(Mathematics – KS3) Year 9 Long Term Plan

Rationale (with end points): In year 9 we aim to build on the knowledge and understanding gained in year 7 and 8. Students will look at key concepts and how to apply them to problem solving style questions. Students will look at topics in more depth to help develop their mathematical reasoning.

Term	Topic	Knowledge	Skills	*Reading /wider reading*
Autumn term 1	**Unit 1: Indices and Standard Form** Unit 1.1 Indices Unit 1.2 Calculations and Estimates Unit 1.3 More Indices Unit 1.4 Standard Form	• Calculate combinations of indices and brackets, including square brackets. • Use index laws to simplify expressions. • Calculate combinations of powers, roots, fractions and brackets. • Estimate answers to calculations. • Understand numbers written in index form that are raised to a power. • Understand negative and zero indices. • Use powers of 10 and their prefixes. • Write large and small numbers using standard form. • Enter and read standard form numbers on a calculator. • Order numbers written in standard form.	• Understand how the sign of a power of a negative number changes the sign of the answer (ie even number powers of a negative number give a positive answer; odd number powers of a negative number give a negative answer). • Understand when to insert square brackets and when to insert round brackets in a calculation. • Understand that the relationship between squares and square roots, cubes and cube roots extends to powers of 4, and 4th root etc. for integers and fractions (positive and negative). • Understand how the rules of indices can be extended to negative powers of products. • Understand how to calculate numbers in standard form, e.g. add or subtract two numbers in standard form, or multiply or divide two numbers in standard form.	Equal, Schmequal by V Kroll
	Unit 2 Expressions and Formulae Unit 2.1 Solving Equations Unit 2.2 Substituting into expressions Unit 2.3 Writing and using Formulae Unit 2.4 Using and rearranging formulae	• Write and solve equations with fractions. • Write and solve equations with the unknown on both sides. • Use the priority of operations when substituting into algebraic expressions. • Substitute values into expressions involving powers and roots. • Write and use formulae. • Substitute into formulae and then solve equations to find unknown values.	• For solutions to equations that are fractions, understand when to give the solution as a fraction or as a decimal (and when it does not matter). • For equations with the unknown on one side, understand that it does not matter which side you 'move' the unknowns too, but if you subtract the smaller term from each side this may often be easier (fewer negatives). • In priority or operations, values under a square (or cube) root are treated as if in a bracket. In particular square root of (a + b) is not equal to square root a + square root b (and similarly for subtraction, and for cube roots).	

	Unit 2.5 Index laws and brackets Unit 2.6 Expanding double brackets	• Change the subject of a formula. • Use the rules for indices for multiplying and dividing. • Simplify expressions involving brackets. • Factorise an expression by taking out an algebraic common factor. • Multiply out double brackets and collect like terms.	• For a real life (linear) graph, understand the relationship between the formula connecting the variables and the equation of the line, and interpret the gradient in a real-life context. • Understand that changing the subject of a formula uses the same process as solving an equation using the balance method. • Understand that changing the subject of a formula may be more efficient for repeated calculations than substituting into a formula and solving an equation. • x to the power -n =1/x to the power n. • Any number or letter to a negative power can be written as a reciprocal but if the original number is '–1< x< 1 then the final answer is not a fraction. • When you raise a number in index form to a power, you multiply the powers. • A quadratic expression has a squared term as its highest power. • You can show that two expressions are equivalent by expanding and simplifying both sides. • You can extend the approach of 'multiply everything in the bracket by everything outside the bracket) to multiplying three binomial expressions.	
Autumn 2	**Unit 3 Dealing with Data** Unit 3.1 Planning a survey Unit 3.2 Collecting Data Unit 3.3 Calculating averages Unit 3.4 Displaying and analysing data Unit 3.5 Presenting and comparing data	• Identify sources of primary and secondary data. • Choose a suitable sample size and what data to collect. • Identify factors that may affect data collection and plan to reduce bias. • Design and use data collection sheets and tables. • Design a good questionnaire. • Find the median from a frequency table.	• Understand that the larger the sample size the more reliable your results, but testing can be time consuming and expensive (or may destroy the product, eg firework testing), so a 10% sample is not always appropriate. • Understand that 'closed' questions eg with tick boxes make questionnaires easier for people to complete, and that reducing options to eg age groups rather than just asking 'age', provides data that is already grouped, and so saves time recording and organising data.	

		• Estimate the mean form a large set of grouped data. • Construct and use a line of best fit to estimate missing values. • Identify and suggest reasons for outliers in data. • Identify further lines of enquiry. • Draw line graphs to represent grouped data. • Draw back-to-back stem and leaf diagrams. • Write a report to show survey results.	• Understand that there is not a 'best' type of data collection sheet, but that data collection sheets have to be designed to match each individual questionnaire/survey. • Understand the effect on the mean of adding a constant to each value in a data set. • Calculate a mean using an assumed mean - and understand when this is more efficient. • Understand that it is best to draw a line of best fit to predict values from a scatter diagram, and that the closer the points on a scatter diagram are to the line of best fit (ie the stronger the correlation), the more accurate the predictions will be. • Understand how for a given set of data, different types of graph (scatter diagram, pie chart, dual bar chart, line graph, stem and leaf including back to back) or different types of table may highlight different features of the data or may better facilitate comparison of data, i.e. begin to choose appropriate graphs to represent data.	
	Unit 4 Multiplicative Reasoning Unit 4.1 Enlargement Unit 4.2 Negative and Fractional scale factors Unit 4.3 Percentage change Unit 4.4 Compound measures Unit 4.5 Direct and inverse proportion	• Enlarge 2D shapes using a positive whole number scale factors and centre of enlargement. • Find the centre of enlargement by drawing lines on a grid. • Understand that the scale factor is the ratio of • corresponding lengths. • Enlarge 2D shapes using a negative whole number of scale factors. • Enlarge 2D shapes using a fractional scale factor. • Find an original value using inverse operations. • Calculate percentage change. • Solve problems using compound measures.	• Understand that scale factors for enlargement are not always integer values, and centres of enlargement do not always have integer coordinates. • Describe enlargements that involve negative and fractional scale factors (by finding the centre of enlargement). • Understand that a combined enlargement, involving positive and/or negative integers and/or fractional scale factors (like a combined transformation), can be described as a single enlargement or single transformation. • Understand there is more than one method for finding an original amount, given a final amount and the percentage increase or decrease (ie inverse operations, or unitary method). Make decisions about the most efficient method to use.	

		• Solve problems using constant rates and related formulae. • Solve best-buy problems. • Solve problems involving inverse proportion.	• Understand how to interpret a scenario that requires the use of percentage change, where it is not a straightforward 'Work out the percentage loss/profits/increase/decrease' question. • Understand that solving problems involving the comparison of compound measures or constant rates may require changing units. • Understand why a speed given (or calculated) may (or may not) be an average speed. • Understand how to distinguish between situations where quantities are in direct, inverse or not proportional at all. • Apply understanding of inverse proportion to compound measures.	
Spring 1	**UNIT 5: CONSTRUCTIONS** 5.1 Using scales 5.2 Basic constructions 5.3 Constructing triangles 5.4 Using accurate scale diagrams	• Use scales on maps and diagrams. • Draw diagrams to scale. • Make accurate constructions using drawing equipment. • Construct accurate triangles. • Construct accurate nets of solids involving triangles. • Construct and draw accurate scale diagrams.	• In a map scale given as a ratio, eg 1:50 000, the units are not given because the ratio applies to any units. Eg 1 cm represents 50 000cm is equivalent to 1 m represents 50 000 m. • Understand why the construction methods for perpendicular and angle bisectors work, by considering properties of intersecting circles and rhombus, and that a circle is the locus of all points equidistant from a fixed point (without using the term locus). • Construct accurate angles of 45, 30, 60 based on known constructions of perpendicular bisector, angle bisector and equilateral triangle. • Constructing accurate scale diagrams (including triangles) is a strategy for solving problems involving finding sizes of angles and unknown lengths. • Plus, building on understanding that shortest distance to a line is perpendicular distance, use Core 3 lesson 5.4 Q9 to discover that points on the angle bisector are equidistant from both arms of the angle.	Algebra: Everything You Need To Know To Master Algebra! by Math Wizo

	UNIT 6: Sequences, inequalities, equations and proportion 6.1 nth term of arithmetic sequences 6.2 Non-linear sequences 6.3 Inequalities 6.4 Solving equations 6.5 Proportion	• Use the nth term to generate an arithmetic sequence. • Find and use the nth term of an arithmetic sequence. • Recognise and continue geometric sequences. • Recognise and continue quadratic sequences. • Represent inequalities on a number line. • Find integer values that satisfy an inequality. • Construct and solve equations including fractions or powers. • Write formulae connecting variables in direct or inverse • proportion. • Use algebra to solve problems involving direct or inverse proportion.	• A sequence may contain more than one sequence. For example in a fractions sequence the numerators may follow one sequence and the denominators another. Or in a pattern sequence, black dots may follow one sequence and white dots another. You can find the nth terms for each sequence and combine them. • Discover/understand the relationship between the 2nd difference of a quadratic sequence and the coefficient of n squared in the nth term. Use this to find the nth term of sequences of the form n squared + b and an squared plus b. • You can solve linear inequalities by doing the same to both sides, but if you multiply or divide both sides by a negative number, this changes the direction of the inequality sign. • You can use trial and improvement to solve an equation if you do not have an algebraic method. • A quantity can be directly proportional to the square or cube of another quantity. Try to relate direct proportion (linear, square and cubic) to relationships and formulae they have already met in mathematics. NB circles not covered till next chapter.	
Spring 2	**UNIT 7: Circles,** Pythagoras and prisms 7.1 Using scales 7.2 Area of a circle 7.3 Pythagoras' theorem Year 9 - Unit 5 - Constructions 7.4 Prisms and cylinders 7.5 Errors and bounds	• Calculate the circumference of a circle. • Estimate calculations involving pi (π). • Solve problems involving the circumference of a circle. • Calculate the area of a circle. • Solve problems involving the area of a circle. • Find the length of an unknown side of a right-angled triangle. • Solve problems involving right-angled triangles. • Calculate the volume and surface area of a right prism.	• Understand that pi is not a number - it is a ratio of the circumference to the diameter for any circle. - Understand that pi is an irrational number - it will not give an exact value. • Solve problems involving arcs of circles. • Understand the effect of estimating pi (including to nearest integer, 1.d.p. and as a fraction 22/7). • Solve problems involving sectors of circles. • Understand how to use Pythagoras's Theorem to show that a triangle is NOT a right-angled triangle. • Understand the advantages/disadvantages of using scale drawing OR Pythagoras' Theorem to find missing lengths on right angled triangles.	Think of a number by Johnny Ball

		• Calculate the volume and surface area of a cylinder. • Convert between m^3, cm^3 and mm^3. • Find the lower and upper bounds for a measurement. • Calculate percentage error intervals.	• Understand that a cylinder is not a prism, but has similarities. • Understand that as you increase the number of sides of a polygon that is the cross section of a prism, then you approach a cylinder. • Understand when a decimal value is not appropriate for an error bound or interval, and how this can change the inequality signs.	
Summer 1	**UNIT 8: GRAPHS** 8.1 Using y = mx + c 8.2 More straight-line graphs 8.3 Simultaneous equations 8.4 Graphs of quadratic functions 8.5 More non-linear graphs **UNIT 9: PROBABILITY** 9.1 Mutually exclusive events	• Write the equation of a line perpendicular to another line • Understand the relationship between the gradients of perpendicular lines • You can plot any linear graph by substituting $x = 0$ and $y = 0$ into its equation, to find the x- and y-intercepts • Find the equation of a line between two points • Understand that a pair of linear simultaneous equations has either no solutions, one solution or infinitely many solutions • Understand that simultaneous equations may not both be linear, e.g. could be linear/quadratic, and therefore could have more than one solution • Draw cubic graphs, recognise their features and distinguish between them and linear or quadratic graphs • Understand that 'A' and 'not A' are mutually exclusive and so P(A) + P(not A) = 1, which leads to P(not A) = 1 – P(A)	• Draw a graph from its equation, without working out points. • Write the equation of a line parallel to another line. • Compare graph lines using their equations. • Draw graphs with equations like ax + by = c. • Rearrange equations of graphs into y = mx + c. • Rearrange equations of graphs into y = mx + c. • Solve problems using simultaneous equations. • Draw graphs with quadratic equations in the form $y = x^2$. • Interpret graphs of quadratic functions. • Draw and interpret graphs showing inverse proportion. • Draw and interpret non-linear graphs. • Identify mutually exclusive outcomes and events. • Work out the probabilities of mutually exclusive outcomes and events.	

	9.2 Experimental and theoretical probability 9.3 Sample space diagrams 9.4 Two-way tables 9.5 Venn diagrams	• Understand the importance of knowing whether events are mutually exclusive before attempting to work out P(A or B) • Understand that a 'fair' dice, spinner, etc. will not have exactly the same experimental probability as theoretical probability • Consider when experimental outcomes and theoretical expected outcomes are close enough, e.g. for a dice, expected number of 6s in 200 throws is 33.33... so if you get 30 6s is it likely to be fair? What if you get 28, or 41? • Understand by seeing patterns in a sample space that you do not always need to fill in all the possible outcomes in a sample space diagram in order to work out the probability. E.g. for two 6 -sided dice there will be 6 × 6 possible outcomes, and the 'doubles' will be on the diagonal; or for two 4-sided dice 1-4, to find P(sum < 5) you only need to fill in part of the sample space grid. • Understand that you can calculate theoretical probabilities from a two-way table of possible outcomes, which is equivalent to a sample space diagram, and that you can calculate estimates of probabilities (experimental probabilities) from two-way tables of surveys or experimental results • Understand that Venn diagrams represent sets of data that are not mutually exclusive, and allow us to calculate probability of P(A and B) when A and B are not mutually exclusive	• Calculate estimates of probability from experiments. • Decide whether a dice or spinner is unbiased. • List all the possible outcomes of one or two events in a sample space diagram. • Decide if a game is fair • Show all the possible outcomes of two events in a two-way table. • Calculate probabilities from two-way tables. • Draw Venn diagrams. • Calculate probabilities from Venn diagrams.	

		• Begin to understand that when A and B are not mutually exclusive, P(A) + P(B) counts the intersection of A and B twice		
Summer 2	**Unit 10: Comparing shapes** 10.1 Congruent and similar shapes 10.2 Ratios in triangles 10.3 The tangent ratio 10.4 The sine ratio 10.5 The cosine ratio 10.6 Using trigonometry to find angles	• Use congruent shapes to solve problems about shapes other than triangles and quadrilaterals • Identify where shapes are similar, congruent or neither, when descriptions only (no diagrams) are given • Solve problems involving similar shapes other than triangles • Understand how to use the tangent ratio and Pythagoras' theorem to find lengths of all sides of a right-angled triangle • Understand that given an angle and the opposite side in a right-angled triangle, it is possible to use tan to find the adjacent side and then use Pythagoras' theorem to find the hypotenuse. However, it is more efficient to use the sine ratio • Use the tangent or sine ratio to find lengths in shapes made up of right-angled triangles • Understand bearings and use trigonometry to solve bearing problems (distances only, not angles) • Identify right-angled triangles in cubes and cuboids • Use trigonometry to find missing lengths and angles in cubes and cuboids	• Use congruent shapes to solve problems about triangles and other polygons. • Work out whether shapes are similar, congruent or neither. • Solve problems involving similar triangles. • Use conventions for naming the sides of a right-angled triangle. • Work out the tangent ratio of any angle. • Use the tangent ratio to work out an unknown side of a right-angled triangle. • Work out the sine ratio of any angle. • Use the sine ratio to work out an unknown side of a right-angled triangle. • Work out the cosine ratio of any angle. • Use the cosine ratio to work out an unknown side of a right-angled triangle. • Use the trigonometric ratios to work out an unknown angle in a right-angled triangle.	Probably Pistachio by Stuart Murphy