Topic	Rationale	Knowledge Acquisition	Key Vocabulary	Skills and Enrichment
11. Multiplicative Reasoning	**This must be taught after unit 4**	Find a value following depreciation. Calculate compound interest. Find a value after repeated percentage decrease. Solve a problem involving compound interest. Calculate using rates of pay. Calculate using rate of water flow. Calculate density. Convert between units of density. Calculate mass given the density and dimensions of an object. Calculate pressure. Convert between units of speed for comparison. Recognise direct proportion. Convert between currencies. Solve problems involving direct proportion. Calculate with inverse proportion.	**Depreciation, interest, simple, compound, density, mass, volume, pressure, force, area, inverse**	**Police Accident Investigation Teams use kinematics formulae to work out the speed of cars involved in serious accidents.** **Repeated proportional change can be used to predicted changes in population size over short periods of time.** **Pressure and density are both examples of compound measures. Water pressure increases with depth and so is an important factor to consider in scuba diving.** **Speed and time are in inverse proportion. The greater the speed, the shorter the time taken to travel a journey.**

Topic	Rationale	Knowledge Acquisition	Key Vocabulary	Skills and Enrichment
12. Congruence	**Students must be familiar with KS3 work on squares, cubes, square roots and cube roots**	Identify congruent triangles, giving reasons. Use different conditions of congruence to prove the congruence of two triangles. Prove triangles are similar using SSS and AAA. Work out missing lengths in similar quadrilaterals. Prove similarity in two triangles and find missing lengths. Prove similarity in two triangles and find missing lengths. Find missing area and perimeter of similar shapes, given length and area information. Find missing volume of similar solids, given length and volume information. Find missing volume of similar solids, given area and volume information.	**Congruence, similar, corresponding**	**All £1 coins are congruent. This means that coin machines can recognise their value.** **A proof is a logical argument that shows something is true. Some mathematicians dedicate their lives to writing proofs.** **We use similarity to draw floor plans to scale.** **You can work out the height of a skyscraper using similar triangles.**

Topic	Rationale	Knowledge Acquisition	Key Vocabulary	Skills and Enrichment
13. More trigonometry	**Right angled trigonometry in unit 5 needs to be covered before this particular unit. A quick recap on this before teaching unit 13 will support with problem solving questions.**	Find the area of a triangle using two sides and the included angle.	**Sine, cosine, tangent, trigonometry, formula, rearrange**	**The *caesium fountain* atomic clock at the National Physical Laboratory in the UK is the most accurate in the world. In 138 million years it is unlikely to be a second out.** **In computer games, the face, body, movement and even the clothing of a character are almost entirely defined by trigonometry.** **Ultrasound scanners use trigonometry to construct pictures of babies in the womb.**
		Use the cosine rule to find the length of a side, without prompting for which rule to use.		
		Use the sine rule to find the length of a side, without prompting for which rule to use.		
		Use the cosine rule to calculate an angle, without prompting for which rule to use.		
		Use the sine rule to calculate an angle, without prompting for which rule to use.		
		Calculate the upper and lower bounds for the length of a side in a right-angled triangle		
		Sketch the graph of tan θ.		
		Find angles, given a value of cos x.		
		Match given trigonometric graphs with their equations.		
		Solve a trigonometric equation without being given a graph.		
		Calculate of the length of a diagonal in a cuboid.		
		Use trigonometry in 3D to calculate unknown lengths.		

Topic	Rationale	Knowledge Acquisition	Key Vocabulary	Skills and Enrichment
14. Further Statistics	**Students need to recap basic work on averages from KS3 before studying this unit of work.**	Understand what makes a good sample. Draw a cumulative frequency table and diagram. Use the diagram to estimate the median and interquartile range. Use the diagram to estimate the number of data items more than a given value. Interpret box plots and compare distributions. Describe a stratified sample. Use a random number list to select data items. Draw a box plot. Identify and discuss outliers. Draw a histogram. Use it to estimate the mean, median and mode, and the number of data items more than a given value.	**Sampling, bias, census, population, cumulative frequency, median, interquartile range, interpret, compare, box plot, stratify, outlier, histogram, estimate**	**To understand our behaviour, scientists often need to know our opinions. As they can't ask all 7 billion of us, they need to sample us.** **Having a 'running total' of data helps you work out how many data values are less than or greater than a given number.** **Simple diagrams help us to interpret and compare data.** **For data grouped in unequal class intervals, you need a histogram.**

Topic	Rationale	Knowledge Acquisition	Key Vocabulary	Skills and Enrichment
15. Equations and Graphs	**A recap of unit 9 may be necessary before teaching this unit**	Interpret a pair of simultaneous equations as a pair of straight lines and their solution as	**Simultaneous, quadratic, function, inequality, region, factorising, quadratic, cubic, linear, iterative, real, imaginary**	**In 200 BC the Chinese discovered a method for solving simultaneous equations.** **In the novel *Animal Farm* by George Orwell, the Pigs declare: ' All animals are equal, but some animals are more equal than others'. Can they be right?** **The ancient Egyptians left behind a scroll showing a solution to a quadratic equation. It may be 4000 years old.**
		Identify the graph of a quadratic function, by factorising, identifying the roots, the y-intercept and the turning point.		
		Shade the area represented by two inequalities.		
		Expand a cubic expression. Identify the roots of a cubic graph.		
		Sketch a graph of a quadratic equation.		
		Use the turning point of a quadratic function to find a possible equation.		
		Calculate an area enclosed by two inequalities.		
		Find the distance between the two points at which a quadratic and linear graph intercept.		
		Find the values that satisfy an inequality by factorising.		
		Identify whether equations have real roots.		
		Use an iterative formula to find the real solution.		

Topic	Rationale	Knowledge Acquisition	Key Vocabulary	Skills and Enrichment
16. Circle Theorems	**Recap of KS3 angles work (angles in parallel lines in particular) may be useful here.**	Use properties of radii in circles to work out unknown angles.	**Radius, tangent, radii, chord, segment, diameter, sector, arc, isosceles, minor, major**	**A theorem is a rule that can be proved by a chain of reasoning.** **The word 'tangent' comes from the Latin verb 'tangere, which means to touch.** **The Greek mathematician Euclid proved many results about circles in the 13 volumes of his *Elements,* which he wrote around 300BC.**
		Use properties of tangents and radii to calculate unknown angles.		
		Use properties of chords to find unknown angles and lengths.		
		Use properties of angles subtended by the same arc and in cyclic quadrilaterals to work		
		Use the angle in a semicircle angles subtended by the same arc to work out unknown angles.		
		Use the angle in a semicircle to work out unknown angles.		
		Use properties of radii and tangents to work out unknown angles.		
		Use the alternate segment theorem to calculate unknown angles.		
		Use circle theorems to prove an inscribed triangle is isosceles.		
		Find the equation of the tangent to a circle, given the point at which the tangent meets		

Topic	Rationale	Knowledge Acquisition	Key Vocabulary	Skills and Enrichment
17. More algebra	**Unit 9 algebraic skills are a pre-requisite for this unit.**	Simplify surds.	**Surds, rationalise, inverse, function, domain, range, formula, subject, algebraic, factorise, solve, simplify, equation, identity**	**Physicists rearrange complex formulae in order to find important measures.** **Bridge designers use algebraic fractions when making sure their designs are structurally safe.** **Aerospace engineers use and simplify algebraic fractions when designing planes.** **Opticians use algebraic fractions use algebraic fractions when working out a lens prescription.** **Pharmacists use algebraic fraction equations to calculate the correct dosage when issuing medication.**
		Rationalise denominators.		
		Find the inverse of given functions.		
		Evaluate functions by substituting in values.		
		Rearrange a formula involving a fraction and a root.		
		Rearrange a formula where the new subject appears more than once.		
		Rearrange a formula involving a fraction and a root.		
		Evaluate a function and solve a function equal to zero.		
		Simplify algebraic fractions by factorising.		
		Add and subtract algebraic fractions, first finding the common denominator.		
		Multiply and divide algebraic fractions by factorising and cancelling.		
		Solve an equation involving algebraic fractions with variables in the denominators.		
		Show that an identity is true.		
		Prove a statement is untrue by identifying a counter-example.		

Topic	Rationale	Knowledge Acquisition	Key Vocabulary	Skills and Enrichment
18. Vectors	**Needs to be taught after the transformations unit.**	Express line vectors as column vectors.	**Vectors, coordinates, magnitude, parallel, multiple, resultant, position vectors, collinear.**	**You can describe journeys using vectors. For example, a flight from Bristol to Birmingham is a vector with magnitude 125km and direction 021^0. The driver of a car going over a road-hump instinctively works out resultant forces. A road-designer does the same, but in advance and with greater accuracy.** **Civil engineers use vectors in road design to model the movement of a vehicle travelling along a curved section of road.** **Planes flying in formation follow parallel vector flight paths.** **Programmers use vectors to calculate collisions between objects and/or people in computer games.**
		Use column vectors with coordinates.		
		Find the magnitude of a vector.		
		Draw the multiple of a vector given in line form. Draw the sum and difference of two vectors given in line form.		
		Find the resultant of two vectors given in column vector form.		
		Find the sum and difference of two vectors given in column vector form. Find the multiple of a vector given in column vector form.		
		Calculate using column vectors.		
		Identify parallel vectors.		
		Express points as position vectors, given their coordinates. Find the vector between the two points.		
		Use position vectors to find column vectors. Understand when points are collinear.		
		Use midpoints and prove lines are parallel using vectors.		

Topic	Rationale	Knowledge Acquisition	Key Vocabulary	Skills and Enrichment
19. Proportion and Graphs	**This unit must be completed after unit 11**	Write and use formulae for direct and inverse proportion. Recognise different types of graphs from their equations. Write and use a formula where one variable is directly proportional to the square of another variable. Write and use a formula where one variable is indirectly proportional to the square of another variable. Understand the effect of transformations on the graphs of functions. Find average acceleration, instantaneous acceleration and distance from a velocity–time graph. Sketch transformations of the graph of a given quadratic function. Find and use an exponential equation, given pairs of coordinates.	**Direct, inverse, proportion, formula, proportional, transformation, function, acceleration, exponential**	**Scientists use statements of proportionality to write equations for different variables. You can use inverse proportion to work out how long it will take different numbers of people to complete a task. Formula 1 engineers use curved speed-time graphs to track the performance of their cars.**