Higher SOW Progression

Patterns and Sequences		
Year 9	Year 10	Year 11
• Recognise Fibonacci numbers • Recognise the Fibonacci sequence • Generate Fibonacci type sequences • Find the next three terms in any Fibonacci type sequence • Substitute numbers into formulae including terms in x2 • Generate terms of a quadratic sequence from a written rule • Generate terms of a quadratic sequence from its nth term • Identify quadratic sequences • Establish the first and second differences of a quadratic sequence • Find the next three terms in any quadratic sequence	• Describe how a sequence continues. • Generate sequences with a given term-to-term rule • Generate simple sequences derived from diagrams and complete a table of results that describes the pattern shown by the diagrams • Generate linear sequences • Work out the value of the nth term of a linear sequence for any given value of n • Generate a sequence where the nth term is given • Work out an expression in terms of n for the nth term of a linear sequence by knowing that the common difference can be used to generate a formula for the nth term. • Solve simple problems involving arithmetic progressions • Work with Fibonacci-type sequences (rule will be given) • Know how to continue the terms of a quadratic sequence • Work out the value of the *n*th term of a sequence for any given value of *n.* • Work out the value of a term in a geometrical progression of the form rn where n is an integer > 0	

Calculating		
Year 9	Year 10	Year 11
• Calculate with positive indices (roots) using written methods • Calculate with negative indices in the context of standard form • Use a calculator to evaluate numerical expressions involving powers (roots) • Interpret a number written in standard form • Add (subtract) numbers written in standard form • Multiply (divide) numbers written in standard form • Convert a 'near miss' into standard form; e.g. 23 × 107	<u>Rounding</u> • Perform money calculations, writing answers using the correct notation • Round numbers to the nearest whole number, 10, 100 or 1000 • Round numbers to a specified number of decimal places • Round numbers to a specified number of significant figures • Use inequality notation to specify error intervals due to truncation or rounding. • Recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction.	

• Enter a calculation written in standard form into a scientific calculator • Interpret the standard form display of a scientific calculator • Understand the difference between truncating and rounding • Identify the minimum and maximum values of an amount that has been rounded (to nearest x, x d.p., x s.f.) • Use inequalities to describe the range of values for a rounded value • Solve problems involving the maximum and minimum values of an amount that has been rounded	<u>Indices</u> • Recall squares of numbers up to 15 × 15 and the cubes of 1, 2, 3, 4, 5 and 10, also knowing the corresponding roots • Calculate and recognise powers of 2, 3, 4, 5 • Calculate and recognise powers of 10 • Understand the notation and be able to work out the value of squares, cubes and powers of 10 • Recognise the notation $\sqrt{25}$ • Solve equations such as x 2 = 25, giving both the positive and negative roots. • Estimate the value of a power of a given positive number • Estimate the value of the root of any given positive number • Identify between which two integers the square root of a positive number lies • Identify between which two integers the cube root of a positive number lies. • Use index laws for multiplication and division of integer powers • Calculate with positive integer indices. • Calculate values using fractional indices • Calculate with negative integer indices <u>Surds</u> • Simplify surds • Rationalise a denominator of the form $\sqrt{a}$ or $b\sqrt{a}$ • Simplify expressions using the rules of surds • Expand brackets where the terms may be written in surd form • Solve equations which may be written in surd form. <u>Standard Form</u> • Know, use and understand the term standard from • Write an ordinary number in standard form • Write a number written in standard form as an ordinary number • Order and calculate with numbers written in standard form • Solve simple equations where the numbers are written in standard form • Interpret calculator displays • Use a calculator effectively for standard form calculations • Solve standard form problems with and without a calculator.	

Higher SOW Progression

Visualising and constructing		
Year 9	Year 10	Year 11
• Use compasses to construct clean arcs • Use ruler and compasses to construct the perpendicular bisector of a line segment • Use ruler and compasses to bisect an angle • Use a ruler and compasses to construct a perpendicular to a line from a point (at a point) • Understand the meaning of locus (loci) • Know how to construct the locus of points a fixed distance from a point (from a line) • Identify when to use the locus of points a fixed distance from a point (from a line) • Identify when a perpendicular bisector is needed to solve a loci problem • Identify when an angle bisector is needed to solve a loci problem • Choose techniques to construct 2D shapes; e.g. rhombus • Combine techniques to solve more complex loci problems • Know how to deal with a change in depth when dealing with plans and elevations • Construct a shape from its plans and elevations • Construct the plan and elevations of a given shape	• 2D representations of 3D shapes • Use 2D representations of 3D shapes • Draw nets and show how they fold to make a 3D solid • Analyse 3D shapes through 2D projections and cross sections, including plans and elevations • Understand and draw front and side elevations and plans of shapes made from simple solids, for example a solid made from small cubes • Understand and use isometric drawings. <u>Constructions and Loci</u> • Measure and draw lines to the nearest mm • Measure and draw angles to the nearest degree • Draw circles or part circles given the radius or diameter • Make accurate drawings of triangles and other 2D shapes using a ruler and a protractor • Make an accurate scale drawing from a sketch, diagram or description • Construct a triangle • Construct an equilateral triangle with a given side or given side length • Construct a perpendicular bisector of a given line, at a given point on a given line and from a given point to a given line • Construct an angle bisector • Construct an angle of 60° • Draw parallel lines • Construct a region, for example, bounded by a circle and an intersecting line • Construct loci, for example, given a fixed distance from a point and a fixed distance from a given line • Construct loci, for example, given equal distances from two points • Construct loci, for example, given equal distances from two line segments	

	• Construct a region that is defined as, for example, less than a given distance or greater than a given distance from a point or line segment • Describe regions satisfying several conditions.	

Algebraic manipulation		
Year 9	Year 10	Year 11
• Understand the meaning of an identity • Multiply two linear expressions of the form (x + a)(x + b) • Multiply two linear expressions of the form (x ± a)(x ± b) • Expand the expression (x ± a)2 • Simplify an expression involving 'x2' by collecting like terms • Identify when it is necessary to remove factors to factorise a quadratic expression • Identify when it is necessary to find two linear expressions to factorise a quadratic expression • Factorise a quadratic expression of the form $x^2 + bx + c$ • Know how to set up an mathematical argument • Work out why two algebraic expressions are equivalent • Create a mathematical argument to show that two algebraic expressions are equivalent • Identify variables in a situation • Distinguish between situations that can be modelled by an expression or a formula • Create an expression or a formula to describe a situation	• Use notation and symbols correctly and understand that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae, and in functions they define new expressions or quantities by referring to known quantities. • Understand that algebra can be used to generalise the laws of arithmetic • Understand phrases such as 'form an equation', 'use a formula', 'write down a term', 'write an expression' and 'prove an identity' when answering a question • Recognise that, for example, 5x + 1 = 16 is an equation • Recognise that, for example, V = IR is a formula • Recognise that x + 3 is an expression • Recognise that (x + 2)2 ≡ x2 + 4x + 4 is an identity • Recognise that 2x + 5 < 16 is an inequality • Write an expression • Manipulate an expression by collecting like terms • Write expressions to solve problems (incl. using squares and cubes) • Multiply a single term over a bracket, for example, a(b + c) = ab + ac know the meaning of and be able to simplify, for example 3x − 2 + 4(x + 5) • multiply two linear expressions, such as (x ± a)(x ± b) and (cx ± a)(dx ± b), for example (2x + 3)(3x − 4) • Know the meaning of the word 'factor' for both numerical work and algebraic work. • Factorise algebraic expressions by taking out common factors for example 3x 2y − 9y or 4x 2 + 6xy • Please Note- Factorising quadratics is in yr 11 SOW along with a recap of double bracket expansion	• simplify by factorising and cancelling expressions of the form $\frac{ax^2 + bx + c}{dx^2 + ex + f}$ • Work with any algebraic expression involving fractions

Higher SOW Progression

Proportional reasoning		
Year 9	Year 10	Year 11
• Know the difference between direct and inverse proportion • Recognise direct (inverse) proportion in a situation • Know the features of a graph that represents a direct (inverse) proportion situation • Know the features of an expression (or formula) that represents a direct (inverse) proportion situation • Understand the connection between the multiplier, the expression and the graph • Know the meaning of congruent (similar) shapes • Identify congruence (similarity) of shapes in a range of situations • Identify the information required to solve a problem involving similar shapes • Finding missing lengths in similar shapes • Understand why speed, density and pressure are known as compound units • Know the definition of density (pressure, population density, speed) • Solve problems involving density (pressure, speed) • Convert between units of density	<u>Ratio and Proportion</u> • Understand the meaning of ratio notation • Make comparisons between two quantities and represent them as a ratio • Interpret a ratio as a fraction • Understand that a line divided in the ratio 1 : 3 means that the smaller part is one-quarter of the whole. • Simplify ratios to their simplest form a : b where a and b are integers • Write a ratio in the form 1 : n or n : 1 • Compare the cost of items using the unit cost of one item as a fraction of the unit cost of another item. • Use equality of ratios to solve problems. • Interpret a ratio in a way that enables the correct proportion of an amount to be calculated (share in a ratio) • Use a fraction of a quantity to compare proportions. • Represent the ratio of two quantities in direct proportion as a linear relationship and represent the relationship graphically • Use ratio to solve, for example geometrical, algebraic, statistical, and numerical problems • Use ratio to solve word problems using informal strategies or using the unitary method of solution • Solve best-buy problems using informal strategies or using the unitary method of solution. • Use fractions and ratios in the context of geometrical problems, for example similar shapes, scale drawings and problem solving involving scales and measures • Relate ratios to fractions and use linear equations to solve problems.	• Direct and inverse proportion • Use proportion to solve problems using informal strategies or the unitary method of solution • Use direct proportion to solve geometrical problems • Calculate an unknown quantity from quantities that vary in direct proportion or inverse proportion • Set up and use equations to solve word and other problems involving direct proportion or inverse proportion • Match direct and inverse proportion graphs to their equations and vice versa • Draw graphs to represent direct and inverse proportion. • Students should be able to: • Understand that an equation of the form y = kx represents direct proportion and that k is the constant of proportionality • Understand that an equation of the form y = $\frac{k}{x}$ represents inverse proportion and that k is the constant of proportionality.

Higher SOW Progression

Solving equations		
Year 9	Year 10	Year 11
• Understand that there are an infinite number of solutions to the equation ax + by = c ($a \neq 0$, $b \neq 0$) • Understand the concept of simultaneous equations • Find approximate solutions to simultaneous equations using a graph • Understand the concept of solving simultaneous equations by elimination* • Target a variable to eliminate • Decide if multiplication of one equation is required • Decide whether addition or subtraction of equations is required • Add or subtract pairs of equations to eliminate a variable • Find the value of one variable in a pair of simple simultaneous equations • Find the value of the second variable in a pair of simple simultaneous equations • Solve two linear simultaneous equations in two variables in very simple cases (no multiplication required) • Solve two linear simultaneous equations in two variables in simple cases (multiplication of one equation only required) • Derive and solve two simultaneous equations • Interpret the solution to a pair of simultaneous equations	• Use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols. For example, formula for area of a triangle, area of a parallelogram, area of a circle, volume of a prism, conversions between measures, wage earned = hours worked $\times$ hourly rate + bonus • Substitute numbers into a formula. • Solve simple linear equations by using inverse operations or by transforming both sides in the same way • Solve simple linear equations with integer coefficients where the unknown appears on one or both sides of the equation or where the equation involves brackets or fractions.	<u>Quadratic Equations</u> • Recap how to multiply two linear expressions, such as $(x \pm a)(x \pm b)$ and $(cx \pm a)(dx \pm b)$, for example $(2x + 3)(3x - 4)$ • multiply two or more binomial expressions • factorise quadratic expressions using the sum and product method, or by inspection (FOIL) • factorise quadratics of the form x 2 + bx + c, the difference of two squares of the form x 2 – a2 • factorise quadratic expressions of the form ax 2 + $bx + c$ <u>Change subject of a formula</u> • change the subject of a formula, including in situations where the subject appears more than once • show that two expressions are equivalent • use identities including equating coefficients <u>Simultaneous Equations</u> • understand that a function is a relationship between two sets of values • understand and use function notation, for example f(x) • substitute values into a function, knowing that, for example f(2) is the value of the function when x = 2 • solve equations that use function notation • understand, interpret and use composite function fg(x) • understand, interpret and use inverse function $f^{-1}(x)$ • Simultaneous Equations • solve simultaneous linear equations by elimination or substitution or any other valid method • find approximate solutions using the point of intersection of two straight lines.

		• appreciate that the solution of f(x) = ax + b is found where y = ax + b intersects with y = f(x) • eg the points of intersection of the graphs of $y = x^2 + 3x - 10$ and $y = 2x + 1$ are the solutions to the equation $x^2 + 3x - 10 = 2x + 1$ or $x^2 + x - 11 = 0$ • solve simultaneous equations when one is linear and the other quadratic • set up a pair of simultaneous linear equations to solve problems

Calculating space		
Year 9	Year 10	Year 11
• Know the vocabulary of circles • Know how to find arc length • Calculate the arc length of a sector when radius is given • Know how to find the area of a sector • Calculate the area of a sector when radius is given • Calculate the angle of a sector when the arc length and radius are known • Know how to find the surface area of a right prism (cylinder) • Calculate the surface area of a right prism (cylinder) • Calculate exactly with multiples of π • Know Pythagoras' theorem • Identify the hypotenuse in a right-angled triangle • Know when to apply Pythagoras' theorem • Calculate the hypotenuse of a right-angled triangle using Pythagoras' theorem • Calculate one of the shorter sides in a right-angled triangle using Pythagoras' theorem	<u>Perimeter and area</u> • Work out the perimeter of a rectangle • Work out the perimeter of a triangle • Calculate the perimeter of shapes made from triangles and rectangles • Calculate the perimeter of compound shapes made from two or more rectangles • Calculate the perimeter of shapes drawn on a grid • Calculate the perimeter of simple shapes • Work out the area of a rectangle • Work out the area of a triangle • Work out the area of a parallelogram • Work out the area of a trapezium • Calculate the area of compound shapes made from triangles and rectangles • Calculate the area of compound shapes made from two or more rectangles, for example an L shape or T shape • Calculate the area of shapes drawn on a grid • Calculate the area of simple shapes • Understand that cubes, cuboids, prisms and cylinders have uniform areas of cross-section. • work out the surface area of nets made up of rectangles and triangles <u>Circumference and Area</u> • Recall the definition of a circle	<u>Volume and 3D shapes</u> • Use 2D representations of 3D shapes • Draw nets and show how they fold to make a 3D solid • Analyse 3D shapes through 2D projections and cross sections, including plans and elevations • Understand and draw front and side elevations and plans of shapes made from simple solids, for example a solid made from small cubes • Understand and use isometric drawings. • Recall and use the formula for the volume of a cube or cuboid • Recall and use the formula for the volume of a cylinder • Recall and use the formula for the volume of a prism • Work out the volume of spheres, pyramids and cones • Work out the volume of compound solids constructed from cubes, cuboids, cones, pyramids, cylinders, spheres and hemispheres • Solve real-life problems using known solid shapes. • Give answers in terms of π and use values given in terms of π in calculations. <u>Equation of a circle</u> • Recognise the equation of a circle, centre (0, 0), radius r • Write down the equation of a circle, centre (0, 0) and radius r

	• Identify and name the parts of a circle • Draw the parts of a circle • Understand related terms of a circle • Draw a circle given the radius or diameter. • Recall and use the formula for the circumference of a circle • Work out the circumference of a circle, given the radius or diameter • Work out the radius or diameter of a circle, given the circumference • Use π = 3.14 or the π button on a calculator • Recall and use the formula for the area of a circle • Work out the area of a circle, given the radius or diameter • Work out the radius or diameter of a circle, given the area • Work out the perimeter of semicircles, quarter circles or other fractions of a circle • Work out the area of semicircles, quarter circles or other fractions of a circle • Calculate the length of arcs of circles • Calculate the area of sectors of circles • Given the lengths or areas of arcs and sectors, calculate the angle subtended at the centre • Given the angle subtended at the centre calculate the radius or diameter for lengths or areas of arcs or sectors • Work out the surface area of spheres, pyramids and cones <u>Properties of Polygons</u> • Recall the properties and definitions of special types of quadrilaterals and identify them • Classify quadrilaterals using common geometric properties. • Name and sketch a given shape • Identify a shape given its properties • List the properties of a given shape • Derive and use the proof that the angle sum of a triangle is 180o	• Work out coordinates of points of intersection of a given circle and a given straight line • Use the fact that the angle between the tangent and radius is 90° to work out the gradient of a tangent and hence the equation of a tangent at a given point. • Circle Theorems • understand that the tangent at any point on a circle is perpendicular to the radius at that point • understand and use the fact that tangents from an external point are equal in length • use congruent triangles to explain why the perpendicular from the centre to a chord bisects the chord • understand that inscribed regular polygons can be constructed by equal division of a circle • prove and use the fact that the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference • prove and use the fact that the angle subtended at the circumference by a semicircle is a right angle • prove and use the fact that angles in the same segment are equal • prove and use the fact that opposite angles of a cyclic quadrilateral sum to 180° • prove and use the alternate segment theorem. <u>Pre-calculus and area under a curve</u> • Calculate the area under a graph consisting of straight lines • Use the areas of trapezia, triangles and rectangles to estimate the area under a curve • Interpret the meaning of the area calculated as the product of the units of the variable on the vertical axis and the units of the variable on the horizontal axis.

	• Calculate and use the sums of interior angles of polygons • Recognise and name regular polygons: pentagons, hexagons, octagons and decagons • Use the angle sum of irregular polygons • Calculate and use the angles of regular polygons • Use the fact that the sum of the interior angles of an n-sided polygon is $180(n-2)$ • Use the fact that the sum of the exterior angles of any polygon is 360o • Use the relationship ' interior angle + exterior angle = 180o ' • Use the sum of the interior angles of a triangle to deduce the sum of the interior angles of any polygon.	

Pythagoras and Trigonometry		
Year 9	Year 10	Year 11
• Appreciate that the ratio of corresponding sides in similar triangles is constant • Label the sides of a right-angled triangle using a given angle • Choose an appropriate trigonometric ratio that can be used in a given situation • Understand that sine, cosine and tangent are functions of an angle • Know how to select the correct mode on a scientific calculator • Use a calculator to find the sine, cosine and tangent of an angle • Know the trigonometric ratios, $\sin\theta = \text{opp/hyp}$, $\cos\theta = \text{adj/hyp}$, $\tan\theta = \text{opp/adj}$ • Set up and solve a trigonometric equation to find a missing side in a right-angled triangle • Set up and solve a trigonometric equation to find a missing angle in a right-angled triangle	<u>Pythagoras and basic Trigonometry</u> (also in calculating space) • Understand, recall and use Pythagoras' theorem in 2D problems • Understand, recall and use trigonometric ratios in right-angled triangles • Use the trigonometric ratios in right-angled triangles to solve problems, including those involving bearings. • Understand, recall and use Pythagoras' theorem in 3D problems • Understand, recall and use trigonometric ratios in 3D problems • Use these ratios in 3D contexts, including finding the angles between a line and a plane. • Recall exact values of sine, cosine and tangent for 0°, 30°, 45° and 60° • Recall that sin 90° = 1 and cos 90° = 0 • Solve right-angled triangles with angles of 30°, 45° or 60° without using a calculator.	• Understand, recall and use Pythagoras' theorem in 2D problems • Understand, recall and use trigonometric ratios in right-angled triangles • Use the trigonometric ratios in right-angled triangles to solve problems, including those involving bearings. • Understand, recall and use Pythagoras' theorem in 3D problems • Understand, recall and use trigonometric ratios in 3D problems • Use these ratios in 3D contexts, including finding the angles between a line and a plane. • Recall exact values of sine, cosine and tangent for 0°, 30°, 45° and 60° • Recall that sin 90° = 1 and cos 90° = 0 • Solve right-angled triangles with angles of 30°, 45° or 60° without using a calculator. <u>Sine and Cosine Rule</u> • Know and apply the Sine rule • Know and apply the Cosine rule • Use the sine and cosine rules to solve 2D and 3D problems.

		• Calculate the area of a triangle using $\frac{1}{2}$ *ab* sin C • Calculate the area of a triangle given the length of two sides and the included angle.

Graphs		
Year 9	Year 10	Year 11
• Use the form y = mx + c to identify parallel lines • Rearrange an equation into the form y = mx + c • Find the equation of a line through one point with a given gradient • Find the equation of a line through two given points • Interpret the gradient of a straight line graph as a rate of change • Plot graphs of quadratic (cubic, reciprocal) functions • Recognise and interpret the graphs of quadratic (cubic, reciprocal) functions • Sketch graphs of quadratic (cubic, reciprocal) functions • Plot and interpret graphs of non-standard functions in real contexts	• Plot points in all four quadrants • Find and use coordinates of points identified by geometrical information, for example the fourth vertex of a rectangle given the other three vertices • Find coordinates of a midpoint, for example on the diagonal of a rhombus • Draw graphs of functions in which y is given explicitly or implicitly in terms of x • Complete tables of values for straight-line graphs • Recognise that equations of the form y = mx + c correspond to straight-line graphs in the coordinate plane with gradient m and y-intercept at (0, c). • Work out the gradient and the intersection with the axes. • Calculate the gradient of a given straight-line given two points or from an equation • Work out the equation of a line, given two points on the line or given one point and the gradient. • Work out the gradients of lines that are parallel and perpendicular to a given line • Show that two lines are parallel or perpendicular using gradients • Know that the gradients of perpendicular lines are the negative reciprocal of each other. • Manipulate the equations of straight lines so that it is possible to tell whether lines are parallel or perpendicular or not (rearrange equations) • Show step-by-step deduction in solving a geometrical problem. <u>Real life graphs</u>	<u>Scatter Graphs</u> • recognise and name positive, negative or no correlation as types of correlation • recognise and name strong, moderate or weak correlation as strengths of correlation • understand that just because a correlation exists, it does not necessarily mean that causality is present • draw a line of best fit by eye for data with strong enough correlation, or know that a line of best fit is not justified due to the lack of correlation • understand outliers and make decisions whether or not to include them when drawing a line of best fit • use a line of best fit to estimate unknown values when appropriate. • look for unusual data values such as a value that does not fit an otherwise good correlation. <u>Quadratic Equations and graphs</u> • solve quadratic equations by factorising, completing the square or using the quadratic formula • solve geometry problems that lead to a quadratic equation that can be solved by using the quadratic formula • read approximate solutions from a graph. • Interpret quadratic graphs by finding roots, intercepts and turning points. • Deduce turning points by completing the square. • Calculate values for a quadratic and draw the graph • Draw, sketch, recognise and interpret quadratic graphs <u>Sketching graphs</u> • Draw, sketch, recognise and interpret linear functions

	• Plot a graph representing a real-life problem from information given in words, in a table or as a formula • Identify the correct equation of a real-life graph from a drawing of the graph • Interpret the meaning of the gradient as the rate of change of the variable on the vertical axis compared to the horizontal axis read from graphs representing real-life situations; for example, work out the cost of a bill for so many units of gas or the number of units for a given cost, and also understand that the intercept of such a graph represents the fixed charge • Interpret linear graphs representing real-life situations; for example, graphs representing financial situations (eg gas, electricity, water, mobile phone bills, council tax) with or without fixed charges, and also understand that the intercept represents the fixed charge or deposit • Plot and interpret distance-time graphs • Interpret line graphs from real-life situations, for example conversion graphs • Interpret graphs showing real-life situations in geometry, such as the depth of water in containers as they are filled at a steady rate • Interpret non-linear graphs showing real-life situations, such as the height of a ball plotted against time. • Match direct and inverse proportion graphs to their equations and vice versa • Draw graphs to represent direct and inverse proportion.	• Draw, sketch, recognise and interpret quadratic graphs • Draw, sketch, recognise and interpret graphs of the form y = x 3 + k where k is an integer • Draw, sketch, recognise and interpret the graph $y = \frac{1}{x}$ with $x \neq 0$ • Draw, sketch, recognise and interpret graphs of the form $y = k x$ for positive values of k • Know and sketch the shapes of the graphs of functions $y = \sin x$, $y = \cos x$ and $y = \tan x$ <u>Transforming functions</u> • Transform the graph of any function $f(x)$ including: $f(x) + a$, $f(x + b)$, $-f(x)$ and $f(-x)$ where a and b are integers • Recognise transformations of functions and be able to write down the function of a transformation given the original function. • nterpret the meaning of the gradient as the rate of change of the variable on the vertical axis compared to the horizontal axis • Draw a tangent at a point on a curve and measure the gradient <u>Gradients and rates of change</u> • Interpret the meaning of the gradient as the rate of change of the variable on the vertical axis compared to the horizontal axis • Understand that if the vertical axis represents speed / velocity and the horizontal axis represents time then the gradient will represent acceleration • Understand that if the vertical axis represents distance and the horizontal axis represents time then the gradient will represent speed / velocity • Understand the difference between positive and negative gradients as rates of change • Understand that the rate of change at a particular instant in time is represented by the gradient of the tangent to the curve at that point • Understand that the average rate of change is represented by a chord.

Higher SOW Progression

Inequalities		
Year 9	Year 10	Year 11
• Understand the meaning of the four inequality symbols • Choose the correct inequality symbol for a particular situation • Represent practical situations as inequalities • Recognise a simple linear inequality • Find the set of integers that are solutions to an inequality • Use set notation to list a set of integers • Use a formal method to solve an inequality • Use a formal method to solve an inequality with unknowns on both sides • Use a formal method to solve an inequality involving brackets • Know how to deal with negative number terms in an inequality • Know how to show a range of values that solve an inequality on a number line • Know when to use an open circle at the end of a range of values shown on a number line • Know when to use an filled circle at the end of a range of values shown on a number line • Use a number line to find the set of values that are true for two inequalities		• know the difference between $<$, $\leqslant$, $\geqslant$, $>$ and $\neq$ • solve simple linear inequalities in one variable • represent the solution set of an inequality on a number line, knowing the correct conventions of an open circle for a strict inequality eg $x < 3$ and a closed circle for an inclusive inequality eg $x \leqslant 3$ • represent inequalities graphically • shade out the side of the boundary line that does not satisfy the inequality • solve quadratic inequalities • understand and use a solution set of discrete values written in the form $\{-2, -1, 0, 1, 2\}$ • understand and use a solution set of continuous values written in the form $-3 < x < 3$

Probability		
Year 9	Year 10	Year 11
• List outcomes of combined events using a tree diagram • Label a tree diagram with probabilities • Label a tree diagram with probabilities when events are dependent • Know when to add two or more probabilities • Know when to multiply two or more probabilities • Use a tree diagram to calculate probabilities of independent combined events • Use a tree diagram to calculate probabilities of dependent combined events	• List all the outcomes for a single event in a systematic way • List all the outcomes for two events in a systematic way • Work out probabilities by counting or listing equally likely outcomes • Draw and complete a two-way table from given information • Calculate probabilities from a two-way table • Complete a frequency table for the outcomes of an experiment • Understand and use the term relative frequency	• Understand that P(A) means the probability of event A • Understand that P(A/) means the probability of event not A • Understand that P(A $\cup$ B) means the probability of event A or B or both • Understand that P(A $\cap$ B) means the probability of event A and B

• Understand that relative frequency tends towards theoretical probability as sample size increases	• Consider differences, where they exist, between the theoretical probability of an outcome and its relative frequency in a practical situation • Understand when outcomes can or cannot happen at the same time • Use this understanding to calculate probabilities • Appreciate that the sum of the probabilities of all possible mutually exclusive outcomes has to be 1 • Find the probability of a single outcome from knowing the probability of all other outcomes. • Design and use frequency trees • Complete a frequency tree from given information • Use a frequency tree to compare frequencies of outcomes.	• Understand a Venn diagram consisting of a universal set and at most two sets, which may or may not intersect • Shade areas on a Venn diagram involving at most two sets, which may or may not intersect • Solve problems given a Venn diagram • Solve problems where a Venn diagram approach is a suitable strategy to use but a diagram is not given in the question. • Complete a tree diagram to show outcomes and probabilities • Know when it is appropriate to add probabilities • Know when it is appropriate to multiply probabilities • Understand the meaning of independence for events • Calculate probabilities when events are dependent • Understand conditional probability • Understand the implications of with or without replacement problems for the probabilities obtained • Use a tree diagram as a method for calculating probabilities for independent and dependant and conditional probabilities • Use a Venn diagram as a method for calculating conditional probabilities.

Representation of data		
Year 9	Year 10	Year 11
• Construct graphs of time series • Interpret graphs of time series • Construct and interpret compound bar charts • Interpret a wider range of non-standard graphs and charts • Understand that correlation does not indicate causation • Interpret a scatter diagram using understanding of correlation • Construct a line of best fit on a scatter diagram	• Draw: frequency tables, bar charts, pie charts, pictograms, vertical line charts for ungrouped discrete numerical data, tables and line graphs for time series data • Draw bar charts including composite bar charts, dual bar charts and multiple bar charts • Draw frequency polygons • Understand which of the diagrams are appropriate for different types of data • Interpret any of the types of diagram	

• Use a line of best fit to estimate values • Know when it is appropriate to use a line of best fit to estimate values	• Obtain information from any of the types of diagram • Draw and interpret cumulative frequency graphs (median, quartiles, interquartile range and box plots are not needed for this topic) • Understand which diagrams are appropriate for different types of data • Understand the difference between grouped and ungrouped data • Understand the advantages and disadvantages of grouping data • Construct histograms for grouped discrete and continuous data • Interpret histograms s for grouped discrete and continuous data.	

Angles, Scale Diagrams and Bearings		
Year 9	Year 10	Year 11
	• Understand the standard conventions for equal sides, parallel lines, naming points, sides and angles of a diagram • Distinguish between acute, obtuse, reflex and right angles • Draw and identify lines that are perpendicular • Work out the size of missing angles at a point on a straight line • Know that vertically opposite angles are equal • Derive and use the proof that the angle sum of a triangle is 180o • Use the fact that the angle sum of a quadrilateral is 360o • Derive and use the proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices • Understand and use the angle properties of parallel lines • Understand the consequent properties of parallelograms • Use angle properties of equilateral, isosceles and right-angled triangles • Justify an answer with explanations such as ‘angles on a straight line’, etc. • Use and interpret maps and scale drawings to calculate unknown values • Construct scale drawings • Recall and use the eight points of the compass and their equivalent three-figure bearings • Use compass point and three-figure bearings to specify direction • Mark points on a diagram given the bearing from another point • Draw and measure a bearing between points on a map or scale drawing (incl the bearing to return to a point)	

Higher SOW Progression

Fractions and decimals		
Year 9	Year 10	Year 11
•	• Convert between fractions and decimals using place value • Compare the value of fractions and decimals (including in statistics and geometry questions) • Order positive and/or negative numbers given as integers, decimals and fractions, including improper fractions. • Add, subtract, multiply and divide decimals using both mental and written methods • Simplify a fraction by cancelling all common factors, using a calculator where appropriate, for example, simplifying fractions that represent probabilities • Identify equivalent fractions • Compare fractions • Convert between mixed numbers and improper fractions • Apply the four rules to fractions with and without a calculator (including mixed numbers) • Multiply and divide a fraction by an integer, by a unit fraction and by a general fraction • Divide an integer by a fraction. • Use formal algebraic methods to convert recurring decimals into fractions	

Numerical methods		
Year 9	Year 10	Year 11
		• Use trial and improvement methods to find approximate solutions of equations where there is no simple analytical method • use suffix notation in recursive formulae • Use Iteration find approximate solutions using recursive formulae

Percentages		
Year 9	Year 10	Year 11
	<u>Basic Percentages</u> • Convert values between percentages, fractions and decimals in order to compare them, for example with probabilities	<u>Growth and decay</u> • Solve problems involving repeated proportional change

	• Interpret percentage as the operator 'so many hundredths of' • Work out the percentage of a shape that is shaded • Shade a given percentage of a shape • Interpret a percentage as a multiplier when solving problems • Calculate a percentage of a quantity • Convert between fractions, decimals and percentages to find the most appropriate method of calculation in a question; for example, 62% of £80 is $0.62 \times$ £80 and 25% of £80 is £80 ÷ 4 • use percentages in real-life situations <u>Calculating with percentages</u> • Calculate a percentage increase or decrease • Solve percentage increase and decrease problems, for example, use $1.12 \times Q$ to calculate a 12% increase in the value of Q and $0.88 \times Q$ to calculate a 12% decrease in the value of Q • Work out one quantity as a percentage of another quantity • Use percentages, decimals or fractions to calculate proportions • Calculate reverse percentages • Solve simple interest problems.	• Use calculators to explore exponential growth and decay using a multiplier and the power • Solve compound interest problems. • Model growth and decay problems mathematically • Solve growth and decay problems, for example using multipliers or iterative processes • Understand that some iterations may have a limiting value

Measures		
Year 9	Year 10	Year 11
	• Interpret scales on a range of measuring instruments, including those for time, temperature and mass, reading from the scale or marking a point on a scale to show a stated value • Know and use standard metric and imperial measures • Make sensible estimates of a range of measures in real-life situations, for example estimate the height of a man or a television mast would be measured in metres. • Recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction. • Recall and use conversions for metric measures for length, area, volume and capacity • Use conversions between imperial units and metric units using common approximations, for example 5 miles $\approx$ 8 kilometres, 1 gallon $\approx$ 4.5 litres, 2.2 pounds $\approx$ 1 kilogram, 1 inch $\approx$ 2.5 centimetres	

	• Write down the maximum or minimum figure for a value rounded to a given accuracy • Combine upper or lower bounds appropriately to achieve an overall maximum or minimum for a situation • Work with practical problems involving bounds including in statistics. For example, finding the midpoint of a class interval, such as $10 < t \leqslant 20$, in order to estimate a mean. • Know that measurements using real numbers depend on the choice of unit • Understand and use compound measures and compound units including area, volume, speed, rates of pay, density and pressure • Understand speed and know the relationship between speed, distance and time • Understand units in common usage such as miles per hour or metres per second. The values used in the question will make the required unit clear.	

Transformations		
Year 9	Year 10	Year 11
	• Describe and transform 2D shapes using single rotations specified by a centre and angle • Describe and transform 2D shapes using single reflections specified by a mirror line • Describe and transform 2D shapes using translations specified by a distance and direction (using a vector) • Describe and transform 2D shapes using enlargements by a positive scale factor specified by a centre and a scale factor • Identify the scale factor of an enlargement of a shape as the ratio of the lengths of two corresponding sides • Identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments • Distinguish properties that are preserved under particular transformations • Identify the scale factor of an enlargement • Construct enlargements with fractional and negative scale factors. • Describe and transform 2D shapes using combined rotations, reflections, translations, or enlargements	

	• Describe a combination of transformations as a single transformation • Understand and use the term 'invariance' for points, lines and shapes achieved by single or combined transformations • Map a point on a shape under a combination of transformations	

Statistical Measures		
Year 9	Year 10	Year 11
	• Find patterns in data that may lead to a conclusion being drawn • Look for unusual data values such as a value that does not fit an otherwise good correlation • Understand that samples may or may not be representative of a population • Understand that the size and construction of a sample will affect how representative it is. • Find the mean, mode (or modal class) median and sometimes the range for a discrete frequency distribution • Calculate an estimate of the mean for a grouped frequency distribution, knowing why it is an estimate • Find the interval containing the median for a grouped frequency distribution • Choose an appropriate measure to be the 'average', according to the nature of the data • Identify outliers • Calculate quartiles and inter-quartile range from a small data set using the positions of the lower quartile and upper quartile respectively • Read off lower quartile, median and upper quartile from a cumulative frequency diagram or a box plot and calculate inter-quartile range • Find an estimate of the median or other information from a histogram • Choose an appropriate measure according to the nature of the data to be the 'average' • Compare two diagrams in order to make decisions about a hypothesis • Use measures of central tendency and measures of dispersion to describe a population • Use statistical diagrams to describe a population.	

	• Compare two distributions in order to make decisions about a hypothesis by comparing the range or the inter-quartile range if available, and a suitable measure of average, such as the mean or median.	

Vectors		
Year 9	Year 10	Year 11
		• Understand and use vector notation • Calculate and represent graphically the sum of two vectors, the difference of two vectors and a scalar multiple of a vector • Calculate the resultant of two vectors • Understand and use the commutative and associative properties of vector addition. • Solve simple geometrical problems in 2D using vector methods • Apply vector methods for simple geometric proofs • Recognise when lines are parallel using vectors • Recognise when three or more points are collinear using vectors • Use vectors to show three or more points are collinear.

Congruence and Similarity		
Year 9	Year 10	Year 11
	• Understand congruence • Identify shapes that are congruent • Understand and use SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments, and to verify standard ruler and compass constructions.	

	• Recognise congruent shapes when rotated, reflected or in different orientations • Understand similarity • Understand similarity of triangles and of other plane figures, and use this to make geometric inferences • Identify shapes that are similar, including all squares, all circles or all regular polygons with equal number of sides • Recognise similar shapes when rotated, reflected or in different orientations • Understand the effect of enlargement on perimeter • Work out the side of one shape that is similar to another shape given the ratio or scale factor of lengths	