## Maths Scheme of Learning Information

Holy Cross maths scheme of work has been collaboratively developed and is based on a model of progression with fluency, reasoning and problem solving at the heart. Originally created by a working group of local maths teachers under the guidance and with support from the Lancashire Maths Consultant. The scheme is regularly developed and updated to ensure it meets the needs of our pupils. Gaps in pupil's knowledge, and local demographics are considered when updates are made.

Our spiral curriculum model is designed to be ambitious, to stretch and challenge pupils of all backgrounds ensuring pupils master new concepts and ideas whilst building their confidence in maths. We use a spiral curriculum so that pupils revisit each topic area regularly, increasing in complexity, throughout their school life. We incorporate ample opportunities of retrieval practice within our lessons and homeworks, this allows pupils to further develop their understanding of topics in lessons. This is part of our approach of teaching for mastery. Our clear and coherent learning objectives ensure pupils do not repeat work unnecessarily.

The sequence of learning is carefully chosen enabling new learning to be related to prior knowledge. Prior concepts are reviewed to encourage essential learning connections. With the disruption to schooling over the past couple of years, our spiral approach to the curriculum has meant we have been able to meet the needs of our pupils.

Pupils who are working below expected standards begin on a stage appropriate for their learning, giving them the opportunity to consolidate their understanding through additional practice. Similarly, those pupils working above expected standards begin on a suitably challenging higher stage. The majority of our pupils begin the sequence of learning at stage 4. Decisions about when to progress are based on pupil's security of understanding and the readiness to progress. As such classes are working at their own pace through the sequence of learning under the experience and expertise of their subjectspecialist teacher. The key aspect of our approach is that every pupil can learn. If a pupil starts at the right place and is given the right amount of time, they can make progress whilst developing a love of maths.

## Stages

## KS2 content

## KS3 content

## GCSE Foundation Content

## GCSE Higher Content

## Averages And Cumulative Frequency

| Stage | Objectives |
| :---: | :---: |
| 3 | Calculate the mean of a set of data |
|  | Solve problems involving the mean |
| 4 | Find the mode, median and range of a set of data |
|  | Calculate the mean, median, mode and range from a frequency table |
|  | Solve problems involving averages including reverse mean |
| $6$ | Understand and calculate the interquartile range of a set of data |
|  | Identify and understand how outliers affect data when finding averages and the range/ interquartile range |
|  | Decide which average is best to use for a given situation |
|  | Using averages, range and interquartile range to describe and compare data sets |
|  | Use lists, tables or diagrams to find averages including stem \& leaf diagrams and vertical line charts |
| 7 | Calculate an estimate of the mean from a grouped frequency table |
|  | Know why it is an estimate of the mean from a grouped frequency table |
|  | Find the class interval containing the median from a grouped frequency table |
|  | State the modal class from a grouped frequency table |
| 8 | Construct a cumulative frequency table and draw a cumulative frequency diagram |
|  | Read off the median, lower and upper quartiles from a cumulative frequency diagram |
|  | Calculate the interquartile range from a cumulative frequency diagram |
|  | Construct a box plot from a set of data and a cumulative frequency diagram |
|  | Calculate the range and inter-quartile range from a box plot and interpret a box plot |
|  | Compare box plots |

## Algebraic Manipulation

| Stage | Objectives |
| :---: | :---: |
| 3 | Use notation and symbols correctly |
|  | Substitute into expressions |
|  | Form a linear expression |
|  | Substitute into and find missing values in function machines |
| 4 | Collect like terms |
|  | Simplify expressions involving multiplying and dividing using correct notation |
|  | Understand that algebraic operations follow the rules of arithmetic |
|  | Expand and simplify expressions involving single brackets |
|  | Know the terminology expression, identity, term and factor |
|  | Factorise a linear expression |
|  | Find equivalent expressions |
| 6 | Expand and simplify the product of two linear expressions including squaring a linear expression |
|  | Factorise quadratic expressions when the coefficient of $x^{2}$ is 1 |
|  | Factorise by finding the difference of two squares |
|  | Form a quadratic expression |
|  | Find equivalent expressions |
| 8 | Use simple proofs to show that two expressions are equivalent |
|  | Multiply more than two brackets together |
|  | Factorise quadratic expressions when the coefficient of $x^{2}$ is $>1$ |
|  | Complete the square including for expressions when the coefficient of $\mathrm{x}^{2}$ is $>1$ |
|  | Find the vertex of a parabola |
| 9 | Understand, interpret and use composite and inverse functions |

## Angles

| Stage | Objectives |
| :---: | :---: |
| $3$ | Name different types of angles |
|  | Label angles with the correct notation |
|  | Measure angles including angles inside shapes |
|  | Estimate the size of angles |
|  | Find missing angles at a point, at a point on a straight line and vertically opposite angles |
| 4 | Label the sides and angles in different ways |
|  | Find missing angles in polygons |
|  | Find the sum of the interior angles of a polygon |
|  | Understand why some shapes tessellate |
| 5 | Understand that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices |
|  | Find and label alternate, co-interior and corresponding angles in parallel lines |
|  | Solve problems involving angles in parallel lines |
|  | State angle facts when giving reasons for your answers using angle notation |
| 6 | Know the sum of the exterior angles of a polygon |
|  | Work out the size of an exterior angle of a regular polygon |
|  | Work out the number of sides of a polygon given information about the angles |
|  | Solve problems involving interior and exterior angles of polygons |
|  | Recall and use the eight points of the compass and their bearings |
|  | Draw and measure bearings |
|  | Work out the bearing to return to a point, given the bearing to leave that point |
|  | Use bearings to solve problems |
| 9 | Know and apply each of the circle theorems |
|  | Prove 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 subtended at the circumference by a semicircle is a right angle; angles in the same segment are equal; opposite angles of a cyclic quadrilateral sum to $180^{\circ}$; and the alternate segment theorem |

Area

| Stage | Objectives |
| :---: | :---: |
| 2 | Define the word 'area' and know the units used to measure area |
|  | Find the area of shapes on a grid |
|  | Draw a shape on a grid with a given area |
|  | Solve problems involving a combination of area and perimeter of shapes on a grid |
| $4$ | Derive formulae for the area of a rectangle, triangle, parallelogram and kite |
|  | Calculate the area of a rectangle, triangle, parallelogram and kite |
|  | Use the properties of shapes to find missing lengths |
|  | Calculate the area of a compound shape made from the above shapes |
|  | Estimate the area of irregular shapes |
|  | Solve worded problems involving area of triangles and quadrilaterals including with mixed units |
|  | Solve problems involving a combination of area and perimeter of triangles and quadrilaterals |
| 5 | Derive formulae for the area of a trapezium |
|  | Calculate the area of a trapezium |
|  | Use the properties of trapezium to find missing lengths |
|  | Know the formula for the area of a circle |
|  | Calculate the area of; a circle, semicircle and quarter-circle giving answers as decimals and in terms of $\Pi$ |
|  | Calculate the radius or diameter of a circle given the area |
|  | Calculate the area of compound shapes involving circles |
|  | Solve worded problems involving finding the area of circles including with mixed units |
|  | Approximate to check answers |
|  | Solve problems involving a combination of area and perimeter of triangles, parallelograms, trapezia and circles |
| 6 | Calculate area of sectors of a circle giving answers as decimals and in terms of $\Pi$ |
|  | Calculate the angle in a sector of a circle given the area and radius or diameter |
|  | Calculate areas of compound shapes including sectors |
|  | Solve worded problems involving the above |
| 7 | Calculate the surface area of; cubes, cuboids, triangular prisms, trapezoids, cylinders, spheres, hemispheres, pyramids, and cones, giving answers as decimals and in terms of $\Pi$ |
|  | Calculate the surface area of irregular prisms and composite solids |
|  | Use the properties of solids to find missing lengths |
|  | Draw the net of a solid given the surface area |
|  | Solve worded problems involving surface area including with mixed units |

## Calculations A

| Stage | Objectives |
| :--- | :--- |
|  | Add and subtract up to three digit integers using a written method |
|  | Use mental methods for addition and subtraction up to two digit integers |
|  | Know and use inverse operations when adding and subtracting integers |
|  | Understand the commutative law and associative law for adding |
|  | Find equivalent calculations |
|  | Use approximation to check answers |
|  | Solve worded and multi-step problems involving adding and subtracting up to three digit integers |
|  | Add and subtract up to five digit integers using a written method |
|  | Use mental methods for addition and subtraction up to three digit integers |
|  | Know and use inverse operations when adding and subtracting integers |
|  | Find equivalent calculations |
|  | Use approximation to check answers |

## Calculations B

| Stage Objectives |  |  |  |  |
| :--- | :--- | :---: | :---: | :---: |
|  | Recall timetables to 12x12 |  |  |  |
|  | Mentally multiply and divide integers in the above timetables |  |  |  |
|  | Count up and back in steps of 100, 1000, 10000 |  |  |  |
|  | Use written methods for multiplication and division of integers (two digit by one digit) |  |  |  |
|  | Understand the commutative law and associative law for multiplying |  |  |  |
|  | Find equivalent calculations |  |  |  |
|  | Use approximation to check answers |  |  |  |
|  | Solve worded and multi-step problems involving the four operations |  |  |  |
|  | Know the affects of multiplying and dividing numbers by positive powers of ten |  |  |  |
|  | Use short and long division writing remainders as integers |  |  |  |
|  | Mentally multiply and divide up to three digit numbers by one digit |  |  |  |
|  | Know and use inverse operations |  |  |  |
|  | Find equivalent calculations |  |  |  |
|  | Approximate to check answers |  |  |  |
|  | Solve worded and multi-step problems involving the four operations |  |  |  |
|  | Use written methods to multiply large integers |  |  |  |
|  | Use short and long division writing remainders as fractions and decimals |  |  |  |
|  | Know the distributive law |  |  |  |
|  | Use the order of operations to solve problems |  |  |  |
|  | Know and use inverse operations |  |  |  |
|  | Find equivalent calculations |  |  |  |
|  | Approximate to check answers |  |  |  |
|  | Solve worded and multi-step problems involving the four operations |  |  |  |

Data

| Stage | Objectives |
| :---: | :---: |
| 2 | Interpret and present ungrouped data in a frequency table, a single bar chart and a pictogram |
|  | Interpret data from a time table and distance-time table |
|  | Complete missing information from a time table |
|  | Solve comparison, sum and difference problems in frequency tables, single bar charts, pictograms, time tables and distance-time tables |
| 3 | Define and recognise discrete and continuous data |
|  | Know the difference between grouped and ungrouped data; and understand the (dis)advantages of grouping data |
|  | Interpret and present discrete data in a grouped frequency table, a dual bar chart and a composite bar chart |
|  | Solve comparison, sum and difference problems in grouped frequency tables, dual bar charts and composite bar charts |
| 4 | Interpret and present data in a frequency diagram and a frequency polygon |
|  | Solve comparison, sum and difference problems in frequency diagrams and frequency polygons |
|  | Interpret and present discrete data in a pie chart |
|  | Solve comparison, sum and difference problems using a pie chart |
| 5 | Plot and interpret a time series graph and a scatter graph |
|  | Use a time series graph to predict a subsequent value |
|  | Draw and use a line of best fit on a scatter graph understanding the effects of interpolation and extrapolation |
|  | Describe the correlation on a scatter graph including the strength |
|  | Understand correlation and causation |
|  | Identify outliers on a scatter graph |
|  | Solve comparison problems using time series graphs and scatter graphs |
|  | Interpret and present data in a two-way table including finding probabilities |
| 6 | Distinguish between primary and secondary data |
|  | Decide whether data is qualitative, quantative, discrete or continuous and use this decision to make sound judgements in choosing suitable diagrams for the data |
|  | Interpret and present data in a range of diagrams, charts and graphs including stem \& leaf diagrams |
|  | Find patterns in data that may lead to a conclusion being drawn including commenting on unusual data values |
|  | Understand that the size and construction of a sample will affect how representative it is |
|  | Understand the advantages of and use stratified sampling |
| 7 | Understand the structure and notation of a Venn diagram |
|  | Shade and identify areas on a Venn diagram; $A \cap B, A \cup B, A^{\prime}, A^{\prime} \cap B, A^{\prime} \cup B,(A \cap B)^{\prime},(A \cup B)^{\prime}$ |
|  | Construct and read information from a Venn diagram |
|  | Solve problems using Venn diagrams |
| 8 | Construct and interpret a histogram for grouped discrete data and continuous data with equal and unequal class intervals |
|  | Find an estimate of the median or other information from a histogram |

## Decimals

| Stag | Objectives |
| :---: | :---: |
| $2$ | Identify the place value of digits in decimals |
|  | Order decimals up to 2 decimal places in context using the symbols < > = $\square \square \square \neq$ |
|  | Count up and back in steps of 0.1, 0.01, 0.001 |
|  | Add and subtract decimals |
|  | Find equivalent calculations |
|  | Use approximation to check answers |
|  | Solve worded and multi-step problems involving adding and subtracting decimals with and without a calculator |
| $3$ | Convert between fractions, decimals and percentages (denominators are factors of 100) with and without a calculator |
|  | Compare and order positive and negative integers, fractions, decimals and percentages using the symbols < > = $\square \square \square \neq$ |
|  | Solve worded and multi-step problems involving fractions, decimals and percentages with and without a calculator |
|  | Use decimals to calculate proportions of shapes that are shaded |
|  | Identify positive and negative decimals on a number line and a scale including in context |
|  | Estimate measures from a scale when between two whole numbers |
|  | Compare and order decimals up to 3 decimal places using the symbols < > = $\square \square \square \neq$ (including in context eg metric measures withdifferent units) |
| 4 | Convert between less familiar fractions, decimals and percentages (including $>1$ \& easy recurring decimals) with and without acalculator |
|  | Compare and order positive and negative integers, fractions, decimals and percentages (including $>1 \&$ easy recurring decimals)using the symbols <> = $\square$ |
|  | Solve worded and multi-step problems involving fractions, decimals and percentages with and without a calculator |
| 5 | Identify decimals and fractions on more difficult number lines |
|  | Multiply and divide a decimal by an integer and by a decimal |
|  | Add, subtract, multiply and divide using a combination of positive and negative integers, decimals and fractions with and with-out a calculator |
|  | Understand the effects of multiplying and dividing numbers between 0 and 1 |
|  | Know the affects of multiplying and dividing by positive and negative powers of 10 ( $0.01,0.1,10,100$, etc) |
|  | Use a given calculation to find the answers to similar calculations |
|  | Find equivalent calculations |
|  | Use approximation to check answers |
|  | Solve worded and multi-step questions involving the above with and without a calculator including household bills |
|  | Convert between fractions, decimals and percentages to find the most appropriate method of calculation in a question |
| 8 | Change recurring decimals into their corresponding fractions using proof |
|  | Change fractions into recurring decimals |

## Negative Numbers

| Stage | Objectives |
| :--- | :--- |
|  | Identify negative numbers on a number line |
|  | Order negative numbers |
|  | Find the difference between a negative and a positive number |
|  | Use negative numbers in context |
| 4 | Add, subtract, multiply and divide negative and positive integers including large integers |
|  | Find equivalent calculations |
|  | Solve worded problems involving negative integers |

## Percentages

| Stage | Objectives |
| :---: | :---: |
| $3$ | Recognise and understand the percent symbol |
|  | Shade a percentage of a shape |
|  | Use percentages to calculate proportions of shapes that are shaded |
| 4 | Calculate a percentage of an amount with and without a calculator including percentages $>100 \%$ and non-integer percentages |
|  | Find equivalent calculations |
|  | Use approximation to check answers |
|  | Solve problems involving calculating a percentage of an amount including reverse percentages |
| 5 | Express one quantity as a percentage of another |
|  | Compare two amounts using percentages |
|  | Calculate a percentage increase/ decrease given two amounts |
|  | Increase and decrease an amount by a percentage with and without a calculator including percentages $>100 \%$ and non-integer percentages |
|  | Solve problems involving increasing/ decreasing an amount by a percentage with and without a calculator |
| 7 | Solve original value problems including non-integer percentages |
|  | Solve simple interest problems including percentages |
|  | Solve growth and decay problems using compound interest including non-integer percentages |
|  | Solve compound problems involving original value |

Fractions

| Stage | Objectives |
| :---: | :---: |
| 2 | Know the names of unit fractions e.g. one half, one twelve |
|  | Compare and order unit fractions to $1 / 12$ and fractions with the same denominator using the symbols $<>=\leq \geq$ |
|  | Count up and down in tenths |
|  | Recognise and find simple equivalent fractions |
| $3$ | Simplify fractions |
|  | Identify positive and negative fractions on a number line and a scale including in context |
|  | Estimate measures from a scale when between two whole numbers |
|  | Recognise and convert between improper fractions and mixed numbers |
|  | Use fractions to calculate proportions of shapes that are shaded |
|  | Write a number as a fraction of another number |
|  | Find equivalent fractions |
|  | Compare and order positive and negative fractions using the symbols $<>=\leq \geq \neq$ including fractions $>1$ |
|  | Find fractions of an integer which leads to an integer answer |
|  | Use a fraction of a quantity to compare proportions |
|  | Find equivalent calculations |
|  | Use approximations to check answers |
|  | Solve worded problems related to finding fractions of amounts and comparing fractions |
| 4 | Identify positive and negative fractions including mixed numbers on a number line |
|  | Add, subtract, multiply and divide positive and negative mixed numbers with different denominators by fractions and integers with and without a calculator |
|  | Find a fraction of a fraction and fraction of an integer which leads to a non-integer answer |
|  | Calculate reverse fractions of amounts |
|  | Increase/decrease an amount by a fraction |
|  | Understand reciprocals |
|  | Find equivalent calculations |
|  | Use approximations to check answers |
|  | Solve worded problems involving the four operations on fractions |
| 9 | Simplify algebraic fractions |
|  | Add, subtract, multiply and divide expressions involving algebraic fractions |

## Indices And Surds

| Stage | Objectives |
| :---: | :---: |
| 2 |  |
| 3 |  |
| 4 | Recognise the notation for square, cube, square root and cube root |
|  | Know the squares and square roots of the first fifteen square numbers |
|  | Understand that there are two numbers that will square to give the same answer |
|  | Recall cubes of; 1, 2, 3, 4, 5 and 10 |
|  | Know the cube roots of the first five cube numbers and cube root of 1000 |
|  | Recognise the first ten powers of 2 |
|  | Work out powers of 10 |
|  | Calculate with roots and positive integer indices |
|  | Use a calculator to find any positive integer power of a number |
|  | Understand and use the vocab; index, indices, power, root, base |
| 5 | Understand the use of standard form |
|  | Write a number in standard form and convert from standard form to a number |
|  | Calculate positive powers of integers and know the value of any number to the power of zero |
|  | Order and compare numbers in standard form $\mathrm{A} \times 10^{n}$, where n is positive, negative or zero |
| 6 | Understand and apply the three laws of indices for numerical and algebraic expressions |
|  | Use the index laws for positive and negative indices |
|  | Understand that the root of a number squared is the number itself; eg $(\sqrt{x})^{2}=x$ |
|  | Calculate with numbers in standard form with and without a calculator |
|  | Solve worded problems involving standard form |
|  | Find equivalent calculations |
| 7 | Calculate values using negative indices |
|  | Understand that $x^{\wedge}-1$ is the reciprocal of $x$ |
| 8 | Estimate powers and roots of any given positive number |
|  | Identify between which two integers the square root and cube root of a positive number lies |
|  | Calculate with fractional indices |
|  | Evaluate, order and compare values that require changing the base |
| 9 | Identify surds |
|  | Understand why it is more accurate to leave an answer in surd form |
|  | Calculate exactly with surds |
|  | Simplify expressions using the rules of surds including those involving squares |
|  | Expand brackets where the terms may be written in surd form |
|  | Rationalise denominators |

Measures

| Stage | Objectives |
| :---: | :---: |
| 2 | Estimate time calculations to the nearest minute |
|  | Tell the time from an analogue clock and a 24 hour digital clock using vocabulary such as o'clock, am and pm, morning and afternoon, noon and midnight |
|  | Solve comparison, sum and difference problems involving time |
| $3$ | Make an accurate scale drawing from a sketch, diagram or description |
|  | Find the real measurement given a scale drawing |
|  | Work out a scale from a scale drawing given an actual length |
|  | Use a scale on a map to work out an actual length and to estimate a length |
|  | Solve problems involving scale drawings |
| 4 | Convert between time given as hours \& minutes and decimal hours with and without a calculator |
|  | Convert between time given as hours \& minutes and minutes |
|  | Convert between time given as hours \& minutes and fractions of an hour |
|  | Compare time written in seconds, minutes and hours |
|  | Solve worded problems involving time |
|  | Solve worded problems involving the Gregorian calendar |
| 5 | Estimate lengths using metric units |
|  | Choose appropriate units for estimating measurements |
|  | Convert between metric units of length and mass |
|  | Convert between imperial units of length and mass |
|  | Convert between metric and imperial measurements |
|  | Read information from conversion graphs for metric and imperial units |
|  | Convert between metric units of area |
|  | Convert between metric units of volume |
|  | Solve problems involving different units |
| 6 | Use compound measures for speed, distance and time including those that require a change of units |
|  | Use compound measures for mass, density and volume |
|  | Use compound measures for pressure, force and area |
| 7 | Apply the concepts of congruence |
|  | Prove that two shapes are similar |
|  | Know the relationship between length, area and volume scale factors |
|  | Find the ratio of the area or volume of two similar shapes |
|  | Understand the effects of enlargement on angles and perimeter |
|  | Understand and compare the areas and volumes of similar shapes |
|  | Find a missing length given two areas, volumes, ratio or scale factor of similar shapes |
|  | Solve problems involving area and volume of similar shapes |

Holy Cross
Maths

CATHOLIC HIGH SCHOOL

## Perimeter

| Stage | Objectives |
| :---: | :---: |
| 2 | Define the word perimeter and know what units to use for perimeter |
|  | Find the perimeter of shapes drawn on a grid |
|  | Measure and calculate the perimeter of a compound shape made from rectangles using mm, cm and m |
|  | Calculate the perimeter of a rectangle, a triangle, a parallelogram and a trapezium |
| 5 | Know and identify parts of a circle |
|  | Construct circles or part circles given the radius or diameter |
|  | Know the formula for circumference of a circle |
|  | Calculate the circumference of a circle giving answers as decimals and in terms of $\Pi$ |
|  | Calculate the perimeter of; a semi-circle and a quarter-circle giving answers as decimals and in terms of $\Pi$ |
|  | Calculate the radius or diameter of a circle given the circumference |
|  | Calculate the perimeter of compound shapes involving circles |
|  | Use approximation to check answers |
|  | Solve problems involving finding the perimeter of circular shapes |
| 6 | Calculate arc lengths giving answers as decimals and in terms of $\Pi$ |
|  | Calculate the perimeter of a sector of a circle giving answers as decimals and in terms of $\Pi$ |
|  | Calculate angles in sectors of circles given the arc length and radius/ diameter |
|  | Calculate the perimeter of compound shapes including sectors |
|  | Solve worded problems involving the above |

Plotting Linear Equations

| Stage | Objectives |
| :---: | :---: |
| 2 | Draw and label axes |
|  | Plot and read coordinates in all four quadrants |
| 3 | Plot horizontal and vertical lines on coordinate grids |
|  | Know the equation of horizontal and vertical lines on coordinate grids |
|  | Find the midpoint of two coordinates graphically and numerically |
|  | Identify coordinates that lie on a graph given the equation |
| 4 | Know that $\mathrm{y}=\mathrm{mx}+\mathrm{c}$ is a linear graph; and understand gradient and y -intercept |
|  | Plot linear graphs with and without a calculator |
|  | Understand the effect on a graph of addition of a constant |
|  | Calculate the gradient from a graph |
|  | Find the equation of a linear graph from a graph or from a list of coordinates |
|  | Identify coordinates that lie on a graph given the equation |
| 5 | State the y -intercept and gradient from an equation including equations not written in the form $\mathrm{y}=\mathrm{mx}+\mathrm{c}$ |
|  | Find the equation of a linear graph given the gradient and y-intercept as a coordinate |
|  | Find the equation of a linear graph including on different scaled axes |
|  | Identify parallel lines to linear graphs given the equation |
|  | Identify graphs with the same y-intercept given the equation |
|  | Solve linear equations graphically |
| 6 | Plot and interpret a linear graph representing a real-life problem from information given in words, in a table or as a formula |
|  | Identify the equation of a real-life linear graph from a drawing of the graph |
|  | Plot and interpret a conversion graph and a distance - time graph |
|  | Interpret the gradient of a linear graph as a rate of change and the y-intercept in context |
| 7 | Calculate the gradient given two points |
|  | Find the equation of a linear graph given two points |
|  | Find the equation of a linear graph given one point and the gradient |
|  | Identify parallel lines, gradients and y-intercepts when the equations need rearranging |
|  | Find the equation of a parallel line given either the equation of the linear graph or the gradient and a point on the line |
|  | Solve problems on coordinate axes |
| 8 | Identify and find perpendicular lines to linear graphs |
|  | Identify perpendicular lines, gradients and y-intercepts when the equations need rearranging |

Plotting Non-Linear Equations

| Stage | Objectives |  |
| :---: | :---: | :---: |
| 6 | Sketch and 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 |  |
|  | Plot graphs of quadratic and cubic equations and functions with and without a calculator including those not written in the form $y=a x^{2}+b x+c$ |  |
|  | Identify coordinates that lie on a quadratic or cubic graph |  |
|  | Recognise graphs of quadratic and cubic equations |  |
| 7 | Solve an equation from a quadratic or cubic graph |  |
|  | Identify and interpret roots, intercepts and turning points on a quadratic graph |  |
|  | Plot graphs of reciprocal functions with and without using a calculator |  |
|  | Recognise graphs of reciprocal functions |  |
|  | Identify coordinates that lie on a reciprocal graph |  |
| 8 | Sketch and draw a velocity/ time graph |  |
|  | Understand the difference between positive and negative gradients as rates of change |  |
|  | Estimate the gradient at a point on a curve by drawing a tangent at a given point and working out its gradient (instantaneous rate of change) |  |
|  | Calculate and interpret the meaning of the gradient and area under a velocity-time graph and a distance-time graph (average rate of change) |  |
| 9 | A | Plot, sketch, interpret and recognise exponential graphs; $y=k^{x}$ for positive values of $k$ |
|  | B | Plot, sketch, interpret and recognise trigonometric graphs |
|  |  | Know the minimum and maximum values for cos and sin |
|  |  | Apply trigonometric graphs in context |
|  | C | Recognise and write down the equation of a circle with centre at the origin and radius $r$ |
|  |  | Work out the coordinates of points of intersection of a given circle and a given straight line |
|  |  | Find the equation of a tangent to a circle at a given point |
|  | D | Sketch and recognise transformations of linear functions, quadratic functions and trigonometric functions based on $y=\sin x$ and $y=\cos x$ for $0 \leq x \leq 360^{\circ}$ |
|  |  | Write down the function following a reflection or translation of a given function |

## Probability

| Stage | Objectives |
| :---: | :---: |
| 4 | Understand and use words associated with probability |
|  | Understand and use the 0-1 probability scale using simple fractions, decimals and percentages |
|  | Apply systematic listing strategies to show all possible outcomes and find probabilities (sample space diagrams) |
|  | Calculate the probability of a single event including from a given ratio |
|  | Understand that experiments rarely give the same results |
|  | Solve comparison probability problems |
| 5 | Understand the terms mutually exclusive and exhaustive |
|  | Understand that the probabilities of all possible outcomes sum to 1 |
|  | Find the probability of an event not happening |
|  | Construct and use a frequency tree to solve problems |
|  | Understand the difference between theoretical probability and relative frequency |
|  | Know how the number of trials in an experiment effects the accuracy of the results |
|  | Estimate probabilities using relative frequency |
|  | Draw and interpret a relative frequency diagram |
|  | Use probability to solve problems including finding the number of expected outcomes |
| 6 | Calculate probabilities when events are independent |
|  | Construct/ complete a tree diagram to show outcomes and probabilities with replacement |
|  | Solve problems involving tree diagrams and other representations |
| 8 | Know the difference between independent events and dependent events |
|  | Calculate probabilities when events are dependent |
|  | Calculate probabilities when events are not mutually exclusive |
|  | Construct/ complete a tree diagram to show outcomes and probabilities without replacement |
|  | Use tree diagrams to solve problems |
|  | Understand the notation $\mathrm{P}(\mathrm{A}), \mathrm{P}\left(\mathrm{A}^{\prime}\right), \mathrm{P}(\mathrm{A} \cup \mathrm{B}), \mathrm{P}(\mathrm{A} \cap \mathrm{B})$ when calculating probabilities from Venn diagrams |
|  | Apply the use of the product rule for counting |
|  | Understand and apply the Petersen Capture-Recapture method |

Pythagoras' Theorem And Trigonometry

| Stage | Objectives |
| :---: | :---: |
| 5 | Use Pythagoras' Theorem in 2D to find missing side lengths |
|  | Know that the hypotenuse is the longest side |
|  | Find the distance between two coordinates Pythagoras' Theorem in 2D |
|  | Use Pythagoras' Theorem in 2D to prove that a triangle is right angled |
|  | Solve worded problems involving Pythagoras' Theorem |
| $7$ | Use trigonometry in 2D to find missing side lengths and angles |
|  | Solve worded problems using trigonometry in 2D including bearings |
|  | Know the exact values of $\sin \theta$ and $\cos \theta$ for $\theta=0^{\circ}, 30^{\circ}, 45^{\circ}, 60^{\circ}$; and $90^{\circ}$ and $\tan \theta$ for $\theta=0^{\circ}, 30^{\circ}, 45^{\circ}$ and $60^{\circ}$ |
|  | Solve right-angled triangle problems with angles of $30^{\circ}, 45^{\circ}$ or $60^{\circ}$ without a calculator |
|  | Solve problems involving a combination of Pythagoras' Theorem and trigonometry |
| 8 | Use Pythagoras' Theorem and trigonometry in 3D to find missing side lengths and angles |
| 9 | Apply the sine rule and cosine rule to find unknown lengths and angles in 2D and 3D shapes |
|  | Apply Area $=1 / 2 \mathrm{absinC}$ to calculate the missing side length, angles or the area of any triangle |
|  | Solve problems involving the above including finding the area of a segment |

Ratio and Proportion

| Stage | Objectives |
| :---: | :---: |
| $3$ | Understand ratio notation |
|  | Simplify ratios and find equivalent ratios |
|  | Use proportion to solve simple problems |
|  | Interpret ratio as a fraction or a percentage |
| 4 | Compare two quantities and represent them as a ratio |
|  | Use ratio and proportion to solve worded problems including recipe style questions |
|  | Write a ratio in the form 1:n or $\mathrm{n}: 1$ with and without a calculator |
|  | Solve simple best buy problems |
| 5 | Use equality of ratios to solve problems |
|  | Divide a quantity in a given ratio |
| 6 | Draw and recognise graphs of two quantities in a given ratio |
|  | Write the ratio of $x$ : $y$ as an equation in terms of $x$ or $y$ |
|  | Given the ratio of $a: b$ and $b: c$ find the ratio of $a: b: c$ |
|  | Solve worded problems involving ratio including 'changing ratio problems' |
|  | Solve more difficult best buy problems and currency conversions which involve changes of units |
| 7 | Solve numerical problems involving direct and inverse proportion |
|  | Recognise and interpret graphs which represent direct proportion and inverse proportion |
|  | Understand that $X$ is inversely proportional to $Y$ is equivalent to $X$ is proportional to $1 / Y$ |
| 8 | Write and use equations of the form $y=k x$ representing direct proportion $y=k / x$ representing inverse proportion; understanding that k is the constant of proportionality |
|  | Recognise and construct equations and graphs which represent direct proportion and inverse proportion |

## Rounding And Limits

| Stage | Objectives |
| :---: | :---: |
| $3$ | Round integers and decimals to the nearest 10, 100, 1000 |
|  | Read and write integers to 10000000 |
|  | Know the place value of each digit up to 10000000 |
|  | Order and compare numbers to 10000000 using =, , <, >, $\leq, \geq$ |
| 5 | Round decimals to a given number of decimal places |
|  | Round numbers to a given number of significant figures |
|  | Round numbers in context such as measures and money |
| 7 | Estimate answers by rounding to 1 significant figure |
|  | Understand over or under estimating |
|  | Use inequalities to specify error intervals when a number has been rounded or truncated |
|  | Interpret limits of accuracy when rounding or truncating |
| 8 | Calculate with upper and lower bounds |

## Sequences

| Stage | Objectives |
| :---: | :---: |
| $2$ | Describe a number sequence using the term to term rule |
|  | Write a sequence of numbers given the term to term rule |
|  | Continue sequences shown in diagrams |
| 4 | Understand the terminology associated with sequences (term to term rule and position to term rule/ nth term) |
|  | Recognise and complete missing terms in sequences of triangular, square and cube numbers; and arithmetic sequences |
|  | Understand and recognise an arithmetic sequence |
|  | Work out the nth term and a given term in an arithmetic sequence |
|  | Generate an arithmetic sequence from the nth term or a diagram |
|  | Justify if a number is in an arithmetic sequence |
|  | Complete a table of results which describe the pattern shown in diagrams |
|  | Solve simple problems involving arithmetic sequences |
| 6 | Work with Fibonacci-type sequences (rule given) |
|  | Recognise and complete missing terms in geometric progressions |
|  | Find the common ratio in a geometric progression and use this to continue a sequence |
|  | Understand and recognise a quadratic sequence |
|  | Know how to continue the terms of a quadratic sequence |
|  | Identify different types of sequences including triangular numbers |
| 8 | Work out the nth term and a given term in a quadratic sequence |
|  | Find the equation of a linear graph given two points |
|  | Generate a quadratic sequence from the nth term or a diagram with and without a calculator |
|  | Solve simple problems involving quadratic sequences |
| 9 | Recognise and solve problems based on Fibonacci-type sequences, involving geometric progressions and other sequences |
|  | Work out the value of a term in a geometrical progression of the form $r^{n}$ where n is an integer and r is a positive rational number or a surd |

## Shape and Construction

| Stage |  | Objectives |
| :---: | :---: | :---: |
| $2$ | A | Name and sketch shapes (polygons with up to 12 sides \& triangles) |
|  |  | Know the difference between regular and irregular polygons |
|  |  | Draw a shape with a given order of rotational symmetry and/ or lines of symmetry |
|  |  | Identify the order of rotational symmetry of a shape |
|  | B | Name solids and describe their properties (faces, vertices, edges) |
|  |  | Understand that cubes, cuboids and triangular prisms are prisms |
|  |  | Draw and identify nets of solids |
|  |  | Build 3D shapes using nets |
|  |  | Identify planes of symmetry in 3D shapes |
| 4 |  | Construct a plan view, front and side elevation of a solid |
|  |  | Recognise a solid from its plan and elevations |
|  |  | Understand and use isometric drawings |
|  |  | Solve problems involving 2D representations of a solid |
| 5 |  | Identify pairs of parallel and perpendicular lines including on a shape |
|  |  | Construct a triangle given SSS, SAS or ASA, a quadrilateral and a regular hexagon |
|  |  | Construct an angle of $60^{\circ}$ |
|  |  | Know and use the properties of triangles and quadrilaterals |
|  |  | Identify a shape given its properties |
| $6$ |  | Construct a perpendicular bisector of a line segment, a perpendicular to a given line from a point, a perpendicular to a given line at a point and an angle bisector |
|  |  | Recognise and use the perpendicular distance from a point to a line as the shortest distance to the line |
|  |  | Construct loci equidistant from; a point, two points, a line, two lines and a shape |
|  |  | Construct and shade regions using circles and lines |
|  |  | Solve worded problems involving loci including bearings |
| 7 |  | 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 |
|  |  | Understand and use vector notation |
|  |  | Calculate and represent graphically the; sum of two vectors, difference of two vectors and scale multiple of a vector |
| 8 |  | Calculate the surface area and volume of a frustum writing answers as decimals and in terms of $\Pi$ |
|  |  | Solve problems involving frustums including with mixed units |
| $9$ |  | Apply vector methods for simple geometric proofs |
|  |  | Recognise when; lines are parallel, and three or more points are co-linear, using vectors |
|  |  | Use vectors to show three or more points are collinear |

## Simultaneous Equations

| Stage | Objectives |
| :---: | :--- |
| 7 | Solve simultaneous linear equations by elimination, substitution and graphically including equations that need rearranging |
|  | Solve worded problems involving simultaneous equations |
|  | Solve simultaneous equations with one linear equation and one quadratic equation, algebraically and graphically (including a <br> line and a circle) |

## Solving Linear Equations

| Stage | Objectives |
| :---: | :---: |
| 3 | Solve one and two step linear equations with positive integer solutions using function machine and balancing methods |
|  | Write an equation to represent a number problem |
| 4 | Solve linear equations with positive or negative; integer and fractional solutions, using function machine and balancing methods including equations with brackets |
|  | Know the terminology; expression, equation, formula, term and factor |
| 5 | Write and solve linear equations |
|  | Solve linear equations with unknowns on both sides with positive or negative; integer and fractional solutions, using function machine and balancing methods |
| 6 | Solve linear inequalities with positive or negative; integer and fractional solutions including representing the solution set on a number line and as a list of integers |
|  | Understand the effect of multiplying or dividing a linear inequality by a negative number |
|  | Represent linear inequalities on a number line and write the inequality given on a number line |
|  | Write down all the integers in a given range |
|  | Work out the smallest or largest integer solution when solving an inequality |
| 7 | Solve more difficult linear equations with positive and negative; integer and fractional solutions |
|  | Solve linear equations with fractional and negative coefficients of $x$ |
|  | Write and solve linear equations with integer coefficients |
|  | Solve simple linear equations where the numbers are written in standard form |
|  | Solve linear equations that use function notation |
| 9 | Write and solve worded linear inequalities |
|  | Write linear inequalities from a coordinate grid |
|  | Represent linear inequalities on a given coordinate grid and shade out the boundary which does NOT satisfy the inequalities |
|  | Use the unshaded region to find the solution(s) including identifying the maximum and minimum values |
|  | Understand the solution(s) in context |

## Solving Non-Linear Equations

| Stage | Objectives |
| :---: | :---: |
| 6 | Solve quadratic equations such as $2 x^{2}=50$, giving both the positive and negative roots |
|  | Solve quadratic equations when the coefficient of $x^{\wedge} 2$ is 1 by factorising |
|  | Understand the solutions are the roots of the quadratic graph |
| 8 | Solve quadratic equations by; factorising, using the formula, and completing the square including when the coefficient of $\mathrm{x}^{2}>1$ |
|  | Use trial and improvement to solve equations |
|  | Solve quadratic equations that use function notation |
|  | Construct and solve quadratic equations and interpret solutions in context |
| 9 | Solve quadratic equations that require rearrangement by; factorising, using the formula, and completing the square including when the coefficient of $x^{2}>1$ |
|  | Identify roots, turning points and intercepts of an equation by completing the square and sketch the graph |
|  | Solve quadratic inequalities in one variable including representing the solution set on a number line and as a list of integers |
|  | Find approximate solutions to equations numerically using iteration (suffix notation) |
|  | Solve equations written in surd form |
|  | Solve equations involving algebraic fractions |

## Transformations

| Stage | Objectives |
| :---: | :---: |
| 2 | Translate a shape on a grid when given the number of squares left/ right and up/down; and describe a translation |
| 3 | Reflect a shape in a given line on a coordinate grid; and describe a reflection on a coordinate grid stating the equation of the horizontal or vertical line of reflection |
| 4 | Translate a shape on a coordinate grid using vector notation; and describe a translation |
|  | Rotate a shape on a coordinate grid; and describe a rotation |
|  | Reflect a shape in a given line on a coordinate grid; and describe a reflection on a coordinate grid stating the equation of the diagonal, horizontal or vertical line of reflection |
| 5 | Translate more difficult shapes on a coordinate grid using vector notation; and describe a translation |
|  | Rotate more difficult shapes on a coordinate grid; and describe a rotation |
|  | Reflect more difficult shapes in a given line on a coordinate grid; and describe a reflection on a coordinate grid stating the equation of the diagonal, horizontal or vertical line of reflection |
|  | Enlarge a shape on a grid and on a coordinate grid by a positive integer scale factor; and describe an enlargement including fractional |
|  | Understand and recognise congruent and similar shapes |
| 8 | Enlarge a shape on a grid and on a coordinate grid by a given negative scale factor; and describe an enlargement including fractional |
|  | Identify and use invariant points |
|  | Describe a combination of transformations as a single transformation |

## Volume

| Stage | Objectives |
| :---: | :---: |
| 4 | Estimate volume and capacity |
|  | Understand the definition of volume and know the units of measurement are $\mathrm{cm}^{3}, \mathrm{~m}^{3}$ etc |
|  | Find the volume and surface area by counting cubes |
|  | Calculate the volume of a cube and cuboid |
|  | Compare volumes of cubes and cuboids |
| 5 | Calculate the volume of a trapezoid, triangular prism, cylinder and compound prisms, writing answers as decimals and in terms of $\Pi$ |
|  | Use the properties of prisms to find missing lengths |
|  | Solve worded problems involving finding the volume of prisms including with mixed units |
| 7 | Calculate the volume of spheres, hemispheres, cones, pyramids and composite solids, writing answers as decimals and in terms of $\Pi$ |
|  | Use the properties of solids to find missing lengths |
|  | Solve worded problems involving the above |
|  | Solve problems involving a combination of surface area and volume of solids |

## Formulae

| Stage |  |  |  |  |
| :--- | :--- | :---: | :---: | :---: |
| 2 | Substitute into a worded formula |  |  |  |
|  | Understand the word 'formula' |  |  |  |
|  | Form expressions and formulae |  |  |  |
|  | Find pairs of numbers that satisfy an equation with two unknowns |  |  |  |
|  | Rearrange simple formulae including the SUVAT equations of motion |  |  |  |
|  | Understand and use function notation |  |  |  |
|  | Substitute positive and negative integers, fractions and decimals into expressions and formulae with and without a calculator |  |  |  |
|  | Know the terminology expression, equation, formula, identity, inequality, term and factor |  |  |  |
| $\boldsymbol{y}$ | Form, rearrange and substitute into more difficult expressions and formulae including formulae used in real life |  |  |  |
|  | Understand and use function notation |  |  |  |

## Factors, Multiples and Primes

| Stage | Objectives |
| :---: | :---: |
| 3 | Understand and use divisibility tests |
|  | Know and identify prime numbers |
|  | Find factors and multiples of a given number |
|  | Understand that factors come in pairs with the exception of square and prime numbers |
|  | Find common factors and common multiples of two or more numbers |
|  | Find the highest common factor and lowest common multiple of two or more numbers |
|  | Solve worded problems involving factors and multiples |
| 6 | Find the prime factorisation of a number with and without a calculator |
|  | Work out the root of a number from a product of prime factors |
|  | Using prime factorisation, find the highest common factor and lowest common multiple of two or more numbers using index notation with and without a calculator |
|  | Solve more difficult worded problems involving factors and multiples |

