Cornwallis Academy
Ambitions for All

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Year 11 Higher Mathematics

Angles in polygons

Learning Objectives

- Calculate the sum of the interior angles of a polygon
- Use the interior angles of polygons to solve problems
- Use x for the unknown to help you solve problems
- Know the sum of the exterior angles of a polygon
- Use the angles of polygons to solve problems

What previous knowledge is required?

- Use conventional terms and notation: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries
- Use the standard conventions for labelling and referring to the sides and angles of triangles
- Draw diagrams from written descriptions.

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

- Used to justify angle relationships in circle theorems and plane geometry
- Helps structure formal reasoning in exam proofs
- Coordinate geometry
- Angle facts help confirm shapes (e.g., proving a shape is a regular polygon or a parallelogram)
- Supports working with slopes and angle conditions indirectly
- Polygons can be split into triangles to apply sine/cosine rules
- Useful in multi-step problem solving involving unknown lengths
- Vectors and mechanics connections
- Exterior angles relate to direction changes in vector paths

Common Misconceptions

- Confusing Interior and Exterior Angles
- Thinking the Interior-Angle Sum Formula Works for Exterior Angles
- Believing All Polygons Have Equal Angles

National Curriculum / Specification

- Apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles
- Understand and use alternate and corresponding angles on parallel lines
- Derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons)

Recurring decimals to fractions

Learning Objectives

- Convert a recurring decimal to a fraction

What previous knowledge is required?

- Decimal place value understanding
- Basic algebra (equations and elimination)
- Fraction simplification skills
- Understanding of repeating decimal notation
- Ability to use powers of 10 correctly

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

- Strengthens algebraic manipulation skills: The method relies on setting up equations and eliminating repeating parts, which is core algebra practice.
- Improves understanding of rational numbers

Common Misconceptions

- Ignoring the non-repeating part
- Using the wrong power of 10 when shifting

National Curriculum / Specification

- convert between fractions and decimals
- recognise that recurring decimals represent rational numbers
- convert recurring decimals to fractions (and vice versa)

Algebraic fractions

Learning Objectives

- Add and subtract algebraic fractions
- Multiply and divide algebraic fractions
- Change the subject of a formula involving fractions where all the variables are in the denominators
- Simplify algebraic fractions

What previous knowledge is required?

- Strong fraction skills
- Good algebra manipulation
- Factorisation ability
- Basic index laws

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

- Simplifying complex expressions
- Solving equations
- Functions and domains
- Graphs of rational functions
- Calculus preparation
- Partial fractions decomposition
- Proof and algebraic reasoning

Common Misconceptions

- Restrictions on variables don't matter
- You can cancel anything that appears in numerator and denominator

National Curriculum / Specification

- Simplify and manipulate algebraic expressions involving algebraic fractions
- Work with algebraic expressions as fractions (rational expressions)
- Factorise quadratics and linear expressions to simplify fractions
- Cancel common factors correctly
- Perform addition, subtraction, multiplication, and division of algebraic fractions

Geometric proofs

Learning Objectives

- Solve geometric problems in two dimensions using vector methods, including where vectors are divided in a given ratio
- Apply vector methods for simple geometric proofs.

What previous knowledge is required?

- "Congruent" vs "equal"
- "Parallel" (∥), "perpendicular" (⊥)
- Segment and angle notation (e.g., ∠ABC, AB)

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

- Improve understanding of geometric properties (angles, triangles, circles, vectors), which often appear in pure maths papers
- Help with proof questions in topics like algebra (e.g., inequalities) by training step-by-step justification

Common Misconceptions

- Diagrams prove the statement

National Curriculum / Specification

- Constructing logical step-by-step arguments
- Using known theorems/definitions to justify each step
- Interpreting diagrams and identifying which facts are relevant

Writing algebraic proofs

Learning Objectives

- Prove a result using algebra

What previous knowledge is required?

- Algebraic manipulation,
- Properties of equality,
- Definitions of even/odd numbers,
- Direct proofs.

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

- **S**trengthens your algebra manipulation
- Develops logical thinking
- Helps with mathematical communication
- Makes identities easier to understand

Common Misconceptions

- Dividing by Zero
- Taking Square Roots Incorrectly
- Assuming Operations Preserve Equivalence in All Cases

National Curriculum / Specification

- Algebraic manipulation and simplification.
- Forming and using expressions.
- Reasoning mathematically.
- Constructing mathematical arguments and proofs.
- Justifying results and proving general statements

Constructing proportion equations

Learning Objectives

- Write and use equations to solve problems involving direct proportion
- Solve problems involving square and cubic proportionality
- Write and use equations to solve problems involving inverse proportion
- Use and recognise graphs showing inverse proportion

What previous knowledge is required?

- Understanding that a fraction represents a ratio of two quantities.
- Simplifying fractions
- Finding equivalent fractions.

- Writing ratios in different forms
- Comparing ratios to determine whether they are equivalent.
- Basic multiplication facts and division skills.
- Understanding how multiplication and division undo each other.
- Using a letter (such as xxx) to represent an unknown quantity.
- Substituting values and interpreting simple equations.
- Equality

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

- Solving proportional relationships
- Modelling real-world situations
- Understanding graphs
- Preparing for logarithms and regression

Common Misconceptions

- Treating a proportion as an equation to solve by adding or subtracting
- Cross-multiplying incorrectly
- Forgetting that order matters
- Thinking all equations with fractions are proportions

National Curriculum / Specification

- Construct and interpret equations describing direct and inverse proportion.
- Use proportional relationships algebraically and graphically.
- Solve more complex proportion problems involving rates of change, similarity, and compound measures.

Rationalising denominators

Learning Objectives

- Understand the difference between rational and irrational numbers
- Rationalise a denominator

What previous knowledge is required?

- Fractions
- Indices and roots
- Simplifying surds
- Expanding brackets
- Difference of two squares
- Rationalising denominators with a single surd
- Rationalising denominators using conjugates

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

- Exact Values and Simplification
- Algebraic Manipulation
- Calculus
- Proof and Mathematical Reasoning
- Coordinate Geometry and Trigonometry

Common Misconceptions

- Thinking rationalising changes the value of a fraction, when it actually only changes its form.
- Believing rationalising is always required, even though in modern Mathematics it is often optional unless specified.

National Curriculum / Specification

- Surds and indices
- Exact calculation
- Algebraic manipulation with irrational numbers

Finding composite functions

Learning Objectives

- Use function notation
- Find composite functions
- Find inverse functions

What previous knowledge is required?

- Understanding what a **function** is: that a function takes an input xxx and produces exactly one output $f(x)f(x)$f(x).
- Function notation: being confident with writing and interpreting $f(x)f(x)$f(x), $g(x)g(x)$g(x), and substituting values into them.
- Substitution skills: replacing variables correctly and carefully, especially when expressions (not just numbers) are involved.
- Algebraic manipulation: expanding brackets, simplifying expressions, and collecting like terms accurately.
- Order of operations (BIDMAS/BODMAS): so you correctly evaluate inside functions first before applying the outer function.
- Evaluating expressions with multiple steps
- Basic knowledge of domains (sometimes): understanding that some inputs may not be valid depending on the function (e.g. division by zero, square roots of negatives in real numbers).
- Working with algebraic expressions inside other expressions: for example, handling $f(2x+3)f(2x+3)$f(2x+3) without incorrectly treating it like a simple number.

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

- calculus (chain rule)
- advanced function work
- modelling
- inverse functions

Common Misconceptions

- Thinking $f(g(x))f(g(x))$f(g(x)) means $f \times g(x)f \backslash times\ g(x)$f×g(x) instead of "put $g(x)g(x)$g(x) into $f(x)f(x)$f(x)".
- Reversing the order: assuming $f(g(x))=g(f(x))f(g(x)) = g(f(x))$f(g(x))=g(f(x)), when order matters and they are usually different.
- Substituting incorrectly, such as replacing only part of the inner function instead of the whole expression.

- Forgetting brackets when substituting, leading to errors like $f(x+2)=x2+2f(x+2) = x^2 + 2$f(x+2)=x2+2 instead of $(x+2)2(x+2)^2$(x+2)2.
- Evaluating both functions separately and then "combining answers" incorrectly, rather than nesting one inside the other.

National Curriculum / Specification

- Use function notation
- Find composite functions $f(g(x))f(g(x))$f(g(x))
- Interpret and evaluate functions

Estimating gradients using tangents

Learning Objectives

- Calculate the gradient of a tangent at a point

What previous knowledge is required?

- Understanding what a gradient (slope) means: rise over run and how it describes steepness and direction.
- Plotting and reading coordinates accurately on a graph.
- Drawing and interpreting straight-line graphs, including recognising constant gradient.
- Basic graph skills: identifying points on a curve and understanding how curves differ from straight lines.
- Knowing how to draw a tangent to a curve (a straight line that just touches the curve at one point).
- Estimating gradients using two points on a straight line (often from the tangent)

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

- exact gradients using differentiation
- motion and rate-of-change modelling

Common Misconceptions

- Thinking the tangent is the same as the curve at a point, rather than a straight line that just *touches* the curve locally.
- Drawing a chord (line between two points on the curve) instead of a true tangent, which gives an average gradient rather than an instantaneous one.
- Believing there is only one correct tangent, when small drawing inaccuracies can lead to slightly different but acceptable estimates.
- Choosing points that are too close together on the tangent, making the gradient very sensitive to reading errors.

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- Drawing a tangent at a point on a curve
- Choosing two points on the tangent
- Calculating gradient

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Surface area and volume of similar shapes

Learning Objectives

- Use the link between scale factors for length, area and volume to solve problems

What previous knowledge is required?

- Similarity of Shapes
- Scale Factors
- Area of 2D Shapes
- Volume of 3D Shapes
- Powers and Indices

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

- Strengthens Understanding of Scaling
- Helps with Geometric Proofs and Problem Solving
- Supports Calculus Intuition

Common Misconceptions

- Thinking Area Scales by the Same Factor as Length
- Thinking Volume Scales by the Same Factor as Length
- Forgetting to Use Square Roots for Area Ratios
- Forgetting to Use Cube Roots for Volume Ratios

National Curriculum / Specification

- Use scale factors, scale diagrams and maps.
- Understand and use the concepts and vocabulary of similarity.
- Apply the concepts of congruence and similarity, including the relationships between lengths, areas and volumes in similar figures.