



## Syllabus

# Cambridge IGCSE™ Mathematics (US) 0444

Use this syllabus for exams in 2025.

Exams are available in the June series.

This syllabus is available only to schools in Arizona in the USA.



Version 2

Please check the syllabus page at [www.cambridgeinternational.org/0444](http://www.cambridgeinternational.org/0444) to see if this syllabus is available in your administrative zone.

For the purposes of screen readers, any mention in this document of Cambridge IGCSE refers to Cambridge International General Certification of Secondary Education.

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## Why choose Cambridge International?

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Cambridge International prepares school students for life, helping them develop an informed curiosity and a lasting passion for learning. We are part of Cambridge University Press & Assessment, which is a department of the University of Cambridge.

Our Cambridge Pathway gives students a clear path for educational success from age 5 to 19. Schools can shape the curriculum around how they want students to learn – with a wide range of subjects and flexible ways to offer them. It helps students discover new abilities and a wider world, and gives them the skills they need for life, so they can achieve at school, university and work.

Our programs and qualifications set the global standard for international education. They are created by subject experts, rooted in academic rigor and reflect the latest educational research. They provide a strong platform for learners to progress from one stage to the next, and are well supported by teaching and learning resources.

Our mission is to provide educational benefit through provision of international programs and qualifications for school education and to be the world leader in this field. Together with schools, we develop Cambridge learners who are confident, responsible, reflective, innovative and engaged – equipped for success in the modern world.

Every year, nearly a million Cambridge students from 10 000 schools in 160 countries prepare for their future with the Cambridge Pathway.

**School feedback:** ‘We think the Cambridge curriculum is superb preparation for university.’

**Feedback from:** Christoph Guttentag, Dean of Undergraduate Admissions, Duke University, USA

### Quality management



Cambridge International is committed to providing exceptional quality. In line with this commitment, our quality management system for the provision of international qualifications and education programs for students aged 5 to 19 is independently certified as meeting the internationally recognized standard, ISO 9001:2015. Learn more at [www.cambridgeinternational.org/ISO9001](http://www.cambridgeinternational.org/ISO9001)

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## **Important: Changes to this syllabus**

**For information about changes to this syllabus for 2025, go to page 48.**

The latest syllabus is version 2, published March 2024. There are no significant changes which affect teaching.

# 1 Why choose this syllabus?

## Key benefits

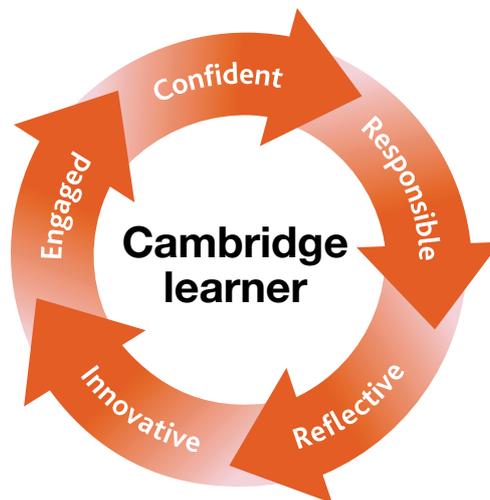
Cambridge IGCSE is the world's most popular international qualification for 14 to 16 year olds, although it can be taken by students of other ages. It is tried, tested and trusted.

Students can choose from 70 subjects in any combination – it is taught by over 4500 schools in over 140 countries.

Our programs balance a thorough knowledge and understanding of a subject and help to develop the skills learners need for their next steps in education or employment.

**Cambridge IGCSE Mathematics (US)** allows students to:

- develop their mathematical knowledge
- develop a feel for numbers, patterns, and relationships
- consider and solve problems and present and interpret results
- communicate and reason using mathematical concepts
- develop a solid foundation for further study.



**School feedback:** ‘The strength of Cambridge IGCSE qualifications is internationally recognized and has provided an international pathway for our students to continue their studies around the world.’

**Feedback from:** Gary Tan, Head of Schools and CEO, Raffles International Group of Schools, Indonesia

## International recognition and acceptance

Our expertise in curriculum, teaching and learning, and assessment is the basis for the recognition of our programs and qualifications around the world. The combination of knowledge and skills in Cambridge IGCSE Mathematics (US) gives learners a solid foundation for further study. Candidates who achieve grades A\* to C are well prepared to follow a wide range of courses including Cambridge International AS & A Level Mathematics.

Cambridge IGCSEs are accepted and valued by leading universities and employers around the world as evidence of academic achievement. Many universities require a combination of Cambridge International AS & A Levels and Cambridge IGCSEs or equivalent to meet their entry requirements.

UK NARIC\*, the national agency in the UK for the recognition and comparison of international qualifications and skills, has carried out an independent benchmarking study of Cambridge IGCSE and found it to be comparable to the standard of the GCSE in the UK. This means students can be confident that their Cambridge IGCSE qualifications are accepted as equivalent to UK GCSEs by leading universities worldwide.

\* Due to the United Kingdom leaving the European Union, the UK NARIC national recognition agency function was re-titled as UK ENIC on 1 March 2021, operated and managed by Ecctis Limited. From 1 March 2021, international benchmarking findings are published under the Ecctis name.

Learn more at [www.cambridgeinternational.org/recognition](https://www.cambridgeinternational.org/recognition)

**School feedback:** ‘Cambridge IGCSE is one of the most sought-after and recognized qualifications in the world. It is very popular in Egypt because it provides the perfect preparation for success at advanced level programmes.’

**Feedback from:** Managing Director of British School of Egypt BSE

## Supporting teachers

We provide a wide range of resources, detailed guidance, innovative training and professional development so that you can give your students the best possible preparation for Cambridge IGCSE. To find out which resources are available for each syllabus go to our School Support Hub.

The School Support Hub is our secure online site for Cambridge teachers where you can find the resources you need to deliver our programs. You can also keep up to date with your subject and the global Cambridge community through our online discussion forums.

Find out more at [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

Support for Cambridge IGCSE			
<b>Planning and preparation</b> <ul style="list-style-type: none"> <li>Schemes of work</li> <li>Specimen papers</li> <li>Syllabus</li> <li>Teacher guides</li> </ul>	<b>Teaching and assessment</b> <ul style="list-style-type: none"> <li>Endorsed resources</li> <li>Online forums</li> <li>Support for coursework and speaking tests</li> </ul>	<b>Learning and revision</b> <ul style="list-style-type: none"> <li>Example candidate responses</li> <li>Past papers and mark schemes</li> <li>Specimen paper answers</li> </ul>	<b>Results</b> <ul style="list-style-type: none"> <li>Candidate Results Service</li> <li>Principal examiner reports for teachers</li> <li>Results Analysis</li> </ul>

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## Professional development

We support teachers through:

- Introductory Training – face-to-face or online
- Extension Training – face-to-face or online
- Enrichment Professional Development – face-to-face or online

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### Supporting exams officers

We provide comprehensive support and guidance for all Cambridge exams officers.

Find out more at: [www.cambridgeinternational.org/eoguide](http://www.cambridgeinternational.org/eoguide)

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## 2 Syllabus overview

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### Goals

The goals describe the purposes of a course based on this syllabus.

The goals are to enable students to:

- develop their mathematical knowledge and oral, written, and practical skills in a way that encourages confidence and provides satisfaction and enjoyment
- read mathematics, and write and talk about the subject in a variety of ways
- develop a feel for numbers, carry out calculations, and understand the significance of the results obtained
- apply mathematics in everyday situations and develop an understanding of the part that mathematics plays in the world around them
- solve problems, present the solutions clearly, check and interpret the results
- develop an understanding of mathematical principles
- recognize when and how a situation may be represented mathematically, identify and interpret relevant factors, and, where necessary, select an appropriate mathematical method to solve the problem
- use mathematics as a means of communication with emphasis on the use of clear expression
- develop an ability to apply mathematics in other subjects, particularly science and technology
- develop the abilities to reason logically, to classify, to generalize, and to prove
- appreciate patterns and relationships in mathematics
- produce and appreciate imaginative and creative work arising from mathematical ideas
- develop their mathematical abilities by considering problems and conducting individual and cooperative enquiry and experiment, including extended pieces of work of a practical and investigative kind
- appreciate the interdependence of different branches of mathematics
- acquire a foundation appropriate to their further study of mathematics and of other disciplines.

Cambridge Assessment International Education is an education organisation and politically neutral. The contents of this syllabus, examination papers and associated materials do not endorse any political view. We endeavour to treat all aspects of the exam process neutrally.



## Content overview

All students will study the following topics:

- 1 Number
- 2 Algebra
- 3 Functions
- 4 Geometry
- 5 Transformations and Vectors
- 6 Geometrical Measurement
- 7 Coordinate Geometry
- 8 Trigonometry
- 9 Probability
- 10 Statistics

This course is tiered to enable effective differentiation for students. The Core content is intended for students targeting grades C to G, and the Extended content is intended for students targeting grades A\* to D. All of the Core content is in the Extended content.

The content structure and the use of tiering allows flexibility for teachers to plan delivery appropriately for their students.

Students should be able to both use techniques listed in the content and apply them to solve problems.

Students should be able to show their working and be able to communicate mathematically, using appropriate notation and structure to communicate their reasoning within a problem.

### Calculators

The syllabus assumes that candidates will have a scientific calculator for Paper 3 (Core) and Paper 4 (Extended).

Calculators are **not** permitted for Paper 1 (Core) and Paper 2 (Extended).

### Formula Lists

The formula lists provided in the written papers are given in section 4 Details of the Assessment.

## Assessment overview

All candidates take two papers.

Candidates who have studied the Core syllabus content, or who are expected to achieve a grade D or below, should be entered for Paper 1, and Paper 3. These candidates will be eligible for grades C to G.

Candidates who have studied the Extended syllabus content (Core and Supplement), and who are expected to achieve a grade C or above, should be entered for Paper 2, and Paper 4. These candidates will be eligible for grades A\* to E.

### Core assessment

Core candidates take Paper 1 and Paper 3. The questions are based on the Core subject content only:

Paper 1: (Core)		Paper 3: (Core)	
1 hour		2 hours	
56 marks	35%	104 marks	65%
Short-answer questions		Structured questions	
Questions will be based on the Core curriculum		Questions will be based on the Core curriculum	
Calculators are <b>not</b> permitted		Scientific calculators are required	
Externally assessed		Externally assessed	

### Extended assessment

Extended candidates take Paper 2 and Paper 4. The questions are based on the Core and Supplement subject content:

Paper 2: (Extended)		Paper 4: (Extended)	
1 hour 30 minutes		2 hours 30 minutes	
70 marks	35%	130 marks	65%
Short-answer questions		Structured questions	
Questions will be based on the Extended curriculum		Questions will be based on the Extended curriculum	
Calculators are <b>not</b> permitted		Scientific calculators are required	
Externally assessed		Externally assessed	

For Paper 3 and Paper 4:

- Three significant figures will be required in answers (or one decimal place for answers in degrees) except where otherwise stated.
- Candidates should use the value of  $\pi$  from their calculator or the value of 3.142.

Information on availability is in the **Before you start** section.

## Assessment objectives

The assessment objectives (AOs) are:

Candidates should be able to:

- organize, interpret, and present information accurately in written, tabular, graphical, and diagrammatic forms
- perform calculations by suitable methods
- use an electronic calculator and also perform some straightforward calculations without a calculator
- understand systems of measurement in everyday use and make use of them in the solution of problems
- estimate, approximate, and work to degrees of accuracy appropriate to the context and convert between equivalent numerical forms
- use mathematical and other instruments to measure and to draw to an acceptable degree of accuracy
- interpret, transform, and make appropriate use of mathematical statements expressed in words or symbols
- recognize and use spatial relationships in two and three dimensions, particularly in solving problems
- recall, apply, and interpret mathematical knowledge in the context of everyday situations
- make logical deductions from given mathematical data
- recognize patterns and structures in a variety of situations, and form generalizations
- respond to a problem relating to a relatively unstructured situation by translating it into an appropriately structured form
- analyze a problem, select a suitable strategy, and apply an appropriate technique to obtain its solution
- apply combinations of mathematical skills and techniques in problem solving
- set out mathematical work, including the solution of problems, in a logical and clear form using appropriate symbols and terminology
- present concise reasoned arguments to justify solutions or generalizations, using symbols, diagrams or graphs and related explanations.

## 3 Subject content

This syllabus gives you the flexibility to design a course that will interest, challenge and engage your learners. Where appropriate you are responsible for selecting resources and examples to support your learners' study. These should be appropriate for the learners' age, cultural background and learning context as well as complying with your school policies and local legal requirements.

Candidates may follow either the Core curriculum or the Extended curriculum. Candidates aiming for grades A\* to C should follow the Extended curriculum.

### Core subject content

1	Number–Core curriculum	Notes/examples
1.1	Knowledge of: natural numbers, integers (positive, negative, and zero), prime numbers, square numbers, rational and irrational numbers, real numbers.  Use of symbols: =, ≠, ≤, ≥, <, >	
1.2	Use of the four operations and parentheses.	Applies to integers, fractions, and decimals. Choose mental or written methods appropriate to the number or context.
1.3	Multiples and factors, including greatest common factor, least common multiple.	GCF and LCM will be used and knowledge of prime factors is assumed.
1.4	Ratio and proportion.	
1.5	Understand and use the language and notation of fractions, decimals, and percentages; recognize equivalences between decimals, fractions, ratios, and percentages and convert between them.  Order quantities given in different forms by magnitude, by first converting into same form.	
1.6	Percentages, including applications such as interest and profit.	Excludes reverse percentages. Includes both simple and compound interest.

1 Number–Core curriculum	Notes/examples
<p>1.7 Meaning and calculation of exponents (powers, indices) including positive, negative, and zero exponents.</p> <p>Explain the definition of radical exponents as an extension to integral exponents.</p> <p>Explain the rules for exponents.</p> <p>Scientific notation (Standard Form) <math>a \times 10^n</math> where <math>1 \leq a &lt; 10</math> and <math>n</math> is an integer.</p>	<p>e.g., work out <math>4^{-3}</math> as a fraction.</p> <p>e.g., work out <math>2^4 \times 2^{-3}</math></p> <p>Convert numbers in and out of scientific notation.</p> <p>Calculate with values in scientific notation.</p>
<p>1.8 Radicals, calculation of square root and cube root expressions.</p>	<p>e.g., the area of a square is <math>54.76 \text{ cm}^2</math>. Work out the length of one side of the square.</p> <p>Find the value of the cube root of 64.</p>
<p>1.9 Use units to understand problems and guide the solution to multi-step problems.</p> <p>Quantities—choose and interpret units and scales, define appropriate quantities (including money).</p> <p>Estimating, rounding, decimal places, and significant figures—choose a level of accuracy appropriate for a problem.</p>	<p>Also relates to graphs and geometrical measurement topics.</p> <p>Includes converting between units, e.g., different currencies.</p> <p>Use estimation to check answers and consider whether the answer is reasonable in the context of the problem.</p>
<p>1.10 Calculations involving time: seconds (s), minutes (min), hours (h), days, months, years including the relation between consecutive units.</p>	<p>1 year = 365 days.</p> <p>Includes familiarity with both 24-hour and 12-hour clocks and extraction of data from dials and schedules.</p>
<p>1.11 Speed, distance, time problems.</p>	

2	Algebra–Core curriculum	Notes/examples
2.1	<i>Extended Curriculum only.</i>	
2.2	<i>Extended Curriculum only.</i>	
2.3	Create expressions and create and solve linear equations, including those with fractional expressions.	Explain each algebraic step of the solution. May be asked to interpret solutions to a problem given in context. Construct a viable argument to justify a solution method.
2.4	Exponents (indices).	Includes rules of exponents with negative exponents. Simple examples only, e.g., $q^3 \times q^{-4}$ , $8x^5 \div 2x^2$
2.5	Rearrangement and evaluation of simple formulae.	e.g., make $r$ the subject of:  <ul style="list-style-type: none"> <li>• <math>p = rt - q</math></li> <li>• <math>w = \frac{r - t}{y}</math></li> </ul> e.g., when $x = -3$ and $y = 4$ , find the value of $xy^2$ .
2.6	Create and solve systems of linear equations in two variables algebraically.	
2.7	Identify terms, factors, and coefficients.	
2.8	Expansion of parentheses (simple examples only). Simplify expressions.	e.g., expand and simplify $4(5c - 3d) - 7c$
2.9	Factorization: common factor only.	e.g., $6x^2 + 9x = 3x(2x + 3)$
2.10	<i>Extended Curriculum only.</i>	
2.11	<i>Extended Curriculum only.</i>	
2.12	<i>Extended Curriculum only.</i>	
2.13	Continuation of a sequence of numbers or patterns; recognize patterns in sequences; generalize to simple algebraic statements, including determination of the $n^{\text{th}}$ term.	e.g., find the $n^{\text{th}}$ term of:  <ul style="list-style-type: none"> <li>• 5 9 13 17 21</li> <li>• 2 4 8 16 32</li> </ul>
2.14	<i>Extended Curriculum only.</i>	

3 Functions-Core curriculum	Notes and examples
3.1 Use function notation. Knowledge of domain and range. Mapping diagrams.	Understand that a function assigns to each element of the domain exactly one element of the range. If $f$ is a function and $x$ is an element of its domain then $f(x)$ denotes the output of $f$ corresponding to the input of $x$ .
3.2 Understand and explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.  Construct tables of values for functions of the form $ax + b$ , $\pm x^2 + ax + b$ , $\frac{a}{x}$ ( $x \neq 0$ ) where $a$ and $b$ are integral constants; draw and interpret such graphs.  Solve associated equations approximately by graphical methods.	
3.3 Write a function that describes a relationship between two quantities.	e.g., $C(x) = 50,000 + 400x$ models the cost of producing $x$ wheelchairs. Write a function that represents the cost of one wheelchair.
3.4 <i>Extended Curriculum only.</i>	
3.5 Recognition of the following function types from the shape of their graphs: linear $f(x) = ax + b$ quadratic $f(x) = ax^2 + bx + c$ reciprocal $f(x) = \frac{a}{x}$  Interpret the key features of the graphs—to include intercepts; intervals where the function is increasing, decreasing, positive, negative; relative maxima and minima; symmetries; end behavior.	Some of $a$ , $b$ , $c$ may be 0
3.6 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	e.g., if the function $h(n)$ gives the number of person-hours it takes to assemble $n$ engines in a factory, then the positive integers would be an appropriate domain for the function.
3.7 <i>Extended Curriculum only.</i>	
3.8 <i>Extended Curriculum only.</i>	
3.9 <i>Extended Curriculum only.</i>	

3	Functions—Core curriculum	Notes and examples
3.10	<i>Extended Curriculum only.</i>	
3.11	<i>Extended Curriculum only.</i>	
3.12	Description and identification, using the language of transformations, of the changes to the graph of $y = f(x)$ when $y = f(x) + k$ , $y = k f(x)$ , $y = f(x + k)$ for $f(x)$ given in section 3.5.	Where $k$ is an integer.
3.13	<i>Extended Curriculum only.</i>	

4 Geometry-Core curriculum	Notes and examples
<p>4.1 Vocabulary: Know precise definitions of acute, obtuse, right angle, reflex, equilateral, isosceles, congruent, similar, regular, pentagon, hexagon, octagon, rectangle, square, kite, rhombus, parallelogram, trapezoid, and simple solid figures.</p>	
<p>4.2 Definitions: Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.</p>	
<p>4.3 Line and rotational symmetry in 2D.</p>	<p>e.g., know properties of triangles, quadrilaterals, and circles directly related to their symmetries.</p>
<p>4.4 Angles around a point. Angles on a straight line and intersecting straight lines. Vertically opposite angles. Alternate and corresponding angles on parallel lines. Angle properties of triangles, quadrilaterals, and polygons. Interior and exterior angles of a polygon.</p>	<p>Formal proof is not required, but candidates will be expected to use reasoned arguments, including justifications, to establish geometric results from given information.</p>
<p>4.5 Construction. Make formal geometric constructions with compass and straight edge only. Copy a segment; copy an angle; bisect a segment; bisect an angle; construct perpendicular lines, including the perpendicular bisector of a line segment. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. Construct the inscribed and circumscribed circles of a triangle. Construct a tangent line from a point outside a given circle to the circle. Angle measurement in degrees. Read and make scale drawings.</p>	

4	Geometry-Core curriculum	Notes and examples
4.6	Vocabulary of circles. Properties of circles: <ul style="list-style-type: none"><li data-bbox="264 398 842 461">• tangent perpendicular to radius at the point of contact</li><li data-bbox="264 474 552 506">• angle in a semicircle.</li></ul>	Formal proof is not required but candidates will be expected to use reasoned arguments, including justifications, to establish geometric results from given information.
4.7	Similarity. Calculation of lengths of similar figures.	Use scale factors and/or angles to check for similarity.
4.8	<i>Extended Curriculum only.</i>	

**5 Transformations and Vectors****Notes and examples**

5.1 Vector notation:  
directed line segment  $\overrightarrow{AB}$ ;  
component form  $\begin{pmatrix} x \\ y \end{pmatrix}$

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5.2 *Extended Curriculum only.*

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5.3 *Extended Curriculum only.*

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5.4 *Extended Curriculum only.*

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5.5 *Extended Curriculum only.*

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5.6 Transformations on the cartesian plane:  
translation, reflection, rotation, enlargement  
(dilation).  
Description of a translation using column vectors.

Representing and describing  
transformations.

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5.7 *Extended Curriculum only.*

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5.8 *Extended Curriculum only.*

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6	Geometrical measurement	Notes and examples
6.1	Units: mm, cm, m, km mm <sup>2</sup> , cm <sup>2</sup> , m <sup>2</sup> , ha, km <sup>2</sup> mm <sup>3</sup> , cm <sup>3</sup> , ml, cl, l, m <sup>3</sup> g, kg	All units will be metric; conversion between units is expected.  Units of time as given in section 1.10.
6.2	Perimeter and area of rectangle, triangle, and compound shapes derived from these. Area of trapezoid and parallelogram.	Formula will be given for area of triangle.
6.3	Circumference and area of a circle.  Arc length and area of sector.	Formulae will be given for circumference and area of a circle.  From sector angles in degrees and simple examples only.
6.4	Surface area and volume of a prism (in particular, cuboid and cylinder). Surface area and volume of a sphere.	Formulae will be given for the lateral surface area of a cylinder and the surface area of a sphere, and the volume of a prism, a cylinder, and a sphere.
6.5	<i>Extended Curriculum only.</i>	
6.6	Use geometric shapes, their measures, and their properties to describe objects.	e.g., modeling a tree trunk or a human torso as a cylinder.
6.7	<i>Extended Curriculum only.</i>	
6.8	<i>Extended Curriculum only.</i>	
6.9	<i>Extended Curriculum only.</i>	

<b>7</b>	<b>Coordinate Geometry</b>	<b>Notes and examples</b>
7.1	Plotting of points and reading from a graph in the cartesian plane.	
7.2	Distance between two points.	Questions on this topic would be structured via diagrams.
7.3	Midpoint of a line segment.	Questions on this topic would be structured via diagrams.
7.4	Slope of a line segment.	
7.5	Interpret and obtain the equation of a straight line as $y = mx + b$ .	e.g., obtain the equation of a straight line graph given a pair of coordinates on the line.
7.6	Slope of parallel line. Find the equation of a line parallel to a given line that passes through a given point.	

8	Trigonometry	Notes and examples
8.1	Use trigonometric ratios and the Pythagorean Theorem to solve right-angled triangles in applied problems.	Problems involving bearings may be included. Know angle of elevation and depression.
8.2	<i>Extended Curriculum only.</i>	
8.3	<i>Extended Curriculum only.</i>	
8.4	<i>Extended Curriculum only.</i>	
8.5	<i>Extended Curriculum only.</i>	

9 Probability	Notes and examples
9.1 Probability $P(A)$ as a fraction, decimal, or percentage. Significance of its value, including using probabilities to make fair decisions.	Includes an understanding that the probability of an event occurring = 1 – the probability of the event not occurring. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”). The knowledge and use of set notation is not expected.
9.2 Relative frequency as an estimate of probability.	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation, e.g., a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?
9.3 Expected number of occurrences.	
9.4 <i>Extended Curriculum only.</i>	
9.5 Possibility diagrams. Tree diagrams including successive selection with or without replacement.	Simple cases only.

## 10 Statistics

10	Statistics	Notes and examples
10.1	Reading and interpretation of graphs or tables of data.	
10.2	Discrete and continuous data.	
10.3	Compound bar chart, dot plot, line graph, pie chart, simple frequency distributions, scatter diagram.	
10.4	Mean, mode, median, and range from lists of discrete data.	
10.5	<i>Extended Curriculum only.</i>	
10.6	<i>Extended Curriculum only.</i>	
10.7	<i>Extended Curriculum only.</i>	
10.8	Understanding and description of correlation (positive, negative, or zero) with reference to a scatter diagram.  Straight line of best fit (by eye) through the mean on a scatter diagram.	

## Extended subject content

1	Number–Extended curriculum	Notes and examples
1.1	<p>Knowledge of: natural numbers, integers (positive, negative, and zero), prime numbers, square numbers, rational and irrational numbers, real numbers.</p> <p>Use of symbols: =, ≠, ≤, ≥, &lt;, &gt;</p>	<p>Understand that the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a non-zero rational number and an irrational number is irrational.</p>
1.2	Use of the four operations and parentheses.	<p>Applies to integers, fractions, and decimals. Choose mental or written methods appropriate to the number or context.</p>
1.3	Multiples and factors, including greatest common factor, least common multiple.	<p>GCF and LCM will be used and knowledge of prime factors is assumed.</p>
1.4	Ratio and proportion.	
1.5	<p>Understand and use the language and notation of fractions, decimals, and percentages; recognize equivalences between decimals, fractions, ratios, and percentages and convert between them.</p> <p>Order quantities given in different forms by magnitude, by first converting into same form.</p>	
1.6	Percentages, including applications such as interest and profit.	<p>Includes reverse percentages. Includes both simple and compound interest. Includes percentiles.</p>
1.7	<p>Meaning and calculation of exponents (powers, indices) including positive, negative, zero, and fractional exponents.</p> <p>Explain the definition of radical exponents as an extension to integral exponents.</p> <p>Explain the rules for exponents.</p> <p>Scientific notation (Standard Form) <math>a \times 10^n</math> where <math>1 \leq a &lt; 10</math> and <math>n</math> is an integer.</p>	<p>e.g., <math>5^{\frac{1}{2}} = \sqrt{5}</math> e.g., evaluate <math>5^{-2}</math>, <math>100^{\frac{1}{2}}</math>, <math>8^{-\frac{2}{3}}</math></p> <p>e.g., work out <math>2^4 \times 2^{-3}</math></p> <p>Convert numbers in and out of scientific notation. Calculate with values in scientific notation.</p>

1	Number–Extended curriculum	Notes and examples
1.8	Radicals, calculation and simplification of square root and cube root expressions.	e.g., simplify $\sqrt{200} + \sqrt{18}$ Write $(2 + \sqrt{3})^2$ in the form $a + b\sqrt{3}$
1.9	Use units to understand problems and guide the solution to multi-step problems.	Also relates to graphs and geometrical measurement topics.
	Quantities—choose and interpret units and scales, define appropriate quantities (including money).	Includes converting between units, e.g., different currencies.
	Estimating, rounding, decimal places, and significant figures—choose a level of accuracy appropriate for a problem.	Use estimation to check answers and consider whether the answer is reasonable in the context of the problem.
1.10	Calculations involving time: seconds (s), minutes (min), hours (h), days, months, years including the relation between consecutive units.	1 year = 365 days. Includes familiarity with both 24-hour and 12-hour clocks and extraction of data from dials and schedules.
1.11	Speed, distance, time problems.	

2	Algebra–Extended curriculum	Notes and examples
2.1	Writing, showing, and interpretation of inequalities on the real number line.	
2.2	Create and solve linear inequalities.	e.g., solve $3x + 5 < 7$ solve $-7 \leq 3n - 1 < 5$
2.3	Create expressions and create and solve linear equations, including those with fractional expressions.	Explain each algebraic step of the solution. May be asked to interpret solutions to a problem given in context. Construct a viable argument to justify a solution method.
2.4	Exponents (indices).	Includes rules of exponents with negative and fractional exponents.  e.g., simplify $2x^{\frac{3}{2}} \times 5x^{-4}$
2.5	Rearrangement and evaluation of formulae.	Includes manipulation of algebraic expressions to prove identities. Formulae may include exponents or cases where the subject appears twice. e.g., make $r$ the subject of <ul style="list-style-type: none"> <li>• <math>V = \frac{4}{3}\pi r^3</math></li> <li>• <math>p = \frac{2r - 3}{r + s}</math></li> </ul> e.g., $y = m^2 - 4n^2$ Find the value of $y$ when $m = 4.4$ and $n = 2.8$
2.6	Create and solve systems of linear equations in two variables algebraically and graphically.	See Functions – Extended curriculum 3.2
2.7	Identify terms, factors, and coefficients. Interpret algebraic expressions in terms of a context.	e.g., interpret $P(1 + r)^n$ as the product of $P$ and a factor not depending on $P$ .
2.8	Expansion of parentheses, including the square of a binomial. Simplify expressions.	e.g., expand $(2x - 5)^2 = 4x^2 - 20x + 25$

2 Algebra–Extended curriculum	Notes and examples
<p>2.9 Use equivalent forms of an expression or function to reveal and explain properties of the quantities or function represented.</p> <p>Factorization:            common factor            difference of squares            trinomial            four term.</p>	$6x^2 + 9x = 3x(2x + 3)$ $9x^2 - 16y^2 = (3x - 4y)(3x + 4y)$ $6x^2 + 11x - 10 = (3x - 2)(2x + 5)$ $xy - 3x + 2y - 6 = (x + 2)(y - 3)$ <p>Use the structure of an expression to identify ways to rewrite it, for example, see <math>x^4 - y^4</math> as <math>(x^2)^2 - (y^2)^2</math>, thus recognizing it as a difference of squares that can be factored as <math>(x^2 - y^2)(x^2 + y^2)</math>.</p>
<p>2.10 Algebraic fractions:            simplification, including use of factorization            addition or subtraction of fractions with linear denominators            multiplication or division and simplification of two fractions.</p>	<p>e.g., simplify <math>\frac{4x^2 - 9}{8x^2 - 10x - 3}</math>, <math>\frac{3}{2x + 1} - \frac{4}{x}</math>,</p> $\frac{7x}{4y^2} \div \frac{21x}{8}$
<p>2.11 Create and solve quadratic equations by:            inspection            factorization            using the quadratic formula            completing the square.</p>	<p>e.g., <math>x^2 = 49</math>  <math>2x^2 + 5x - 3 = 0</math>  <math>3x^2 - 2x - 7 = 0</math></p> <p>Write <math>x^2 - 6x + 9</math> in the form <math>(x - a)^2 + b</math> and state the minimum value of the function.</p> <p>Quadratic formula will be given.</p>
<p>2.12 Solve simple rational and radical equations in one variable and discount any extraneous solutions.</p>	<p>e.g., solve <math>\sqrt{x} + 2 = 6</math>, <math>x^{-3} = 27</math>, <math>2y^4 = 32</math></p>
<p>2.13 Continuation of a sequence of numbers or patterns; recognize patterns in sequences; generalize to simple algebraic statements, including determination of the <math>n^{\text{th}}</math> term.</p> <p>Derive the formula for the sum of a finite geometric series, and use the formula to solve problems.</p>	<p>e.g., find the <math>n^{\text{th}}</math> term of:</p> <ul style="list-style-type: none"> <li>• 5 9 13 17 21</li> <li>• 2 4 8 16 32</li> <li>• 2 5 10 17 26</li> <li>• 3 6 12 24 48</li> </ul> <p>For a common ratio that is not 1.            e.g., calculate mortgage payments.</p>
<p>2.14 Express direct and inverse variation in algebraic terms and use this form of expression to find unknown quantities.</p>	<p>e.g., <math>y \propto x</math>, <math>y \propto \sqrt{x}</math>, <math>y \propto \frac{1}{x}</math>, <math>y \propto \frac{1}{x^2}</math></p>

3 Functions—Extended curriculum	Notes and examples
<p>3.1 Use function notation. Knowledge of domain and range. Mapping diagrams.</p>	<p>e.g., <math>f(x)</math>; <math>f:x</math></p> <p>Understand that a function assigns to each element of the domain exactly one element of the range. If <math>f</math> is a function and <math>x</math> is an element of its domain then <math>f(x)</math> denotes the output of <math>f</math> corresponding to the input of <math>x</math>.</p>
<p>3.2 Understand and explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.</p> <p>Construct tables of values and construct graphs of functions of the form <math>ax^n</math> where <math>a</math> is a rational constant and <math>n = -2, -1, 0, 1, 2, 3</math> and simple sums of not more than three of these and of functions of the type <math>a^x</math> where <math>a</math> is a positive integer.</p> <p>Solve associated equations approximately by graphical methods.</p>	
<p>3.3 Write a function that describes a relationship between two quantities.</p>	<p>e.g., <math>C(x) = 50,000 + 400x</math> models the cost of producing <math>x</math> wheelchairs. Write a function that represents the cost of one wheelchair.</p>
<p>3.4 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).</p>	<p>e.g., given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</p>
<p>3.5 Recognition of the following function types from the shape of their graphs:</p> <p>linear <math>f(x) = ax + b</math>  quadratic <math>f(x) = ax^2 + bx + c</math>  cubic <math>f(x) = ax^3 + bx^2 + cx + d</math>  reciprocal <math>f(x) = \frac{a}{x}</math>  exponential <math>f(x) = a^x</math> with <math>0 &lt; a &lt; 1</math> or <math>a &gt; 1</math>  trigonometric <math>f(x) = a \sin(bx)</math>; <math>a \cos(bx)</math>; <math>\tan x</math></p> <p>Interpret the key features of the graphs—to include intercepts; intervals where the function is increasing, decreasing, positive, negative; relative maxima and minima; symmetries; end behavior and periodicity.</p>	<p>Some of <math>a</math>, <math>b</math>, <math>c</math> and <math>d</math> may be 0</p> <p>Including period and amplitude.</p>

3 Functions–Extended curriculum	Notes and examples										
3.6 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	e.g., if the function $h(n)$ gives the number of person-hours it takes to assemble $n$ engines in a factory, then the positive integers would be an appropriate domain for the function.										
3.7 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.	e.g., average speed between 2 points.  e.g., use a tangent to the curve to find the slope.										
3.8 Behavior of linear, quadratic, and exponential functions: linear $f(x) = ax + b$ quadratic $f(x) = ax^2 + bx + c$ exponential $f(x) = a^x$ with $0 < a < 1$ or $a > 1$	Observe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.  Use the properties of exponents to interpret expressions for exponential functions,  e.g., identify percent rate of change in functions such as $y = (1.02)^t$ , $y = (0.97)^t$ , $y = (1.01)^{12t}$ , $y = (1.2)^{t/10}$ , and classify them as representing exponential growth or decay.										
3.9 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input–output pairs (include reading these from a table).	e.g., find the function or equation for the relationship between $x$ and $y$ <table border="1" data-bbox="925 1265 1228 1355"> <tr> <td><math>x</math></td> <td>-2</td> <td>0</td> <td>2</td> <td>4</td> </tr> <tr> <td><math>y</math></td> <td>3</td> <td>5</td> <td>7</td> <td>9</td> </tr> </table>	$x$	-2	0	2	4	$y$	3	5	7	9
$x$	-2	0	2	4							
$y$	3	5	7	9							
3.10 Simplification of formulae for composite functions such as $f(g(x))$ where $g(x)$ is a linear expression.	e.g., $f(x) = 6 + 2x$ , $g(x) = 7x$ , $f(g(x)) = 6 + 2(7x) = 6 + 14x$										
3.11 Inverse function $f^{-1}$	Find an inverse function.  Solve an equation of the form $f(x) = c$ for a simple function that has an inverse.  Read values of an inverse function from a graph or a table, given that the function has an inverse.										
3.12 Description and identification, using the language of transformations, of the changes to the graph of $y = f(x)$ when $y = f(x) + k$ , $y = k f(x)$ , $y = f(x + k)$ for $f(x)$ given in section 3.5.	Where $k$ is an integer.										

**3 Functions—Extended curriculum****Notes and examples**

3.13 Graph the solutions to a linear inequality in two variables as a half-plane (region), excluding the boundary in the case of a strict inequality. Graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

e.g., identify the region bounded by the inequalities  $y > 3$ ,  $2x + y < 12$ ,  $y \leq x$

4 Geometry–Extended curriculum	Notes and examples
<p>4.1 Vocabulary: Know precise definitions of acute, obtuse, right angle, reflex, equilateral, isosceles, congruent, similar, regular, pentagon, hexagon, octagon, rectangle, square, kite, rhombus, parallelogram, trapezoid, and simple solid figures.</p>	
<p>4.2 Definitions: Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.</p>	
<p>4.3 Line and rotational symmetry in 2D and 3D.</p>	<p>e.g., know properties of triangles, quadrilaterals, and circles directly related to their symmetries.</p> <p>For example, given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.</p> <p>Recognize symmetry properties of the prism and the pyramid.</p>
<p>4.4 Angles around a point. Angles on a straight line and intersecting straight lines. Vertically opposite angles. Alternate and corresponding angles on parallel lines. Angle properties of triangles, quadrilaterals, and polygons. Interior and exterior angles of a polygon.</p>	<p>Formal proof is not required, but candidates will be expected to use reasoned arguments, including justifications, to establish geometric results from given information.</p>

4	Geometry–Extended curriculum	Notes and examples
4.5	<p>Construction.</p> <p>Make formal geometric constructions with compass and straight edge only.</p> <p>Copy a segment; copy an angle; bisect a segment; bisect an angle; construct perpendicular lines, including the perpendicular bisector of a line segment.</p> <p>Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.</p> <p>Construct the inscribed and circumscribed circles of a triangle.</p> <p>Construct a tangent line from a point outside a given circle to the circle.</p> <p>Angle measurement in degrees.</p> <p>Read and make scale drawings.</p>	
4.6	<p>Vocabulary of circles.</p> <p>Properties of circles:</p> <ul style="list-style-type: none"> <li>• tangent perpendicular to radius at the point of contact</li> <li>• tangents from a point</li> <li>• angle in a semicircle</li> <li>• angles at the center and at the circumference on the same arc</li> <li>• cyclic quadrilateral.</li> </ul> <p>Use the following symmetry properties of a circle:</p> <ul style="list-style-type: none"> <li>• equal chords are equidistant from the center</li> <li>• the perpendicular bisector of a chord passes through the center</li> <li>• tangents from an external point are equal in length.</li> </ul>	<p>Formal proof is not required but candidates will be expected to use reasoned arguments, including justifications, to establish geometric results from given information.</p>
4.7	<p>Similarity.</p> <p>Calculation of lengths of similar figures.</p> <p>Area and volume scale factors.</p>	<p>Use scale factors and/or angles to check for similarity.</p> <p>Use of the relationships between areas of similar figures and extension to volumes and surface areas of similar solids.</p>
4.8	<p>Congruence.</p> <p>Recognize that two shapes are congruent and use this to solve problems.</p>	

5 Transformations and Vectors	Notes and examples
5.1 Vector notation: $\mathbf{a}$ ; directed line segment $\overrightarrow{AB}$ ; component form $\begin{pmatrix} x \\ y \end{pmatrix}$ use appropriate symbols for vectors and their magnitudes	e.g., $\mathbf{v}$ , $ \mathbf{v} $
5.2 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. Use position vectors.	See also section 5.6, translations using column vectors.
5.3 Calculate the magnitude of a vector $\begin{pmatrix} x \\ y \end{pmatrix}$ as $\sqrt{x^2 + y^2}$ .	
5.4 Add and subtract vectors.	Both algebraic (component) and geometric (parallelogram rule) addition/subtraction. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes. Understand vector subtraction $\mathbf{v} - \mathbf{w}$ as $\mathbf{v} + (-\mathbf{w})$ , where $-\mathbf{w}$ is the additive inverse of $\mathbf{w}$ , with the same magnitude as $\mathbf{w}$ and pointing in the opposite direction.
5.5 Multiply a vector by a scalar.	e.g., $\left  3 \begin{pmatrix} -4 \\ 3 \end{pmatrix} \right  = 3(5) = 15$ $c \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} cx \\ cy \end{pmatrix}$ If $c \mathbf{v}  \neq 0$ , the direction of $c\mathbf{v}$ is either along $\mathbf{v}$ (for $c > 0$ ) or against $\mathbf{v}$ (for $c < 0$ ).
5.6 Transformations on the cartesian plane: translation, reflection, rotation, enlargement (dilation), stretch. Description of a translation using column vectors.	Representing and describing transformations.
5.7 Inverse of a transformation.	
5.8 Combined transformations.	e.g., find the <b>single</b> transformation that can replace a rotation of $180^\circ$ around the origin followed by a translation by the vector $\begin{pmatrix} 4 \\ -2 \end{pmatrix}$

6	Geometrical Measurement	Notes and examples
6.1	Units: mm, cm, m, km mm <sup>2</sup> , cm <sup>2</sup> , m <sup>2</sup> , ha, km <sup>2</sup> mm <sup>3</sup> , cm <sup>3</sup> , ml, cl, l, m <sup>3</sup> g, kg	All units will be metric; conversion between units expected.  Units of time as given in section 1.10.
6.2	Perimeter and area of rectangle, triangle, and compound shapes derived from these. Area of trapezoid and parallelogram.	
6.3	Circumference and area of a circle. Arc length and area of sector.	From sector angles in degrees only.
6.4	Surface area and volume of a prism and a pyramid (in particular, cuboid, cylinder, and cone). Surface area and volume of a sphere.	Formulae will be given for the lateral surface area of a cylinder and a cone, the surface area of a sphere, and the volume of a pyramid, a cone, and a sphere.
6.5	Areas and volumes of compound shapes.	Involving combinations of the shapes in section 6.4.
6.6	Use geometric shapes, their measures, and their properties to describe objects.	e.g., modeling a tree trunk or a human torso as a cylinder.
6.7	Identify the shapes of two-dimensional cross sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.	
6.8	Apply concepts of density based on area and volume in modeling situations.	e.g. persons per square mile, BTUs per cubic foot.
6.9	Apply geometric methods to solve design problems.	e.g., design an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios.

7	Coordinate Geometry	Notes and examples
7.1	Plotting of points and reading from a graph in the cartesian plane.	
7.2	Distance between two points.	e.g., use coordinates to compute the perimeters of polygons and areas of triangles using the distance formula.
7.3	Midpoint of a line segment. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	
7.4	Slope of a line segment.	
7.5	Interpret and obtain the equation of a straight line as $y = mx + b$ . Interpret and obtain the equation of a straight line as $ax + by = d$ ( $a$ , $b$ , and $d$ are integers).	e.g., obtain the equation of a straight line graph given a pair of coordinates on the line.
7.6	Slope of parallel line. Find the equation of a line parallel to a given line that passes through a given point. Slope of perpendicular line. Find the equation of a line perpendicular to a given line that passes through a given point.	Understand and explain how the slopes of parallel and perpendicular lines are related.

8	Trigonometry	Notes and examples
8.1	Use trigonometric ratios and the Pythagorean Theorem to solve right-angled triangles in applied problems. Know the exact values for the trigonometric ratios of $0^\circ$ , $30^\circ$ , $45^\circ$ , $60^\circ$ , $90^\circ$ .	Problems involving bearings may be included. Know angle of elevation and depression.
8.2	Extend sine and cosine values to angles between $0^\circ$ and $360^\circ$ . Explain and use the relationship between the sine and cosine of complementary angles. Graph and know the properties of trigonometric functions.	
8.3	Sine Rule (Law of Sines).	Formula will be given. ASA, SSA (ambiguous case included where the angle is obtuse)
8.4	Cosine Rule (Law of Cosines)	Formula will be given. SAS, SSS.
8.5	Area of triangle.	Formula will be given.

9 Probability	Notes and examples
9.1 Probability $P(A)$ as a fraction, decimal, or percentage. Significance of its value, including using probabilities to make fair decisions.	Includes an understanding that the probability of an event occurring = 1 – the probability of the event not occurring. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”). The knowledge and use of set notation is not expected.
9.2 Relative frequency as an estimate of probability.	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation, e.g., a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?
9.3 Expected number of occurrences.	
9.4 Combining events: Apply the addition rule $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ Apply the multiplication rule $P(A \text{ and } B) = P(A) \times P(B)$ .	Understand that two events are independent if the probability of $A$ and $B$ occurring together is the product of their probabilities and use this characterization to determine if they are independent.
9.5 Possibility diagrams. Tree diagrams including successive selection with or without replacement.	

10	Statistics	Notes and examples
10.1	Reading and interpretation of graphs or tables of data.	Make inferences to support or cast doubt on initial conjectures; relate results and conclusions to the original question.
10.2	Discrete and continuous data.	
10.3	Compound bar chart, dot plot, line graph, pie chart, simple frequency distributions, scatter diagram.	
10.4	Mean, mode, median, and range from lists of discrete data. Mean, modal class, median, and range from grouped and continuous data.	The term <i>estimated mean</i> may be used in questions involving grouped continuous data.
10.5	Histograms with frequency density on the vertical axis.	Includes histograms with unequal class intervals.
10.6	Cumulative frequency table and curve and box plots. Median, quartiles, percentiles, and interquartile range.	
10.7	Use and interpret statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range) of two or more different data sets.	
10.8	Understanding and description of correlation (positive, negative, or zero) with reference to a scatter diagram. Straight line of best fit (by eye) through the mean on a scatter diagram.	

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## 4 Details of the assessment

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### Core Assessment

#### Paper 1 – (Core)

Written paper, 1 hour, 56 marks

Candidates answer all questions.

This paper consists of short-answer questions based on the Core curriculum.

This is a compulsory component for Core candidates.

This written paper is an externally set assessment, marked by Cambridge International.

#### Paper 3 – (Core)

Written paper, 2 hours, 104 marks

Candidates answer all questions.

This paper consists of structured questions based on the Core curriculum.

This is a compulsory component for Core candidates.

This written paper is an externally set assessment, marked by Cambridge International.

### Extended Assessment

#### Paper 2 – (Extended)

Written paper, 1 hour 30 minutes, 70 marks

Candidates answer all questions.

This paper consists of short-answer questions based on the Extended curriculum.

This is a compulsory component for Extended candidates.

This written paper is an externally set assessment, marked by Cambridge International.

#### Paper 4 – (Extended)

Written paper, 2 hours 30 minutes, 130 marks

Candidates answer all questions.

This paper consists of structured questions based on the Extended curriculum.

This is a compulsory component for Extended candidates.

This written paper is an externally set assessment, marked by Cambridge International.

## Formula Lists

### Formula List for Core Papers 1 and 3

Area,  $A$ , of triangle, base  $b$ , height  $h$ .

$$A = \frac{1}{2}bh$$

Area,  $A$ , of circle, radius  $r$ .

$$A = \pi r^2$$

Circumference,  $C$ , of circle, radius  $r$ .

$$C = 2\pi r$$

Lateral surface area,  $A$ , of cylinder of radius  $r$ , height  $h$ .

$$A = 2\pi rh$$

Surface area,  $A$ , of sphere of radius  $r$ .

$$A = 4\pi r^2$$

Volume,  $V$ , of prism, cross-sectional area  $A$ , length  $l$ .

$$V = Al$$

Volume,  $V$ , of cylinder of radius  $r$ , height  $h$ .

$$V = \pi r^2 h$$

Volume,  $V$ , of sphere of radius  $r$ .

$$V = \frac{4}{3}\pi r^3$$

### Formula List for Extended Papers 2 and 4

For the equation  $ax^2 + bx + c = 0$

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

Lateral surface area,  $A$ , of cylinder of radius  $r$ , height  $h$ .

$$A = 2\pi rh$$

Lateral surface area,  $A$ , of cone of radius  $r$ , sloping edge  $l$ .

$$A = \pi rl$$

Surface area,  $A$ , of sphere of radius  $r$ .

$$A = 4\pi r^2$$

Volume,  $V$ , of pyramid, base area  $A$ , height  $h$ .

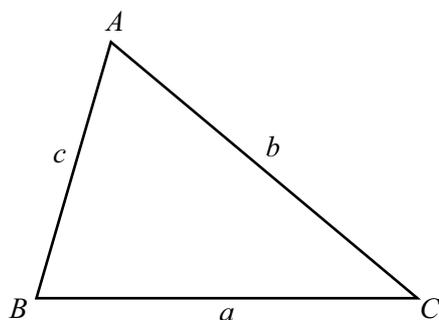
$$V = \frac{1}{3}Ah$$

Volume,  $V$ , of cone of radius  $r$ , height  $h$ .

$$V = \frac{1}{3}\pi r^2 h$$

Volume,  $V$ , of sphere of radius  $r$ .

$$V = \frac{4}{3}\pi r^3$$



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

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

$$\text{Area} = \frac{1}{2}bc \sin A$$

## Command words

Command words and their meanings help candidates know what is expected from them in the exams. The table below includes command words used in the assessment for this syllabus. The use of the command word will relate to the subject context.

Command word	What it means
<b>Calculate</b>	work out from given facts, figures or information
<b>Construct</b>	make an accurate drawing
<b>Describe</b>	state the points of a topic / give characteristics and main features
<b>Determine</b>	establish with certainty
<b>Explain</b>	set out purposes or reasons / make the relationships between things clear / say why and/or how and support with relevant evidence
<b>Give</b>	produce an answer from a given source or recall/memory
<b>Plot</b>	mark point(s) on a graph
<b>Sketch</b>	make a simple freehand drawing showing the key features, taking care over proportions
<b>Work out</b>	calculate from given facts, figures or information with or without the use of a calculator
<b>Write</b>	give an answer in a specific form
<b>Write down</b>	give an answer without significant working

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## 5 What else you need to know

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This section is an overview of other information you need to know about this syllabus. It will help to share the administrative information with your exams officer so they know when you will need their support. Find more information about our administrative processes at [www.cambridgeinternational.org/eoguide](http://www.cambridgeinternational.org/eoguide)

### Before you start

#### Previous study

We recommend that learners starting this course should have studied a mathematics curriculum such as the Cambridge Lower Secondary program or equivalent national educational framework.

#### Guided learning hours

We design Cambridge IGCSE syllabi to require about 130 guided learning hours for each subject. This is for guidance only. The number of hours a learner needs to achieve the qualification may vary according to each school and the learners' previous experience of the subject.

#### Availability and timetables

All Cambridge schools are allocated to one of six administrative zones. Each zone has a specific timetable. This syllabus is **not** available in all administrative zones. To find out about availability check the syllabus page at [www.cambridgeinternational.org/0444](http://www.cambridgeinternational.org/0444)

You can view the timetable for your administrative zone at [www.cambridgeinternational.org/timetables](http://www.cambridgeinternational.org/timetables)

You can enter candidates in the June exam series.

Check you are using the syllabus for the year the candidate is taking the exam.

Private candidates can enter for this syllabus. For more information, please refer to the *Cambridge Guide to Making Entries*.

#### Combining with other syllabi

Candidates can take this syllabus alongside other Cambridge International syllabi in a single exam series. The only exceptions are:

- Cambridge IGCSE Mathematics (0580)
- syllabi with the same title (or the title Mathematics) at the same level.

Cambridge IGCSE and Cambridge IGCSE (9–1) syllabi are at the same level.

#### Group awards: Cambridge ICE

Cambridge ICE (International Certificate of Education) is a group award for Cambridge IGCSE. It allows schools to offer a broad and balanced curriculum by recognising the achievements of learners who pass exams in a range of different subjects.

Learn more about Cambridge ICE at [www.cambridgeinternational.org/cambridgeice](http://www.cambridgeinternational.org/cambridgeice)

## Making entries

Exams officers are responsible for submitting entries to Cambridge International. We encourage them to work closely with you to make sure they enter the right number of candidates for the right combination of syllabus components. Entry option codes and instructions for submitting entries are in the *Cambridge Guide to Making Entries*. Your exams officer has a copy of this guide.

## Exam administration

To keep our exams secure, we produce question papers for different areas of the world, known as administrative zones. We allocate all Cambridge schools to an administrative zone determined by their location. Each zone has a specific timetable. Some of our syllabi offer candidates different assessment options. An entry option code is used to identify the components the candidate will take relevant to the administrative zone and the available assessment options.

## Support for exams officers

We know how important exams officers are to the successful running of exams. We provide them with the support they need to make your entries on time. Your exams officer will find this support, and guidance for all other phases of the Cambridge Exams Cycle, at [www.cambridgeinternational.org/eoguide](http://www.cambridgeinternational.org/eoguide)

## Retakes

Candidates can retake the whole qualification as many times as they want to. Information on retake entries is at [www.cambridgeinternational.org/retakes](http://www.cambridgeinternational.org/retakes)

## Language

This syllabus and the related assessment materials are available in English only.

## Accessibility and equality

### Syllabus and assessment design

Cambridge International works to avoid direct or indirect discrimination. We develop and design syllabuses and assessment materials to maximise inclusivity for candidates of all national, cultural or social backgrounds and candidates with protected characteristics; these protected characteristics include special educational needs and disability, religion and belief, and characteristics related to gender and identity. In addition, the language and layout used are designed to make our materials as accessible as possible. This gives all candidates the fairest possible opportunity to demonstrate their knowledge, skills and understanding and helps to minimise the requirement to make reasonable adjustments during the assessment process.

### Access arrangements

Access arrangements (including modified papers) are the principal way in which Cambridge International complies with our duty, as guided by the UK Equality Act (2010), to make 'reasonable adjustments' for candidates with special educational needs (SEN), disability, illness or injury. Where a candidate would otherwise be at a substantial disadvantage in comparison to a candidate with no SEN, disability, illness or injury, we may be able to agree pre-examination access arrangements. These arrangements help a candidate by minimising accessibility barriers and maximising their opportunity to demonstrate their knowledge, skills and understanding in an assessment.

**Important:**

- Requested access arrangements should be based on evidence of the candidate's barrier to assessment and should also reflect their normal way of working at school; this is in line with the *Cambridge Handbook* [www.cambridgeinternational.org/eoguide](http://www.cambridgeinternational.org/eoguide)
- For Cambridge International to approve an access arrangement, we will need to agree that it constitutes a reasonable adjustment, involves reasonable cost and timeframe and does not affect the security and integrity of the assessment.
- Availability of access arrangements should be checked by centres at the start of the course. Details of our standard access arrangements and modified question papers are available in the *Cambridge Handbook* [www.cambridgeinternational.org/eoguide](http://www.cambridgeinternational.org/eoguide)
- Please contact us at the start of the course to find out if we are able to approve an arrangement that is not included in the list of standard access arrangements.
- Candidates who cannot access parts of the assessment may be able to receive an award based on the parts they have completed.

## After the exam

### Grading and reporting

Grades A\*, A, B, C, D, E, F or G indicate the standard a candidate achieved at Cambridge IGCSE.

A\* is the highest and G is the lowest. 'Ungraded' means that the candidate's performance did not meet the standard required for grade G. 'Ungraded' is reported on the statement of results but not on the certificate.

In specific circumstances your candidates may see one of the following letters on their statement of results:

- Q (PENDING)
- X (NO RESULT).

These letters do not appear on the certificate.

On the statement of results and certificates, Cambridge IGCSE is shown as INTERNATIONAL GENERAL CERTIFICATE OF SECONDARY EDUCATION (IGCSE).

## How students and teachers can use the grades

Assessment at Cambridge IGCSE has two purposes:

- 1 to measure learning and achievement  
The assessment confirms achievement and performance in relation to the knowledge, understanding and skills specified in the syllabus, to the levels described in the grade descriptions.
- 2 to show likely future success  
The outcomes help predict which students are well prepared for a particular course or career and/or which students are more likely to be successful.  
The outcomes help students choose the most suitable course or career.

## Grade descriptions

Grade descriptions are provided to give an indication of the standards of achievement candidates awarded particular grades are likely to show. Weakness in one aspect of the examination may be balanced by a better performance in some other aspect.

### Grade A

At this level, candidates should make clear, concise, and accurate statements, demonstrating ease and confidence in the use of symbolic forms and accuracy of arithmetic manipulation. They should apply the mathematics they know in familiar and unfamiliar contexts.

- Candidates should understand and use direct and inverse proportion. A further understanding of percentages should be evident by relating percentage change to change to a multiplying factor and vice versa, e.g., multiplication by 1.03 results in a 3% increase.
- Knowledge of the four rules for fractions should be applied to the simplification of algebraic fractions. Building on their knowledge of algebraic manipulation, candidates should be able to manipulate linear and quadratic equations and systems of linear equations. They should be able to use positive, negative, and fractional exponents in both numerical and algebraic work, and interpret the description of a situation in terms of algebraic formulae and equations. Their knowledge of graphs of algebraic functions should be extended to the intersections and slopes of these graphs.
- The basic knowledge of scale factors should be extended to two and three dimensions and applied to calculating lengths, areas, and volumes between actual values and scale models. The basic right-angled trigonometry knowledge should be extended to an understanding of and solving problems on non-right-angled triangles.
- At this level, candidates should be able to process data, discriminating between necessary and redundant information.

## Grade C

At this level, candidates are expected to show some insight into the mathematical structures of problems, which enables them to justify generalizations, arguments, or solutions. Mathematical presentation and stages of derivations should be more extensive in order to generate fuller solutions. They should appreciate the difference between mathematical explanation and experimental evidence.

- Candidates should now apply the four rules of number to positive and negative integers, fractions, and decimal fractions, in order to solve problems. Percentage should be extended to problems involving calculating one quantity as a percentage of another and its application to percentage change. Calculations would now involve several operations and allow candidates to demonstrate fluent and efficient use of calculators, as well as giving reasonable approximations. The relationship between decimal and standard form of a number should be appreciated and applied to positive and negative powers of 10. They should be familiar with the differences between simple and compound interest and apply this to calculating both.
- Candidates now need to extend their basic knowledge of sequences to recognize, and in simple cases formulate, rules for generating a pattern or sequence. While extending the level of difficulty of solving linear equations by involving appropriate algebraic manipulation, candidates are also expected to solve simple systems of equations in two unknowns. Work with formulae extends into harder substitution and evaluating the remaining term, as well as transforming simple formulae. The knowledge of basic algebra is extended to the use of parentheses and common factor factorization. On graph work, candidates should be able to plot points from given values and use them to draw and interpret algebraic graphs of linear and quadratic functions.
- Candidates are expected to extend perimeter and area beyond rectilinear shapes to circles. They are expected to appreciate and use area and volume units in relation to finding the volume and surface area of a prism and cylinder. The basic construction work, with appropriate geometrical instruments, should now be extended and applied to accurate scale diagrams to solve a two-dimensional problem. The Pythagorean Theorem and trigonometry of right-angled triangles should be understood and applied to solving, by calculation, problems in a variety of contexts. The calculation of angles in a variety of geometrical figures, including polygons and to some extent circles, should be expected from straightforward diagrams.
- Candidates should be able to use a frequency table to construct a pie chart. They need to understand and construct a scatter diagram and apply this to a judgment of the correlation existing between two quantities.

## Grade F

At this level, candidates are expected to identify and obtain necessary information. They would be expected to recognize if their solutions to problems are sensible. An understanding of simple situations should enable candidates to describe them, using symbols, words, and diagrams. They draw simple, basic conclusions with explanations where appropriate.

- With an understanding of place value, candidates should be able to perform calculations using the four rules on positive integers and decimal fractions (one operation only), using a calculator where necessary. They should be able to convert between fractions, decimals, and percentages for the purpose of comparing quantities between 0 and 1 in a variety of forms, and reduce a fraction to its simplest form. Candidates should appreciate the idea of direct proportion, and the solution of simple problems involving ratio should be expected. Basic knowledge of percentage is needed to apply to simple problems involving percentage parts of quantities. They need to understand and apply metric units of length, mass, and capacity, together with conversion between units in these areas of measure. The ability to recognize and continue a straightforward pattern in sequences and understand the terms multiples, factors, and squares is needed as a foundation to higher grade levels of applications in the areas of number and algebra.
- At this level, the algebra is very basic, involving the construction of simple algebraic expressions, substituting numbers for letters, and evaluating simple formulae. Candidates should appreciate how a simple linear equation can represent a practical situation and be able to solve such equations.

- Knowledge of names and recognition of simple plane figures and common solids is basic to an understanding of shape and space. This will be applied to the perimeter and area of a rectangle and other rectilinear shapes. The skill of using geometrical instruments, ruler, protractor, and compasses is required for applying to measuring lengths and angles and drawing a triangle given three sides.
- Candidates should be familiar with reading data from a variety of sources and be able to extract data from them, in particular timetables. The tabulation of the data is expected in order to form frequency tables and draw a bar chart. They will need the skill of plotting given points on a graph. From a set of numbers, they should be able to calculate the mean.

## Changes to this syllabus for 2025

The syllabus has been updated. This is version 2, published March 2024.

**You must read the whole syllabus before planning your teaching programme.** We review our syllabi regularly to make sure they continue to meet the needs of our schools. In updating this syllabus, we have made it easier for teachers and students to understand, keeping the familiar features that teachers and schools value.

### Changes to version 2 of this syllabus, published March 2024

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**Advanced notice of withdrawal**

This syllabus will be withdrawn from June 2025

The last examination series will be held in June 2025.

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There are no significant changes which affect teaching.

Any textbooks endorsed to support the syllabus for examination from 2024 are still suitable for use with this syllabus.



**School feedback:** ‘While studying Cambridge IGCSE and Cambridge International A Levels, students broaden their horizons through a global perspective and develop a lasting passion for learning.’

**Feedback from:** Zhai Xiaoning, Deputy Principal, The High School Affiliated to Renmin University of China

We are committed to making our documents accessible in accordance with the WCAG 2.1 Standard. We are always looking to improve the accessibility of our documents. If you find any problems or you think we are not meeting accessibility requirements, contact us at [info@cambridgeinternational.org](mailto:info@cambridgeinternational.org) with the subject heading: Digital accessibility. If you need this document in a different format, contact us and supply your name, email address and requirements and we will respond within 15 working days.

Cambridge Assessment International Education, The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom  
t: +44 (0)1223 553554      email: [info@cambridgeinternational.org](mailto:info@cambridgeinternational.org)      [www.cambridgeinternational.org](http://www.cambridgeinternational.org)

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