CHURCH STRETTON SCHOOL

Mathematics Department

Key stage 4: Higher

	Term	Topic	Learning Outcomes	Assessment
Year 9	Spring 2	Unit 5: Polygons, Angles and Parallel Lines	• 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 to deduce and use the angle sum in any polygon and 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. •	End of Unit Test

	Summer 1	Unit 6: Graphs - The Basics	• 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.	
		Unit 6: Co-ordinate Geometry	• 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;	End of Unit Test

			• 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 $-\frac{1}{m}$. •	
	Summer 2	Unit 6: Non Linear Graphs	• 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 + • $y^2 = r^2$.	

End of year assessment
This will include all topics covered
Misconceptions will be addressed as part of the end of year assessment review process

	Autumn 1	Unit 7: Area and volume	• calculate exactly with fractions, surds and multiples of π; simplify surd expressions involving squares (e.g. √12 = √(4 × 3) = √4 × √3 = 2√3) and rationalise denominators. • use standard units of mass, length, time, money and other measures (including standard compound measures) using decimal quantities where appropriate. • estimate answers; check calculations using approximation and estimation, including answers obtained using technology. • round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures); use inequality notation to specify simple error intervals due to truncation or rounding. • apply and interpret limits of accuracy, including upper and lower bounds. • change freely between related standard units (e.g. time, length, area, volume/capacity, mass) and compound units (e.g. speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts. • use conventional terms and notation: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries; use the standard conventions for labelling and referring to the sides and angles of triangles; draw diagrams from written description. • identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment. • identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres. • use standard units of measure and related concepts (length, area, volume/capacity, mass, time, money, etc.). • know and apply formulae to calculate: area of triangles, parallelograms, trapezia; volume of cuboids and other right prisms (including cylinders).	

			• know the formulae: circumference of a circle = 2πr = πd, area of a circle = πr²; calculate: perimeters of 2D shapes, including circles; areas of circles and composite shapes; surface area and volume of spheres, pyramids, cones and composite solids. • calculate arc lengths, angles and areas of sectors of circles.	
Year 10	Autumn 2	Unit 8: Constructions and Transformations	• Distinguish properties that are preserved under particular transformations; • Recognise and describe rotations – know that 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 also $y = x$ 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. •	
			• Draw 3D shapes using isometric grids; • 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';	End of Unit Test

			• 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	
	Spring 1	Unit 9: Equations and Inequalities	• 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;	End of Unit Test

CHURCH STRETTON SCHOOL	Mathematics Department	Key stage 4: Higher

	Term	Topic	Learning Outcomes	Assessment
Year 10	Spring 2	Unit 10: Probability	• 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 outcome; • 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;	End of Unit Test

			• Use a Venn diagram to calculate conditional probability; • Compare experimental data and theoretical probabilities; • Compare relative frequencies from samples of different sizes. •	
		Unit 11: Multiplicative Reasoning	• 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);	End of Unit test

			• 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. •	

	Term	Topic	Learning Outcomes	Assessment
Year 10	Summer 1	Unit 12: Similarity and Congruence	• 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;	End of Unit Test

			• 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 have to find missing lengths first using similar triangles. •	
	Summer 2	Unit 13: Advanced Trigonometry	• 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 $\sin\theta$ and $\cos\theta$ for $\theta = 0°$, 30°, 45° , 60° and 90° and exact value of $\tan\theta$ for $\theta = 0°$, 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 $f(x)$. • 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.	End of Unit Test

CHURCH STRETTON SCHOOL	Mathematics Department	Key stage 4: Higher

End of year assessment
This will include all topics covered
Misconceptions will be addressed as part of the end of year assessment review process

	Term	Topic	Learning Outcomes	Assessment
Year 11	Autumn 1	Unit 14: Statistics	• 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 (see note); •	
			• 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;	End of Unit Test

			• 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	
	Autumn 2	Unit 15: Advanced Algebra	• Sketch a graph of a quadratic function, by factorising or by using the formula, identifying roots and y-intercept, turning point; • 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.	

	Term	Topic	Learning Outcomes	Assessment
		Unit 16: 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°; •	
		Unit 16: 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.	Mock Exam
	Spring 1	Unit 17: Advanced Algebra	• 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).	
		Unit 18: Vectors and 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	

	Term	Topic	Learning Outcomes	Assessment
Year 11	Spring 2	Unit 19: Proportion	• 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.	
			• Recognise and interpret graphs showing direct and indirect 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.	

Exam dates:

Paper 1: 19th May 2023
Paper 2: 7th June 2023
Paper 3: 14th June 2023