Year Overview

Year 10 Higher Tier

	Term 01	Term 02	Term 03	Term 04	Term 05	Term 06
Topic(s)	1. Numbers 2. Statistical Diagrams	1. Numbers 2. Ratio 3. Geometry	1. Algebra 2. Geometry	3. Probability 4. Algebra	1. Algebra 2. Geometry	1. Statistics
Marking & Assessment Points	Bi - termly modular assessments End of term assessments	Bi - termly modular assessments End of term assessments	Bi - termly modular assessments End of term assessments	Bi - termly modular assessments End of term assessments	Bi - termly modular assessments End of term assessments	Bi - termly modular assessments End of term assessments

Term 5 Year 10 [Higher Tier Maths] | Algebra

Topic Overview: In this term, we transition from geometric reasoning to algebraic fluency and statistical analysis. You will master the art of "mathematical logic" through Algebraic Proofs, where you must prove a statement is true for all integers using formal notation (e.g., 2n for even numbers).

You will also tackle Simultaneous Equations, moving from the intersection of two lines (Linear) to the more complex intersections of curves and lines (Quadratic). In Transforming Graphs, the focus is on how changing an equation—such as f(x) + a or f(ax)—physically shifts or stretches a curve on a grid. Finally, you will refine your Probability skills, using product rules and tree diagrams to calculate the likelihood of combined events.

Prior & Subsequent Knowledge

1. Prior Knowledge (The Foundation)

- Expansion & Factorisation: You must be fluent in expanding brackets and factorising quadratics ($x^2 + bx + c$) to solve simultaneous equations.
- Algebraic Manipulation: Rearranging formulas is essential; you'll often need to make x or y the subject before you can substitute.
- Basic Probability: Understanding that probabilities sum to 1 and knowing how to use simple "Expected Frequency."
- Plotting Linear Graphs: Knowing how to plot y = mx + c is the starting point for all graph transformations.

2. Related Knowledge (Current GCSE Context)

- Linear Simultaneous Equations: Finding the single coordinate where two straight lines cross.
- Simultaneous Equations with a Quadratic: Solving systems that lead to a quadratic equation, often resulting in two pairs of coordinates (x_1, y_1) and (x_2, y_2).
- Probability Equations: Using the Product Rule for Counting and conditional probability notation.
  Key Formula: For independent events, $P(A \text{ and } B) = P(A) \times P(B)$.
- Transforming Graphs: Recognizing four main movements:
  1. f(x) + a (Vertical shift)
  2. f(x + a) (Horizontal shift - *remember, it's the opposite of what you'd expect!*)
  3. a f(x) (Vertical stretch)
  4. f(ax) (Horizontal stretch)

3. Subsequent Knowledge (The Next Steps)

- Calculus (A-Level Prep): Transforming graphs and solving equations are the direct precursors to finding gradients of curves (differentiation).
- Functions: Advanced notation like composite functions fg(x) and inverse functions $f^{-1}(x)$.
- Set Theory: Using Venn diagrams and notation like $\cap$ (intersection) and $\cup$ (union) for more complex probability proofs.
- Vector Proofs: Using the logic found in algebraic proofs to prove that lines are parallel or collinear in 2D space.

Lesson 01

Lesson Title	National Curriculum or Specification Link	Declarative Knowledge	Procedural Knowledge	Diagnostic questions for each phase of the lesson.	Push Yourself Activities	Resources Link	Literacy and Oracy	Cross Curricular
Algebraic Proof	GCSE Mathematics (Higher): G13 - Argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments and proofs.	* A **proof** is a rigorous mathematical argument where each step follows logically from the previous one. * **Even numbers** are represented as 2n. * **Odd numbers** are represented as 2n+1 or 2n-1. * **Consecutive integers** are n, n+1, n+2. * **Consecutive even integers** are 2n, 2n+2. * **The product** of two odd numbers is always odd; the **sum** of two even numbers is always even.	* Setting up expressions using "n" to represent integers. * Expanding and simplifying algebraic brackets accurately. * **Factorising** at the final step to show a multiple (e.g., factorising out a '2' to prove a result is even). * Writing a concluding statement to link the algebra back to the original conjecture.	**Check Point 01 (Entry):** "If n is any integer, why does 2n always represent an even number?" **Check Point 02 (Mid):** "Expand and simplify $(n+1)^2 - n^2$. What does this result tell you about the difference between consecutive squares?" **Check Out Questions** 1. Prove algebraically that the sum of any two odd numbers is even. 2. Prove that the square of any odd number is always odd. 3. Prove that $(n+1)^2 - (n-1)^2$ is always a multiple of 4 for any integer n. 4. Prove that the sum of three consecutive integers is always a multiple of 3. 5. **Challenge:** Prove that the difference between the squares of any two consecutive odd numbers is always a multiple of 8.	**Activity 01 (The Geometric Link):** Draw a diagram to visually represent why $(n+1)^2 - n^2 = 2n+1$. How does this visual "L-shape" relate to the algebraic proof? **Activity 02 (Counter-Proof):** Research "Proof by Exhaustion" and "Disproof by Counter-example." Find one value of n that disproves the statement: "n^2 + n + 41 always produces a prime number."	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Key Terminology for the Lesson** • **Identity (\equiv):** A statement that is true for all values of the variable. • **Conjecture:** A mathematical statement that is believed to be true but not yet proven. • **Integer (n):** A whole number (positive, negative, or zero). • **Factor:** A number or expression that divides another exactly. • **Multiple:** The product of an integer and another term (e.g., 4(x+1) is a multiple of 4). **Literacy:** "The Anatomy of a Proof." Write a 200-word explanation for a peer on why "showing it works for n=1, 2, \text{ and } 3" is not a valid mathematical proof. **Oracy:** "Logic Walkthrough." In pairs, one student performs the algebraic steps on a mini-whiteboard while the other must verbally explain the *logical justification* for each step	**Philosophy/Law:** The concept of "Deductive Reasoning"—moving from general rules to a specific, certain conclusion. **Computer Science:** Use of Boolean logic and "if-then" statements in programming algorithms. **Science:** Deriving formulas in Physics (e.g., $v^2 = u^2 + 2as$) using algebraic substitution.

							(e.g., "I am factorising by 2 to demonstrate the result is even").	

Lesson 02

Lesson Title	National Curriculum or Specification Link	Declarative Knowledge	Procedural Knowledge	Diagnostic questions for each phase of the lesson.	Push Yourself Activities	Resources Link	Literacy and Oracy	Cross Curricular
Probability equations	**GCSE Mathematics:** P9 - Calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and solve problems involving algebraic expressions.	* **The Sum of Probabilities:** For mutually exclusive events, Σ P = 1. * **Independent Events:** P(A and B) = P(A) x P(B). * **Dependent Events:** P(A and B) = P(A) x P(B	* Translating word problems into algebraic equations. * Setting up and solving **quadratic equations** derived from double-event tree diagrams (e.g., picking two beads without replacement). * Simplifying algebraic fractions within a probability context. * Rejecting "impossible" solutions (e.g., a negative value for a number of items).	**Check Point 01:** "A bag has x blue counters and 5 red counters. Write an expression for the probability of picking a blue counter." **Check Point 02:** "If the probability of picking two blue counters (with replacement) is 1/9, set up an equation to find x." **Check Out Questions** 1. A box contains n yellow socks and 3 white socks. The probability of picking two yellow socks at random **with replacement** is 16/49. Find n. 2. There are x apples in a crate. 4 are rotten. The probability of picking two "good" apples **without replacement** is 1/2 . Form an equation in the form $ax^2 + bx + c = 0$. 3. Solve the equation from Question 2 to find the total number of apples in the crate. 4. The probability of event A happening is x. The probability of event B happening is x+0.2. If they are independent and P(A \text{ and } B) = 0.15, find x. 5. **Challenge:** In a bag of n counters, 6 are red. The probability of picking two red counters without replacement is ⅓ . Show that $n^2 - n - 90 = 0$ and find n.	**Activity 01 (The General Formula):** Given a bag with n total items and r red items, derive a general algebraic formula for the probability of picking two red items *without replacement*. **Activity 02 (Variable Rates):** Create a probability tree diagram where the branches are labeled with expressions like (2x), (x^2), and (0.5-x). Determine the value of x that makes the total probability sum to 1.	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Key Terminology** • **Mutually Exclusive:** Events that cannot happen at the same time. • **Independent:** The outcome of one event does not affect the other. • **Conditional Probability:** The probability of an event given that another has occurred (e.g., "Without Replacement"). • **Quadratic Equation:** An equation where the highest power of the variable is 2, often appearing in "two-pick" probability problems. • **Outcome Space:** The set of all possible results. **Literacy:** "The Logic of Chance." Write a paragraph explaining why a quadratic equation often yields two solutions, but why	**Biology (Genetics):** Using Punnett squares and probability equations to predict the frequency of genotypes (e.g., Hardy-Weinberg equilibrium: $p^2 + 2pq + q^2 = 1$). **Economics/Finance:** Actuarial science uses complex probability equations to calculate insurance premiums and risk assessment. **History:** The development of probability theory through the correspondence of Pascal and Fermat.

							in a "counters in a bag" problem, one of those solutions is usually discarded. (150 words). **Oracy:** "Equation Dictation." Student A describes a probability scenario (e.g., "I have x sweets, 3 are lemon, I take two without replacement..."). Student B must "translate" this live into a mathematical equation on the board.	

Lesson 03

Lesson Title	National Curriculum or Specification Link	Declarative Knowledge	Procedural Knowledge	Diagnostic questions for each phase of the lesson.	Push Yourself Activities	Resources Link	Literacy and Oracy	Cross Curricular
Linear simultaneous equations	**GCSE Mathematics:** A19 - Solve two simultaneous equations in two variables (linear/linear) algebraically; find approximate solutions using a graph.	* **Simultaneous Equations:** A set of equations that are all true at the same time for the same values of x and y. * **Elimination Method:** Adding or subtracting equations to "cancel out" one variable. * **Substitution Method:** Replacing one variable with an expression from the other equation. * **Graphical Solution:** The point of intersection (x, y) of two straight lines.	* Aligning equations vertically (stacking x, y, and constants). * Multiplying one or both equations to create matching coefficients. * Deciding whether to **Add** or **Subtract** (Rule: "Same Sign Subtract" / SSS). * Substituting the first found value back into the simplest original equation. * Checking the final (x, y) pair in the *other* equation to verify accuracy.	**Check Point 01:** "If 3x + y = 10 and x + y = 4, should you add or subtract the equations to eliminate y?" **Check Point 02:** "I have 2x + 3y = 12 and 4x - y = 5. What is the most efficient first step to make the x coefficients match?" **Check Out Questions** 1. Solve x + y = 15 and x - y = 3. 2. Solve 2x + 3y = 16 and 5x - 3y = 5. 3. Solve 3x + 2y = 19 and x + 4y = 23. 4. A coffee shop sells 2 lattes and 3 teas for £11. They sell 4 lattes and 1 tea for £12. Find the cost of a latte and a tea. 5. **Challenge:** Solve 4x + 3y = 1 and 3x - 5y = 23 (requires multiplying both equations).	**Activity 01 (The Graphical Link):** Draw the lines y = 2x + 1 and x + y = 7 on a coordinate grid. Identify the intersection point. Then, solve the same pair algebraically. Compare the results. **Activity 02 (Infinite or Zero?):** Create a pair of simultaneous equations that have **no solution** (parallel lines) and a pair that have **infinite solutions** (identical lines). Explain your logic.	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Key Terminology** • **Coefficient:** The number in front of the variable (e.g., in 5x, 5 is the coefficient). • **Variable:** The letter representing the unknown value. • **Intersection:** The physical point on a graph where the two lines cross. • **Consistent:** A system of equations that has at least one set of solutions. • **Elimination:** The process of removing one variable to make a solvable one-variable equation. **Literacy:** "The Language of Logic." Write a set of 'Step-by-Step' instructions for a Year 9 student. Use keywords: *Coefficient*, *Variable*, *Eliminate*, and *Substitute*. **Oracy:** "The Error Spotter." Present a pre-written "incorrect" solution to the class. Students must work in pairs to verbally explain exactly where the mistake happened (e.g., "They subtracted a negative	**Business/Economics:** Break-even analysis. Finding the point where the Cost function and Revenue function meet. **Chemistry:** Balancing chemical equations and determining concentrations in mixtures. **Geography:** Comparing population growth models of two different cities to find when they will be equal.

							instead of adding").	

Lesson 04

Lesson Title	National Curriculum or Specification Link	Declarative Knowledge	Procedural Knowledge	Diagnostic questions for each phase of the lesson.	Push Yourself Activities	Resources Link	Literacy and Oracy	Cross Curricular
Simultaneous equations with a quadratic	**GCSE Mathematics (Higher):** A19 - Solve two simultaneous equations in two variables (linear/quadratic) algebraically; find approximate solutions using a graph.	* **The Method:** Substitution is the primary tool (Elimination rarely works here). * **Possible Solutions:** There can be 0, 1 (tangent), or 2 (intersection) pairs of solutions. * **Equation Forms:** One equation is linear (e.g., $y = x + 3$) and the other is quadratic (e.g., $y = x^2$ or $x^2 + y^2 = 25$). * **The Goal:** Create a single quadratic equation in one variable.	* **Rearrange** the linear equation to make x or y the subject. * **Substitute** this expression into the quadratic equation. * **Expand and Simplify** to get the quadratic into the form $ax^2 + bx + c = 0$. * **Solve** the quadratic using factorising or the quadratic formula. * **Find Pairs:** Substitute both x-values back into the *linear* equation to find the corresponding y-values.	**Check Point 01:** "If $y = x - 2$, substitute this into $x^2 + y^2 = 10$. What does the new equation look like before simplifying?" **Check Point 02:** "You have found x = 3 and x = -1. Why must you find two y values to complete the solution?" **Check Out Questions** 1. Solve $y = x + 1$ and $y = x^2 - 5$. 2. Solve $x + y = 7$ and $x^2 + y^2 = 25$ (The intersection of a line and a circle). 3. Find the coordinates of the points where the line y = 2x - 1 meets the curve y = x^2 + x - 7. 4. Prove that the line $y = x - 5$ never meets the circle $x^2 + y^2 = 4$. 5. **Challenge:** Solve $2x - y = 1$ and $x^2 + y^2 = 2$. Give your answers in surd form.	**Activity 01 (The Tangent Challenge):** A line y = kx is a tangent to the circle x^2 + y^2 = 9. Use the discriminant (b^2 - 4ac = 0) to find the possible values of k. **Activity 02 (Visualizing Intersection):** Use a graphing tool to plot y = x^2 - 2 and y = 2x + 1. Zoom in on the intersection points. Now, solve it algebraically and see how the decimal coordinates on the screen match your exact solutions.	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Key Terminology** • **Substitution:** Replacing a variable with an equivalent expression. • **Tangent:** A line that touches a curve at exactly one point. • **Discriminant (b^2 - 4ac):** Used to determine if the line hits the curve 0, 1, or 2 times. • **Coordinate Pair:** Solutions must be written as (x_1, y_1) and (x_2, y_2). • **Simultaneous:** Occurring at the same time; the point where both equations are "satisfied." **Literacy:** "The Tale of Two Points." Write a summary explaining why we substitute the linear into the quadratic and not the other way around. Use the term *efficiency*. (150 words).	**Physics:** Projectile motion. Finding where a ball (parabola) hits a slanted roof (linear slope). **Civil Engineering:** Calculating where a support beam (linear) will intersect with an arched bridge (quadratic curve). **Astronomy:** Calculating the intersection of a planetary orbit and the path of a comet.

							Oracy: "The Logic Chain." In pairs, explain the "Point of Intersection" concept. One student explains what the solution represents on a graph, while the other explains what it represents in the algebra.	

Lesson 05

Lesson Title	National Curriculum or Specification Link	Declarative Knowledge	Procedural Knowledge	Diagnostic questions for each phase of the lesson.	Push Yourself Activities	Resources Link	Literacy and Oracy	Cross Curricular
Transforming Graphs	A12**GCSE Mathematics:** A13 - Sketch translations and reflections of the graph of a given function f(x). Understand the effect of $f(x) + a$, $f(x + a)$, $af(x)$, and $f(ax)$.	* **Translation:** A shift in position without changing shape or orientation. * **Reflection:** A "mirror image" across an axis. * **Inside the Bracket:** Affects the x-coordinates (horizontal) and often acts "opposite" to what is expected. * **Outside the Bracket:** Affects the y-coordinates (vertical) and follows the sign.	* Identifying the vector for translations: a units up for $f(x)+a$ and a units left for $f(x+a)$. * Mapping coordinates from a base graph to a transformed graph (e.g., (x, y) to (x, -y)). * Sketching a transformed quadratic or cubic when the original turning point is known. * Describing a transformation fully when given two graphs.	**Check Point 01:** "The point (3, 5) lies on $y = f(x)$. What are the new coordinates of this point on the graph $y = f(x) - 2$?" **Check Point 02:** "How does the graph of $y = f(x+4)$ differ from $y = f(x)$? (Direction and magnitude)." **Check Out Questions** 1. Describe the transformation that maps $y = x^2$ onto $y = (x-3)^2$. 2. The graph of $y = f(x)$ has a minimum point at (2, -4). Write the coordinates of the minimum point on $y = f(x+1) + 5$. 3. Sketch the graph of $y = \sin(x)$ and then sketch $y = \sin(x) + 1$ on the same axes. 4. If $y = f(x)$ is reflected in the x-axis, what is the new equation in terms of f(x)? 5. **Challenge:** The curve $y = x^2 - 4x + 1$ is translated by the vector $\binom{0}{3}$. Write the equation of the new curve in the form $y = ax^2 + bx + c$.	**Activity 01 (The Combined Shift):** Given a function f(x), sketch $y = -f(x+2)$. This requires a reflection and a translation. Does the order in which you perform them matter? Prove your answer with a sketch. **Activity 02 (Trig Transformations):** Using a dynamic geometry tool (like Desmos), investigate how changing 'a' in $y = a\sin(x)$ affects the amplitude, and how 'b' in $y = \sin(bx)$ affects the period.	Slides Worksheet Differentiated Worksheet Check Out | Google Form	• **Key Terminology:** **Mapping:** How one set of points "moves" to another. **Invariant Point:** A point on a graph that remains unchanged after a transformation (e.g., the y-intercept during a horizontal stretch). **Function Notation:** Using f(x) to represent any curve or equation. **Asymptote:** A line that a curve approaches but never touches; these also move during translations. **Literacy:** "Inside vs. Outside." Write a short mnemonic or "rule of thumb" guide for a student who keeps confusing $f(x+a)$ with $f(x)+a$. Explain the "input vs. output" logic. **Oracy:** "Transformation Taboo." One student describes a transformation (e.g., "The graph moves 3 units left") without using the words 'shift', 'move', or 'plus'. The partner must write the correct function notation (e.g., $f(x+3)$).	**Physics:** Wave interference and phase shifts. Moving a wave graph horizontally represents a "phase shift" in sound or light waves. **Music Technology:** Synthesizers use envelope transformations to change the pitch or volume over time, which are essentially functions being stretched or shifted. **Architecture:** Using symmetry and reflections to create aesthetically pleasing patterns in building facades.

Term 5 Year 10 [Higher Tier Maths] | Shape

Topic Overview: This term, we shift our focus to Shape, Space, and Measures, moving from abstract calculations to the physical visualization of objects. You will learn to represent 3D objects in 2D using Plans and Elevations and master the four Geometric Transformations.
A key challenge this term is precision. Whether you are performing a Rotation around a specific coordinate or using a compass for Loci, a 1mm error can be the difference between a correct and incorrect answer. We will also combine geometry with trigonometry through Bearings, requiring a firm grasp of both angle rules and directional accuracy.

Prior & Subsequent Knowledge

1. Prior Knowledge (The Foundation)

- Coordinate Geometry: Mastery of (x, y) coordinates is essential for defining centers of rotation and translation vectors.
- Angle Rules: A deep understanding of parallel line theorems (alternate and corresponding angles) is vital for calculating bearings.
- Scale and Ratio: Understanding how to simplify ratios to use scale factors in maps and drawings.
- Properties of 2D Shapes: Recognizing the symmetry and side lengths of squares, triangles, and regular polygons.

2. Related Knowledge (Current GCSE Context)

- Transformations: * Reflection: Flipping a shape over a mirror line (e.g., y = x).
    - Rotation: Turning a shape around a center point (requires angle, direction, and center).
    - Translation: Moving a shape using a vector
    - Enlargement: Changing size via a scale factor and center (including fractional and negative factors).
- Plans and Elevations: Drawing the "Bird's eye view" (Plan) and side/front views of 3D prisms.
- Construction and Loci: Using a compass and ruler to find regions that satisfy specific conditions, such as being equidistant from two points.
- Bearings: Measuring three-digit angles clockwise from North (e.g., 045 degrees).

3. Subsequent Knowledge (The Next Steps)

- Similarity and Congruence: Using enlargement theory to prove two shapes are mathematically similar (Area = SF^2, Volume = SF^3).
- Vectors: Translating geometry into algebraic notation; understanding how shapes move in a 2D plane through vector addition.
- 3D Trigonometry: Using elevations and plans to identify right-angled triangles within complex 3D shapes to find missing lengths or angles.
- Design and Engineering: These topics form the basis of CAD (Computer-Aided Design) and architectural mapping.

Lesson 01

Lesson Title	National Curriculum or Specification Link	Declarative Knowledge	Procedural Knowledge	Diagnostic questions for each phase of the lesson.	Push Yourself Activities	Resources Link	Literacy and Oracy	Cross Curricular
Plan and Elevation	G13	• Plan and Elevation are two-dimensional representations of three-dimensional objects. They involve looking at a three dimensional object from the top, the front and the side. The faces and edges that are seen from the top, front or side, are then drawn as seen.	Draw plans and elevations	**Check Point 01:** **Check Point 02:** **Check Out Questions (05 questions):** Which view of an object shows its length and width from above? a) Front Elevation b) Side Elevation c) Plan View d) Isometric View If you are looking at the front of a house, which dimensions are you typically seeing in its front elevation? a) Length and Depth b) Width and Height c) Depth and Height d) Overall Volume A standard brick has dimensions of 21.5 cm (length) × 10.25 cm (width) × 6.5 cm (height). What would its plan view look like, including dimensions? A right circular cone has a base diameter of 8 cm and a perpendicular height of 10 cm. If you view the cone directly from its side, what shape and dimensions would its front elevation be? A square-based pyramid has a base side length of 6 cm and a slant height of 8	**Activity 01:** • **Task:** Provide students with two or three *orthographic projections* (a *plan view* and two *elevations*) of a moderately complex 3D object (e.g., a step block, an L-shaped prism, an object with a cut-out). • **Instructions:** "Given these *plan* and *elevation* views, sketch an *isometric view* or a 3D perspective drawing of the object. You must label the *front*, *side*, and *top* views on your initial drawings and ensure your 3D sketch accurately reflects all visible and implied *dimensions* from the given views." **Activity 02:** • **Task:** "Design a small, multi-level structure (e.g., a two-story shed, a complex birdhouse, a futuristic living pod). It must have at least two distinct levels or sections." • **Challenge:** If possible, build a small physical model of your structure based purely on your drawn plans and elevations, or have a	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Key Terminology:** Plan Elevation Front Elevation Side Elevation Top View Orthographic Projection 2D Representation 3D Object Viewpoint Scale Dimensions (Length, Width, Height) Perpendicular Parallel Isometric View (for comparison/contrast) Hidden Lines (Advanced) **Literacy:** **Title: "Blueprint Basics: Communicating 3D in 2D"** **Task:** Imagine you are writing a simple guide for a "Young Builders' Club" newsletter. Your task is to explain what *plans* and *elevations* are and why they are essential tools for anyone designing or building objects, from a simple toy house to a complex building. Your article should be	**Design & Technology (D&T) / Engineering:** • **Architecture & Product Design:** Fundamental for designing, communicating, and manufacturing any physical product or structure. Engineers and designers constantly use plans and elevations. • **CAD (Computer-Aided Design):** The digital representation of objects in CAD software directly uses the principles of orthographic projection to generate various views. • **Construction:** Builders read and interpret plans and elevations to construct buildings accurately. **Art & Design:** • **Technical Drawing:** Orthographic projections are a core skill in technical drawing, used to precisely represent objects. • **Sculpture/3D Art:** Artists sometimes use similar principles to

				cm. What shape and dimensions would its side elevation be? An object has a plan view that is a circle and a front elevation that is a rectangle. What kind of 3D solid is it most likely to be? A scale on a map is given as 1:500. If a swimming pool measures 10 cm by 5 cm on the map, what are its actual dimensions in meters?	peer try to build it from your drawings to test their accuracy.		200-250 words. **Oracy:** **Title: "Build It with Words: Explaining a 3D Object"** **Task:** Work in pairs. You have a simple 3D object (e.g., a small block model, a stacked set of cubes, a simple carton) that your partner cannot see. Your task is to describe its *plan* and *elevations* verbally so your partner can sketch it. **Presentation:** Conduct a structured verbal description and sketching session (3-4 minutes). Student A describes, and Student B sketches and asks clarifying questions. Afterwards, compare the sketch to the actual object.	plan their 3D creations from different angles. ● **Perspective Drawing:** While different, understanding orthographic views enhances the comprehension of spatial relationships for perspective.

Lesson 02

Lesson Title	National Curriculum or Specification Link	Declarative Knowledge	Procedural Knowledge	Diagnostic questions for each phase of the lesson.	Push Yourself Activities	Resources Link	Literacy and Oracy	Cross Curricular
Reflection	**GCSE Mathematics:** G7 - Describe, sketch and draw using conventional terms and notations: reflections... including using a line of reflection (mirror line) given by an equation.	* **Reflection:** A transformation where every point is mapped to a point the same distance from the mirror line on the opposite side. * **Mirror Line Equations:** x=a (vertical), y=b (horizontal), y=x (diagonal), and y=-x (negative diagonal). * **Object vs. Image:** The original shape is the object; the result is the image. * **Invariant Points:** Points that lie exactly on the mirror line do not move.	* Drawing mirror lines from their algebraic equations. * Counting squares perpendicular to the mirror line to find the position of the image. * Describing a reflection fully by identifying the equation of the mirror line. * Using a "perpendicular bisector" logic for diagonal reflections.	**Check Point 01:** "What is the equation of the line that passes through (3, 0), (3, 5), and (3, -10)?" **Check Point 02:** "If a point at (2, 4) is reflected in the line y=x, where does it land?" **Check Out Questions** 1. Reflect Triangle A in the line y = 2. 2. Reflect Shape B in the line x = -1. 3. Describe fully the transformation that maps Shape C onto Shape D if the mirror line passes through (0,0) and (5,5). 4. A point at (a, b) is reflected in the x-axis. What are the new coordinates? 5. **Challenge:** Reflect the curve y = x^2 in the line y = 0. What is the equation of the new curve?	**Activity 01 (Double Reflection):** Reflect a shape in the line x=2, and then reflect that image in the line x=5. What single transformation (translation) would have moved the shape from start to finish? Can you find a rule for the distance? **Activity 02 (The y=mx+c Challenge):** Reflect a simple point in a line that isn't horizontal, vertical, or y=x (e.g., y = 2x + 1). How do gradients and perpendicular lines help here?	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Key Terminology** • **Perpendicular:** At a 90 o angle to the mirror line. • **Congruent:** The object and image are the same size and shape (reflection is an isometric transformation). • **Orientation:** The "direction" the shape faces (this changes in a reflection). • **Vector:** While usually for translations, a reflection can be thought of as a series of movements perpendicular to the mirror. **Literacy:** "The Anatomy of Symmetry." Write a guide for a younger student explaining the difference between x=3 and y=3. Why is x=3 a vertical line even though the x-axis is horizontal? **Oracy:** "Describe the Flip." In pairs, Student A describes a reflection (e.g., "Reflect the square in the line y=-x") while Student B, who	**Art & Design:** Using "Reflectional Symmetry" in logo design (e.g., Starbucks or Apple) and Islamic geometric patterns. **Physics (Optics):** Law of Reflection: The angle of incidence equals the angle of reflection (i=r). **Biology:** Bilateral symmetry in organisms (humans, butterflies, etc.).

							cannot see the grid, must predict the final coordinates of the vertices.	

Lesson 03

Lesson Title	National Curriculum or Specification Link	Declarative Knowledge	Procedural Knowledge	Diagnostic questions for each phase of the lesson.	Push Yourself Activities	Resources Link	Literacy and Oracy	Cross Curricular
Enlargement	G7	An enlargement increases or decreases the size of the shape (object). The new shape (image) is a similar shape. The increase in size from one shape to another is called a scale factor. The position of the enlarged shape is determined by a point	Enlarge shapes by fractional and negative scale factors	**Check Point 01:** **Check Point 02:** **Check Out Questions (05 questions):**	**Activity 01:** **Problem Solving:** A rectangle ABCD has vertices A(1, 2), B(4, 2), C(4, 4), and D(1, 4). • Enlarge the rectangle by a scale factor of 2 with the centre of enlargement at (0, 0). State the coordinates of the image A'B'C'D'. • Enlarge the *original* rectangle ABCD by a scale factor of 21	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Key Terminology:** Transformation Enlargement Object (Pre-image) Image Centre of Enlargement Scale Factor Positive Scale Factor Negative Scale Factor Invariant Point Congruent Similar Ratio Area Scale Factor	• **Art & Design:** Artists use enlargement to scale up **sketches for murals, paintings**, or **sculptures** . Designers enlarge logos, blueprints, and patterns

		called the centre of enlargement.			with the centre of enlargement at (1, 2). State the coordinates of the image A''B''C''D''. ● What relationship exists between the area of A'B'C'D' and the area of ABCD? **Activity 02:** Research and explain the effects of a **negative scale factor** in an enlargement. How does it affect the position and orientation of the image relative to the object and the centre of enlargement? Provide a clear example on a coordinate grid (described in words) to illustrate your explanation.		Volume Scale Factor Coordinates Origin **Literacy:** You are writing a helpful guide for a fellow student on how to perform an **enlargement** of a shape on a coordinate grid. Explain what an enlargement is, how it differs from other transformations like translation, reflection, and rotation. Detail the two crucial pieces of information needed for an enlargement: the **centre of enlargement** and the **scale factor**. Provide a clear, step-by-step example using a simple polygon, demonstrating how to find the coordinates of the enlarged image when the centre is the origin and when it is not. **Oracy:** Prepare a short, interactive presentation (2-3 minutes) for a group of young aspiring artists or designers. Explain the concept of **enlargement** and why it's more than just "making something bigger." Use a physical object (e.g., a small toy or a drawing) and	for various applications. ● ● **Architecture & Engineering:** Architects and engineers create **scale drawings and models** of buildings, bridges, and machines. Understanding enlargement is critical for accurately translating these designs to real-world dimensions and for anticipating material requirements. ● ● **Photography:** The process of **zooming in or out** on a camera lens is an application of enlargement. Understanding scale factors helps

							demonstrate how choosing a different **centre of enlargement** changes the position of the enlarged image, even with the same **scale factor**. Discuss how artists might use enlargement to scale sketches for murals, or how designers might scale logos for different applications (e.g., business card vs. billboard).	photographers compose shots and interpret the perspective. Printing photos at different sizes also involves enlargement. • • **Biology (Microscopy):** When viewing specimens under a **microscope** , the magnification power is essentially a scale factor, enlarging the object for detailed observation. • • **Mapping/Cartography:** Maps are **scaled-down representations** of real-world areas. Understanding scale factors is essential for interpreting distances and areas on maps

								and for creating accurate cartographic representations. •

Lesson 04

Lesson Title	National Curriculum or Specification Link	Declarative Knowledge	Procedural Knowledge	Diagnostic questions for each phase of the lesson.	Push Yourself Activities	Resources Link	Literacy and Oracy	Cross Curricular
Translations	G7	A translation moves a shape from one location to another. The new shape is congruent to the original shape. The size of the shape does not change, and the shape is not reflected or rotated	Translate by a vector	**Check Point 01:** **Check Point 02:** **Check Out Questions (05 questions):** A point P has coordinates $(5,3)$. It is translated by the vector $\begin{pmatrix}-2\\4\end{pmatrix}$. What are the coordinates of the image point P'? Point Q has coordinates $(-1,-7)$. It is translated by the vector $\begin{pmatrix}6\\2\end{pmatrix}$. What are the coordinates of the image point Q'? A point R at $(2,8)$ is translated to its image R' at $(-3,5)$. What is the translation vector? A rectangle has a vertex at B$(4, -1)$. If the rectangle is translated by the vector $\begin{pmatrix}-5\\-3\end{pmatrix}$, what are the coordinates of the translated vertex B'? A point Y' has coordinates $(-1,9)$. It is the image of point Y after a translation by the vector $\begin{pmatrix}-4\\5\end{pmatrix}$. What are the coordinates of the original point Y? Which of the following properties is **always** preserved during a translation? a) Size of the shape b) Orientation of the shape c) Position of the shape d) Both a and b A point N has coordinates $(0,0)$. It undergoes two consecutive translations: first by $\mathbf{t_1} = \begin{pmatrix}3\\-2\end{pmatrix}$, and then by $\mathbf{t_2} = \begin{pmatrix}-1\\5\end{pmatrix}$. What are the final coordinates of the image point N''?	**Activity 01:** **Problem Solving:** A quadrilateral has vertices at P(2, 1), Q(5, 1), R(6, 4), and S(3, 4). • Translate the quadrilateral by the vector $\begin{pmatrix}-4\\2\end{pmatrix}$. Write down the coordinates of the image P'Q'R'S'. • Describe the single translation that would map the image P'Q'R'S' back onto the original quadrilateral PQRS. • If the original quadrilateral PQRS is translated by vector a and then by vector b, what single vector represents the combined translation? **Activity 02:** **Investigation:** Research and explain how **translations** are used in **computer programming** to move objects on a screen. Discuss how game engines or graphics libraries implement translations using coordinate transformations. Provide a conceptual example of how a character's position might be updated in a simple 2D game	Slides Worksheet Differentiated Worksheet Check Out | Google Form	• **Key Terminology:** • Transformation • Translation • Object (Pre-image) • Image • Vector • Column Vector • Horizontal Movement • Vertical Movement • Direction • Magnitude • Invariant Point (though no points are invariant in a non-zero translation) • Congruent • Coordinates • Origin • • **Literacy:** • You are writing a simple instruction guide for a robot that can move objects on a grid. Write a clear and concise explanation of what a **translation** is. Explain how a **column vector** is used to describe	• **Computer Science/Game Development:** Translations are fundamental in **2D and 3D computer graphics** . Game characters move, objects slide, and camera views shift using translation vectors. • • **Physics:** In **kinematics**, translation describes the **linear motion** of objects (e.g., a car moving along a straight road, a ball rolling without spinning). Vectors are used to represent displacement, velocity, and acceleration. • • **Robotics:** Programming

					using translation vectors.		a translation, detailing what the top and bottom numbers represent. Provide a step-by-step example using a simple shape (e.g., a triangle) on a coordinate grid (which you can describe in words) and show how to find the coordinates of the translated image using a given translation vector. • • **Oracy:** • • Prepare a short, interactive demonstration (2-3 minutes) for a group of younger students to illustrate the concept of translation. Use a physical object (e.g., a toy car, a block) on a large grid drawn on the floor or a table. Demonstrate how to move the object a specific number	robots to move from one point to another in a workspace involves precise **translations**. Engineers use translation vectors to command robotic arms or mobile robots to reach specific locations. • • **Art & Design (Pattern Making):** In textile design, wallpaper design, or creating repeating patterns, **translations** are used to shift a basic motif across a surface to create a continuous design without rotation or reflection. • • **Logistics/Supply Chain Management:** Understanding translation (movement of

							of units horizontally and vertically without rotating or reflecting it. Explain that the object's size and orientation remain the same. Ask the audience to describe the "move" using simple directional language (e.g., "3 steps right, 2 steps up"). •	goods) is essential for optimizing **delivery routes**, **warehouse layouts**, and the efficient flow of materials from one point to another. •

Lesson 05

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Rotation	**GCSE Mathematics:** G7 - Identify, describe and construct rotations, including identifying the center, angle, and direction of rotation.	* **Center of Rotation:** The fixed point around which a shape turns (given as a coordinate). * **Angle:** Usually 90 o, 180 o, or 270 o. * **Direction:** Clockwise or Anticlockwise (180 o does not require a direction). * **Congruence:** The image remains the same size and shape as the object.	* Using tracing paper to perform rotations: trace shape, pin the center, and turn. * Describing a rotation fully by finding the center, angle, and direction. * Rotating a shape algebraically (e.g., 90 o clockwise around the origin maps (x, y) \to (y, -x)). * Identifying the center of rotation using perpendicular bisectors of	**Check Point 01:** "If you rotate a shape 90 o clockwise, which other rotation would land it in the exact same place?" (270 o anticlockwise). **Check Point 02:** "A point at (0, 4) is rotated 180 o around the origin (0, 0). Where does it land?" **Check Out Questions** 1. Rotate Shape A 90 o clockwise about the point (1, 2). 2. Rotate Shape B 180 o about the origin (0, 0). 3. Describe fully the transformation that maps Shape C to Shape D (identify all three	**Activity 01 (Rotational Symmetry):** Create a shape that has rotational symmetry of order 4 but no lines of reflectional symmetry. Explain why these two properties are independent. **Activity 02 (The Composite Spin):** Rotate a shape 90 o about (0,0), then rotate that *image* 90 o about the point (2,2). Is the result the same as a single 180 o rotation? Prove it with a sketch.	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Literacy:** "The Manual." Write a set of instructions for a student who has lost their tracing paper. How can they use a ruler and a compass (or just coordinates) to rotate a point 90 o? **Oracy:** "The Navigator." One student closes their eyes. The other student must guide them to rotate a physical object on a desk by giving precise instructions: "Rotate 90 degrees clockwise	**Engineering:** Gears and cogs. Understanding how a 90 o turn in one gear affects the rotation of another. **Geography:** Compass bearings and navigation. A bearing of 090 o is a 90 o clockwise rotation from North. **Astronomy:** The rotation of planets on their axes and their orbits around the sun.

			lines joining corresponding points.	components). 4. A square is rotated 90 o around its own center. How many invariant points are there? 5. **Challenge:** A point (x, y) is rotated 90 o anticlockwise about the origin. Write its new coordinates in terms of x and y.			around the bottom-left corner."	0

Lesson 06

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Bearings and scale drawing	G15	In mathematics, a bearing is an angle measured clockwise from north. . It specifies the direction from one point to another point using an angle measure, and is usually given as a three-figure bearing.	Draw scale drawings Solve problems involving bearings	**Check Point 01:** **Check Point 02:** **Check Out Questions (05 questions):** A boat sails from point A to point B on a bearing of 045◦. In what direction does the boat travel? If the bearing from town P to town Q is 080◦, what is the bearing from town Q back to town P? A map has a scale of 1:50,000. If the distance between two villages on the map is 3 cm, what is the actual distance between the villages in kilometers? Town B is directly East of Town A. What is the bearing of Town B from Town A? You need to draw a school field	**Activity 01:** **Problem Solving:** A ship leaves Port A and sails on a bearing of 070◦ for 50 km to Port B. From Port B, it then sails on a bearing of 160◦ for 80 km to Port C. • Using a scale of 1 cm = 10 km, draw a scale diagram to represent the ship's journey. • From your diagram, determine the **bearing of Port A from Port C** and the **direct distance between Port A and Port C**. **Activity 02:**	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Key Terminology:** Bearing True Bearing Compass Bearing North Line Clockwise Degrees (◦) Scale Scale Factor Ratio Actual Distance Map Distance Plotting Navigation Protractor Ruler **Literacy:** You are writing a practical guide for a new scout troop learning **basic navigation**. Explain how to take and plot a **three-figure bearing** from one point to	• **Geography:** Bearings and scale drawings are fundamental for **map reading, navigation, fieldwork**, and understanding **geospatial data** . They are used for plotting routes, locating features, and measuring distances on maps. • • **Outdoor Education/Scouting:** These skills are essential for **orienteering, hiking**, and **survival training** , enabling individuals to navigate unknown

				that is 100 meters long. If you want the drawing to be 20 cm long, what scale should you use for your drawing? (Express as 1:n) From a lighthouse L, a ship S is on a bearing of 135° and is 5 km away. a) Sketch a diagram showing the lighthouse, the ship, and the bearing. b) What is the bearing of the lighthouse L from the ship S? An airplane flies from Airport A on a bearing of 090° for 150 km to Airport B. Then, it flies from Airport B on a bearing of 180° for 200 km to Airport C. On a scale drawing where 1 cm represents 50 km: a) How long would the line segment from A to B be on your drawing? b) What is the bearing of Airport A from Airport C?	**Investigation:** Research different types of **compasses** (e.g., traditional magnetic compass, prismatic compass, digital compass) and explain how each is used to take bearings in the field. Compare their accuracy and practical uses. How do these tools relate to the mathematical concept of bearings?		another on a map. Include clear instructions on how to draw a north line, use a protractor correctly, and measure the angle clockwise. Then, explain how to use the map's **scale** to convert a measured distance on the map into a real-world distance. Use a simple, relatable scenario, like finding a hidden treasure. **Oracy:** Prepare a short, interactive demonstration (2-3 minutes) for a group of fellow students on how to accurately use a **scale** on a map or drawing. Use a large map (or a printout of one) and a ruler. Demonstrate how to read different types of scales (e.g., ratio scale like 1:50,000, or a bar scale). Explain the importance of scale for accurate measurement and discuss how an incorrect scale can lead to significant errors in real-world applications (e.g., building too big/small, misjudging travel time).	terrain safely and efficiently. • **Aviation/Maritime Studies:** Pilots and sailors rely heavily on bearings for **navigation** , plotting courses, avoiding obstacles, and ensuring safe travel over long distances. Scale drawings are used in planning flight paths and shipping routes. • **Architecture/Engineering (Early Stages):** While detailed blueprints use specific dimensions, early conceptual **site plans** or **urban planning sketches** often involve scale drawings to represent proposed structures and their relation to the surrounding environment.

Lesson 07

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Constructions and Loci	G2	Loci are a set of points with the same property. Loci can be used to accurately construct lines and shapes.	Use loci to solve problems Construct triangles Bisect a line Construct the shortest distance from a point to a line using a ruler and compass Bisect an angle using a ruler and compass only Construct angles and triangles using a ruler and compass	**Check Point 01:** **Check Point 02:** **Check Out Questions (05 questions):** What is the locus of all points that are exactly 5 cm away from a point X? Describe the path traced by a point that moves so that it is always equidistant from two fixed points A and B. If you have two straight lines, L1 and L2, that intersect, what is the locus of all points that are equidistant from L1 and L2? You are asked to construct a line that passes through the midpoint of a line segment AB and is perpendicular to AB. What is the common name for this construction? A builder needs to place a security camera so that it covers an equal viewing angle on two walls that meet at a corner. Which geometric construction would help determine the best position for the camera? A goat is tethered by a 3-meter rope to a post located at the corner of a	**Activity 01:** **Problem Solving:** A triangular plot of land has vertices A, B, and C. A well is to be dug on this plot such that it is **equidistant from sides AB and AC**, and also **equidistant from points B and C**. • Describe the construction lines you would draw on a map to locate the exact position of the well. • Explain which two loci would need to be found to pinpoint the well's location. **Check Point 01** Bisect an 8cm straight line **Activity 02:** 1. **Investigation:** Research and explain how to construct an **equilateral triangle** and a **regular**	Slides Worksheet Differentiated Worksheet Check Out | Google Form	**Key Terminology:** Construction Locus (Loci - plural) Perpendicular Bisector Angle Bisector Equidistant Fixed Point Fixed Line Compass Ruler (Straightedge) Arc Intersect Region Inscribed Circumscribed **Literacy:** You are preparing a step-by-step instruction manual for a new student learning geometric constructions. Choose two fundamental constructions: the perpendicular bisector of a line segment and the angle bisector of an angle. For each, write clear, precise, and numbered instructions, detailing how to perform the construction using only a compass and a straightedge. You should also explain *why* each construction works (e.g., in terms of being equidistant from points/lines). **Oracy:** Prepare a short,	• **Architecture & Urban Planning:** Loci are crucial for **site planning**, **zoning regulations**, and determining optimal locations for facilities (e.g., emergency services, public parks) that need to be equidistant from certain areas or avoid others. Constructions are used in precise drawing. • • **Geography:** Geographers use loci concepts for defining **catchment areas**, **service areas** (e.g., nearest fire station), or **safe zones** around natural hazards. They use construction techniques for creating accurate maps and overlays. • • **Engineering (Civil & Mechanical):** Engineers use constructions for precise **technical drawings** and

				square garden with 5-meter sides. Draw or describe the boundary of the area the goat can graze within the garden. You have performed a construction where you opened your compass to a certain radius, placed the compass point at the vertex of an angle, drew an arc intersecting both arms, then from these intersection points, drew two more arcs that intersect inside the angle. Finally, you drew a line from the vertex through this intersection point. What construction did you complete?	**hexagon** using only a compass and a straightedge. Explain the underlying geometric principles that make these constructions possible, relating them to fixed points and distances. **Check Point 02:** Construct a 15 degree angle.		interactive presentation (2-3 minutes) for a group of urban planners or architects, explaining the practical applications of **loci** in real-world planning and design. Use a large piece of paper or a whiteboard to draw simple scenarios. For example, demonstrate finding the ideal location for a new hospital equidistant from three towns, or the safe zone around a hazardous building. Explain how understanding loci helps in defining regions, optimizing placement, and ensuring safety or fairness.	understanding **tolerances** in designs. Loci help in determining the range of motion for mechanical parts or safe operating zones for machinery. • • **Computer Science (Computational Geometry):** Algorithms for tasks like **pathfinding**, **nearest neighbor searches**, and **Voronoi diagrams** (which define regions based on proximity to points) are based on the mathematical principles of loci.