

Unit A Number Properties

Pre-Unit Revision: Even, Odd, Prime and Square numbers. Factors and Multiples.

Unit Content: There are an infinite number of primes but no algebraic formula. (1 is not a prime number). Whole number division, with remainders, leading to the proof that there are an infinite number of primes. Prime factorisation using ladders or trees. HCF and LCM from prime factorisation and problems involving them. Square Root from Prime Factors. Powers of numbers; squares, cubes and higher powers. Linear Sequences. Using Method of Differences to find the next terms. Using given formulas for the terms of sequences, substituting in to find the value of particular terms. (Not finding nth term rules).

Mental Skills: Recall of primes up to 100. Finding HCF and LCM mentally for small numbers. Find factors and multiples associated with tables 12 12. Recall of square numbers up to 20 20. Recall of powers of 2 up to 64.

What to know: Primes up to 100. How to find the prime factorisation, HCF and LCM of numbers. How to find the square root a number from its prime factors. How to find the next term in linear sequences and higher ones by substitution.

Unit B Rounding and Calculator

Pre-Unit Revision: Place-value, what each column is worth. Rounding to the nearest 10,100 etc.

Unit Content: The motivation for rounding numbers. Rounding to a given number of decimal places and significant figures. Estimating the value of expressions involving up to 3 operations. Rough answers using 1 s.f.

Use a scientific calculator ($fx - 85WA$): exploration of the functions; in particular square, square root, π , x^y , cube, cube root, reciprocal, fraction and Exp keys and what they mean; key in fractions and recognise equivalent decimal forms; use memory and bracket keys. Find whole number remainders after division. Recognise recurring decimals. Key in money calculations and measurement of time i.e. 4 hours 15 minutes is keyed as 4.25 hours. Underlying principles: order of operations, BODMAS. (e.g. $3 \times 4 + 5 = 17$, $3(4 + 5) = 27$).

Mental Skills: Using calculator to evaluate numerical problems involving up to 3 operations.

What to know: The difference between rounding to significant figures and decimal places. How to use 'decider' digits for rounding. How to estimate or check a calculation mentally. How to use a calculator to solve numerical problems. Understand the use of the main keys on a calculator.

Unit C Circles

Pre-Unit Revision: Recurring and non-recurring decimals and their fraction equivalents. Multiplication by a top-heavy fraction ($22/7$).

Unit Content: Circle vocabulary: definitions of radius, diameter, circumference, chord, segment and sector. Definition of Pi as the number of times the diameter of a circle fits around its circumference. Investigating this value. The accepted values of Pi. Using 3.142 and $22/7$. The circumference of a circle. A wheel in one rotation moves forwards a distance equal to its own circumference. The Area of a circle, demonstrated by slicing into sectors and reforming into a pseudo-rectangle. Perimeters and areas of semicircles and quadrants. The area of an annulus as the difference between the area of outer and inner circles. Answers to 3 s.f.

Mental Skills: Estimating the circumference and area of circles using $Pi = 3$.

What to know: The numerical values of Pi. The formulae for circumference and area of a circle and how to apply them to things which are and are not full circles. That a wheel moves forwards its circumference for each revolution.

Unit D Bearings

Pre-Unit Revision: Allied and alternate angles. Use of a 180° protractor to measure and draw angles.

Unit Content: The location of a place using its distance and bearing FROM a fixed point. Bearings measured in degrees, clockwise from the North. The link between Bearings and Eight-point compass directions. Combining up to three stages of a journey, given in terms of distances and bearings. Use of scale in converting between real and drawn distances e.g. 1 : 100 000 is equivalent to 1cm to 1km. Accurate measuring and drawing. Calculating Back-bearings using alternate, corresponding and allied angles.

Mental Skills: Mental imagery of the bearing of one point from another. Recall of the bearings of the eight-point compass. Finding real and drawn distances using a given scale.

What to know: Bearings are measured clockwise from North (000°). The bearings of each of the eight points of the compass. How to use a half-moon protractor to measure and draw bearings. How to use alternate, corresponding and allied angles to help find back-bearings to ensure accuracy. How to use the 'scale' of a drawing.

Unit E Division

Pre-Unit Revision: Division of whole numbers, short division, division by factors, division with double-digit carries. Division to obtain fractions and decimals. Cancelling fractions to lowest terms.

Unit Content: Clarification of concepts, vocabulary and symbolism; 'divide by' and 'divide into'. The idea of a reciprocal, as a number divided into one. Division of fractions, multiplying by the reciprocal. Division of decimals using a variety of methods; including converting each of the two decimals into a fraction and then treating as fraction division, and converting into a single fraction then using equivalent fractions, multiplying by ten, hundred etc to ensure the denominator is no longer a decimal. Division of numbers and algebraic terms by subtracting indices. Simplifying algebraic fractions by cancelling down and dealing with powers.

Mental Skills: Simple fraction division, e.g. how many halves in 3? ($3 \div \frac{1}{2}$). Division by a single-digit decimal. Alternative methods (e.g. dividing by 5 as doubling and dividing by 10).

What to know: The techniques for dividing fractions and decimals. How to divide algebraic terms. How to divide by powers of ten mentally. When and how to cancel. How to select the best method to suit the particular numbers involved.

Unit F Brackets and Factorising

Pre-Unit Revision: Multiplying and dividing algebraic terms. Numerical Highest Common Factors.

Unit Content: Expanding a single bracket by a number outside then by algebraic terms outside. Collecting like terms as a follow-up step to expanding an expression with two or three brackets. Care with negative signs, especially with two negatives inside and outside brackets: e.g. $3(4x + 2y) - 5(3x - y)$. Finding HCF of a pair of numbers. Extending this idea to cover pairs of algebraic terms. Factorising pairs of algebraic terms by taking out the HCF and placing it outside a single bracket.

Mental Skills: Identifying common algebraic factors.

What to know: How to expand brackets by multiplying. How to avoid traps with negative signs. How to identify algebraic common factors and extract them to factorise expressions. How to use multiplying out as a way of checking factorisations. How to check that an expression is fully factorised.

Unit G Equations

Pre-Unit Revision: Opposite operations. Simple linear equations. Adding fractions.

Unit Content: Equations with unknowns on both sides by first step subtracting the smaller unknown term from both sides. Equations with brackets e.g. $3(4x - 7) = 15$ divide both sides by 3 or by multiplying out brackets first. Equations with brackets on both sides of the equation: $3(2x - 1) = 2(2 - x)$ by multiplying out brackets. Equations with fractions (but with unknowns on the top only e.g. $x/3 + x/2 = 15$) by converting into common denominators.

Mental Skills: Solving simple one step equations mentally. The arithmetic of substituting trial solutions values into equations.

What to know: That operations must be applied equally to both sides when solving an equation. How to find and record the inverse operations applied. How to identify the correct order in which to apply the inverse operations, depending on the structure of the expression in the equations. Solve equations with unknowns on both sides, with brackets, and with fractions.

Unit H Statistics

Pre-Unit Revision: Tally, Bar and Pie charts. Mean, Median and Modes as representative values.

Unit Content: Frequency tables for discrete data and finding the Mean, Mode, Median and Range from them. Grouping of continuous data into class intervals. Compare two simple distributions, using the range and one of the mode, median and mean. Relating two sets of data in Scatter-diagrams. Drawing lines of best fit by eye. Ideas of correlation; positive/negative and weak/strong as descriptions.

Mental Skills: Interpreting and reading information from displays of data. Using scales.

What to know: Recall the definitions of Mean, Median, Mode, Range. How to find these in a set of numerical data. How to draw scatter-diagrams, draw lines of best fit and draw implications of different types of correlation linking two sets of data. How to draw a Bar Chart and Pie Chart.

Unit I Percentages

Pre-Unit Revision: Equivalence of simple percentages as fractions and decimals.

Unit Content: Formal written arithmetic techniques for calculating percentages of an amount; percentages as hundredths multiplied by the amount or decimal part of it by multiplying: e.g. 60% of 45 is $60/100$ of 45, 24% of 2.5 metres is the same as $0.24 \times 250\text{cm}$. The commutivity of this operation: i.e. 60% of 45 is the same as 45% of 60. Finding VAT at 17.5% of an amount, as sum of 10%, 5% and 2.5%. Finding one quantity as a percentage of another, by turning into a fraction and then converting into a percentage. Percentage problems, including percentage increase and decrease, profit and loss; but only using two-step methods.

Mental Skills: Converting percentages to and from decimals and fractions. Estimating percentages of quantities. Calculating accurately percentages of quantities by breaking it down into easy steps: e.g. to find 35% of 80: 10% of it is 8, so 30% is $3 \times 8 = 24$, 5% is half of 10% so 5% of 80 is 4; putting it together $24 + 4$ is 28. Finding one number as a percentage of another in simple cases: e.g. 40cm is removed from a plank of wood 1.6m long, what percentage remains?

What to know: How to convert between fractions, decimals and percentages. Learn the basic results by heart. How to analyse a percentage problem to determine the calculation required. How to find a given percentage of an amount. How to find one quantity as a percentage of another. How to increase/decrease a quantity by a given percentage. How to find the percentage change given an original and new value. How to be flexible in building a required percentage of a quantity from landmark blocks such as 10% of it. How to find V.A.T at 17.5%.

Unit J Area and Volume

Pre-Unit Revision: Areas of square, rectangle, parallelogram, and triangle. Volume of cuboid.

Unit Content: Area of trapezium, rhombus, dart and kite, Area of compound rectangular shapes, including finding missing lengths and subtracting area of a 'hole' (dimensions may be given in different metric units). Surface area as the total area of all of the faces of a 3D shape. Net of cuboids, prisms and pyramids and their surface area. Surface area of a cylinder, including unwrapping the curved surface to form a rectangle. Volume of prisms as area of uniform cross-section times length of perpendicular edge. Finding missing edge of a cuboid given the volume and the other two edges.

Mental Skills: 'Seeing' faces of shapes from 3D diagram. Use of visual imagery in planning a net. Calculate simple examples mentally of perimeter and area of rectangle, triangle and volume of a cuboid.

What to know: The formulae for areas of triangle, parallelogram, trapezium, rhombus, dart and kite. How to find the area of rectangular compound shapes. How to find the surface area of a solid with and without its net. How to recognise a prism and use its cross-section area to find the volume. How to find the curved surface area and total surface area of a cylinder.

Unit K Ratio and Proportion

Pre-Unit Revision: Multiples; e.g. A is one-and-a-half times B. Unit quantities; what one unit is worth.

Unit Content: The idea of ratio, expressing the multiplicative relationship between two quantities; expressing this in alternative forms: e.g. If X:Y is 5:7 then 'X is $\frac{5}{7}$ of Y' and 'Y is 1 and $\frac{2}{5}$ of X'. Cancelling ratios to lowest terms. Converting decimals and fractions into ratios. Using a given ratio to find missing values and splitting a quantity into parts according to a given ratio. The use of ratio to express map scales: converting between real and map distances using a given map scale.

Mental Skills: Cancelling down ratios to lowest terms, identifying and dividing by their HCF.

What to know: How to interpret the information given in ratio form as a fractional relationship and as a scale factor. How to use a given ratio to solve proportion problems using multiplying factors and how to split a quantity into a given ratio. How to use a ratio to express map scales.

Unit L Pythagoras

Pre-Unit Revision: Squares and square roots.

Unit Content: The definition of the hypotenuse as the longest side of a right-angled triangle. Its length depends symmetrically on the length of the perpendicular sides. Demonstration of Pythagoras theorem geometrically using areas of squares. Using Pythagoras to calculate the length of the hypotenuse and then adapting the method and notation to find one of the perpendicular sides. Use of a calculator to find non-integer square roots, rounding to 3 s.f. Pythagorean triples as sets of whole numbers forming the sides of right-angled triangles. Learn (3,4,5), (5,12,13) (8,15,17). Applications of Pythagoras to the distance between two points on a grid and ladders against a wall.

Mental Skills: Mentally squaring numbers from 1 to 12 and corresponding square roots.

What to know: When Pythagoras can be used to find missing lengths. Remember the sequence of steps required in applying Pythagoras for finding hypotenuse and perpendicular sides. Know the Pythagorean triples.

Unit M Transformations

Pre-Unit Revision: Translation, Reflection and Rotation.

Unit Content: Combining transformations: translation, reflection and rotation to form a set of transformations of a shape. The idea of Enlargement, scale factor and centre of enlargement. Enlargement of a shape on a grid from a given centre of enlargement by a positive whole number scale factor. Centres outside, inside and on the shape itself. Using counting horizontally and vertically from the centre of enlargement for each vertex to find the position of the new vertices; once to the original shape, twice for a scale factor 2.

What happens to the area when a shape is enlarged. Area scale factors are the square of the corresponding enlargement scale factor for length.

Mental Skills: Multiplying numbers with up to one decimal place by 2, 3, 4 and 5.

What to know: How to translate, reflect and rotate a shape. How to draw an enlargement given the information, using vectors on a grid and measuring on plain paper. Scale factors for area are the square of those for length.

Unit N Probability

Pre-Unit Revision: Probability as a measure of the likelihood of an event/outcome given as a lowest terms fraction. Simple examples of single events; e.g. dice and beads in bags.

Unit Content: The $p(\text{even/outcome})$ notation for stating probabilities. The probability scale from 0 to 1. All probabilities total one, therefore $p(E') = 1 - p(E)$. Combined events. Using combination tables (possibility spaces) to list all possible combined outcomes for a pair of events. e.g. for rolling a pair of dice. Problems involving expected numbers of outcomes. Practical examples, with coins, dice and cards. Sampling. Discussion of probability related issues; e.g. assessing risk.

Mental Skills: Multiplying and cancelling fractions to lowest terms. Giving simple probabilities.

What to know: That probabilities have a total of 1. How to find probabilities for combined events (using possibility spaces). The structure of a pack of playing cards. How to distinguish independent conditions e.g. number and suit.

Unit O Geometric Constructions

Pre-Unit Revision: Use of compasses to draw circles. Accuracy in drawing and measuring lines and angles.

Unit Content: Construction of triangles using rulers, protractors and compasses to fit given information about lengths and angles. Construction of quadrilaterals: rectangle, parallelogram, rhombus, kite. Construction of perpendicular bisectors of a line and bisector of an angle.

Mental Skills: Mental imagery predicting location of points not yet constructed; whereabouts will it be?

What to know: How to carry out accurately the constructions with a ruler, a protractor and compasses for various triangles, rectangle, parallelogram, rhombus, kite. Construct perpendicular bisector of a line and bisector of an angle. That all given information must be recorded on the diagram. How to measure angles and lengths accurately.

Unit P Algebraic Relations

Pre-Unit Revision: Basic algebraic representation and the solution of equations.

Unit Content: Reading and writing algebraic expressions using letters to represent the relationship between variables. e.g. Harry is 3 years older than Jack. Jack is x years old so Harry is $x + 3$ years old. His mother is four times Jack's age: $4x$. Including the use of brackets: e.g. $2(1 + w)$ for the perimeter of a rectangle. Using algebraic expressions in context, e.g. to represent lengths. Manipulating expressions (e.g. finding perimeter). Using algebraic expressions to build formulae and equations in context. e.g. The cost c of n items at 20 pence is $c = 20n$ pence. Substituting numerical values into formulae.

Mental Skills: Manipulating algebraic expressions using the four arithmetic operations, collecting like terms and expanding brackets.

What to know: How to write algebraic expressions using letters to represent the relationship between variables. How to use algebraic expressions to form equations and formulae. How to substitute numerical values into formulae.