Cornwallis Academy
Ambitions for All

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

Year 10 Mathematics

Ratio and Proportion

Learning Objectives

- Use ratio notation.
- Write a ratio in its simplest form.
- Solve simple problems using ratios.
- Use ratios involving decimals.
- Write and use ratios for shapes and their enlargements.
- Use ratios to convert between units.
- Divide a quantity into 2 parts in a given ratio.
- Divide a quantity into 3 parts in a given ratio.
- Solve word problems using ratios.
- Use bar models to help solve ratio problems.
- Compare ratios.
- Write ratios in the form 1 : n or n : 1.
- Solve ratio and proportion problems.
- Use the unitary method to solve proportion problems.
- Solve proportion problems in words.
- Work out which product is better value for money.
- Recognise and use direct proportion on a graph.
- Understand the link between the unit ratio and the gradient.
- Recognise different types of proportion.
- Solve word problems involving direct and inverse proportion.

What previous knowledge is required?

- Understanding of the four operations: addition, subtraction, multiplication and division.
- Knowledge of multiplication tables and factors.
- Ability to simplify fractions and recognise equivalent fractions.
- Understanding of place value, decimals and percentages.
- Basic problem-solving skills involving number calculations.
- Experience of comparing quantities and measures.
- Understanding of scale and measurement units (e.g. cm, m, g, kg).
- Ability to interpret simple graphs and coordinates.
- Familiarity with algebraic notation and simple formulae.
- Understanding of enlargement and scale factors from geometry.
- Experience of reading and interpreting word problems.

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

- Provides a foundation for proportional reasoning used throughout GCSE Mathematics.
- Supports work on fractions, percentages and rates of change.
- Develops financial mathematics skills, including value for money and budgeting.
- Prepares students for more advanced algebra involving proportional relationships.
- Supports understanding of gradients and linear graphs.
- Provides a basis for studying direct and inverse proportion at Higher Tier.
- Helps with scale drawings, similarity and trigonometry in geometry.
- Develops problem-solving and mathematical modelling skills.
- Supports science topics involving formulae, rates, density, speed and unit conversions.

- Prepares students for vocational and real-life applications involving recipes, maps, finance and measurements.
- Strengthens reasoning skills needed for interpreting data and statistical comparisons.

Common Misconceptions

- Writing ratios in the wrong order when comparing quantities.
- Simplifying only one part of a ratio instead of all parts.
- Confusing ratios with fractions or percentages.
- Forgetting that all parts of a ratio must be scaled by the same multiplier.
- Using addition rather than multiplication when scaling ratios.
- Incorrectly dividing a quantity into ratio parts by sharing equally.
- Miscounting the total number of ratio parts before dividing.
- Confusing ratio with difference (e.g. 2:3 means one more, rather than a multiplicative relationship).
- Mixing units when forming or comparing ratios.
- Assuming larger numbers always represent better value for money.
- Believing direct proportion graphs do not need to pass through the origin.
- Confusing direct and inverse proportion relationships.
- Assuming the gradient and unit rate are unrelated.
- Incorrectly comparing ratios without converting them to equivalent forms.
- Failing to identify the constant of proportionality in problems.

National Curriculum / Specification

Number (Ratio, proportion and rates of change)

- **N5** – Understand and use place value for decimals, measures and integers of any size.
- **N11** – Use the concepts and vocabulary of prime numbers, factors and multiples.
- **N12** – Use multiplication and division, including inverse operations.
- **N13** – Use standard written methods for multiplication and division.
- **N14** – Interpret and compare numbers in standard and decimal form.
- **N15** – Round numbers and measures appropriately.
- **N16** – Use the four operations, including formal written methods, applied to decimals.
- **N24** – Use ratio notation, including reduction to simplest form.
- **N25** – Divide a given quantity into two parts in a given part-to-part or part-to-whole ratio.
- **N26** – Express the division of a quantity into two parts as a ratio.
- **N27** – Understand and use proportion as equality of ratios.
- **N28** – Relate ratios to fractions and proportions.
- **N29** – Define percentage as "number of parts per hundred".
- **N30** – Understand and use percentage change.
- **N31** – Solve problems involving percentage change and proportional growth.
- **N32** – Use compound units such as speed, unit pricing and density.
- **N33** – Compare lengths, areas and volumes using ratio notation.
- **N34** – Understand and use scale factors, scale diagrams and maps.
- **N35** – Understand that X is inversely proportional to Y when XY is constant.
- **N36** – Understand that Y is directly proportional to X when Y = kX.
- **N37** – Interpret equations describing direct and inverse proportion.

Algebra

- **A23** – Recognise, sketch and interpret graphs of linear functions.
- **A24** – Identify and interpret gradients and intercepts of linear graphs.
- **A25** – Recognise and interpret graphs representing direct proportion.
- **A26** – Construct and interpret equations representing direct proportion.

Geometry and Measures

- **G7** – Use scale factors, scale diagrams and maps.
- **G19** – Use ratio and proportion in geometric contexts, including enlargement.
- **G24** – Convert between related standard units.

Statistics

- **S6** – Interpret and construct tables, charts and graphs to solve problems involving proportional reasoning and comparisons.

Right-Angled Triangles

Learning Objectives

- Understand Pythagoras' theorem.
- Calculate the length of the hypotenuse in a right-angled triangle.
- Solve problems using Pythagoras' theorem.
- Calculate the length of a line segment AB.
- Calculate the length of a shorter side in a right-angled triangle.

- Solve problems using Pythagoras' theorem.
- Understand and recall the sine ratio in right-angled triangles.
- Use the sine ratio to calculate the length of a side in a right-angled triangle.
- Use the sine ratio to solve problems.
- Use the sine ratio to calculate an angle in a right-angled triangle.
- Use the sine ratio to solve problems.
- Understand and recall the cosine ratio in right-angled triangles.
- Use the cosine ratio to calculate the length of a side in a right-angled triangle.
- Use the cosine ratio to calculate an angle in a right-angled triangle.
- Use the cosine ratio to solve problems
- Understand and recall the tangent ratio in right-angled triangles.
- Use the tangent ratio to calculate the length of a side in a right-angled triangle
- Use the tangent ratio to calculate an angle in a right-angled triangle.
- Solve problems using an angle of elevation or angle of depression
- Understand and recall trigonometric ratios in right-angled triangles.
- Use trigonometric ratios to solve problems.
- Know the exact values of the sine, cosine and tangent of some angles

What previous knowledge is required?

- Recognition and properties of triangles, including identifying right-angled triangles.
- Understanding of angles and angle notation.
- Knowledge that angles in a triangle sum to 180°.
- Ability to measure and calculate lengths accurately.
- Understanding of square numbers and square roots.
- Fluency with the four operations (addition, subtraction, multiplication and division).
- Knowledge of BIDMAS when carrying out calculations.
- Familiarity with algebraic notation and substitution into formulae.
- Understanding of coordinates and plotting points on a grid.
- Ability to rearrange simple formulae and solve simple equations.
- Experience using a scientific calculator, including square root and inverse functions.
- Knowledge of ratio and proportion from previous units.
- Understanding of enlargement and scale drawings.
- Familiarity with rounding and expressing answers to a given degree of accuracy.

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

- Develops algebraic reasoning through the manipulation of trigonometric equations.
- Strengthens geometric problem-solving skills.
- Supports coordinate geometry, including finding distances between points.
- Provides essential knowledge for studying vectors and geometric proofs.
- Helps students understand graphs of trigonometric functions in later courses.
- Supports learning in physics, including forces, motion, waves and vector quantities.
- Develops modelling skills used in engineering, architecture, construction and surveying.
- Provides methods for solving real-world problems involving heights, distances and navigation.
- Reinforces the use of mathematical reasoning, estimation and calculator skills.
- Builds connections between geometry, algebra and proportional reasoning.

Common Misconceptions

- Thinking the hypotenuse is simply the longest side rather than specifically the side opposite the right angle.
- Applying Pythagoras’ theorem to triangles that are not right-angled.
- Adding side lengths directly instead of using squares when applying Pythagoras’ theorem.

- Forgetting to square root the final answer when finding a missing side.
- Using the wrong side as the hypotenuse in calculations.
- Confusing the "opposite", "adjacent" and "hypotenuse" sides when using trigonometry.
- Mixing up the sine, cosine and tangent ratios.
- Using SOHCAHTOA incorrectly because the chosen angle is not identified first.
- Entering trigonometric calculations incorrectly on a calculator.
- Forgetting to set the calculator to degree mode.
- Using the inverse trigonometric function incorrectly when finding an angle.
- Confusing angle of elevation with angle of depression.
- Measuring elevation or depression from the vertical rather than the horizontal.
- Assuming exact trigonometric values can only be approximated using a calculator.
- Believing trigonometric ratios depend on the size of the triangle rather than the angle.
- Rounding too early during multi-step calculations, leading to inaccurate answers.
- Forgetting to include appropriate units in final answers.

National Curriculum / Specification

Geometry and Measures

- **G1** – Derive and apply standard facts about angles.
- **G3** – Use the properties and definitions of special types of quadrilaterals and triangles.
- **G4** – Derive and use the standard ruler and compass constructions.
- **G6** – Apply angle facts, triangle properties and reasoning to solve geometric problems.
- **G7** – Use scale factors, scale diagrams and maps.
- **G8** – Understand and use congruence and similarity.
- **G9** – Identify and apply circle definitions and properties where relevant to geometric reasoning.
- **G16** – Know and apply Pythagoras' theorem to calculate missing lengths in right-angled triangles.
- **G17** – Know and apply the trigonometric ratios sine, cosine and tangent in right-angled triangles.
- **G18** – Know the exact values of sin θ and cos θ for 0°, 30°, 45°, 60° and 90°, and tan θ for 0°, 30°, 45° and 60°.
- **G19** – Use trigonometric ratios and Pythagoras' theorem to solve problems in two-dimensional and three-dimensional contexts.

Number

- **N2** – Use and interpret positive numbers, including calculations involving roots.
- **N6** – Use powers and roots, including square roots.
- **N15** – Round numbers and measures appropriately.
- **N16** – Apply the four operations to integers and decimals.

Algebra

- **A4** – Translate simple situations into algebraic expressions and formulae.
- **A5** – Substitute numerical values into formulae and expressions.
- **A6** – Understand and use algebraic formulae.
- **A7** – Solve equations involving unknown values arising from geometric contexts.

Ratio, Proportion and Rates of Change

- **N27** – Understand and use proportion as equality of ratios.
- **N36** – Understand direct proportional relationships and their applications within similar triangles and trigonometry.

Key National Curriculum focus

- **G16** – Pythagoras' theorem.
- **G17** – Trigonometric ratios (sine, cosine and tangent).
- **G18** – Exact trigonometric values.

- **G19** – Solving geometric and real-world problems using trigonometry and Pythagoras' theorem.

Probability

Learning Objectives

- Calculate probabilities from equally likely events.
- Calculate probabilities of mutually exclusive and exhaustive events.
- Solve probability problems.
- Work out probabilities from sample space diagrams.
- Draw and use sample space diagrams to solve probability problems.
- Estimate and interpret probabilities based on experimental data.
- Make predictions from experimental data.
- Understand the language of sets and Venn diagrams.
- Use Venn diagrams to solve probability problems.
- Solve problems using frequency trees and tree diagrams.
- Work out probabilities using tree diagrams.
- Understand independent events.
- Understand when events are not independent.
- Solve probability problems involving events that are not independent.

What previous knowledge is required?

- Understanding of fractions, decimals and percentages.
- Ability to simplify fractions and find equivalent fractions.
- Knowledge of the four operations (addition, subtraction, multiplication and division).
- Understanding of ratio and proportional reasoning.
- Ability to organise information in tables and lists.
- Familiarity with basic data handling and interpreting charts.
- Understanding of sets of objects and classification.
- Knowledge of simple counting strategies.
- Experience of reading and interpreting word problems.
- Understanding of outcomes and events in everyday situations.
- Ability to calculate totals and compare quantities.
- Familiarity with basic algebraic notation and mathematical vocabulary

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

- Provides a foundation for more advanced probability at Higher GCSE and A Level.
- Develops logical and systematic problem-solving skills.
- Supports understanding of statistics and data analysis.
- Builds skills in interpreting risk and uncertainty in real-life situations.
- Prepares students for conditional probability and more complex probability trees.
- Strengthens understanding of set notation and Venn diagrams used in further mathematics.
- Supports work in science involving experimental results and reliability.
- Develops modelling skills used in economics, finance and social sciences.
- Helps students evaluate evidence and make informed predictions.
- Reinforces proportional reasoning and fraction calculations.
- Provides a basis for studying probability distributions and statistical inference in future courses.
- Encourages critical thinking about chance, fairness and randomness

Common Misconceptions

- Assuming all outcomes are equally likely when they are not.
- Confusing an outcome with an event.
- Forgetting that probabilities must lie between 0 and 1.
- Giving probabilities greater than 1 or less than 0.

- Assuming past outcomes affect future independent events (e.g. the "gambler's fallacy").
- Believing that a small number of trials will always reflect theoretical probability.
- Adding probabilities when multiplication is required.
- Multiplying probabilities when addition is required.
- Forgetting that probabilities of exhaustive events add to 1.
- Confusing mutually exclusive events with independent events.
- Assuming mutually exclusive events are always independent.
- Omitting outcomes from sample space diagrams.
- Double-counting outcomes in sample spaces or Venn diagrams.
- Misinterpreting overlaps in Venn diagrams.
- Using incorrect totals when calculating probabilities from Venn diagrams.
- Forgetting to adjust probabilities after an item has been removed (without replacement).
- Misreading branches on tree diagrams.
- Assuming experimental probability and theoretical probability must be identical.
- Using frequencies instead of probabilities when moving through tree diagrams

National Curriculum / Specification

Statistics and Probability

- **S1** – Describe, interpret and compare observed distributions of a single variable.
- **S2** – Interpret and construct appropriate tables, charts and diagrams.
- **S3** – Summarise and interpret data.
- **S5** – Use language and properties precisely to analyse statistical data.
- **S6** – Interpret and construct tables and diagrams for grouped and ungrouped data.
- **S7** – Apply statistics to describe populations and samples.
- **S8** – Use probability scales from 0 to 1.
- **S9** – Understand that probabilities of all possible outcomes sum to 1.
- **S10** – Use theoretical models to calculate probabilities.
- **S11** – Enumerate sets and combinations of outcomes systematically.
- **S12** – Construct and interpret sample space diagrams.
- **S13** – Calculate probabilities from sample spaces.
- **S14** – Understand and use mutually exclusive and independent events.
- **S15** – Calculate probabilities of combined events, including through tree diagrams.
- **S16** – Calculate expected frequencies from known probabilities.
- **S17** – Use relative frequency as an estimate of probability.
- **S18** – Apply ideas of randomness, fairness and equally likely outcomes.
- **S19** – Use and interpret experimental data to estimate probabilities and make predictions.

Number

- **N2** – Use and interpret positive numbers and fractions.
- **N3** – Order positive and negative integers, decimals and fractions.
- **N4** – Use the concepts and vocabulary of factors, multiples and fractions.
- **N15** – Round numbers and measures appropriately.
- **N16** – Apply the four operations to fractions, decimals and percentages.

Ratio, Proportion and Rates of Change

- **N27** – Understand and use proportion as equality of ratios.
- **N28** – Relate ratios to fractions and proportions when interpreting probabilities.
- **N36** – Apply proportional reasoning to experimental probability and relative frequency.

Algebra

- **A4** – Translate situations into mathematical representations.
- **A5** – Substitute values into expressions and formulae where probabilities are represented algebraically.

Key National Curriculum focus

- **S8** – Probability scale from 0 to 1.
- **S9** – Probabilities sum to 1.
- **S10–S13** – Theoretical probability and sample space diagrams.
- **S14–S15** – Mutually exclusive events, independent events and tree diagrams.
- **S17–S19** – Experimental probability, relative frequency and prediction.

Multiplicative Reasoning

Learning Objectives

- Calculate percentage profit or loss
- Express a given number as a percentage of another in more complex situations
- Find the original amount given the final amount after a percentage increase of decrease
- Find an amount after repeated percentage change
- Solve growth and decay problems
- Solve problems involving compound measures

- Convert between speed, distance and time
- Calculate average speed, distance and time
- Use formulae to calculate speed and acceleration
- Use ratio and proportion in measures and conversions
- Use inverse proportion

What previous knowledge is required?

- Understanding of fractions, decimals and percentages, and how to convert between them.
- Ability to calculate percentages of amounts.
- Knowledge of percentage increase and percentage decrease in simple contexts.
- Understanding of the four operations (addition, subtraction, multiplication and division).
- Fluency with decimal calculations and place value.
- Knowledge of ratio notation and simplifying ratios.
- Ability to solve simple ratio and proportion problems.
- Understanding of scale factors and multiplicative relationships.
- Familiarity with standard units of measure (length, mass, capacity and time).
- Experience converting between metric units.
- Understanding of formulae and substitution into formulae.
- Ability to rearrange simple formulae.
- Familiarity with interpreting word problems and extracting relevant information.
- Understanding of direct proportion from earlier ratio work.

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

- Provides a foundation for financial mathematics, including budgeting, loans, taxation and interest calculations.
- Supports further study of compound growth and decay at GCSE Higher Tier and beyond.
- Develops understanding of exponential change used in science, economics and geography.
- Strengthens algebraic skills through the use and rearrangement of formulae.
- Prepares students for more advanced work on rates of change and functions.
- Supports GCSE Science topics involving speed, acceleration, density and pressure.
- Develops modelling skills used in engineering, business and economics.
- Reinforces proportional reasoning, a key concept across mathematics.
- Helps students interpret and compare real-world data involving rates and measures.
- Provides essential problem-solving skills for practical applications such as travel planning and financial decision-making.
- Prepares students for direct and inverse proportion problems at Higher Tier.
- Builds confidence in using mathematical methods to solve multi-step contextual problems.

Common Misconceptions

- Calculating percentage profit or loss using the selling price rather than the original cost price.
- Confusing percentage increase with percentage decrease.
- Assuming that a percentage increase followed by the same percentage decrease returns to the original amount.
- Adding repeated percentage changes instead of using multipliers.
- Forgetting that repeated percentage change is multiplicative rather than additive.
- Using the final amount instead of the original amount when calculating percentages.
- Dividing instead of multiplying when applying percentage multipliers.
- Multiplying instead of dividing when working backwards to find an original value.
- Confusing growth factors (greater than 1) with decay factors (less than 1).
- Mixing units when calculating compound measures.

- Forgetting to convert time units consistently when calculating speed.
- Using minutes directly instead of converting to hours when required.
- Rearranging formulae incorrectly.
- Confusing average speed with speed at a particular moment.
- Assuming inverse proportion behaves the same way as direct proportion.
- Believing that if one quantity doubles, the other must also double.
- Failing to recognise inverse proportional relationships in practical situations.
- Using incorrect conversion factors when converting between units.
- Rounding too early during multi-step calculations, leading to inaccurate answers.

National Curriculum / Specification

Number – Ratio, Proportion and Rates of Change

- **N24** – Use ratio notation and apply ratio reasoning in a range of contexts.
- **N27** – Understand and use proportion as equality of ratios.
- **N28** – Relate ratios to fractions and proportions.
- **N29** – Define percentage as "number of parts per hundred".
- **N30** – Interpret percentages and percentage changes.
- **N31** – Solve problems involving percentage change, including successive percentage changes.
- **N32** – Solve problems involving compound measures such as speed.
- **N33** – Compare lengths, areas and volumes using ratio notation and scaling.
- **N34** – Use scale factors and proportional reasoning.
- **N35** – Understand and use inverse proportion.
- **N36** – Understand and use direct proportion.
- **N37** – Interpret and use equations describing direct and inverse proportion.

Number

- **N5** – Use place value and decimals in calculations.
- **N15** – Round numbers and measures appropriately.
- **N16** – Apply the four operations to integers, decimals and fractions.
- **N17** – Use standard units of mass, length, time, money and other measures.

Algebra

- **A4** – Translate situations into algebraic expressions and formulae.
- **A5** – Substitute numerical values into formulae.
- **A6** – Understand and use algebraic formulae.
- **A7** – Solve equations arising from mathematical and practical contexts.
- **A12** – Rearrange formulae to change the subject.

Geometry and Measures

- **G24** – Convert between related standard units.
- **G25** – Use compound measures such as speed, density and pressure.

Key National Curriculum focus

- **N30–N31** – Percentages, profit and loss, growth and decay, and repeated percentage change.
- **N32** – Compound measures, including speed, distance and time calculations.
- **N35–N37** – Direct and inverse proportion.
- **A5–A12** – Formulae, substitution and rearrangement.
- **G24–G25** – Unit conversions and compound measures.

Constructions, Loci and Bearings

Learning Objectives

- Recognise 3D shapes and their properties.
- Describe 3D shapes using the correct mathematical words.
- Understand the 2D shapes that make up 3D objects.
- Identify and sketch planes of symmetry of 3D shapes.
- Draw and interpret plans and elevations of 3D shapes.
- Make accurate drawings of triangles using a ruler, protractor and compasses.
- Identify SSS, ASA, SAS and RHS triangles as unique from a given description.
- Identify congruent triangles.
- Draw diagrams to scale.
- Use scales on maps and diagrams to work out lengths and distances.
- Solve problems involving scales.
- Accurately draw angles and 2D shapes using a ruler, protractor and compasses.
- Construct a polygon inside a circle.
- Draw accurate nets.
- Bisect angles and lines using rulers and compasses.
- Find the shortest distance from a point to a line.
- Draw loci for the path of points that follow a given rule.
- Identify regions bounded by loci to solve practical problems.
- Find and use three-figure bearings.
- Use angles at parallel lines to work out bearings.
- Solve problems involving bearings and scale diagrams.

What previous knowledge is required?

- Recognition and properties of common 2D shapes (triangles, quadrilaterals, polygons and circles).
- Understanding of basic 3D shapes such as cubes, cuboids, prisms, pyramids, cylinders, cones and spheres.
- Knowledge of angle facts, including angles on a straight line, around a point and in triangles.
- Ability to measure and draw angles using a protractor.
- Understanding of symmetry, including lines of symmetry in 2D shapes.
- Familiarity with parallel lines and angle relationships.
- Experience using geometric instruments accurately (ruler, protractor and compasses).
- Understanding of scale and proportional reasoning.
- Knowledge of ratio and unit conversions.
- Ability to measure lengths and calculate distances.
- Understanding of coordinates and basic geometric notation.
- Familiarity with congruence and properties of triangles.
- Experience interpreting diagrams, maps and simple plans.

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

- Develops precision in geometric drawing and construction.
- Provides a foundation for more advanced geometric reasoning and proof.
- Supports work with congruence, similarity and trigonometry.
- Strengthens understanding of scale drawings and proportional reasoning.
- Prepares students for coordinate geometry and transformations.
- Supports interpretation of engineering, architectural and technical drawings.
- Develops spatial reasoning skills essential for STEM subjects.
- Provides foundations for navigation, surveying and map-reading applications.
- Supports further study of vectors and geometric problem solving.
- Enhances understanding of loci and regions used in optimisation and design problems.
- Develops accuracy and logical reasoning required for higher-level mathematics.
- Reinforces the use of mathematical tools and conventions in practical contexts.

Common Misconceptions

- Confusing faces, edges and vertices when describing 3D shapes.
- Assuming all 3D shapes have planes of symmetry.
- Drawing plans and elevations from the wrong viewpoint.
- Confusing plans with elevations.
- Assuming different triangle constructions can produce more than one triangle when the conditions actually determine a unique triangle.
- Mixing up the conditions SSS, SAS, ASA and RHS.
- Confusing congruent triangles with similar triangles.
- Measuring scale drawings incorrectly because units are not converted first.
- Assuming scale factors apply through addition rather than multiplication.
- Drawing constructions freehand instead of using compasses accurately.
- Using a ruler rather than compasses to bisect an angle.
- Forgetting that the shortest distance from a point to a line is always perpendicular.
- Drawing loci as single lines when they should represent complete regions.
- Not drawing construction arcs clearly enough to justify loci solutions.
- Confusing loci boundaries with the shaded solution region.
- Measuring bearings from the wrong line instead of north.
- Measuring bearings anticlockwise instead of clockwise.
- Writing bearings with fewer than three figures (e.g. 45° instead of 045°).
- Confusing bearings with ordinary angle measurements.
- Using incorrect scale conversions when solving bearing and map problems.
- Forgetting to include units when interpreting scale diagrams.

National Curriculum / Specification

Geometry and Measures

- **G1** – Use conventional terms and notation for lines, angles and shapes.
- **G2** – Use the standard conventions for labelling geometric diagrams.
- **G3** – Derive and apply properties of triangles, quadrilaterals and other plane figures.
- **G4** – Derive and use standard ruler and compass constructions.
- **G5** – Use the standard constructions to solve geometrical problems.
- **G6** – Apply angle facts and geometric reasoning to solve problems.
- **G7** – Use scale factors, scale diagrams and maps.
- **G8** – Understand and apply congruence conditions.
- **G9** – Understand and use the properties of circles.
- **G10** – Identify, describe and construct congruent figures.
- **G11** – Describe and transform 2D and 3D shapes.
- **G12** – Identify and describe symmetries of 2D and 3D shapes.
- **G13** – Interpret and draw plans and elevations of 3D shapes.
- **G14** – Construct and interpret nets of 3D solids.
- **G15** – Use geometrical constructions and loci to solve problems.
- **G20** – Interpret and use bearings.
- **G21** – Solve geometrical problems involving bearings and scale drawings.

Number – Ratio, Proportion and Rates of Change

- **N27** – Understand and use proportion as equality of ratios.
- **N33** – Use ratio notation in practical contexts.
- **N34** – Use scale factors, scale diagrams and maps.
- **N36** – Apply proportional reasoning in geometrical contexts.

Algebra

- **A4** – Translate practical situations into mathematical representations.
- **A5** – Substitute values into formulae where required in geometric calculations.

Statistics

- **S6** – Interpret diagrams and graphical representations when solving practical problems involving scale and location.

Key National Curriculum focus

- **G4–G5** – Geometric constructions using ruler and compasses.
- **G7** – Scale drawings and maps.
- **G8–G10** – Congruence and triangle conditions.
- **G13–G14** – Plans, elevations and nets.
- **G15** – Loci and construction problems.
- **G20–G21** – Bearings and navigation problems.

Quadratic Equations and Graphs

Learning Objectives

- Multiply double brackets.
- Recognise quadratic expressions.

- Square single brackets.
- Plot graphs of quadratic functions.
- Recognise a quadratic function.
- Use quadratic graphs to solve problems
    - Solve quadratic equations $ax^2 + bx + c = 0$ using a graph.
        - Solve quadratic equations using a graph.
- Factorise quadratic expressions.
- Solve quadratic functions algebraically.

What previous knowledge is required?

- Understanding of algebraic notation and vocabulary (terms, expressions, equations and variables).
- Ability to simplify algebraic expressions by collecting like terms.
- Knowledge of the distributive law and expanding single brackets.
- Fluency with multiplication facts and arithmetic operations.
- Understanding of powers, squares and square numbers.
- Ability to substitute values into algebraic expressions and formulae.
- Knowledge of coordinates and plotting points on a graph.
- Understanding of Cartesian axes and graph scales.
- Ability to draw and interpret linear graphs.
- Understanding of solving linear equations.
- Familiarity with factors and factor pairs of numbers.
- Knowledge of inverse operations and algebraic manipulation.
- Experience of interpreting graphs in real-world contexts

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

- Provides a foundation for Higher GCSE algebra topics.
- Develops understanding of polynomial functions and their graphs.
- Supports further study of quadratic equations using completing the square and the quadratic formula.
- Builds algebraic reasoning and problem-solving skills.
- Strengthens links between algebraic and graphical representations.
- Prepares students for simultaneous equations involving quadratic functions.
- Supports work with transformations of graphs.
- Provides foundations for A Level Mathematics topics such as functions, calculus and advanced algebra.
- Develops mathematical modelling skills used in science, engineering and economics.
- Helps students interpret curved relationships in practical situations.
- Reinforces factorisation techniques that are used throughout algebra.
- Supports understanding of optimisation and maximum/minimum problems in later mathematics.

Common Misconceptions

- Believing that $(a + b)^2 = a^2 + b^2$ rather than $(a + b)^2 = a^2 + 2ab + b^2$
- Expanding double brackets incorrectly by missing terms.
- Forgetting to multiply every term in one bracket by every term in the other bracket.
- Confusing quadratic expressions with linear expressions.
- Thinking any equation containing is automatically in its simplest quadratic form.
- Plotting quadratic graphs as straight lines rather than curves.
- Using too few points when drawing a quadratic graph.
- Assuming quadratic graphs are always symmetrical about the y-axis.
- Misreading graph scales when plotting points.
- Thinking a quadratic equation has only one solution.

- Forgetting that some quadratic equations have two solutions.
- Confusing x-intercepts with y-intercepts.
- Reading solutions inaccurately from a graph.
- Assuming graph solutions are always exact.
- Factorising quadratics incorrectly by choosing factors that do not produce the middle term.
- Forgetting that factorised expressions must multiply back to the original quadratic.
- Solving only one factor when using the factor method.
- Confusing factors with terms.
- Ignoring negative signs when factorising or solving equations.
- Believing all quadratic expressions can be factorised easily using integers.

National Curriculum / Specification

Algebra

- **A1** – Use and interpret algebraic notation correctly.
- **A2** – Substitute numerical values into formulae and expressions.
- **A3** – Understand and use the concepts and vocabulary of expressions, equations and formulae.
- **A4** – Simplify and manipulate algebraic expressions.
- **A5** – Multiply out expressions involving brackets.
- **A6** – Understand and use algebraic formulae.
- **A7** – Solve linear equations and extend algebraic reasoning.
- **A12** – Derive and solve equations from mathematical situations.
- **A13** – Recognise, sketch and interpret graphs of linear and non-linear functions.
- **A14** – Plot and interpret graphs of quadratic functions.
- **A15** – Identify where graphs intersect the axes and interpret these points.
- **A16** – Estimate solutions to equations graphically.
- **A17** – Solve quadratic equations graphically.
- **A18** – Solve quadratic equations algebraically by factorisation.

Number

- **N6** – Use powers and roots, including square numbers and square roots.
- **N16** – Apply the four operations, including multiplication and division.
- **N17** – Use standard mathematical conventions and notation.

Geometry and Measures

- **G1** – Apply geometrical reasoning where quadratic relationships arise in coordinate geometry contexts.

Key National Curriculum focus

- **A4–A5** – Manipulating algebraic expressions and expanding brackets.
- **A13–A17** – Plotting, interpreting and using quadratic graphs.
- **A18** – Solving quadratic equations algebraically through factorisation.
- **N6** – Understanding squares and powers within quadratic expressions.

Perimeter, Area and Volume

Learning Objectives

- Calculate the circumference of a circle.
- Solve problems involving the circumference of a circle.

- Calculate the circumference and radius of a circle.
- Write error intervals for rounded and truncated values.
- Work out the area of a circle.
- Work out the radius or diameter of a circle.
- Solve problems involving the area of a circle.
- Give answers in terms of π.
- Understand and use maths language for circles and perimeters.
- Work out areas and perimeters of sectors of circles.
- Solve problems involving areas and perimeters of 2D shapes.
- Work out the volume and surface area of cylinders.
- Work out the volume of a pyramid.
- Work out the surface area of a pyramid.
- Work out the volume of a cone.
- Work out the surface area of a cone.
- Work out the volume and surface area of a sphere.
- Work out the volume and surface area of composite solids.

What previous knowledge is required?

- Understanding of perimeter and area of rectangles, triangles, parallelograms and other basic 2D shapes.
- Knowledge of the properties of circles, including radius, diameter and circumference.
- Understanding of the relationship between radius and diameter.
- Familiarity with the concept and use of π (pi).
- Ability to substitute values into formulae.
- Knowledge of square numbers, cubes and powers.
- Fluency with the four operations (addition, subtraction, multiplication and division).
- Understanding of units of length, area and volume.
- Ability to convert between related units of measurement.
- Experience calculating volumes of cuboids and prisms.
- Understanding of nets and surface area of simple solids.
- Familiarity with rounding numbers and using a calculator accurately.
- Knowledge of fractions, percentages and proportional reasoning.
- Understanding of sectors and angles in circles

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

- Provides a foundation for Higher GCSE topics involving circles and 3D geometry.
- Supports work with trigonometry, coordinate geometry and mensuration.
- Develops fluency in using mathematical formulae.
- Strengthens algebraic skills through rearranging and applying formulae.
- Supports further study of engineering, architecture and design.
- Provides essential knowledge for construction, manufacturing and surveying applications.
- Develops spatial reasoning and visualisation skills.
- Supports science topics involving volume, density and capacity.
- Prepares students for A Level Mathematics and STEM-related courses.
- Reinforces problem-solving involving compound and composite shapes.
- Helps students interpret and model real-world objects mathematically.
- Develops understanding of accuracy, estimation and error bounds in measurement.

Common Misconceptions

- Confusing circumference with area.
- Using the diameter instead of the radius in circle formulae.
- Forgetting to halve the diameter when finding the radius.

- Using the wrong formula for circumference or area.
- Rounding π too early and introducing inaccuracies.
- Forgetting to give exact answers in terms of π when required.
- Mixing units of length, area and volume.
- Forgetting that area units are squared and volume units are cubed.
- Confusing surface area with volume.
- Calculating the volume of a solid when the question asks for surface area.
- Omitting curved surfaces when calculating total surface area.
- Using incorrect dimensions when working with cylinders, cones or spheres.
- Forgetting that the volume of a pyramid is one-third of the volume of the corresponding prism.
- Forgetting that the volume of a cone is one-third of the volume of the corresponding cylinder.
- Calculating sectors using the whole circle rather than the required fraction.
- Confusing arc length with sector area.
- Misinterpreting composite solids and missing parts of the shape.
- Assuming rounded values are exact values.
- Writing incorrect error intervals for rounded or truncated measurements.
- Rounding intermediate calculations too early in multi-step problems.

National Curriculum / Specification

Geometry and Measures

- **G1** – Use conventional terms and notation for geometric figures and measures.
- **G9** – Identify and apply circle definitions and properties, including radius, diameter and circumference.
- **G17** – Derive and apply standard circle formulae.
- **G18** – Calculate the perimeter and area of circles and composite shapes.
- **G19** – Calculate arc lengths, angles and areas of sectors of circles.
- **G20** – Calculate the surface area of spheres, pyramids, cones and composite solids.
- **G21** – Calculate the volumes of prisms, cylinders, pyramids, cones and spheres.
- **G22** – Solve problems involving volume and surface area.
- **G23** – Apply geometrical knowledge to solve practical and contextual problems.
- **G24** – Convert between related standard units.
- **G25** – Use compound measures and measurement formulae where appropriate.

Number

- **N6** – Use powers and roots, including squares and cubes.
- **N15** – Round numbers and measures appropriately.
- **N16** – Apply the four operations to calculations involving measures.
- **N17** – Use standard units of mass, length, area, volume and capacity.
- **N18** – Use calculators efficiently and interpret calculator outputs.
- **N20** – Understand and use upper and lower bounds.
- **N21** – Interpret and calculate with error intervals.

Algebra

- **A5** – Substitute numerical values into formulae.
- **A6** – Understand and use mathematical formulae.
- **A12** – Rearrange formulae where required to find unknown measurements.

Ratio, Proportion and Rates of Change

- **N34** – Use scale factors and proportional reasoning in geometric contexts.

Fractions, Indices and Standard Form

Learning Objectives

- Multiply and divide mixed numbers and fractions.
- To know and use the laws of indices.
- Write large numbers in standard form.
- Convert numbers from standard form into ordinary numbers
- Write small numbers in standard form.
- Convert numbers from standard form with negative powers into ordinary numbers.
- To multiply and divide numbers in standard form.
- To add and subtract numbers in standard form.

What previous knowledge is required?

- Understanding of fractions, including proper, improper and mixed-number fractions.
- Ability to convert between mixed numbers and improper fractions.
- Knowledge of equivalent fractions and simplifying fractions.
- Fluency with the four operations (addition, subtraction, multiplication and division).
- Understanding of multiplication and division involving integers and decimals.

- Knowledge of powers and square numbers.
- Familiarity with place value, including very large and very small numbers.
- Understanding of negative numbers and number operations.
- Ability to use a calculator efficiently.
- Knowledge of decimal notation and powers of ten.
- Understanding of factors and multiples.
- Familiarity with mathematical notation and algebraic expressions

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

- Provides a foundation for Higher GCSE algebra and number topics.
- Develops fluency in manipulating fractions used throughout mathematics.
- Supports algebraic fraction work in later GCSE studies.
- Strengthens understanding of exponential growth and decay.
- Prepares students for scientific notation used in science, engineering and technology.
- Supports work with standard form in physics, chemistry and astronomy.
- Develops efficiency when working with very large or very small numbers.
- Provides essential knowledge for advanced index laws at Higher GCSE and A Level.
- Supports algebraic manipulation involving powers and roots.
- Reinforces calculator skills and numerical accuracy.
- Helps students understand mathematical modelling in scientific contexts.
- Builds confidence in interpreting and communicating numerical information

Common Misconceptions

- Multiplying mixed numbers without first converting them to improper fractions.
- Adding denominators when multiplying fractions.
- Forgetting to invert the second fraction when dividing fractions.
- Cancelling terms incorrectly when simplifying fractions.
- Confusing multiplication and division rules for fractions.
- Believing that
- Applying index laws incorrectly to addition and subtraction.
- Confusing powers with multiplication (e.g. thinking)
- Using the wrong index law when multiplying or dividing powers.
- Forgetting that a negative index does not mean a negative number.
- Writing standard form with a number greater than or equal to 10 before the multiplication sign.
- Writing standard form with a coefficient less than 1.
- Moving the decimal point in the wrong direction when converting standard form.
- Confusing positive and negative powers of ten.
- Thinking that is larger than
- Forgetting to adjust the power when multiplying or dividing numbers in standard form.
- Adding or subtracting numbers in standard form without first converting them to the same power of ten.
- Rounding too early during calculations involving standard form.

National Curriculum / Specification

Number

- **N1** – Apply the four operations, including formal written methods, to integers, decimals and fractions.
- **N2** – Use and interpret positive and negative numbers in context.
- **N3** – Order positive and negative integers, decimals and fractions.
- **N4** – Use the concepts and vocabulary of factors, multiples and powers.
- **N5** – Use place value for integers and decimals of any size.
- **N6** – Use powers and roots, including square, cube and higher powers.
- **N7** – Use positive integer powers and associated real roots.
- **N8** – Recognise and use relationships between operations, including inverse operations.
- **N9** – Use the laws of indices for multiplication and division of powers.
- **N10** – Express numbers in standard form and use standard form in calculations.
- **N15** – Round numbers and measures appropriately.
- **N16** – Apply the four operations to fractions, decimals and integers.

Algebra

- **A1** – Use and interpret algebraic notation correctly.
- **A4** – Simplify and manipulate algebraic expressions.
- **A5** – Understand and use algebraic formulae involving powers and indices.
- **A12** – Apply algebraic reasoning when simplifying expressions containing indices.

Ratio, Proportion and Rates of Change

- **N27** – Understand multiplicative relationships and proportional reasoning.
- **N36** – Apply proportional reasoning in numerical and scientific contexts.

Geometry and Measures

- **G24** – Convert between related numerical forms and units where powers of ten are used.

Congruence, Similarity and Vectors

Learning Objectives

- Understanding similarity
- Use similarity to solve angle problems
- Find the scale factor of an enlargement
- Use similarity to solve problems
- Determine when two shapes are definitely not (or may not be) similar
- Understand the similarity of regular polygons
- Calculate perimeters of similar shapes
- Recognise congruent shapes
- Use congruence to work out unknown angles
- Use congruence to work out unknown sides and angles in triangles and shapes made of triangles
- Add vectors
- Find the resultant of two vectors
- Subtract vectors
- Find multiples of a vector
- Identify two column vectors that are parallel
- Solve problems using vectors

What previous knowledge is required?

- Understanding of the properties of 2D shapes, particularly triangles and polygons.
- Knowledge of angle facts, including angles in triangles, quadrilaterals and polygons.
- Understanding of corresponding, alternate and co-interior angles in parallel lines.
- Familiarity with enlargement and scale factors from transformations.
- Knowledge of ratio and proportional reasoning.
- Ability to calculate and compare lengths and perimeters.
- Understanding of symmetry and geometric properties.
- Familiarity with congruence conditions (SSS, SAS, ASA and RHS).
- Experience drawing and interpreting scale diagrams.
- Understanding of coordinates and basic geometric notation.
- Knowledge of vectors as directed line segments.
- Ability to perform addition, subtraction and multiplication with integers.
- Understanding of column vector notation.
- Experience solving multi-step geometric problems.

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

- Supports further study of trigonometry through similar triangles.
- Develops understanding of geometric reasoning and mathematical justification.
- Strengthens proportional reasoning through scale factors and similarity.
- Supports work with area and volume scale factors in more advanced mathematics.
- Prepares students for coordinate geometry and transformational geometry.
- Develops algebraic thinking through vector manipulation.
- Provides mathematical tools used in engineering, architecture, computer graphics and navigation.
- Enhances spatial reasoning and visualisation skills.
- Supports problem-solving involving scale drawings, maps and models.
- Reinforces logical deduction and mathematical communication.

Common Misconceptions

- Confusing similar shapes with congruent shapes.
- Believing similar shapes must be the same size.
- Assuming congruent shapes can be different sizes.
- Forgetting that corresponding angles in similar shapes are equal.
- Comparing side lengths incorrectly when checking similarity.
- Using addition rather than multiplication when applying scale factors.
- Assuming shapes are similar because they look alike.
- Believing all polygons with the same number of sides are similar.
- Forgetting that regular polygons with the same number of sides are always similar.
- Confusing perimeter scale factors with area scale factors.
- Using incorrect corresponding sides when calculating scale factors.
- Assuming congruent shapes must have the same orientation.
- Forgetting that congruent shapes can be rotated, reflected or translated.
- Mixing up congruence conditions such as SSS, SAS, ASA and RHS.
- Adding vectors by adding magnitudes only rather than corresponding components.
- Confusing vector direction with vector size.
- Treating vectors as ordinary numbers.
- Subtracting vectors incorrectly by failing to reverse direction.
- Assuming parallel vectors must be identical.
- Forgetting that parallel vectors can have different magnitudes.
- Confusing vector notation with coordinates.
- Omitting vector notation when giving answers.

National Curriculum / Specification

Geometry and Measures

- **G1** – Use conventional terms and notation for geometric figures and properties.
- **G3** – Derive and apply properties of triangles, quadrilaterals and polygons.
- **G6** – Apply angle facts and geometric reasoning to solve problems.
- **G7** – Use scale factors, scale diagrams and maps.
- **G8** – Understand and apply the concepts of congruence and similarity.
- **G9** – Identify and apply geometric properties to solve problems.
- **G10** – Use congruence criteria and reason mathematically with congruent figures.
- **G11** – Understand and use similarity, including relationships between corresponding lengths.
- **G12** – Apply similarity to solve geometric problems.
- **G13** – Understand and use scale factors in geometric contexts.
- **G14** – Apply geometric reasoning to regular polygons and related shapes.

Ratio, Proportion and Rates of Change

- **N27** – Understand and use proportion as equality of ratios.
- **N28** – Relate ratios to proportional relationships.
- **N33** – Compare lengths, areas and volumes using ratio notation.
- **N34** – Use scale factors and proportional reasoning.
- **N36** – Apply direct proportional relationships in geometric contexts.

Algebra

- **A1** – Use and interpret algebraic notation correctly.
- **A4** – Simplify and manipulate mathematical expressions and relationships.
- **A21** – Describe translations as vectors.
- **A22** – Apply addition and subtraction of vectors and use vectors in geometric proofs and problem solving.

Number

- **N16** – Apply the four operations in geometric and vector calculations.

More Algebra

Learning Objectives

- Draw and interpret graphs of cubic functions.
- Draw and interpret graphs of y=1x
- Draw and interpret non-linear graphs to solve problems.
- Solve simultaneous equations by drawing a graph.
- Write and solve simultaneous equations
- Solve simultaneous equations algebraically
- Change the subject of a formula

What previous knowledge is required?

- Understanding of algebraic notation, variables and expressions.
- Ability to simplify expressions by collecting like terms.
- Knowledge of substitution into expressions and formulae.
- Understanding of solving linear equations.
- Familiarity with coordinates and plotting points on a graph.
- Ability to draw and interpret linear graphs.

- Understanding of quadratic graphs and their key features.
- Knowledge of graph scales and coordinate axes.
- Familiarity with inverse operations.
- Understanding of fractions and reciprocal relationships.
- Ability to manipulate simple formulae.
- Experience solving equations in one variable.
- Knowledge of basic geometric and scientific formulae.
- Understanding of intersections of graphs and what they represent.
- Fluency with arithmetic operations involving integers, fractions and decimals

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

- Develops understanding of a wider range of functions and graphs.
- Supports further study of polynomial functions, including cubic functions.
- Strengthens graphical interpretation and modelling skills.
- Builds connections between algebraic and graphical methods.
- Prepares students for solving more complex simultaneous equations.
- Develops algebraic manipulation skills required throughout mathematics.
- Reinforces logical and systematic problem-solving approaches.
- Supports science and engineering applications involving formulae and modelling.
- Provides essential skills for rearranging scientific and mathematical formulae.
- Enhances understanding of mathematical relationships between variables.
- Develops confidence in selecting appropriate methods to solve problems.

Common Misconceptions

- Plotting cubic graphs using too few points, leading to inaccurate shapes.
- Assuming cubic graphs are symmetrical like quadratic graphs.
- Confusing the graph of with a straight line grap
- Drawing the graph of through the axes when it never touches them.
- Believing non-linear graphs have a constant gradient.
- Misreading coordinates from curved graphs.
- Assuming graph intersections always occur at integer values.
- Confusing the x-coordinate and y-coordinate of an intersection point.
- Forgetting that simultaneous equations represent two conditions that must both be true.
- Using only one equation when solving simultaneous equations.
- Making sign errors when eliminating variables algebraically.
- Adding equations when subtraction is required, or vice versa.
- Failing to substitute solutions back into the original equations to check answers.
- Treating formula rearrangement as arithmetic rather than balancing equations.
- Moving terms across the equals sign without applying inverse operations correctly.
- Forgetting to apply operations to every term when rearranging formulae.
- Confusing multiplication by a variable with addition of a variable.
- Losing brackets when rearranging formulae involving multiple terms.

National Curriculum / Specification

Algebra

- **A1** – Use and interpret algebraic notation correctly.
- **A2** – Substitute numerical values into formulae and expressions.
- **A3** – Understand and use the concepts and vocabulary of expressions, equations, formulae and identities.
- **A4** – Simplify and manipulate algebraic expressions.
- **A5** – Understand and use algebraic formulae.
- **A6** – Solve linear equations in one unknown.
- **A7** – Solve equations arising from mathematical and practical contexts.
- **A12** – Rearrange formulae to change the subject.
- **A13** – Recognise, sketch and interpret graphs of linear and non-linear functions.
- **A14** – Plot and interpret graphs of reciprocal functions
- **A15** – Plot and interpret graphs of cubic functions.
- **A16** – Identify and interpret key features of graphs.
- **A17** – Estimate solutions to equations graphically.
- **A18** – Solve simultaneous equations graphically.
- **A19** – Solve simultaneous equations algebraically.

Number

- **N2** – Use and interpret positive and negative numbers in calculations.
- **N5** – Use place value and decimals appropriately in calculations.
- **N16** – Apply the four operations to integers, decimals and fractions.

Ratio, Proportion and Rates of Change

- **N36** – Understand direct proportional relationships.
- **N37** – Interpret equations and graphical relationships between variables.

Geometry and Measures

- **G23** – Apply mathematical modelling and interpretation in practical contexts involving graphs and formulae.