**GCSE Mathematics (9-1)**

**Foundation tier – Skills Aud****it**

= I fully understand and would be confident to answer an exam question

= I understand the concept but need to practice more questions

= I need to revise the concept and practise easier questions

|  |  |  |  |
| --- | --- | --- | --- |
|  | ☺ |  | ☹ |
| **UNIT 1: Number, powers, decimals, HCF and LCM, roots and rounding** | | | |
| **Subunit 1a Interges and Place Value** | | | |
| Use and order positive and negative numbers (integers) and decimals; use the symbols <, > and understand the ≠ symbol; |  |  |  |
| Add, subtract, multiply and divide positive and negative numbers (integers); |  |  |  |
| Recall all multiplication facts to 10 × 10, and use them to derive quickly the corresponding division facts; |  |  |  |
| Multiply or divide any number by powers of 10; |  |  |  |
| Use brackets and the hierarchy of operations (not including powers); |  |  |  |
| Round numbers to a given power of 10; |  |  |  |
| Check answers by rounding and using inverse operations. |  |  |  |
| **Subunit 1b. Decimals** | | | |
| Use decimal notation and place value; |  |  |  |
| Identify the value of digits in a decimal or whole number; |  |  |  |
| Compare and order decimal numbers using the symbols <, >; |  |  |  |
| Understand the ≠ symbol (not equal); |  |  |  |
| Write decimal numbers of millions, e.g. 2 300 000 = 2.3 million; |  |  |  |
| Add, subtract, multiply and divide decimals, including calculations involving money; |  |  |  |
| Multiply or divide by any number between 0 and 1; |  |  |  |
| Round to the nearest integer; |  |  |  |
| Round to a given number of decimal places and significant figures; |  |  |  |
| Estimate answers to calculations by rounding numbers to 1 significant figure; |  |  |  |
| Use one calculation to find the answer to another. |  |  |  |
| **Subunit 1c. Indices, powers and roots** | | | |
| Find squares and cubes: |  |  |  |
| recall integer squares up to 10 x 10 and the corresponding square roots; |  |  |  |
| understand the difference between positive and negative square roots; |  |  |  |
| recall the cubes of 1, 2, 3, 4, 5 and 10; |  |  |  |
| Use index notation for squares and cubes; |  |  |  |
| Recognise powers of 2, 3, 4, 5; |  |  |  |
| Evaluate expressions involving squares, cubes and roots: |  |  |  |
| add, subtract, multiply and divide numbers in index form; |  |  |  |
| cancel to simplify a calculation; |  |  |  |
| Use index notation for powers of 10, including negative powers; |  |  |  |
| Use the laws of indices to multiply and divide numbers written in index notation; |  |  |  |
| Use brackets and the hierarchy of operations with powers inside the brackets, or raising brackets to powers; |  |  |  |
| Use calculators for all calculations: positive and negative numbers, brackets, square, cube, powers and roots, and all four operations. |  |  |  |
| **Subunit: 1d. Factors, multiples and primes** | | | |
| List all three-digit numbers that can be made from three given integers; |  |  |  |
| Recognise odd, even and prime (two digit) numbers; |  |  |  |
| Identify factors and multiples and list all factors and multiples of a number systematically; |  |  |  |
| Find the prime factor decomposition of positive integers and 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; |  |  |  |
| 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 two factors; |  |  |  |
| Solve simple problems using HCF, LCM and prime numbers. |  |  |  |
| **UNIT 2: Expressions, substituting into simple formulae, expanding and factorising** | | | |
| **Subunit 2a. Algebra: the basics** | | | |
| Use notation and symbols correctly; |  |  |  |
| Write an expression; |  |  |  |
| Select an expression/equation/formula/identity from a list; |  |  |  |
| Manipulate and simplify algebraic expressions by collecting ‘like’ terms; |  |  |  |
| Multiply together two simple algebraic expressions, e.g. 2*a* × 3*b*; |  |  |  |
| Simplify expressions by cancelling, e.g.  = 2*x*; |  |  |  |
| Use index notation and the index laws when multiplying or dividing algebraic terms; |  |  |  |
| Understand the ≠ symbol and introduce the identity ≡ sign; |  |  |  |
| **Subunit 2b. Expressions and substitution into formula** | | | |
| Multiply a single number term over a bracket; |  |  |  |
| Write and simplify expressions using squares and cubes; |  |  |  |
| Simplify expressions involving brackets, i.e. expand the brackets, then add/subtract; |  |  |  |
| Argue mathematically to show algebraic expressions are equivalent; |  |  |  |
| Recognise factors of algebraic terms involving single brackets; |  |  |  |
| Factorise algebraic expressions by taking out common factors; |  |  |  |
| Write expressions to solve problems representing a situation; |  |  |  |
| Substitute numbers into simple algebraic expressions; |  |  |  |
| Substitute numbers into expressions involving brackets and powers; |  |  |  |
| Substitute positive and negative numbers into expressions; |  |  |  |
| Derive a simple formula, including those with squares, cubes and roots; |  |  |  |
| Substitute numbers into a (word) formula; |  |  |  |
| **UNIT 3: Drawing and interpreting graphs, tables and charts** | | | |
| **Subunit: 3a. Tables, charts and graphs** | | | |
| Use suitable data collection techniques (data to be integer and decimal values); |  |  |  |
| Design and use data-collection sheets for grouped, discrete and continuous data, use inequalities for grouped data, and introduce ≤ and ≥ signs; Sort, classify and tabulate data, both discrete and continuous quantitative data, and qualitative data; Extract data from lists and tables; |  |  |  |
| Use correct notation for time, 12- and 24-hour clock and work out time taken for a journey from a timetable; |  |  |  |
| Construct tables for time–series d  ata; |  |  |  |
| Design, complete and use two-way tables for discrete and grouped data; |  |  |  |
| Calculate the total frequency from a frequency table; |  |  |  |
| Read off frequency values from a table; |  |  |  |
| Read off frequency values from a frequency table; |  |  |  |
| Find greatest and least values from a frequency table; |  |  |  |
| Identify the mode from a frequency table; |  |  |  |
| Identify the modal class from a grouped frequency table; |  |  |  |
| Plotting coordinates in first quadrant and read graph scales in multiples; |  |  |  |
| Produce and interpret:  pictograms;  composite bar charts;  dual/comparative bar charts for categorical and ungrouped discrete data;  bar-line charts;  vertical line charts;  line graphs;  line graphs for time–series data;  histograms with equal class intervals;  stem and leaf (including back-to-back); |  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Calculate total population from a bar chart or table; |  |  |  |
| Find greatest and least values from a bar chart or table; |  |  |  |
| Find the mode from a stem and leaf diagram; |  |  |  |
| Identify the mode from a bar chart; |  |  |  |
| Recognise simple patterns, characteristic and relationships in bar charts and line graphs; |  |  |  |
| Interpret and discuss any data. |  |  |  |
| **Subunit: 3b. Pie charts** | | | |
| Interpret tables; represent data in tables and charts; |  |  |  |
| Know which charts to use for different types of data sets; |  |  |  |
| Draw circles and arcs to a given radius; |  |  |  |
| Know there are 360 degrees in a full turn, 180 degrees in a half turn, and 90 degrees in a quarter turn; |  |  |  |
| Measure and draw angles, to the nearest degree; Construct pie charts for categorical data and discrete/continuous numerical data; |  |  |  |
| Interpret simple pie charts using simple fractions and percentages; ,  and multiples of 10% sections; |  |  |  |
| From a pie chart:  find the mode;  find the total frequency; |  |  |  |
|  |  |  |
|  |  |  |
| Understand that the frequency represented by corresponding sectors in two pie charts is dependent upon the total populations represented by each of the pie charts. |  |  |  |
| **Subunit 3c. Scatter graphs** | | | |
| Draw scatter graphs; |  |  |  |
| Interpret points on a scatter graph; |  |  |  |
| Identify outliers and ignore them on scatter graphs; |  |  |  |
| Draw the line of best fit on a scatter diagram by eye, and understand what it represents; |  |  |  |
| Use the line of best fit make predictions; interpolate and extrapolate apparent trends whilst knowing the dangers of so doing; |  |  |  |
| Distinguish between positive, negative and no correlation using lines of best fit; |  |  |  |
| Use a line of best fit to predict values of a variable given values of the other variable; |  |  |  |
| Interpret scatter graphs in terms of the relationship between two variables; |  |  |  |
| Interpret correlation in terms of the problem; |  |  |  |
| Understand that correlation does not imply causality; |  |  |  |
| State how reliable their predictions are, i.e. not reliable if extrapolated. |  |  |  |
| **UNIT 4: Fractions and percentages** | | | |
| **Subunit 4a. Fractions, decimals and percentages** | | | |
| Use diagrams to find equivalent fractions or compare fractions; |  |  |  |
| Write fractions to describe shaded parts of diagrams; |  |  |  |
| Express a given number as a fraction of another, using very simple numbers, some cancelling, and where the fraction is both < 1 and > 1; |  |  |  |
| Write a fraction in its simplest form and find equivalent fractions; |  |  |  |
| Order fractions, by using a common denominator; |  |  |  |
| Compare fractions, use inequality signs, compare unit fractions; |  |  |  |
| Convert between mixed numbers and improper fractions; |  |  |  |
| Add and subtract fractions; |  |  |  |
| Add fractions and write the answer as a mixed number; |  |  |  |
| Multiply and divide an integer by a fraction; |  |  |  |
| Multiply and divide a fraction by an integer, including finding fractions of quantities or measurements, and apply this by finding the size of each category from a pie chart using fractions; |  |  |  |
| Understand and use unit fractions as multiplicative inverses; |  |  |  |
| Multiply fractions: simplify calculations by cancelling first; |  |  |  |
| Divide a fraction by a whole number and another fraction; |  |  |  |
| Recall the fraction-to-decimal conversion and convert fractions to decimals; |  |  |  |
| Convert a fraction to a decimal to make a calculation easier,  e.g. 0.25 × 8 =  × 8, or  × 10 = 0.375 × 10; |  |  |  |
| Recognise recurring decimals and convert fractions such as ,  and  into recurring decimals; |  |  |  |
| Compare and order fractions, decimals and integers, using inequality signs; |  |  |  |
| Understand that a percentage is a fraction in hundredths; |  |  |  |
| Express a given number as a percentage of another number; |  |  |  |
| Convert between fractions, decimals and percentages; |  |  |  |
| Order fractions, decimals and percentages, including use of inequality signs. |  |  |  |
| **Subunit 4b. Percentages** | | | |
| Express a given number as a percentage of another number; |  |  |  |
| Find a percentage of a quantity without a calculator: 50%, 25% and multiples of 10% and 5%; |  |  |  |
| Find a percentage of a quantity or measurement (use measurements they should know from Key Stage 3 only); |  |  |  |
| Calculate amount of increase/decrease; |  |  |  |
| Use percentages to solve problems, including comparisons of two quantities using percentages; |  |  |  |
| Percentages over 100%; |  |  |  |
| Use percentages in real-life situations, including percentages greater than 100%: |  |  |  |
| Price after VAT (not price before VAT); |  |  |  |
| Value of profit or loss; |  |  |  |
| Simple interest; |  |  |  |
| Income tax calculations; |  |  |  |
| Use decimals to find quantities; |  |  |  |
| Find a percentage of a quantity, including using a multiplier; |  |  |  |
| Use a multiplier to increase or decrease by a percentage in any scenario where percentages are used; |  |  |  |
| Understand the multiplicative nature of percentages as operators. |  |  |  |
| **UNIT 5: Equations, inequalities and sequences** | | | |
| **Subunit 5a. Equations and inequalities** | | | |
| Select an expression/equation/formula/identity from a list; |  |  |  |
| Write expressions and set up simple equations including forming an equation from a word problem; |  |  |  |
| Use function machines; |  |  |  |
| Solve simple equations including those:   * with integer coefficients, in which the unknown appears on either side or on both sides of the equation; * which contain brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution; * with one unknown, with integer or fractional coefficients; |  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Rearrange simple equations; |  |  |  |
| Substitute into a formula, and solve the resulting equation; |  |  |  |
| Find an approximate solution to a linear equation using a graph; |  |  |  |
| Solve angle or perimeter problems using algebra. |  |  |  |
| Show inequalities on number lines; |  |  |  |
| Write down whole number values that satisfy an inequality; |  |  |  |
| Solve an inequality such as –3 < 2*x* + 1 <7 and show the solution set on a number line; |  |  |  |
| Solve two inequalities in *x*, find the solution sets and compare them to see which value of *x* satisfies both; |  |  |  |
| Use the correct notation to show inclusive and exclusive inequalities; |  |  |  |
| Construct inequalities to represent a set shown on a number line; |  |  |  |
| Solve simple linear inequalities in one variable, and represent the solution set on a number line; |  |  |  |
| Round answers to a given degree of accuracy; |  |  |  |
| Use inequality notation to specify simple error intervals due to truncation or rounding. |  |  |  |
| **5b. Sequences** | | | |
| Recognise sequences of odd and even numbers, and other sequences including Fibonacci sequences; |  |  |  |
| Use function machines to find terms of a sequence; |  |  |  |
| Write the term-to-term definition of a sequence in words; |  |  |  |
| Find a specific term in the sequence using position-to-term or term-to-term rules; |  |  |  |
| Generate arithmetic sequences of numbers, triangular number, square and cube integers and sequences derived from diagrams; |  |  |  |
| Recognise such sequences from diagrams and draw the next term in a pattern sequence; |  |  |  |
| Find the next term in a sequence, including negative values; |  |  |  |
| Find the *n*th term |  |  |  |
| for a pattern sequence; |  |  |  |
| a linear sequence; |  |  |  |
| of an arithmetic sequence; |  |  |  |
| Use the *n*th term of an arithmetic sequence to |  |  |  |
| generate terms; |  |  |  |
| decide if a given number is a term in the sequence, or find the first term over a certain number; |  |  |  |
| find the first term greater/less than a certain number; |  |  |  |
| Continue a geometric progression and find the term-to-term rule, including negatives, fraction and decimal terms; |  |  |  |
| Continue a quadratic sequence and use the *n*th term to generate terms; |  |  |  |
| Distinguish between arithmetic and geometric sequences. |  |  |  |
| **UNIT 6: Angles, polygons and parallel lines** | | | |
| **6a. Properties of shapes, parallel lines and angle facts** | | | |
| Estimate sizes of angles; |  |  |  |
| Measure angles using a protractor; |  |  |  |
| Use geometric language appropriately; |  |  |  |
| Use letters to identify points, lines and angles; |  |  |  |
| Use two-letter notation for a line and three-letter notation for an angle; |  |  |  |
| Describe angles as turns and in degrees and understand clockwise and anticlockwise; |  |  |  |
| Know that there are 360° in a full turn, 180° in a half turn and 90° in a quarter turn; |  |  |  |
| Identify a line perpendicular to a given line on a diagram and use their properties; |  |  |  |
| Identify parallel lines on a diagram and use their properties; |  |  |  |
| Find missing angles using properties of corresponding and alternate angles; |  |  |  |
| Understand and use the angle properties of parallel lines. |  |  |  |
| Recall the properties and definitions of special types of quadrilaterals, including symmetry properties; |  |  |  |
| List the properties of each special type of quadrilateral, or identify (name) a given shape; |  |  |  |
| Draw sketches of shapes; |  |  |  |
| Classify quadrilaterals by their geometric properties and name all quadrilaterals that have a specific property; |  |  |  |
| Identify quadrilaterals from everyday usage; |  |  |  |
| Given some information about a shape on coordinate axes, complete the shape; Understand and use the angle properties of quadrilaterals; |  |  |  |
| Use the fact that angle sum of a quadrilateral is 360°; |  |  |  |
| Recall and use properties of angles at a point, angles at a point on a straight line, right angles, and vertically opposite angles; |  |  |  |
| Distinguish between scalene, equilateral, isosceles and right-angled triangles; |  |  |  |
| Derive and use the sum of angles in a triangle; |  |  |  |
| Find a missing angle in a triangle, using the angle sum of a triangle is 180°; |  |  |  |
| Understand and use the angle properties of triangles, use the symmetry property of isosceles triangle to show that base angles are equal; |  |  |  |
| Use the side/angle properties of isosceles and equilateral triangles; |  |  |  |
| Understand and use the angle properties of intersecting lines; |  |  |  |
| Understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices; Use geometrical language appropriately, give reasons for angle calculations and show step-by-step deduction when solving problems. |  |  |  |
| **6b. Interior and exterior angles of polygons** | | | |
| Recognise and name pentagons, hexagons, heptagons, octagons and decagons; |  |  |  |
| Understand ‘regular’ and ‘irregular’ as applied to polygons; |  |  |  |
| Use the sum of angles of irregular polygons; |  |  |  |
| Calculate and use the sums of the interior angles of polygons; |  |  |  |
| Calculate and use the angles of regular polygons; |  |  |  |
| Use the sum of the interior angles of an *n*-sided polygon; |  |  |  |
| Use the sum of the exterior angles of any polygon is 360°; |  |  |  |
| Use the sum of the interior angle and the exterior angle is 180°; |  |  |  |
| Identify shapes which are congruent (by eye); |  |  |  |
| Explain why some polygons fit together and others do not; |  |  |  |
| **UNIT 7: Statistics, sampling and the averages** | | | |
| Specify the problem and:  plan an investigation;  decide what data to collect and what statistical analysis is needed;  consider fairness; |  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Recognise types of data: primary secondary, quantitative and qualitative; |  |  |  |
| Identify which primary data they need to collect and in what format, including grouped data; |  |  |  |
| Collect data from a variety of suitable primary and secondary sources; |  |  |  |
| Understand how sources of data may be biased and explain why a sample may not be representative of a whole population; |  |  |  |
| Understand sample and population. |  |  |  |
| Calculate the mean, mode, median and range for discrete data; |  |  |  |
| Interpret and find a range of averages as follows:  median, mean and range from a (discrete) frequency table;  range, modal class, interval containing the median, and estimate of the mean from a grouped data frequency table;  mode and range from a bar chart;  median, mode and range from stem and leaf diagrams;  mean from a bar chart; |  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Understand that the expression 'estimate' will be used where appropriate, when finding the mean of grouped data using mid-interval values; |  |  |  |
| Compare the mean, median, mode and range (as appropriate) of two distributions using bar charts, dual bar charts, pictograms and back-to-back stem and leaf; |  |  |  |
| Recognise the advantages and disadvantages between measures of average. |  |  |  |
| **UNIT 8: Perimeter, area and volume** | | | |
| Indicate given values on a scale, including decimal value; |  |  |  |
| Know that measurements using real numbers depend upon the choice of unit; |  |  |  |
| Convert between units of measure within one system, including time and metric units to metric units of length, area and volume and capacity e.g. 1ml = 1cm3; |  |  |  |
| Make sensible estimates of a range of measures in everyday settings; |  |  |  |
| Measure shapes to find perimeters and areas using a range of scales; |  |  |  |
| Find the perimeter of  rectangles and triangles;  parallelograms and trapezia;  compound shapes; |  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Recall and use the formulae for the area of a triangle and rectangle; |  |  |  |
| Find the area of a trapezium and recall the formula; |  |  |  |
| Find the area of a parallelogram; |  |  |  |
| Calculate areas and perimeters of compound shapes made from triangles and rectangles; |  |  |  |
| Estimate surface areas by rounding measurements to 1 significant figure; |  |  |  |
| Find the surface area of a prism; |  |  |  |
| Find surface area using rectangles and triangles; |  |  |  |
| Identify and name common solids: cube, cuboid, cylinder, prism, pyramid, sphere and cone; |  |  |  |
| Sketch nets of cuboids and prisms; |  |  |  |
| Recall and use the formula for the volume of a cuboid; |  |  |  |
| Find the volume of a prism, including a triangular prism, cube and cuboid; |  |  |  |
| Calculate volumes of right prisms and shapes made from cubes and cuboids; |  |  |  |
| Estimate volumes etc by rounding measurements to 1 significant figure; |  |  |  |
| **UNIT 9: Real-life and algebraic linear graphs** | | | |
| **9a. Real-life graphs** | | | |
| Use input/output diagrams; |  |  |  |
| Draw, label and scale axes; |  |  |  |
| Use axes and coordinates to specify points in all four quadrants in 2D; |  |  |  |
| Identify points with given coordinates and coordinates of a given point in all four quadrants; |  |  |  |
| Find the coordinates of points identified by geometrical information in 2D (all four quadrants); |  |  |  |
| Find the coordinates of the midpoint of a line segment; Read values from straight-line graphs for real-life situations; |  |  |  |
| Draw straight line graphs for real-life situations, including ready reckoner graphs, conversion graphs, fuel bills graphs, fixed charge and cost per unit; |  |  |  |
| Draw distance–time graphs and velocity–time graphs; |  |  |  |
| Work out time intervals for graph scales; |  |  |  |
| Interpret distance–time graphs, and calculate: the speed of individual sections, total distance and total time; |  |  |  |
| Interpret information presented in a range of linear and non-linear graphs; |  |  |  |
| Interpret graphs with negative values on axes; |  |  |  |
| Find the gradient of a straight line from real-life graphs; |  |  |  |
| Interpret gradient as the rate of change in distance–time and speed–time graphs, graphs of containers filling and emptying, and unit price graphs. |  |  |  |
| **9b. Straight-line graphs** | | | |
| Use function machines to find coordinates (i.e. given the input *x*, find the output *y*); |  |  |  |
| Plot and draw graphs of *y* = *a*, *x* = *a*, *y* = *x* and *y* = –*x*; |  |  |  |
| Recognise straight-line graphs parallel to the axes; |  |  |  |
| Recognise that equations of the form *y* = *mx* + *c* correspond to straight-line graphs in the coordinate plane; |  |  |  |
| Plot and draw graphs of straight lines of the form *y* = *mx* + *c* using a table of values; |  |  |  |
| Sketch a graph of a linear function, using the gradient and *y*-intercept; |  |  |  |
| Identify and interpret gradient from an equation *y* = *mx* + *c*; |  |  |  |
| Identify parallel lines from their equations; |  |  |  |
| Plot and draw graphs of straight lines in the form *ax* + *by* = *c*; |  |  |  |
| Find the equation of a straight line from a graph; |  |  |  |
| Find the equation of the line through one point with a given gradient; |  |  |  |
| Find approximate solutions to a linear equation from a graph. |  |  |  |
| **UNIT 10: Transformations** | | | |
| Identify congruent shapes by eye; |  |  |  |
| Understand that rotations are specified by a centre, an angle and a direction of rotation; |  |  |  |
| Find the centre of rotation, angle and direction of rotation and describe rotations fully using the angle, direction of turn, and centre; |  |  |  |
| Rotate and draw the position of a shape after rotation about the origin or any other point including rotations on a coordinate grid; |  |  |  |
| Identify correct rotations from a choice of diagrams; |  |  |  |
| Understand that translations are specified by a distance and direction using a vector; |  |  |  |
| Translate a given shape by a vector; |  |  |  |
| Use column vectors to describe and transform 2D shapes using single translations on a coordinate grid; |  |  |  |
| Understand that distances and angles are preserved under rotations and translations, so that any figure is congruent under either of these transformations; |  |  |  |
| Understand that reflections are specified by a mirror line; |  |  |  |
| Identify correct reflections from a choice of diagrams; |  |  |  |
| Identify the equation of a line of symmetry; |  |  |  |
| Transform 2D shapes using single reflections (including those not on coordinate grids) with vertical, horizontal and diagonal mirror lines; |  |  |  |
| Describe reflections on a coordinate grid; |  |  |  |
| Scale a shape on a grid (without a centre specified); |  |  |  |
| Understand that an enlargement is specified by a centre and a scale factor; |  |  |  |
| Enlarge a given shape using (0, 0) as the centre of enlargement, and enlarge shapes with a centre other than (0, 0); |  |  |  |
| Find the centre of enlargement by drawing; |  |  |  |
| Describe and transform 2D shapes using enlargements by: |  |  |  |
| a positive integer scale factor; |  |  |  |
| a fractional scale factor; |  |  |  |
| Identify the scale factor of an enlargement of a shape as the ratio of the lengths of two corresponding sides, simple integer scale factors, or simple fractions; |  |  |  |
| Understand that distances and angles are preserved under reflections, so that any figure is congruent under this transformation; |  |  |  |
| Understand that similar shapes are enlargements of each other and angles are preserved – define similar in this unit. |  |  |  |
| **UNIT 11: Ratio and Proportion** | | | |
| **11a. Ratio** | | | |
| Understand and express the division of a quantity into a of number parts as a ratio; |  |  |  |
| Write ratios in their simplest form; |  |  |  |
| Write/interpret a ratio to describe a situation; |  |  |  |
| Share a quantity in a given ratio including three-part ratios; |  |  |  |
| Solve a ratio problem in context: |  |  |  |
| use a ratio to find one quantity when the other is known; |  |  |  |
| use a ratio to compare a scale model to a real-life object; |  |  |  |
| use a ratio to convert between measures and currencies; |  |  |  |
| problems involving mixing, e.g. paint colours, cement and drawn conclusions; |  |  |  |
| Compare ratios; |  |  |  |
| Write ratios in form 1 : *m* or *m* : 1; |  |  |  |
| Write a ratio as a fraction; |  |  |  |
| Write a ratio as a linear function; |  |  |  |
| Write lengths, areas and volumes of two shapes as ratios in simplest form; |  |  |  |
| Express a multiplicative relationship between two quantities as a ratio or a fraction. |  |  |  |
| **11b. Proportion** | | | |
| Understand and use proportion as equality of ratios; |  |  |  |
| Solve word problems involving direct and inverse proportion; |  |  |  |
| Work out which product is the better buy; |  |  |  |
| Scale up recipes; |  |  |  |
| Convert between currencies; |  |  |  |
| Find amounts for 3 people when amount for 1 given; |  |  |  |
| Solve proportion problems using the unitary method; |  |  |  |
| Recognise when values are in direct proportion by reference to the graph form; |  |  |  |
| Understand inverse proportion: as *x* increases, *y* decreases (inverse graphs done in later unit); |  |  |  |
| Understand direct proportion ---> relationship *y* = *kx*. |  |  |  |
| **UNIT 12: Right-angled triangles: Pythagoras and trigonometry** | | | |
| Understand, recall and use Pythagoras’ Theorem in 2D, including leaving answers in surd form and being able to justify if a triangle is right-angled or not; |  |  |  |
| Calculate the length of the hypotenuse and of a shorter side in a right-angled triangle, including decimal lengths and a range of units; |  |  |  |
| Apply Pythagoras’ Theorem with a triangle drawn on a coordinate grid; |  |  |  |
| Calculate the length of a line segment AB given pairs of points; |  |  |  |
| Understand, use and recall the trigonometric ratios sine, cosine and tan, and apply them to find angles and lengths in general triangles in 2D figures; |  |  |  |
| Use the trigonometric ratios to solve 2D problems including angles of elevation and depression; |  |  |  |
| Round answers to appropriate degree of accuracy, either to a given number of significant figures or decimal places, or make a sensible decision on rounding in context of question; |  |  |  |
| 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°. |  |  |  |
| **UNIT 13: Probability** | | | |
| Distinguish between events which are impossible, unlikely, even chance, likely, and certain to occur; |  |  |  |
| Mark events and/or probabilities on a probability scale of 0 to 1; |  |  |  |
| Write probabilities in words or fractions, decimals and percentages; |  |  |  |
| Find the probability of an event happening using theoretical probability; |  |  |  |
| Use theoretical models to include outcomes using dice, spinners, coins; |  |  |  |
| List all outcomes for single events systematically; |  |  |  |
| Work out probabilities from frequency tables, frequency trees, and two way tables; |  |  |  |
| Record outcomes of probability experiments in tables; |  |  |  |
| Add simple probabilities; |  |  |  |
| Identify different mutually exclusive outcomes and know that the sum of the probabilities of all outcomes is 1; |  |  |  |
| Using 1 – *p* as the probability of an event not occurring where *p* is the probability of the event occurring; |  |  |  |
| Find a missing probability from a list or table including algebraic terms; |  |  |  |
| Find the probability of an event happening using relative frequency; |  |  |  |
| Estimate the number of times an event will occur, given the probability and the number of trials – for both experimental and theoretical probabilities; |  |  |  |
| List all outcomes for combined events systematically; |  |  |  |
| Use and draw sample space diagrams; |  |  |  |
| Work out probabilities from Venn diagrams to represent real-life situations and also ‘abstract’ sets of numbers/values; |  |  |  |
| Use union and intersection notation; |  |  |  |
| Compare experimental data and theoretical probabilities; |  |  |  |
| Compare relative frequencies from samples of different sizes; |  |  |  |
| Find the probability of successive events, such as several throws of a single dice; |  |  |  |
| Use tree diagrams to calculate the probability of two independent events; |  |  |  |
| Use tree diagrams to calculate the probability of two dependent events. |  |  |  |
| **UNIT 14: Multiplicative reasoning:** **more percentages, rates of change, compound measures** | | | |
| Understand and use compound measures:  density;  pressure;  speed:  convert between metric speed measures;  read values in km/h and mph from a speedometer;  calculate average speed, distance, time – in miles per hour as well as metric measures;  use kinematics formulae to calculate speed, acceleration (with formula provided and variables defined in the question);  change d/t in m/s to a formula in km/h, i.e. d/t × (60 × 60)/1000 – with support; |  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Express a given number as a percentage of another number in more complex situations; |  |  |  |
| Calculate percentage profit or loss; |  |  |  |
| Make calculations involving repeated percentage change, not using the formula; |  |  |  |
| Find the original amount given the final amount after a percentage increase or decrease; |  |  |  |
| Use compound interest; |  |  |  |
| Use a variety of measures in ratio and proportion problems: |  |  |  |
| currency conversion; |  |  |  |
| rates of pay; |  |  |  |
| best value; |  |  |  |
| Set up, solve and interpret the answers in growth and decay problems; |  |  |  |
| Understand that *X* is inversely proportional to *Y* is equivalent to *X* is proportional to ; |  |  |  |
| Interpret equations that describe direct and inverse proportion. |  |  |  |
| **UNIT 15: Constructions: triangles, nets, plan and elevation, loci, scale drawings and bearings** | | | |
| **15a. Plans and elevations** | | | |
| Understand clockwise and anticlockwise; |  |  |  |
| Draw circles and arcs to a given radius or given the diameter; |  |  |  |
| Measure and draw lines, to the nearest mm; |  |  |  |
| Measure and draw angles, to the nearest degree; |  |  |  |
| Know and use compass directions; |  |  |  |
| Draw sketches of 3D solids; |  |  |  |
| Know the terms face, edge and vertex; |  |  |  |
| Identify and sketch planes of symmetry of 3D solids; |  |  |  |
| Make accurate drawings of triangles and other 2D shapes using a ruler and a protractor; |  |  |  |
| Construct diagrams of everyday 2D situations involving rectangles, triangles, perpendicular and parallel lines; |  |  |  |
| 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. |  |  |  |
| **15b. Constructions, loci and bearings** | | | |
| Understand congruence, as two shapes that are the same size and shape; |  |  |  |
| Visually identify shapes which are congruent; |  |  |  |
| Use straight edge and a pair of compasses to do standard constructions: |  |  |  |
| understand, from the experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not; |  |  |  |
| construct the perpendicular bisector of a given line; |  |  |  |
| construct the perpendicular from a point to a line; |  |  |  |
| construct the bisector of a given angle; |  |  |  |
| construct angles of 90°, 45°; |  |  |  |
| Draw and construct diagrams from given instructions, including the following: |  |  |  |
| 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 may be defined by ‘nearer to’ or ‘greater than’; |  |  |  |
| Find and describe regions satisfying a combination of loci; |  |  |  |
| Use constructions to solve loci problems (2D only); |  |  |  |
| Use and interpret maps and scale drawings; |  |  |  |
| Estimate lengths using a scale diagram; |  |  |  |
| Make an accurate scale drawing from a diagram; |  |  |  |
| Use three-figure bearings to specify direction; |  |  |  |
| Mark on a diagram the position of point *B* given its bearing from point *A*; |  |  |  |
| Give a bearing between the points on a map or scaled plan; |  |  |  |
| Given the bearing of a point *A* from point *B*, work out the bearing of *B* from *A*; |  |  |  |
| Use accurate drawing to solve bearings problems; |  |  |  |
| Solve locus problems including bearings. |  |  |  |
| **UNIT 16: A****lgebra: quadratic equations and graphs** | | | |
| **16a. Quadratic equations: expanding and factorising** | | | |
| Define a ‘quadratic’ expression; |  |  |  |
| Multiply together two algebraic expressions with brackets; |  |  |  |
| Square a linear expression, e.g. (*x* + 1)2; |  |  |  |
| Factorise quadratic expressions of the form *x*2 + *bx* + *c*; |  |  |  |
| Factorise a quadratic expression *x*2 – *a*2 using the difference of two squares; |  |  |  |
| Solve quadratic equations by factorising; |  |  |  |
| Find the roots of a quadratic function algebraically. |  |  |  |
| **16b. Quadratic equations: graphs** | | | |
| Generate points and plot graphs of simple quadratic functions, then more general quadratic functions; |  |  |  |
| Identify the line of symmetry of a quadratic graph; |  |  |  |
| Find approximate solutions to quadratic equations using a graph; |  |  |  |
| Interpret graphs of quadratic functions from real-life problems; |  |  |  |
| Identify and interpret roots, intercepts and turning points of quadratic graphs. |  |  |  |
| **UNIT 17: Perimeter, area and volume 2: circles, cylinders, cones and spheres** | | | |
| Recall the definition of a circle and identify, name and draw parts of a circle including tangent, chord and segment; |  |  |  |
| Recall and use formulae for the circumference of a circle and the area enclosed by a circle circumference of a circle = 2*πr* = *πd*, area of a circle = *πr*2; |  |  |  |
| Use *π* ≈ 3.142 or use the *π* button on a calculator; |  |  |  |
| Give an answer to a question involving the circumference or area of a circle in terms of *π*; |  |  |  |
| Find radius or diameter, given area or perimeter of a circles; |  |  |  |
| Find the perimeters and areas of semicircles and quarter-circles; |  |  |  |
| Calculate perimeters and areas of composite shapes made from circles and parts of circles; |  |  |  |
| Calculate arc lengths, angles and areas of sectors of circles; |  |  |  |
| Find the surface area and volume of a cylinder; |  |  |  |
| Find the surface area and volume of spheres, pyramids, cones and composite solids; |  |  |  |
| Round answers to a given degree of accuracy. |  |  |  |
| **U****NIT 18: More fractions, reciprocals, standard form, zero and negative indices** | | | |
| **18a. Fractions** | | | |
| Add and subtract mixed number fractions; |  |  |  |
| Multiply mixed number fractions; |  |  |  |
| Divide mixed numbers by whole numbers and vice versa; |  |  |  |
| Find the reciprocal of an integer, decimal or fraction; |  |  |  |
| Understand ‘reciprocal’ as multiplicative inverse, knowing that any non-zero number multiplied by its reciprocal is 1 (and that zero has no reciprocal because division by zero is not defined). |  |  |  |
| **18b. Indices and standard form** | | | |
| Use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer powers, fractions and powers of a power; |  |  |  |
| Use numbers raised to the power zero, including the zero power of 10; |  |  |  |
| 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. |  |  |  |
| **UNIT 19: Congruence, similarity and vectors** | | | |
| **19a. Similarity and congruence in 2D** | | | |
| Use the basic congruence criteria for triangles (SSS, SAS, ASA and RHS); |  |  |  |
| Solve angle problems involving congruence; |  |  |  |
| Identify shapes which are similar; including all circles or all regular polygons with equal number of sides; |  |  |  |
| Understand similarity of triangles and of other plane shapes, use this to make geometric inferences, and solve angle problems using similarity; |  |  |  |
| Identify the scale factor of an enlargement of a shape as the ratio of the lengths of two corresponding sides; |  |  |  |
| Understand the effect of enlargement on perimeter of shapes; |  |  |  |
| Solve problems to find missing lengths in similar shapes; |  |  |  |
| Know that scale diagrams, including bearings and maps are ‘similar’ to the real-life examples. |  |  |  |
| **19b. Vectors** | | | |
| Understand and use column notation in relation to vectors; |  |  |  |
| Be able to represent information graphically given column vectors; |  |  |  |
| Identify two column vectors which are parallel; |  |  |  |
| Calculate using column vectors, and represent graphically, the sum of two vectors, the difference of two vectors and a scalar multiple of a vector. |  |  |  |
| **UNIT 20: Rearranging equations, graphs of cubic and reciprocal functions and simultaneous equations** | | | |
| Know the difference between an equation and an identity and use and understand the  ≠ symbol; |  |  |  |
| Change the subject of a formula involving the use of square roots and squares; |  |  |  |
| Answer ‘show that’ questions using consecutive integers (*n*, *n* + 1), squares *a*2, *b*2, even numbers 2*n*, and odd numbers 2*n* +1; |  |  |  |
| Solve problems involving inverse proportion using graphs, and read values from graphs; |  |  |  |
| Find the equation of the line through two given points; |  |  |  |
| Recognise, sketch and interpret graphs of simple cubic functions; |  |  |  |
| Recognise, sketch and interpret graphs of the reciprocal function  with *x* ≠ 0; |  |  |  |
| Use graphical representations of inverse proportion to solve problems in context; |  |  |  |
| identify and interpret the gradient from an equation *ax* + *by* = *c*; |  |  |  |
| Write simultaneous equations to represent a situation; |  |  |  |
| Solve simultaneous equations (linear/linear) algebraically and graphically; |  |  |  |
| Solve simultaneous equations representing a real-life situation, graphically and algebraically, and interpret the solution in the context of the problem; |  |  |  |