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International Examinations

Cambridge
IGCSE

SYLLABUS

Cambridge IGCSE®
Additional Mathematics
0606

For examination in June and November 2017, 2018 and 2019.
Also available for examination in March 2017, 2018 and 2019 for India only.

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Changes to syllabus for 2017, 2018 and 2019

This syllabus has been updated. Significant changes to the syllabus are indicated by black vertical lines either side of the text.

You are advised to read the whole syllabus before planning your teaching programme.

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1. Introduction

1.1 Why choose Cambridge?

Cambridge International Examinations is part of the University of Cambridge. We prepare school students for life, helping them develop an informed curiosity and a lasting passion for learning. Our international qualifications are recognised 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 organisation, we devote our resources to delivering high-quality educational programmes that can unlock learners' potential.

Our programmes set the global standard for international education. They are created by subject experts, are rooted in academic rigour, and provide a strong platform for progression. Over 10 000 schools in 160 countries work with us to prepare nearly a million learners for their future with an international education from Cambridge.

Cambridge learners

Cambridge programmes and qualifications develop not only subject knowledge but also skills. We encourage Cambridge learners to be:

- **confident** in working with information and ideas – their own and those of others
- **responsible** for themselves, responsive to and respectful of others
- **reflective** as learners, developing their ability to learn
- **innovative** and equipped for new and future challenges
- **engaged** intellectually and socially, ready to make a difference.

Recognition

Cambridge IGCSE is recognised by leading universities and employers worldwide, and is an international passport to progression and success. It provides a solid foundation for moving on to higher level studies. Learn more at **www.cie.org.uk/recognition**

Support for teachers

A wide range of materials and resources is available to support teachers and learners in Cambridge schools. Resources suit a variety of teaching methods in different international contexts. Through subject discussion forums and training, teachers can access the expert advice they need for teaching our qualifications. More details can be found in Section 2 of this syllabus and at **www.cie.org.uk/teachers**

Support for exams officers

Exams officers can trust in reliable, efficient administration of exams entries and excellent personal support from our customer services. Learn more at **www.cie.org.uk/examsofficers**

Our systems for managing the provision of international qualifications and education programmes for learners aged 5 to 19 are certified as meeting the internationally recognised standard for quality management, ISO 9001:2008. Learn more at **www.cie.org.uk/ISO9001**

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1.2 Why choose Cambridge IGCSE?

Cambridge IGCSEs are international in outlook, but retain a local relevance. The syllabuses provide opportunities for contextualised learning and the content has been created to suit a wide variety of schools, avoid cultural bias and develop essential lifelong skills, including creative thinking and problem-solving.

Our aim is to balance knowledge, understanding and skills in our programmes and qualifications to enable students to become effective learners and to provide a solid foundation for their continuing educational journey.

Through our professional development courses and our support materials for Cambridge IGCSEs, we provide the tools to enable teachers to prepare learners to the best of their ability and work with us in the pursuit of excellence in education.

Cambridge IGCSEs are considered to be an excellent preparation for Cambridge International AS and A Levels, the Cambridge AICE (Advanced International Certificate of Education) Group Award, Cambridge Pre-U, and other education programmes, such as the US Advanced Placement program and the International Baccalaureate Diploma programme. Learn more about Cambridge IGCSEs at **www.cie.org.uk/cambridgesecondary2**

Guided learning hours

Cambridge IGCSE syllabuses are designed on the assumption that learners have about 130 guided learning hours per subject over the duration of the course, but this is for guidance only. The number of hours required to gain the qualification may vary according to local curricular practice and the learners' prior experience of the subject.

1.3 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 Cambridge IGCSE Mathematics examination.

Successful Cambridge 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.

Prior learning

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

Progression

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

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

1.4 Cambridge ICE (International Certificate of Education)

Cambridge ICE is a group award for Cambridge IGCSE. It gives schools the opportunity to benefit from offering a broad and balanced curriculum by recognising the achievements of learners who pass examinations in a number of different subjects.

Learn more about Cambridge ICE at **www.cie.org.uk/cambridgesecondary2**

1.5 How can I find out more?

If you are already a Cambridge school

You can make entries for this qualification through your usual channels. If you have any questions, please contact us at **info@cie.org.uk**

If you are not yet a Cambridge school

Learn about the benefits of becoming a Cambridge school at **www.cie.org.uk/startcambridge**. Email us at **info@cie.org.uk** to find out how your organisation can register to become a Cambridge school.

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2. Teacher support

2.1 Support materials

We send Cambridge syllabuses, past question papers and examiner reports to cover the last examination series to all Cambridge schools.

You can also go to our public website at **www.cie.org.uk/igcse** to download current and future syllabuses together with specimen papers or past question papers and examiner reports from one series.

For teachers at registered Cambridge schools a range of additional support materials for specific syllabuses is available from Teacher Support, our secure online support for Cambridge teachers. Go to **http://teachers.cie.org.uk** (username and password required).

2.2 Endorsed resources

We work with publishers providing a range of resources for our syllabuses including print and digital materials. Resources endorsed by Cambridge go through a detailed quality assurance process to ensure they provide a high level of support for teachers and learners.

We have resource lists which can be filtered to show all resources, or just those which are endorsed by Cambridge. The resource lists include further suggestions for resources to support teaching.

2.3 Training

We offer a range of support activities for teachers to ensure they have the relevant knowledge and skills to deliver our qualifications. See **www.cie.org.uk/events** for further information.

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3. Assessment at a glance

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.	2 hours	80
Paper 2 10–12 questions of various lengths No choice of question.	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.

Availability

This syllabus is examined in the June and November examination series. This syllabus is also available for examination in March for India only.

This syllabus is available to private candidates.

Detailed timetables are available from **www.cie.org.uk/examsofficers**

Centres in the UK that receive government funding are advised to consult the Cambridge website **www.cie.org.uk** for the latest information before beginning to teach this syllabus.

Combining this with other syllabuses

Candidates can combine this syllabus in an examination series with any other Cambridge syllabus, except:

- syllabuses with the same title at the same level
- 4037 Additional Mathematics

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

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4. Syllabus aims and assessment objectives

4.1 Syllabus 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.

4.2 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.

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5. 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 Cambridge 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 Cambridge 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.

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 — $n(A)$ "…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 — $A \not\subset B$

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Theme or topic	Curriculum objectives
2. 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 $y = \lvert f(x) \rvert$, 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	• 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) 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 $a^x = b$

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Theme or topic	Curriculum objectives
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
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 and 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)

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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 • state the order of 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, **O**, and identity, **I**, matrix) • calculate the determinant and inverse, $\mathbf{A}^{-1}$, of a non-singular 2 × 2 matrix and solve simultaneous linear equations
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 • 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, 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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6. Mathematical notation

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

Mathematical Notation

1. Set Notation

$\in$	is an element of
$\notin$	is not an element of
$\{x_1, x_2, \ldots\}$	the set with elements x_1, x_2, …
$\{x: \ldots\}$	the set of all x such that…
$\mathrm{n}(A)$	the number of elements in set A
$\varnothing$	the empty set
$\mathscr{E}$	universal set
A'	the complement of the set A
$\mathbb{N}$	the set of natural numbers, {1, 2, 3, …}
$\mathbb{Z}$	the set of integers {0, ±1, ±2, ±3, …}
$\mathbb{Z}^+$	the set of positive integers {1, 2, 3, …}
$\mathbb{Z}_n$	the set of integers modulo n, {0, 1, 2, …, 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, $\{x \in \mathbb{Q}: x \geqslant 0\}$
$\mathbb{R}$	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 $\{x \in \mathbb{R}: x \geqslant 0\}$
$\mathbb{R}^n$	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
$[a, b]$	the closed interval $\{x \in \mathbb{R}: a \leqslant x \leqslant b\}$
$[a, b)$	the interval $\{x \in \mathbb{R}: a \leqslant x < b\}$
$(a, b]$	the interval $\{x \in \mathbb{R}: a < x < b\}$
(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

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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
$\leqslant$, $\not>$	is less than or equal to, is not greater than
$>$; $\gg$	is greater than, is much greater than
$\geqslant$, $\not<$	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
$\sum_{i=1}^{n} a_i$	$a_1 + a_2 + \ldots + a_n$
$\sqrt{a}$	the positive square root of the real number a
$\lvert a \rvert$	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 $n, r \in \mathbb{N}$, $0 \leqslant r \leqslant n$
	$\frac{n(n-1)\ldots(n-r+1)}{r!}$, for $n \in \mathbb{Q}$, $r \in \mathbb{N}$

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4. Functions

f	function f
$\mathrm{f}(x)$	the value of the function f at x
$\mathrm{f}: A \to B$	f is a function under which each element of set A has an image in set B
$\mathrm{f}: x \mapsto y$	the function f maps the element x to the element y
f^{-1}	the inverse of the function f
$\mathrm{g} \circ \mathrm{f}$, gf	the composite function of f and g which is defined by $(\mathrm{g} \circ \mathrm{f})(x)$ or $\mathrm{gf}(x) = \mathrm{g}(\mathrm{f}(x))$
$\lim_{x \to a} \mathrm{f}(x)$	the limit of $\mathrm{f}(x)$ as x tends to a
$\Delta x; \delta x$	an increment of x
$\frac{\mathrm{d}y}{\mathrm{d}x}$	the derivative of y with respect to x
$\frac{\mathrm{d}^n y}{\mathrm{d}x^n}$	the nth derivative of y with respect to x
$\mathrm{f}'(x)$, $\mathrm{f}''(x)$, …, $\mathrm{f}^{(n)}(x)$	the first, second, …, nth derivatives of $\mathrm{f}(x)$ with respect to x
$\int y \mathrm{d}x$	indefinite integral of y with respect to x
$\int_a^b y \, \mathrm{d}x$	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
$\dot{x}$, $\ddot{x}$, …	the first, second, … 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

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6. Circular and Hyperbolic Functions and Relations

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

7. Complex Numbers

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

8. Matrices

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

9. Vectors

$\mathbf{a}$	the vector $\mathbf{a}$
$\overrightarrow{AB}$	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
$\lvert \mathbf{a} \rvert$	the magnitude of $\mathbf{a}$
$\lvert \overrightarrow{AB} \rvert$	the magnitude of $\overrightarrow{AB}$
$\mathbf{a} \cdot \mathbf{b}$	the scalar product of $\mathbf{a}$ and $\mathbf{b}$
$\mathbf{a} \times \mathbf{b}$	the vector product of $\mathbf{a}$ and $\mathbf{b}$

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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
$\mathrm{P}(A)$	probability of the event A
A'	complement of the event A, the event 'not A'
$\mathrm{P}(A\|B)$	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, …	observations
f_1, f_2, …	frequencies with which the observations x_1, x_2, … occur
$\mathrm{p}(x)$	the value of the probability function $\mathrm{P}(X = x)$ of the discrete random variable X
p_1, p_2, …	probabilities of the values x_1, x_2, … of the discrete random variable X
$\mathrm{f}(x)$, $\mathrm{g}(x)$, …	the value of the probability density function of the continuous random variable X
$\mathrm{F}(x)$, $\mathrm{G}(x)$, …	the value of the (cumulative) distribution function $\mathrm{P}(X \leqslant x)$ of the random variable X
$\mathrm{E}(X)$	expectation of the random variable X
$\mathrm{E}[\mathrm{g}(X)]$	expectation of $\mathrm{g}(X)$
$\mathrm{Var}(X)$	variance of the random variable X
$\mathrm{G}(t)$	the value of the probability generating function for a random variable which takes integer values
$\mathrm{B}(n, p)$	binomial distribution, parameters n and p
$\mathrm{Po}(\mu)$	Poisson distribution, mean μ
$\mathrm{N}(\mu, \sigma^2)$	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 $\mathrm{N}(0, 1)$
Φ	corresponding cumulative distribution function
ρ	linear product-moment correlation coefficient for a population
r	linear product-moment correlation coefficient for a sample
$\mathrm{Cov}(X, Y)$	covariance of X and Y

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7. Other information

Equality and inclusion

Cambridge International Examinations has taken great care in the preparation of this syllabus and assessment materials to avoid bias of any kind. To comply with the UK Equality Act (2010), Cambridge has designed this qualification with the aim of avoiding direct and indirect discrimination.

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

Candidates who are unable to access the assessment of any component may be eligible to receive an award based on the parts of the assessment they have taken.

Information on access arrangements is found in the *Cambridge Handbook* which can be downloaded from the website **www.cie.org.uk/examsofficer**

Language

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

Grading and reporting

Cambridge IGCSE results are shown by one of the grades A*, A, B, C, D, E, F or G indicating the standard achieved, A* being the highest and G the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for grade G. 'Ungraded' will be reported on the statement of results but not on the certificate. The letters Q (result pending), X (no results) and Y (to be issued) may also appear on the statement of results but not on the certificate.

Entry codes

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