Syllabus

Cambridge IGCSE Additional Mathematics
Syllabus code 0606
For examination in June and November 2011

UNIVERSITY of CAMBRIDGE
International Examinations

Note for Exams Officers: Before making Final Entries, please check availability of the codes for the components and options in the E3 booklet (titled "Procedures for the Submission of Entries") relevant to the exam session. Please note that component and option codes are subject to change.

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1. Introduction

1.1 Why choose Cambridge?

University of Cambridge International Examinations (CIE) is the world's largest provider of international qualifications. Around 1.5 million students from 150 countries enter Cambridge examinations every year. What makes educators around the world choose Cambridge?

Recognition

Cambridge IGCSE is internationally recognised by schools, universities and employers as equivalent to UK GCSE. Cambridge IGCSE is excellent preparation for A/AS Level, the Advanced International Certificate of Education (AICE), US Advanced Placement Programme and the International Baccalaureate (IB) Diploma. Learn more at **www.cie.org.uk/recognition**.

Support

CIE provides a world-class support service for teachers and exams officers. We offer a wide range of teacher materials to Centres, plus teacher training (online and face-to-face) and student support materials. Exams officers can trust in reliable, efficient administration of exams entry and excellent, personal support from CIE Customer Services. Learn more at **www.cie.org.uk/teachers**.

Excellence in education

Cambridge qualifications develop successful students. They not only build understanding and knowledge required for progression, but also learning and thinking skills that help students become independent learners and equip them for life.

Not-for-profit, part of the University of Cambridge

CIE is part of Cambridge Assessment, a not-for-profit organisation and part of the University of Cambridge. The needs of teachers and learners are at the core of what we do. CIE invests constantly in improving its qualifications and services. We draw upon education research in developing our qualifications.

1. Introduction

1.2 Why choose Cambridge IGCSE Additional Mathematics?

Cambridge IGCSE Additional Mathematics is accepted by universities and employers as proof of essential mathematical knowledge and ability.

The Additional Mathematics syllabus is intended for high ability candidates who have achieved, or are likely to achieve, Grade A*, A or B in the IGCSE Mathematics examination.

Successful IGCSE Additional Mathematics candidates gain lifelong skills, including:

- the further development of mathematical concepts and principles
- the extension of mathematical skills and their use in more advanced techniques
- an ability to solve problems, present solutions logically and interpret results
- a solid foundation for further study.

1.3 Cambridge International Certificate of Education (ICE)

Cambridge ICE is the group award of the International General Certificate of Secondary Education (IGCSE). It requires the study of subjects drawn from the five different IGCSE subject groups. It gives schools the opportunity to benefit from offering a broad and balanced curriculum by recognising the achievements of students who pass examinations in at least seven subjects, including two languages, and one subject from each of the other subject groups.
The Cambridge portfolio of IGCSE qualifications provides a solid foundation for higher level courses such as GCE A and AS Levels and the International Baccalaureate Diploma as well as excellent preparation for employment.
A wide range of IGCSE subjects is available and these are grouped into five curriculum areas. Additional Mathematics (0606) falls into Group IV, Mathematics.
Learn more about ICE at **www.cie.org.uk/qualifications/academic/middlesec/ice**.

1.4 How can I find out more?

If you are already a Cambridge Centre

You can make entries for this qualification through your usual channels, e.g. CIE Direct. If you have any queries, please contact us at **international@cie.org.uk**.

If you are not a Cambridge Centre

You can find out how your organisation can become a Cambridge Centre. Email us at **international@cie.org.uk**. Learn more about the benefits of becoming a Cambridge Centre at **www.cie.org.uk**.

2. Assessment at a glance

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All candidates will take two written papers.

The syllabus content will be assessed by Paper 1 and Paper 2.

Paper	Duration	Marks
Paper 1 10–12 questions of various lengths No choice of question except that the last question will consist of two alternatives, only one of which must be answered. The mark allocations for the last question will be in the range of 10–12 marks.	2 hours	80
Paper 2 10–12 questions of various lengths No choice of question except that the last question will consist of two alternatives, only one of which must be answered. The mark allocations for the last question will be in the range of 10–12 marks.	2 hours	80

Grades A* to E will be available for candidates who achieve the required standards. Since there is no Core Curriculum for this syllabus, Grades F and G will not be available. Therefore, candidates who do not achieve the minimum mark for Grade E will be unclassified.

Calculators
The syllabus assumes that candidates will be in possession of an electronic calculator with scientific functions for both papers.
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.

List of formulae
Relevant mathematical formulae will be provided on the inside covers of the question papers.

3. Syllabus aims and assessment

3.1 Aims

The aims of the syllabus listed below are not in order of priority.

The aims are to enable candidates to:

- consolidate and extend their elementary 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 beauty, power and usefulness of mathematics.

3.2 Assessment objectives

The examination will test the ability of candidates to:

- recall and use manipulative technique
- interpret and use mathematical data, symbols and terminology
- comprehend numerical, algebraic and spatial concepts and relationships
- recognise the appropriate mathematical procedure for a given situation
- formulate problems into mathematical terms and select and apply appropriate techniques of solution.

Any of the above objectives can be assessed in any question in Papers 1 and 2.

3. Syllabus aims and assessment

3.3 Exam combinations

A candidate can combine this syllabus in an exam session with any other CIE syllabus, except:

- 4037 Additional Mathematics

Please note that IGCSE, Cambridge International Level1/Level 2 Certificates and O Level syllabuses are at the same level.

4. Syllabus content

The Additional Mathematics syllabus is intended for high ability candidates who have achieved, or are likely to achieve Grade A*, A or B in the IGCSE Mathematics examination. The curriculum objectives are therefore assessed at one level only (Extended). As for Extended level syllabuses in other subjects, Grades A* to E will be available.

The Curriculum objectives (Core and Supplement) for IGCSE Mathematics will be assumed as prerequisite knowledge.

Proofs of standard results will not be required unless specifically mentioned below.

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

4. Syllabus content

Theme or topic	Curriculum objectives
	Candidates should be able to:
1. Set language and notation	• use set language and notation, and Venn diagrams to describe sets and represent relationships between sets as follows: $A = \{x: x \text{ is a natural number}\}$ $B = \{(x,y): y = mx + c\}$ $C = \{x: a \leqslant x \leqslant b\}$ $D = \{a, b, c, \ldots\}$ • understand and use the following notation: Union of A and B — $A \cup B$ Intersection of A and B — $A \cap B$ Number of elements in set A — $\mathrm{n}(A)$ "…is an element of…" — $\in$ "…is not an element of…" — $\notin$ Complement of set A — A' The empty set — $\varnothing$ Universal set — $\mathscr{E}$ A is a subset of B — $A \subseteq B$ A is a proper subset of B — $A \subset B$ A is not a subset of B — $A \nsubseteq B$ A is not a proper subset of B — $A \not\subset B$
2. Functions	• understand the terms: function, domain, range (image set), one-one function, inverse function and composition of functions • use the notation $\mathrm{f}(x) = \sin x$, $\mathrm{f}: x \mapsto \lg x \ (x > 0)$, $\mathrm{f}^{-1}(x)$ and $\mathrm{f}^2(x)$ [$= \mathrm{f}(\mathrm{f}(x))$] • understand the relationship between $y = \mathrm{f}(x)$ and $y = \lvert \mathrm{f}(x) \rvert$, where $\mathrm{f}(x)$ 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

4. Syllabus content

Theme or topic	Curriculum objectives
3. 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
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 simultaneous equations in two unknowns with at least one linear equation
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) • 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

4. Syllabus content

Theme or topic	Curriculum objectives
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 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, b are positive integers and c is an integer • use the relationships $\frac{\sin A}{\cos A} = \tan A$, $\frac{\cos A}{\sin A} = \cot A$, $\sin^2 A + \cos^2 A = 1$, $\sec^2 A = 1 + \tan^2 A$, $\operatorname{cosec}^2 A = 1 + \cot^2 A$ and 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. Binomial expansions	• use the Binomial Theorem for expansion of $(a + b)^n$ for positive integral n • use the general term $\binom{n}{r} a^{n-r} b^r$, $0 < r \leqslant n$ (knowledge of the greatest term and properties of the coefficients is not required)

4. Syllabus content

Theme or topic	Curriculum objectives
13. Vectors in 2 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 • use relative velocity, including solving problems on interception (but not closest approach)
14. Matrices	• display information in the form of a matrix of any order and interpret the data in a given matrix • solve problems involving the calculation of the sum and product (where appropriate) of two matrices and interpret the results • calculate the product of a scalar quantity and a matrix • use the algebra of 2 × 2 matrices (including the zero and identity matrix) • calculate the determinant and inverse of a non-singular 2 × 2 matrix and solve simultaneous linear equations

4. Syllabus content

Theme or topic	Curriculum objectives
15. Differentiation and integration	• understand the idea of a derived function • use the notations f′(x), f″(x), $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$, $\left[=\frac{d}{dx}\left(\frac{dy}{dx}\right)\right]$ • 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 • discriminate between maxima and minima by any method • understand integration as the reverse process of differentiation • integrate sums of terms in powers of x, excluding $\frac{1}{x}$ • integrate functions of the form $(ax + b)^n$ (excluding $n = -1$), e^{ax+b}, sin $(ax + b)$, cos $(ax + b)$ • 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

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