Cambridge Assessment International Education

# Syllabus

## Cambridge IGCSE™

## Mathematics (US) 0444

For examination in June and November 2020 and 2021.
This syllabus is available only to schools in Arizona in the USA.

Version 1

Cambridge Pathway

# Why Choose Cambridge?

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

Our international qualifications are recognized by the world's best universities and employers, giving students a wide range of options in their education and career. As a not-for-profit organization, we devote our resources to delivering high-quality educational programs that can unlock learners' potential.

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 an international education from Cambridge International.

"We think the Cambridge curriculum is superb preparation for university."

**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**

# Contents



**Changes to this syllabus**

For information about changes to this syllabus for 2020 and 2021, go to page 42.

# 1 Why Choose This Syllabus?

## Key Benefits

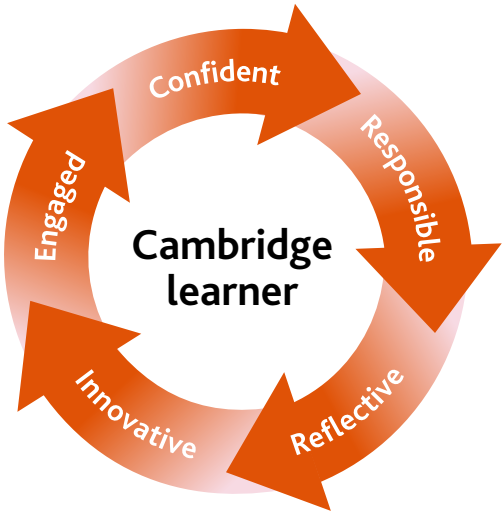
Cambridge IGCSE™ syllabi are created especially for international students. For over 25 years, we have worked with schools and teachers worldwide to develop syllabi that are suitable for different countries, different types of schools, and for learners with a wide range of abilities.

Cambridge IGCSE Mathematics (US) allows learners 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.

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.

Our approach encourages learners to be:




"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."

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

## Recognition and Progression

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. Candidates must study the extended curriculum to be able to progress on to Cambridge International AS 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.

Learn more at **www.cambridgeinternational.org/recognition**

## Supporting Teachers

We provide a wide range of practical resources, detailed guidance, and innovative training and professional development so that you can give your learners the best possible preparation for Cambridge IGCSE.

**Teaching Resources**

- School Support Hub
  **www.cambridgeinternational.org/support**
- Syllabus
- Scheme of work
- Learner guide
- Discussion forum
- Resource list
- Endorsed textbooks and digital resources

**Exam Preparation Resources**

- Question papers
- Mark schemes
- Example candidate responses to understand what examiners are looking for at key grades
- Examiner reports to improve future teaching

**Support for Cambridge IGCSE**

**Training**

- Face-to-face workshops around the world
- Online self-study training
- Online tutor-led training
- Cambridge Professional Development Qualifications

**Community**

You can find useful information, as well as share your ideas and experiences with other teachers, on our social media channels and community forums.

Find out more at
**www.cambridgeinternational.org/social-media**

"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 programs."

**Mrs Omnia Kassabgy**, Managing Director of British School in Egypt BSE

# 2 Syllabus Overview

## 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.

### Support for Cambridge IGCSE Mathematics (US)

Our School Support Hub **www.cambridgeinternational.org/support** provides Cambridge schools with a secure site for downloading specimen and past question papers, mark schemes, grade thresholds, and other curriculum resources specific to this syllabus. The School Support Hub community offers teachers the opportunity to connect with each other and to ask questions related to the syllabus.

# 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 G–C, and the Extended content is intended for students targeting grades D–A*. 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 be in possession of 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 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 candidates take:**

**Paper 1 (Core)** 1 hour 35%

56 marks

Short-answer questions

Questions will be based on the Core curriculum

Calculators are **not** permitted

Externally assessed

**and:**

**Paper 3 (Core)** 2 hours 65%

104 marks

Structured questions

Questions will be based on the Core curriculum

Scientific calculators are required

Externally assessed

**Extended candidates take:**

**Paper 2 (Extended)** 1 hour 30 minutes 35%

70 marks

Short-answer questions

Questions will be based on the Extended curriculum

Calculators are **not** permitted

Externally assessed

**and:**

**Paper 4 (Extended)** 2 hours 30 minutes 65%

130 marks

Structured questions

Questions will be based on the Extended curriculum

Scientific calculators are required

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.

## Assessment Objectives

The assessment objectives (AOs) are:

- 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

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

| 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.<br><br>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.<br><br>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.<br>Includes both simple and compound interest. |
| 1.7 | Meaning and calculation of exponents (powers, indices) including positive, negative, and zero exponents.<br><br>Explain the definition of radical exponents as an extension to integral exponents.<br><br>Explain the rules for exponents.<br><br>Scientific notation (Standard Form) $a \times 10^n$ where $1 \leqslant a < 10$ and $n$ is an integer. | e.g., work out $4^{-3}$ as a fraction.<br><br>e.g., work out $2^4 \times 2^{-3}$<br><br>Convert numbers in and out of scientific notation.<br>Calculate with values in scientific notation. |

| 1 | Number—Extended curriculum | Notes/Examples |
|---|---|---|
| 1.1 | Knowledge of: natural numbers, integers (positive, negative, and zero), prime numbers, square numbers, rational and irrational numbers, real numbers.<br><br>Use of symbols: =, ≠, ⩽, ⩾, <, > | 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. |
| 1.2 | Use of the four operations and parentheses. | Applies to integers, fractions, and decimals.<br>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.<br><br>Order quantities given in different forms by magnitude, by first converting into same form. | |
| 1.6 | Percentages, including applications such as interest and profit. | Includes reverse percentages.<br>Includes both simple and compound interest.<br>Includes percentiles. |
| 1.7 | Meaning and calculation of exponents (powers, indices) including positive, negative, zero, and fractional exponents.<br><br>Explain the definition of radical exponents as an extension to integral exponents.<br><br>Explain the rules for exponents.<br><br>Scientific notation (Standard Form) $a \times 10^n$ where $1 \leqslant a < 10$ and $n$ is an integer. | e.g., $5^{\frac{1}{2}} = \sqrt{5}$<br>e.g., evaluate $5^{-2}$, $100^{\frac{1}{2}}$, $8^{-\frac{2}{3}}$<br><br>e.g., work out $2^4 \times 2^{-3}$<br><br>Convert numbers in and out of scientific notation.<br>Calculate with values in scientific notation. |

| 1 | Number—Core curriculum | Notes/Examples |
|---|---|---|
| 1.8 | Radicals, calculation of square root and cube root expressions. | e.g., the area of a square is 54.76 $cm^2$.<br>Work out the length of one side of the square.<br><br>Find the value of the cube root of 64. |
| 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.<br>Includes familiarity with both 24-hour and 12-hour clocks and extraction of data from dials and schedules. |
| 1.11 | Speed, distance, time problems. | |

| 1 | Number—Extended curriculum | Notes/Examples |
|---|---|---|
| 1.8 | Radicals, calculation and simplification of square root and cube root expressions. | e.g., simplify $\sqrt{200}+\sqrt{18}$<br>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.<br>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—Core curriculum | Notes/Examples |
|---|---|---|
| 2.1 | *Extended Curriculum only.* | |
| 2.2 | *Extended Curriculum only.* | |
| 2.3 | Create expressions and create and solve linear equations, including those with fractional expressions. | Explain each algebraic step of the solution.<br>May be asked to interpret solutions to a problem given in context.<br>Construct a viable argument to justify a solution method. |
| 2.4 | Exponents (indices). | Includes rules of exponents with negative exponents.<br>Simple examples only,<br>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:<br>• $p = rt - q$<br>• $w = \frac{r-t}{y}$<br>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).<br>Simplify expressions. | e.g., expand and simplify $4(5c - 3d) - 7c$ |

| 2 | Algebra—Extended curriculum | Notes/Examples |
|---|---|---|
| 2.1 | Writing, showing, and interpretation of inequalities on the real number line. | |
| 2.2 | Create and solve linear inequalities. | e.g., solve $3x + 5 < 7$<br>solve $-7 \leqslant 3n - 1 < 5$ |
| 2.3 | Create expressions and create and solve linear equations, including those with fractional expressions. | Explain each algebraic step of the solution.<br>May be asked to interpret solutions to a problem given in context.<br>Construct a viable argument to justify a solution method. |
| 2.4 | Exponents (indices). | Includes rules of exponents with negative and fractional exponents.<br>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.<br>Formulae may include exponents or cases where the subject appears twice.<br>e.g., make *r* the subject of<br>• $V = \frac{4}{3}\pi r^3$<br>• $p = \frac{2r - 3}{r + s}$<br>e.g., $y = m^2 - 4n^2$<br>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 3.2* |
| 2.7 | Identify terms, factors, and coefficients.<br>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—Core curriculum | Notes/Examples |
|---|---|---|
| 2.9 | Factorization: common factor only. | e.g., $6x^2 + 9x = 3x(2x + 3)$ |
| 2.10 | *Extended Curriculum only.* | |
| 2.11 | *Extended Curriculum only.* | |
| 2.12 | *Extended Curriculum only.* | |
| 2.13 | Continuation of a sequence of numbers or patterns; recognize patterns in sequences; generalize to simple algebraic statements, including determination of the $n^{th}$ term. | e.g., find the $n^{th}$ term of:<br>• 5 9 13 17 21<br>• 2 4 8 16 32 |
| 2.14 | *Extended Curriculum only.* | |

| 2 | Algebra—Extended curriculum | Notes/Examples |
|---|---|---|
| 2.9 | Use equivalent forms of an expression or function to reveal and explain properties of the quantities or function represented.<br>Factorization:<br>common factor<br>difference of squares<br>trinomial<br>four term. | $6x^2 + 9x = 3x(2x + 3)$<br>$9x^2 - 16y^2 = (3x - 4y)(3x + 4y)$<br>$6x^2 + 11x - 10 = (3x - 2)(2x + 5)$<br>$xy - 3x + 2y - 6 = (x + 2)(y - 3)$<br>Use the structure of an expression to identify ways to rewrite it, for example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$. |
| 2.10 | Algebraic fractions:<br>simplification, including use of factorization<br>addition or subtraction of fractions with linear denominators<br>multiplication or division and simplification of two fractions. | e.g., simplify $\frac{4x^2 - 9}{8x^2 - 10x - 3}$, $\frac{3}{2x + 1} - \frac{4}{x}$, $\frac{7x}{4y^2} \div \frac{21x}{8}$ |
| 2.11 | Create and solve quadratic equations by:<br>inspection<br>factorization<br>using the quadratic formula<br>completing the square. | e.g., $x^2 = 49$<br>$2x^2 + 5x - 3 = 0$<br>$3x^2 - 2x - 7 = 0$<br>Write $x^2 - 6x + 9$ in the form $(x - a)^2 + b$ and state the minimum value of the function.<br>Quadratic formula will be given. |
| 2.12 | Solve simple rational and radical equations in one variable and discount any extraneous solutions. | e.g., solve $\sqrt{x} + 2 = 6, x^{-3} = 27, 2y^4 = 32$ |
| 2.13 | Continuation of a sequence of numbers or patterns; recognize patterns in sequences; generalize to simple algebraic statements, including determination of the $n^{th}$ term.<br><br>Derive the formula for the sum of a finite geometric series, and use the formula to solve problems. | e.g., find the $n^{th}$ term of:<br>• 5 9 13 17 21<br>• 2 4 8 16 32<br>• 2 5 10 17 26<br>• 3 6 12 24 48<br>For a common ratio that is not 1. e.g., calculate mortgage payments. |
| 2.14 | Express direct and inverse variation in algebraic terms and use this form of expression to find unknown quantities. | e.g., $y \propto x$, $y \propto \sqrt{x}$, $y \propto \frac{1}{x}$, $y \propto \frac{1}{x^2}$ |

| 3 | Functions—Core curriculum | Notes/Examples |
|---|---|---|
| 3.1 | Use function notation.<br>Knowledge of domain and range.<br>Mapping diagrams. | Understand that a function assigns to each element of the domain exactly one element of the range. If $\mathrm{f}$ is a function and $x$ is an element of its domain then $\mathrm{f}(x)$ denotes the output of $\mathrm{f}$ 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.<br><br>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.<br><br>Solve associated equations approximately by graphical methods. | |
| 3.3 | Write a function that describes a relationship between two quantities. | e.g., $\mathrm{C}(x) = 50{,}000 + 400x$ models the cost of producing $x$ wheelchairs. Write a function that represents the cost of one wheelchair. |
| 3.4 | *Extended Curriculum only.* | |
| 3.5 | Recognition of the following function types from the shape of their graphs:<br>linear $\mathrm{f}(x) = ax + b$<br>quadratic $\mathrm{f}(x) = ax^2 + bx + c$<br>reciprocal $\mathrm{f}(x) = \frac{a}{x}$<br><br>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 | Functions—Extended curriculum | Notes/Examples |
|---|---|---|
| 3.1 | Use function notation.<br>Knowledge of domain and range.<br>Mapping diagrams. | e.g., $f(x)$; $f:x$<br><br>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.<br><br>Construct tables of values and construct graphs of functions of the form $ax^n$ where $a$ is a rational constant and $n = -2, -1, 0, 1, 2, 3$ and simple sums of not more than three of these and for functions of the type $a^x$ where $a$ is a positive integer.<br><br>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 | Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). | e.g., given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. |
| 3.5 | Recognition of the following function types from the shape of their graphs:<br>linear $f(x) = ax + b$<br>quadratic $f(x) = ax^2 + bx + c$<br>cubic $f(x) = ax^3 + bx^2 + cx + d$<br>reciprocal $f(x) = \frac{a}{x}$<br>exponential $f(x) = a^x$ with $0 < a < 1$ or $a > 1$<br>trigonometric $f(x) = a\sin(bx)$; $a\cos(bx)$; $\tan x$<br><br>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. | Some of $a$, $b$, $c$ and $d$ may be $0$<br><br>Including period and amplitude. |

| 3 | Functions—Core curriculum | Notes/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 $\mathrm{h}(n)$ 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 | *Extended Curriculum only.* | |
| 3.8 | *Extended Curriculum only.* | |
| 3.9 | *Extended Curriculum only.* | |
| 3.10 | *Extended Curriculum only.* | |
| 3.11 | *Extended Curriculum only.* | |
| 3.12 | Description and identification, using the language of transformations, of the changes to the graph of $y = \mathrm{f}(x)$ when $y = \mathrm{f}(x) + k, y = k\,\mathrm{f}(x), y = \mathrm{f}(x + k)$ for $\mathrm{f}(x)$ given in section 3.5. | Where $k$ is an integer. |
| 3.13 | *Extended Curriculum only.* | |

| 3 | Functions—Extended curriculum | Notes/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 $\mathrm{h}(n)$ 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.<br>Estimate the rate of change from a graph. | e.g., average speed between 2 points<br>e.g., use a tangent to the curve to find the slope |
| 3.8 | Behavior of linear, quadratic, and exponential functions:<br>linear $\mathrm{f}(x) = ax + b$<br>quadratic $\mathrm{f}(x) = ax^2 + bx + c$<br>exponential $\mathrm{f}(x) = a^x$ 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.<br>Use the properties of exponents to interpret expressions for exponential functions,<br>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 $y$<br>$x$ \| $-2$ $0$ $2$ $4$<br>$y$ \| $3$ $5$ $7$ $9$ |
| 3.10 | Simplification of formulae for composite functions such as $\mathrm{f}(\mathrm{g}(x))$ where $\mathrm{g}(x)$ is a linear expression. | e.g., $\mathrm{f}(x) = 6 + 2x$, $\mathrm{g}(x) = 7x$,<br>$\mathrm{f}(\mathrm{g}(x)) = 6 + 2(7x) = 6 + 14x$ |
| 3.11 | Inverse function $\mathrm{f}^{-1}$. | Find an inverse function.<br>Solve equation of form $\mathrm{f}(x) = c$ for a simple function that has an inverse.<br>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 $y = \mathrm{f}(x)$ when $y = \mathrm{f}(x) + k, y = k\,\mathrm{f}(x), y = \mathrm{f}(x + k)$ for $\mathrm{f}(x)$ given in section 3.5. | Where $k$ is an integer. |
| 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 $y > 3$, $2x + y < 12$, $y \leqslant x$. |

| 4 | Geometry—Core curriculum | Notes/Examples |
|---|---|---|
| 4.1 | Vocabulary:<br>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. | |
| 4.2 | Definitions:<br>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. | |
| 4.3 | Line and rotational symmetry in 2D. | e.g., know properties of triangles, quadrilaterals, and circles directly related to their symmetries. |
| 4.4 | Angles around a point.<br>Angles on a straight line and intersecting straight lines.<br>Vertically opposite angles.<br>Alternate and corresponding angles on parallel lines.<br>Angle properties of triangles, quadrilaterals, and polygons.<br>Interior and exterior angles of a polygon. | Formal proof is not required, but candidates will be expected to use reasoned arguments, including justifications, to establish geometric results from given information. |
| 4.5 | Construction.<br>Make formal geometric constructions with compass and straight edge only.<br>Copy a segment; copy an angle; bisect a segment; bisect an angle; construct perpendicular lines, including the perpendicular bisector of a line segment.<br>Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.<br>Construct the inscribed and circumscribed circles of a triangle.<br>Construct a tangent line from a point outside a given circle to the circle.<br>Angle measurement in degrees.<br>Read and make scale drawings. | |

| 4 | Geometry—Extended curriculum | Notes/Examples |
|---|---|---|
| 4.1 | Vocabulary:<br>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. | |
| 4.2 | Definitions:<br>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. | |
| 4.3 | Line and rotational symmetry in 2D and 3D. | e.g., know properties of triangles, quadrilaterals, and circles directly related to their symmetries.<br>For example, given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.<br>Recognize symmetry properties of the prism and the pyramid. |
| 4.4 | Angles around a point.<br>Angles on a straight line and intersecting straight lines.<br>Vertically opposite angles.<br>Alternate and corresponding angles on parallel lines.<br>Angle properties of triangles, quadrilaterals, and polygons.<br>Interior and exterior angles of a polygon. | Formal proof is not required, but candidates will be expected to use reasoned arguments, including justifications, to establish geometric results from given information. |
| 4.5 | Construction.<br>Make formal geometric constructions with compass and straight edge only.<br>Copy a segment; copy an angle; bisect a segment; bisect an angle; construct perpendicular lines, including the perpendicular bisector of a line segment.<br>Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.<br>Construct the inscribed and circumscribed circles of a triangle.<br>Construct a tangent line from a point outside a given circle to the circle.<br>Angle measurement in degrees.<br>Read and make scale drawings. | |

| 4 | Geometry—Core curriculum | Notes/Examples |
|---|---|---|
| 4.6 | Vocabulary of circles.<br>Properties of circles:<br>• tangent perpendicular to radius at the point of contact<br>• angle in a semicircle. | 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.<br>Calculation of lengths of similar figures. | Use scale factors and/or angles to check for similarity. |
| 4.8 | *Extended Curriculum only.* | |

| 4 | Geometry—Extended curriculum | Notes/Examples |
|---|---|---|
| 4.6 | Vocabulary of circles.<br>Properties of circles:<br>• tangent perpendicular to radius at the point of contact<br>• tangents from a point<br>• angle in a semicircle<br>• angles at the center and at the circumference on the same arc<br>• cyclic quadrilateral.<br><br>Use the following symmetry properties of a circle:<br>• equal chords are equidistant from the center<br>• the perpendicular bisector of a chord passes through the center<br>• tangents from an external point are equal in length. | 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.<br>Calculation of lengths of similar figures.<br>Area and volume scale factors. | Use scale factors and/or angles to check for similarity.<br>Use of the relationships between areas of similar figures and extension to volumes and surface areas of similar solids. |
| 4.8 | Congruence.<br>Recognize that two shapes are congruent and use this to solve problems. | |

| 5 | Transformations and Vectors—Core curriculum | Notes/Examples |
|---|---|---|
| 5.1 | Vector notation:<br>directed line segment $\overrightarrow{AB}$ ;<br>component form $\begin{pmatrix} x \\ y \end{pmatrix}$ | |
| 5.2 | *Extended Curriculum only.* | |
| 5.3 | *Extended Curriculum only.* | |
| 5.4 | *Extended Curriculum only.* | |
| 5.5 | *Extended Curriculum only.* | |
| 5.6 | Transformations on the cartesian plane:<br>translation, reflection, rotation, enlargement (dilation).<br>Description of a translation using column vectors. | Representing and describing transformations. |
| 5.7 | *Extended Curriculum only.* | |
| 5.8 | *Extended Curriculum only.* | |

| 5 | Transformations and Vectors—Extended curriculum | Notes/Examples |
|---|---|---|
| 5.1 | Vector notation:<br>**a**; directed line segment $\overrightarrow{AB}$;<br>component form $\begin{pmatrix} x \\ y \end{pmatrix}$<br>use appropriate symbols for vectors and their magnitudes | e.g., **v**, $\lvert\mathbf{v}\rvert$ |
| 5.2 | Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.<br>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.<br>Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.<br>Understand vector subtraction **v** – **w** as **v** + (–**w**), where –**w** is the additive inverse of **w**, with the same magnitude as **w** and pointing in the opposite direction. |
| 5.5 | Multiply a vector by a scalar. | e.g., $\left\lvert 3\begin{pmatrix} -4 \\ 3 \end{pmatrix}\right\rvert = 3(5) = 15$<br>$c\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} cx \\ cy \end{pmatrix}$<br>If $c\lvert\mathbf{v}\rvert \neq 0$, the direction of $c\mathbf{v}$ is either along **v** (for $c > 0$) or against **v** (for $c < 0$). |
| 5.6 | Transformations on the cartesian plane: translation, reflection, rotation, enlargement (dilation), stretch.<br>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 **single** transformation that can replace a rotation of 180° around the origin followed by a translation by vector $\begin{pmatrix} 4 \\ -2 \end{pmatrix}$ |

| 6 | Geometrical Measurement—Core curriculum | Notes/Examples |
|---|---|---|
| 6.1 | Units: mm, cm, m, km<br>$mm^2$, $cm^2$, $m^2$, ha, $km^2$<br>$mm^3$, $cm^3$, ml, cl, l, $m^3$<br>g, kg | All units will be metric; conversion between units is expected.<br><br>Units of time as given in section 1.10. |
| 6.2 | Perimeter and area of rectangle, triangle, and compound shapes derived from these.<br>Area of trapezoid and parallelogram. | Formula will be given for area of triangle. |
| 6.3 | Circumference and area of a circle.<br><br>Arc length and area of sector. | Formulae will be given for circumference and area of a circle.<br>From sector angles in degrees and simple examples only. |
| 6.4 | Surface area and volume of a prism (in particular, cuboid, and cylinder).<br>Surface area and volume of a sphere. | Formulae will be given for the lateral surface area of cylinder and the surface area of a sphere, and the volume of a prism, a cylinder, and a sphere. |
| 6.5 | *Extended Curriculum only.* | |
| 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 | *Extended Curriculum only.* | |
| 6.8 | *Extended Curriculum only.* | |
| 6.9 | *Extended Curriculum only.* | |

| 6 | Geometrical Measurement—Extended curriculum | Notes/Examples |
|---|---|---|
| 6.1 | Units: mm, cm, m, km<br>$mm^2$, $cm^2$, $m^2$, ha, $km^2$<br>$mm^3$, $cm^3$, ml, cl, l, $m^3$<br>g, kg | All units will be metric; conversion between units expected.<br><br>Units of time as given in section 1.10. |
| 6.2 | Perimeter and area of rectangle, triangle, and compound shapes derived from these.<br>Area of trapezoid and parallelogram. | |
| 6.3 | Circumference and area of a circle.<br>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).<br>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—core curriculum | Notes/Examples |
|---|---|---|
| 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.<br>Find the equation of a line parallel to a given line that passes through a given point. | |

| 8 | Trigonometry—Core curriculum | Notes/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 | *Extended Curriculum only.* | |
| 8.3 | *Extended Curriculum only.* | |
| 8.4 | *Extended Curriculum only.* | |
| 8.5 | *Extended Curriculum only.* | |

| 7 | Coordinate Geometry—Extended curriculum | Notes/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.<br>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 $y = mx + b$.<br>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.<br>Find the equation of a line parallel to a given line that passes through a given point.<br>Slope of perpendicular line.<br>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—Extended curriculum | Notes/Examples |
|---|---|---|
| 8.1 | Use trigonometric ratios and the Pythagorean Theorem to solve right-angled triangles in applied problems.<br>Know the exact values for the trigonometric ratios of 0°, 30°, 45°, 60°, 90°. | Problems involving bearings may be included.<br>Know angle of elevation and depression. |
| 8.2 | Extend sine and cosine values to angles between 0° and 360°.<br>Explain and use the relationship between the sine and cosine of complementary angles.<br>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—Core curriculum | Notes/Examples |
|---|---|---|
| 9.1 | Probability $P(A)$ as a fraction, decimal, or percentage.<br>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.<br>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").<br>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 | *Extended Curriculum only.* | |
| 9.5 | Possibility diagrams.<br>Tree diagrams including successive selection with or without replacement. | Simple cases only. |

| 9 | Probability—Extended curriculum | Notes/Examples |
|---|---|---|
| 9.1 | Probability $\mathrm{P}(A)$ as a fraction, decimal, or percentage.<br>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.<br>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").<br>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:<br>Apply the addition rule $\mathrm{P}(A \text{ or } B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A \text{ and } B)$<br>Apply the multiplication rule $\mathrm{P}(A \text{ and } B) = \mathrm{P}(A) \times \mathrm{P}(B)$. | 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.<br>Tree diagrams including successive selection with or without replacement. | |

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

| 10 | Statistics—Extended curriculum | Notes/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 plots, line graph, pie chart, simple frequency distributions, scatter diagram. | |
| 10.4 | Mean, mode, median, and range from lists of discrete data.<br>Mean, modal class, median, and range from grouped and continuous data. | The term *estimated mean* 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.<br>Median, quartiles, percentiles, and inter quartile 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.<br>Straight line of best fit (by eye) through the mean on a scatter diagram. | |

# 4 Details of the Assessment

## Core Assessment

### Paper 1 (Core)

**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)

**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)

**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)

**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.

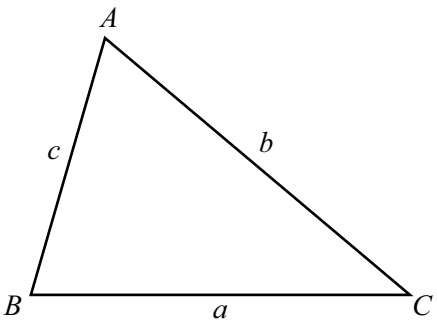
# Formula Lists

## 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

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 |
|---|---|
| **Calculate** | work out from given facts, figures or information, generally using a calculator |
| **Construct** | make an accurate drawing |
| **Describe** | state the points of a topic/give characteristics and main features |
| **Determine** | establish with certainty |
| **Explain** | set out purposes or reasons/ make the relationships between things evident/ provide why and/or how and support with relevant evidence |
| **Give** | produce an answer from a given source or recall/memory |
| **Plot** | mark point(s) on a graph |
| **Show (that)** | provide structured evidence that leads to a given result |
| **Sketch** | make a simple freehand drawing showing the key features |
| **Work out** | calculate from given facts, figures or information with or without the use of a calculator |
| **Write** | give an answer in a specific form |
| **Write down** | give an answer without significant working |

# 5 What Else You Need to Know

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/examsofficers**

## 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 based on learners having about 130 guided learning hours for each subject during the course but this is for guidance only. The number of hours a learner needs to achieve the qualification may vary according to local practice and their previous experience of the subject.

### Availability and Timetables

You can enter candidates in the June and November exam series. You can view the timetable for your administrative zone at **www.cambridgeinternational.org/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 the availability visit the syllabus page at **www.cambridgeinternational.org/igcse**

### Combining with Other Syllabi

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

- 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 recognizing the achievements of learners who pass examinations in a range of different subjects.

Learn more about Cambridge ICE at **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 one 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/examsofficers**

## Retakes

Candidates can retake the whole qualification as many times as they want to. This is a linear qualification so candidates cannot re-sit individual components.

## Equality and Inclusion

We have taken great care to avoid bias of any kind in the preparation of this syllabus and related assessment materials. In compliance with the UK Equality Act (2010) we have designed this qualification to avoid any direct and indirect discrimination.

The standard assessment arrangements may present unnecessary barriers for candidates with disabilities or learning difficulties. We can put arrangements in place for these candidates to enable them to access the assessments and receive recognition of their attainment. We do not agree access arrangements if they give candidates an unfair advantage over others or if they compromise the standards being assessed.

Candidates who cannot access the assessment of any component may be able to receive an award based on the parts of the assessment they have completed.

Information on access arrangements is in the *Cambridge Handbook* at
**www.cambridgeinternational.org/examsofficers**

## Language

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

# 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 (result pending)
- X (no result)
- Y (to be issued)

These letters do not appear on the certificate.

# How Students and Teachers Can Use the Grades

Assessment at Cambridge IGCSE has two purposes.

- 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.
- 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

  – help students choose the most suitable course or career.

# Grade Descriptions

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of a candidate's performance in the examination may be balanced by a better performance in others.

### 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 2020 and 2021

The syllabus has been updated. This is version 1, published February 2019.

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| **Changes to syllabus content** | • The order of the syllabus sections is updated. Please see the contents page of this syllabus.<br>• A subject content overview is now included. Please see section 2 of this syllabus.<br>• Information about the command words used in the assessment is now included.<br>• The formula lists now appear in section 4 Details of the Assessment.<br>• Minor changes to the wording of some sections have been made to improve clarity. |
| **Changes to assessment (including changes to specimen papers)** | • The wording and layout of the front covers of the question papers have been updated to ensure our instructions are clearer for candidates.<br>• The wording and layout of the front covers of the mark schemes have been updated. The generic wording has been updated. |

In addition to reading the syllabus, teachers should refer to the updated specimen assessment materials.

The syllabus and specimen papers use our new name Cambridge Assessment International Education.

**You are strongly advised to read the whole syllabus before planning your teaching program.**

"While studying Cambridge IGCSE and Cambridge International A Levels, students broaden their horizons through a global perspective and develop a lasting passion for learning."

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

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