E1	Number

	Extended curriculum	Notes/Examples
E1.1	Identify and use natural numbers, integers (positive, negative and zero), prime numbers, square and cube numbers, common factors and common multiples, rational and irrational numbers (e.g. π, $\sqrt{2}$), real numbers, reciprocals.	Includes expressing numbers as a product of prime factors. Finding the lowest common multiple (LCM) and highest common factor (HCF) of two or more numbers.
E1.2	Use language, notation and Venn diagrams to describe sets and represent relationships between sets.	Notation

Definition of sets

e.g. $A = \{x: x \text{ is a natural number}\}$

$\quad B = \{(x, y): y = mx + c\}$

$\quad C = \{x: a \leqslant x \leqslant b\}$

$\quad D = \{a, b, c, \ldots\}$

Number of elements in set A	$\text{n}(A)$
"… is an element of …"	$\in$
" …is not an element of …"	$\notin$
Complement of set A	A'
The empty set	$\varnothing$
Universal set	$\mathscr{E}$
A is a subset of B	$A \subseteq B$
A is a proper subset of B	$A \subset B$
A is not a subset of B	$A \nsubseteq B$
A is not a proper subset of B	$A \not\subset B$
Union of A and B	$A \cup B$
Intersection of A and B	$A \cap B$

	Extended curriculum	Notes/Examples
E1.3	Calculate with squares, square roots, cubes and cube roots and other powers and roots of numbers.	Work out $3^2 \times \sqrt[4]{16}$
E1.4	Use directed numbers in practical situations.	e.g. temperature changes, flood levels.
E1.5	Use the language and notation of simple vulgar and decimal fractions and percentages in appropriate contexts. Recognise equivalence and convert between these forms.	Includes the conversion of recurring decimals to fractions, e.g. change $0.\dot{7}$ to a fraction
E1.6	Order quantities by magnitude and demonstrate familiarity with the symbols $=, \neq, >, <, \geqslant, \leqslant$.	
E1.7	Understand the meaning of indices (fractional, negative and zero) and use the rules of indices.	$5^{\frac{1}{2}} = \sqrt{5}$ Find the value of 5^{-2}, $100^{\frac{1}{2}}$, $8^{-\frac{2}{3}}$ Work out $2^{-3} \times 2^4$, $(2^3)^2$, $(2^{-3} \div 2^4)$
	Use the standard form $A \times 10^n$ where n is a positive or negative integer, and $1 \leqslant A < 10$.	Convert numbers into and out of standard form. Calculate with values in standard form.
E1.8	Use the four rules for calculations with whole numbers, decimals and fractions (including mixed numbers and improper fractions), including correct ordering of operations and use of brackets.	Applies to positive and negative numbers.

E1	Number	
	Extended curriculum continued	Notes/Examples

E1.9 Make estimates of numbers, quantities and lengths, give approximations to specified numbers of significant figures and decimal places and round off answers to reasonable accuracy in the context of a given problem.

E1.10 Give appropriate upper and lower bounds for data given to a specified accuracy.

e.g. measured lengths.

Obtain appropriate upper and lower bounds to solutions of simple problems given data to a specified accuracy.

e.g. the calculation of the perimeter or the area of a rectangle.

E1.11 Demonstrate an understanding of ratio and proportion.

To include numerical problems involving direct and inverse proportion.

Increase and decrease a quantity by a given ratio.

Calculate average speed.

Use ratio and scales in practical situations.

Use common measures of rate.

Formulae for other rates will be given in the question e.g. pressure and density.

E1.12 Calculate a given percentage of a quantity.

Express one quantity as a percentage of another.

Calculate percentage increase or decrease.

Carry out calculations involving reverse percentages.

e.g. finding the cost price given the selling price and the percentage profit.

E1.13 Use a calculator efficiently.

Apply appropriate checks of accuracy.

E1.14 Calculate times in terms of the 24-hour and 12-hour clock.

Read clocks, dials and timetables.

E1.15 Calculate using money and convert from one currency to another.

E1.16 Use given data to solve problems on personal and household finance involving earnings, simple interest and compound interest.

Includes discount, profit and loss.

Knowledge of compound interest formula is required.

Extract data from tables and charts.

E1.17 Use exponential growth and decay in relation to population and finance.

e.g. depreciation, growth of bacteria.

E2	**Algebra and graphs**

	Extended curriculum	Notes/Examples
E2.1	Use letters to express generalised numbers and express basic arithmetic processes algebraically.	
	Substitute numbers for words and letters in complicated formulae.	
	Construct and rearrange complicated formulae and equations.	e.g. rearrange formulae where the subject appears twice.
E2.2	Manipulate directed numbers.	
	Use brackets and extract common factors.	e.g. expand $3x(2x - 4y)$ e.g. factorise $9x^2 + 15xy$
	Expand products of algebraic expressions.	e.g. expand $(x + 4)(x - 7)$ Includes products of more than two brackets, e.g. $(x + 4)(x - 7)(2x + 1)$
	Factorise where possible expressions of the form: $ax + bx + kay + kby$ $a^2x^2 - b^2y^2$ $a^2 + 2ab + b^2$ $ax^2 + bx + c$	
E2.3	Manipulate algebraic fractions.	e.g. $\dfrac{x}{3} + \dfrac{x-4}{2}, \dfrac{2x}{3} - \dfrac{3(x-5)}{2}, \dfrac{3a}{4} \times \dfrac{9a}{10},$ $\dfrac{3a}{4} \div \dfrac{9a}{10}, \dfrac{1}{x-2} + \dfrac{2}{x-3}$
	Factorise and simplify rational expressions.	e.g. $\dfrac{x^2 - 2x}{x^2 - 5x + 6}$
E2.4	Use and interpret positive, negative and zero indices.	
	Use and interpret fractional indices.	e.g. solve $32^x = 2$
	Use the rules of indices.	e.g. simplify $3x^{-4} \times \frac{2}{3}x^{\frac{1}{2}}, \frac{2}{5}x^{\frac{1}{2}} \div 2x^{-2}, \left(\dfrac{2x^5}{3}\right)^3$
E2.5	Derive and solve linear equations in one unknown.	
	Derive and solve simultaneous linear equations in two unknowns.	
	Derive and solve simultaneous equations, involving one linear and one quadratic.	
	Derive and solve quadratic equations by factorisation, completing the square and by use of the formula.	
	Derive and solve linear inequalities.	Including representing and interpreting inequalities on a number line. Interpretation of results may be required.

E2	Algebra and graphs

Extended curriculum continued

Notes/Examples

E2.6 Represent inequalities graphically and use this representation to solve simple linear programming problems.

The conventions of using broken lines for strict inequalities and shading unwanted regions will be expected.

E2.7 Continue a given number sequence.

Recognise patterns in sequences including the term to term rule and relationships between different sequences.

Subscript notation may be used.

Find and use the nth term of sequences.

Linear, quadratic, cubic and exponential sequences and simple combinations of these.

E2.8 Express direct and inverse proportion in algebraic terms and use this form of expression to find unknown quantities.

E2.9 Use function notation, e.g. $f(x) = 3x - 5$,

$f: x \mapsto 3x - 5$, to describe simple functions.

Find inverse functions $f^{-1}(x)$.

Form composite functions as defined by $gf(x) = g(f(x))$.

E2.10 Interpret and use graphs in practical situations including travel graphs and conversion graphs.

Draw graphs from given data.

Apply the idea of rate of change to simple kinematics involving distance–time and speed–time graphs, acceleration and deceleration.

May include estimation and interpretation of the gradient of a tangent at a point.

Calculate distance travelled as area under a speed–time graph.

E2.11 Construct tables of values and draw graphs for functions of the form ax^n (and simple sums of these) and functions of the form $ab^x + c$.

a and c are rational constants, b is a positive integer, and $n = -2, -1, 0, 1, 2, 3$.

Sums would not include more than three functions.

Solve associated equations approximately, including finding and interpreting roots by graphical methods.

Find turning points of quadratics by completing the square.

Draw and interpret graphs representing exponential growth and decay problems.

Recognise, sketch and interpret graphs of functions.

Linear, quadratic, cubic, reciprocal and exponential.

Knowledge of turning points and asymptotes is required.

E2	Algebra and graphs

Extended curriculum continued

Notes/Examples

E2.12 Estimate gradients of curves by drawing tangents.

E2.13 Understand the idea of a derived function.

Use the derivatives of functions of the form ax^n, and simple sums of not more than three of these.

Apply differentiation to gradients and turning points (stationary points).

Discriminate between maxima and minima by any method.

a is a rational constant and n is a positive integer or 0.

e.g. $2x^3 + x - 7$

E3	Coordinate geometry

Extended curriculum   **Notes/Examples**

E3.1   Demonstrate familiarity with Cartesian coordinates in two dimensions.

E3.2   Find the gradient of a straight line.

Calculate the gradient of a straight line from the coordinates of two points on it.

E3.3   Calculate the length and the coordinates of the midpoint of a straight line from the coordinates of its end points.

E3.4   Interpret and obtain the equation of a straight line graph.

E3.5   Determine the equation of a straight line parallel to a given line.

e.g. find the equation of a line parallel to $y = 4x - 1$ that passes through $(0, -3)$.

E3.6   Find the gradient of parallel and perpendicular lines.

e.g. find the gradient of a line perpendicular to $y = 3x + 1$.

e.g. find the equation of a line perpendicular to one passing through the coordinates $(1, 3)$ and $(-2, -9)$.

E4	Geometry

	Extended curriculum	Notes/Examples
E4.1	Use and interpret the geometrical terms: point, line, parallel, bearing, right angle, acute, obtuse and reflex angles, perpendicular, similarity and congruence. Use and interpret vocabulary of triangles, quadrilaterals, circles, polygons and simple solid figures including nets.	
E4.2	Measure and draw lines and angles. Construct a triangle given the three sides using a ruler and a pair of compasses only.	
E4.3	Read and make scale drawings.	
E4.4	Calculate lengths of similar figures. Use the relationships between areas of similar triangles, with corresponding results for similar figures and extension to volumes and surface areas of similar solids.	
E4.5	Use the basic congruence criteria for triangles (SSS, ASA, SAS, RHS).	
E4.6	Recognise rotational and line symmetry (including order of rotational symmetry) in two dimensions. Recognise symmetry properties of the prism (including cylinder) and the pyramid (including cone). Use the following symmetry properties of circles: • equal chords are equidistant from the centre • the perpendicular bisector of a chord passes through the centre • tangents from an external point are equal in length.	Includes properties of triangles, quadrilaterals and circles directly related to their symmetries.

E4	Geometry

Extended curriculum continued

Notes/Examples

E4.7 Calculate unknown angles using the following geometrical properties:

- angles at a point
- angles at a point on a straight line and intersecting straight lines
- angles formed within parallel lines
- angle properties of triangles and quadrilaterals
- angle properties of regular polygons
- angle in a semicircle
- angle between tangent and radius of a circle
- angle properties of irregular polygons
- angle at the centre of a circle is twice the angle at the circumference
- angles in the same segment are equal
- angles in opposite segments are supplementary; cyclic quadrilaterals
- alternate segment theorem.

Candidates will be expected to use the correct geometrical terminology when giving reasons for answers.

E5	**Mensuration**

	Extended curriculum	Notes/Examples
E5.1	Use current units of mass, length, area, volume and capacity in practical situations and express quantities in terms of larger or smaller units.	Convert between units including units of area and volume.
E5.2	Carry out calculations involving the perimeter and area of a rectangle, triangle, parallelogram and trapezium and compound shapes derived from these.	
E5.3	Carry out calculations involving the circumference and area of a circle. Solve problems involving the arc length and sector area as fractions of the circumference and area of a circle.	Answers may be asked for in multiples of π.
E5.4	Carry out calculations involving the surface area and volume of a cuboid, prism and cylinder. Carry out calculations involving the surface area and volume of a sphere, pyramid and cone.	Answers may be asked for in multiples of π. Formulae will be given for the surface area and volume of the sphere, pyramid and cone in the question.
E5.5	Carry out calculations involving the areas and volumes of compound shapes.	Answers may be asked for in multiples of π.

E6	**Trigonometry**	
	Extended curriculum	Notes/Examples
E6.1	Interpret and use three-figure bearings.	Measured clockwise from the North, i.e. 000°–360°.
E6.2	Apply Pythagoras' theorem and the sine, cosine and tangent ratios for acute angles to the calculation of a side or of an angle of a right-angled triangle.	Angles will be quoted in degrees. Answers should be written in degrees and decimals to one decimal place.
	Solve trigonometric problems in two dimensions involving angles of elevation and depression.	
	Know that the perpendicular distance from a point to a line is the shortest distance to the line.	
E6.3	Recognise, sketch and interpret graphs of simple trigonometric functions.	
	Graph and know the properties of trigonometric functions.	
	Solve simple trigonometric equations for values between 0° and 360°.	e.g. $\sin x = \frac{\sqrt{3}}{2}$ for values of x between 0° and 360°.
E6.4	Solve problems using the sine and cosine rules for any triangle and the formula area of triangle = $\frac{1}{2}\,ab \sin C$.	Includes problems involving obtuse angles.
E6.5	Solve simple trigonometrical problems in three dimensions including angle between a line and a plane.	

E7	**Vectors and transformations**

Extended curriculum	Notes/Examples

E7.1 Describe a translation by using a vector represented by e.g. $\begin{pmatrix} x \\ y \end{pmatrix}$, $\overrightarrow{AB}$ or **a**.

Add and subtract vectors.

Multiply a vector by a scalar.

E7.2 Reflect simple plane figures.

Rotate simple plane figures through multiples of 90°.

Construct given translations and enlargements of simple plane figures.

Positive, fractional and negative scale factors for enlargements.

Recognise and describe reflections, rotations, translations and enlargements.

Positive, fractional and negative scale factors for enlargements.

E7.3 Calculate the magnitude of a vector $\begin{pmatrix} x \\ y \end{pmatrix}$ as $\sqrt{x^2 + y^2}$.

Represent vectors by directed line segments.

Use the sum and difference of two vectors to express given vectors in terms of two coplanar vectors.

Use position vectors.

Vectors will be printed as $\overrightarrow{AB}$ or **a** and their magnitudes denoted by modulus signs, e.g. $\left| \overrightarrow{AB} \right|$ or $|\mathbf{a}|$.

In their answers to questions, candidates are expected to indicate a in some definite way, e.g. by an arrow or by underlining, thus $\overrightarrow{AB}$ or <u>a</u>.

E8	Probability

	Extended curriculum	Notes/Examples
E8.1	Calculate the probability of a single event as either a fraction, decimal or percentage.	Problems could be set involving extracting information from tables or graphs.
E8.2	Understand and use the probability scale from 0 to 1.	
E8.3	Understand that the probability of an event occurring = 1 – the probability of the event not occurring.	
E8.4	Understand relative frequency as an estimate of probability. Expected frequency of occurrences.	
E8.5	Calculate the probability of simple combined events, using possibility diagrams, tree diagrams and Venn diagrams.	In possibility diagrams, outcomes will be represented by points on a grid, and in tree diagrams, outcomes will be written at the end of branches and probabilities by the side of the branches.
E8.6	Calculate conditional probability using Venn diagrams, tree diagrams and tables.	e.g. Two dice are rolled. Given that the total showing on the two dice is 7, find the probability that one of the dice shows the number 2.

E9	Statistics

	Extended curriculum	Notes/Examples
E9.1	Collect, classify and tabulate statistical data.	
E9.2	Read, interpret and draw inferences from tables and statistical diagrams.	
	Compare sets of data using tables, graphs and statistical measures.	
	Appreciate restrictions on drawing conclusions from given data.	
E9.3	Construct and interpret bar charts, pie charts, pictograms, stem-and-leaf diagrams, simple frequency distributions, histograms with equal and unequal intervals and scatter diagrams.	For unequal intervals on histograms, areas are proportional to frequencies and the vertical axis is labelled 'frequency density'.
E9.4	Calculate the mean, median, mode and range for individual and discrete data and distinguish between the purposes for which they are used.	
E9.5	Calculate an estimate of the mean for grouped and continuous data.	
	Identify the modal class from a grouped frequency distribution.	
E9.6	Construct and use cumulative frequency diagrams.	
	Estimate and interpret the median, percentiles, quartiles and interquartile range.	
	Construct and interpret box-and-whisker plots.	
E9.7	Understand what is meant by positive, negative and zero correlation with reference to a scatter diagram.	
E9.8	Draw, interpret and use lines of best fit by eye.	