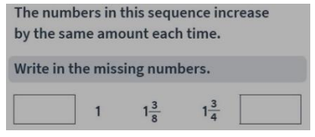
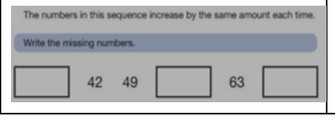
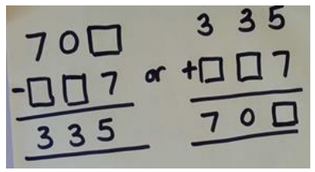
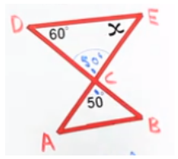
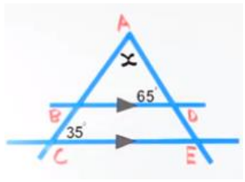
KS3 Maths Progression Map

In each year, pupils will be learning to:

Themes within subject	Year 5	Year 6	Year 7	Year 8	Year 9
Reasoning	**Making connections** **use simple known facts (eg properties of rectangles) to calculate answers, explaining the method clearly.** **Opportunities for making connections to be explicit:** **Empty box questions involving + and -** **712 - ( ) = 306** **In solving missing box questions using +/- can children make connections between the operator and the position of the empty box**	**Making connections** **apply known mathematical facts, eg properties of angles, lines and shapes to calculate answers** **Opportunities for making connections to be explicit:** **Empty box questions involving X and /** **480 / ( ) = 6** **In solving missing box questions using +/- can children make connections between the operator and the position of the empty box**	**Making connections** **Express number problems algebraically Eg. The cost of a photo album book is £1.25 for binding and printing, with an additional cost of 45p per photograph. Select the algebraic equation that best represents the problem and explain your reasoning.** **i)x=125y-45 ii) x=45y-1250 iii) x=45y+125** **Opportunities for making connections to be explicit:** **Empty box questions involving decimals and all 4 operations making connections between the position of the empty box and the operator.** **Make connections with missing values in algebraic function machines (Input and output)**	**Making connections** **Opportunities for making connections to be explicit:** **make connections between number relationships, and their algebraic and graphical representations Eg. Linear sequences and the representation on a graph 3n+2 in a numerical sequence will be the line y=3x+2 on a graph. Does the nth 3n suggest the gradient?** **y = mx + c is an important real-life equation. The gradient, m, represents rate of change (eg, cost per concert ticket) and the y-intercept, c, represents a starting value (eg, an admin fee)**	**Making Connections** **identify multiple variables and express relations between variables algebraically and graphically**
	Pattern **identify more complex and symbolic patterns, including number sequences such as 2n, 2n+1** **use simple known facts (eg properties of rectangles) to generalise further, explaining the method clearly.** **Explain using mathematical vocabulary what is happening in increasing/ decreasing sequences** **500…405…310…215…**	**Pattern** **express generalisations about broken number sequences with a common difference (Including number, decimal, fractions)** **Eg. _, 1, 1 ¾ , 2 ½, _** **0.25, 1, …., 2.5, ……**  	**Pattern** **Write a conjecture that describes a linear or non-linear sequence. Use the conjecture to find the next number or pattern.Eg: 2,4,12,48,240** **generate sequences such as 2n, 2n+1 and n^2 and start to understand the idea of a general term** **Link to lessons on term to term rules (Sequences Autumn 1)**	**Pattern** **make and test conjectures about patterns and relationships**; look for proofs or counter- examples **Eg: 1, ¼, 1/9, 1/16, 1/25 (Use conjecture to demonstrate that the denominator is a square number) Predict the next 3 terms using conjecture.** **Sequences based on square and cube numbers Eg. square number +5** **Triangular numbers- Can you come up with a way of finding the 15th number? n(n+1)/2**	**Pattern** **make and test conjectures about more complex relationships using inductive reasoning Eg: Make and test a conjecture about the product of two odd numbers. 1x3+3, 2x5=15, 3x9=28, 5x7=35. Pattern is that an odd number is the outcome)** **Find a counterexample to show that the conjecture is false. Eg if n is a real number then n squared > n . Is ½ squared >½ ?**

	Reasoning methods **use both examples and counter-examples to justify conclusions, explaining use** **Prime numbers (Aut1)** **All prime numbers are odd and all odd numbers are prime.** **Use calculations such as odd+odd=? odd +even?** Draw bar models to understand and justify what number operations to required to solve a multi step problem	**Reasoning methods** **develop and evaluate lines of enquiry** **make use of complex Venn diagrams to illustrate classifying, e.g. geometry and properties of polygons. Common factors, square, prime, composite numbers.** **Draw a bar model to help understand the context of a question in addition to the calculations. Eg. The change + the cost are equal to the initial amount.**	**Reasoning methods** **interpret when the structure of a numerical problem requires additive or multiplicative reasoning** Eg: **Tom is seven years older than his sister louise.Graph the relationship between Tom's age and louise's age. Is the relationship multiplicative or additive?Explain** Measures of average questions (including fraction within fraction unit)	**Reasoning methods** **extend and formalise their knowledge of ratio and proportion in working with measures and geometry** **Ratio (Aut 1) modelling of scaling used in the context of maps, measurement scles and shape.** interpret when the structure of a numerical problem requires additive,**multiplicative** or propor**tional reasoning.** **Writing algebraic expressions and equations from statements. Eg: The value of y is five more than the value of x. Y=x+5** **Model**	**Reasoning methods** **extend and formalise their knowledge of ratio and proportion in formulating proportional relations algebraically** interpret when the structure of a numerical problem requires additive, multiplicative or proportional reasoning
	Deduction and proof **search for a solution by trying out own ideas and justifying solutions** **check their methods and work independently** **express generalisations and proofs using symbolic notation as well as words** **Number statement questions** **One number is twice as big as another number. They both add to … what could the two numbers be?** **Tom says 4/9 > 5/8 because 9 is bigger than**	**Deduction and proof** **explain reasoning using precise mathematical language** **Thought bubble questions often seen in SATS Eg. Tom says that the fraction 20/100 is the same as 100 divided by 20. Explain your answer.** **decide how best to represent conclusions** **Missing digits problems involving the four operations and using the inverse and rearrangement of a formal method and the missing digits.**  	**Deduction and proof** **Reason deductively missing angle problems.Eg. Find missing angles in more complex triangular constructions, involving opposite and parallel angles. (Year 7 summer 1- Use know facts to make simple proofs- focus on straight line, opposite and simple parallel angles in triangular constructions)**  **explore what can and cannot be inferred in number, and begin to express their arguments formally.** **Summer term- Prime numbers and proof. LO:Make and test a conjecture-Goldbach's conjecture says that every even number greater than 2 can be written as the sum of two prime numbers.**	**Deduction and proof** **Reason deductively missing angle problems involving parallel,alternate and corresponding angles.(Year 8- Summer 1- Prove geometric facts)**  **explore what can and cannot be inferred in statistical and probabilistic settings, and begin to express their arguments formally. EG. make connections between theoretical and experimental probabilities and discuss the differences**	**Deduction and proof** **begin to reason deductively in geometry, number and algebra, including using geometrical constructions** **explore what can and cannot be inferred in statistical and probabilistic settings, and begin to express their arguments formally.**
	Year 5 (While solving number and practical problems)	**Year 6** (While solving number and practical problems)	**Year 7**	**Year 8**	**Year 9**
Problem solving	**Interpreting** **choose the best way to represent the information in a problem,** e.g. verbal description, tables, charts, pictures, database etc.	**Interpreting** **turn simple expressions and formulae from symbols to words and vice-versa** **solve problems involving the calculation of percentages Eg . Incorporate money and measures, 15% of £360 and the use of percentages for comparison . Would you rather have 35% of £80 or 22% of £60?**	**Interpreting** Turn a mathematical description such as y equals 5 times x or p is 3 more than twice q into a formula or algebraic description **Solve problems with fractions greater than 1 and percentages greater than 100% making links to financial maths (1)**	**Interpreting** Turn a mathematical description involving fractions such as A plus 7 is 6 less than half of B or three-quarters of x is 3 times one more than half y into a formula **solve problems involving percentage change, including: percentage increase, decrease and original value problems (1) Incorporate into geometry (area/volume) and financial problems involving cost and interest over a rate of time.**	**Interpreting** *Turn a mathematical description involving more complex expressions involving brackets, such as (P subtract 1) halved is 6 times Q plus 10 or A equals the positive-square-root of (B plus 1), into a formula* solve financial problems involving simple interest, e.g. working out how much interest will be paid on a credit card loan where only a minimum is paid each month, and how much this adds up to over a year. (beginning to introduce the concept behind compound interest)

		solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts solve problems involving unequal sharing and grouping using knowledge of fractions and multiples solve problems involving similar shapes where the scale factor is known or can be found[1]	**Solve simple financial problems expressed in words** such as relating yearly salary to monthly/weekly Solve problems involving a given quantity into two parts in a given part:whole ratio to finding a fraction of a quantity(1)	**Solve financial problems expressed in words that demand two steps**, eg calculating yearly tax after subtracting a tax free amount Solve ratio problems involving one or more amounts and the difference between them. express the division of a quantity into two parts as a ratio(1) Solve problems involving direct proportion, scale factors including diagrams and maps	Solve complex ratio problems involving two ratios. Eg. a:b =5:2 b:c=3:1 find the ratio a:b:c solve problems with scale factors involving similar and complex shapes(1)
	Evaluating outcomes **present information/results in a clear and organised way, including using ICT if appropriate** **reflect on others' explanations, methods and strategies, and use these to improve their own work**	**Evaluating outcomes** **round answers to specific degrees of accuracy using a wide range of units** **estimate and give solutions to an appropriate degree of accuracy**	**Evaluating outcomes** **Round answers to 1 significant figure when making an approximation (will this affect how precise the approximation is?)**	**Evaluating outcomes** **Round answers to 2 significant figures when making an approximation (will this affect how precise the approximation is?)** **Evaluate expressions with variables using the order of operations**	**Evaluating outcomes** **develop mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems and round solutions to any decimal place and sig fig.**
	Modelling **use the meaning of the equals sign as equivalence in laying out a problem, eg 4x35=2x2x35**	**Modelling** **use letters and symbols to represent unknown numbers and variables eg in a table, formula or equation**	**Modelling** Turn a function involving two variables into a graph Turn a function involving two variables into a formula or a linear algebraic expression **Given a simple mathematical model, test whether it expresses what is happening in the real world**	**Modelling** Turn a linear sequence written numerically and algebraically into a graph. **model how the equation y=kx can be linked to direct proportion Eg. Link to currency conversion graphs** **solve problems involving direct proportion, including graphical and algebraic representations** **describe simple mathematical relationships between two variables that can be seen in the data derived from students' own experiments or observations** **Given a more complex mathematical model, test whether it expresses what is happening in the real world and give reasons for whether it is a good model** **use a scatter graph to illustrate simple mathematical relationships between two variables Eg. The relationship between house prices and the distance from London**	**Modelling** **solve problems involving direct and inverse proportion, including graphical and algebraic representations** **describe simple mathematical relationships between two variables (bivariate data) in observational and experimental contexts** **relate changes in situations or procedures to changes in algebraic expressions, formulae or graphs** **Comment on strengths and weaknesses in a given mathematical model of a real situation** e.g. simplification of turning weather in Fahrenheit to Celsius – take off 30 and halve.
	Selecting method **decide which operations to use and why, for multi-step problems** **decide which methods to use and why, for multi-step problems** **make connections to previous work to suggest ways to tackle complex problems** **record the steps or calculations needed to solve a problem, using symbols where appropriate**	**Selecting method** **solve problems by breaking down complex problems into simpler steps or tasks** **try alternative approaches and resources to overcome difficulties, including ICT**	**Selecting method** **Use the idea of simplifying a problem with easier numbers to work out how to solve it** **(Opportunities to make this explicit in the lesson: To use estimation, through rounding to the nearest whole number or to one decimal place, to estimate answers** **Use inverses and working backwards to work out how to solve a problem (Make this explicit in Algebra function machine lesson**	**Selecting method** **use familiar compound units, such as speed, to solve problems** **Use sketching a graph or Venn diagrams to help work out how to solve a problem**	**Selecting method** **use less familiar compound units, such as density, to solve problems** **Choose most efficient method to solve a problem**

			and later in directed number unit when solving equations using directed numbers)		

KS3 Maths Progression Map

	Year 5	Year 6	Year 7	Year 8	Year 9	End of ks4 (just a summary of new learning)
Number- Structure	**Representation** **read and write numbers to at least 1 000 000** **determine the value of each digit for numbers to at least 1 000 000** **order and compare numbers to at least 1 000 000** **read Roman numerals to 1000 (M)** **recognise years written in Roman numerals**	**Representation** **Read and write numbers up to 10 000 000** **Determine the value of each digit in a number up to at least 10,000,000**	**Representation** **Read and write numbers up to one billion and determine the value of each digit.** **use the number line as a model to position decimals, measures and integers of any size** **Write 10, 100, 1000 etc. as powers of 10** **Write positive integers in the form A × 10^n** **write 10,100, 10000 etc as negative powers of ten(move to year 8)** **Write decimals in the form Ax10n**	**Representation** **Understand the multiplicative relationship between the numbers represented by any two digits in any number** **write negative powers of 10 (standard form)** **write numbers greater than 1 in standard form**	**Representation** **Write in the form A × 10^n (n any positive or negative integer) the multiplicative relationship between the numbers represented by any two digits in any number**	
	Use and Compare **determine the value of each digit to at least 1 000 000** **order and compare numbers to at least 1 000 000** **round any number up to 1 000 000 to the nearest 10** **round any number up to 1 000 000 to the nearest 100** **round any number up to 1 000 000 to the nearest 1 000** **round any number up to 1 000 000 to the nearest 10 000** **round any number up to 1 000 000 to the nearest 100 000**	**Use and Compare** **order and compare numbers up to 10 000 000** **compare and order fractions, including fractions >1** **compare and order fractions, including fractions <not>1** **compare and order fractions whose denominators are all multiples of the same number** **use common factors to simplify fractions; use common multiples to express fractions in the same denomination** **compare and order fractions, including fractions >1** **use, read, write and convert between standard units, converting measurements of length, mass,**	**Use and Compare** **order positive and negative integers, decimals and fractions** **use the number line as a model for ordering integers, decimals and fractions** **use the symbols =, ≠, <, >, ≤, ≥ to order and compare any number up to one billion.** **use the symbols =, ≠, <, >, ≤, ≥ to order and compare negative integers, decimals and fractions** **Order a list of integers to find the range and median** **define percentage as 'number of parts per hundred', and know their decimal and fraction equivalents** **appreciate the infinite nature of the set of integers** **use and convert between standard units of money**	**Use and Compare** **compare and order numbers in standard form** **relate percentages to decimals and fractions by showing their relative positions on a number line** **appreciate the infinite nature of the sets of rational numbers** **use and convert fractions of standard units of measures'** **Compare and order numbers in standard form**	**Use and Compare** **order numbers given in the standard form A x 10^n where n is a positive or negative integer or zero. Make calculations with numbers in standard form.** **use the number line as a model for ordering of the real numbers** **use the symbols =, ≠, <, >, ≤, ≥ to make order statements about real numbers** **relate percentages to decimals and fractions, moving efficiently between the different forms in any context** **understand some numbers are irrational** **use and convert between standard units of measures given in the standard form A x 10n 1≤A<10, where n is a positive or negative integer or zero'**	**Order positive and negative integers, decimals and fractions use the symbols =, ≠, <, >, ≤, ≥** **Apply systematic listing strategies including product rule for counting**

		volume and time from a smaller unit of measure to a larger unit	and other measures,to any number of decimal places			
	Accuracy of rounding and approximation in contextual calculations round any number up to 1 000 000 to the nearest 10 round any number up to 1 000 000 to the nearest 100 round any number up to 1 000 000 to the nearest 1 000 round any number up to 1 000 000 to the nearest 10 000 round any number up to 1 000 000 to the nearest 100 000	Accuracy of rounding and approximation in contextual calculations round any number up to 1 000 000 to the nearest 10, 100, 1 000, 10 000 and 100 000 round any whole number to a required degree of accuracy Round decimals, including those within measure, with three decimal places to the nearest whole number and to one decimal place use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy	Accuracy of rounding and approximation in contextual calculations round numbers and measures to 1 significant figure use estimation, through rounding to the nearest whole number or to one decimal place, to estimate answers	Accuracy of rounding and approximation in contextual calculations round numbers and measures to powers of 10 and 2 significant figures. round numbers to two or three decimal places, to estimate answers	Accuracy of rounding and approximation in contextual calculations round numbers and measures to any number of significant figures calculate possible resulting errors expressed using inequality notation $a<x\leq b$ Understand and use error interval notation. Calculate the upper and lower bounds of an expression involving the four operations; and problems involving measurements; perimeters; areas; and volumes of 2D and 3D shapes. Find the upper and lower bounds in real life situations using measurements given to the appropriate degree of accuracy.	Estimate answers, check calculations using approximation and estimation including answers obtained using technology Round answers to the appropriate degree of accuracy, use inequality notation to simple error intervals due to truncation or rounding Apply and interpret limits of accuracy including upper and lower bounds

	Year 5	Year 6	Year 7	Year 8	Year 9	End of ks4 (just a summary of new learning)

Calculation using 4 operations **(including formal written methods)**	**Calculation** **add and subtract whole numbers with more than 4 digits, including using formal written methods** **multiply numbers up to 4 digits by a one- -digit number using a formal written method** **multiply numbers up to 4 digits by a two-digit number using long multiplication** **divide numbers up to 4 digits by a one-digit number using the formal written method of short division**	**Calculation** ***4 operations combined:*** **Solve problems involving addition, subtraction, multiplication and division[1]** **multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication** **divide numbers up to 4-digits by a two-digit whole number using the formal written method of short division where appropriate** **divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division** **add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions** **use equivalent fractions to add and subtract fractions with different denominators** **use equivalent fractions to add and subtract mixed numbers** **multiply simple pairs of proper fractions, writing the answer in its simplest form, e.g. 1/4 × 1/2 = 1/8** **divide proper fractions by whole numbers, e.g. 1/3 ÷ 2 = 1/6** **use their knowledge of the order of operations to carry out calculations involving the four operations**	**Calculation** **multiply positive and negative numbers** **divide by positive and negative numbers** **multiply by decimals (+ and -)** **divide by decimals (+ and -)** **use order of operations including brackets** **recognise and use relationships between the operations +, –, ×, ÷, including inverse operations** **recognise and use the inverse relationship between squaring and finding the square root** **(See higher powers and roots lesson)**	**Calculation** **use conventional notation for the priority of operations, including powers** **Add and subtract numbers in standard form** **Multiply and divide numbers in standard form** **multiply proper and improper fractions, and mixed numbers (+ and -)** **Adding and subtracting expressions with indices** **Calculate with negative fractions** **Calculate with algebraic fractions** **Simplifying algebraic expressions by multiplying indices** **Simplifying algebraic expressions by dividing indices** **Using the addition and subtraction law for indices**	**Calculation** **use the four operations applied to real numbers, whether positive or negative** **use conventional notation for the priority of operations, including reciprocals** **use A = $^1/_n$ of B implies B = nA, and A = n% of B implies B = $^{(100A)}/_n$**	**Calculate exactly with fractions, surds and multiples of π**

KS3 Progression Map

	Year 5	Year 6	Year 7	Year 8	Year 9	End of ks4 (just a summary of new learning)
Number properties (whole number)	**Number properties (whole number)** **identify multiples** **identify factors** **find all factor pairs of a number** **find common factors of two numbers** **know and use the vocabulary of prime numbers** **know and use the vocabulary of prime factors** **know and use the vocabulary of composite (non-prime) numbers** **establish whether a number up to 100 is prime**	**Number properties (whole number)** **identify common factors, common multiples and prime numbers**	**Number properties (whole number)** **Find common factors of a set including highest common factor, and lowest common multiple** **Use a venn diagram to calculate HCF/LCM** **Write a number over 100 as a product of its primes** **Explore higher powers and roots in calculations with number**	**Number properties (whole number)** **use addition and subtraction laws of indices to simplify algebraic expressions** **Find the power of a power with brackets and indices to simplify algebraic expressions**	**Number properties (whole number)** **use product notation and the unique factorisation property** **use integer powers and associated real roots (square, cube and higher),recognise powers of 2, 3, 4, 5 (take out)** **Simplify expressions by using powers of zero** **Use negative indices to simplify expressions** **estimate powers and roots of any given positive number by considering the values it must lie between.**	Use the concepts and vocabulary of prime numbers, factors, multiples, common factors, HCF, LCM, prime factorisation including product notation and **unique factorisation theorem**
Number properties (Fractions, decimals, percentages)	**Number properties (Fractions, decimals, percentages)** **read and write decimal numbers as fractions (e.g. 0.71 = 71/100)** **recognise and use thousandths** **relate thousandths to tenths, hundredths and decimal equivalents**	**Number properties (Fractions, decimals, percentages)** **associate a fraction with division and calculate decimal equivalents for a simple fraction, e.g. $^3/_8$ = 0.375** **recall and use equivalences between simple fractions, decimals and percentages, including in different contexts**	**Number properties (Fractions, decimals, percentages)** **work interchangeably with terminating decimals and their corresponding percentages**	**Number properties (Fractions, decimals, percentages)** **work interchangeably with terminating decimals and their corresponding fractions (such as 3.5 and $^7/_2$)**	**Number properties (Fractions, decimals, percentages)** **work interchangeably with terminating decimals their corresponding fractions and percentages** **write a number in standard form A x 10^n $1 \leq A < 10$, where n is a positive or negative integer or zero**	**Recognise and use relationships including formal written methods to integers, decimals, fractions, mixed numbers.**

KS3 Progression Map

	Year 5	Year 6	Year 7	Year 8	Year 9	End of ks4 (just a summary of new learning)
Linking and extending percentages, decimals and fractions	**Linking and extending percentages, decimals and fractions** recognise the percent symbol (%) solve problems which require knowing percentage and decimal equivalents of $^1/_2$, $^1/_4$, $^1/_5$, $^2/_5$, $^4/_5$ solve problems which require knowing percentage and decimal equivalents of fractions with a multiple of 10 or 25 as the denominator	**Linking and extending percentages, decimals and fractions** solve problems involving the calculation of percentages [for example, of measures, and such as 15% of 360] and the use of percentages for comparison with fractions.	**Linking and extending percentages, decimals and fractions** Convert fluently between fractions, decimals and percentages Explore fractions above one, decimals and percentages	**Linking and extending percentages, decimals and fractions** Express one number as a fraction or a percentage of another with and without a calculator Express percentages and percentage changes as a fraction or a decimal Choose appropriate methods to solve complex percentage problems Calculate percentage increase and decrease using a multiplier	**Linking and extending percentages, decimals and fractions** understand why an "n% increase" is not the inverse operation of an "n% decrease"	**Linking and extending percentages, decimals and fractions** Set up, solve and interpret the answers in growth and decay problems including compound interest and work with general iterative processes
Ratio and Proportion and rates of change **Multiplicative relationships**	**Ratio and Proportion and rates of change** **Multiplicative relationships**	**Ratio and Proportion and rates of change** **Multiplicative relationships** solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts	**Ratio and Proportion and rates of change** **Multiplicative relationships** change freely between related standard units: Eg: (4 hours = 4 × 360 seconds), length (7 mm = 7 × 0.1 cm), area ($9\ m^2 = 9 \times 10000\ cm^2$) volume/capacity ($3\ mm^3 = 3 \times 0.001\ cm^3$) mass (5 kg = 5 × 1000 g) express one quantity as a whole-number multiple of another, and by reversing the expression of the same relationship express one quantity as a unit fraction of another	**Ratio and Proportion and rates of change** **Multiplicative relationships** change freely between related standard units, for example speed (m per sec to km per hour and vice-versa) express one quantity as a fraction of another, where the fraction is less than 1 and where it is greater than 1 Understand scale factors as multiplicative representations	**Ratio and Proportion and rates of change** **Multiplicative relationships** change freely between related standard units, for example acceleration given the expression of quantity A as a non-unit fraction of quantity B know immediately how to express quantity B as a fraction of quantity A	**Ratio and Proportion and rates of change** **Multiplicative relationships** Change freely between related standard units, for example density, pressure in numerical and algebraic contexts Use compound units such as speed, rates of pay, unit pricing, density and pressure Use scale factors, scale diagrams and maps Interpret the gradient of a straight line as a rate of change Interpret the rate of change of graphs of containers filling and emptying. Interpret the gradient at a point on a curve as the instantaneous rate of change; apply the concepts of average and instantaneous rate of change in numerical, algebraic and graphical contexts

Ratio notation and number multipliers **Ratio - Percentage change**	**Ratio notation and number multipliers**	**Ratio notation and number multipliers** **solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts (1)** **solve problems involving unequal sharing and grouping using knowledge of fractions and multiples (1)** **solve problems involving similar shapes where the scale factor is known or can be found(1)** **solve problems involving enlarging or reducing similar shapes where the scale factor is known** **solve problems involving enlarging or reducing similar shapes where the scale can be found**	**Ratio notation and number multipliers** **understand that a multiplicative relationship between two quantities can be expressed as a ratio or a fraction** **relate the language of ratios and the associated calculations to the arithmetic of fractions** **Solve problems involving a given quantity into two parts in a given part:whole ratio to finding a fraction of a quantity(1)**	**Ratio notation and number multipliers** **use ratio notation, including reduction to simplest integer form** **understand that a multiplicative relationship between two quantities that can be expressed as a ratio of the form 1 : n where n is an integer can also be expressed as the unit fraction $^1/_n$** **use scale factors of scale diagrams and maps in everyday contexts** **compare ratio and fractions** **A / (A + B) from the ratio A : B in appropriate contexts** **use scale factors when constructing similar shapes by enlargement** **Understand ratio as gradient** **Solve problems involving a given quantity into two parts in a given part:part or part:whole ratio; express the division of a quantity into two parts as a ratio(1)** **understand that a multiplicative relationship between two quantities can be expressed as a ratio or a fraction**	**Ratio notation and number multipliers** **understand that a multiplicative relationship between two quantities can be expressed as a ratio, fraction or decimal** **use ratio notation to express relationships between side-lengths of right-angled triangles** **solve problems with scale factors involving similar and complex shapes(1)** **relate the language of ratios and the associated calculations to linear functions** **distinguish between contexts involving comparisons expressed using a : b notation in which the idea of 'part' is a helpful model and contexts in which the idea of 'part' is not a helpful model**	**Ratio notation and number multipliers** **Set up and use equations to solve word problems involving direct and inverse proportion, including graphical and algebraic representations** **Compare lengths, areas and volumes using ratio notation; make links to similarity including the trigonometric ratios and scale factors** **Divide a given quantity into parts; part:part; or part:whole; apply ratio to real life contexts and problems**
	Ratio -Percentage change	**Ratio -Percentage change** **solve problems involving the calculation of percentages [for example, of measures, and such as 15% of £360] and the use of percentages for comparison (1)**	**Ratio -Percentage change** **Solve problems with fractions greater than 1 and percentages greater than 100% (1)**	**Ratio -Percentage change** **solve problems involving percentage change, including: percentage increase, decrease and original value problems (1)** **Find the original amount given the percentage less than 100%** **Find the original amount given the percentage greater than 100%** **Choose appropriate methods to solve complex percentage problems**	**Ratio -Percentage change** **solve problems involving simple, compound interest and depreciation in financial mathematics** **work out the multiplier for repeated proportional change as a single decimal number** **represent repeated proportional change using a multiplier raised by a power**	

KS3 Maths Progression Map

	Year 5	Year 6	Year 7	Year 8	Year 9	End of ks4 (just a summary of new learning)
Algebra- Notation and Vocabulary	**Algebra- Notation and Vocabulary**	**Algebra- Notation and Vocabulary** **Substitute whole numbers for letters in a simple formula**	**Algebra- Notation and Vocabulary** **ab in place of a × b** **3y in place of y + y + y and 3 × y** **a^2 in place of a × a** **$^a/_b$ in place of $a \div b$** **single brackets** **Write expressions using algebraic notation including scientific formulae** **understand the correct and incorrect use of '='** **understand and use the concepts and vocabulary of expressions, equations, equality, inequalities, terms and factors** **Use inverse operations to find the input given the output** **Use diagrams and letters to generalise number operations** **Use diagrams and letters with single function machines and with a series of two function machines** **Find the function machine given a simple and two-step expression** **Substitute values into single and two-step operation expressions** **Find numerical inputs and outputs for a series of two function machines**	**Algebra- Notation and Vocabulary** **a^2b in place of $a \times a \times b$** **a^3 in place of $a \times a \times a$** **double brackets** **substitute negative integer values into formulae and expressions, including scientific formulae** **understand and use the concepts and vocabulary of expressions, equations, inequalities, terms, factors and correlation / covariation**	**Algebra- Notation and Vocabulary** **triple brackets** **use and interpret algebraic notation, including coefficients written as fractions rather than as decimals** **substitute numerical values into formulae and expressions, including scientific formulae** understand and use the concepts and vocabulary of expressions, equations, inequalities, terms, factors, correlation / covariation and **parameters**	**Algebra- Notation and Vocabulary** **Know the difference between an equation and an identity** **Define a quadratic expression** **Use function notation f(x)** **Find f(x) + g(x); 2f(x); f(3x) algebraically** **Interpret the reverse process as the inverse function** **Interpret the succession of two functions as a composite function: for example: for two functions f(x) and g(x) find gf(x) (the use for formal function notation is expected)**

Algebra-Manipulation	**Algebra-Manipulation**	**Algebra-Manipulation** **find pairs of numbers that satisfy an equation with two unknowns** **enumerate possibilities of combinations of two variables** **express missing number problems algebraically**	**Algebra-Manipulation** **multiply a single term over a bracket** **Solve one-step linear equations involving +/- using inverse operations** **Solve one-step linear equations involving x/÷ using inverse operations** **Simplify algebraic expressions by collecting like terms, using the ≡ symbol**	**Algebra-Manipulation** **collecting like terms (powers)** **Expand multiple single brackets and simplify** **Expand a pair of binomials** **Factorise into a single bracket** **Solve one- step linear equations,including brackets** **Form and solve simple inequalities** **Solve equations with unknowns on both sides** **Simplifying algebraic expressions by using (+-x÷) laws of indices** **Identify and use formulae, expressions, identities and equations**	**Algebra-Manipulation** **Examine relational meanings before acting on expressions eg.recognise situations in which different ways of seeing the situation lead to equivalent expressions,** **use manipulation and simplification to show that the expressions are equivalent (e.g. sequences of "dot patterns")** **recognise situations in which it is helpful to rearrange formulae to change the subject, and explain why it is helpful** **rearrange formulae including where the subject appears twice; are powers; and where the subject appears in the denominator** **use algebraic methods to solve linear equations in one variable (including all forms that require rearrangement) that express facts observed in situations, and interpret the solution** **Use index laws including zero; fractional; and negative powers** **Factorise quadratic expression x^2+bx+c and the difference of two squares**	**Algebra-Manipulation** **Solve 'show that' proof questions using consecutive integers (n, n+1); squares a^2; even numbers 2n; odd numbers 2n+1.** **Expand two or more binomials** **Derive simple formulae** **Solve linear equations with integer and fractional coefficients** Substitute positive and negative values into a formula including: brackets; powers; **standard form.** **Use formulae from other subjects; including kinematics: v=u+at; v^2= u^2+2as; s=ut + 1/2at^2** **Set up and solve equations involving direct and inverse portion and relate the algebraic solution to a graphical representation** **Write statements of proportionality for square, cube or other powers** **Use y=kx and y=k/x to solve proportional problems** **x÷ with algebraic fractions** **Set up and solve to find the exact solution to two simultaneous equations (linear/linear or linear/quadratic algebraically** **Interpret the solutions to two simultaneous equations in the context of the question** **Solve inequalities -3 < 2x+1 < 7 and show solution set on a number line** **Solve two inequalities in x and find solution sets that satisfy both.** **Represent a solution set using set notation for problems identifying the two solutions to two different inequalities showing this as the intersection of the two solution sets i.e. x^2-3x-10<0 as {-3<x<5}** **Set up and solve quadratics by factorising; completing the square; and using the quadratic formula** **Solve quadratics arising from algebraic fractions** **Find approximate solutions to equations numerically using iteration**

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Expressing and exploring algebraic relationships through graphs	**Expressing and exploring algebraic relationships through graphs**	**Expressing and exploring algebraic relationships through graphs** describe positions on the full coordinate grid (all four quadrants)	**Expressing and exploring algebraic relationships through graphs** Turn a function involving two variables into a graph(1)	**Expressing and exploring algebraic relationships through graphs** Identify and draw lines that are parallel to the axes Recognise and use the line y=x Recognise and use lines of the form y=kx Explore the gradient of the line y=kx (H) Recognise and use lines of the form y=x+a Explore graphs with negative gradient (y=-kx, y=a-x, x+y=a) Plot graphs of the form y=mx+c (equation of a straight line and put it into context) Explore non-linear graphs Find the midpoint of a line segment	**Expressing and exploring algebraic relationships through graphs** understand the relationship between the coordinates of two points when each point is the reflection of the other in the *y*-axis, the *x*-axis, the line $y = x$ or the line $y = -x$ sketch and produce graphs of linear and quadratic functions of one variable with appropriate scaling, using equations in *x* and *y* and the Cartesian plane reduce a linear equation that expresses a relationship between two variables in a situation to the standard form $y = mx + c$ calculate and interpret gradients and intercepts of graphs of such linear equations numerically, graphically, algebraically find the equation of a line in the form y=mx+c and ax+by=c given two points use linear and quadratic graphs to estimate values of *y* for given values of *x to find approximate of* solutions of simultaneous linear equations Draw and interpret distance-time; velocity-time conversion and real life graphs Generate the equations of lines parallel and perpendicular to a given line Know that parallel lines have the gradient m and perpendicular lines have the gradient -1/m Find the equation of a line through two given points Calculate the length of a line segment given the coordinates of the end points	**Expressing and exploring algebraic relationships through graphs** Recognise linear, quadratic, cubic, reciprocal and circle graphs. Draw the graphs of these functions using a table of values For a circle use $x^2 + y^2 = r^2$ for radius r centred at the origin and for a reciprocal use $y = 1/x$ where $x \neq 0$ Find the equation of the tangent to a circle at a given point Sketch the graph of a quadratic function by factorising, identifying roots, y-intercept and the turning point Identify the line of symmetry and give the equation of a quadratic graph Solve quadratic inequalities in one variable by factorising and sketching the graph to find the critical values Recognise, sketch and interpret the graphs of exponential functions $y = k^x$ for positive values of k and integer values of x Use a calculator to explore exponential growth and decay Apply transformations to linear, quadratic and cubic functions Estimate the area under a quadratic curve by using trapezia Interpret the gradient of linear and non-linear graphs including: curved distance-time and curved velocity-time graphs For non-linear distance-time graphs and velocity-time graphs estimate the speed or acceleration at one point from the tangent and the average speed over several second by finding the gradient of the chord

Sequences	**describe simple linear number sequences** **describe simple linear number sequences in words (eg sequences like 2n, 2n+1)** **in simple linear number sequences, identify what a later term might be without identifying the term before (eg 2, 4, 6, -, ?,)**	**generate and describe linear number sequences** **Find pairs of numbers that satisfy an equation with two unknowns** **enumerate possibilities of combinations of two variables**	**Predict and check next terms in a more complex linear sequence involving graphical representations.** **Recognise and predict the differences in linear and non-linear sequences including those in tables and graphs.** **Explain the term to term rule in a linear sequence (such as 'an expression for the value of the *n*th term is n + 2') from either the term-to-term or the position-to-term rule**	**Form a linear sequence given a rule in a written description** **Generate sequences given a complex algebraic rule** **Find the rule for the nth term of a linear sequence**	**generate terms of a quadratic sequence from either a term-to-term or a position-to-term rule** **Find the nth term for a quadratic sequence** **recognise more complex geometric sequences and appreciate other sequences that arise including where rn is an integer; r is rational >0 or a surd**	**Estimate the gradient of a non linear graph at a given point by drawing the tangent and finding the gradient of the tangent** **Interpret the gradient of a linear/non linear graph in financial contexts** **Recognise when values are in direct or inverse proportion by reference to the graphical form**

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Constructing, measuring and using geometric notation	understand that in a rectangle opposite sides are parallel and equal understand the difference between interior and exterior angles understand that in a rectangle interior angles are 90° understand that in a rectangle interior angles add up to 360° understand that in a rectangle diagonals are same length and bisect (halve) each other Draw and Measure angles up to 180°	understand that in a triangle angles add up to 180° understand that in an equilateral triangle each angle is 60° understand that in an isosceles triangle two angles are equal understand that in a quadrilateral, interior angles add up to 360° understand that in a regular polygon, exterior angles add up to 360° draw 2-D shapes using given dimensions and angles illustrate and name radius, diameter and circumference know that the diameter is twice the radius draw and reflect rectangles, parallelograms and rhombuses in the axes	Understand and use letter and labelling conventions including those for geometric figures Draw and measure line segments including geometric figures Draw and measure angles between 180° and 360° Construct triangles using SSS Construct triangles using SSS, SAS and ASA Construct more complex polygons using SSS, SAS and ASA Interpret simple pie charts using proportion Interpret pie charts using a protractor	Identify and calculate with alternate and corresponding angles Identify and calculate with co-interior, alternate, and corresponding angles Constructions of triangles and special quadrilaterals Investigate the properties of special quadrilaterals Identify and calculate with sides and angles in special quadrilaterals Construct an angle bisector Construct a perpendicular bisector of a line segment	draw and measure line segments and angles in geometric figures, including interpreting scale drawings undertake calculations and solve problems involving: perimeters of 2-D shapes (including circles and parts of circles), areas of circles and composite shapes	Understand a proof that the exterior angle of a triangle is equal to the sum of the other two interior angles; obtain similar proofs Apply and prove the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results Identify congruent shapes and understand congruence by using SSS/SAS/ASA/RHS Construct the nets, front/side elevations and plan view of 3D solids Construct, use and interpret maps and scale drawings Use ruler and compasses to construct: regular hexagon inside a circle; angles of 60,90,30,45; a perpendicular from a line to a point Know that the perpendicular distance from a point to a line is the shortest Identify a region bounded by a circle and an intersecting line Construct loci given the distance from a point and a line; equal distances from two points or two line segments Construct regions defined as nearer to or greater than Describe regions that satisfy a combination of loci; including bearings Calculate bearings and solve problems with bearings Use all transformations: reflections; rotations; translations and enlargements to transform 2D shapes on a grid Describe a transformation using a combination of other transformations Distinguish properties that are preserved under transformations Find the equation of a mirror line Describe translations using column vectors Enlarge shapes using fractional and negative scale factors Use formal geometric proof for similarity of two given triangles Know that enlargement is specified by a centre and a scale factor Understand the effect of enlargement on angles; perimeter; area; and volume Know and use the relationship between linear; area; and volume scale factors in 3D
<u>Calculating using geometrical reasoning</u>	know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles draw given angles, and measure them in degrees (°) identify: - angles at a point and one whole turn (total 360°) - angles at a point on a straight line and 2 1 a turn (total 180°) - other multiples of 90o use the properties of rectangles to deduce related facts and find missing lengths and angles - distinguish between regular and irregular polygons based on reasoning about equal sides and angles measure and calculate the perimeter of composite rectilinear shapes in centimetres and metres	recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles find unknown angles in any triangles, quadrilaterals, and regular polygons recognise that shapes with the same areas can have different perimeters and vice versa recognise when it is possible to use formulae for area and volume of shapes calculate the area of parallelograms and triangles	Solve complex angle problems involving angles on a straight line, a point and opposite. Find and use the angle sum of any polygon Recognise angles in parallel lines Understand and use parallel line angles rules Use known facts to obtain simple proofs	Understand and use the properties of diagonals of quadrilaterals Understand and use the sum of exterior angles of any polygon Solve Complex problems with parallel line angles Investigate angles between parallel lines and the transversal Calculate the area of trapeziums Calculate missing interior angles in regular polygons Calculate the area of a circle and parts of a circle without a calculator Calculate the area of a circle and parts of a circle with a calculator	use Pythagoras' Theorem and trigonometric ratios in similar triangles to solve problems involving right-angled triangles Use the trigonometric ratios to find angles; sides; angles of depression and elevation Find the exact values of the sinθ and cosθ for θ = 0, 30, 45, 60, 90 using triangles with angles of 30, 45, 60 degrees Recognise, sketch and interpret the graphs of the trigonometric functions. Use these graphs to solve problems. Know and apply the formula for the area of a non-right angled triangle i.e. A = 1/2absinC Know and apply the sine and cosine rules in 2D, including problems with bearings	

	calculate and compare the area of rectangles (including squares), and including using standard units, square centimetres (cm^2) and square metres (m^2) and estimate the area of irregular shapes estimate volume, e.g. using 1 cm^3 blocks to build cuboids (including cubes) estimate capacity, e.g. using water	calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm^3) and cubic metres (m^3), and extending to other units, e.g. mm3 and km^3			Use the sine and cosine rules in 3D Solve problems with Pythagoras' Theorem in 3D Find the angle between line and a plane Understand the language of planes and recognise diagonals in 3De Find the surface area of prisms Calculate the surface area and volume of composite 3D shapes Find the volume and surface areas of cylinders; pyramids; spheres; and cones Solve problems involving frustums of cones where you have to find missing lengths first using similar shape properties Convert between metric measures in area and volume.	Understand and use all vector notation; including parallel vectors and those in opposite directions Calculate the resultant; sum; difference; and scalar of two vectors Find the length of a vector using Pythagoras' theorem Solve geometric problems in 2D where vectors are divided in a given ratio Use vectors to construct geometric arguments and proof

Probability			**Identify and represent sets** **Interpret and create Venn diagrams** **Understand and use the intersection of sets** **Understand and use the union of sets** **Understand and use the complement of a set** **Generate sample spaces for single events** **Calculate the probability of a single event** **Understand and use the probability scale** **Know that the sum of probabilities for all possible outcomes is 1**	**Construct sample spaces for one or more events** **Calculate probabilities from a sample space** **Find probabilities from two-way tables** **Calculate probabilities from Venn diagrams** **Use the product rule for finding the total number of possible outcomes**	**record, describe and analyse the frequency of outcomes of more complex probability experiments involving: randomness, fairness, equally and unequally likely outcomes, using appropriate language and the 0-1 probability scale;** **generate theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes and use these to calculate theoretical probabilities.**	**Understand conditional probabilities and decide if two events are independent** **Calculate the probability of independent and dependent combined events including using tree diagrams and other representations and know the underlying assumptions** **Calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams** **Use union and intersection notation P(AnB) and P(AuB)** **Use P(A and B) = P(A) x P(B); P(A or B) = P(A) + P(B)** **Understand that empirical unbiased samples tend towards theoretical probability distributions with increasing sample size**
Statistics	read and interpret information in complex tables, including timetables solve multi step problems using information presented in a line graph complete missing information in complex tables, including timetables	interpret pie charts construct pie charts construct line graphs with two variables interpret the mean as an average calculate the mean identify when it is appropriate to calculate the mean and when not use pie charts to solve problems use line graphs to solve problems identify simple relationships in line graphs	Order a list of integers and find the median and range	Draw and interpret scatter graphs Understand and describe linear correlation Draw and use line of best fit Identify non-linear relationships in graphs Identify different types of data and catagorise Read and interpret ungrouped frequency tables Read and interpret grouped frequency tables Represent grouped discrete data Represent continuous data grouped into equal classes Construct and interpret two-way tables	describe simple mathematical relationships between two variables (bivariate data) in observational and experimental contexts Construct and interpret stem and leaf diagrams Estimate the mean from grouped data Know the appropriate use of cumulative frequency diagrams and tables; construct and interpret them Find the median, quartiles and interquartile range from CF diagrams Draw and interpret box plots Find the median, quartiles and interquartile range from box plots	**Understand that correlation does not imply causality and iInterpolate and extrapolate apparent trends, whilst knowing the dangers of doing so** **Understand what is meant by sample and population and how sampling may affect reliability** **Identify possible sources of bias and how to minimise it** **Select, define and justify a sampling scheme including: random; and systematic sampling** **Use capture-recapture methods for sampling** **Produce histograms for grouped data of equal and unequal class width and know their appropriate use** **Use and understand frequency density in a variety of problems** **Estimate the mean, median and number of people in an interval from a histogram** **Construct and interpret time series graphs and comment on trends and know their appropriate use**