

## 2 Mathematics (Specification A) content

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### Foundation Tier

1: Numbers and the number system	11
2: Equations, formulae and identities	15
3: Sequences, functions and graphs	17
4: Geometry and trigonometry	19
5: Vectors and transformation geometry	23
6: Statistics and probability	24

### Higher Tier

1: Numbers and the number system	29
2: Equations, formulae and identities	31
3: Sequences, functions and graphs	33
4: Geometry and trigonometry	36
5: Vectors and transformation geometry	38
6: Statistics and probability	39



# Foundation Tier

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**Externally assessed**

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## Description

The Pearson Edexcel International GCSE in Mathematics (Specification A) requires students to demonstrate application and understanding of the following.

### Number

- Use numerical skills in a purely mathematical way and in real-life situations.

### Algebra

- Use letters as equivalent to numbers and as variables.
- Understand the distinction between expressions, equations and formulae.
- Use algebra to set up and solve problems.
- Demonstrate manipulative skills.
- Construct and use graphs.

### Geometry

- Use properties of angles.
- Understand a range of transformations.
- Work within the metric system.
- Understand ideas of space and shape.
- Use ruler, compasses and protractor appropriately.

### Statistics

- Understand basic ideas of statistical averages.
- Use a range of statistical techniques.
- Use basic ideas of probability.

Students should be able to demonstrate **problem-solving skills** by translating problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes.

Students should be able to demonstrate **mathematical reasoning skills** by:

- making deductions and drawing conclusions from mathematical information
- constructing chains of reasoning
- presenting arguments and proofs
- interpreting and communicating information accurately.

## Assessment information

Each paper is assessed through a 2-hour examination set and marked by Pearson.

The total number of marks for each paper is 100.

Each paper will assess the full range of targeted grades at Foundation Tier (5–1).

Each paper will have approximately equal marks available for each of the targeted grades.

There will be approximately 40% of questions targeted at grades 5 and 4, across papers 1F and 1H to aid standardisation and comparability of award between tiers.

Diagrams will not necessarily be drawn to scale and measurements should not be taken from diagrams unless instructions to this effect are given.

Each student may be required to use mathematical instruments, e.g. pair of compasses, ruler, protractor.

A Foundation Tier formulae sheet (*Appendix 4*) will be included in the written examinations.

Tracing paper may be used in the examinations.

A calculator may be used in the examinations (please see *page 42* for further information).

Questions will be set in SI units (international system of units).

# AO1 Numbers and algebra

## 1 Numbers and the number system

	Students should be taught to:	Notes
<b>1.1 Integers</b>	<b>A</b> understand and use integers (positive, negative and zero)	
	<b>B</b> understand place value	
	<b>C</b> use directed numbers in practical situations	e.g. temperatures
	<b>D</b> order integers	
	<b>E</b> use the four rules of addition, subtraction, multiplication and division	
	<b>F</b> use brackets and the hierarchy of operations	
	<b>G</b> use the terms 'odd', 'even', 'prime numbers', 'factors' and 'multiples'	
	<b>H</b> identify prime factors, common factors and common multiples	
<b>1.2 Fractions</b>	<b>A</b> understand and use equivalent fractions, simplifying a fraction by cancelling common factors	$\frac{8}{60} = \frac{2}{15}$ in its simplest form (lowest terms)
	<b>B</b> understand and use mixed numbers and vulgar fractions	
	<b>C</b> identify common denominators	
	<b>D</b> order fractions and calculate a given fraction of a given quantity	
	<b>E</b> express a given number as a fraction of another number	
	<b>F</b> use common denominators to add and subtract fractions and mixed numbers	$\frac{2}{3} + \frac{5}{7}, \quad 3\frac{1}{5} - 2\frac{2}{3}$
	<b>G</b> convert a fraction to a decimal or a percentage	$\frac{3}{5} = 0.6 = 60\%$ $\frac{4}{9} = 0.4444... = 44.4...%$
	<b>H</b> understand and use unit fractions as multiplicative inverses	$3 \div 5 = 3 \times \frac{1}{5}$
	<b>I</b> multiply and divide fractions and mixed numbers	$\frac{2}{3} \times \frac{5}{7}, \quad 3\frac{1}{5} \div 2\frac{2}{3}$

	Students should be taught to:	Notes
<b>1.3 Decimals</b>	<b>A</b> use decimal notation	
	<b>B</b> understand place value	
	<b>C</b> order decimals	
	<b>D</b> convert a decimal to a fraction or a percentage	Terminating decimals only
	<b>E</b> recognise that a terminating decimal is a fraction	$0.65 = \frac{65}{100} = \frac{13}{20}$
<b>1.4 Powers and roots</b>	<b>A</b> identify square numbers and cube numbers	
	<b>B</b> calculate squares, square roots, cubes and cube roots	
	<b>C</b> use index notation and index laws for multiplication and division of positive and negative integer powers including zero	
	<b>D</b> express integers as a product of powers of prime factors	$720 = 2^4 \times 3^2 \times 5$
	<b>E</b> find highest common factors (HCF) and lowest common multiples (LCM)	
<b>1.5 Set language and notation</b>	<b>A</b> understand the definition of a set	
	<b>B</b> use the set notation $\cup$ , $\cap$ and $\in$ and $\notin$	$\mathcal{E}$ = universal set $\emptyset$ = empty set
	<b>C</b> understand the concept of the universal set and the empty set and the symbols for these sets	
	<b>D</b> understand and use the complement of a set	Use the notation $A'$
	<b>E</b> use Venn diagrams to represent sets	

	Students should be taught to:	Notes
<b>1.6 Percentages</b>	<b>A</b> understand that 'percentage' means 'number of parts per 100'	
	<b>B</b> express a given number as a percentage of another number	
	<b>C</b> express a percentage as a fraction and as a decimal	
	<b>D</b> understand the multiplicative nature of percentages as operators	$15\% \text{ of } 120 = \frac{15}{100} \times 120$
	<b>E</b> solve simple percentage problems, including percentage increase and decrease	
	<b>F</b> use reverse percentages	In a sale, prices were reduced by 30%. The sale price of an item was £17.50 Calculate the original price of the item
	<b>G</b> use compound interest and depreciation	
<b>1.7 Ratio and proportion</b>	<b>A</b> use ratio notation, including reduction to its simplest form and its various links to fraction notation	Express in the form $1 : n$
	<b>B</b> divide a quantity in a given ratio or ratios	Share £416 in the ratio 5 : 3 or 4 : 3 : 1
	<b>C</b> use the process of proportionality to evaluate unknown quantities	
	<b>D</b> calculate an unknown quantity from quantities that vary in direct proportion	$s$ varies directly as $t$ Find the missing value in a table
	<b>E</b> solve word problems about ratio and proportion	Including maps and scale diagrams
<b>1.8 Degree of accuracy</b>	<b>A</b> round integers to a given power of 10	
	<b>B</b> round to a given number of significant figures or decimal places	
	<b>C</b> identify upper and lower bounds where values are given to a degree of accuracy	
	<b>D</b> use estimation to evaluate approximations to numerical calculations	By rounding values to 1 significant figure
<b>1.9 Standard form</b>	<b>A</b> calculate with and interpret numbers in the form $a \times 10^n$ where $n$ is an integer and $1 \leq a < 10$	$150\,000\,000 = 1.5 \times 10^8$

	<b>Students should be taught to:</b>	<b>Notes</b>
<b>1.10 Applying number</b>	<b>A</b> use and apply number in everyday personal, domestic or community life	
	<b>B</b> carry out calculations using standard units of mass, length, area, volume and capacity	Metric units only
	<b>C</b> understand and carry out calculations using time, and carry out calculations using money, including converting between currencies	
<b>1.11 Electronic calculators</b>	<b>A</b> use a scientific electronic calculator to determine numerical results	

## 2 Equations, formulae and identities

	Students should be taught to:	Notes
<b>2.1 Use of symbols</b>	<b>A</b> understand that symbols may be used to represent numbers in equations or variables in expressions and formulae	
	<b>B</b> understand that algebraic expressions follow the generalised rules of arithmetic	
	<b>C</b> use index notation for positive and negative integer powers (including zero)	$a \times a \times a = a^3$ $a^{-5} = \frac{1}{a^5}$ ; $a^0 = 1$
	<b>D</b> use index laws in simple cases	$x^m \times x^n = x^{m+n}$ $x^m \div x^n = x^{m-n}$ $(x^m)^n = x^{mn}$
<b>2.2 Algebraic manipulation</b>	<b>A</b> evaluate expressions by substituting numerical values for letters	
	<b>B</b> collect like terms	
	<b>C</b> multiply a single term over a bracket	$3x(2x + 5)$
	<b>D</b> take out common factors	Factorise fully $8xy + 12y^2$
	<b>E</b> expand the product of two simple linear expressions	Expand and simplify $(x + 8)(x - 5)$
	<b>F</b> understand the concept of a quadratic expression and be able to factorise such expressions (limited to $x^2 + bx + c$ )	Factorise $x^2 + 10x + 24$
<b>2.3 Expressions and formulae</b>	<b>A</b> understand that a letter may represent an unknown number or a variable	
	<b>B</b> use correct notational conventions for algebraic expressions and formulae	
	<b>C</b> substitute positive and negative integers, decimals and fractions for words and letters in expressions and formulae	Evaluate $2x - 3y$ when $x = 4$ and $y = -5$
	<b>D</b> use formulae from mathematics and other real-life contexts expressed initially in words or diagrammatic form and convert to letters and symbols	
	<b>E</b> derive a formula or expression	
	<b>F</b> change the subject of a formula where the subject appears once	Make $r$ the subject of $A = \pi r^2$ Make $t$ the subject of $v = u + at$

	Students should be taught to:	Notes
<b>2.4 Linear equations</b>	<b>A</b> solve linear equations, with integer or fractional coefficients, in one unknown in which the unknown appears on either side or both sides of the equation	$5x + 8 = 12$ $7(x + 3) = 5x - 8$ $\frac{4x + 5}{2} = 3$
	<b>B</b> set up simple linear equations from given data	The three angles of a triangle are $a^\circ$ , $(a + 10)^\circ$ , $(a + 20)^\circ$ . Find the value of $a$
<b>2.5 Proportion</b>	<b>Higher Tier only</b>	
<b>2.6 Simultaneous linear equations</b>	<b>A</b> calculate the exact solution of two simultaneous equations in two unknowns	$x + y = 14$ , $x - y = 2$  $2a + 5b = 12$ , $3a + b = 5$
<b>2.7 Quadratic equations</b>	<b>A</b> solve quadratic equations by factorisation (limited to $x^2 + bx + c = 0$ )	Solve $x^2 + x - 30 = 0$
<b>2.8 Inequalities</b>	<b>A</b> understand and use the symbols $>$ , $<$ , $\geq$ and $\leq$	To include double-ended inequalities e.g. $1 < x \leq 5$
	<b>B</b> understand and use the convention for open and closed intervals on a number line	
	<b>C</b> solve simple linear inequalities in one variable and represent the solution set on a number line	$3x - 2 < 10$ , so $x < 4$ $7 - x \leq 5$ , so $x \geq 2$ $3 < x + 2 \leq 5$ so $1 < x \leq 3$
	<b>D</b> represent simple linear inequalities on rectangular Cartesian graphs	Shade the region defined by the inequalities $x \geq 0$ , $y \geq 1$ , $x + y \leq 5$
	<b>E</b> identify regions on rectangular Cartesian graphs defined by simple linear inequalities	Conventions for the inclusion of boundaries are not required

### 3 Sequences, functions and graphs

	Students should be taught to:	Notes
<b>3.1 Sequences</b>	<b>A</b> generate terms of a sequence using term-to-term and position-to-term definitions of the sequence	Including odd, even, squares, multiples and powers
	<b>B</b> find subsequent terms of an integer sequence and the rule for generating it	5, 9, 13, 17, ... (add 4)  1, 2, 4, 8, ... (multiply by 2)
	<b>C</b> use linear expressions to describe the $n$ th term of arithmetic sequences	1, 3, 5, 7, 9, ... $n$ th term is $2n - 1$  $n$ th term is $4n + 3$ , write down the first 3 terms of the sequence
<b>3.2 Function notation</b>	<b>Higher Tier only</b>	
<b>3.3 Graphs</b>	<b>A</b> interpret information presented in a range of linear and non-linear graphs	To include speed/time and distance/time graphs
	<b>B</b> understand and use conventions for rectangular Cartesian coordinates	
	<b>C</b> plot points $(x, y)$ in any of the four quadrants or locate points with given coordinates	
	<b>D</b> determine the coordinates of points identified by geometrical information	
	<b>E</b> determine the coordinates of the midpoint of a line segment, given the coordinates of the two end points	
	<b>F</b> draw and interpret straight line conversion graphs	To include currency conversion graphs
	<b>G</b> find the gradient of a straight line	gradient = (increase in $y$ ) $\div$ (increase in $x$ )

	<b>Students should be taught to:</b>	<b>Notes</b>
	<b>H</b> recognise that equations of the form $y = mx + c$ are straight line graphs with gradient $m$ and intercept on the $y$ -axis at the point $(0, c)$	Write down the gradient and coordinates of the $y$ intercept of $y = 3x + 5$ ; Write down the equation of the straight line with gradient 6 that passes through the point $(0, 2)$
	<b>I</b> recognise, generate points and plot graphs of linear and quadratic functions	To include $x = k$ , $y = c$ , $y = x$ , $y - x = 0$  Including completion of values in tables and equations of the form $ax + by = c$
<b>3.4 Calculus</b>	<b>Higher Tier only</b>	

## A02 Shape, space and measure

### 4 Geometry

	Students should be taught to:	Notes
<b>4.1 Angles, lines and triangles</b>	<b>A</b> distinguish between acute, obtuse, reflex and right angles	
	<b>B</b> use angle properties of intersecting lines, parallel lines and angles on a straight line	Angles at a point, vertically opposite angles, alternate angles, corresponding angles, allied angles
	<b>C</b> understand the exterior angle of a triangle property and the angle sum of a triangle property	
	<b>D</b> understand the terms 'isosceles', 'equilateral' and 'right-angled triangles' and the angle properties of these triangles	
<b>4.2 Polygons</b>	<b>A</b> recognise and give the names of polygons	To include parallelogram, rectangle, square, rhombus, trapezium, kite, pentagon, hexagon and octagon
	<b>B</b> understand and use the term 'quadrilateral' and the angle sum property of quadrilaterals	The four angles of a quadrilateral are $90^\circ$ , $(x + 15)^\circ$ , $(x + 25)^\circ$ and $(x + 35)^\circ$ Find the value of $x$
	<b>C</b> understand and use the properties of the parallelogram, rectangle, square, rhombus, trapezium and kite	
	<b>D</b> understand the term 'regular polygon' and calculate interior and exterior angles of regular polygons	
	<b>E</b> understand and use the angle sum of polygons	For a polygon with $n$ sides, the sum of the interior angles is $(2n - 4)$ right angles
	<b>F</b> understand congruence as meaning the same shape and size	
	<b>G</b> understand that two or more polygons with the same shape and size are said to be congruent to each other	

	<b>Students should be taught to:</b>	<b>Notes</b>
<b>4.3 Symmetry</b>	<b>A</b> identify any lines of symmetry and the order of rotational symmetry of a given two-dimensional figure	Name a quadrilateral with no lines of symmetry and order of rotational symmetry of 2
<b>4.4 Measures</b>	<b>A</b> interpret scales on a range of measuring instruments	
	<b>B</b> calculate time intervals in terms of the 24-hour and the 12-hour clock	Use am and pm
	<b>C</b> make sensible estimates of a range of measures	
	<b>D</b> understand angle measure including three-figure bearings	
	<b>E</b> measure an angle to the nearest degree	
	<b>F</b> understand and use the relationship between average speed, distance and time	
	<b>G</b> use compound measure such as speed, density and pressure	Formula for pressure will be given
<b>4.5 Construction</b>	<b>A</b> measure and draw lines to the nearest millimetre	
	<b>B</b> construct triangles and other two-dimensional shapes using a combination of a ruler, a protractor and compasses	
	<b>C</b> solve problems using scale drawings	
	<b>D</b> use straight edge and compasses to: (i) construct the perpendicular bisector of a line segment (ii) construct the bisector of an angle	
<b>4.6 Circle properties</b>	<b>A</b> recognise the terms 'centre', 'radius', 'chord', 'diameter', 'circumference', 'tangent', 'arc', 'sector' and 'segment' of a circle	
	<b>B</b> understand chord and tangent properties of circles	Two tangents from a point to a circle are equal in length  Tangents are perpendicular to the radius at the point of contact  The line from the centre of a circle which is perpendicular to a chord bisects the chord (and the converse)

	<b>Students should be taught to:</b>	<b>Notes</b>
<b>4.7 Geometrical reasoning</b>	<b>A</b> give informal reasons, where required, when arriving at numerical solutions to geometrical problems	Reasons will only be required for geometrical calculations based on lines (including chords and tangents), triangles or polygons
<b>4.8 Trigonometry and Pythagoras' theorem</b>	<b>A</b> know, understand and use Pythagoras' theorem in two dimensions	
	<b>B</b> know, understand and use sine, cosine and tangent of acute angles to determine lengths and angles of a right-angled triangle	
	<b>C</b> apply trigonometrical methods to solve problems in two dimensions	To include bearings
<b>4.9 Mensuration of 2D shapes</b>	<b>A</b> convert measurements within the metric system to include linear and area units	e.g. $\text{cm}^2$ to $\text{m}^2$ and vice versa
	<b>B</b> find the perimeter of shapes made from triangles and rectangles	
	<b>C</b> find the area of simple shapes using the formulae for the areas of triangles and rectangles	
	<b>D</b> find the area of parallelograms and trapezia	
	<b>E</b> find circumferences and areas of circles using relevant formulae; find perimeters and areas of semicircles	
<b>4.10 3D shapes and volume</b>	<b>A</b> recognise and give the names of solids	To include cube, cuboid, prism, pyramid, cylinder, sphere and cone
	<b>B</b> understand the terms 'face', 'edge' and 'vertex' in the context of 3D solids	
	<b>C</b> find the surface area of simple shapes using the area formulae for triangles and rectangles	
	<b>D</b> find the surface area of a cylinder	
	<b>E</b> find the volume of prisms, including cuboids and cylinders, using an appropriate formula	
	<b>F</b> convert between units of volume within the metric system	e.g. $\text{cm}^3$ to $\text{m}^3$ and vice versa and 1 litre = $1000 \text{ cm}^3$

	<b>Students should be taught to:</b>	<b>Notes</b>
<b>4.11 Similarity</b>	<b>A</b> understand and use the geometrical properties that similar figures have corresponding lengths in the same ratio but corresponding angles remain unchanged	
	<b>B</b> use and interpret maps and scale drawings	

## 5 Vectors and transformation geometry

	Students should be taught to:	Notes
<b>5.1 Vectors</b>	<b>Higher Tier only</b>	
<b>5.2 Transformation geometry</b>	<b>A</b> understand that rotations are specified by a centre and an angle	
	<b>B</b> rotate a shape about a point through a given angle	
	<b>C</b> recognise that an anti-clockwise rotation is a <i>positive</i> angle of rotation and a clockwise rotation is a <i>negative</i> angle of rotation	
	<b>D</b> understand that reflections are specified by a mirror line	Such as $x = 1$ , $y = 2$ , $y = x$ , $y - x = 0$
	<b>E</b> construct a mirror line given an object and reflect a shape given a mirror line	e.g. reflect a triangle in the line $y = x$
	<b>F</b> understand that translations are specified by a distance and direction	
	<b>G</b> translate a shape	
	<b>H</b> understand and use column vectors in translations	
	<b>I</b> understand that rotations, reflections and translations preserve length and angle so that a transformed shape under any of these transformations remains congruent to the original shape	
	<b>J</b> understand that enlargements are specified by a centre and a scale factor	Positive scale factor only (including fractions)
	<b>K</b> understand that enlargements preserve angles and not lengths	
	<b>L</b> enlarge a shape given the scale factor	With or without a centre given
<b>M</b> identify and give complete descriptions of transformations		

## A03 Handling Data

### 6 Statistics and probability

	Students should be taught to:	Notes
<b>6.1 Graphical representation of data</b>	<b>A</b> use different methods of presenting data	Pictograms, bar charts and pie charts, and only two-way tables
	<b>B</b> use appropriate methods of tabulation to enable the construction of statistical diagrams	
	<b>C</b> interpret statistical diagrams	
<b>6.2 Statistical measures</b>	<b>A</b> understand the concept of average	Data could be in a list or tabulated form
	<b>B</b> calculate the mean, median, mode and range for a discrete data set	Includes simple problems using these measures
	<b>C</b> calculate an estimate for the mean for grouped data	
	<b>D</b> identify the modal class for grouped data	
<b>6.3 Probability</b>	<b>A</b> understand the language of probability	Outcomes, equal likelihood, events, random
	<b>B</b> understand and use the probability scale	$P(\text{certainty}) = 1$ $P(\text{impossibility}) = 0$
	<b>C</b> understand and use estimates or measures of probability from theoretical models	
	<b>D</b> find probabilities from a Venn diagram	
	<b>E</b> understand the concepts of a sample space and an event, and how the probability of an event happening can be determined from the sample space	For the tossing of two coins, the sample space can be listed as: Heads ( $H$ ), Tails ( $T$ ): ( $H, H$ ), ( $H, T$ ), ( $T, H$ ), ( $T, T$ )
	<b>F</b> list all the outcomes for single events and for two successive events in a systematic way	
	<b>G</b> estimate probabilities from previously collected data	
	<b>H</b> calculate the probability of the complement of an event happening	$P(A') = 1 - P(A)$

	<b>Students should be taught to:</b>	<b>Notes</b>
	<b>I</b> use the addition rule of probability for mutually exclusive events	$P(\text{Either } A \text{ or } B \text{ occurring})$ $= P(A) + P(B)$ when $A$ and $B$ are mutually exclusive
	<b>J</b> understand and use the term 'expected frequency'	Determine an estimate of the number of times an event with a probability of 0.4 will happen over 300 tries



# Higher Tier

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**Externally assessed**

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## Description

**Knowledge of the Foundation Tier content is assumed for students being prepared for the Higher Tier.** The Pearson Edexcel International GCSE in Mathematics (Specification A) requires students to demonstrate application and understanding of the following:

### Number

- Use numerical skills in a purely mathematical way and in real-life situations.

### Algebra

- Use letters as equivalent to numbers and as variables.
- Understand the distinction between expressions, equations and formulae.
- Use algebra to set up and solve problems.
- Demonstrate manipulative skills.
- Construct and use graphs.

### Geometry

- Use the properties of angles.
- Understand a range of transformations.
- Work within the metric system.
- Understand ideas of space and shape.
- Use ruler, compasses and protractor appropriately.

### Statistics

- Understand basic ideas of statistical averages.
- Use a range of statistical techniques.
- Use basic ideas of probability.

Students should also be able to demonstrate **problem-solving skills** by translating problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes.

Students should be able to demonstrate **mathematical reasoning skills** by:

- making deductions and drawing conclusions from mathematical information
- constructing chains of reasoning
- presenting arguments and proofs
- interpreting and communicating information accurately.

## Assessment information

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The total number of marks for each paper is 100.

Questions will assume knowledge from the Foundation Tier subject content.

Each paper will assess the full range of targeted grades at Higher Tier (9–4).

Each paper will have approximately 40% of the marks distributed evenly over grades 4 and 5 and approximately 60% of the marks distributed evenly over grades 6, 7, 8 and 9.

There will be approximately 40% of questions targeted at grades 5 and 4, across papers 2F and 2H, to aid standardisation and comparability of award between tiers.

Diagrams will not necessarily be drawn to scale and measurements should not be taken from diagrams unless instructions to this effect are given.

Each student may be required to use mathematical instruments, e.g. pair of compasses, ruler, protractor.

A Higher Tier formulae sheet (*Appendix 5*) will be included in the written examinations.

Tracing paper may be used in the examinations.

A calculator may be used in the examinations (please see *page 42* for further information).

Questions will be set in SI units (international system of units).

# AO1 Number and algebra

## 1 Numbers and the number system

	Students should be taught to:	Notes
<b>1.1 Integers</b>	See Foundation Tier	
<b>1.2 Fractions</b>	See Foundation Tier	
<b>1.3 Decimals</b>	<b>A</b> convert recurring decimals into fractions	$0.3\dot{2} = 0.322\dots = \frac{29}{90}$
<b>1.4 Powers and roots</b>	<b>A</b> understand the meaning of surds	Simplify: $\sqrt{8} + 3\sqrt{32}$
	<b>B</b> manipulate surds, including rationalising a denominator	Express in the form $a + b\sqrt{2} : (3 + 5\sqrt{2})^2$  Rationalise: $\frac{2}{\sqrt{8}} ; \frac{1}{2 - \sqrt{3}}$
	<b>C</b> use index laws to simplify and evaluate numerical expressions involving integer, fractional and negative powers	Evaluate: $\sqrt[3]{8^2}, 625^{-\frac{1}{2}}, \left(\frac{1}{25}\right)^{\frac{3}{2}}$
<b>1.5 Set language and notation</b>	<b>A</b> understand sets defined in algebraic terms, and understand and use subsets	If $A$ is a subset of $B$ , then $A \subset B$
	<b>B</b> use Venn diagrams to represent sets and the number of elements in sets	
	<b>C</b> use the notation $n(A)$ for the number of elements in the set $A$	
	<b>D</b> use sets in practical situations	
<b>1.6 Percentages</b>	<b>A</b> use repeated percentage change	Calculate the total percentage increase when an increase of 30% is followed by a decrease of 20%
	<b>B</b> solve compound interest problems	
<b>1.7 Ratio and proportion</b>	See Foundation Tier	

	<b>Students should be taught to:</b>	<b>Notes</b>
<b>1.8 Degree of accuracy</b>	<b>A</b> solve problems using upper and lower bounds where values are given to a degree of accuracy	The dimensions of a rectangle are 12 cm and 8 cm to the nearest cm  Calculate, to 3 significant figures, the smallest possible area as a percentage of the largest possible area
<b>1.9 Standard form</b>	<b>A</b> solve problems involving standard form	
<b>1.10 Applying number</b>	<b>See Foundation Tier</b>	
<b>1.11 Electronic calculators</b>	<b>See Foundation Tier</b>	

## 2 Equations, formulae and identities

	Students should be taught to:	Notes
<b>2.1</b> Use of symbols	<b>A</b> use index notation involving fractional, negative and zero powers	
<b>2.2</b> Algebraic manipulation	<b>A</b> expand the product of two or more linear expressions	Expand and simplify $(x + 2)(x + 3)(x - 1)$
	<b>B</b> understand the concept of a quadratic expression and be able to factorise such expressions	Factorise $6x^2 - 5x - 6$
	<b>C</b> manipulate algebraic fractions where the numerator and/or the denominator can be numeric, linear or quadratic	Express as a single fraction $\frac{3x+1}{x+2} - \frac{x-2}{x-1}$ Simplify $\frac{2x^2 + 3x}{4x^2 - 9}$
	<b>D</b> complete the square for a given quadratic expression	Write $2x^2 + 6x - 1$ in the form $a(x + b)^2 + c$
	<b>E</b> use algebra to support and construct proofs	
<b>2.3</b> Expressions and formulae	<b>A</b> understand the process of manipulating formulae or equations to change the subject, to include cases where the subject may appear twice or a power of the subject occurs	Make $r$ the subject of $V = \frac{4}{3}\pi r^3$ Make $a$ the subject of $3a + 5 = \frac{4 - a}{r}$ Make $l$ the subject of $T = 2\pi\sqrt{\frac{l}{g}}$
<b>2.4</b> Linear equations	<b>See Foundation Tier</b>	For example $\frac{2x-3}{6} + \frac{x+2}{3} = \frac{5}{2}$

	<b>Students should be taught to:</b>	<b>Notes</b>
<b>2.5 Proportion</b>	<b>A</b> set up problems involving direct or inverse proportion and relate algebraic solutions to graphical representation of the equations	To include only the following: $y \propto x, y \propto \frac{1}{x}$ $y \propto x^2, y \propto \frac{1}{x^2}$ $y \propto x^3, y \propto \frac{1}{x^3}$ $y \propto \sqrt{x}, y \propto \frac{1}{\sqrt{x}}$
<b>2.6 Simultaneous linear equations</b>	<b>A</b> calculate the exact solution of two simultaneous equations in two unknowns	$2x + 3y = 17$ $3x - 5y = 35$
	<b>B</b> interpret the equations as lines and the common solution as the point of intersection	
<b>2.7 Quadratic equations</b>	<b>A</b> solve quadratic equations by factorisation	$2x^2 - 3x + 1 = 0,$ $x(3x - 2) = 5$
	<b>B</b> solve quadratic equations by using the quadratic formula or completing the square	
	<b>C</b> form and solve quadratic equations from data given in a context	
	<b>D</b> solve simultaneous equations in two unknowns, one equation being linear and the other being quadratic	$y = 2x - 11$ and $x^2 + y^2 = 25$  $y = 11x - 2$ and $y = 5x^2$
<b>2.8 Inequalities</b>	<b>A</b> solve quadratic inequalities in one unknown and represent the solution set on a number line	$x^2 \leq 25, 4x^2 > 25$ $x^2 + 3x + 2 > 0$
	<b>B</b> identify harder examples of regions defined by linear inequalities	Shade the region defined by the inequalities $x \leq 4,$ $y \leq 2x + 1,$ $5x + 2y \leq 20$

### 3 Sequences, functions and graphs

	Students should be taught to:	Notes
<b>3.1 Sequences</b>	<b>A</b> understand and use common difference ( $d$ ) and first term ( $a$ ) in an arithmetic sequence	e.g. given 2nd term is 7 and 5th term is 19, find $a$ and $d$
	<b>B</b> know and use $n$ th term $= a + (n - 1)d$	
	<b>C</b> find the sum of the first $n$ terms of an arithmetic series ( $S_n$ )	e.g. given $4 + 7 + 10 + 13 + \dots$ find sum of first 50 terms
<b>3.2 Function notation</b>	<b>A</b> understand the concept that a function is a mapping between elements of two sets	
	<b>B</b> use function notations of the form $f(x) = \dots$ and $f: x \mapsto \dots$	
	<b>C</b> understand the terms 'domain' and 'range' and which values may need to be excluded from a domain	$f(x) = \frac{1}{x-2}$ exclude $x = 2$
	<b>D</b> understand and find the composite function $fg$ and the inverse function $f^{-1}$	'fg' will mean 'do g first, then f'
<b>3.3 Graphs</b>	<p><b>A</b> recognise, plot and draw graphs with equation:</p> $y = Ax^3 + Bx^2 + Cx + D$ <p>in which:</p> <p>(i) the constants are integers and some could be zero</p> <p>(ii) the letters <math>x</math> and <math>y</math> can be replaced with any other two letters or:</p> $y = Ax^3 + Bx^2 + Cx + D + \frac{E}{x} + \frac{F}{x^2}$ <p>in which:</p> <p>(i) the constants are numerical and at least three of them are zero</p> <p>(ii) the letters <math>x</math> and <math>y</math> can be replaced with any other two letters or:</p> $y = \sin x, y = \cos x, y = \tan x$ <p>for angles of any size (in degrees)</p>	$y = x^3$ $y = 3x^3 - 2x^2 + 5x - 4$ $y = 2x^3 - 6x + 2$ $V = 60w(60 - w)$ $y = \frac{1}{x}, x \neq 0,$ $y = 2x^2 + 3x + \frac{1}{x},$ $x \neq 0,$ $y = \frac{1}{x}(3x^2 - 5),$ $x \neq 0,$ $w = \frac{5}{d^2}, d \neq 0$

	<b>Students should be taught to:</b>	<b>Notes</b>
	<b>B</b> apply to the graph of $y = f(x)$ the transformations $y = f(x) + a$ , $y = f(ax)$ , $y = f(x + a)$ , $y = af(x)$ for linear, quadratic, sine and cosine functions	
	<b>C</b> interpret and analyse transformations of functions and write the functions algebraically	
	<b>D</b> find the gradients of non-linear graphs	By drawing a tangent
	<b>E</b> find the intersection points of two graphs, one linear ( $y_1$ ) and one non-linear ( $y_2$ ), and recognise that the solutions correspond to the solutions of $(y_2 - y_1) = 0$	The $x$ values of the intersection of the two graphs: $y = 2x + 1$ $y = x^2 + 3x - 2$ are the solutions of: $x^2 + x - 3 = 0$ Similarly, the $x$ values of the intersection of the two graphs: $y = 5$ $y = x^3 - 3x^2 + 7$ are the solutions of: $x^3 - 3x^2 + 2 = 0$
	<b>F</b> calculate the gradient of a straight line given the coordinates of two points	Find the equation of the straight line through (1, 7) and (2, 9)
	<b>G</b> find the equation of a straight line parallel to a given line; find the equation of a straight line perpendicular to a given line	Find the equation of the line perpendicular to $y = 2x + 5$ through the point (3, 7)
<b>3.4 Calculus</b>	<b>A</b> understand the concept of a variable rate of change	
	<b>B</b> differentiate integer powers of $x$	
	<b>C</b> determine gradients, rates of change, stationary points, turning points (maxima and minima) by differentiation and relate these to graphs	Find the coordinates of the maximum and minimum points
	<b>D</b> distinguish between maxima and minima by considering the general shape of the graph only	

	<b>Students should be taught to:</b>	<b>Notes</b>
	<p><b>E</b> apply calculus to linear kinematics and to other simple practical problems</p>	<p>The displacement, <math>s</math> metres, of a particle from a fixed point <math>O</math> after <math>t</math> seconds is given by:</p> $s = 24t^2 - t^3,$ $0 \leq t \leq 20$ <p>Find expressions for the velocity and the acceleration.</p>

## A02 Shape, space and measures

### 4 Geometry and trigonometry

	Students should be taught to:	Notes
<b>4.1</b> <b>Angles, lines</b> <b>and triangles</b>	<b>See Foundation Tier</b>	
<b>4.2</b> <b>Polygons</b>	<b>See Foundation Tier</b>	
<b>4.3</b> <b>Symmetry</b>	<b>See Foundation Tier</b>	
<b>4.4</b> <b>Measures</b>	<b>See Foundation Tier</b>	
<b>4.5</b> <b>Construction</b>	<b>See Foundation Tier</b>	
<b>4.6</b> <b>Circle properties</b>	<b>A</b> understand and use the internal and external intersecting chord properties	
	<b>B</b> recognise the term 'cyclic quadrilateral'	
	<b>C</b> understand and use angle properties of the circle including: <ul style="list-style-type: none"> <li>(i) angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the remaining part of the circumference</li> <li>(ii) angle subtended at the circumference by a diameter is a right angle</li> <li>(iii) angles in the same segment are equal</li> <li>(iv) the sum of the opposite angles of a cyclic quadrilateral is <math>180^\circ</math></li> <li>(v) the alternate segment theorem</li> </ul>	Formal proof of these theorems is not required
<b>4.7</b> <b>Geometrical reasoning</b>	<b>A</b> provide reasons, using standard geometrical statements, to support numerical values for angles obtained in any geometrical context involving lines, polygons and circles	
<b>4.8</b> <b>Trigonometry and Pythagoras' theorem</b>	<b>A</b> understand and use sine, cosine and tangent of obtuse angles	
	<b>B</b> understand and use angles of elevation and depression	

	<b>Students should be taught to:</b>	<b>Notes</b>
	<b>C</b> understand and use the sine and cosine rules for any triangle	
	<b>D</b> use Pythagoras' theorem in three dimensions	
	<b>E</b> understand and use the formula $\frac{1}{2}ab\sin C$ for the area of a triangle	
	<b>F</b> apply trigonometrical methods to solve problems in three dimensions, including finding the angle between a line and a plane	The angle between two planes will not be required
<b>4.9 Mensuration</b>	<b>A</b> find perimeters and areas of sectors of circles	Radian measure is excluded
<b>4.10 3D shapes and volume</b>	<b>A</b> find the surface area and volume of a sphere and a right circular cone using relevant formulae	
<b>4.11 Similarity</b>	<b>A</b> understand that areas of similar figures are in the ratio of the square of corresponding sides	
	<b>B</b> understand that volumes of similar figures are in the ratio of the cube of corresponding sides	
	<b>C</b> use areas and volumes of similar figures in solving problems	

## 5 Vectors and transformation geometry

	Students should be taught to:	Notes
<b>5.1 Vectors</b>	<b>A</b> understand that a vector has both magnitude and direction	
	<b>B</b> understand and use vector notation including column vectors	The notations $\overline{OA}$ and $\mathbf{a}$ will be used
	<b>C</b> multiply vectors by scalar quantities	
	<b>D</b> add and subtract vectors	
	<b>E</b> calculate the modulus (magnitude) of a vector	Find the magnitude: of $\begin{pmatrix} 5 \\ -3 \end{pmatrix}$
	<b>F</b> find the resultant of two or more vectors	$\overline{OA} = 3\mathbf{a}$ , $\overline{AB} = 2\mathbf{b}$ , $\overline{BC} = \mathbf{c}$ so: $\overline{OC} = 3\mathbf{a} + 2\mathbf{b} + \mathbf{c}$ $\overline{CA} = -\mathbf{c} - 2\mathbf{b}$
<b>G</b> apply vector methods for simple geometrical proofs		
<b>5.2 Transformation geometry</b>	<b>See Foundation Tier</b>	

## A03 Handling data

### 6 Statistics and probability

	Students should be taught to:	Notes
<b>6.1 Graphical representation of data</b>	<b>A</b> construct and interpret histograms	For continuous variables with unequal class intervals
	<b>B</b> construct cumulative frequency diagrams from tabulated data	
	<b>C</b> use cumulative frequency diagrams	
<b>6.2 Statistical measures</b>	<b>A</b> estimate the median from a cumulative frequency diagram	
	<b>B</b> understand the concept of a measure of spread	
	<b>C</b> find the interquartile range from a discrete data set	The terms 'upper quartile' and 'lower quartile' may be used
	<b>D</b> estimate the interquartile range from a cumulative frequency diagram	
<b>6.3 Probability</b>	<b>A</b> draw and use tree diagrams	
	<b>B</b> determine the probability that two or more independent events will occur	
	<b>C</b> use simple conditional probability when combining events	Picking two balls out of a bag, one after the other, without replacement
	<b>D</b> apply probability to simple problems	