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GCSE

Methods in Mathematics (Pilot)

For use in pilot centres only

Content exemplification

Edexcel GCSE in Methods in Mathematics (2MM01)

For first teaching from September 2010

A PEARSON COMPANY

Contents

Specification at a glance

The Edexcel GCSE in Methods in Mathematics comprises two units – Units 1 and 2.

Unit 1	**Methods 1**	***Unit code 1F: 5MM1F** ***Unit code 1H: 5MM1H**
• Externally assessed • Availability: June and November • First assessment: June 2011		**50% of the total GCSE**
Overview of content **1** Number **2** Algebra **3** Geometry **4** Probability		

Overview of assessment
• One written paper
• Tiered papers
  ○ Foundation Tier grades C-G available
  ○ Higher Tier grades A*-D available (E allowed)
• 1 hour 45 minutes (Foundation paper)
• 1 hour 45 minutes (Higher paper)
• 100 marks
• Non-calculator		

Unit 2	Methods 2	*Unit code 2F: 5MM2F *Unit code 2H: 5MM2H
• Externally assessed • Availability: June and November • First assessment: June 2011		**50% of the total GCSE**
Overview of content **1** Number **2** Algebra **3** Geometry		

Overview of assessment
• One written paper
• Tiered papers
  ○ Foundation Tier grades C-G available
  ○ Higher Tier grades A*-D available (E allowed)
• 1 hour 45 minutes (Foundation paper)
• 1 hour 45 minutes (Higher paper)
• 100 marks
• Calculator allowed		

Subject content

The content of the specification has been grouped into topic areas:

- Number
- Algebra
- Geometry
- Probability.

The specification content consists of a reference (ref), a content descriptor and examples of concepts and skills.

Content that is Higher Tier only is indicated in **bold type**.

The content of Higher Tier subsumes the content of Foundation Tier.

The content of Unit 2 subsumes the content of Unit 1.

An overview of the content follows, showing in which units it is assessed.

The same content descriptors may appear in each unit, but concepts and skills are developed through the units, so the concepts and skills may be different.

Unit 1: Methods 1

Foundation

Overview

Content overview

This unit contains:

1 Number

- Four operations
- Factors and multiples
- Indices, squares and roots
- Fractions and decimals
- Operations and accuracy
- Venn diagrams

2 Algebra

- Manipulating expressions
- Equations
- Formulae
- Sequences
- Coordinates
- Straight-line graphs

3 Geometry

- Angles of lines and triangles
- Quadrilaterals
- Symmetry
- Transformations
- Vectors
- Congruence and similarity
- Circles
- Perimeter, area and volume

4 Probability

- Probability measures
- Relative probability
- Mutually exclusive outcomes
- Set theory and Venn diagrams
- Comparing probabilities

Assessment overview

- 50% of the qualification
- One written paper
- 1 hour 45 minutes in total
- 100 marks in total
- Non-calculator
- Grades C-G available
- Available in June and November

References

Each topic in this unit contains a specification reference (for example, **MP a** for Methods, Probability, Statement a), the content descriptor and examples of concepts and skills associated with that content descriptor.

1 Number

What students need to learn:

Ref	Content descriptor	Concepts and skills
MN a	Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations	• Multiply and divide numbers using the commutative, associative and distributive laws and factorisation where possible, or place value adjustments *Examples:* ○ 56.7 ÷ 0.28 ○ 14.3 × 4.6 ○ 57 × 23 + 57 × 77 • Use inverse operations *Example:* calculate 354 × 78 = 27612, then check by calculating 27612 ÷ 78 • Use brackets and the hierarchy of operations *Examples:* ○ insert brackets so that 20 – 3 × 2 = 34 ○ BIDMAS: work out 5 × (2 + 3) and 5 × 2 + 3 ○ find the value of 3 × (2 + 5^2) • Use one calculation to find the answer to another *Example:* given that 354 × 78 = 27612, what is: (i) 35.4 × 7.8 (ii) 27.612 ÷ 3.54

Ref	Content descriptor	Concepts and skills
MN b	Arithmetic of real numbers	• Add, subtract, multiply and divide whole numbers, integers, negative numbers, fractions and decimals *Examples:* ○ 48 × 27, 777 ÷ 37, 27.6 × 23, 36.2 ÷ 0.2, –2 + –4 ○ 365 + 45 + 1026, 30 – 5.91, 2.56 ÷ 1.6 ○ non-calculator methods to find 365 × 54, 753 ÷ 36 ○ $\frac{2}{3}-\frac{1}{4}$, $2\frac{1}{3}+1\frac{3}{4}$, $3\frac{1}{3}\times 2\frac{2}{5}$, $\frac{5}{8}-\frac{3}{4}$, $\frac{3}{4}\times 5$, ○ how many $\frac{3}{4}$ ounce portions in 8 ounces? ○ two rods have lengths of $1\frac{1}{2}$ inches and $2\frac{3}{4}$ inches. What is their total length? ○ the four operations as applied to negative numbers 5 + (–7), 13 – (–5), 3 × –5, –10 ÷ –5 • Recall all multiplication facts to 10 × 10, and use them to derive quickly the corresponding division facts *Example:* know that 8 × 7 = 56, 56 ÷ 7 = 8 and 56 ÷ 8 = 7 • Multiply or divide any number by powers of 10 *Examples:* 356 × 100, 356 ÷ 100, 0.7 ÷ 1000, 8.8 × 10 • Multiply or divide by any number between 0 and 1 *Examples:* 3.56 × 0.023, 3.56 ÷ 0.01, 3 × 0.4 • Select a variety of methods for addition, subtraction, multiplication and division of integers and decimals

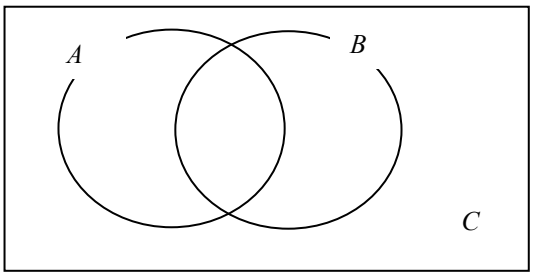
Ref	Content descriptor	Concepts and skills
MN b	Arithmetic of real numbers (*continued*)	• Solve a problem involving division by a decimal *Example:* how many pieces of wood each 0.2 m long can be cut from a piece 3.5 m long? • Write numbers in words • Write numbers from words *Examples:* ○ write 50 million in figures ○ write fifty-five thousand two hundred and six in figures ○ write 675 543 in words
MN c	Numbers and their representations including powers, roots, indices (with integer powers)	• Recall integer squares from 2×2 to 15×15 and the corresponding square roots *Examples:* ○ find the value of squares and square roots ○ find a value for the square root of 100 ○ find the value of $\sqrt{64}$ ○ find the length of a square with an area of 81 cm^2 ○ know that both −3 and +3 are the square roots of 9 • Recall the cubes of 2, 3, 4, 5 and 10 *Example:* explain why the cube of 2 is not 6 • Select a square number or a cube number from a list • Order integers, decimals and fractions *Examples:* ○ place a series of positive and negative numbers in ascending or descending order ○ arrange in order, smallest first 5, 2, −6, 0, −3 ○ write $\frac{3}{8}, \frac{1}{4}, \frac{3}{10}$ in descending order

Ref	Content descriptor	Concepts and skills
MN c	Numbers and their representations including powers, roots, indices (with integer powers) (*continued*)	○ write two different fractions with values between $\frac{1}{4}$ and $\frac{1}{2}$ • Understand and use positive numbers and negative integers, both as positions and translations on a number line *Examples:* 3 – 5, –4 + 7, –3 – 7 • Find equivalent fractions *Example:* explain why $\frac{3}{4}$ is the same as $\frac{6}{8}$ • Write a fraction in its simplest form *Examples:* ○ write $\frac{16}{24}$ as a fraction in its simplest form ○ express $\frac{28}{35}$ in its simplest form • Compare fractions *Examples:* ○ compare fractions using diagrams ○ compare shaded fractions of shapes, giving answers in simplified forms ○ select appropriate operations, methods and strategies to solve number problems, including trial and improvement where a more efficient method of solution is not obvious • Convert between mixed numbers and improper fractions *Examples:* ○ write improper fractions as mixed numbers and vice versa ○ write $\frac{27}{10}$ as $2\frac{7}{10}$ • Find the value of calculations using indices *Examples:* ○ find the values of 2^3, 3^2, 7^0, 8^1 ○ find the values of 2^4, $2^3 + 3^2$

Ref	Content descriptor	Concepts and skills
MN c	Numbers and their representations including powers, roots, indices (with integer powers) (*continued*)	○ which is larger 2^3 or 3^2? • Use index notation for squares and cubes *Examples:* ○ $2^3 = 8$ ○ $3^4 = 9^2 = 81$ • Use index notation for powers of 10 *Example:* write down the value of 10^6 • Use index laws for multiplication and division of integer powers, and powers of a power *Examples:* ○ $5^7 \div 5^3$, $3^3 \times 3^4$, $(4^2)^3$ ○ what is the value of $4^5 \div 4^3$?

Ref	Content descriptor	Concepts and skills
MN d	Approximate to specified or appropriate degrees of accuracy including a given power of ten, number of decimal places and significant figures	• Round numbers to a given power of 10 *Examples:* ○ write 54 327 to the nearest thousand ○ round the number 23 578 to the nearest ten • Round to the nearest integer and to any given number of significant figure(s) *Examples:* ○ write 37 451 correct to two significant figures ○ write 0.000 726 9 correct to one significant figure • Round to a given number of decimal places *Examples:* ○ write the answer to a money problem to the nearest penny and/or pound (unprompted) ○ round 1.537 to 2 decimal places • Estimate answers to calculations, including use of rounding *Examples:* ○ estimate $\frac{52.9\times3.1}{19.5-1.9}$, $\frac{68\times401}{198}$ ○ 348 × 23 approximates to 300 × 20 (ie one significant figure) ○ work to stated levels of accuracy ○ round practical measurements correct to 1 mm if appropriate ○ give answer to two decimal places, or to one significant figure, or rounded to the nearest integer

Ref	Content descriptor	Concepts and skills
MN e	Use the concepts and vocabulary of factor (divisor), multiple, common factor, common multiple, highest common factor, (HCF), least common multiple, (LCM), prime number and prime factor decomposition	• Identify factors, multiples and prime numbers *Example:* pick multiples of 4, factors of 56, and a prime number, from a list of numbers • Find the common factors and common multiples of two numbers *Example:* list all the common factors of 24 and 36 • Recognise odd and even numbers • Find the Highest Common Factor (HCF) and the Lowest Common Multiple (LCM) of two numbers *Examples:* ○ find the HCF of 24 and 36 ○ find the LCM of 15 and 20
MN f	Understand that factors of a number can be derived from its prime factorisation	• Find the prime factor decomposition of positive integers *Examples:* ○ write 18 as the product of its prime factors ○ write 252 as $2^2 \times 3^2 \times 7$ ○ express the answer either as the product of prime factors, or the product of powers of prime factors • Understand that the number of factors relates to the type of number *Example:* prime numbers have exactly 2 factors • Use prime factorisation to find HCF and LCM

Ref	Content descriptor	Concepts and skills
MN p	Understand and use Venn diagrams to solve problems	• Use Venn diagrams to represent sets *Example:* A = {factors of 24}, B = {odd numbers}. Draw a Venn diagram to display this information • Interpret Venn diagrams *Examples:* ○ complete a Venn diagram ○ use a Venn diagram to find the numbers which are both factors of 24 and odd • Draw a Venn diagram using given information *Example:* there are 34 students in class 11G. 16 students study French. 12 students study German. 8 students study both French and German. How many students do not study French or German? • Use a given Venn diagram to solve a problem • Understand and be able to find the intersection and union of sets *Example:* if A = {whole numbers from 1 to 20} and B = {prime numbers}, how many numbers are prime between 1 and 20? • Understand and use Venn diagrams to solve problems *Example:*  if A = {factors of 120}, B = {odd numbers} C = {whole numbers up to 150}, complete the Venn diagram. How many numbers are in B but not A?

2 Algebra

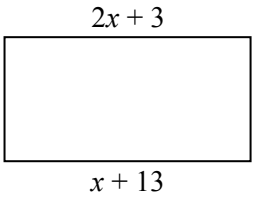
What students need to learn:

Ref	Content descriptor	Concepts and skills
MA a	Distinguish the different roles played by letter symbols in algebra, using the correct notation	• Use notation and symbols correctly *Examples:* ○ know that letter symbols can be used to denote variables ○ understand that if you have x small boxes of 6 eggs and y large boxes of 12 eggs, then the total number of eggs is $6x + 12y$ ○ if n is an even number, what type of number is $n - 1$? ○ know that $2a$ is $a + a$ or $2 \times a$
MA b	Distinguish in meaning between the words equation, inequality, formula and expression	• Write an expression *Examples:* ○ know that $5x$, $2a + b$ are expressions ○ know that $5x + 2 = 12$ is an equation ○ know that $V = \mathrm{Ir}$ is a formula ○ know that $x < 12$ is an inequality ○ a class has x boys and y girls. Write an expression, in terms of x and y, for the total number of students in the class ○ understand that if a rectangle has one side of length $a + 1$ and one side of length 4, the area of the rectangle is $4(a + 1) = 4a + 4$ • Select an expression/equation/formula from a list *Example:* identify an expression from a list of equations, formulae and expressions
MA c	Manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, taking out common factors	• Manipulate algebraic expressions by collecting like terms *Examples:* simplify: $x + 5 - 2x - 1 + 4 - x$, $3a + 2c - a - 3c + 2$ $a \times b \times 2$

Ref	Content descriptor	Concepts and skills
MA c	Manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, taking out common factors (*continued*)	• Multiply a single term over a bracket *Examples:* ○ $2x(x+4) = 2x^2 + 8x$ ○ expand and simplify $3(2x-1) - 2(2x-3)$ ○ understand that the transformation of algebraic expressions obeys the rules of generalised arithmetic, eg $a(b+c) = ab + ac$ • Write expressions using squares and cubes • Use simple instances of index laws *Examples:* simplify: $x^2 \times x^3$, $x^6 \div x^4$ $\frac{t^6}{t^2} = x^4$, $(x^3)^2$ • Substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$ • Factorise algebraic expressions by taking out common factors *Examples:* factorise: $x^2 + 3x = x(x+3)$ $9x - 3 = 3(3x-1)$ factorise fully: $6x^2 - 9x = 3x(2x-3)$ $2ab^2 + 4ab = 2ab(b+2)$ • Write expressions to solve problems *Example:* find an expression for the total length in cm of $(x+3)$ cm and $(2x+5)$ cm • Substitute numbers into simple formulae (NB: Multiplying two linear expressions, factorising quadratic expressions including the difference of two squares and simplifying rational expressions are assessed at Higher Tier only)

Ref	Content descriptor	Concepts and skills
MA d	Set up, and solve simple equations and inequalities	• Set up simple equations *Example:* find the size of angle a in a triangle with angles of sizes a, $a + 10$, and $a + 20$ • Rearrange simple equations • Solve simple equations *Examples:* $3x^2 = 48$, $3 = \frac{12}{x}$ • Solve linear equations with integer coefficients, in which the unknown appears on either side or on both sides of the equation *Examples:* $11 - 4x = 2$, $4x + 7 = 3$, $3x = 2x + 1$, $2a + 4 = a + 7$ • Solve linear equations which include brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution *Examples:* $2(1 - x) = 6(2 + x)$, $2a - 4 = a - 7$ • Solve linear equations in one unknown, with integer or fractional coefficients *Examples:* $\frac{x}{4} + 1 = 5$, $4 + \frac{3x}{5} = x$

Ref	Content descriptor	Concepts and skills
MA i	Generate terms of a sequence using term-to-term and position-to-term definitions	• Recognise sequences of odd and even numbers • Generate simple sequences of numbers, squared integers and sequences derived from diagrams *Examples:* ○ find the next (or the 10th) term in 1, 2, 4, 8, … ○ find the next (or the 6th) term in 1, 3, 6, 10, … ○ find the next (or the 10th) term in 1, 4, 5, 8, 9, 12, … ○ draw the next diagram in a sequence of diagrams • Write the term-to-term definition in words for a sequence *Example:* explain how to generate the next term of the sequence 5, 12, 19, 26, … • Find a specific term in the sequence using position-to-term or term-to-term rules *Examples:* ○ a sequence has an nth term, given by nth term = $3n + 7$. What is the 20th term? ○ for the sequence, 4, 9, 13, 17, … find the 10th term in this sequence • Identify whether a number can be a term in a sequence

Ref	Content descriptor	Concepts and skills
MA j	Form linear expressions to describe the nth term of a sequence	• Find the nth term of an arithmetic sequence *Examples:* ○ what is the nth term of this arithmetic sequence 2, 7, 12, 17, 22, …? ○ interpret numerical and algebraic information based upon number patterns and sequences of diagrams ○ present and interpret solutions in the context of the original problem • Use the nth term of an arithmetic sequence *Example:* relate solutions back to the original number sequence or sequence of drawings
MA k	Use algebra to support and construct arguments	• Describe a situation or expression algebraically • Write down an equation from a diagram *Example:*  write down an equation and solve it for x

Ref	Content descriptor	Concepts and skills
MA l	Use the conventions for coordinates in the plane and plot points in all four quadrants	• Use axes and coordinates to specify points in all four quadrants in 2-D • Identify points with given coordinates *Example:* identify points given the following coordinates (3, 4), (0, 6), (–2, 4) (NB: Points may be in the first quadrant or all four quadrants) • Identify coordinates of given points • Find coordinates of points identified by geometrical information • Find the coordinates of the midpoint of the line segment AB, given the coordinates of A and B *Example:* if A is the point (1, 7) and B is the point (5, 3), find the midpoint of AB
MA m	Recognise and plot equations that correspond to straight-line graphs in the coordinate plane	• Draw, label and scale axes • Plot and draw graphs of functions in which y is given explicitly in terms of x, or implicitly, or by using a table of values *Examples:* $y = 4, x = 3, y = 2x + 3, x + y = 7, \ y = \frac{1}{2}x - 1$ • Recognise that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane • Recognise that, in a mathematical context, an equation in the form $y = mx + c$ is a straight line • Plot and draw graphs of straight lines with equations of the form $y = mx + c$ *Example:* plot $y = 6 - x$ with or without a table of values • Find the gradient of a straight line from a graph

Ref	Content descriptor	Concepts and skills
MA n	Use geometric information to complete diagrams on a coordinate grid	• Find the coordinates of points identified by geometrical information *Examples:* ○ A = (4, 6), B = (8, 6). Plot a point C so that the area of triangle ABC = 6 cm^2 ○ find the two possible coordinates of the fourth vertex of a parallelogram with vertices at (2, 1), (–7, 3) and (5, 6) ○ identify whether enough information is available to solve a problem when using a coordinate grid
MA t	Recognise and use equivalence in numerical, algebraic and graphical representations	• Understand link between conversion graphs and associated formulae and equations • Use a graph to find approximate solutions to equations *Examples:* ○ use a range of strategies to create algebraic or graphical representations of a problem and its solution ○ move from one form of representation to another to get different perspectives of the problem ○ compare two tariffs A and B graphically, to see which is the best value for different amounts of consumption

3 Geometry

What students need to learn:

Ref	Content descriptor	Concepts and skills
MG a	Recall and use properties of angles at a point, angles at a point on a straight line (including right angles) and vertically opposite angles	• Recall and use properties of angles: ○ at a point ○ at a point on a straight line, including right angles ○ vertically opposite angles *Examples:* ○ use the sum of three angles on a straight line to find a missing angle ○ use the sum of four angles at a point to find a missing angle ○ use the sum of three angles on a straight line and/or the sum of four angles at a point, of which one may be 90°, to find a missing angle, giving reasons • Distinguish between acute, obtuse, reflex and right angles by identifying angles in a diagram *Examples:* ○ in any given diagram, identify an acute, an obtuse and a right angle ○ give a time when the hands of a clock are perpendicular to one another • Name angles • Estimate sizes of angles • Give reasons when calculating missing angles *Examples:* ○ 'the sum of the angles on a straight line is 180°' ○ 'the sum of the angles at a point is 360°' • Use two-letter notation for a line and three-letter notation for an angle *Examples:* ○ use geometric language appropriately ○ identify points, lines and angles

Ref	Content descriptor	Concepts and skills
MG a	Recall and use properties of angles at a point, angles at a point on a straight line (including right angles) and vertically opposite angles (*continued*)	• Identify perpendicular lines on a shape or diagram *Examples:* ○ recall and use properties of perpendicular lines ○ mark perpendicular lines on a diagram
MG b	Understand and use the angle properties of parallel and intersecting lines, triangles and quadrilaterals	• Distinguish between scalene, isosceles, equilateral, and right-angled triangles • Understand and use the angle properties of triangles • Understand the angle properties of intersecting lines • Give reasons for angle calculations • Identify parallel lines on a shape or diagram • Use the side/angle properties of isosceles and equilateral triangles • Understand and use the fact that the angle sum of a triangle is 180°
MG c	Recall the properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus	• Draw sketches of shapes • Classify quadrilaterals by their geometric properties • Name all quadrilaterals that have a specific property • Use the symmetry properties of quadrilaterals • List the properties of each, or identify (name) a given shape from its properties • Recall the properties and definitions of special types of quadrilaterals *Examples:* ○ name all the quadrilaterals that have a pair of opposite sides that are parallel or that have diagonals which intersect at right angles ○ given the size of one angle of a parallelogram, write down the opposite angle

Ref	Content descriptor	Concepts and skills
MG d	Recognise reflection and rotation symmetry of 2-D shapes	• Recognise reflection symmetry of 2-D shapes • Understand the concept of line symmetry and be able to identify and draw lines of symmetry on a shape • Draw and complete diagrams with a given number of lines of symmetry • State the line of reflective symmetry as a simple algebraic equation *Example:* ○ use $x = 3$ as an axis of symmetry • Recognise rotational symmetry of 2-D shapes • Understand the concept of rotational symmetry • Be able to identify the order of rotational symmetry of a 2-D shape • Draw or complete diagrams with a given order of rotational symmetry *Examples:* ○ identify countries' flags, road signs, creatures (butterflies), wallpaper patterns or buildings having line and/or rotational symmetry ○ on a grid, shade additional squares so that a pattern has line or rotational symmetry

Ref	Content descriptor	Concepts and skills
MG j	Describe and transform 2-D shapes using single or combined rotations, reflections, translations, or enlargements by a positive scale factor and distinguish properties that are preserved under particular transformations	• Describe and transform 2-D shapes using single rotations *Example:* give the angle of rotation as a fraction of a turn or in degrees • Understand that rotations are specified by a centre and an (anticlockwise) angle • Find the centre of rotation • Rotate a shape about the origin, or any other point • Describe and transform 2-D shapes using single reflections • Understand that reflections are specified by a mirror line *Example:* reflect a triangle in the x-axis or the y-axis or $y = \pm x$ • Identify the equation of a mirror line of symmetry • Describe and transform 2-D shapes using single translations • Describe and transform 2-D shapes using enlargements by a positive scale factor *Example:* enlarge shapes using (0, 0) as the centre of enlargement • Understand that an enlargement is specified by a centre and a scale factor • Scale a shape on a grid (centre not specified) • Find the centre of enlargement • Enlarge a shape using a centre other than (0, 0) • Describe and transform 2-D shapes using combined rotations, reflections, translations, or enlargements *Example:* describe the single transformation that describes the result of a combination of the rotation of a triangle by 180°, centre (0, 0), followed by a reflection in the x-axis

Ref	Content descriptor	Concepts and skills
MG j	Describe and transform 2-D shapes using single or combined rotations, reflections, translations, or enlargements by a positive scale factor and distinguish properties that are preserved under particular transformations (*continued*)	• Distinguish properties that are preserved under particular transformations • Identify the scale factor of an enlargement of a shape as the ratio of the lengths of two corresponding sides • Describe a transformation • Understand that distances and angles are preserved under rotations, reflections and translations, so that the image is congruent under these transformations
MG k	Use 2-D vectors to describe translations	• Use vector notation to describe translations • Understand that translations are specified by a distance and direction (using a vector) • Translate a given shape by the vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$ • Describe a translation using a vector
MG m	Understand congruence and similarity, including the relationship between lengths in similar figures	• Understand congruence • Understand similarity *Example:* recognise similar shapes • Identify shapes that are similar, including all circles or all regular polygons with an equal number of sides • Identify shapes that are congruent • Understand what makes two shapes congruent or similar *Example:* identify similar or congruent shapes drawn on a grid • Understand the relationships between lengths in similar figures *Example:* find a missing side in one triangle given it is similar to a second triangle • Recognise that all corresponding angles in similar shapes are equal in size when the lengths of sides are not

Ref	Content descriptor	Concepts and skills
MG q	Distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment	• Recall the definition of a circle and identify (name) and draw the parts of a circle *Example:* match diagrams to the mathematical names of the parts of a circle • Understand related circle terms such as semicircle and quarter circle • Draw a circle, given the radius or diameter
MG s	Calculate perimeters and areas of shapes made from triangles and rectangles	• Calculate perimeters of compound shapes made from triangles and rectangles • Find the perimeter of rectangles and triangles • Find the areas of rectangles, squares and triangles • Calculate areas of compound shapes made from triangles and rectangles • Recall and use the formulae for the area of a triangle, rectangle and a parallelogram • Find the area of a trapezium • Split a compound shape into constituent parts in order to find its area or perimeter *Example:* perimeters and surface areas could be a feature of the problem to be solved

4 Probability

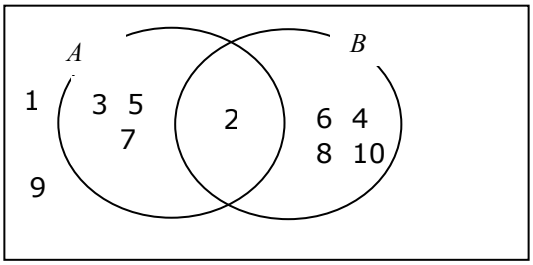
What students need to learn:

Ref	Content descriptor	Concepts and skills
MP a	Understand and use the vocabulary of probability and the probability scale	• 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 *Examples:* ○ mark with a cross (X) the probability that one roll of a fair dice will give an even number ○ know that an event with probability of 0.68 is more likely to happen than an event with a probability of 0.65 • Write probabilities using fractions, percentages and decimals and words *Example:* ○ $\frac{3}{4}$ or 0.75 or 75% (NB: Do not write probabilities using 3:4, 3 out of 4 or 3 in 4) ○ state the likelihood that – the roll of a fair dice will show an odd number – it will snow in Scotland next year
MP b	Understand and use theoretical models for probabilities including the model of equally likely outcomes	• Understand theoretical models to include outcomes using dice, spinners, and coins *Example:* theoretical models of finding the probability of an event happening to include outcomes using dice, spinners, coins etc • Calculate the probability of successive events, such as two throws of a single dice • Estimate the number of times an event will occur, given the probability and the number of trials • Recognise when events are equally likely to occur

Ref	Content descriptor	Concepts and skills
MP c	Understand and use estimates of probability from relative frequency	• Understand and use estimates of probability • Find the probability of an event happening using relative frequency *Examples:* ○ understand and use estimates or measures of probability from examples ○ estimate the number of times an event will occur, given the probability and the number of trials • Estimate the number of times an event will occur, given the relative frequency and the number of trials
MP d	Use of sample spaces for situations where outcomes are single events and for situations where outcomes are two successive events	• List all outcomes for single events, and for two successive events, in a systematic way *Examples:* ○ spinning two coins or throwing two dice ○ spinning a coin and throwing a dice ○ writing outcomes as H1, *H2*, H3, *H4*, H5, *H6*, T1, T2, T3, T4, T5, T6, and then finding the probability of getting a head and throwing an even number on the dice • Use and draw sample space diagrams • Add simple probabilities using sample space diagrams *Example:* given a sample space diagram for throwing two fair dice, work out the probability of getting any double or a total of 7

Ref	Content descriptor	Concepts and skills
MP e	Identify different mutually exclusive and exhaustive outcomes and know that the sum of the probabilities of all these outcomes is 1	• Identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1 • Add simple probabilities *Example:* if the probability of taking a red counter is 0.2, and a blue counter 0.3, then the probability of taking a red or blue counter is 0.5 • Use $1 - p$ 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 *Examples:* ○ find probabilities from a two-way table ○ find the probability (x) of Dave winning the race, given that the probabilities of other athletes winning are shown in the table
MP f	Understand and use set notation to describe events and compound events	• Understand that: ○ $\mathrm{P}(A)$ represents the probability of an event A happening ○ $\mathrm{P}(A')$ represents the probability of event A **not** happening ○ $\mathrm{P}(A') = 1 - \mathrm{P}(A)$

Andy	Bill	Chas	Dave
0.35	0.1	0.25	x

Ref	Content descriptor	Concepts and skills
MP g	Use Venn diagrams to represent the number of possibilities and hence find probabilities	• Use a Venn diagram to find probabilities *Example:* $\mathcal{E}$ = { integers from 1 to 10}, A ={prime numbers}, B ={even numbers} The Venn diagram shows numbers 1 to 10  $\mathrm{P}(A) = \frac{4}{10}$ $\mathrm{P}(B) = \frac{5}{10}$ $\mathrm{P}(A \cup B) = \frac{8}{10}$ $\mathrm{P}(A \cap B) = \frac{1}{10}$
MP j	Compare experimental data and theoretical probabilities, and make informal inferences about the validity of the model giving rise to the theoretical probabilities	• Compare experimental data and theoretical probabilities *Examples:* ○ understand that: – rolling a fair dice 6 times is not likely to result in one each of 1, 2, 3, 4, 5 and 6 – rolling a dice 60 times is likely to result in about 10 each of 1, 2, 3, 4, 5 and 6 – rolling a dice 600 times is more likely to result in about $\frac{1}{6}$th of 600 for each of 1, 2, 3, 4, 5 and 6 ○ explain whether or not a dice is fair if throwing it 600 times results in 200 sixes

Ref	Content descriptor	Concepts and skills
MP k	Understand that when a statistical experiment or survey is repeated there will usually be different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics	• Compare relative frequencies from samples of different sizes *Example:* Bill throws a coin 10 times and gets 5 heads. Jenny throws the same coin 600 times and gets 290 heads. Who, Bill or Jenny, will be able to get the best estimate for the probability of getting a head?

Unit 2: Methods 2

Foundation

Overview

Content overview

This unit contains:

1 Number

- Four operations
- Decimals
- Percentages
- Ratio and direct proportion
- Using calculators

2 Algebra

- Formulae
- Inequalities
- Solving equations graphically
- Coordinates

3 Geometry

- Angles and lines
- Polygons
- Tessellations
- Congruency and similarity
- Pythagoras
- Area and circumference of quarter-, semi- and full circles
- Perimeter, area and volume

Assessment overview

- 50% of the qualification
- One written paper
- 1 hour 45 minutes
- 100 marks
- Calculator allowed
- Grades C-G available
- The content of Unit 2 subsumes the content of Unit 1. However, the content of Unit 1 will not be the direct focus of the assessment
- Available June and November

References

Each topic in this unit contains a specification reference (for example, **MAP a** for Methods, Algebra, Statement a), the content descriptor and examples of concepts and skills associated with that content descriptor.

1 Number

What students need to learn:

Ref	Content descriptor	Concepts and skills
MN a	Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations	• 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) • Find reciprocals *Example:* find the reciprocal of 0.2 • Use inverse operations *Example:* calculate 354 × 78 = 27612, then check by calculating 27612 ÷ 78 • Understand and use unit fractions as multiplicative inverses *Examples:* by thinking of multiplication by $\frac{1}{5}$ as division by 5, or multiplication by $\frac{6}{7}$ as multiplication by 6 followed by division by 7 (or vice versa) • Solve word problems about ratio and proportions, including using informal strategies and the unitary method of solution *Examples:* ○ 28 cm of wire has a mass of 8 g. Find the mass of 45 cm of the same wire ○ cheese pie for 4 people requires 250 g of cheese. How much cheese is needed for cheese pie for 10 people? ○ select trial and improvement methods where a standard procedure is inappropriate ○ set out a solution to a multi-step problem in a logical progression ○ solve reverse rate problems

Ref	Content descriptor	Concepts and skills
MN b	Arithmetic of real numbers	• Add, subtract, multiply and divide whole numbers, negative numbers, integers, fractions and decimals using a calculator • Multiply or divide any number by powers of 10 • Add, subtract, multiply and divide decimals with any number of decimal places, using a calculator
MN g	Understand that 'percentage' means 'number of parts per 100' and use this to compare proportions	• Order fractions, decimals and percentages *Example:* order fractions in a list including percentages and decimals • Convert between fractional, decimal and percentage forms *Examples:* ○ 20% means 20 parts per hundred or $\frac{20}{100}$ or $\frac{1}{5}$ ○ write in order of size 0.7, $\frac{3}{5}$, 50%, $\frac{2}{3}$
MN h	Use multipliers for percentage change	• Find a percentage of a quantity • Use percentages to solve problems *Example:* 15% of 60 means $\frac{15}{100} \times 60$ or 0.15×60 • Use a multiplier to increase or decrease by a percentage *Example*: increase 80 by 5% by using a multiplier of 1.05 (NB: Repeated proportional change is only on Higher Tier)

Ref	Content descriptor	Concepts and skills
MN i	Interpret fractions, decimals and percentages as operators	• Interpret percentage as an operator • Find percentages of quantities • Calculate a given fraction of a given quantity • Express a given number as a fraction of another *Examples:* ○ write 33 out of 55 as a fraction in its simplest form ○ write 40 cm as a fraction of 2 m • Use decimals to find quantities • Express a given number as a percentage of another *Example*: work out 27 as a percentage of 150 • Understand the multiplicative nature of percentages as operators *Examples:* ○ 30% increase on £150 gives a total calculated as £(1.3 × 150) ○ 20% discount on £150 gives a total calculated as £(0.8 × 150) ○ analyse a problem and choose whether to use fractions, decimals or percentages as multipliers to solve it

Ref	Content descriptor	Concepts and skills
MN j	Understand and use the relationship between fractions and decimal representations including recurring and terminating decimals	• Recall the fraction to decimal conversion of familiar simple fractions *Examples:* $\frac{1}{2}, \frac{1}{4}, \frac{1}{5}, \frac{1}{10}, \frac{1}{100}, \frac{1}{8}$ • Convert between fractions and decimals using a calculator *Examples:* ○ 0.137 = $\frac{137}{1000}$ ○ write $\frac{3}{8}$ as a decimal ○ write 1.25 as a mixed number ○ write 0.35 as a fraction in its simplest form • Recognise that recurring decimals are exact fractions, and that some exact fractions are recurring decimals *Examples:* ○ $\frac{1}{7}$ = 0.142857142857… ○ $\frac{1}{3} = 0.\dot{3}$ ○ explain why $\frac{1}{3}$ is not 0.3 • Use the decimal-to-fraction conversion of familiar simple fractions • Convert between recurring decimals and fractions • Understand a fraction to recurring decimal proof by understanding the behaviour of the remainders

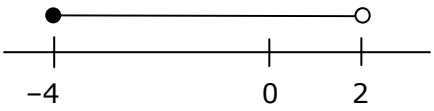
Ref	Content descriptor	Concepts and skills
MN k	Understand and use the relationship between ratio and fractions	• Represent a situation using fractions or a ratio *Examples:* ○ write a ratio in the form $1:n$ or $n:1$ ○ understand that the ratio 2:3 is $\frac{2}{5}:\frac{3}{5}$ ○ write 20:12 as a ratio in its simplest form • Use fractions and ratios in a problem *Example:* Bill and Mary share a sum of money in the ratio 3:5 What fraction of the sum does Bill get?
MN l	Find proportional change, using fractions, decimals and percentages	• Use a multiplier to increase or decrease by a percentage in any scenario where percentages, fractions or decimals are used *Examples:* ○ a multiplier of 1.05 corresponds to an increase of 5% ○ a multiplier of $\frac{4}{5}$ corresponds to a decrease of $\frac{1}{5}$ • Use percentages, fractions and decimals to find proportions • Understand how fractions, decimals and percentages can be used to scale between proportions *Example:* Jim earns £400 and spends £120 on rent. Ali earns £500 and spends £160 on rent. Who spends the larger proportion on rent?

Ref	Content descriptor	Concepts and skills
MN m	Understand and use direct proportion	• Calculate an unknown quantity from quantities that vary in direct proportion *Example:* Bill takes 4 hours to lay 200 bricks. How long will it take him to lay 170 bricks? • Solve word problems about ratio and proportion, including using informal strategies and the unitary method of solution *Example:* a 250 g box of popcorn costs £1.20 a 400 g box of popcorn costs £2.10 which is the best value? • Scale between quantities in direct proportions *Example:* A map is drawn to a scale of 1:20000 If a distance measures 6 cm on the map, what is the real distance?
MN n	Divide a quantity in a given ratio	• Divide a quantity in a given ratio *Examples:* ○ share £15 in the ratio 3:2 ○ share 20 metres of ribbon in the ratio 11:6:3 • Solve a ratio problem *Example:* Bill and Mary share a sum of money in the ratio 3:5 Bill receives £12. How much does Mary receive?

Ref	Content descriptor	Concepts and skills
MN o	Use calculators effectively and efficiently	• Use a calculator effectively and efficiently • Know how to enter complex calculations and use function keys for squares, powers and reciprocals • Understand, and interpret, the calculator display, particularly when the display has been rounded by the calculator *Examples:* ○ recognise that when a calculator is used to work out £5 ÷ 2, the calculator display of 2.5 should be written as £2.50 ○ understand that premature rounding can cause problems when undertaking calculations with more than one step ○ $\frac{2}{3}$ = 0.67 is an example of premature rounding • Use an extended range of calculator functions, including +, –, ×, ÷, x^2, $\sqrt{x}$, memory, $\frac{1}{x}$, x^y, brackets, reciprocals (NB: Trigonometrical functions are only assessed at Higher Tier)

2 Algebra

What students need to learn:

Ref	Content descriptor	Concepts and skills
MA d	Set up, and solve simple equations and inequalities	• Set up linear inequalities in one variable • Solve simple linear inequalities in one variable *Examples:* ○ use a number line to represent an inequality ○ notation $-4 \leq x < 2$ represented on a number line  ○ when x is an integer, give all the solutions of $-2 \leq x < 4$ ○ show $b > 2$ on a number line ○ solve the inequality $2x + 3 > 7$ ○ write down an inequality shown on a number line • Use the correct notation to show inclusive and exclusive inequalities (NB: Linear inequalities in two variables, and represented in diagrammatic form, are assessed at Higher Tier only)
MA g	Solve quadratic equations approximately using a graph	• Generate points and plot graphs of simple quadratic functions, then more general quadratic functions *Examples:* ○ $y = 3x^2 + 4$ ○ $y = x^2 - 2x + 1$ • Use the graph to solve approximate solutions of a quadratic equation from the graph of the corresponding quadratic function *Example:* draw the graph of $y = x^2 + 3x - 2$, and use the graph to find estimations to the solutions to $x^2 + 3x - 2 = 0$ and $x^2 + 3x - 2 = 8$

Ref	Content descriptor	Concepts and skills
MA h	Derive a formula, substitute numbers into a formula and change the subject of a formula	• Derive formulae, including those with cubes, squares and roots ○ write a formula for the cost C, in pounds, of buying m magazines at £3 each and b books at £7 each ○ write a formula for T, the total number of eggs, when you have x small boxes of 6 eggs and y large boxes of 12 eggs • Use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols *Examples:* ○ formulae for the area of a triangle, the area enclosed by a circle ○ wage earned = hours worked $\times$ rate per hour ○ area of a triangle or a parallelogram or volume of a prism ○ find the perimeter of a rectangle given its area A and the length l of one side • Substitute numbers into a formula *Examples:* ○ find the value of $2(x+5)$ when $x=7$ or $x=-9$ ○ if $C=\frac{x(y+1)}{9}$, find the value of C when $x=30$ and $y=-7$ ○ convert temperature between degrees Fahrenheit and degrees Celsius ○ find the value of P in the formula $P=2(l+w)$ when $l=8$ and $w=5$ • Change the subject of a formula *Examples:* ○ find r given that $C=2\pi r$ ○ find x given that $y=mx+c$ • Substitute positive and negative numbers into expressions such as $3x^2+4$ and $2x^3$

Ref	Content descriptor	Concepts and skills
MA l	Use the conventions for coordinates in the plane and plot points in all four quadrants	• Calculate the length of a line segment using Pythagoras' theorem *Example:* given the coordinates of points A and B, calculate the length of AB
MA t	Recognise and use equivalence in numerical, algebraic and graphical representations	• Understand connections between line graphs and associated formulae *Example:* the total cost of using a telephone is a fixed charge plus a charge per unit which can lead to a straight-line graph • Use graphs to solve quadratic equations

3 Geometry

What students need to learn:

Ref	Content descriptor	Concepts and skills
MG b	Understand and use the angle properties of parallel and intersecting lines, triangles and quadrilaterals	• Understand and use the angle properties of parallel lines *Examples:* ○ recognise that two rails of a railway track are parallel ○ give reasons for angle calculations – 'alternate angles are equal' [Z angles are not accepted as a reason] – 'corresponding angles are equal' [F angles are not accepted as a reason] • Mark parallel lines on a diagram • Use the properties of corresponding and alternate angles • Understand and use the angle properties of quadrilaterals *Example:* use the fact that the sum of angles in a quadrilateral is 360° • Give reasons for angle calculations *Examples:* ○ 'the sum of the angles in a triangle is 180°' ○ 'the base angles of an isosceles triangle are equal' • Explain why the angle sum of a quadrilateral is 360° by using two triangles • Understand the proof that the angle sum of a triangle is 180° • Understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices

Ref	Content descriptor	Concepts and skills
MG e	Calculate and use the sums of the interior and exterior angles of polygons	• Calculate and use the sums of the interior angles of polygons • Use geometrical language appropriately and recognise and name pentagons, hexagons, heptagons, octagons and decagons • Use the properties of irregular polygons *Example:* find a missing angle in an irregular polygon • Calculate and use the angles of regular polygons • Use the sum of the interior angles of an n-sided polygon *Examples:* ○ find the size of each interior angle or of each exterior angle or the number of sides of a regular polygon given one of the three pieces of information ○ two angles of a pentagon are each 90°. The other 3 angles are the same size. Find the size of one of these angles • Use the fact that the sum of the exterior angles of any polygon is 360° *Example:* given the size of each exterior angle of a regular polygon, find the number of sides • Use the fact that the sum of the interior and exterior angle of a polygon is 180°
MG f	Solve problems in the context of tiling patterns and tessellation	• Tessellate regular polygons and other 2-D shapes *Example:* tessellate at least 6 kites • Tessellate combinations of polygons *Example:* tessellate tiles • Relate tessellation of shapes to geometric properties • Explain why some shapes tessellate while others do not

Ref	Content descriptor	Concepts and skills
MG m	Understand congruence and similarity, including the relationship between lengths in similar figures	• Know the relationship between linear scale factors of mathematically similar shapes and side lengths *Example:* given the lengths of a pair of corresponding sides and the length of another side AB, work out the length of the side corresponding to AB • Use congruence or similarity to solve problems *Example:* recognise similar shapes • Recognise that all corresponding angles are equal in size when the corresponding lengths of sides are equal in size
MG n	Use Pythagoras' theorem in 2-D	• Understand, recall and use Pythagoras' theorem in 2-D *Examples:* ○ calculate the diagonal of a rectangle given the length and width of the rectangle ○ calculate the length of a playground slide, given the vertical and horizontal dimensions ○ use Pythagoras' Theorem in problems relating to perimeter and length • Calculate the length of a side of a right-angled triangle given the length of the other two sides

Ref	Content descriptor	Concepts and skills
MG r	Find circumferences of circles and areas enclosed by circles	• Find circumferences and areas enclosed by circles • Recall and use the formulae for the circumference of a circle and the area enclosed by a circle. • Use $\pi \approx 3.142$ or the π button on a calculator • Find the perimeters and areas of semicircles and quarter circles *Examples:* ○ find the circumference of a bicycle wheel, given the radius or diameter ○ find the area of a circular table, given the radius or diameter ○ find the perimeter of a semicircular carpet, given the diameter ○ find the number of revolutions of a wheel of diameter 50 cm, travelling 100 metres
MG s	Calculate perimeters and areas of shapes made from triangles and rectangles	• Find the surface area of simple shapes (including prisms) using the formulae for triangles and rectangles *Example:* find the total surface area of a triangular prism • Find the surface area of a cylinder
MG u	Calculate volumes of right prisms and of shapes made from cubes and cuboids	• Calculate volumes of right prisms, including triangular prisms, and shapes made from cubes and cuboids • Recall and use the formula for the volume of a cuboid • Find the volume of a compound solid • Find the volume of a cylinder

Unit 1: Methods 1

Higher

Overview

Content overview

This unit contains:

1 Number

- Four operations
- Multiples and factors
- Indices, roots and squares
- Index laws
- Standard form
- Fractions and decimals
- **Surds**
- Accuracy
- Venn diagrams

2 Algebra

- Manipulating expressions
- Equations
- **Quadratic equations**
- Sequences
- Coordinates
- Linear graphs
- **Gradient**

3 Geometry

- Angles
- Quadrilaterals
- Symmetry
- Congruence
- Circles
- Circle theorems
- Transformations
- Area and perimeter
- **Vectors**

4 Probability

- Probability measures
- Relative probability
- Mutually exclusive outcomes
- Mutually exclusive and independent events
- Set notation and Venn diagrams
- **Tree diagrams**

Assessment overview

- 50% of the qualification
- One written paper
- 1 hour 45 minutes
- 100 marks
- Non-calculator
- Grades A*-D available (E allowed)
- Available in June and November

References

Each topic in this unit contains a specification reference (for example, **MG a** for Methods, Geometry, Statement a), the content descriptor and examples of concepts and skills associated with that content descriptor.

Content that is Higher Tier only is indicated in **bold type**.

The content of Foundation Tier is subsumed in the content for Higher Tier.

1 Number

What students need to learn:

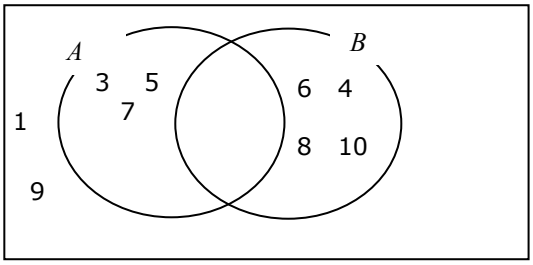
Ref	Content descriptor	Concepts and skills
MN a	Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations	• Use number operations to solve problems *Examples:* ○ break down a complex calculation by using simpler steps ○ use appropriate procedures for addition, subtraction, multiplication and division of integers and decimals, understanding where to position the decimal point • Use inverse operations *Example:* check that if 354 × 78 = 27 612, then 27 612 ÷ 78 = 354 • Use brackets and the hierarchy of operations • Use one calculation to find the answer to another
MN b	Arithmetic of real numbers, **including exact calculation with surds and π**	• Add, subtract, multiply and divide whole numbers, integers, negative numbers, fractions and decimals *Examples:* ○ $\frac{2}{3}-\frac{1}{4}$, $2\frac{1}{3}+1\frac{3}{4}$, $3\frac{1}{3}\times 2\frac{2}{5}$, $1\frac{5}{8}\div\frac{3}{4}$, $\frac{3}{4}\times 36$ ○ 3 × −5, −3 × −5, 10 ÷ −5, −10 ÷ −5 ○ 0.347 + 2.351, 0.62 ÷ 0.4 • Recall multiplication facts up to 10 x 10 and use them to quickly derive the corresponding division factors • Multiply and divide by powers of 10 • Multiply or divide by any number between 0 and 1 *Example:* 3.56 × 0.023, 3.56 ÷ 0.01 • **Use surds and π in exact calculations, without a calculator** • **Write $(3-\sqrt{3})^2$ in the form $a+b\sqrt{3}$ where a and b are integers**

Ref	Content descriptor	Concepts and skills
MN b	Arithmetic of real numbers, **including exact calculation with surds and π** (*continued*)	• **Rationalise a denominator** ***Examples*:** ○ **rationalise** $\frac{1}{\sqrt{3}}$ ○ **simplify** $\frac{1}{3-3\sqrt{2}}$ ○ **rationalise a denominator in a mathematical context**
MN c	Numbers and their representations including powers, roots, indices (integers, **fractional and negative**), and **standard index form**	• Recall integer squares from 2×2 to 15×15 and the corresponding square roots • Recall the cubes of 2, 3, 4, 5 and 10 *Examples:* ○ find the square root of 64 ○ work out the cube root of 64 ○ find the length of a square with a volume of 81 cm^3 ○ explain why the cube of 2 is not 6 • Select a square number, cube number from a list • Order integers, decimals and fractions *Example:* arrange in order, largest first $\frac{1}{3}$, 0.4, 35%, 0.27, $\frac{1}{4}$ • Understand and use positive numbers and negative integers, both as positions and translations on a number line *Example:* 3 –5, -4 + 7, -3 –7 • Order fractions *Examples:* ○ arrange in order, largest first $\frac{1}{3}$, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{4}$ ○ find two fractions between $\frac{1}{4}$ and $\frac{1}{2}$

Ref	Content descriptor	Concepts and skills
MN c	Numbers and their representations including powers, roots, indices (integers, **fractional and negative**), and **standard index form** (*continued*)	• Understand and find equivalent fractions *Example:* write two fractions that are both equivalent to $\frac{2}{3}$ • Write a fraction in its simplest form *Examples:* ○ write $\frac{16}{24}$ as a fraction in its simplest form ○ write 33 out of 55 as a fraction in its simplest form • Convert between mixed numbers and improper fractions • Use index notation for integer powers of 10, cubes and squares • **Recall that $n^0 = 1$ and $n^{-1} = \frac{1}{n}$ for positive integers n, as well as $n^{\frac{1}{2}} = \sqrt{n}$ and $n^{\frac{1}{3}} = \sqrt[3]{n}$ for any positive number n** *Examples:* ○ write down the value of 10^6, 10^0, $\mathbf{9^{-1}}$, 5^{-2}, $25^{\frac{1}{2}}$, $64^{\frac{1}{3}}$, including $\left(\frac{1}{8}\right)^{\frac{1}{3}}$ ○ **find the number of square mm in a square cm** ○ **explain why there are 10^3 or 1000 mm^3 in 1 cm^3** ○ which is larger, 2^3 or 3^2, $64^{\frac{1}{2}}$ **or** $64^{\frac{1}{3}}$?

Ref	Content descriptor	Concepts and skills
MN c	Numbers and their representations including powers, roots, indices (integers, **fractional and negative**), and **standard index form** (*continued*)	• Use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer, **fractional and negative** powers, and where a power is raised to a power *Examples:* ○ $5^7 \div 5^5$, $3^3 \times 3^4$, $(5^2)^3$ ○ **$5^7 \div 5^{-5}$, 3×3^{-4}** ○ $64^{\frac{2}{3}}$, $\left(\frac{2}{3}\right)^{-2}$ • **Use standard form, expressed in conventional notation** • **Be able to write very large and very small numbers, presented in a context, in standard form** ***Examples:*** **$35000 = 3.5 \times 10^4$,** **0.00643×10^{-3}** • **Convert between ordinary and standard form representations, converting to standard form to make sensible estimates for calculations involving multiplication and division** • **Calculate with standard form** ***Examples:*** ○ **$2.4 \times 10^7 \times 5 \times 10^3$** ○ **$(2.4 \times 10^7) \div (5 \times 10^3)$**
MN d	Approximate to specified or appropriate degrees of accuracy including a given power of ten, number of decimal places and significant figures	• Use previous understanding of integers and place value to deal with arbitrarily large positive numbers and round them to a given power of 10 • Round to the nearest integer and to any number of significant figures • Round to a given number of decimal places • Estimate answers to calculations, including use of rounding *Example:* estimate the value of $\frac{12.4 \times 35.7}{61.7}$

Ref	Content descriptor	Concepts and skills
MN e	Use the concepts and vocabulary of factor (divisor), multiple, common factor, common multiple, highest common factor, least common multiple, prime number and prime factor decomposition	• Identify factors, multiples and prime numbers from a list of numbers *Example:* from a list of numbers select a multiple of 7, the factors of 56, and a prime number • Find the prime factor decomposition of positive integers *Example:* write 48 as a product of its prime factors • Find the common factors and common multiples of two or three numbers *Example:* list all the common factors of 24 and 36
MN f	Understand that factors of a number can be derived from its prime factorisation	• Find the prime factor decomposition of positive integers • Understand that the number of factors relate to the type of number (square, prime etc) • Use prime factorisation to find Highest Common Factor (HCF) and Lowest Common Multiple (LCM) *Examples:* ○ find the LCM and HCF of 24 and 60 ○ find the time lapse between synchronous flashes of two lighthouses with two different lengths of time between flashes

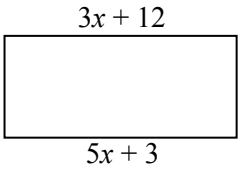
Ref	Content descriptor	Concepts and skills
MN p	Understand and use Venn diagrams to solve problems	• Use Venn diagrams to represent sets • Interpret Venn diagrams • Draw a Venn diagram using given information • Use a Venn diagram to solve a problem • **Understand and be able to find the intersection and union of sets** ***Examples:*** **Understand and use set notation** $\mathcal{E}$ = { integers from 1 to 10}, A = {prime numbers}, B = {even numbers} The Venn diagram shows numbers 1 to 10  $A \cup B) = \{2, 3, 4, 5, 6, 7, 8, 10\}$ $A \cap B = \{2\}$

2 Algebra

What students need to learn:

Ref	Content descriptor	Concepts and skills
MA a	Distinguish the different roles played by letter symbols in algebra, using the correct notation	• Use notation and symbols correctly *Examples:* ○ understand that if you have x small boxes of 6 eggs and y large boxes of 12 eggs, then the total number of eggs is $6x + 12y$ ○ apply algebraic manipulation techniques in an algebraic context ○ interpret algebraic information by factorising, using index laws and substituting numbers into an algebraic expression
MA b	Distinguish in meaning between the words equation, inequality, formula, **identity** and expression	• Write an expression • Select an expression/**identity**/equation/ formula from a list *Example:* $4(x + 1) = 4x + 4$ is an **identity**

Ref	Content descriptor	Concepts and skills
MA c	Manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, taking out common factors, **multiplying two linear expressions, factorising quadratic expressions including the difference of two squares, and simplifying rational expressions**	• Multiply a single term over a bracket *Examples:* expand and simplify: $2(x+4)-(1-x)$ $5x(3x+4)-2x(5-4x)$ • Manipulate algebraic expressions by collecting like terms • Write expressions using squares and cubes • Use instances of index laws, including use of **fractional, zero and negative powers** and power of a power *Examples:* simplify: $x^2 \times x^3$ $x^6 \div x^4$ $\frac{t^6}{t^2} = t^4$ $(x^2)^3 = x^6$ • Substitute positive and negative numbers into expressions such as $3x^2+4$ and $2x^3$ • Factorise algebraic expressions by taking out common factors • **Expand the product of two linear expressions** ***Examples:*** ○ $(x+2)(x-5) = x^2-3x-10$ ○ $(3x+2)(2x-5) = 6x^2-11x-10$ • **Factorise quadratic expressions** ***Examples:*** ○ $6x^2+x-2 = (3x+2)(2x-1)$ ○ **factorise by grouping like terms** $6(x+y)^2-4(x+y)$, $3a-6b+ax-2bx$ • **Factorise quadratic expressions using the difference of two squares** ***Examples:*** **Factorise:** x^2-9 $81p^2-16q^2$

Ref	Content descriptor	Concepts and skills
MA c	Manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, taking out common factors, **multiplying two linear expressions, factorising quadratic expressions including the difference of two squares, and simplifying rational expressions** (*continued*)	• **Simplify rational expressions by adding, subtracting, multiplying and cancelling** ***Examples:*** **simplify completely** ○ $\frac{1}{x}+\frac{3}{2-x}$ ○ $\frac{2(x+1)^2}{(x+1)}$ ○ $\frac{2x^2+3x+1}{x^2+2x+1}$
MA d	Set up, and solve simple equations	• Set up simple equations *Example:* set up an equation based on this rectangle  • Solve simple equations • Solve linear equations, with integer coefficients, in which the unknown appears on either side or on both sides of the equation *Examples:* solve: $11-4x=2$ $4x+7=3$ $2x+3=5x-6$ • Solve linear equations which include brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution *Examples:* $3(2x+1)=8,\ 2(1-x)=6(2+x)$

Ref	Content descriptor	Concepts and skills
MA d	Set up and solve simple equations (*continued*)	• Solve linear equations in one unknown, with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation *Examples:* $\frac{x}{4}+1=5$, $\frac{2x-3}{6}+\frac{x+2}{3}=\frac{5}{2}$, $\frac{17-x}{4}=2-x$
MA g	Solve quadratic equations approximately using a graph, **exactly by factorising, completing the square**	• **Solve simple quadratic equations by factorisation and completing the square** *Examples:* ○ **solve $x^2+5x-6=0, 2x^2-7x+3=0$** ○ **write $x^2+4x-5=0$ in the form $(x+a)^2+b=0$** **Hence solve the equation** • Solve quadratic equations approximately by using a graph
MA i	Generate terms of a sequence using term-to-term and position-to-term definitions	• Recognise odd and even sequences of numbers • Generate simple sequences of numbers, squared integers and sequences derived from diagrams • Describe the term-to-term definition in words for a sequence • Write the nth term of an arithmetic sequence • Generate specific terms in a sequence using the position-to-term and term-to-term definitions

Ref	Content descriptor	Concepts and skills
MA j	Form linear **and quadratic** expressions to describe the nth term of a sequence	• Find the nth term of an arithmetic sequence *Example:* what is the nth term of the arithmetic sequence 2, 7, 12, 17, 22? • Use the nth term of an arithmetic sequence *Example:* relate solutions back to the original sequence • **Find the nth term of a quadratic sequence** ***Example:*** **2 6 12 20 30, …**
MA k	Use algebra to support and construct arguments **and proofs**	• Form an algebraic expression from a given statement and rearrange this **to arrive at a proof** ***Example:*** **show that the sum of consecutive terms of the sequence, 1, 3, 6, 10, … is a square number**
MA l	Use the conventions for coordinates in the plane and plot points in all four quadrants	• Use axes and coordinates to specify points in all four quadrants in 2–D **and 3–D** • Identify points with given coordinates • Identify coordinates of given points (Note: Points may be in the first quadrant or all four quadrants) • Find the coordinates of the midpoint of the line segment AB, given the coordinates of A and B

MA m	Recognise and plot equations that correspond to straight-line graphs in the coordinate plane	• Plot and draw graphs of functions in which y is given explicitly in terms of x, or implicitly *Examples:* ○ $y = 4, x = 3$ ○ $y = 2x + 3, x + y = 7$ ○ $y = \frac{1}{2}x + 1$ ○ $x + y = 6$ • Draw, label and scale axes • Recognise that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane • Recognise that, in a mathematical context, an equation in the form $y = mx + c$ is a straight line • Plot and draw graphs of straight lines with equations of the form $y = mx + c$ *Example:* draw the graph of $y = 2x + 3$
MA n	Use geometric information to complete diagrams on a coordinate grid	• Find the coordinates of points identified by geometrical information in 2-D *Example:* find the coordinates of the fourth vertex of a parallelogram when the coordinates of the other three vertices are given

Ref	Content descriptor	Concepts and skills
MA o	**Use $y = mx + c$**	• **Understand that the form $y = mx + c$ represents a straight line and that m is the gradient of the line and c is the value of the y-intercept** • **Find the gradient of lines given by equations of the form $y = mx + c$ (when values are given for m and c)** ***Example:*** **match equations with simple sketch graphs** • Find the gradient of a straight line from a graph ***Examples:*** ○ **write down the gradient of the graph $y = 3x + 2$** ○ find the gradient of a straight line drawn on a coordinate grid ○ **find the gradient of the line joining (–2, –3) and (3, 5)**
MA t	Recognise and use equivalence in numerical, algebraic and graphical representations	• Understand the connections between graphs and associated formulae and equations *Example:* compare two tariffs A and B graphically to see which is the best value for different amounts of consumption • Use graphs to find approximate solutions to equations

3 Geometry

What students need to learn:

Ref	Content descriptor	Concepts and skills

MG a	Recall and use properties of angles at a point, angles at a point on a straight line (including right angles), perpendicular lines, and vertically opposite angles	• Recall and use properties of angles
		  ○ angles at a point
		  ○ angles at a point on a straight line
		  ○ perpendicular lines
		  ○ vertically opposite angles
		• Find the size of missing angles
		• Use two letter notation for a line and three letter notation for an angle

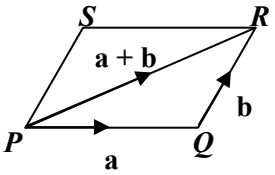
MG b	Understand and use the angle properties of parallel and intersecting lines, triangles and quadrilaterals	• Identify parallel lines on a shape or diagram • Distinguish between scalene, isosceles, equilateral, and right-angled triangles • Understand and use the angle properties of triangles • Understand and use the angle properties of intersecting lines • Give reasons for angle calculations • **Recall and use these basic properties of angles in more complex problems**
MG c	Recall the properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus	• Recall the properties and definitions of special types of quadrilateral • List the properties of each, or identify (name) a given shape • Use symmetry properties of quadrilaterals • Classify quadrilaterals by their geometric properties

Ref	Content descriptor	Concepts and skills
MG d	Recognise reflection and rotation symmetry of 2-D shapes	• Recognise reflection symmetry • Draw lines of reflection • State the line of symmetry as a simple algebraic equation • Recognise rotational symmetry • Identify the order of rotational symmetry

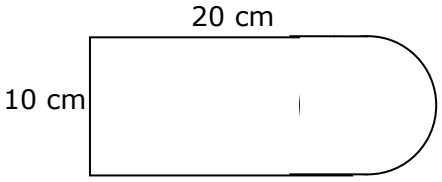
MG g	**Understand, prove and use circle theorems, intersecting chords**	• **Understand and use the fact that the tangent at any point on a circle is perpendicular to the radius at that point**
		• **Understand and use the fact that tangents from an external point are equal in length**
		• **Find missing angles on diagrams**
		• **Give reasons for angle calculations involving the use of tangent theorems**
		• **Prove and use:**
		  ○ **the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference**
		  ○ **the angle in a semicircle is a right angle**
		  ○ **angles in the same segment are equal**
		  ○ **opposite angles of a cyclic quadrilateral sum to 180°**
		  ○ **alternate segment theorem**
		  ○ **the perpendicular from the centre of a circle to a chord bisect the chord**
		• **Know and use the fact that for two chords AB and CD of a circle, intersecting at the point X;** $AX \times XB = CX \times XD$

Ref	Content descriptor	Concepts and skills
MG j	Describe and transform 2-D shapes using single or combined rotations, reflections, translations, or enlargements by a positive scale factor **then use positive fractional and negative scale factors** and distinguish properties that are preserved under particular transformations	• Describe and transform 2-D shapes using single rotations • Understand that rotations are specified by a centre and an (anticlockwise) angle • Find the centre of rotation • Rotate a shape about the origin, or any other point *Example:* rotate a triangle by 90° (a quarter of a whole turn) clockwise about the point (1, 2) to give another triangle • Describe and transform 2-D shapes using single reflections • Understand that reflections are specified by a mirror line *Example:* reflect a triangle in the x-axis (or the y-axis or $y = \pm x$ • Identify the equation of a line of symmetry *Example:* $x = a, y = b, \ y = \pm x$ • Describe and transform 2-D shapes using single translations • Describe and transform 2-D shapes using enlargements by a positive and/or **a negative or fractional scale factor** • Understand that an enlargement is specified by a centre and a scale factor *Examples:* ○ enlarge a given shape by scale factor 3 (**or** $2\frac{1}{2}$), centre (0, 0) ○ **enlarge a shape scale factor** $-1\frac{1}{2}$, **centre (0, 0)** ○ find the centre of enlargement ○ scale a shape on a grid (centre not specified)

Ref	Content descriptor	Concepts and skills
MG j	Describe and transform 2-D shapes using single or combined rotations, reflections, translations, or enlargements by a positive scale factor **then use positive fractional and negative scale factors** and distinguish properties that are preserved under particular transformations (*continued*)	• Enlarge a shape using a centre other than (0, 0) ***Example:*** **enlarge a shape centre (2, 3), with scale factor –0.5** • Describe and transform 2-D shapes using combined rotations, reflections, translations, or enlargements *Example:* find the single transformation that describes the result of a combination of the rotation of a triangle by 180°, centre (0, 0) followed by a reflection in the x-axis • Use congruence to show that translations, rotations and reflections preserve length and angle, so that any figure is congruent to its image under any of these transformations • Distinguish properties that are preserved under particular transformations • Recognise that enlargements preserve angle but not length • Identify the scale factor of an enlargement of a shape as the ratio of the lengths of two corresponding sides • Describe a transformation
MG k	Use 2-D vectors to describe translations	• Understand that translations are specified by a distance and direction (using a vector) • Describe translations fully using a column vector • Translate a given shape by the vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$

Ref	Content descriptor	Concepts and skills
MG I	**Use vectors to solve simple geometric problems and construct geometric arguments**	• **Understand and use vector notation** **(NB: the notation $\overrightarrow{AB}$ or a in bold type will be used)** • **Find equal and parallel vectors** • **Calculate, and represent graphically, the sum of two vectors, the difference of two vectors and a scalar multiple of a vector** • **Understand simple applications to geometry in two dimensions** • **Given a directed line segment representing a vector $\mathbf{p}$, draw a directed line segment to represent $k\mathbf{p}$, where k is a scalar** • **Find the resultant of two vectors** • **Use the triangle law of vector addition** • **Understand that the resultant of the vectors $\mathbf{a}$ and $\mathbf{b}$ is the vector $\mathbf{a} + \mathbf{b}$ along the diagonal PR of the parallelogram $PQRS$**  • **Understand and use the commutative and associative properties of vector addition** • **Solve simple geometric problems in 2-D using vector methods** • **Join the midpoints of the sides of any quadrilateral to form a parallelogram** • **Prove that three or more points are collinear** ***Example:*** $k(\mathbf{b} - \mathbf{a}) = (\mathbf{c} - \mathbf{a})$

Ref	Content descriptor	Concepts and skills
MG m	Understand congruence and similarity, including the relationship between lengths, **areas and volumes** in similar figures	• Identify similar shapes • Identify congruent shapes • Understand the relationships between lengths, **areas and volumes** in similar figures *Example:* $\frac{A_1}{A_2}=\left(\frac{L_1}{L_2}\right)^2$; $\frac{V_1}{V_2}=\left(\frac{L_1}{L_2}\right)^3$ • **Identify similar solids** • **Understand and use SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments and to verify standard straight-edge and pair of compasses constructions** • Understand similarity of triangles and of other plane figures, and use this to make geometric inferences • Recognise that all corresponding angles in similar figures are equal in size when the lengths of sides are not • Use scale factors to find the length of a missing side in each of two similar triangles, given the lengths of a pair of corresponding sides • **Understand a formal geometric proof of similarity of two given triangles**
MG q	Distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment	• Recall the definition of a circle and identify (name) and draw the parts of a circle • Understand also related terms such as semicircle and quarter circle *Examples:* ○ semicircle and quarter circle ○ match diagrams to the mathematical names of the parts of the circle • Draw a circle given the radius or diameter

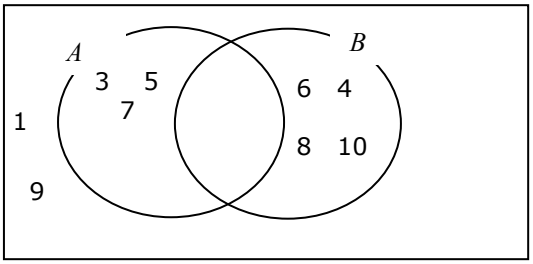
Ref	Content descriptor	Concepts and skills
MG s	Calculate perimeters and areas of shapes made from triangles and rectangles **and other shapes**	• Measure sides of a rectangle to find perimeter/area • Find the perimeter of simple shapes, including rectangles and triangles • Calculate perimeters of shapes made from triangles and rectangles • Calculate areas of shapes made from triangles and rectangles • Recall and use the formulae for the area of a triangle, a rectangle and a parallelogram • Find the area of a trapezium • Find the area of a compound shape, made from triangles, rectangles **and other shapes** *Example:*  find the area and the perimeter of this shape. Give your answer in terms of π • Find the formula for the area of a parallelogram, derived from triangles and rectangles • Split a compound shape into constituent parts in order to find its area • Calculate the perimeter and area of compound shapes made from triangles, rectangles **and other shapes**

4 Probability

What students need to learn:

Ref	Content descriptor	Concepts and skills
MP a	Understand and use the vocabulary of probability and the probability scale	• Use the vocabulary of probability appropriately • Write probabilities using fractions, percentages or decimals
MP b	Understand and use theoretical models for probabilities including the model of equally likely outcomes	• Use theoretical models of probability to include outcomes using dice, spinners, coins, etc • Find the probability of successive events, such as several throws of a single dice • Find an estimate for the number of times an event will occur, given the probability and the number of trials
MP c	Understand and use estimates of probability from relative frequency	• Understand and use estimates of measures of probability • Calculate the probability of successive events, such as several throws of a single dice • Use relative frequency to estimate the number of times an event occurs, given the number of trials
MP d	Use of sample spaces for situations where outcomes are single events and for situations where outcomes are two successive events	• List all outcomes for single events, and for two successive events, in a systematic way • Use and draw sample space diagrams *Example:* given a sample space diagram for throwing two fair dice, work out the probability of getting any double or a total of 7

Ref	Content descriptor	Concepts and skills
MP e	Identify different mutually exclusive and exhaustive outcomes and know that the sum of the probabilities of all these outcomes is 1	• Identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1 • Add simple probabilities • Use $1-p$ 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
MP f	Understand and use set notation to describe events and compound events	• Understand that: ○ $\mathrm{P}(A)$ represents the probability of an event A happening ○ $\mathrm{P}(A')$ represents the probability of event A **not** happening ○ $\mathrm{P}(A') = 1 - \mathrm{P}(A)$ ○ **If A and B are mutually exclusive, then $\mathrm{P}(A \cup B)$ represents the probability of either A or B happening** ○ $\mathbf{P}(A \cup B) = \mathbf{P}(A) + \mathbf{P}(B)$ ○ **If A and B are independent, then $\mathrm{P}(A \cap B)$ represents the probability that both A and B happen and $\mathbf{P}(A \cap B) = \mathbf{P}(A) \times \mathbf{P}(B)$**

Ref	Content descriptor	Concepts and skills
MP g	Use Venn diagrams to represent the number of possibilities and hence find probabilities	• Use Venn diagrams to find probabilities *Example*: A = {prime numbers}, B = {even numbers} The Venn Diagram shows numbers 1 to 10 ξ = {1, 2, 3,……10}  $\mathrm{P}(A) = \frac{4}{10}$ $\mathrm{P}(B) = \frac{5}{10}$ $\mathrm{P}(A \cup B) = \frac{8}{10}$ $\mathrm{P}(A \cap B) = \frac{1}{10}$
MP h	**Use tree diagrams to represent outcomes of compound events, recognising when events are independent or dependent**	• **Draw a probability tree diagram based on given information** • **Use of a tree diagram to show conditional probability**
MP i	**Know when to add or multiply probabilities: if A and B are mutually exclusive, then the probability of A or B occurring is $\mathrm{P}(A) + \mathrm{P}(B)$; if A and B are independent events, the probability of A and B occurring is $\mathrm{P}(A) \times \mathrm{P}(B)$**	• **Understand conditional probabilities** • **Understand selection with or without replacement**
MP j	Compare experimental data and theoretical probabilities, and make informal inferences about the validity of the model giving rise to the theoretical probabilities	• Compare experimental data and theoretical probabilities

Ref	Content descriptor	Concepts and skills
MP k	Understand that when a statistical experiment or survey is repeated there will usually be different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics	• Compare relative frequencies from samples of different sizes

Unit 2: Methods 2

Higher

Overview

Content overview

This unit contains:

1 Number

- Four operations
- Decimals
- Percentages and **repeated proportional change**
- Direct **and inverse proportion**
- Ratio
- **Using π and surds in exact calculations**
- Using calculators

2 Algebra

- **Simultaneous equations, including where one equation is quadratic**
- **Quadratic equations**
- Formulae
- Inequalities
- Coordinates
- Straight-line graphs
- Gradients of lines
- **Graphs of functions**
- **Graphs of direct and indirect proportion**
- **Quadratic functions**
- **Graphs of loci**
- **Transformation of functions**

3 Geometry

- Angles and lines
- Polygons
- Tessellations
- Congruency and similarity
- **Proof using congruency**
- Pythagoras' theorem
- **Trigonometry**
- Circles
- Perimeter, area and volume of compound shapes
- Mensuration

Assessment overview

- 50% of the qualification
- One written paper
- 1 hour 45 minutes
- 100 marks
- Calculator allowed
- Grades A*-D available (E allowed)
- Available June and November

References

Each topic in this unit contains a specification reference (for example, **MP a** for Methods, Probability, Statement a), the content descriptor and examples of concepts and skills associated with that content descriptor.

Content that is Higher Tier only is indicated in **bold type**.

The content of Foundation Tier is subsumed in the content for Higher Tier.

The content of Unit 2 subsumes the content of Unit 1. However, the content of Unit 1 will not be the direct focus of assessment.

1 Number

What students need to learn:

Ref	Content descriptor	Concepts and skills
MN a	Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations	• 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) • Find reciprocals *Example:* find the reciprocal of 0.2 • Use inverse operations *Example:* check that if 354 × 78 = 27 612, then 27 612 ÷ 78 = 354 • **Understand that the inverse operation of raising a positive number to a power n is raising the result of this operation to the power $\frac{1}{n}$** *Example:* if $x^3 = 8$ then $x = 8^{\frac{1}{3}}$ • Understand and use unit fractions as multiplicative inverses *Example:* understand that multiplication by $\frac{1}{5}$ is the same as division by 5, or multiplication by $\frac{6}{7}$ is the same as multiplication by 6 followed by division by 7 (or vice versa) • Solve word problems about ratio and proportion, including using formal strategies and the unitary method of solution

Ref	Content descriptor	Concepts and skills
MN b	Arithmetic of real numbers, including **exact calculation with surds and π**	• Add, subtract, multiply and divide whole numbers, negative numbers, integers, fractions and decimals using a calculator • Solve a problem involving division by a decimal • Recall the fraction-to-decimal conversion of familiar fractions • **Give an answer to a question involving the area of a circle as 25π** • **Give an answer, when using Pythagoras' theorem as $\sqrt{13}$**
MN g	Understand that 'percentage' means 'number of parts per 100' and use this to compare proportions	• Convert between fractions, decimals and percentages *Examples:* ○ 20% means 20 parts per hundred or $\frac{20}{100}$ or $\frac{1}{5}$ ○ which is the greater fraction; 1.5 out of 8 or 2 out of 10? • Compare proportions using percentages
MN h	Use multipliers for percentage change; **work with repeated percentage change; solve reverse percentage problems**	• Use percentages to solve problems • **Understand compound interest** • Find amount after a percentage increase or decrease • **Calculate an original amount when given the transformed amount after a percentage change** • **Understand repeated proportional change** ***Examples:*** ○ **find heights of bounces for a bouncing ball reaching 70% of its previous height with each bounce** ○ **find the total amount if £200 is invested at 5% compound interest for 3 years** ○ **find the total amount if £5000 is invested at 2.8% for 10 years** ○ **explore exponential growth and decay using a multiplier**

Ref	Content descriptor	Concepts and skills
MN h	Use multipliers for percentage change; **work with repeated percentage change; solve reverse percentage problems** (*continued*)	• **Reverse percentage calculations** ***Example:*** **Smith got 60% of the votes in an election. He got 1560 votes. How many votes were cast altogether?** • Use a multiplier to increase or decrease by a percentage in any scenario where percentages are used
MN i	Interpret fractions, decimals and percentages as operators	• Find percentages of quantities *Example:* calculate 26 as a percentage of 150 • Calculate a given fraction of a given quantity • Express a given number as a fraction of another *Examples:* ○ write 33 out of 55 as a fraction in its simplest form ○ write 40 cm as a fraction of 2 m ○ 15% of Y means $\frac{15}{100} \times Y$ or $0.15 \times Y$ • Express a given number as a percentage of another *Example:* calculate 26 as a percentage of 150 • Understand the multiplicative nature of percentages as operators *Examples:* ○ a multiplier of 1.05 corresponds to an increase of 5% ○ 30% increase on £150 gives a total calculated as £(1.3×150), while 20% discount gives a total calculated as £(0.8×150) • **Represent repeated proportional change using a multiplier raised to a power** ***Example:*** **two successive increases of 50% correspond to a multiplication of 2.25**

Ref	Content descriptor	Concepts and skills
MN j	Understand and use the relationship between fractions and decimal representations including recurring and terminating decimals	• Recall the fraction-to-decimal conversion of familiar simple fractions *Examples:* $\frac{1}{2}, \frac{1}{4}, \frac{1}{5}, \frac{1}{10}, \frac{1}{100}, \frac{1}{3}, \frac{2}{3}, \frac{1}{8}$ • Convert between fractions and decimals using a calculator *Examples:* ○ write 0.35 as a fraction in its simplest form ○ write 1.25 as a mixed number using a calculator • Distinguish between fractions with denominators that have prime factors of 2 and 5 only (which are represented by terminating decimals), and other fractions (which are represented by recurring decimals) *Examples:* ○ $\frac{1}{7}$ = 0.142857142857… ○ change $0.3\dot{7}$ into a fraction ○ know that $\frac{1}{3} = 0.\dot{3}$ and $0.3\dot{7}$ = 0.37777… ○ which of the following can be written as terminating fractions, $\frac{3}{4}, \frac{1}{6}, \frac{7}{10}, \frac{3}{15}$? ○ explain why $\frac{1}{3}$ is not 0.3 • Convert between recurring decimals and fractions • Understand a recurring decimal to fraction proof ***Examples:*** ○ **convert $0.3\dot{7}$, $2.3\dot{4}$ to fractions** ○ **show 0.142857142857… = $\frac{1}{7}$**

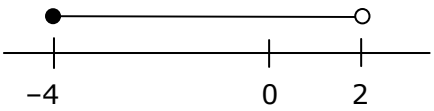
Ref	Content descriptor	Concepts and skills
MN k	Understand and use the relationship between ratio and fractions	• Represent a situation using fractions or ratios *Examples:* ○ write a ratio in the form $1:n$ or $n:1$ ○ understand that the ratio 2:3 is $\frac{2}{5}:\frac{3}{5}$ ○ write 20:12 as a ratio in its simplest form • Move between fractions and ratios in a problem
MN l	Find proportional change and **repeated proportional change,** using fractions, decimals and percentages	• Use percentages, fractions and decimals to solve problems • Calculate an original amount when given the transformed amount after a percentage change • **Use repeated proportional change using fractions, decimals or percentages** • Use a multiplier to increase or decrease by a percentage, fraction or decimal in any scenario where these are used • **Represent repeated proportional change using a multiplier raised to a power** ***Example:*** **when £P is invested at r% for n years** **the amount P is multiplied by** $\left(1+\frac{r}{100}\right)^n$

Ref	Content descriptor	Concepts and skills
MN m	Understand and use direct **and inverse** proportion	• Calculate an unknown quantity from quantities that vary in direct **or inverse** proportion • Solve word problems about ratio and proportion, including using informal strategies and the unitary method of solution ***Examples:*** ○ **if y varies inversely as x, and $y = 4$ when $x = 0.5$** ○ **Find the value of y when $x = 10$** ○ find the mass of 35 cm of pipe given the mass of 25 cm of the same pipe ○ **use the inverse square law to model the volume of sound received from a loudspeaker** ○ find the cost of 5 pens given the cost of 7 pens ○ **interpret a graph to help decide on a rule that connects two variables using direct and inverse proportion** ○ **solve direct proportion problems** ○ **solve proportion problems that involve either the square law or the inverse square law** • Represent a situation using direct or **inverse** proportion ***Example:*** **the mass of a solid iron ball is proportional to the cube of its radius**
MN n	Divide a quantity in a given ratio	• Divide a quantity in a given ratio *Examples:* ○ share £15 in the ratio 3:2 ○ share 20 metres of ribbon in the ratio 11:6:3 • Solve a ratio problem in a context *Example:* change a recipe for 6 people to one for 8 people

Ref	Content descriptor	Concepts and skills
MN o	Use calculators effectively and efficiently, including **trigonometrical** functions	• Use a calculator effectively and efficiently • Know how to enter complex calculations and use function keys for squares, powers and reciprocals • Understand, and interpret, the calculator display, particularly when the display has been rounded by the calculator • Use an extended range of calculator functions, including $+$, $-$, $\times$, $\div$, x^2, $\sqrt{x}$, memory, x^y, $x^{1/y}$, brackets, **trigonometric** and reciprocal functions • **Use standard form display and know how to enter numbers in standard form** • **Use calculators for reverse percentage calculations by doing an appropriate division**

2 Algebra

What students need to learn:

Ref	Content descriptor	Concepts and skills
MA d	Set up, and solve simple equations and inequalities	• Solve simple linear inequalities in one variable **or two variables** *Examples:* ○ notation $-4 \leq x < 2$ represented on a number line  ○ when x is an integer, give all the solutions of $-2 \leq x < 4$ ○ show $b > 2$ on a number line ○ solve the inequality $2x + 3 > 7$ ○ Write down an inequality shown on a number line ○ **shade the region defined by $y > 3$, $y \leq 7 - x$, $x > 0$** ○ **mark with a cross, points with integer coordinates that are in the region defined by $x + y \leq 4, x \geq 0$ and $y \geq 0$** • **Use the correct notation to show inclusive and exclusive inequalities**
MA e	**Set up and use equations that describe direct and inverse proportion**	• **Set up and use equations to solve problems involving direct proportion or inverse proportion** ***Example:*** **when a ball is thrown up with an initial velocity v, the height reached is proportional to the square of the velocity.** **When $v = 10$, $h = 5$** **Express v in terms of h** • **Relate algebraic solutions to graphical representation of the equations** *Examples:* $y \propto x, y \propto x^2, y \propto x^3$ $y \propto \sqrt{x}, y \propto \frac{1}{x}, y \propto \frac{1}{x^2}$

Ref	Content descriptor	Concepts and skills
MA f	**Set up, and solve simultaneous equations in two unknowns where one of the equations might include squared terms in one or both unknowns**	• Find the exact solutions of two simultaneous equations in two unknowns • Use elimination or substitution to solve simultaneous equations *Examples:* Solve for x and y: ○ $x + y = 8$ **and** $2x + y = 1$ ○ $x - y = 3$ **and** $3x - 2y = 8$ ○ $3x + y = 8$ **and** $y = 2x - 2$ • Interpret a pair of simultaneous equations as a pair of straight lines and their common solution as the point of intersection ***Example:*** **draw graphs and solve for x and y** $y = 3x - 4$, $y = 4 - x$ • Set up and solve a pair of simultaneous equations in two variables ***Example:*** **Find the cost of a pen and the cost of a pencil given the following:** **2 pens and 3 pencils cost 35p** **3 pens and 2 pencils cost 40p** • **Solve exactly two simultaneous equations in two unknowns, one of which is linear in each unknown, and the other is linear in one unknown and quadratic in the other, or where the second equation is of the form $x^2 + y^2 = r^2$** ***Examples:*** ○ **solve the following for x and y** $y = 11x - 2$ $y = 5x^2$ ○ **solve** $x + y = 1$ $x^2 + y^2 = 25$

Ref	Content descriptor	Concepts and skills
MA f	**Set up, and solve simultaneous equations in two unknowns where one of the equations might include squared terms in one or both unknowns** (*continued*)	• **Find approximate solutions to simultaneous equations formed from one linear function and one quadratic function using a graphical approach** ***Examples:*** ○ **draw the graphs of $y = 2x + 3$ and $x^2 + y^2 = 15$ and use these to find an approximate solution to the pair of simultaneous equations $y = 2x + 3$ and $x^2 + y^2 = 15$, giving the solutions to one decimal place** ○ **use $y = 2x^2 - 3$ and $y = 3 - x$ to solve the quadratic equation $2x^2 + x - 6 = 0$** • **Select and apply algebraic and graphical techniques to solve simultaneous equations where one is linear and one quadratic** ***Example:*** **solve graphically the simultaneous equations** **$4x - 3y = 24$ and $x^2 + y^2 = 25$**

Ref	Content descriptor	Concepts and skills
MA g	Solve quadratic equations approximately using a graph, **exactly using the formula**	• **Solve simple quadratic equations by using the quadratic formula** ***Example:*** **solve $3x^2 + 2x - 1 = 0$, giving your answer to 2 decimal places** • Generate points and plot graphs of simple quadratic functions, then more general quadratic functions ***Examples:*** ○ **plot the graphs of $y = x^2$, $y = 3x^2 + 4$, $y = x^2 - 2x + 1$** ○ plot the graph of $y = x^2 + 1$ • Find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function ***Examples:*** ○ **draw the graph of $y = 2x^2 - 3$ and find the values of x when $2x^2 - 3 = 0$** ○ draw the graph of $y = x^2 + 3x - 2$ and use the graph to find the solutions to $x^2 + 3x - 2 = 0$ • Select and use the correct mathematical techniques to draw quadratic graphs

Ref	Content descriptor	Concepts and skills
MA h	Derive a formula, substitute numbers into a formula and change the subject of a formula	• Derive a formula • Use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols • Substitute positive and negative numbers into a formula and expression *Examples:* ○ write a formula for T, the total number of eggs, when you have x small boxes of 6 eggs and y large boxes of 12 eggs ○ substitute a = –3.5, substitute $b = \frac{4}{5}$ into $5b^2 - 4a$ • Change the subject of a formula **including cases where the subject is on both sides of the original formula, or where a power of the subject appears** ***Examples:*** ○ $v^2 = u^2 + 2as$ **Make *u* the subject** ○ $y = \frac{x+3}{x-1}$ **Make x the subject**
MA k	Use algebra to support and construct arguments **and proofs**	• Form an algebraic expression from a given statement **and rearrange this to arrive at a proof** ***Example:*** **prove that the sum of any four consecutive integers is even but is never a multiple of 4**
MA l	Use the conventions for coordinates in the plane and plot points in all four quadrants	• Given the coordinates of points A and B, in 2-D calculate the length of AB

Ref	Content descriptor	Concepts and skills
MA o	**Use $y = mx + c$ and understand the relationship between gradients of parallel and perpendicular lines**	• **Use the method of finding a gradient to see how one variable increases in relation to another** • **Analyse problems and use gradients to interpret how one variable changes in relation to another** • **Explore the gradients of parallel lines and lines perpendicular to each other** • **Write down the equation of a line parallel or perpendicular to a given line** ***Example:*** **find an equation of the line perpendicular to $y = 4x - 7$ which passes through (8, 6)** • **Select and use the fact that when $y = mx + c$ is the equation of a straight line then the gradient of a line parallel to it will have a gradient of m and a line perpendicular to this line will have a gradient of $-\frac{1}{m}$** ***Example:*** **find the gradient of the line perpendicular to $2x - 3y = 12$** • **Interpret and analyse a straight-line graph and generate equations of lines parallel and perpendicular to the given line**

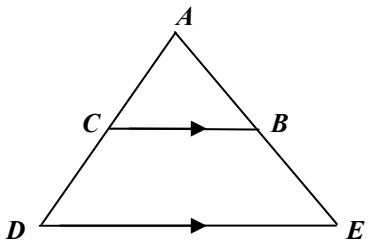
Ref	Content descriptor	Concepts and skills
MA p	Draw, sketch, recognise graphs of linear, quadratic simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$, the function $y = k^x$ for integer values of x and simple positive values of k, the trigonometric functions $y = \sin x$, $y = \cos x$ and $y = \tan x$	• Plot graphs of simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$, the exponential function $y = k^x$ for integer values of x and simple positive values of k, the circular functions $y = \sin x$, $y = \cos x$ and $y = \tan x$ within the range -360° to +360° ***Examples:*** plot the graphs of the following: ○ $y = x^3 + 2x^2$ ○ $y = 2\sin(3x + 90°)$ ○ $y = 5 \times (\frac{1}{2})^x$ • Recognise the characteristic shapes of all these functions • Draw and plot a range of mathematical functions • Interpret and analyse a range of mathematical functions and be able to draw them, recognising that they were of the correct shape
MA q	Understand and use the Cartesian equation of a circle centred at the origin and link to the trigonometric functions	• Know that $x^2 + y^2 = r^2$ represents the equation of a circle, centre (0,0), radius r • Be able to draw the graph of a circle of equation $x^2 + y^2 = r^2$ ***Example:*** draw the graph of $x^2 + y^2 = 9$ • Understand that the graphs of the trigonometric functions can be generated from movement around a circle, centre (0,0), radius 1
MA r	Construct the graphs of simple loci	• Construct the graphs of simple loci including the circle $x^2 + y^2 = r^2$ for a circle of radius r centred at the origin of coordinates ***Example:*** the line $y = x$ is the locus of all points equidistant from (1, 0) and (0, 1)

Ref	Content descriptor	Concepts and skills
MA r	**Construct the graphs of simple loci** **(*continued*)**	• **Find graphically the intersection points of a given straight line with this circle and know that this corresponds to solving the simultaneous equations representing the line and the circle** • **Select and apply construction techniques and understanding of loci to draw graphs based on circles and/or perpendicular lines** ***Example:*** **the line $x = 5$ is the perpendicular bisector of the line segment joining (0, 0) to (10, 0)**
MA s	**Sketch simple transformations of a given function**	• **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 $f(x)$** • **Select, apply and sketch the transformations of reflection, rotation, enlargement and translation of functions expressed algebraically** ***Example:*** **$y = 2f(\frac{x}{2})$ is an enlargement with scale factor 2 and centre O** • **Interpret and analyse transformations of functions and write the functions algebraically**
MA t	**Recognise and use equivalence in numerical, algebraic and graphical representations**	• Understand the link between conversion graphs and associated formulae • **Recognise that simultaneous equations can be solved algebraically or graphically** • **Use linear and quadratic and other graphs to find approximate solutions to equations** ***Example:*** **use the graph of $y = 2^x$ to find an approximate solution to the equation $2^x = 12$**

3 Geometry

What students need to learn:

Ref	Content descriptor	Concepts and skills
MG b	Understand and use the angle properties of parallel and intersecting lines, triangles and quadrilaterals	• Understand and use the angle properties of parallel lines • Mark parallel lines on a diagram • Find missing angles using properties of corresponding and alternate angles • Understand and use the angle properties of quadrilaterals *Example:* investigate angles in a quadrilateral by using two triangles • Give reasons for angle calculations • Explain why the angle sum of a quadrilateral is 360° • Understand the proof that the angle sum of a triangle is 180° • Understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices
MG e	Calculate and use the sums of the interior and exterior angles of polygons	• Calculate and use the sums of the interior angles of polygons • Recognise and name pentagons, hexagons, heptagons, octagons and decagons • Use the angle properties of irregular polygons • Calculate and use the angles of regular polygons • Use the sum of the interior angles of an n-sided polygon • Use the fact that the sum of the exterior angles of any polygon is 360° • Use the fact that the sum of the interior and exterior angle is 180° • Find the size of each interior angle, or the size of each exterior angle, or the number of sides of a regular polygon, given one of the three pieces of information

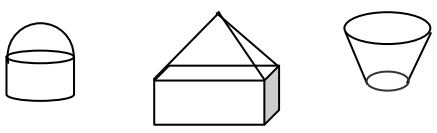
Ref	Content descriptor	Concepts and skills
MG f	Solve problems in the context of tiling patterns and tessellation	• Tessellate regular polygons and other 2-D shapes *Example:* tessellate at least six kites • Tessellate combinations of polygons and relate to a problem *Example:* tessellate tiles • Explain why some shapes tessellate whilst others do not • Understand how properties of shapes connect to tessellations
MG h	**Understand and use the midpoint and the intercept theorems**	• **Know that when CB and DE are parallel, $\frac{CD}{DA}=\frac{BE}{EA}$, $\frac{AC}{CD}=\frac{AB}{BE}$**  **Know that the line drawn through the midpoint of one side of a triangle parallel to a second side, bisects the third side**

Ref	Content descriptor	Concepts and skills
MG i	**Understand and construct geometrical proofs using formal arguments, including proving the congruence, or non congruence of two triangles in all possible cases**	• **Understand and use SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments** • **Verify standard ruler and pair of compasses constructions**
MG m	Understand congruence and similarity, including the relationship between lengths, **areas and volumes** in similar figures	• **Understand the effect of enlargement on perimeter and area of 2-D shapes and perimeter, area and volume of 3-D solids** • **Understand that enlargement does not have the same effect on area and volume** • **Use simple examples of the relationship between enlargement and areas and volumes of simple shapes and solids** • **Use the effect of enlargement on areas and volumes of shapes and solids** • **Know the relationships between linear, area and volume scale factors of mathematically similar shapes and solids** ***Example:*** **$SF_A = SF_L^2$; $SF_V = SF_L^3$**
MG n	**Use Pythagoras' theorem in 2-D and 3-D**	• Understand, recall and use Pythagoras' theorem in 2-D, **then in 3-D problems** • **Calculate the height (altitude) of an isosceles triangle given the lengths of all three sides** • **Understand the language of planes, and recognise the diagonals of a cuboid** • Calculate the length of a diagonal of a rectangle given the length and width of the rectangle ***Example:*** **calculate the length of the diagonal of a cuboid with edges of length 2 cm, 3 cm and 4 cm**

Ref	Content descriptor	Concepts and skills
MG o	**Use the trigonometrical ratios to solve 2-D and 3-D problems**	• **Use the trigonometric ratios to solve 2-D and 3-D problems** • **Understand, recall and use trigonometric relationships in right-angled triangles, and use these to solve problems in 2-D and 3-D configurations** • **Calculate the length of a size of the side or angle of a right-angled triangle given the length of one side and an angle, or the lengths of two sides** ***Examples:*** **calculate the gradient of slope of a staircase given the rise and depth of each stair** • **Find the angle between a line and a plane (but not the angle between two planes or between two skew lines)** ***Example:*** **a cuboid has edges of length 2 cm, 3 cm and 4 cm. Find the angles between the diagonal of the cuboid and each of the faces.** • **Calculate the angle between the diagonal of a cuboid and the base of the cuboid or the angle between the sloping edge of a pyramid and the base of the pyramid** • **Find angles of elevation and angles of depression** ***Example:*** **calculate the height of a tower given the angle of elevation of the top of the tower from the ground and the horizontal distance from the foot of the tower**

Ref	Content descriptor	Concepts and skills
MG p	**Use the sine and cosine rule to solve problems in 2-D and 3-D**	• **Use the sine and cosine rules to solve 2-D and 3-D problems** ***Examples:*** ○ **find the three angles of a scalene triangle given the length of each side** ○ **find the bearing and distance from the original location having travelled 1.3 km on a bearing of 054° and then 2.5 km on a bearing of 125°** • **Find the three angles of a scalene triangle given the length of each side** • **Find the length of a side of a scalene triangle given, the lengths of two sides and the size of the included angle, or the size of two angles and the length of one side**

Ref	Content descriptor	Concepts and skills
MG r	Find circumferences of circles and areas enclosed by circles	• Find circumferences of circles and areas enclosed by circles • Recall and use the formulae for the circumference of a circle and the area enclosed by a circle *Examples:* ○ find the circumference of a bicycle wheel, given its radius or diameter ○ find the area of a circular table, given the radius or diameter ○ find the number of revolutions of a wheel of diameter 50 cm can travel in a 100 m • Use $\pi \approx 3.142$ or the π button on a calculator • Find the perimeters and areas of semi circles and quarter circles *Examples:* ○ find the distance moved by the tip of the hand of a clock, of radius 5 cm, in 15 minutes ○ find the perimeter of a semicircular carpet, given the diameter • **Calculate the lengths of arcs and the areas of sectors of circles** ***Examples:*** ○ **find the area of a biscuit, in the shape of a sector of radius 9 cm and with an angle of 20°** ○ work out areas and perimeters of segments • **Give answers in terms of π** • Find the surface area of a cylinder
MG s	Calculate perimeters and areas of shapes made from triangles and rectangles **and other shapes**	• Find the surface area of simple shapes (prisms) using the formulae for triangles and rectangles, **and other shapes**

Ref	Content descriptor	Concepts and skills
MG t	**Calculate the area of a triangle using $\frac{1}{2}ab\sin C$**	• **Calculate the area of a triangle, given the length of two sides and the included angle** ***Example:*** **calculate the area of a triangular field given the lengths of two sides and the included angle**
MG u	Calculate volumes of right prisms and of shapes made from cubes and cuboids	• Calculate volumes of right prisms, including the triangular prism, and shapes made from cubes and cuboids • Find the volume of a compound solid constructed from cubes and cuboids • Recall and use the formula for the volume of a cuboid *Examples:* ○ find the height of a cuboid that has a volume of 40 cm^3, length 5 cm and width 2 cm ○ find the greatest number of small boxes that can fit in a larger box, given all the dimensions. How does the orientation of the larger box affect this greatest number? • Find the volume of a cylinder *Example:* a cup holds 30 m/ of liquid. 20 cupfuls are poured into a cylindrical container of base radius 8 cm. Work out the height of the liquid in the container
MG v	**Solve mensuration problems involving more complex shapes and solids**	• **Solve problems involving more complex shapes and solids, including segments of circles and frustums of cones** • **Find the surface area and volumes of compound solids constructed from; cubes, cuboids, cones, pyramids, spheres, hemispheres, cylinder eg**  • **Find the area of a segment of a circle given the radius and length of the chord**

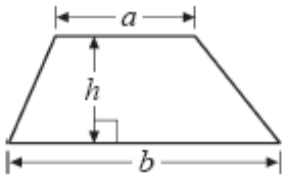
Formulae sheets

Foundation Tier

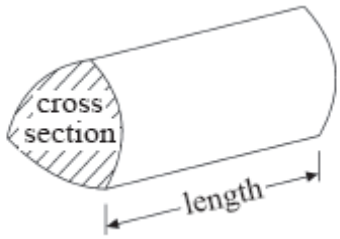
You must not write on this formulae page.

Anything you write on this formulae page will gain NO credit.

Area of trapezium = $\frac{1}{2}(a+b)h$



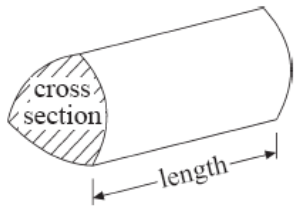
Volume of prism = area of cross section × length



GCSE Mathematics

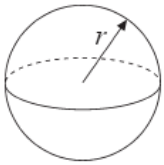
Formulae: Higher Tier

Volume of a prism = area of cross section × length



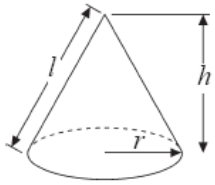
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$

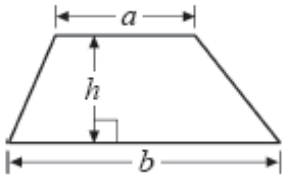


Volume of cone $= \frac{1}{3}\pi r^2 h$

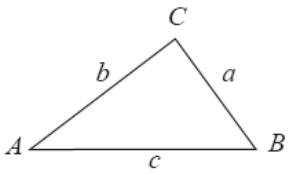
Curved surface area of cone $= \pi r l$



Area of trapezium $= \frac{1}{2}(a+b)h$



In any triangle ABC



Sine Rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine Rule $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle $= \frac{1}{2}ab\sin C$

The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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Prepared by Ali Melville and Sharon Wood

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