CAMBRIDGE
International Education

Syllabus

Cambridge O Level
Additional Mathematics 4037

Use this syllabus for exams in 2028, 2029 and 2030.
Exams are available in the June and November series.
This syllabus is **not** available in all administrative zones.
Please check the syllabus page at **www.cambridgeinternational.org/4037** to see if this syllabus is available in your administrative zone.

Version 1

For the purposes of screen readers, any mention in this document of Cambridge IGCSE refers to Cambridge International General Certificate of Secondary Education.

Cambridge Pathway

Why choose Cambridge?

We work with schools worldwide to build an education that shapes knowledge, understanding and skills. Together, we give learners the confidence they need to thrive and make a positive impact in a changing world.

As part of the University of Cambridge, we offer a globally trusted and flexible framework for education from age 3 to 19, informed by research, experience, and listening to educators.

With recognised qualifications, high-quality resources, comprehensive support and valuable insights, we help schools prepare every student for the opportunities and challenges ahead.

Qualifications that are recognised and valued worldwide

From the world's top-ranked universities to local higher education institutions, Cambridge qualifications open doors to a world of opportunities.

Setting a global standard

With over 160 years of experience in delivering fair, valid and reliable assessments to students worldwide, we offer a global, recognised performance standard for international education.

Your path, your way

Schools can adapt our curriculum, high-quality teaching and learning resources and flexible assessments to their local context. Our aligned offer helps Cambridge schools support every learner to reach their potential and thrive.

Learning with lasting impact

Cambridge learners build subject knowledge and conceptual understanding, and develop a broad range of skills, learning habits and attributes to help make them ready for the world.

Improving learning outcomes through data-led insight and action

Our trusted baseline and diagnostic assessments, together with our insights and evaluation service, help schools turn data into knowledge and actionable insights, to inform teaching decisions and improve learner outcomes.

Bringing together a community of experts

We bring together the collective knowledge of experts and our diverse community of educators worldwide, supporting them to learn from one another and share ideas and information.

Tackling the climate crisis together

We believe that education is key to tackling the climate crisis. Together with Cambridge schools, we can empower young people with the skills and knowledge to take action on climate change, helping them be ready for the world.

School feedback: 'We think the Cambridge curriculum is superb preparation for university.'

Feedback from: Christoph Guttentag, Dean of Undergraduate Admissions, Duke University, USA

Contents

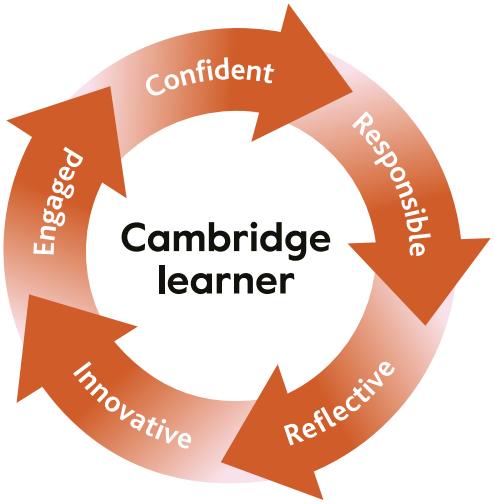
Important: Changes to this syllabus

The latest syllabus is version 1, published September 2025. There are no significant changes which affect teaching.

Any textbooks endorsed to support the syllabus for examination from 2025 are still suitable for use with this syllabus.

1 Why choose this syllabus?

Key benefits



Cambridge O Level is typically for 14 to 16 year olds and is an internationally recognised qualification. It has been designed especially for an international market and is sensitive to the needs of different countries. Cambridge O Level is designed for learners whose first language may not be English, and this is acknowledged throughout the examination process.

Our programmes promote a thorough knowledge and understanding of a subject and help to develop the skills learners need for their next steps in education or employment.

Cambridge O Level Additional Mathematics enriches learners' understanding of connections within mathematics, refining their reasoning and analytical skills. This course reinforces learners' competency, confidence, and fluency in their use of techniques with and without a calculator, strengthening mathematical understanding and communication skills. It requires a fluent and confident ability to solve problems in abstract mathematics.

Cambridge O Level Additional Mathematics encourages learners to further develop their mathematical ability in problem solving, to provide strong progression for advanced study of mathematics or highly numerate subjects. It is designed to stretch the more able candidates and provides a smooth transition to Cambridge International AS & A Level Mathematics.

Our approach in Cambridge O Level Additional Mathematics encourages learners to be:

confident, in using mathematical language and more complex concepts to ask questions, explore ideas and communicate

responsible, by taking ownership of their learning to prepare for independent mathematical learning, and applying their mathematical knowledge and skills so that they can reason, problem solve and work collaboratively

reflective, by making connections within mathematics and across other subjects, and in evaluating methods and presenting logical arguments to justify solutions

innovative, by applying their knowledge and understanding to solve unfamiliar problems creatively, flexibly and efficiently, selecting from a range of mathematical techniques

engaged, by the beauty, patterns and structure of mathematics, they are curious to learn about the relevance of its many applications in society and the economy.

School feedback: 'Cambridge O Level has helped me develop thinking and analytical skills which will go a long way in helping me with advanced studies.'

Feedback from: Kamal Khan Virk, former student at Beaconhouse Garden Town Secondary School, Pakistan, who went on to study Actuarial Science at the London School of Economics

Qualifications that are recognised and valued worldwide

Cambridge qualifications prepare and equip learners with the skills they need to thrive at university and beyond. The world's best higher education institutions recognise our qualifications and value the critical thinking skills, independent research abilities and deep subject knowledge that Cambridge learners bring.

We continually work with universities and colleges in every part of the world to ensure that they understand and accept our qualifications. Cambridge O Level provides a springboard to the Cambridge Advanced stage, as well as other post-16 routes. The combination of knowledge and skills in Cambridge O Level 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.

Many universities require a combination of Cambridge International AS & A Levels and Cambridge O Levels or equivalent to meet their entry requirements.

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

Supporting teachers

We believe education works best when teaching and learning are closely aligned to the curriculum, resources and assessment. Our high-quality teaching support helps to maximise teaching time and enables teachers to engage learners of all backgrounds and abilities.

We aim to provide the following support for each Cambridge qualification:

- Syllabus
- Specimen question papers and mark schemes
- Specimen paper answers
- Schemes of Work
- Example candidate responses
- Past papers and mark schemes
- Principal examiner reports for teachers

These resources are available on the School Support Hub at **www.cambridgeinternational.org/support**, our secure online site for Cambridge teachers. Your exams officer can provide you with a login.

Additional teaching & learning resources are also available for many syllabuses and vary according to the nature of the subject and the structure of the assessment of each syllabus. These can include ready-built lesson materials, digital resources and multimedia for the classroom and homework, guidance on assessment and much more. Beyond the resources available on the Schools Support Hub, a wide range of endorsed textbooks and associated teaching and learning support are available from Cambridge at **www.cambridge.org/education** and from other publishers. Resources vary according to the nature of the subject and the structure of the assessment of each syllabus.

You can also contact our global Cambridge community or talk to a senior examiner on our discussion forums.

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

Professional development

Find the next step on your professional development journey.

- **Introduction courses** – An introduction to Cambridge programmes and qualifications. For teachers who are new to Cambridge programmes or new to a specific syllabus.
- **Focus on Teaching courses** – These are for teachers who want to explore a specific area of teaching and learning within a syllabus or programme.
- **Focus on Assessment courses** – These are for teachers who want to understand the assessment of a syllabus in greater depth.
- **Marking workshops** – These workshops help you become more familiar with what examiners are looking for, and provide an opportunity to raise questions and share your experiences of the syllabus.
- **Enrichment Professional Development** – Transform your approach to teaching with our Enrichment workshops. Each workshop focuses on a specific area of teaching and learning practice.
- **Cambridge Professional Development Qualifications (PDQs)** – Practice-based programmes that transform professional learning for practicing teachers. Available at Certificate and Diploma level.

For more information visit **www.cambridgeinternational.org/support-and-training-for-schools**

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.

Students following a course based on this syllabus will:

- engage in mathematics in a way that builds on their existing mathematical knowledge and enhances their enjoyment of the subject
- develop their instinct for mathematical enquiry and use it flexibly to suit the requirements of a situation
- reinforce and extend mathematical skills and apply them to complex problems
- use creativity and resilience to analyse and solve problems
- reinforce their competency, confidence, and fluency in their use of techniques with and without a calculator, strengthening mathematical understanding and communication skills
- justify their reasoning using structured arguments
- extend their ability to reason logically, make inferences and draw conclusions
- enrich their understanding of interdependence of, and connections between, different areas of mathematics
- acquire a solid foundation for advanced study of mathematics or highly numerate subjects.

We are 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 study the following topics:

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

The subject content is organised by topic and is **not** presented in a teaching order. This content structure allows flexibility for teachers to plan delivery in a way that is appropriate for their learners. Learners are expected to use techniques listed in the content and apply them to solve problems with or without a calculator, as appropriate.

This O Level syllabus shares content with other mathematics syllabuses. For further support see the School Support Hub for IGCSE Additional Mathematics. Textbooks endorsed to support IGCSE Additional Mathematics are suitable for use with this syllabus.

Assessment overview

All candidates take two components. Candidates will be eligible for grades A* to E.

Candidates should have a scientific calculator for Paper 2. Please see the *Cambridge Handbook* at **www.cambridgeinternational.org/eoguide** for guidance on use of calculators in the examinations. Calculators are **not** allowed for Paper 1.

All candidates take:	
Paper 1	2 hours
Non-calculator	50%
80 marks	
Structured and unstructured questions	
Use of a calculator is **not** allowed	
Externally assessed	

and:	
Paper 2	2 hours
Calculator	50%
80 marks	
Structured and unstructured questions	
A scientific calculator is required	
Externally assessed	

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

Assessment objectives

The assessment objectives (AOs) are:

AO1 Knowledge and understanding of mathematical techniques

Candidates should be able to:

- recall and apply mathematical knowledge and techniques
- carry out routine procedures in mathematical and abstract situations
- understand and use mathematical notation and terminology
- perform calculations with and without a calculator
- organise, process, present and understand information in written form, tables, graphs and diagrams
- work to degrees of accuracy appropriate to the context
- recognise and use spatial relationships in two and three dimensions.

AO2 Analyse, interpret and communicate mathematically

Candidates should be able to:

- analyse a problem and identify a suitable strategy to solve it, including using a combination of processes where appropriate
- make connections between different areas of mathematics
- recognise patterns in a variety of situations and make and justify generalisations
- make logical inferences and draw conclusions from mathematical data or results
- communicate methods and results in a clear and logical form
- interpret information in different forms and change from one form of representation to another.

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 O Level %**
AO1 Knowledge and understanding of mathematical techniques	45–55
AO2 Analyse, interpret and communicate mathematically	45–55
Total	100

Assessment objectives as a percentage of each component

Assessment objective	**Weighting in components %**	
	Paper 1	**Paper 2**
AO1 Knowledge and understanding of mathematical techniques	45–55	45–55
AO2 Analyse, interpret and communicate mathematically	45–55	45–55
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 O Level Mathematics (or an equivalent syllabus) is assumed. Cambridge O Level material which is not included in the subject content, such as surds and indices, 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.

A List of formulas is provided on page 2 of the examination papers for candidates to refer to during the examinations. Please note that not all required formulas are given; the 'Notes and examples' column of the subject content will indicate where a formula is given in the examination papers and when a formula is **not** given i.e. knowledge of a formula is required.

Formulas for:

- curved surface area of a cone
- surface area of a sphere
- volume of a pyramid or a cone
- volume of a sphere
- sine rule
- cosine rule
- area of a non-right-angled triangle (no diagram is given in the List of formulas)

are also given in the List of formulas to assist candidates in the examinations.

Syllabus content

1 Functions

Candidates should be able to:		Notes/Examples
1.1	Understand the terms: function, domain, range (image set), one–one function, many–one function, inverse function and composition of functions.	Includes explaining in words why a given function is a function.
1.2	Find the domain and range of functions.	Includes inverse functions and composite functions. The domain of f may need to be restricted for f^{-1} and/or gf to exist. Domain $\mathrm{gf} \subseteq$ Domain f Range $\mathrm{gf} \subseteq$ Range g

continued

1 Functions continued

1.3	Recognise and use function notation.	Examples include: • $f(x) = 2e^x$ • $f: x \mapsto \lg x$, for $x > 0$ • $f^{-1}(x)$ • $fg(x)$ [= $f(g(x))$] • $f^2(x)$ [= $f(f(x))$] The notation $f^2(x)$ will not be used with trigonometric functions.
1.4	Understand the relationship between $y = f(x)$ and $y = \lvert f(x) \rvert$, where $f(x)$ may be linear, quadratic, cubic or trigonometric.	If $f(x)$ is trigonometric it will be one of the following: • $y = a \sin bx + c$ • $y = a \cos bx + c$ • $y = a \tan bx + c$ where a is a positive integer, b is a simple fraction or integer, and c is an integer. Fractions will have a denominator of 2, 3, 4, 6 or 8 only.
1.5	Explain in words why a given function does not have an inverse.	
1.6	Find the inverse of a one–one function.	Correct notation must be used. For example: • $f(x) = e^{2x}$ • $f^{-1}(x) = \frac{1}{2} \ln x$
1.7	Form and use composite functions.	Understand that order of functions is important, i.e. fg may not be the same as gf.
1.8	Use sketch graphs to show the relationship between a function and its inverse.	Understand that each function is the reflection of the other in the line $y = x$.

2 Quadratic functions

Candidates should be able to:		Notes/Examples
2.1	Find the maximum or minimum value of the quadratic function $f: x \mapsto ax^2 + bx + c$ by completing the square or by differentiation.	
2.2	Use the maximum or minimum value of $f(x)$ to sketch the graph of $y = f(x)$ or determine the range for a given domain.	Candidates should use correct notation to write a domain or range.
2.3	Know the conditions for $f(x) = 0$ to have:	Understand how the discriminant relates to the roots of the equation.
(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.	

continued

2 Quadratic functions continued

2.4	Solve quadratic equations for real roots.	Formula is given in the List of formulas. Students are expected to be able to use factorisation, the quadratic formula and completing the square. On the calculator paper, correct answers are acceptable without working.
2.5	Find the solution set for quadratic inequalities either graphically or algebraically.	Solutions should be written in the correct form. For example: • $-3 < x < 4$ • $x < 1$ or $x > 6$

3 Factors of polynomials

Candidates should be able to:		Notes/Examples
3.1	Know and use the remainder and factor theorems.	
3.2	Find factors of polynomials.	For a cubic polynomial, students are first expected to obtain a product of a linear factor and a quadratic factor, for example by observation or by algebraic long division.
3.3	Solve cubic equations.	

4 Equations, inequalities and graphs

Candidates should be able to:		Notes/Examples
4.1	Solve equations of the type • $\|ax + b\| = c\ (c \geqslant 0)$ • $\|ax + b\| = cx + d$ • $\|ax + b\| = \|cx + d\|$ • $\|ax^2 + bx + c\| = d$ using algebraic or graphical methods.	For graphical solutions, an accurate graph is expected. For algebraic methods, any valid method is acceptable.
4.2	Solve graphically or algebraically inequalities of the type • $k\|ax + b\| > c\ (c \geqslant 0)$ • $k\|ax + b\| \leqslant c\ (c > 0)$ • $k\|ax + b\| \leqslant \|cx + d\|$ where $k > 0$ • $\|ax + b\| \leqslant cx + d$ • $\|ax^2 + bx + c\| > d$ • $\|ax^2 + bx + c\| \leqslant d$	For graphical solutions, an accurate graph is expected. For algebraic methods, any valid method is acceptable.

continued

4 Equations, inequalities and graphs continued

4.3	Use substitution to form and solve a quadratic equation in order to solve a related equation.	For example: • $x^{\frac{4}{3}} + x^{\frac{2}{3}} - 12 = 0$ • $2(\ln 5x)^2 + \ln 5x - 6 = 0$ • $3e^x = 12 - 5e^{-x}$ Candidates are expected to identify the appropriate substitution.
4.4	Sketch the graphs of cubic polynomials and their moduli, when given as a product of three linear factors.	The points of intersection of the graph with the coordinate axes should be clearly labelled.
4.5	Solve graphically cubic inequalities of the form • $f(x) \geqslant d$ • $f(x) > d$ • $f(x) \leqslant d$ • $f(x) < d$ where $f(x)$ is a product of three linear factors and d is a constant.	

5 Simultaneous equations

Candidates should be able to:		Notes/Examples
5.1	Solve simultaneous equations in two unknowns by elimination or substitution.	For example: • $y - x + 3 = 0$ and $x^2 - 3xy + y^2 + 19 = 0$ • $xy^2 = 4$ and $xy = 3$ • $\frac{x}{y} + \frac{2y}{x} = 4$ and $y = x - 2$

6 Logarithmic and exponential functions

Candidates should be able to:		Notes/Examples
6.1	Know and use simple properties and graphs of the logarithmic and exponential functions, including $\ln x$ and e^x.	Logarithms may be given to any base. Understand that $f(x) = e^x$ and $g(x) = \ln x$ are each the inverse of the other. Understand the asymptotic nature of the graphs of logarithmic and exponential functions. State the equations of any asymptotes. Graphs are limited to $y = ke^{nx} + a$ and $y = k\ln(ax + b)$ where n, k, a and b are integers. Series expansions are **not** required.

continued

6 Logarithmic and exponential functions continued

6.2	Know and use the laws of logarithms, including change of base of logarithms.	For example: • Write $3 + 2\lg p - \lg q$ as a single base 10 logarithm. • Write $\frac{1}{\log_5 e}$ as a natural logarithm.
6.3	Solve equations of the form $a^x = b$.	

7 Straight-line graphs

Candidates should be able to:		Notes/Examples
7.1	Use the equation of a straight line.	
7.2	Know and use the condition for two lines to be parallel or perpendicular.	
7.3	Solve problems involving midpoint and length of a line, including finding and using the equation of a perpendicular bisector.	
7.4	Transform given relationships to and from straight-line form, including determining unknown constants by calculating the gradient or intercept of the transformed graph.	For example: • To straight-line form $y = Ax^n$ $y = Ab^x$ • From straight-line form to an equation of the form $y^2 = Ax^3 + B$ $e^{2y} = Ax^2 + B$ $y^3 = A\ln x + B$

8 Coordinate geometry of the circle

Candidates should be able to:		Notes/Examples
8.1	Know and use the equation of a circle with radius r and centre (a, b).	Identify the centre and radius of a circle using a circle equation in any form. For example: • $(x - a)^2 + (y - b)^2 = r^2$ • $x^2 + y^2 + 2gx + 2fy + c = 0$ Formula is given in the List of formulas.
8.2	Solve problems involving the intersection of a circle and a straight line.	Includes finding points of intersection. Includes determining whether a straight line: • is a tangent • is a chord • does not intersect the circle.

continued

8 Coordinate geometry of the circle continued

8.3	Solve problems involving tangents to a circle.	Includes finding equations of tangents. No use of calculus is expected.
8.4	Solve problems involving the intersection of two circles.	Includes finding points of intersection, finding the equation of a common chord or determining whether two circles: • intersect • touch • do not intersect.

9 Circular measure

Candidates should be able to:		Notes/Examples
9.1	Solve problems involving the arc length and sector area of a circle, including knowledge and use of radian measure.	Use of radian measure is expected in the solution of problems which may involve compound shapes. Formulas are not given.

10 Trigonometry

Candidates should be able to:		Notes/Examples
10.1	Know and use the six trigonometric functions of angles of any magnitude.	sine, cosine, tangent, secant, cosecant, cotangent
10.2	Understand and use the amplitude and period of a trigonometric function, including the relationship between graphs of related trigonometric functions.	For example: $y = \sin x$ and $y = 3\sin 2x$ The period may be in either degrees or radians.
10.3	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, and c is an integer.	Graphs will be drawn over a given domain which may be in either degrees or radians. For a graph of $y = a \tan bx + c$, the x-coordinate of any asymptote should be clearly labelled. Fractions will have a denominator of 2, 3, 4, 6 or 8 only.
10.4	Use the relationships: • $\sin^2 A + \cos^2 A = 1$ • $\sec^2 A = 1 + \tan^2 A$ • $\operatorname{cosec}^2 A = 1 + \cot^2 A$	Trigonometric identities are given in the List of formulas.

continued

10 Trigonometry continued

10.5	Solve, for a given domain, trigonometric equations involving the six trigonometric functions.	Includes the use of the relationships in 10.4. For example: • $4 \cot \theta = \tan \theta$ • $2 \sec^2 \theta + \tan \theta - 3 = 0$ • $5 \sin \frac{\theta}{3} + 2 \cos \frac{\theta}{3} = 0$ • $3 \operatorname{cosec} \left(2\theta - \frac{\pi}{12}\right) = 4$
10.6	Prove trigonometric relationships involving the six trigonometric functions.	Includes the use of the relationships in 10.4. For example: • $\sin x \tan x + \cos x = \sec x$ • $\frac{\sin \theta}{1 + \cos \theta} + \frac{1 + \cos \theta}{\sin \theta} = 2 \operatorname{cosec} \theta$

11 Permutations and combinations

Candidates should be able to:		Notes/Examples
11.1	Recognise the difference between permutations and combinations and know when each should be used.	
11.2	Know and use the notation $n!$ and the expressions for permutations and combinations of n items taken r at a time.	Includes 0! = 1.
11.3	Solve problems on arrangement and selection using permutations or combinations.	Problems will be either in an everyday context or based on an algebraic problem. Problems involving: • repetition of objects • objects arranged in a circle • both permutations and combinations, are **not** included.

12 Series

Candidates should be able to:	Notes/Examples
12.1 Use the binomial theorem for expansion of $(a+b)^n$ for positive integer n.	Includes simplification of coefficients. Formula is given in the List of formulas.
12.2 Use the general term $\binom{n}{r}a^{n-r}b^r,\ 0 \leqslant r \leqslant n$.	For example: Find the term independent of x in the expansion of $\left(2x+\frac{1}{x}\right)^{10}$. Knowledge of the greatest term and properties of the coefficients is **not** required.
12.3 Recognise arithmetic and geometric progressions and understand the difference between them.	
12.4 Use the formulas for the nth term and for the sum of the first n terms to solve problems involving arithmetic or geometric progressions.	Problems may be in context. Formulas are given in the List of formulas.
12.5 Use the condition for the convergence of a geometric progression, and the formula for the sum to infinity of a convergent geometric progression.	Includes explaining why a particular geometric progression has or does not have a sum to infinity. Formula is given in the List of formulas.

13 Vectors in two dimensions

Candidates should be able to:	Notes/Examples
13.1 Understand and use vector notation.	Vectors will be given in any form including: $\begin{pmatrix}a\\b\end{pmatrix}$, $\overrightarrow{AB}$, $\mathbf{p}$, $a\mathbf{i}-b\mathbf{j}$ Candidates are expected to use correct vector notation.
13.2 Know and use position vectors and unit vectors.	For example: The unit vector in the same direction as $\mathbf{a}$ is $\frac{a}{\lvert a\rvert}$.
13.3 Find the magnitude of a vector; add and subtract vectors and multiply vectors by scalars.	Includes: • equating like vectors • solving problems using vector geometry, with a diagram given in more complex cases.
13.4 Compose and resolve velocities.	Determine a resultant vector by adding two or more vectors together. Includes the use of a velocity vector to determine position and solve problems in context such as particles colliding.

14 Calculus

No formulas will be given in the List of formulas for the Calculus section.

Candidates should be able to:		Notes/Examples
14.1	Understand the idea of a derived function.	Only an informal understanding of the idea of a limit is expected, and the technique of differentiation from first principles is **not** required.
14.2	Use the notations $f'(x)$, $f''(x)$, $\frac{dy}{dx}$, $\frac{d^2y}{dx^2} = \frac{d}{dx}\left(\frac{dy}{dx}\right)$ δx, $\delta x \to 0$, $\frac{\delta y}{\delta x}$.	
14.3	Know and use the derivatives of the standard functions x^n (for any rational n), $\sin x$, $\cos x$, $\tan x$, e^x, $\ln x$.	Includes constant multiples, sums and composite functions (use of chain rule). For example, differentiate $(3x^2 + 4)^{\frac{1}{3}}$. For trigonometric functions angles will always be in radians.
14.4	Differentiate products and quotients of functions.	
14.5	Use differentiation to find gradients, tangents and normals.	
14.6	Use differentiation to find stationary points.	Points of inflexion are **not** included.
14.7	Apply differentiation to connected rates of change, small increments and approximations.	
14.8	Apply differentiation to practical problems involving maxima and minima.	
14.9	Use the first and second derivative tests to discriminate between maxima and minima.	Points of inflexion are **not** included. Full justification of conclusions is expected. An explanation of how to distinguish between a maximum point and a minimum point may be required. Unless specified otherwise, any valid method is allowed.
14.10	Understand integration as the reverse process of differentiation.	Solutions for indefinite integrals should include an arbitrary constant.
14.11	Integrate sums of terms in powers of x, including $\frac{1}{x}$ and $\frac{1}{ax+b}$.	Solutions for indefinite integrals should include an arbitrary constant.

continued

14 Calculus continued

14.12	Integrate functions of the form: • $(ax + b)^n$ for any rational n • $\sin(ax + b)$ • $\cos(ax + b)$ • $\sec^2(ax + b)$ • e^{ax+b}	Includes the case where $n = -1$. For trigonometric functions angles will always be in radians. Solutions for indefinite integrals should include an arbitrary constant.
14.13	Evaluate definite integrals and apply integration to the evaluation of plane areas.	Plane areas include: • between a line and a curve • between two curves • a sum of two areas.
14.14	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.	For example: Given the velocity of a particle is $v = 3t^2 - 30t + 72$ find its acceleration when $t = 2$.
14.15	Make use of the relationships in 14.14 to draw and use the following graphs: • displacement–time • distance–time • velocity–time • speed–time • acceleration–time.	For example: A particle moves in a straight line. Its displacement s, from a fixed point at time, t, is given by $s = 3t^3 - 10t^2 + 4t + 8$ for $0 \leqslant t \leqslant 3$. Sketch its displacement–time graph, its speed–time graph, its acceleration–time graph.

Faculty feedback: 'Understanding how and why our climate is changing and providing the knowledge and skills to explore the challenges plays a key role in every student's education.'

Feedback from: Dr Amy Munro-Faure, Head of Education and Student Engagement of Cambridge Zero

4 Details of the assessment

All candidates 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.

Paper 1

Written paper, 2 hours, 80 marks

Use of a calculator is **not** allowed.

Candidates answer **all** questions.

Structured and unstructured questions.

This paper consists of questions based on any part of the content.

This is a compulsory component for all candidates.

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

Paper 2

Written paper, 2 hours, 80 marks

A scientific calculator is required.

Candidates answer **all** questions.

Structured and unstructured questions.

This paper consists of questions based on any part of the content.

This is a compulsory component for all candidates.

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

List of formulas

Equation of a circle with centre (a, b) and radius r. $(x-a)^2+(y-b)^2=r^2$

Curved surface area, A, of cone of radius r, sloping edge l. $A=\pi rl$

Surface area, A, of sphere of radius r. $A=4\pi r^2$

Volume, V, of pyramid or cone, base area A, height h. $V=\frac{1}{3}Ah$

Volume, V, of sphere of radius r. $V=\frac{4}{3}\pi r^3$

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

$$u_n=a+(n-1)d$$

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

Geometric series

$$u_n=ar^{n-1}$$

$$S_n=\frac{a(1-r^n)}{1-r}\quad(r\neq1)$$

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

Identities

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

Formulas for ΔABC

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

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

$$\Delta=\frac{1}{2}ab\sin C$$

Mathematical conventions

Mathematics is a universal language where there are some similarities and differences around the world. The guidance below outlines the conventions that are used in Cambridge examinations, and we encourage candidates to follow these conventions.

Working with graphs

- A **plot** of a graph should have points clearly marked, for example as small crosses (×), and **must**:
  - be drawn on a grid or graph paper
  - cover the range of values that has been requested. Candidates should calculate the coordinates of points and connect them appropriately (where a table of values is not provided, the candidate must decide on points required to draw the graph accurately so that it has the most important features listed in sketching a graph)
  - have each point plotted to an accuracy of within half of the smallest square on the grid.
- A **sketch** of a graph does not have to be accurate or to scale, nor does it need to be on graph or squared paper, but it **must**:
  - be drawn freehand
  - show the most important features, e.g. x-intercepts, y-intercepts, stationary points, symmetry, and asymptotes, with coordinates of relevant values marked on the axes, where required
  - have labelled axes, e.g. with x and y
  - interact with the axes appropriately, e.g. by intersecting or by tending towards
  - fall within the correct quadrants
  - show the correct long-term behaviour if no domain has been specified.
- Graphs should extend as far as possible across any given grid, within any constraints of the domain.
- Where graphs of functions are:
  - linear, they should be ruled
  - non-linear, the points should be joined with a smooth curve
  - the modulus of a non-linear function, it should have cusps.
- Values should be read off a graph to an accuracy of within half of the smallest square on the grid.

Communicating mathematically

- If candidates are asked to show their working, or show that a given result is true, they cannot gain full marks without clearly communicating and fully justifying their method.
- A numerical answer should not be given as a combination of fractions and decimals, e.g. $\frac{1}{0.2}$ is **not** acceptable.
- When asked to 'simplify', the candidate must simplify fully.
- When asked to 'factorise', the candidate must factorise fully.

Accuracy

- Answers are expected to be given in their simplest form unless the question states otherwise.
- Where a question asks for 'exact values' the answer may need to be given in terms of π, e, natural logarithms, surds or a combination of these, depending on the question.
- Where answers are not exact values:
  - angles in degrees should be given to at least one decimal place
  - all other values should be given to at least three significant figures

  unless a different accuracy is defined in the question.
- Answers that are exact to four or five significant figures should not be rounded unless the question states otherwise.
- In order to obtain an answer correct to an appropriate degree of accuracy, a higher degree of accuracy will often be needed within the working.
- If a question asks to prove or show a given answer to a specified degree of accuracy, candidates must show full working, intermediate answers and the final answer to at least one degree of accuracy more than that asked for.

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
Calculate	work out from given facts, figures or information
Describe	state the points of a topic / give characteristics and main features
Determine	establish with certainty
Explain	set out purposes or reasons / make the relationships between things clear / say why and/or how and support with relevant evidence
Give	produce an answer from a given source or recall/memory
Plot	mark point(s) on a graph
Sketch	make a simple freehand drawing showing the key features, taking care over proportions
State	express in clear terms
Verify	confirm a given statement/result is true
Work out	calculate from given facts, figures or information with or without the use of a calculator
Write	give an answer in a specific form
Write down	give an answer without significant working

5 What else you need to know

This section is an overview of other information you need to know about this syllabus. It will help to share the administrative information with your exams officer so they know when you will need their support. Find more information about our administrative processes at **www.cambridgeinternational.org/eoguide**

Before you start

Previous study

We recommend that learners starting this course should have studied a mathematics curriculum such as the Cambridge Lower Secondary programme or equivalent national educational framework. Knowledge of the subject content of Cambridge O Level/IGCSE Mathematics is assumed. This includes the use of indices and surds.

Guided learning hours

We design Cambridge O Level syllabuses to require about 130 guided learning hours for each subject. This is for guidance only. The number of hours a learner needs to achieve the qualification may vary according to each school and the learners' 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. Find your administrative zone at **www.cambridgeinternational.org/adminzone**. This syllabus is **not** available in all administrative zones.

Cambridge O Levels are available to centres in administrative zones 3, 4 and 5.

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.

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

Private candidates can enter for this syllabus. For more information, please refer to the *Cambridge Guide to Making Entries*.

Combining with other syllabuses

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

- Cambridge IGCSE Additional Mathematics (0606)
- syllabuses with the same title at the same level.

Cambridge O Level, Cambridge IGCSE and Cambridge IGCSE (9–1) syllabuses are at the same level.

Making entries

Exams officers are responsible for submitting entries. 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 access to 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 an 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 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.

Learn more about retake entries, including definitions and information on entry deadlines, at **www.cambridgeinternational.org/retakes**

To confirm what entry options are available for this syllabus, refer to the *Cambridge Guide to Making Entries* for the relevant series. Regulations for carrying forward component marks can be found in the *Cambridge Handbook* for the relevant year of assessment at **www.cambridgeinternational.org/eoguide**

Language

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

Accessibility and equality

Syllabus and assessment design

At Cambridge we recognise that our candidates have highly diverse socio-economic, cultural and linguistic backgrounds, and may also have a variety of protected characteristics. Protected characteristics include special educational needs and disability (SEND), religion and belief, and characteristics related to gender and identity.

We follow accessible design principles to make our syllabuses and assessment materials as accessible and inclusive as possible. We review language accessibility, visual resources, question layout and the contexts used in questions. Using this approach means that we give all candidates the fairest possible opportunity to demonstrate their knowledge, skills and understanding.

Access arrangements

Our design principles aim to make sure our assessment materials are accessible for all candidates. To further minimise barriers faced by candidates with SEND, illness or injury, we offer a range of access arrangements and modified papers. This is the principal way in which we comply with our duty to make 'reasonable adjustments', as guided by the UK Equality Act 2010.

Important:

Requested access arrangements should be based on evidence of the candidate's barrier to taking an assessment and should also reflect their normal way of working. For Cambridge to approve an access arrangement, we need to agree that it constitutes a reasonable adjustment and does not affect the security or integrity of the assessment. This is explained in section 1.3 of the *Cambridge Handbook* **www.cambridgeinternational.org/eoguide**

Applying for access arrangements

- Details of our standard access arrangements and modified question papers are available in section 1.3 of the *Cambridge Handbook* **www.cambridgeinternational.org/eoguide**
- Centres are expected to check the availability of access arrangements and modified question papers at the start of the course. Check the *Cambridge Handbook*, the assessment objectives listed in the syllabus document and, where applicable, any access arrangement restrictions listed in the syllabus document.
- Contact us at the start of the course to find out if we can approve an access arrangement that is not listed in the *Cambridge Handbook*.
- All applications should be made by the deadlines published in the *Cambridge Handbook*.

After the exam

Grading and reporting

Grades A*, A, B, C, D or E indicate the standard a candidate achieved at Cambridge O Level.

A* is the highest and E is the lowest. 'Ungraded' means that the candidate's performance did not meet the standard required for grade E. '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, Cambridge O Level is shown as GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL.

On certificates, Cambridge O Level is shown as General Certificate of Education.

How students and teachers can use the grades

Assessment at Cambridge IGCSE has two purposes:

1 to measure learning and achievement

The assessment confirms achievement and performance in relation to the knowledge, understanding and skills specified in the syllabus.

2 to show likely future success

The outcomes help predict which students are well prepared for or likely to be successful in a particular course or career.

The outcomes help students choose the most suitable course or career.

Changes to this syllabus for 2028, 2029 and 2030

The syllabus has been updated. This is version 1, published September 2025.

You must read the whole syllabus before planning your teaching programme. We review our syllabuses regularly to make sure they continue to meet the needs of our schools. In updating this syllabus, we have made it easier for teachers and students to understand, keeping the familiar features that teachers and schools value.

There are no significant changes which affect teaching.

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

Any textbooks endorsed to support the syllabus for examination from 2025 are still suitable for use with this syllabus.

Syllabuses and specimen materials represent the final authority on the content and structure of all of our assessments.

With a Customer Services team available 24 hours a day, 6 days a week, and dedicated regional teams supporting schools in 160 countries, we understand your local context and are here to guide you so you can provide your learners with everything they need to prepare for Cambridge O Level.

Quality management

We are committed to providing exceptional quality. In line with this commitment, our quality management system for the provision of international education programmes and qualifications for students aged 5 to 19 is independently certified as meeting the internationally recognised standard, ISO 9001:2015.
Learn more at **www.cambridgeinternational.org/about-us/our-standards/**

We are committed to making our documents accessible in accordance with the WCAG 2.1 Standard. We are always looking to improve the accessibility of our documents. If you find any problems or you think we are not meeting accessibility requirements, contact us at **info@cambridgeinternational.org** with the subject heading: Digital accessibility. If you need this document in a different format, contact us and supply your name, email address and requirements and we will respond within 15 working days.

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