Cambridge Assessment
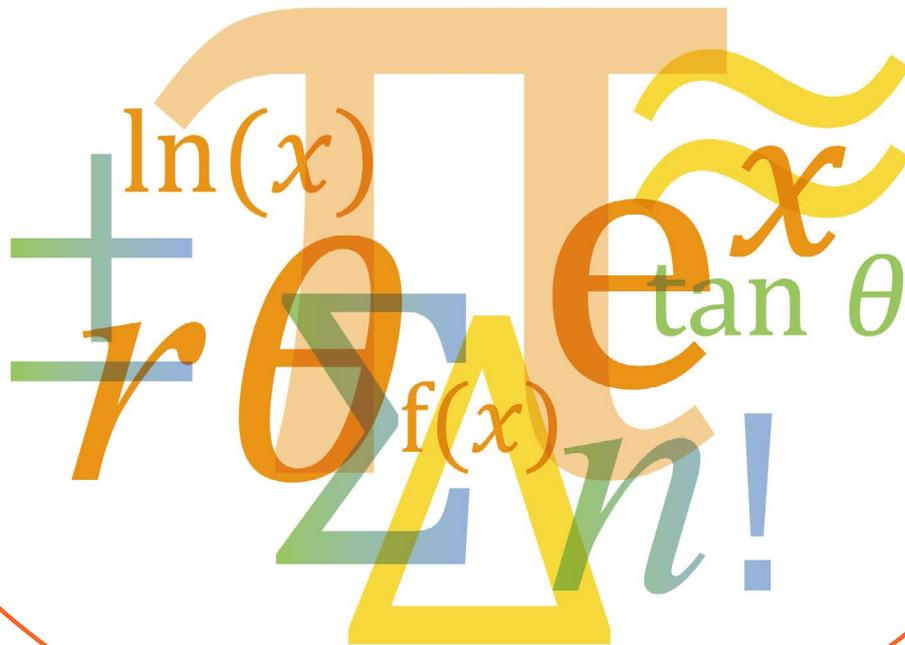## International Education

Syllabus

Cambridge IGCSE™
Additional Mathematics 0606

Use this syllabus for exams in 2023 and 2024.
Exams are available in the June and November series.
Exams are also available in the March series in India only.

Cambridge Pathway

Why choose Cambridge International?

Cambridge International 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 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 programmes and qualifications set the global standard for international education. They are created by subject experts, rooted in academic rigour 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 programmes 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.

'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 programmes for students aged 5 to 19 is independently certified as meeting the internationally recognised standard, ISO 9001:2015. Learn more at **www.cambridgeinternational.org/ISO9001**

Contents

Important: Changes to this syllabus

For information about changes to this syllabus for 2023 and 2024, go to page 19.

The latest syllabus is version 1, published September 2020. There are no significant changes which affect teaching.

Any textbooks endorsed to support the syllabus for examination from 2020 are still suitable for use with this syllabus.

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 4800 schools in over 150 countries.

Cambridge IGCSE Additional Mathematics supports learners in building competency, confidence and fluency in their use of techniques and mathematical understanding. This course helps learners to develop a feel for quantity, patterns and relationships. Learners will develop their reasoning, problem-solving and analytical skills in a variety of contexts.

Cambridge IGCSE Additional Mathematics provides a strong foundation of mathematical knowledge both for candidates studying mathematics at a higher level and those who will require mathematics to support skills in other subjects. It is designed to stretch the most able candidates and provides a smooth transition to Cambridge AS & A Level Mathematics.

Our programmes 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.
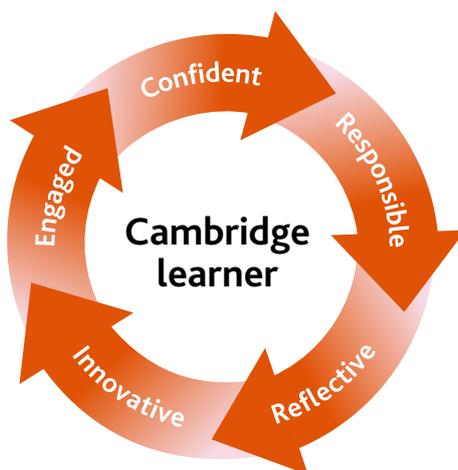
'The strength of Cambridge IGCSE qualifications is internationally recognised and has provided an international pathway for our students to continue their studies around the world.'

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

International recognition and acceptance

The combination of knowledge and skills in Cambridge IGCSE Additional Mathematics 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, or other qualifications at that level.

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 reformed 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.

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

'Cambridge IGCSE is one of the most sought-after and recognised qualifications in the world. It is very popular in Egypt because it provides the perfect preparation for success at advanced level programmes.'
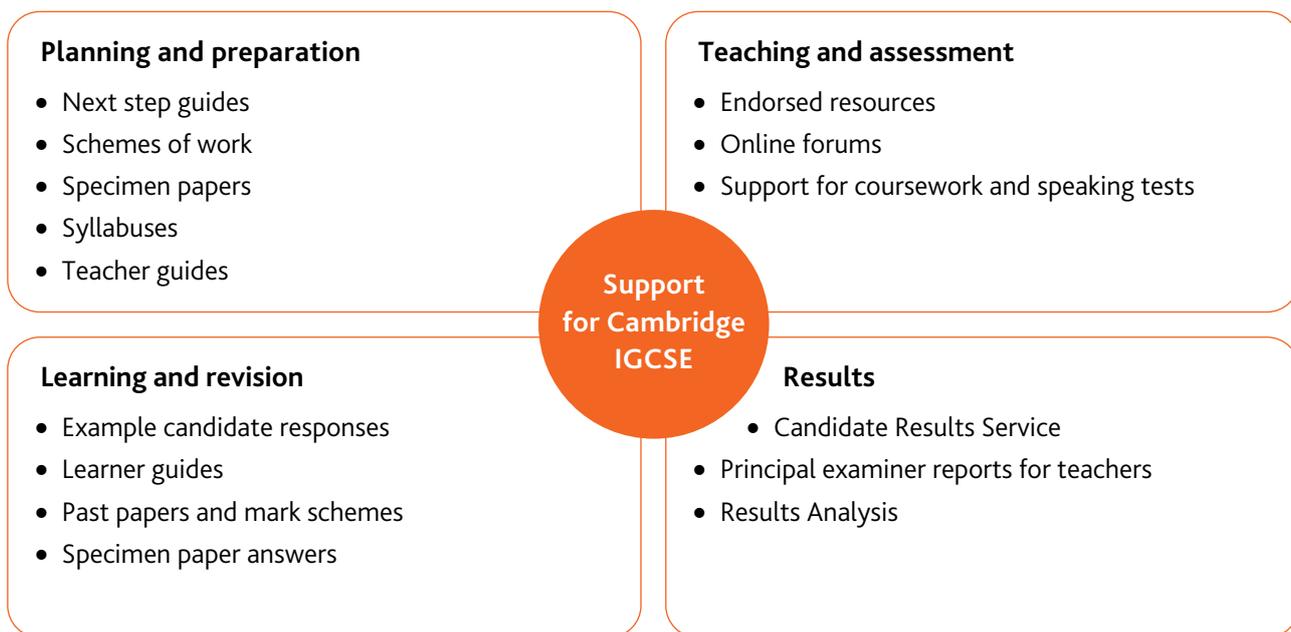
Managing Director of British School in Egypt BSE

Supporting teachers

We provide a wide range of resources, detailed guidance and 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 programmes. 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

Planning and preparation
- Next step guides
- Schemes of work
- Specimen papers
- Syllabuses
- Teacher guides

Teaching and assessment
- Endorsed resources
- Online forums
- Support for coursework and speaking tests

Support for Cambridge IGCSE

Learning and revision
- Example candidate responses
- Learner guides
- Past papers and mark schemes
- Specimen paper answers

Results
- Candidate Results Service
- Principal examiner reports for teachers
- Results Analysis

Sign up for email notifications about changes to syllabuses, including new and revised products and services at **www.cambridgeinternational.org/syllabusupdates**

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

Find out more at **www.cambridgeinternational.org/events**

- Cambridge Professional Development Qualifications

Find out more at **www.cambridgeinternational.org/profdev**

Supporting exams officers

We provide comprehensive support and guidance for all Cambridge exams officers. Find out more at: **www.cambridgeinternational.org/eoguide**

2 Syllabus overview

Aims

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

They are not listed in order of priority.

The aims are to:

- consolidate and extend their mathematical skills, and use these in the context of more advanced techniques
- further develop their knowledge of mathematical concepts and principles, and use this knowledge for problem solving
- appreciate the interconnectedness of mathematical knowledge
- acquire a suitable foundation in mathematics for further study in the subject or in mathematics-related subjects
- devise mathematical arguments and use and present them precisely and logically
- integrate information technology (IT) to enhance the mathematical experience
- develop the confidence to apply their mathematical skills and knowledge in appropriate situations
- develop creativity and perseverance in the approach to problem solving
- derive enjoyment and satisfaction from engaging in mathematical pursuits, and gain an appreciation of the elegance and usefulness of mathematics
- provide foundation for AS Level/Higher study.

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 candidates will study the following topics:

1   Functions
2   Quadratic functions
3   Equations, inequalities and graphs
4   Indices and surds
5   Factors of polynomials
6   Simultaneous equations
7   Logarithmic and exponential functions
8   Straight line graphs
9   Circular measure
10   Trigonometry
11   Permutations and combinations
12   Series
13   Vectors in two dimensions
14   Differentiation and integration

The content of Cambridge IGCSE Mathematics is assumed as prerequisite knowledge for this qualification.

Calculators

The syllabus assumes that candidates will be in possession of a scientific calculator for both papers.

Candidates must show all necessary working; no marks will be given to unsupported answers from a calculator.

Non-exact numerical answers will be required to be given correct to three significant figures, or one decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

Mathematical notation

The list of mathematical notation that may be used in examinations for this syllabus is available on our website at **www.cambridgeinternational.org/0606**

Assessment overview

All candidates take **two** components.

Candidates are eligible for grades A* to E. Grades F and G will not be available. Candidates who do not achieve the minimum mark for grade E will be unclassified.

All candidates take:		and:	
Paper 1	2 hours 50%	**Paper 2**	2 hours 50%
80 marks		80 marks	
Candidates answer all questions		Candidates answer all questions	
Scientific calculators are required		Scientific calculators are required	
Externally assessed		Externally assessed	

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

Assessment objectives

The assessment objectives (AOs) are:

AO1 Demonstrate knowledge and understanding of mathematical techniques

Candidates should be able to:

- recall and use mathematical manipulative techniques
- interpret and use mathematical data, symbols and terminology
- comprehend numerical, algebraic and spatial concepts and relationships.

AO2 Apply mathematical techniques

Candidates should be able to:

- recognise the appropriate mathematical procedure for a given situation
- formulate problems into mathematical terms and select and apply appropriate techniques.

Weighting for assessment objectives

The approximate weightings allocated to each of the assessment objectives (AOs) are summarised below.

Assessment objectives as a percentage of the qualification

Assessment objective	Weighting in IGCSE %
AO1 Demonstrate knowledge and understanding of mathematical techniques	50
AO2 Apply mathematical techniques	50
Total	100

Assessment objectives as a percentage of each component

Assessment objective	Weighting in components %	
	Paper 1	Paper 2
AO1 Demonstrate knowledge and understanding of mathematical techniques	50	50
AO2 Apply mathematical techniques	50	50
Total	100	100

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.

Knowledge of the content of Cambridge IGCSE Mathematics (or an equivalent syllabus) is assumed.

Cambridge IGCSE material which is not included in the subject content will not be tested directly but it may be required in response to questions on other topics.

Proofs of results will not be required unless specifically mentioned in the syllabus.

Candidates will be expected to be familiar with the scientific notation for the expression of compound units, e.g. $5\,\text{m}\,\text{s}^{-1}$ for 5 metres per second.

1   Functions

- understand the terms: function, domain, range (image set), one-one function, inverse function and composition of functions
- use the notation $f(x) = \sin x$, $f: x \mapsto \lg x$, $(x > 0)$, $f^{-1}(x)$ and $f^2(x)$ $[= f(f(x))]$
- understand the relationship between $y = f(x)$ and $y = |f(x)|$, where $f(x)$ may be linear, quadratic or trigonometric
- explain in words why a given function is a function or why it does not have an inverse
- find the inverse of a one-one function and form composite functions
- use sketch graphs to show the relationship between a function and its inverse

2   Quadratic functions

- find the maximum or minimum value of the quadratic function $f : x \mapsto ax^2 + bx + c$ by any method
- use the maximum or minimum value of $f(x)$ to sketch the graph or determine the range for a given domain
- know the conditions for $f(x) = 0$ to have:

  (i) two real roots, (ii) two equal roots, (iii) no real roots

  and the related conditions for a given line to

  (i) intersect a given curve, (ii) be a tangent to a given curve, (iii) not intersect a given curve
- solve quadratic equations for real roots and find the solution set for quadratic inequalities

3   Equations, inequalities and graphs

- solve graphically or algebraically equations of the type $|ax + b| = c \ (c \geqslant 0)$ and $|ax + b| = |cx + d|$
- solve graphically or algebraically inequalities of the type
  $|ax + b| > c \ (c \geqslant 0)$, $|ax + b| \leqslant c \ (c > 0)$ and $|ax + b| \leqslant |cx + d|$
- use substitution to form and solve a quadratic equation in order to solve a related equation
- sketch the graphs of cubic polynomials and their moduli, when given in factorised form
  $y = k(x - a)(x - b)(x - c)$
- solve cubic inequalities in the form $k(x - a)(x - b)(x - c) \leqslant d$ graphically

4   Indices and surds

- perform simple operations with indices and with surds, including rationalising the denominator

5   Factors of polynomials

- know and use the remainder and factor theorems
- find factors of polynomials
- solve cubic equations

6   Simultaneous equations

- solve simple simultaneous equations in two unknowns by elimination or substitution

7   Logarithmic and exponential functions

- know simple properties and graphs of the logarithmic and exponential functions including $\ln x$ and e^x (series expansions are not required) and graphs of $ke^{nx} + a$ and $k \ln(ax + b)$ where n, k, a and b are integers
- know and use the laws of logarithms (including change of base of logarithms)
- solve equations of the form $a^x = b$

8   Straight line graphs

- interpret the equation of a straight line graph in the form $y = mx + c$
- transform given relationships, including $y = ax^n$ and $y = Ab^x$, to straight line form and hence determine unknown constants by calculating the gradient or intercept of the transformed graph
- solve questions involving mid-point and length of a line
- know and use the condition for two lines to be parallel or perpendicular, including finding the equation of perpendicular bisectors

9	**Circular measure**

- solve problems involving the arc length and sector area of a circle, including knowledge and use of radian measure

10	**Trigonometry**

- know the six trigonometric functions of angles of any magnitude (sine, cosine, tangent, secant, cosecant, cotangent)
- understand amplitude and periodicity and the relationship between graphs of related trigonometric functions, e.g. $\sin x$ and $\sin 2x$
- draw and use the graphs of

$y = a \sin bx + c$

$y = a \cos bx + c$

$y = a \tan bx + c$

where a is a positive integer, b is a simple fraction or integer (fractions will have a denominator of 2, 3, 4, 6 or 8 only), and c is an integer
- use the relationships

$\sin^2 A + \cos^2 A = 1$

$\sec^2 A = 1 + \tan^2 A$, $\operatorname{cosec}^2 A = 1 + \cot^2 A$

$\dfrac{\sin A}{\cos A} = \tan A$, $\dfrac{\cos A}{\sin A} = \cot A$
- solve simple trigonometric equations involving the six trigonometric functions and the above relationships (not including general solution of trigonometric equations)
- prove simple trigonometric identities

11	**Permutations and combinations**

- recognise and distinguish between a permutation case and a combination case
- know and use the notation $n!$ (with $0! = 1$), and the expressions for permutations and combinations of n items taken r at a time
- answer simple problems on arrangement and selection (cases with repetition of objects, or with objects arranged in a circle, or involving both permutations and combinations, are excluded)

12	**Series**

- use the Binomial Theorem for expansion of $(a + b)^n$ for positive integer n
- use the general term $\dbinom{n}{r} a^{n-r} b^r$, $0 \leqslant r \leqslant n$ (knowledge of the greatest term and properties of the coefficients is not required)
- recognise arithmetic and geometric progressions
- use the formulae for the nth term and for the sum of the first n terms to solve problems involving arithmetic or geometric progressions
- use the condition for the convergence of a geometric progression, and the formula for the sum to infinity of a convergent geometric progression

13 Vectors in two dimensions

- use vectors in any form, e.g. $\begin{pmatrix} a \\ b \end{pmatrix}$, $\overrightarrow{AB}$, $\mathbf{p}$, $a\mathbf{i} - b\mathbf{j}$
- know and use position vectors and unit vectors
- find the magnitude of a vector; add and subtract vectors and multiply vectors by scalars
- compose and resolve velocities

14 Differentiation and integration

- understand the idea of a derived function
- use the notations $f'(x)$, $f''(x)$, $\dfrac{dy}{dx}$, $\dfrac{d^2y}{dx^2}\left[= \dfrac{d}{dx}\left(\dfrac{dy}{dx}\right)\right]$
- use the derivatives of the standard functions x^n (for any rational n), $\sin x$, $\cos x$, $\tan x$, e^x, $\ln x$, together with constant multiples, sums and composite functions of these
- differentiate products and quotients of functions
- apply differentiation to gradients, tangents and normals, stationary points, connected rates of change, small increments and approximations and practical maxima and minima problems
- use the first and second derivative tests to discriminate between maxima and minima
- understand integration as the reverse process of differentiation
- integrate sums of terms in powers of x including $\dfrac{1}{x}$ and $\dfrac{1}{ax+b}$
- integrate functions of the form $(ax+b)^n$ for any rational n, $\sin(ax+b)$, $\cos(ax+b)$, e^{ax+b}
- evaluate definite integrals and apply integration to the evaluation of plane areas
- apply differentiation and integration to kinematics problems that involve displacement, velocity and acceleration of a particle moving in a straight line with variable or constant acceleration, and the use of x–t and v–t graphs

4 Details of the assessment

All candidates will take **two** written papers.

Grades A* to E will be available for candidates who achieve the required standards. Grades F and G will not be available. Therefore, candidates who do not achieve the minimum mark for grade E will be unclassified.

Candidates must show all necessary working; no marks will be given to unsupported answers from a calculator.

Paper 1

2 hours, 80 marks

Candidates answer **all** questions.

This paper consists of questions of various lengths.

Electronic calculators are required.

This is a compulsory component for all candidates.

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

Paper 2

2 hours, 80 marks

Candidates answer **all** questions.

This paper consists of questions of various lengths.

Electronic calculators are required.

This is a compulsory component for all candidates.

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

Each paper includes the formulae list.

List of formulae

1. ALGEBRA

Quadratic Equation

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

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

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \ldots + \binom{n}{r}a^{n-r}b^r + \ldots + b^n$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!\,r!}$

Arithmetic series $\quad u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series $\quad u_n = ar^{n-1}$

$$S_n = \frac{a(1 - r^n)}{1 - r} \ (r \neq 1)$$

$$S_\infty = \frac{a}{1 - r} \ (|r| < 1)$$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

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

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

$$\Delta = \frac{1}{2} bc \sin A$$

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
Analyse	examine in detail to show meaning, identify elements and the relationship between them
Assess	make an informed judgement
Calculate	work out from given facts, figures or information
Comment	give an informed opinion
Compare	identify/comment on similarities and/or differences
Consider	review and respond to given information
Contrast	identify/comment on differences
Define	give precise meaning
Demonstrate	show how or give an example
Describe	state the points of a topic / give characteristics and main features
Develop	take forward to a more advanced stage or build upon given information
Discuss	write about issue(s) or topic(s) in depth in a structured way
Evaluate	judge or calculate the quality, importance, amount, or value of something
Examine	investigate closely, in detail
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
Identify	name/select/recognise
Justify	support a case with evidence/argument
Outline	set out main points
Predict	suggest what may happen based on available information
Sketch	make a simple freehand drawing showing the key features, taking care over proportions
State	express in clear terms
Suggest	apply knowledge and understanding to situations where there are a range of valid responses in order to make proposals / put forward considerations
Summarise	select and present the main points, without detail

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/eoguide**

Before you start

Previous study

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

Guided learning hours

We design Cambridge IGCSE syllabuses 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

All Cambridge schools are allocated to one of six administrative zones. Each zone has a specific timetable.

You can view the timetable for your administrative zone at **www.cambridgeinternational.org/timetables**

You can enter candidates in the June and November exam series. If your school is in India, you can also enter your candidates in the March exam series.

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

Private candidates can enter for this syllabus.

Combining with other syllabuses

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

- Cambridge O Level Additional Mathematics (4037)
- syllabuses with the same title at the same level.

Cambridge IGCSE, Cambridge IGCSE (9–1) and Cambridge O Level syllabuses 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**

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 syllabuses 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**

Retakes

Candidates can retake the whole qualification as many times as they want to. Information on retake entries is at **www.cambridgeinternational.org/entries**

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 our effort to comply with the UK Equality Act (2010) we have taken all reasonable steps to avoid any direct and indirect discrimination.

The standard assessment arrangements may present barriers for candidates with impairments. Where a candidate is eligible, we may be able to make arrangements to enable that candidate to access 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/eoguide**

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 (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:

- 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 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 descriptions for Cambridge IGCSE Additional Mathematics will be published after the first assessment of the syllabus in 2020. Find more information at **www.cambridgeinternational.org/0606**

Changes to this syllabus for 2023 and 2024

The syllabus has been updated. This is version 1, published September 2020.

There are no significant changes which affect teaching.

You must read the whole syllabus before planning your teaching programme.

Any textbooks endorsed to support the syllabus for examination from 2020 are still suitable for use with this syllabus.

'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