

Syllabus

Cambridge O Level Additional Mathematics

Syllabus code 4037

For examination in June and November 2013



UNIVERSITY *of* CAMBRIDGE
International Examinations

Contents

Cambridge O Level Additional Mathematics Syllabus code 4037

1. Introduction	2
1.1 Why choose Cambridge?	
1.2 Why choose Cambridge O Level Additional Mathematics?	
1.3 How can I find out more?	
2. Assessment at a glance	4
3. Syllabus aims and objectives	6
3.1 Aims	
3.2 Assessment objectives	
4. Curriculum content	7
5. Mathematical notation	12
6. Resource list	17
7. Additional information	18
7.1 Guided learning hours	
7.2 Recommended prior learning	
7.3 Progression	
7.4 Component codes	
7.5 Grading and reporting	
7.6 Resources	

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?

Developed for an international audience

International O Levels have been designed specially for an international audience and are sensitive to the needs of different countries. These qualifications are designed for students whose first language may not be English and this is acknowledged throughout the examination process. The curriculum also allows teaching to be placed in a localised context, making it relevant in varying regions.

Recognition

Cambridge O Levels are internationally recognised by schools, universities and employers as equivalent to UK GCSE. They are excellent preparation for A/AS Level, the Advanced International Certificate of Education (AICE), US Advanced Placement Programme and the International Baccalaureate (IB) Diploma. CIE is accredited by the UK Government regulator, the Office of the Qualifications and Examinations Regulator (Ofqual). 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 build not only 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 O Level Additional Mathematics?

International O Levels are established qualifications that keep pace with educational developments and trends. The International O Level curriculum places emphasis on broad and balanced study across a wide range of subject areas. The curriculum is structured so that students attain both practical skills and theoretical knowledge.

Cambridge O Level Additional Mathematics is recognised by universities and employers throughout the world as proof of mathematical knowledge and understanding. Successful Cambridge O Level 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.

Students may also study for a Cambridge O Level in Mathematics and in Statistics. In addition to Cambridge O Levels, CIE also offers Cambridge IGCSE and International A & AS Levels for further study in Mathematics as well as other maths-related subjects. See www.cie.org.uk for a full list of the qualifications you can take.

1.3 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. your regional representative, the British Council or 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 either your local British Council representative or CIE 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

Cambridge O Level Additional Mathematics Syllabus code 4037

All candidates will take two written papers.

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

Paper 1	Duration	Marks
10–12 questions of various lengths There will be no choice of question.	2 hours	80

Paper 2	Duration	Marks
10–12 questions of various lengths There will be no choice of question.	2 hours	80

Calculators

The syllabus assumes that candidates will be in possession of a silent electronic calculator with scientific functions for both papers. The General Regulations concerning the use of electronic calculators are contained in the *Handbook for Centres*.

Mathematical Instruments

Apart from the usual mathematical instruments, candidates may use flexicurves in this examination.

Mathematical Notation

Attention is drawn to the list of mathematical notation at the end of this booklet.

2. Assessment at a glance

Availability

This syllabus is examined in the May/June examination session and the October/November examination session.

This syllabus is available to private candidates.

International O levels are available to Centres in Administrative Zones 3, 4 and 5. Centres in Administrative Zones 1, 2 or 6 wishing to enter candidates for International O Level examinations should contact CIE Customer Services.

Combining this with other syllabuses

Candidates can combine this syllabus in an examination session with any other CIE syllabus, except:

- syllabuses with the same title at the same level
- 0606 IGCSE Additional Mathematics

Please note that IGCSE, Cambridge International Level 1/Level 2 Certificates and O Level syllabuses are at the same level.

3. Syllabus aims and objectives

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.

4. Curriculum content

Knowledge of the content of CIE's Ordinary level Syllabus D (or an equivalent Syllabus) is assumed.

O Level material which is not repeated in the syllabus below 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 ms^{-1} for 5 metres per second.

Theme or topic	Curriculum objectives																								
	<i>Candidates should be able to:</i>																								
1. Set language and notation	<ul style="list-style-type: none"> • use set language and notation, and Venn diagrams to describe sets and represent relationships between sets as follows: $A = \{x: x \text{ is a natural number}\}$ $B = \{(x, y): y = mx + c\}$ $C = \{x: a \leq x \leq b\}$ $D = \{a, b, c, \dots\}$ • understand and use the following notation: <table style="width: 100%; border: none;"> <tr> <td style="padding: 2px;">Union of A and B</td> <td style="text-align: right; padding: 2px;">$A \cup B$</td> </tr> <tr> <td style="padding: 2px;">Intersection of A and B</td> <td style="text-align: right; padding: 2px;">$A \cap B$</td> </tr> <tr> <td style="padding: 2px;">Number of elements in set A</td> <td style="text-align: right; padding: 2px;">$n(A)$</td> </tr> <tr> <td style="padding: 2px;">“...is an element of...”</td> <td style="text-align: right; padding: 2px;">\in</td> </tr> <tr> <td style="padding: 2px;">“...is not an element of...”</td> <td style="text-align: right; padding: 2px;">\notin</td> </tr> <tr> <td style="padding: 2px;">Complement of set A</td> <td style="text-align: right; padding: 2px;">A'</td> </tr> <tr> <td style="padding: 2px;">The empty set</td> <td style="text-align: right; padding: 2px;">\emptyset</td> </tr> <tr> <td style="padding: 2px;">Universal set</td> <td style="text-align: right; padding: 2px;">\mathcal{U}</td> </tr> <tr> <td style="padding: 2px;">A is a subset of B</td> <td style="text-align: right; padding: 2px;">$A \subseteq B$</td> </tr> <tr> <td style="padding: 2px;">A is a proper subset of B</td> <td style="text-align: right; padding: 2px;">$A \subset B$</td> </tr> <tr> <td style="padding: 2px;">A is not a subset of B</td> <td style="text-align: right; padding: 2px;">$A \not\subseteq B$</td> </tr> <tr> <td style="padding: 2px;">A is not a proper subset of</td> <td style="text-align: right; padding: 2px;">$A \not\subset B$</td> </tr> </table> 	Union of A and B	$A \cup B$	Intersection of A and B	$A \cap B$	Number of elements in set A	$n(A)$	“...is an element of...”	\in	“...is not an element of...”	\notin	Complement of set A	A'	The empty set	\emptyset	Universal set	\mathcal{U}	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	$A \not\subseteq B$	A is not a proper subset of	$A \not\subset B$
Union of A and B	$A \cup B$																								
Intersection of A and B	$A \cap B$																								
Number of elements in set A	$n(A)$																								
“...is an element of...”	\in																								
“...is not an element of...”	\notin																								
Complement of set A	A'																								
The empty set	\emptyset																								
Universal set	\mathcal{U}																								
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	$A \not\subseteq B$																								
A is not a proper subset of	$A \not\subset B$																								

4. Curriculum content

Theme or topic	Curriculum objectives
2. Functions	<ul style="list-style-type: none"> • 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
3. Quadratic functions	<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> (i) two real roots, (ii) two equal roots, (iii) no real roots and the related conditions for a given line to <ul style="list-style-type: none"> (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	<ul style="list-style-type: none"> • perform simple operations with indices and with surds, including rationalising the denominator
5. Factors of polynomials	<ul style="list-style-type: none"> • know and use the remainder and factor theorems • find factors of polynomials • solve cubic equations
6. Simultaneous equations	<ul style="list-style-type: none"> • solve simultaneous equations in two unknowns with at least one linear equation

4. Curriculum content

Theme or topic	Curriculum objectives
7. Logarithmic and exponential functions	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
9. Circular measure	<ul style="list-style-type: none"> solve problems involving the arc length and sector area of a circle, including knowledge and use of radian measure
10. Trigonometry	<ul style="list-style-type: none"> 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 $\frac{\sin A}{\cos A} = \tan A, \quad \frac{\cos A}{\sin A} = \cot A, \quad \sin^2 A + \cos^2 A = 1,$ $\sec^2 A = 1 + \tan^2 A, \quad \operatorname{cosec}^2 A = 1 + \cot^2 A$ 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

4. Curriculum content

Theme or topic	Curriculum objectives
11. Permutations and combinations	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> use the Binomial Theorem for expansion of $(a + b)^n$ for positive integral n use the general term $\binom{a}{b} a^{n-r} b^r$, $0 < r \leq n$ <p>(knowledge of the greatest term and properties of the coefficients is not required)</p>
13. Vectors in 2 dimensions	<ul style="list-style-type: none"> use vectors in any form, e.g. $\begin{pmatrix} a \\ b \end{pmatrix}$, \vec{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	<ul style="list-style-type: none"> 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. Curriculum content

Theme or topic	Curriculum objectives
15. Differentiation and integration	<ul style="list-style-type: none">• 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

5. Mathematical notation

The list which follows summarises the notation used in the CIE's Mathematics examinations. Although primarily directed towards Advanced/HSC (Principal) level, the list also applies, where relevant, to examinations at O Level/S.C.

Mathematical Notation

1. Set Notation

\in	is an element of
\notin	is not an element of
$\{x_1, x_2, \dots\}$	the set with elements x_1, x_2, \dots
$\{x: \dots\}$	the set of all x such that...
$n(A)$	the number of elements in set A
\emptyset	the empty set
\mathcal{E}	universal set
A'	the complement of the set A
\mathbb{N}	the set of positive integers, $\{1, 2, 3, \dots\}$
\mathbb{Z}	the set of integers $\{0, \pm 1, \pm 2, \pm 3, \dots\}$
\mathbb{Z}^+	the set of positive integers $\{1, 2, 3, \dots\}$
\mathbb{Z}_n	the set of integers modulo n , $\{0, 1, 2, \dots, n-1\}$
\mathbb{Q}	the set of rational numbers
\mathbb{Q}^+	the set of positive rational numbers, $\{x \in \mathbb{Q}: x > 0\}$
\mathbb{Q}_0^+	the set of positive rational numbers and zero, $\{x \in \mathbb{Q}: x \geq 0\}$
\mathbb{R}	the set of real numbers
\mathbb{R}^+	the set of positive real numbers $\{x \in \mathbb{R}: x > 0\}$
\mathbb{R}_0^+	the set of positive real numbers and zero $\{x \in \mathbb{R}: x \geq 0\}$
\mathbb{R}^n	the real n tuples
\mathbb{C}	the set of complex numbers
\subseteq	is a subset of
\subset	is a proper subset of
$\not\subseteq$	is not a subset of
$\not\subset$	is not a proper subset of
\cup	union
\cap	intersection

5. Mathematical notation

$[a, b]$	the closed interval $\{x \in \mathbb{R}: a \leq x \leq b\}$
$[a, b)$	the interval $\{x \in \mathbb{R}: a \leq x < b\}$
$(a, b]$	the interval $\{x \in \mathbb{R}: a < x \leq b\}$
(a, b)	the open interval $\{x \in \mathbb{R}: a < x < b\}$
yRx	y is related to x by the relation R
$y \sim x$	y is equivalent to x , in the context of some equivalence relation

2. Miscellaneous Symbols

$=$	is equal to
\neq	is not equal to
\equiv	is identical to or is congruent to
\approx	is approximately equal to
\cong	is isomorphic to
\propto	is proportional to
$<; \ll$	is less than, is much less than
\leq, \nlessgtr	is less than or equal to, is not greater than
$>; \gg$	is greater than, is much greater than
\geq, \ngtr	is greater than or equal to, is not less than
∞	infinity

3. Operations

$a + b$	a plus b
$a - b$	a minus b
$a \times b, ab, a.b$	a multiplied by b
$a \div b, \frac{a}{b}, a/b$	a divided by b
$a : b$	the ratio of a to b
$\sum_{i=1}^n a_i$	$a_1 + a_2 + \dots + a_n$
\sqrt{a}	the positive square root of the real number a
$ a $	the modulus of the real number a
$n!$	n factorial for $n \in \mathbb{N}$ ($0! = 1$)
$\binom{n}{r}$	the binomial coefficient $\frac{n!}{r!(n-r)!}$, for $n, r \in \mathbb{N}$, $0 \leq r \leq n$
	$\frac{n(n-1)\dots(n-r+1)}{r!}$, for $n \in \mathbb{Q}$, $r \in \mathbb{N}$

5. Mathematical notation

4. Functions

f

function f

$f(x)$

the value of the function f at x

$f: A \rightarrow B$

f is a function under which each element of set A has an image in set B

$f: x \mapsto y$

the function f maps the element x to the element y

f^{-1}

the inverse of the function f

$g \circ f, gf$

the composite function of f and g which is defined by $(g \circ f)(x)$ or $gf(x) = g(f(x))$

$\lim_{x \rightarrow a} f(x)$

the limit of $f(x)$ as x tends to a

$\Delta x, \delta x$

an increment of x

$\frac{dy}{dx}$

the derivative of y with respect to x

$\frac{d^n y}{dx^n}$

the n th derivative of y with respect to x

$f'(x), f''(x), \dots, f^{(n)}(x)$

the first, second, \dots , n th derivatives of $f(x)$ with respect to x

$\int y dx$

indefinite integral of y with respect to x

$\int_a^b y dx$

the definite integral of y with respect to x for values of x between a and b

$\frac{\partial y}{\partial x}$

the partial derivative of y with respect to x

\dot{x}, \ddot{x}, \dots

the first, second, \dots derivatives of x with respect to time

5. Exponential and Logarithmic Functions

e

base of natural logarithms

$e^x, \exp x$

exponential function of x

$\log_a x$

logarithm to the base a of x

$\ln x$

natural logarithm of x

$\lg x$

logarithm of x to base 10

5. Mathematical notation

6. Circular and Hyperbolic Functions and Relations

$\sin, \cos, \tan,$ $\operatorname{cosec}, \sec, \cot$	}	the circular functions
$\sin^{-1}, \cos^{-1}, \tan^{-1},$ $\operatorname{cosec}^{-1}, \sec^{-1}, \cot^{-1}$	}	the inverse circular relations
$\sinh, \cosh, \tanh,$ $\operatorname{cosech}, \operatorname{sech}, \operatorname{coth}$	}	the hyperbolic functions
$\sinh^{-1}, \cosh^{-1}, \tanh^{-1},$ $\operatorname{cosech}^{-1}, \operatorname{sech}^{-1}, \operatorname{coth}^{-1}$	}	the inverse hyperbolic relations

7. Complex Numbers

i	square root of -1
z	a complex number, $z = x + iy$ $= r(\cos \theta + i \sin \theta), r \in \mathbb{R}_0^+$ $= re^{i\theta}, r \in \mathbb{R}_0^+$
$\operatorname{Re} z$	the real part of z , $\operatorname{Re}(x + iy) = x$
$\operatorname{Im} z$	the imaginary part of z , $\operatorname{Im}(x + iy) = y$
$ z $	the modulus of z , $ x + iy = \sqrt{x^2 + y^2}, r(\cos \theta + i \sin \theta) = r$
$\arg z$	the argument of z , $\arg(r(\cos \theta + i \sin \theta)) = \theta, -\pi < \theta \leq \pi$
z^*	the complex conjugate of z , $(x + iy)^* = x - iy$

8. Matrices

\mathbf{M}	a matrix \mathbf{M}
\mathbf{M}^{-1}	the inverse of the square matrix \mathbf{M}
\mathbf{M}^T	the transpose of the matrix \mathbf{M}
$\det \mathbf{M}$	the determinant of the square matrix \mathbf{M}

9. Vectors

\mathbf{a}	the vector \mathbf{a}
\vec{AB}	the vector represented in magnitude and direction by the directed line segment AB
$\hat{\mathbf{a}}$	a unit vector in the direction of the vector \mathbf{a}
$\mathbf{i}, \mathbf{j}, \mathbf{k}$	unit vectors in the directions of the cartesian coordinate axes
$ \mathbf{a} $	the magnitude of \mathbf{a}
$ \vec{AB} $	the magnitude of \vec{AB}
$\mathbf{a} \cdot \mathbf{b}$	the scalar product of \mathbf{a} and \mathbf{b}
$\mathbf{a} \times \mathbf{b}$	the vector product of \mathbf{a} and \mathbf{b}

5. Mathematical notation

10. Probability and Statistics

A, B, C etc.	events
$A \cup B$	union of events A and B
$A \cap B$	intersection of the events A and B
$P(A)$	probability of the event A
A'	complement of the event A , the event 'not A '
$P(A B)$	probability of the event A given the event B
X, Y, R , etc.	random variables
x, y, r , etc.	values of the random variables X, Y, R , etc.
x_1, x_2, \dots	observations
f_1, f_2, \dots	frequencies with which the observations x_1, x_2, \dots occur
$p(x)$	the value of the probability function $P(X = x)$ of the discrete random variable X
p_1, p_2, \dots	probabilities of the values x_1, x_2, \dots of the discrete random variable X
$f(x), g(x), \dots$	the value of the probability density function of the continuous random variable X
$F(x), G(x), \dots$	the value of the (cumulative) distribution function $P(X \leq x)$ of the random variable X
$E(X)$	expectation of the random variable X
$E[g(X)]$	expectation of $g(X)$
$\text{Var}(X)$	variance of the random variable X
$G(t)$	the value of the probability generating function for a random variable which takes integer values
$B(n, p)$	binomial distribution, parameters n and p
$\text{Po}(\mu)$	Poisson distribution, mean μ
$N(\mu, \sigma^2)$	normal distribution, mean μ and variance σ^2
μ	population mean
σ^2	population variance
σ	population standard deviation
\bar{x}	sample mean
s^2	unbiased estimate of population variance from a sample, $s^2 = \frac{1}{n-1} \sum (x - \bar{x})^2$
ϕ	probability density function of the standardised normal variable with distribution $N(0, 1)$
Φ	corresponding cumulative distribution function
ρ	linear product-moment correlation coefficient for a population
r	linear product-moment correlation coefficient for a sample
$\text{Cov}(X, Y)$	covariance of X and Y

6. Resource list

The following titles represent some of the texts available in the UK at the time of printing this booklet. Teachers are encouraged to choose texts for class use which they feel will be of interest to their students and will support their own teaching style. ISBN numbers are provided wherever possible.

Author	Title	Date	Publisher	ISBN
Backhouse, J K & Houldsworth S P T	<i>Essential Pure Mathematics: A First Course</i>	1991	Longman	0582066581
Backhouse, J K & Houldsworth S P T	<i>Pure Mathematics: A First Course</i>	1985	Longman	0582353866
Bostock L & Chandler S	<i>Mathematics: Core Maths for Advanced Level</i>	2000	Nelson Thornes	0748755098
Bostock L & Chandler S	<i>Mathematics: Pure Mathematics 1</i>	1978	Nelson Thornes	0859500926
Emanuel, R	<i>Pure Mathematics 1</i>	2001	Longman	0582405505
Harwood Clarke, L	<i>Additional Pure Mathematics</i>	1980	Heinemann	0435511874
Talbert, J F	<i>Additional Maths Pure and Applied</i>	1995	Longman	0582265118

Resources are also listed on CIE's public website at www.cie.org.uk. Please visit this site on a regular basis as the Resource lists are updated through the year.

Access to teachers' email discussion groups, suggested schemes of work and regularly updated resource lists may be found on the CIE Teacher Support website at <http://teachers.cie.org.uk>. This website is available to teachers at registered CIE Centres.

7. Additional information

7.1 Guided learning hours

O Level syllabuses are designed on the assumption that candidates have about 130 guided learning hours per subject over the duration of the course. ('Guided learning hours' include direct teaching and any other supervised or directed study time. They do not include private study by the candidate.)

However, this figure is for guidance only, and the number of hours required may vary according to local curricular practice and the candidates' prior experience of the subject.

7.2 Recommended prior learning

We recommend that candidates who are beginning this course should be currently studying or have previously studied O Level or IGCSE Mathematics.

7.3 Progression

O Level Certificates are general qualifications that enable candidates to progress either directly to employment, or to proceed to further qualifications.

Candidates who are awarded grades C to A* in O Level Additional Mathematics are well prepared to follow courses leading to AS and A Level Mathematics, or the equivalent.

7.4 Component codes

Because of local variations, in some cases component codes will be different in instructions about making entries for examinations and timetables from those printed in this syllabus, but the component names will be unchanged to make identification straightforward.

7.5 Grading and reporting

Ordinary Level (O Level) results are shown by one of the grades A*, A, B, C, D or E indicating the standard achieved, Grade A* being the highest and Grade E the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for Grade E. 'Ungraded' will be reported on the statement of results but not on the certificate.

7. Additional information

Percentage uniform marks are also provided on each candidate's statement of results to supplement their grade for a syllabus. They are determined in this way:

- A candidate who obtains...
 - ... the minimum mark necessary for a Grade A* obtains a percentage uniform mark of 90%.
 - ... the minimum mark necessary for a Grade A obtains a percentage uniform mark of 80%.
 - ... the minimum mark necessary for a Grade B obtains a percentage uniform mark of 70%.
 - ... the minimum mark necessary for a Grade C obtains a percentage uniform mark of 60%.
 - ... the minimum mark necessary for a Grade D obtains a percentage uniform mark of 50%.
 - ... the minimum mark necessary for a Grade E obtains a percentage uniform mark of 40%.
 - ... no marks receives a percentage uniform mark of 0%.

Candidates whose mark is none of the above receive a percentage mark in between those stated according to the position of their mark in relation to the grade 'thresholds' (i.e. the minimum mark for obtaining a grade). For example, a candidate whose mark is halfway between the minimum for a Grade C and the minimum for a Grade D (and whose grade is therefore D) receives a percentage uniform mark of 55%.

The uniform percentage mark is stated at syllabus level only. It is not the same as the 'raw' mark obtained by the candidate, since it depends on the position of the grade thresholds (which may vary from one session to another and from one subject to another) and it has been turned into a percentage.

7.6 Resources

Copies of syllabuses, the most recent question papers and Principal Examiners' reports for teachers are available on the Syllabus and Support Materials CD-ROM, which is sent to all CIE Centres.

Resources are also listed on CIE's public website at **www.cie.org.uk**. Please visit this site on a regular basis as the Resource lists are updated through the year.

Access to teachers' email discussion groups, suggested schemes of work and regularly updated resource lists may be found on the CIE Teacher Support website at **<http://teachers.cie.org.uk>**. This website is available to teachers at registered CIE Centres.

University of Cambridge International Examinations
1 Hills Road, Cambridge, CB1 2EU, United Kingdom
Tel: +44 (0)1223 553554 Fax: +44 (0)1223 553558
Email: international@cie.org.uk Website: www.cie.org.uk

© University of Cambridge International Examinations 2010