**Autumn Half Term 1**

**Calculations, checking and rounding**

* 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* × *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 and hierarchy of operations**

* 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 =  for positive integers n as well as,  = √*n* and  = 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 ;
* 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, √*x*, memory, *x y*, , brackets;
* Use calculators for all calculations: positive and negative numbers, brackets, powers and roots, four operations.

**Factors, multiples, primes, standard form and surds**

* 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. √12 = √(4 × 3) = √4 × √3 = 2√3).

**Autumn Half Term 2**

**Algebra: the basics, setting up, rearranging and solving equations**

* 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 3*x* + 4 and 2*x*3 and then into expressions involving brackets and powers;
* Simplify expressions by cancelling,
* 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 simplify expressions by factorising, including subsequently collecting like terms;
* Expand the product of two linear expressions including squaring 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. 6*x* + 4 ≠ 3(*x* + 2), and introduce identity ≡ sign;
* Solve linear equations
* Derive a formula and set up equations from word problems, then solve these, interpreting the solution in the context of the problem;
* Use and substitute formulae from maths and other subjects, including the kinematics formulae *v* = *u* + *at*, *v*2 – *u*2 = 2*as*, and *s* = *ut* +  *at*2;
* Change the subject of a formula, including cases where the subject is on both sides, or involving fractions and small powers of the subject;
* Simple proofs; 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**

* Recognise simple sequences including at the most basic level odd, even, triangular, square and cube numbers and Fibonacci-type sequences;
* 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 *n*th term of an arithmetic sequence;
* Use the *n*th term of an arithmetic sequence to decide if a given number is a term in the sequence,
* Continue a quadratic sequence and use the *n*th term to generate terms;
* Find the *n*th term of quadratic sequences;
* Distinguish between arithmetic and geometric 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;

**Averages and range**

* Design and use two-way tables for discrete and grouped data;
* Sort, classify and tabulate data and discrete or continuous quantitative data;
* Calculate mean and range, find median and mode from a small data set;
* Recognise the advantages and disadvantages between measures of average;
* Construct and interpret stem and leaf diagrams
* Calculate the mean, mode, median and range from a frequency table

**Representing and interpreting data and scatter graphs**

* Produce and interpret: composite bar charts; comparative and dual bar charts; pie charts; frequency polygons; line graphs and histograms
* Construct and interpret time–series graphs, comment on trends;
* Compare the mean and range of two distributions, or median or mode as appropriate;
* Draw and interpret scatter graphs in terms of the relationship between two variables;
* 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 causation

**Spring Half Term 1**

**Fractions and percentages**

* 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,
* Find a fraction of a quantity or measurement, including within a context;
* Convert a fraction to a decimal (including recurring decimals)
* Convert between mixed numbers and improper fractions;
* Add and subtract fractions, and multiply and divide fractions including mixed numbers;
* 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, including those greater than 100%
* Find a percentage of a quantity;
* Find the new amount after a percentage increase or decrease;
* Work out a percentage increase (decrease), including: simple interest, income tax, 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
* Find the original amount given the final amount after a percentage increase or decrease (reverse percentages), including VAT;
* Describe percentage increase/decrease with fractions, e.g. 150% increase means 2 ½ times as big;
* Choose fractions, decimals or percentages appropriately for calculations.

**Ratio and proportion**

* Express the division of a quantity into a number 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;
* 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 and to scale up recipes

**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, & 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 to solve geometric problems
* Understand & use angle properties of parallel lines and find missing angles using the corresponding and alternate angles, giving reasons
* Calculate and use the sums of the interior and exterior angles of polygons
* Use the side/angle properties of compound shapes, including solving angle and symmetry problems and using algebra

**Pythagoras’ Theorem and trigonometry**

* 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
* 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°.

**Spring Half Term 2**

**Graphs: the basics and real-life graphs**

* Identify and plot points in all four quadrants;
* Draw and interpret straight-line graphs for real-life situations, conversion graphs, fuel bills, fixed charge and cost per item;
* Draw distance–time and velocity–time graphs;
* Use graphs to calculate various measures, 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;
* 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 and coordinate 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;
* 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 .

**Quadratic, cubic and other 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  with *x* ≠ 0 using tables of values;
* Draw circles, centre the origin, equation *x*2 + *y*2 = *r*2.

**Summer Half Term 1**

**Perimeter, area and circles**

* 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*πr* = *πd* and area of a circle = *πr*2) using a variety of metric measures;
* Use *π* ≈ 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 also 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 in terms of *π*;
* Form equations involving more complex shapes and solve these equations.

**3D forms and volume, cylinders, cones and spheres**

* 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 solid 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 cm3;
* Use volume to solve problems;
* Estimating surface area, perimeter and volume by rounding measurements to 1 significant figure to check reasonableness of answers;
* Use *π* ≈ 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 in terms of *π*;
* Form equations involving more complex shapes and solve these equations.

**Accuracy and bounds**

* 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 bound.

**Summer Half Term 2**

**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, describe and construct reflections on a coordinate grid, including mirror lines of the form , *x* = *a*, *y* = *a*, *y* = *x*, *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, 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,
* 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 and bearings**

* 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’;
* 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 and simultaneous equations**

* 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;