George Stephenson High School Secondary Scheme of Work: Year 10H - Higher

Unit	Lessons	Key Progression Indicators Knowledge, Understanding and Skills
Calculations, Checking & Rounding	3	• Add, subtract, multiply and divide decimals, whole numbers including any number between 0 and 1; • Put digits in the correct place in a decimal calculation and use one calculation to find the answer to another; • Use the product rule for counting (i.e. if there are m ways of doing one task and for each of these, there are n ways of doing another task, then the total number of ways the two tasks can be done is $m \times n$ ways); • Round numbers to the nearest 10, 100, 1000, the nearest integer, to a given number of decimal places and to a given number of significant figures; • Estimate answers to one- or two-step calculations, including use of rounding numbers and formal estimation to 1 significant figure: mainly whole numbers and then decimals.
Indices, Roots, Reciprocals & Hierarchy of Operations	4	• Use index notation for integer powers of 10, including negative powers; • Recognise powers of 2, 3, 4, 5; • Use the square, cube and power keys on a calculator and estimate powers and roots of any given positive number, by considering the values it must lie between, e.g. the square root of 42 must be between 6 and 7; • Find the value of calculations using indices including positive, fractional and negative indices; • Recall that $n^0 = 1$ and $n^{-1} = \frac{1}{n}$ for positive integers n as well as, $n^{\frac{1}{2}} = \sqrt{n}$ and $n^{\frac{1}{3}} = \sqrt[3]{n}$ for any positive number n; • Understand that the inverse operation of raising a positive number to a power n is raising the result of this operation to the power $\frac{1}{n}$; • Use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer powers, fractional and negative powers, and powers of a power; • Solve problems using index laws; • Use brackets and the hierarchy of operations up to and including with powers and roots inside the brackets, or raising brackets to powers or taking roots of brackets; • Use an extended range of calculator functions, including +, -, ×, ÷, x^2, $\sqrt{x}$, memory, x^y, $x^{\frac{1}{y}}$, brackets; • Use calculators for all calculations: positive and negative numbers, brackets, powers and roots, four operations.

Factors, Multiples, Primes, Standard Form & Surds	7	• Identify factors, multiples and prime numbers; • Find the prime factor decomposition of positive integers – write as a product using index notation; • Find common factors and common multiples of two numbers; • Find the LCM and HCF of two numbers, by listing, Venn diagrams and using prime factors – include finding LCM and HCF given the prime factorisation of two numbers; • Solve problems using HCF and LCM, and prime numbers; • Understand that the prime factor decomposition of a positive integer is unique, whichever factor pair you start with, and that every number can be written as a product of prime factors. • Convert large and small numbers into standard form and vice versa; • Add, subtract, multiply and divide numbers in standard form; • Interpret a calculator display using standard form and know how to enter numbers in standard form; • Understand surd notation, e.g. calculator gives answer to sq rt 8 as 4 rt 2; • Simplify surd expressions involving squares (e.g. $\sqrt{12} = \sqrt{(4 \times 3)} = \sqrt{4} \times \sqrt{3} = 2\sqrt{3}$).
Algebra: the basics, setting up, Rearranging and Solving Equations	8	• Use algebraic notation and symbols correctly; • Know the difference between a term, expression, equation, formula and an identity; • Write and manipulate an expression by collecting like terms; • Substitute positive and negative numbers into expressions such as $3x + 4$ and $2x^3$ and then into expressions involving brackets and powers; • Substitute numbers into formulae from mathematics and other subject using simple linear formulae, e.g. $l \times w$, $v = u + at$; • Simplify expressions by cancelling, e.g. $\frac{4x}{2} = 2x$; • Use instances of index laws for positive integer powers including when multiplying or dividing algebraic terms; • Use instances of index laws, including use of zero, fractional and negative powers; • Multiply a single term over a bracket and recognise factors of algebraic terms involving single brackets and simplify expressions by factorising, including subsequently collecting like terms; • Expand the product of two linear expressions, i.e. double brackets working up to negatives in both brackets and also similar to $(2x + 3y)(3x - y)$; • Know that squaring a linear expression is the same as expanding double brackets; • Factorise quadratic expressions of the form $ax^2 + bx + c$; • Factorise quadratic expressions using the difference of two squares. • Set up simple equations from word problems and derive simple formulae;

		• Understand the ≠ symbol (not equal), e.g. $6x + 4 \neq 3(x + 2)$, and introduce identity ≡ sign; • Solve linear equations, with integer coefficients, in which the unknown appears on either side or on both sides of the equation; • Solve linear equations which contain brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution; • Solve linear equations in one unknown, with integer or fractional coefficients; • Set up and solve linear equations to solve a problem; • Derive a formula and set up simple equations from word problems, then solve these equations, interpreting the solution in the context of the problem; • Substitute positive and negative numbers into a formula, solve the resulting equation including brackets, powers or standard form; • Use and substitute formulae from mathematics and other subjects, including the kinematics formulae $v = u + at$, $v^2 - u^2 = 2as$, and $s = ut + \frac{1}{2}at^2$; • Change the subject of a simple formula, i.e. linear one-step, such as $x = 4y$; • Change the subject of a formula, including cases where the subject is on both sides of the original formula, or involving fractions and small powers of the subject; • Simple proofs and use of ≡ in “show that” style questions; know the difference between an equation and an identity; • Use iteration to find approximate solutions to equations, for simple equations in the first instance, then quadratic and cubic equations
Sequences	4	• Recognise simple sequences including at the most basic level odd, even, triangular, square and cube numbers and Fibonacci-type sequences (including those involving numbers in standard form or index form); • Generate sequences of numbers, squared integers and sequences derived from diagrams; • Describe in words a term-to-term sequence and identify which terms cannot be in a sequence; • Generate specific terms in a sequence using the position-to-term rule and term-to-term rule; • Find and use (to generate terms) the nth term of an arithmetic sequence; • Use the nth term of an arithmetic sequence to decide if a given number is a term in the sequence, or find the first term above or below a given number; • Identify which terms cannot be in a sequence by finding the nth term; • Continue a quadratic sequence and use the nth term to generate terms; • Find the nth term of quadratic sequences; • Distinguish between arithmetic and geometric sequences; • Use finite/infinite and ascending/descending to describe sequences;

		• Recognise and use simple geometric progressions (rn where n is an integer, and r is a rational number > 0 or a surd); • Continue geometric progression and find term to term rule, including negative, fraction and decimal terms; • Solve problems involving sequences from real life situations.

Averages and range	4	• Design and use two-way tables for discrete and grouped data;
		• Use information provided to complete a two-way table;
		• Sort, classify and tabulate data and discrete or continuous quantitative data;
		• Calculate mean and range, find median and mode from a small data set;
		• Use a spreadsheet to calculate mean and range, and find median and mode;
		• Recognise the advantages and disadvantages between measures of average;
		• Construct and interpret stem and leaf diagrams (including back-to-back diagrams):
		  ○ find the mode, median, range, as well as the greatest and least values from stem and leaf diagrams, and compare two distributions from stem and leaf diagrams (mode, median, range);
		• Calculate the mean, mode, median and range from a frequency table (discrete data);
		• Construct and interpret grouped frequency tables for continuous data:
		  ○ for grouped data, find the interval which contains the median and the modal class;
		  ○ estimate the mean with grouped data;
		• Understand that the expression 'estimate' will be used where appropriate, when finding the mean of grouped data using mid-interval values

Representing and Interpreting Data & Scatter Graphs	4	• Know which charts to use for different types of data sets;
		• Produce and interpret composite bar charts;
		• Produce and interpret comparative and dual bar charts;
		• Produce and interpret pie charts:
		  ○ find the mode and the frequency represented by each sector;
		  ○ compare data from pie charts that represent different-sized samples;
		• Produce and interpret frequency polygons for grouped data:
		  ○ from frequency polygons, read off frequency values, compare distributions, calculate total population, mean, estimate greatest and least possible values (and range);
		• Produce frequency diagrams for grouped discrete data:
		  ○ read off frequency values, calculate total population, find greatest and least values;
		• Produce histograms with equal class intervals:
		  ○ estimate the median from a histogram with equal class width or any other information, such as the number of people in each interval;

		• Produce line graphs: ○ read off frequency values, calculate total population, find greatest and least values; • Construct and interpret time-series graphs, comment on trends; • Compare the mean and range of two distributions, or median or mode as appropriate; • Recognise simple patterns, characteristics relationships in bar charts, line graphs and frequency polygons; • Draw and interpret scatter graphs in terms of the relationship between two variables; • Draw lines of best fit by eye, understanding what these represent; • Identify outliers and ignore them on scatter graphs; • Use a line of best fit, or otherwise, to predict values of a variable given values of the other variable; • Distinguish between positive, negative and zero correlation using lines of best fit, and interpret correlation in terms of the problem; • Understand that correlation does not imply causality, and appreciate that correlation is a measure of the strength of the association between two variables and that zero correlation does not necessarily imply 'no relationship' but merely 'no linear correlation'; • Explain an isolated point on a scatter graph; • Use the line of best fit make predictions; interpolate and extrapolate apparent trends whilst knowing the dangers of so doing.
Fractions & Percentages	10	• Express a given number as a fraction of another; • Find equivalent fractions and compare the size of fractions; • Write a fraction in its simplest form, including using it to simplify a calculation, e.g. 50 ÷ 20 = $\frac{50}{20}$ = $\frac{5}{2}$ = **2.5**; • Find a fraction of a quantity or measurement, including within a context; • Convert a fraction to a decimal to make a calculation easier; • Convert between mixed numbers and improper fractions; • Add and subtract fractions, including mixed numbers; • Multiply and divide fractions, including mixed numbers and whole numbers and vice versa; • Understand and use unit fractions as multiplicative inverses; • By writing the denominator in terms of its prime factors, decide whether fractions can be converted to recurring or terminating decimals; • Convert a fraction to a recurring decimal and vice versa; • Find the reciprocal of an integer, decimal or fraction; • Convert between fractions, decimals and percentages; • Express a given number as a percentage of another number;

		• Express one quantity as a percentage of another where the percentage is greater than 100% • Find a percentage of a quantity; • Find the new amount after a percentage increase or decrease; • Work out a percentage increase or decrease, including: simple interest, income tax calculations, value of profit or loss, percentage profit or loss; • Compare two quantities using percentages, including a range of calculations and contexts such as those involving time or money; • Find a percentage of a quantity using a multiplier and use a multiplier to increase or decrease by a percentage in any scenario where percentages are used; • Find the original amount given the final amount after a percentage increase or decrease (reverse percentages), including VAT; • Use calculators for reverse percentage calculations by doing an appropriate division; • Use percentages in real-life situations, including percentages greater than 100%; • Describe percentage increase/decrease with fractions, e.g. 150% increase means $2\frac{1}{2}$ times as big; • Understand that fractions are more accurate in calculations than rounded percentage or decimal equivalents, and choose fractions, decimals or percentages appropriately for calculations.
Ratio and proportion	6	• Express the division of a quantity into a number of parts as a ratio; • Write ratios in form 1: m or m : 1 and to describe a situation; • Write ratios in their simplest form, including three-part ratios; • Divide a given quantity into two or more parts in a given part: part or part: whole ratio; • Use a ratio to find one quantity when the other is known; • Write a ratio as a fraction and as a linear function; • Identify direct proportion from a table of values, by comparing ratios of values; • Use a ratio to compare a scale model to real-life object; • Use a ratio to convert between measures and currencies, e.g. £1.00 = €1.36; • Scale up recipes; • Convert between currencies.
Polygons, Angles and Parallel lines	6	• Classify quadrilaterals by their geometric properties and distinguish between scalene, isosceles and equilateral triangles; • Understand ‘regular’ and ‘irregular’ as applied to polygons; • Understand the proof that the angle sum of a triangle is 180°, and derive and use the sum of angles in a triangle; • Use symmetry property of an isosceles triangle to show that base angles are equal;

		• Find missing angles in a triangle using the angle sum in a triangle AND the properties of an isosceles triangle; • Understand a proof of, and use the fact that, the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices; • Explain why the angle sum of a quadrilateral is 360°; use the angle properties of quadrilaterals and the fact that the angle sum of a quadrilateral is 360°; • Understand and use the angle properties of parallel lines and find missing angles using the properties of corresponding and alternate angles, giving reasons; • Use the angle sums of irregular polygons; • Calculate and use the sums of the interior angles of polygons; use the sum of angles in a triangle and use the angle sum in any polygon to derive the properties of regular polygons; • Use the sum of the exterior angles of any polygon is 360°; • Use the sum of the interior angles of an n-sided polygon; • Use the sum of the interior angle and the exterior angle is 180°; • Find the size of each interior angle, or the size of each exterior angle, or the number of sides of a regular polygon, and use the sum of angles of irregular polygons; • Calculate the angles of regular polygons and use these to solve problems; • Use the side/angle properties of compound shapes made up of triangles, lines and quadrilaterals, including solving angle and symmetry problems for shapes in the first quadrant, more complex problems and using algebra; • Use angle facts to demonstrate how shapes would 'fit together' and work out interior angles of shapes in a pattern.
Pythagoras' Theorem and Trigonometry	6	• Understand, recall and use Pythagoras' Theorem in 2D; • Given three sides of a triangle, justify if it is right-angled or not; • Calculate the length of the hypotenuse in a right-angled triangle (including decimal lengths and a range of units); • Find the length of a shorter side in a right-angled triangle; • Calculate the length of a line segment AB given pairs of points; • Give an answer to the use of Pythagoras' Theorem in surd form; • Understand, use and recall the trigonometric ratios sine, cosine and tan, and apply them to find angles and lengths in general triangles in 2D figures; • Use the trigonometric ratios to solve 2D problems; • Find angles of elevation and depression; • Know the exact values of sin θ and cos θ for θ = 0°, 30°, 45°, 60° and 90°; know the exact value of tan θ for θ = 0°, 30°, 45° and 60°.

Graphs: the basics and real-life graphs	4	• Identify and plot points in all four quadrants; • Draw and interpret straight-line graphs for real-life situations, including ready reckoner graphs, conversion graphs, fuel bills, fixed charge and cost per item; • Draw distance-time and velocity-time graphs; • Use graphs to calculate various measures (of individual sections), including: unit price (gradient), average speed, distance, time, acceleration; including using enclosed areas by counting squares or using areas of trapezia, rectangles and triangles; • Find the coordinates of the midpoint of a line segment with a diagram given and coordinates; • Find the coordinates of the midpoint of a line segment from coordinates; • Calculate the length of a line segment given the coordinates of the end points; • Find the coordinates of points identified by geometrical information. • Find the equation of the line through two given points.

Linear Graphs & Coordinate Geometry	8	• Plot and draw graphs of $y = a$, $x = a$, $y = x$ and $y = -x$, drawing and recognising lines parallel to axes, plus $y = x$ and $y = -x$;
		• Identify and interpret the gradient of a line segment;
		• Recognise that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane;
		• Identify and interpret the gradient and y-intercept of a linear graph given by equations of the form $y = mx + c$;
		• Find the equation of a straight line from a graph in the form $y = mx + c$;
		• Plot and draw graphs of straight lines of the form $y = mx + c$ with and without a table of values;
		• Sketch a graph of a linear function, using the gradient and y-intercept (i.e. without a table of values);
		• Find the equation of the line through one point with a given gradient;
		• Identify and interpret gradient from an equation $ax + by = c$;
		• Find the equation of a straight line from a graph in the form $ax + by = c$;
		• Plot and draw graphs of straight lines in the form $ax + by = c$;
		• Interpret and analyse information presented in a range of linear graphs:
		  ○ use gradients to interpret how one variable changes in relation to another;
		  ○ find approximate solutions to a linear equation from a graph;
		  ○ identify direct proportion from a graph;
		  ○ find the equation of a line of best fit (scatter graphs) to model the relationship between quantities;
		• Explore the gradients of parallel lines and lines perpendicular to each other;
		• Interpret and analyse a straight-line graph and generate equations of lines parallel and perpendicular to the given line;

		• Select and use the fact that when $y = mx + c$ is the equation of a straight line, then the gradient of a line parallel to it will have a gradient of m and a line perpendicular to this line will have a gradient of $-\frac{1}{m}$.
Quadratic, Cubic and Other Graphs	4	• Recognise a linear, quadratic, cubic, reciprocal and circle graph from its shape; • Generate points and plot graphs of simple quadratic functions, then more general quadratic functions; • Find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function; • Interpret graphs of quadratic functions from real-life problems; • Draw graphs of simple cubic functions using tables of values; • Interpret graphs of simple cubic functions, including finding solutions to cubic equations; • Draw graphs of the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$ using tables of values; • Draw circles, centre the origin, equation $x^2 + y^2 = r^2$.
Perimeter, Area & Circles	6	• Recall and use the formulae for the area of a triangle, rectangle, trapezium and parallelogram using a variety of metric measures; • Calculate the area of compound shapes made from triangles, rectangles, trapezia and parallelograms using a variety of metric measures; • Find the perimeter of a rectangle, trapezium and parallelogram using a variety of metric measures; • Calculate the perimeter of compound shapes made from triangles and rectangles; • Estimate area and perimeter by rounding measurements to 1 significant figure to check reasonableness of answers; • Recall the definition of a circle and name and draw parts of a circle; • Recall and use formulae for the circumference of a circle and the area enclosed by a circle (using circumference = $2\pi r = \pi d$ and area of a circle = πr^2) using a variety of metric measures; • Use $\pi \approx 3.142$ or use the π button on a calculator; • Calculate perimeters and areas of composite shapes made from circles and parts of circles (including semicircles, quarter-circles, combinations of these and incorporating other polygons); • Calculate arc lengths, angles and areas of sectors of circles; • Find radius or diameter, given area or circumference of circles in a variety of metric measures; • Give answers to an appropriate degree of accuracy or in terms of π; • Form equations involving more complex shapes and solve these equations.

3D Forms & Volume, Cylinders, Cones & Spheres	6	• Find the surface area of prisms using the formulae for triangles and rectangles, and other (simple) shapes with and without a diagram; • Draw sketches of 3D solids and identify planes of symmetry of 3D solids, and sketch planes of symmetry; • Recall and use the formula for the volume of a cuboid or prism made from composite 3D solids using a variety of metric measures; • Convert between metric measures of volume and capacity, e.g. 1 ml = 1 cm^3; • Use volume to solve problems; • Estimating surface area, perimeter and volume by rounding measurements to 1 significant figure to check reasonableness of answers; • Use $\pi \approx 3.142$ or use the π button on a calculator; • Find the volume and surface area of a cylinder; • Recall and use the formula for volume of pyramid; • Find the surface area of a pyramid; • Use the formulae for volume and surface area of spheres and cones; • Solve problems involving more complex shapes and solids, including segments of circles and frustums of cones; • Find the surface area and volumes of compound solids constructed from cubes, cuboids, cones, pyramids, spheres, hemispheres, cylinders; • Give answers to an appropriate degree of accuracy or in terms of π; • Form equations involving more complex shapes and solve these equations.
Accuracy & Bounds	4	• Calculate the upper and lowers bounds of numbers given to varying degrees of accuracy; • Calculate the upper and lower bounds of an expression involving the four operations; • Find the upper and lower bounds in real-life situations using measurements given to appropriate degrees of accuracy; • Find the upper and lower bounds of calculations involving perimeters, areas and volumes of 2D and 3D shapes; • Calculate the upper and lower bounds of calculations, particularly when working with measurements; • Use inequality notation to specify an error interval due to truncation or rounding.
Transformations	8	• Distinguish properties that are preserved under transformations; • Recognise and describe rotations – know that they are specified by a centre and an angle; • Rotate 2D shapes using the origin or any other point (not necessarily on a coordinate grid); • Identify the equation of a line of symmetry;

		• Recognise and describe reflections on a coordinate grid – know to include the mirror line as a simple algebraic equation, $x = a$, $y = a$, $y = x$, $y = -x$ and lines not parallel to the axes; • Reflect 2D shapes using specified mirror lines including lines parallel to the axes and $y = x$ and $y = -x$; • Recognise and describe single translations using column vectors on a coordinate grid; • Translate a given shape by a vector; • Understand the effect of one translation followed by another, in terms of column vectors (to introduce vectors in a concrete way); • Enlarge a shape on a grid without a centre specified; • Describe and transform 2D shapes using enlargements by a positive integer, positive fractional, and negative scale factor; • Know that an enlargement on a grid is specified by a centre and a scale factor; • Identify the scale factor of an enlargement of a shape; • Enlarge a given shape using a given centre as the centre of enlargement by counting distances from centre, and find the centre of enlargement by drawing; • Find areas after enlargement and compare with before enlargement, to deduce multiplicative relationship (area scale factor); given the areas of two shapes, one an enlargement of the other, find the scale factor of the enlargement (whole number values only); • Use congruence to show that translations, rotations and reflections preserve length and angle, so that any figure is congruent to its image under any of these transformations; • Describe and transform 2D shapes using combined rotations, reflections, translations, or enlargements; • Describe the changes and invariance achieved by combinations of rotations, reflections and translations.
Constructions, Loci & Bearings	8	• Understand and draw front and side elevations and plans of shapes made from simple solids; • Given the front and side elevations and the plan of a solid, draw a sketch of the 3D solid; • Use and interpret maps and scale drawings, using a variety of scales and units; • Read and construct scale drawings, drawing lines and shapes to scale; • Estimate lengths using a scale diagram; • Understand, draw and measure bearings; • Calculate bearings and solve bearings problems, including on scaled maps, and find/mark and measure bearings • Use the standard ruler and compass constructions: ○ bisect a given angle;

		○ construct a perpendicular to a given line from/at a given point; ○ construct angles of 90°, 45°; ○ perpendicular bisector of a line segment; • Construct: ○ a region bounded by a circle and an intersecting line; ○ a given distance from a point and a given distance from a line; ○ equal distances from two points or two-line segments; ○ regions which may be defined by ‘nearer to’ or ‘greater than’; • Find and describe regions satisfying a combination of loci, including in 3D; • Use constructions to solve loci problems including with bearings; • Know that the perpendicular distance from a point to a line is the shortest distance to the line.
Solving Quadratic & Simultaneous Equations	8	• Factorise quadratic expressions in the form $ax^2 + bx + c$; • Set up and solve quadratic equations; • Solve quadratic equations by factorisation and completing the square; • Solve quadratic equations that need rearranging; • Solve quadratic equations by using the quadratic formula; • Find the exact solutions of two simultaneous equations in two unknowns; • Use elimination or substitution to solve simultaneous equations; • Solve exactly, by elimination of an unknown, two simultaneous equations in two unknowns: ○ linear / linear, including where both need multiplying; ○ linear / quadratic; ○ linear / $x^2 + y^2 = r^2$; • Set up and solve a pair of simultaneous equations in two variables for each of the above scenarios, including to represent a situation; • Interpret the solution in the context of the problem;
Inequalities	6	• Show inequalities on number lines; • Write down whole number values that satisfy an inequality; • Solve simple linear inequalities in one variable, and represent the solution set on a number line; • Solve two linear inequalities in x, find the solution sets and compare them to see which value of x satisfies both solve linear inequalities in two variables algebraically; • Use the correct notation to show inclusive and exclusive inequalities.

Probability	8	• Write probabilities using fractions, percentages or decimals; • Understand and use experimental and theoretical measures of probability, including relative frequency to include outcomes using dice, spinners, coins, etc; • Estimate the number of times an event will occur, given the probability and the number of trials; • Find the probability of successive events, such as several throws of a single dice; • List all outcomes for single events, and combined events, systematically; • Draw sample space diagrams and use them for adding simple probabilities; • Know that the sum of the probabilities of all outcomes is 1; • Use $1 - p$ as the probability of an event not occurring where p is the probability of the event occurring; • Work out probabilities from Venn diagrams to represent real-life situations and also 'abstract' sets of numbers/values; • Use union and intersection notation; • Find a missing probability from a list or two-way table, including algebraic terms; • Understand conditional probabilities and decide if two events are independent; • Draw a probability tree diagram based on given information, and use this to find probability and expected number of outcomes; • Understand selection with or without replacement; • Calculate the probability of independent and dependent combined events; • Use a two-way table to calculate conditional probability; • Use a tree diagram to calculate conditional probability; • Use a Venn diagram to calculate conditional probability; • Compare experimental data and theoretical probabilities; • Compare relative frequencies from samples of different sizes.

Multiplicative Reasoning	8	• Express a multiplicative relationship between two quantities as a ratio or a fraction, e.g. when A:B are in the ratio 3:5, A is $\frac{3}{5}B$. When $4a = 7b$, then $a = \frac{7b}{4}$ or a:b is 7:4;
		• Solve proportion problems using the unitary method;
		• Work out which product offers best value and consider rates of pay;
		• Work out the multiplier for repeated proportional change as a single decimal number;
		• Represent repeated proportional change using a multiplier raised to a power, use this to solve problems involving compound interest and depreciation;
		• Understand and use compound measures and:
		  ○ convert between metric speed measures;
		  ○ convert between density measures;
		  ○ convert between pressure measures;

		• Use kinematics formulae from the formulae sheet to calculate speed, acceleration, etc (with variables defined in the question); • Calculate an unknown quantity from quantities that vary in direct or inverse proportion; • Recognise when values are in direct proportion by reference to the graph form, and use a graph to find the value of k in $y = kx$; • Set up and use equations to solve word and other problems involving direct proportion (this is covered in more detail in unit 19); • Relate algebraic solutions to graphical representation of the equations; • Recognise when values are in inverse proportion by reference to the graph form; • Set up and use equations to solve word and other problems involving inverse proportion and relate algebraic solutions to graphical representation of the equations.
Similarity & Congruence in 2D & 3D	8	• Understand and use SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments, and to verify standard ruler and pair of compasses constructions; • Solve angle problems by first proving congruence; • Understand similarity of triangles and of other plane shapes, and use this to make geometric inferences; • Prove that two shapes are similar by showing that all corresponding angles are equal in size and/or lengths of sides are in the same ratio/one is an enlargement of the other, giving the scale factor; • Use formal geometric proof for the similarity of two given triangles; • Understand the effect of enlargement on angles, perimeter, area and volume of shapes and solids; • Identify the scale factor of an enlargement of a similar shape as the ratio of the lengths of two corresponding sides, using integer or fraction scale factors; • Write the lengths, areas and volumes of two shapes as ratios in their simplest form; • Find missing lengths, areas and volumes in similar 3D solids; • Know the relationships between linear, area and volume scale factors of mathematically similar shapes and solids; • Use the relationship between enlargement and areas and volumes of simple shapes and solids; • Solve problems involving frustums of cones where you must find missing lengths first using similar triangles.

Unit	Lessons	Key Progression Indicators Knowledge, Understanding and Skills
Graphs of Trigonometric Functions		• Recognise, sketch and interpret graphs of the trigonometric functions (in degrees) y = sin x, y = cos x and y = tan x for angles of any size. • Know the exact values of sin θ and cos θ for θ = 0°, 30°, 45° , 60° and 90° and exact value of tan θ for θ = 0°, 30°, 45° and 60° and find them from graphs. • Apply to the graph of y = f(x) the transformations y = −f(x), y = f(−x) for sine, cosine and tan functions f(x). • Apply to the graph of y = f(x) the transformations y = f(x) + a, y = f(x + a) for sine, cosine and tan functions f(x).
Further Trigonometry		• Know and apply Area = $\frac{1}{2}ab$ sin C to calculate the area, sides or angles of any triangle. • Know the sine and cosine rules and use to solve 2D problems (including involving bearings). • Use the sine and cosine rules to solve 3D problems. • Understand the language of planes, and recognise the diagonals of a cuboid. • Solve geometrical problems on coordinate axes. • Understand, recall and use trigonometric relationships and Pythagoras' Theorem in right-angled triangles, and use these to solve problems in 3D configurations. • Calculate the length of a diagonal of a cuboid. • Find the angle between a line and a plane.

Collecting Data		• Specify the problem and plan:
		  ○ decide what data to collect and what analysis is needed;
		  ○ understand primary and secondary data sources;
		  ○ consider fairness;
		• Understand what is meant by a sample and a population;
		• Understand how different sample sizes may affect the reliability of conclusions drawn;
		• Identify possible sources of bias and plan to minimise it;
		• Write questions to eliminate bias, and understand how the timing and location of a survey can ensure a sample is representative.

Cumulative Frequency, Box Plots & Histograms		• By the end of the sub-unit, students should be able to: • Use statistics found in all graphs/charts in this unit to describe a population; • Know the appropriate uses of cumulative frequency diagrams; • Construct and interpret cumulative frequency tables, cumulative frequency graphs/diagrams and from the graph:

		○ estimate frequency greater/less than a given value; ○ find the median and quartile values and interquartile range; • Compare the mean and range of two distributions, or median and interquartile range, as appropriate; • Interpret box plots to find median, quartiles, range and interquartile range and draw conclusions; • Produce box plots from raw data and when given quartiles, median and identify any outliers; • Know the appropriate uses of histograms; • Construct and interpret histograms from class intervals with unequal width; • Use and understand frequency density; • From histograms: ○ complete a grouped frequency table; ○ understand and define frequency density; • Estimate the mean and median from a histogram with unequal class widths or any other information from a histogram, such as the number of people in a given interval.
Quadratics, expanding more than two brackets, sketching graphs, graphs of circles, cubes & quadratics		• Sketch a graph of a quadratic function, by factorising or by using the formula, identifying roots, y-intercept and turning point by completing the square; • Be able to identify from a graph if a quadratic equation has any real roots; • Find approximate solutions to quadratic equations using a graph; • Expand the product of more than two linear expressions; • Sketch a graph of a quadratic function and a linear function, identifying intersection points; • Sketch graphs of simple cubic functions, given as three linear expressions; • Solve simultaneous equations graphically: ○ find approximate solutions to simultaneous equations formed from one linear function and one quadratic function using a graphical approach; ○ find graphically the intersection points of a given straight line with a circle; ○ solve simultaneous equations representing a real-life situation graphically, and interpret the solution in the context of the problem; • Solve quadratic inequalities in one variable, by factorising and sketching the graph to find critical values; • Represent the solution set for inequalities using set notation, i.e. curly brackets and ‘is an element of’ notation;

		○ for problems identifying the solutions to two different inequalities, show this as the intersection of the two solution sets, i.e. solution of $x^2 - 3x - 10 < 0$ as $\{x: -3 < x < 5\}$; • Solve linear inequalities in two variables graphically; • Show the solution set of several inequalities in two variables on a graph; • Use iteration with simple converging sequences.
Circle Theorems		• Recall the definition of a circle and identify (name) and draw parts of a circle, including sector, tangent, chord, segment; • Prove and use the facts that: ○ the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference; ○ the angle in a semicircle is a right angle; ○ the perpendicular from the centre of a circle to a chord bisects the chord; ○ angles in the same segment are equal; ○ alternate segment theorem; ○ opposite angles of a cyclic quadrilateral sum to 180°; • Understand and use the fact that the tangent at any point on a circle is perpendicular to the radius at that point; • Find and give reasons for missing angles on diagrams using: ○ circle theorems; ○ isosceles triangles (radius properties) in circles; ○ the fact that the angle between a tangent and radius is 90°; • the fact that tangents from an external point are equal in length.
Circle Geometry		• Select and apply construction techniques and understanding of loci to draw graphs based on circles and perpendiculars of lines; • Find the equation of a tangent to a circle at a given point, by: ○ finding the gradient of the radius that meets the circle at that point (circles all centre the origin); ○ finding the gradient of the tangent perpendicular to it; ○ using the given point; • Recognise and construct the graph of a circle using $x^2 + y^2 = r^2$ for radius r centred at the origin of coordinates.

Changing the Subject of a Formulae (more complex), Algebraic Fractions, Solving Equations arising from Algebraic Fractions, Rationalising Surds, Proof.		• Rationalise the denominator involving surds; • Simplify algebraic fractions; • Multiply and divide algebraic fractions; • Solve quadratic equations arising from algebraic fraction equations; • Change the subject of a formula, including cases where the subject occurs on both sides of the formula, or where a power of the subject appears; • Change the subject of a formula such as $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$, where all variables are in the denominators; • Solve 'Show that' and proof questions using consecutive integers (n, n + 1), squares a^2, b^2, even numbers 2n, odd numbers 2n +1; • Use function notation; • Find f(x) + g(x) and f(x) − g(x), 2f(x), f(3x) etc algebraically; • Find the inverse of a linear function; • Know that $f^{-1}(x)$ refers to the inverse function; • For two functions f(x) and g(x), find gf(x).
Vectors & Geometric Proof		• Understand and use vector notation, including column notation, and understand and interpret vectors as displacement in the plane with an associated direction. • Understand that 2**a** is parallel to **a** and twice its length, and that **a** is parallel to −**a** in the opposite direction. • Represent vectors, combinations of vectors and scalar multiples in the plane pictorially. • Calculate the sum of two vectors, the difference of two vectors and a scalar multiple of a vector using column vectors (including algebraic terms). • Find the length of a vector using Pythagoras' Theorem. • Calculate the resultant of two vectors. • Solve geometric problems in 2D where vectors are divided in a given ratio. • Produce geometrical proofs to prove points are collinear and vectors/lines are parallel.
Reciprocal & Exponential Graphs; Gradient & Area under Graphs		• Recognise, sketch and interpret graphs of the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$ • State the value of x for which the equation is not defined; • Recognise, sketch and interpret graphs of exponential functions $y = k^x$ for positive values of k and integer values of x; • Use calculators to explore exponential growth and decay; • Set up, solve and interpret the answers in growth and decay problems;

		• Interpret and analyse transformations of graphs of functions and write the functions algebraically, e.g. write the equation of f(x) + a, or f(x − a):
		  ○ apply to the graph of y = f(x) the transformations y = −f(x), y = f(x) for linear, quadratic, cubic functions;
		  ○ apply to the graph of y = f(x) the transformations y = f(x) + a, y = f(x + a) for linear, quadratic, cubic functions;
		• Estimate area under a quadratic or other graph by dividing it into trapezia;
		• Interpret the gradient of linear or non-linear graphs, and estimate the gradient of a quadratic or non-linear graph at a given point by sketching the tangent and finding its gradient;
		• Interpret the gradient of non-linear graph in curved distance-time and velocity-time graphs:
		  ○ for a non-linear distance-time graph, estimate the speed at one point in time, from the tangent, and the average speed over several seconds by finding the gradient of the chord;
		  ○ for a non-linear velocity-time graph, estimate the acceleration at one point in time, from the tangent, and the average acceleration over several seconds by finding the gradient of the chord;
		• Interpret the gradient of a linear or non-linear graph in financial contexts;
		• Interpret the area under a linear or non-linear graph in real-life contexts;
		• Interpret the rate of change of graphs of containers filling and emptying;
		• Interpret the rate of change of unit price in price graphs.

Direct & Inverse Proportion		• Recognise and interpret graphs showing direct and inverse proportion; • Identify direct proportion from a table of values, by comparing ratios of values, for x squared and x cubed relationships; • Write statements of proportionality for quantities proportional to the square, cube or other power of another quantity; • Set up and use equations to solve word and other problems involving direct proportion; • Use $y = kx$ to solve direct proportion problems, including questions where students find k, and then use k to find another value; • Solve problems involving inverse proportion using graphs by plotting and reading values from graphs; • Solve problems involving inverse proportionality; • Set up and use equations to solve word and other problems involving direct proportion or inverse proportion.