- Assuming any equal angles indicate parallel lines.
- Identifying the wrong angle pair in diagrams.

Missing Angles

- Using the wrong angle rule when several angle facts apply.
- Forgetting to use all available information before calculating.
- Assuming adjacent angles are equal.

Triangles

- Forgetting that angles in a triangle sum to 180°.
- Believing all isosceles triangles have a horizontal base.
- Misidentifying equal angles in isosceles triangles.
- Confusing interior and exterior angles.

Angle Proofs

- Providing answers without justification.
- Using numerical examples instead of general reasoning.
- Assuming a statement is true because it works for one example.

Polygons

- Confusing the formulas for:
  - interior angle sum
  - exterior angle sum
- Believing exterior angles sum to 360° only in regular polygons.
- Forgetting that all polygons have an exterior angle sum of 360°.

Regular Polygons

- Assuming all polygons are regular.
- Confusing a single interior angle with the total interior angle sum.
- Using the wrong number of sides in calculations.

Tessellations and Fitting Together

- Assuming all regular polygons tessellate.
- Forgetting that angles meeting at a point must total 360°.
- Believing shape size affects tessellation.

Angle Problems Using Equations

- Solving the equation correctly but not finding the required angle.
- Using incorrect algebraic expressions for angles.
- Forgetting to substitute the value of $x$back into the diagram.
- Making arithmetic errors after solving the equation.

Geometrical Reasoning

- Giving answers without mathematical justification.
- Missing important angle facts already shown in the diagram.

- Using assumptions based on appearance rather than stated information.

National Curriculum / Specification

Geometry and Measures

- **G1** – Derive and apply standard results relating to angles and shapes.
- **G2** – Use the properties and definitions of special types of quadrilaterals and triangles.
- **G3** – Identify and apply angle facts involving:
  - points
  - straight lines
  - parallel lines
  - triangles
  - quadrilaterals
- **G4** – Derive and use the sum of angles in triangles and other polygons.
- **G5** – Understand and use congruence in geometric contexts.
- **G6** – Solve geometrical problems involving properties of shapes.
- **G7** – Use geometrical reasoning to justify conclusions.
- **G8** – Interpret mathematical relationships geometrically.
- **G9** – Apply geometrical facts in increasingly complex problems.

Algebra

- **A1** – Use and interpret algebraic notation.
- **A3** – Use algebraic expressions and equations.
- **A7** – Solve linear equations.
- **A12** – Use algebra to generalise and justify geometric results.

Ratio, Proportion and Rates of Change

- **R6** – Express relationships algebraically and solve associated problems.

Averages and Range

Learning Objectives

- Calculate the mean from a list and from a frequency table
- Compare sets of data using the mean and range
- Find the mode, median and range from a stem and leaf diagram
- Identify outliers
- Estimate the range from a grouped frequency table
- Recognise the advantages and disadvantages of each type of average
- Find the mode, modal class and median from a frequency table
- Estimate the mean of grouped data
- Understand the need for sampling
- Understand how to avoid bias

What previous knowledge is required?

- Read and interpret data from:
  - tables
  - frequency tables
  - bar charts
  - stem-and-leaf diagrams
- Organise data systematically.
- Count frequencies accurately.
- Understand place value and perform calculations with whole numbers and decimals.
- Use the four operations (addition, subtraction, multiplication and division) confidently.

- Calculate totals from lists of data.
- Order numbers from smallest to largest.
- Find the middle value in an ordered list.
- Understand basic statistical vocabulary, including:
    - data
    - frequency
    - category
    - variable
    - survey
- Interpret scales and numerical information.
- Understand simple estimation and rounding.
- Recognise different methods of data collection.
- Understand that data can be represented in different forms

How will this term's content help with future learning?

- Provides essential statistical skills required throughout GCSE Mathematics.
- Develops the ability to summarise and interpret large sets of data.
- Supports future work on:
    - cumulative frequency
    - box plots
    - histograms
    - probability
    - statistical inference
- Develops understanding of how averages are used in real-life contexts such as:
    - business
    - science
    - economics
    - sport
- Strengthens numerical fluency through calculations involving frequency tables and grouped data.
- Introduces ideas of data reliability and validity.
- Develops critical thinking when interpreting statistical claims.
- Supports understanding of sampling techniques used in research and surveys.
- Builds skills needed to compare distributions and make informed conclusions from data.
- Helps students evaluate whether conclusions are justified by the evidence available.

Common Misconceptions

Mean

- Adding the data values but forgetting to divide by the number of values.
- Dividing by the number of categories instead of the total frequency.
- Using the midpoint incorrectly when estimating the mean from grouped data.
- Believing the mean must always be one of the values in the data set.

Mean from Frequency Tables

- Adding frequencies rather than multiplying values by frequencies.
- Dividing by the number of rows instead of the total frequency.
- Forgetting to calculate the total frequency.

Comparing Data Using Mean and Range

- Comparing data using only the mean and ignoring the range.
- Assuming the highest mean always represents the "best" data set.
- Ignoring the effect of spread when comparing distributions.

Median

- Forgetting to order the data first.
- Choosing the middle position incorrectly.

- Selecting one of the two middle values rather than finding their average when required.
- Confusing median with mean.

Mode

- Assuming there is always only one mode.
- Confusing the mode with the largest value.
- Misidentifying the modal class in grouped data.

Range

- Calculating largest value ÷ smallest value instead of subtracting.
- Ignoring outliers when calculating the range.
- Confusing range with average.

Stem-and-Leaf Diagrams

- Forgetting to order leaves correctly.
- Omitting a key.
- Reading values incorrectly from stems and leaves.
- Misidentifying the median or mode from the diagram.

Grouped Data

- Assuming all values within a class interval are identical.
- Forgetting that the mean calculated is only an estimate.
- Using class boundaries incorrectly.

Outliers

- Automatically removing outliers without considering context.
- Assuming every unusual value is an error.
- Ignoring the impact of outliers on the mean and range.

Sampling

- Believing larger samples are always unbiased.
- Confusing sample size with representativeness.
- Assuming a sample perfectly reflects the whole population.

Bias

- Thinking bias only occurs intentionally.
- Believing a survey is unbiased simply because many people participated.
- Ignoring the wording of questions when considering bias.

National Curriculum / Specification

Statistics

- **S1 –** Describe, interpret and compare observed distributions of data.
- **S2** – Interpret and construct tables and other statistical diagrams.
- **S3** – Calculate and interpret appropriate measures of central tendency and spread.
- **S4** – Understand and use:
  - mean
  - median
  - mode
  - range
- **S5** – Compare distributions using appropriate statistical measures**.**
- **S6** – Identify patterns, trends and relationships in data**.**
- **S7 –** Interpret statistical results and draw appropriate conclusions**.**
- **S8 –** Understand the importance of sampling.
- **S9 –** Recognise potential sources of bias and understand how to minimise them.

Number

- **N2 –** Use the four operations accurately in increasingly complex calculations.
- **N9 –** Round numbers and use approximation where appropriate.

- **N10 –** Use estimation to check calculations and interpret results.

Ratio, Proportion and Rates of Change

- **R8 –** Interpret and compare data represented in different forms.

Perimeter, Area and Volume

Learning Objectives

- Calculate the perimeter and area of rectangles, parallelograms and triangles
- Calculate a missing length given the area
- Calculate the area and perimeter of trapezia
- Find the height of a trapezium given its area
- Convert between area measures
- Calculate the perimeter and area of shapes made from triangles and rectangles
- Calculate areas in hectares, and convert between ha and m^2
- Calculate the surface area of a cuboid
- Calculate the surface area of a prism
- Calculate the volume of a cuboid
- Calculate the volume of a prism
- Use a flow diagram to solve problems
- Convert between measures of volume
- Solve problems involving surface area and volume

What previous knowledge is required?

- Understand and use common metric units of length:
  - mm
  - cm
  - m
  - km
- Convert between basic metric units of length.
- Use the four operations confidently with whole numbers and decimals.
- Calculate with fractions and percentages where appropriate.
- Understand place value and rounding.
- Measure and draw lengths accurately.
- Recognise and identify:
  - rectangles
  - triangles
  - parallelograms
  - trapezia
  - cuboids
  - prisms
- Understand basic properties of 2D and 3D shapes.
- Calculate perimeter by adding side lengths.
- Know the area formula for a rectangle.
- Understand the meaning of:
  - area
  - perimeter
  - surface area
  - volume
- Substitute values into simple formulae.
- Rearrange simple formulae and solve one-step equations.

- Interpret diagrams and extract relevant measurements.
- Use multiplication and division with powers of 10.

How will this term's content help with future learning?

- Provides essential foundations for all GCSE Geometry and Measure topics.
- Develops understanding of area and volume formulae used throughout mathematics and science.
- Supports future learning in:
  - circles
  - sectors
  - cylinders
  - cones
  - spheres
  - compound measures
- Builds fluency in using mathematical formulae.
- Strengthens algebraic skills through finding missing lengths and dimensions.
- Develops spatial reasoning and visualisation skills.
- Supports work involving:
  - scale drawings
  - similarity
  - transformations
  - trigonometry
- Provides foundations for engineering, construction, design and scientific applications.
- Develops problem-solving skills involving multi-step calculations.
- Reinforces unit conversion skills needed throughout GCSE Mathematics.

Common Misconceptions

Perimeter

- Confusing perimeter with area.
- Multiplying dimensions instead of adding side lengths.
- Missing sides when calculating compound shape perimeters.
- Using incorrect units.

Area of Rectangles, Triangles and Parallelograms

- Using perimeter formulas instead of area formulas.
- Forgetting to divide by 2 when finding the area of a triangle.
- Using a sloping side instead of the perpendicular height in a parallelogram.
- Confusing base and height.

Missing Lengths from Area

- Dividing by the wrong dimension.
- Rearranging formulas incorrectly.
- Forgetting to include units in answers.

Trapezia

- Adding parallel sides incorrectly in the area formula.
- Forgetting to divide by 2.
- Using a non-perpendicular measurement as the height.
- Confusing area and perimeter calculations.

Area Unit Conversions

- Treating area conversions as length conversions.
- Thinking:
  - $1\,m^2 = 100\,cm^2$
    rather than
  - $1\,m^2 = 10{,}000\,cm^2$
- Forgetting that area units are squared.

Composite Areas
- Missing parts of the shape.
- Double-counting sections.
- Subtracting or adding areas incorrectly.
- Using inconsistent units.

Hectares
- Confusing hectares with square metres.
- Forgetting:
  - $1 \text{ ha} = 10{,}000m^2$
- Using linear conversion methods for area.

Surface Area
- Confusing surface area with volume.
- Missing faces when calculating total surface area.
- Counting faces twice.
- Forgetting units should be squared.

Surface Area of Prisms
- Ignoring the end faces.
- Calculating only the lateral surface area.
- Misidentifying the prism cross-section.

Volume of Cuboids
- Adding dimensions instead of multiplying.
- Forgetting the third dimension.
- Using square units instead of cubic units.

Volume of Prisms
- Multiplying all measurements without finding the cross-sectional area first.
- Confusing prism length with height.
- Using the wrong cross-sectional area formula.

Flow Diagrams
- Following operations in the wrong order.
- Working forwards when the problem requires working backwards.
- Missing inverse operations.

Volume Unit Conversions
- Treating volume conversions like length conversions.
- Forgetting that volume units are cubed.
- Assuming:
  - $1m^3 = 1000cm^3$
    instead of
  - $1m^3 = 1{,}000{,}000cm^3$

Problem Solving
- Choosing the wrong formula.
- Failing to convert units before calculating.
- Giving answers with incorrect units.
- Rounding too early in multi-step calculations.

National Curriculum / Specification

Geometry and Measures
- **G1 –** Derive and apply standard results to calculate perimeter, area and volume.
- **G2** – Calculate and solve problems involving:
  - perimeter
  - area

  - volume
  - surface area
- **G3** – Understand and use appropriate units of measurement.
- **G4** – Convert between related metric units.
- **G5** – Understand and use compound measures and derived units.
- **G6** – Interpret mathematical relationships geometrically.
- **G7** – Apply geometrical knowledge to solve practical problems.
- **G8** – Use geometrical reasoning in increasingly complex contexts.

Ratio, Proportion and Rates of Change

- **R1 –** Change freely between related standard units.
- **R2** – Use scale factors and proportional reasoning in geometrical contexts.
- **R6** – Express relationships algebraically and solve associated problems.

Algebra

- **A2 –** Substitute numerical values into formulae and expressions.
- **A5** – Understand and use standard mathematical formulae.
- **A7** – Solve equations arising from geometrical formulae.

Number

- **N2 –** Use the four operations accurately.
- **N9** – Round numbers appropriately and interpret answers in context.
- **N10** – Use estimation to check calculations.

Graphs

Learning Objectives

- Find the midpoint of a line segment
- Recognise, name and plot straight line graphs
- Recognise, name and plot the graphs of y=x and y=-x
- Generate and plot coordinates from a rule
- Plot straight line graphs from tables of values
- Draw graphs to represent relationships
- Find the gradient of a line
- Identify and interpret the gradient from an equation
- Understand that parallel lines have the same gradient
- Understand what m and c represent in y=mx+c
- Find the equations of straight line graphs
- Sketch graphs given the values of m and c
- Draw and interpret graphs from real data
- Use distance-time graphs to solve problems
- Draw distance-time graphs
- Interpret rate of change on graphs
- Draw and interpret a range of graphs
- Understand when predictions are reliable

What previous knowledge is required?

- Plot coordinates in all four quadrants.
- Read and interpret coordinates accurately.
- Understand the coordinate grid and axes:
  - x-axis
  - y-axis
  - origin

- Use positive and negative numbers confidently.
- Recognise simple algebraic expressions and equations.
- Substitute values into expressions.
- Generate values from a simple rule.
- Complete tables of values.
- Understand the meaning of variables such as $x$and y.
- Calculate with integers and decimals.
- Understand basic ratio and proportional relationships.
- Read and interpret:
  - tables
  - charts
  - line graphs
- Understand the concept of rate and speed in everyday contexts.
- Recognise horizontal and vertical lines.
- Calculate differences between values.
- Understand simple geometric concepts such as midpoint.

How will this term's content help with future learning?

- Provides the foundation for coordinate geometry throughout GCSE Mathematics.
- Develops understanding of relationships between variables.
- Supports future work on:
  - simultaneous equations
  - quadratic graphs
  - cubic graphs
  - reciprocal graphs
  - transformations of graphs
- Builds understanding of mathematical modelling.
- Develops interpretation of real-life data through graphical representations.
- Strengthens algebraic skills by linking equations and graphs.
- Supports understanding of:
  - gradient
  - rate of change
  - proportional relationships
- Forms the basis for studying:
  - trigonometric graphs
  - functions
  - calculus concepts (future study)
- Develops problem-solving skills using graphical methods.
- Helps students evaluate trends and make informed predictions.
- Supports applications in:
  - science
  - geography
  - economics
  - engineering

Common Misconceptions

Coordinates

- Reversing the order of coordinates and writing (y, x) instead of (x, y).
- Plotting coordinates in the wrong quadrant.
- Counting intervals incorrectly on the axes.

Midpoint of a Line Segment

- Finding half of one coordinate only.
- Adding coordinates instead of averaging them.
- Forgetting to calculate both the x-coordinate and y-coordinate midpoint.

Straight Line Graphs

- Plotting points inaccurately.
- Joining points with curves instead of straight lines.
- Using inconsistent scales on axes.

Graphs of $y = x$ and $y = -x$

- Confusing positive and negative gradients.
- Assuming all straight-line graphs pass through the origin.
- Drawing $y = -x$as a vertical reflection incorrectly.

Generating Coordinates from a Rule

- Substituting values incorrectly.
- Performing operations in the wrong order.
- Making arithmetic errors when completing tables of values.

Gradient

- Calculating gradient as:
  - horizontal change ÷ vertical change
    instead of
  - vertical change ÷ horizontal change.
- Confusing steepness with position on the graph.
- Assuming all increasing lines have the same gradient.

Gradient from an Equation

- Confusing the gradient and intercept in $y = mx + c$.
- Thinking $c$represents the gradient.
- Misreading negative gradients.

Parallel Lines

- Believing parallel lines must have the same y-intercept.
- Thinking parallel lines can cross.
- Confusing parallel and perpendicular lines.

Equation of a Line

- Using coordinates instead of the gradient and intercept.
- Forgetting that $c$is the y-intercept.
- Misidentifying where the graph crosses the y-axis.

Sketching Graphs from $y = mx + c$

- Plotting only one point.
- Ignoring the gradient direction.
- Using an incorrect y-intercept.

Real-Life Graphs

- Assuming graphs always represent physical movement.
- Ignoring units on axes.
- Reading values from the wrong axis.

Distance-Time Graphs

- Confusing distance-time graphs with speed-time graphs.
- Believing steeper graphs represent longer journeys rather than faster speeds.
- Thinking a downward line means travelling backwards rather than distance decreasing in a different context.
- Assuming horizontal sections mean the journey has ended rather than the object has stopped.

Rate of Change

- Confusing gradient with total distance travelled.

- Assuming a larger y-value always means a faster rate.
- Ignoring the scale when comparing gradients.

Predictions

- Assuming all predictions are reliable.
- Making extreme extrapolations beyond the data range.
- Not distinguishing between:
    - interpolation (within the data)
    - extrapolation (outside the data).

General Graph Interpretation

- Ignoring scales and units.
- Reading graph values inaccurately.
- Assuming relationships are linear when they are not.
- Drawing conclusions not supported by the data.

National Curriculum / Specification

Algebra

- **A1 –** Use and interpret algebraic notation.
- **A2** – Substitute numerical values into expressions and formulae.
- **A6** – Model situations mathematically and express relationships algebraically.
- **A9** – Generate terms from a rule and represent relationships.
- **A11** – Plot specified points and draw graphs of linear functions.
- **A12** – Interpret mathematical relationships both algebraically and graphically.

Ratio, Proportion and Rates of Change

- **R7 –** Interpret gradients and rates of change in graphical contexts.
- **R8** – Interpret and compare data represented graphically.
- **R9** – Use graphical representations to solve problems involving proportion and change.

Geometry and Measures

- **G7 –** Use coordinates in all four quadrants.
- **G8** – Find and interpret midpoints of line segments.
- **G9** – Interpret geometrical relationships in coordinate form.

Statistics

- **S1 –** Interpret and construct graphs and charts.
- **S6** – Identify patterns and trends in graphical data.
- **S7** – Draw conclusions and make predictions from graphical information.

Number

- **N2 –** Use the four operations accurately when generating coordinates and calculating gradients.
- **N10** – Use estimation and approximation when interpreting graphical information.

Transformations

Learning Objectives

- Translate a shape on a coordinate grid
- Use a column vector to describe a translation
- Draw a reflection of a shape in a mirror
- Draw reflections on a coordinate grid
- Describe reflections on a coordinate grid
- Rotate a shape on a coordinate grid
- Describe a rotation
- Enlarge a shape by a scale factor
- Enlarge a shape using a centre of enlargement

- Identify the scale factor of an enlargement
- Find the centre of enlargement
- Describe an enlargement
- Transform shapes using more than one transformation
- Describe combined transformations of shapes on a grid

What previous knowledge is required?

- Plot and read coordinates in all four quadrants.
- Use coordinate grids accurately.
- Understand the x-axis and y-axis.
- Recognise and describe common 2D shapes.
- Identify lines of symmetry in shapes.
- Understand clockwise and anticlockwise directions.
- Measure and recognise angles, particularly:
  - 90°
  - 180°
  - 270°
- Use positive and negative numbers confidently.
- Calculate horizontal and vertical movements on a coordinate grid.
- Understand basic geometric vocabulary:
  - vertex
  - side
  - congruent
  - orientation
- Recognise shape properties and compare shapes.
- Understand scale and proportional change in simple contexts.
- Draw accurately using rulers and grids.
- Understand the concept of coordinates as ordered pairs.

How will this term's content help with future learning?

- Provides the foundation for transformational geometry throughout GCSE Mathematics.
- Develops spatial reasoning and visualisation skills.
- Supports future learning on:
  - congruence
  - similarity
  - tessellations
  - symmetry
  - vectors
- Builds understanding of geometric proof and reasoning.
- Develops coordinate geometry skills used in:
  - graphs
  - loci
  - constructions
- Strengthens understanding of scale factors and proportional reasoning.
- Supports work involving:
  - area scale factors
  - volume scale factors
  - similarity and enlargement
- Provides preparation for Higher Tier topics involving transformations and vectors.
- Develops mathematical communication through accurate descriptions of transformations.
- Encourages systematic problem-solving when combining transformations.

- Supports applications in:
  - design
  - engineering
  - architecture
  - computer graphics

Common Misconceptions

Translation

- Moving shapes in the wrong direction.
- Confusing horizontal and vertical movement.
- Counting grid squares incorrectly.
- Translating only some vertices rather than the entire shape.

Column Vectors

- Writing vectors as coordinates rather than movements.
- Reversing the order of vector components.
- Confusing positive and negative values.
- Writing movement up/down before left/right.

Reflection

- Reflecting individual points inaccurately.
- Measuring distance from the mirror line incorrectly.
- Assuming reflected shapes change size.
- Confusing reflection with rotation.
- Forgetting that reflected shapes reverse orientation.

Reflections on Coordinate Grids

- Confusing reflection in:
  - x-axis
  - y-axis
  - $y = x$
- Counting squares from the shape instead of from the mirror line.
- Reflecting across the wrong line.

Rotation

- Rotating around the wrong centre.
- Mixing up clockwise and anticlockwise directions.
- Rotating the shape by the wrong angle.
- Rotating individual points inconsistently.
- Assuming the centre of rotation must be inside the shape.

Describing Rotations

- Omitting the centre of rotation.
- Giving only the angle.
- Confusing the direction of rotation.
- Using incorrect coordinate notation.

Enlargement

- Adding to side lengths instead of multiplying by the scale factor.
- Believing enlargement always makes shapes larger.
- Forgetting that scale factors between 0 and 1 produce reductions.
- Changing shape proportions during enlargement.

Centre of Enlargement

- Measuring from the wrong vertex.
- Assuming the centre lies inside the shape.
- Drawing inaccurate enlargement lines.

- Using side lengths rather than corresponding vertices.

Scale Factor

- Confusing scale factor with the amount added.
- Reversing image and object measurements when calculating scale factor.
- Assuming all enlargements have whole-number scale factors.

Describing Enlargements

- Giving the scale factor but not the centre.
- Confusing enlargement with stretching.
- Assuming orientation changes during enlargement.

Combined Transformations

- Performing transformations in the wrong order.
- Describing only one transformation.
- Losing track of intermediate images.
- Assuming transformations can always be performed in any order.

General Transformation Errors

- Confusing:
  - translation
  - reflection
  - rotation
  - enlargement
- Forgetting to preserve shape properties.
- Using inaccurate plotting.
- Assuming transformed shapes always change size.

National Curriculum / Specification

Geometry and Measures

- **G1 –** Identify and describe geometrical properties of shapes.
- **G2** – Use geometrical language accurately.
- **G3** – Derive and apply properties of shapes.
- **G4** – Identify and apply symmetry properties.
- **G5** – Use transformations including:
  - translations
  - reflections
  - rotations
  - enlargements
- **G6** – Describe transformations mathematically.
- **G7** – Use coordinates in all four quadrants.
- **G8** – Interpret and construct geometrical relationships on coordinate grids.
- **G9** – Solve geometrical problems involving transformations.

Ratio, Proportion and Rates of Change

- **R2 –** Use scale factors and proportional reasoning.
- **R3** – Understand multiplicative relationships in enlargement.
- **R6** – Apply proportional reasoning in geometric contexts.

Algebra

- **A1 –** Use mathematical notation accurately, including coordinate notation.
- **A12** – Interpret mathematical relationships geometrically and algebraically.

Number

- **N1 –** Use positive and negative numbers in coordinate geometry.
- **N2** – Apply numerical calculations when determining transformations and scale factors.