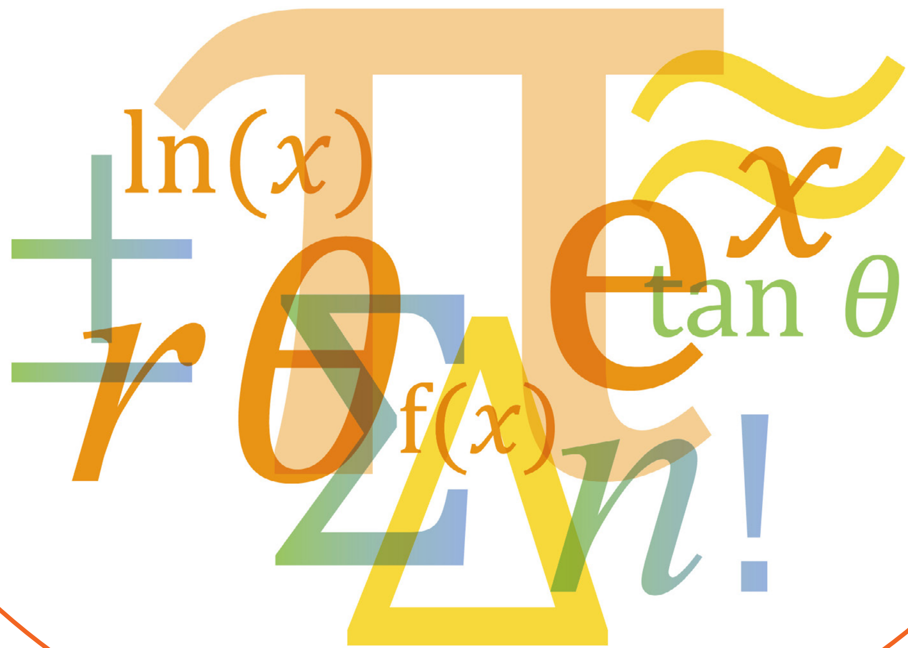
Cambridge Assessment International Education

Syllabus

Cambridge O Level

Additional Mathematics 4037

Use this syllabus for exams in 2025, 2026 and 2027.
Exams are available in the June and November series.



Version 1
Please check the syllabus page at **www.cambridgeinternational.org/4037**
to see if this syllabus is available in your administrative zone.

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 International?

Cambridge International prepares school students for life, helping them develop an informed curiosity and a lasting passion for learning. We are part of Cambridge University Press & Assessment, which is a department of the University of Cambridge.

Our Cambridge Pathway gives students a clear path for educational success from age 5 to 19. Schools can shape the curriculum around how they want students to learn – with a wide range of subjects and flexible ways to offer them. It helps students discover new abilities and a wider world, and gives them the skills they need for life, so they can achieve at school, university and work.

Our programmes and qualifications set the global standard for international education. They are created by subject experts, rooted in academic rigour and reflect the latest educational research. They provide a strong platform for learners to progress from one stage to the next, and are well supported by teaching and learning resources.

Our mission is to provide educational benefit through provision of international programmes and qualifications for school education and to be the world leader in this field. Together with schools, we develop Cambridge learners who are confident, responsible, reflective, innovative and engaged – equipped for success in the modern world.

Every year, nearly a million Cambridge students from 10 000 schools in 160 countries prepare for their future with the Cambridge Pathway.

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

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

Quality management

Cambridge International is committed to providing exceptional quality. In line with this commitment, our quality management system for the provision of international qualifications and education programmes for students aged 5 to 19 is independently certified as meeting the internationally recognised standard, ISO 9001:2015. Learn more at **www.cambridgeinternational.org/ISO9001**

Contents

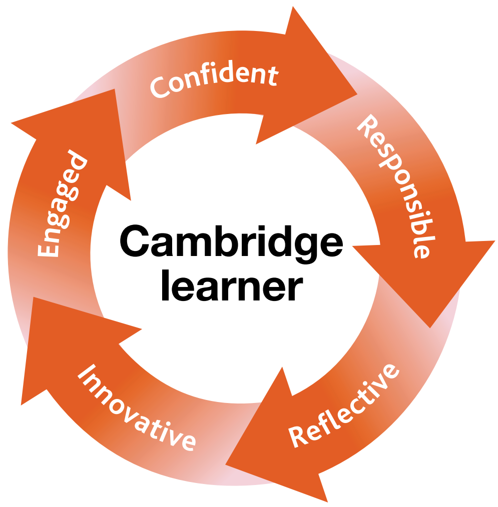
Important: Changes to this syllabus

For information about changes to this syllabus for 2025, 2026 and 2027, go to page 30.

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

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

International recognition and acceptance

Our expertise in curriculum, teaching and learning, and assessment is the basis for the recognition of our programmes and qualifications around the world. 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.

Cambridge O Levels are accepted and valued by leading universities and employers around the world as evidence of academic achievement. Many universities require a combination of Cambridge International AS & A Levels and Cambridge O Levels or equivalent to meet their entry requirements.

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

Supporting teachers

We provide a wide range of resources, detailed guidance, innovative training and professional development so that you can give your students the best possible preparation for Cambridge O Level. To find out which resources are available for each syllabus go to our School Support Hub.

The School Support Hub is our secure online site for Cambridge teachers where you can find the resources you need to deliver our programmes. You can also keep up to date with your subject and the global Cambridge community through our online discussion forums.

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

Support for Cambridge O Level			
Planning and preparation	**Teaching and assessment**	**Learning and revision**	**Results**
• Schemes of work • Specimen papers • Syllabuses • Teacher guides	• Endorsed resources • Online forums • Support for coursework	• Example candidate responses • Past papers and mark schemes • Specimen paper answers	• Candidate Results Service • Principal examiner reports for teachers

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

Professional development

We support teachers through:

- Introductory Training – face-to-face or online
- Extension Training – face-to-face or online
- Enrichment Professional Development – face-to-face or online

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

- Cambridge Professional Development Qualifications

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

Supporting exams officers

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

2 Syllabus overview

Aims

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

The aims are to enable students to:

- 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.

Cambridge Assessment International Education is an education organisation and politically neutral. The contents of this syllabus, examination papers and associated materials do not endorse any political view. We endeavour to treat all aspects of the exam process neutrally.

Content overview

All candidates 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:		**and:**	
Paper 1	2 hours	**Paper 2**	2 hours
Non-calculator	50%	Calculator	50%
80 marks		80 marks	
Structured and unstructured questions		Structured and unstructured questions	
Use of a calculator is **not** allowed		A scientific calculator is required	
Externally assessed		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. $5\,\mathrm{m\,s^{-1}}$ 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

1	Functions (continued)	
1.3	Recognise and use function notation.	Examples include: • $\mathrm{f}(x) = 2\mathrm{e}^x$ • $\mathrm{f} : x \mapsto \lg x$, for $x > 0$ • $\mathrm{f}^{-1}(x)$ • $\mathrm{fg}(x)$ [$= \mathrm{f}(\mathrm{g}(x))$] • $\mathrm{f}^2(x)$ [$= \mathrm{f}(\mathrm{f}(x))$] The notation $\mathrm{f}^2(x)$ will not be used with trigonometric functions.
1.4	Understand the relationship between $y = \mathrm{f}(x)$ and $y = \|\mathrm{f}(x)\|$, where $\mathrm{f}(x)$ may be linear, quadratic, cubic or trigonometric.	If $\mathrm{f}(x)$ 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: • $\mathrm{f}(x) = \mathrm{e}^{2x}$ • $\mathrm{f}^{-1}(x) = \frac{1}{2} \ln x$
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 $\mathrm{f} : x \mapsto ax^2 + bx + c$ by completing the square or by differentiation.	
2.2	Use the maximum or minimum value of $\mathrm{f}(x)$ to sketch the graph of $y = \mathrm{f}(x)$ 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 $\mathrm{f}(x) = 0$ 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.	Understand how the discriminant relates to the roots of the equation.

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 • $\lvert ax+b\rvert = c \ (c \geqslant 0)$ • $\lvert ax+b\rvert = cx+d$ • $\lvert ax+b\rvert = \lvert cx+d\rvert$ • $\lvert ax^2+bx+c\rvert = d$ 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 • $k\lvert ax+b\rvert > c \ (c \geqslant 0)$ • $k\lvert ax+b\rvert \leqslant c \ (c > 0)$ • $k\lvert ax+b\rvert \leqslant \lvert cx+d\rvert$ where $k > 0$ • $\lvert ax+b\rvert \leqslant cx+d$ • $\lvert ax^2+bx+c\rvert > d$ • $\lvert ax^2+bx+c\rvert \leqslant d$	For graphical solutions, an accurate graph is expected. For algebraic methods, any valid method is acceptable.

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.

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 $\dfrac{1}{\log_5 e}$ 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.

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.

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

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 $f'(x)$, $f''(x)$, $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}\left[= \frac{d}{dx}\left(\frac{dy}{dx}\right)\right]$ 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 $\left(3x^2 + 4\right)^{\frac{1}{3}}$. 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.

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.

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. 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

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

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

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

Identities

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

$\sec^2 A = 1 + \tan^2 A$

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

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
Show (that)	provide structured evidence that leads to a given result
Sketch	make a simple freehand drawing showing the key features
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. 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 enter candidates in the June and November exam series. You can view the timetable for your administrative zone at **www.cambridgeinternational.org/timetables**

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 to Cambridge International. We encourage them to work closely with you to make sure they enter the right number of candidates for the right combination of syllabus components. Entry option codes and instructions for submitting entries are in the *Cambridge Guide to Making Entries*. Your exams officer has a copy of this guide.

Exam administration

To keep our exams secure, we produce question papers for different areas of the world, known as administrative zones. We allocate all Cambridge schools to 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 your entries on time. Your exams officer will find this support, and guidance for all other phases of the Cambridge Exams Cycle, at **www.cambridgeinternational.org/eoguide**

Retakes

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

Language

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

Accessibility and equality

Syllabus and assessment design

Cambridge International works to avoid direct or indirect discrimination. We develop and design syllabuses and assessment materials to maximise inclusivity for candidates of all national, cultural or social backgrounds and candidates with protected characteristics; these protected characteristics include special educational needs and disability, religion and belief, and characteristics related to gender and identity. In addition, the language and layout used are designed to make our materials as accessible as possible. This gives all candidates the fairest possible opportunity to demonstrate their knowledge, skills and understanding and helps to minimise the requirement to make reasonable adjustments during the assessment process.

Access arrangements

Access arrangements (including modified papers) are the principal way in which Cambridge International complies with our duty, as guided by the UK Equality Act (2010), to make 'reasonable adjustments' for candidates with special educational needs (SEN), disability, illness or injury. Where a candidate would otherwise be at a substantial disadvantage in comparison to a candidate with no SEN, disability, illness or injury, we may be able to agree pre-examination access arrangements. These arrangements help a candidate by minimising accessibility barriers and maximising their opportunity to demonstrate their knowledge, skills and understanding in an assessment.

Important:

- Requested access arrangements should be based on evidence of the candidate's barrier to assessment and should also reflect their normal way of working at school; this is in line with the *Cambridge Handbook* **www.cambridgeinternational.org/eoguide**
- For Cambridge International to approve an access arrangement, we will need to agree that it constitutes a reasonable adjustment, involves reasonable cost and timeframe and does not affect the security and integrity of the assessment.
- Availability of access arrangements should be checked by centres at the start of the course. Details of our standard access arrangements and modified question papers are available in the *Cambridge Handbook* **www.cambridgeinternational.org/eoguide**
- Please contact us at the start of the course to find out if we are able to approve an arrangement that is not included in the list of standard access arrangements.
- Candidates who cannot access parts of the assessment may be able to receive an award based on the parts they have completed.

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 and certificates, Cambridge O Level is shown as GENERAL CERTIFICATE OF EDUCATION (GCE O LEVEL).

How students and teachers can use the grades

Assessment at Cambridge O Level 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, to the levels described in the grade descriptions.
2. to show likely future success

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

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

Grade descriptions

Grade descriptions are provided to give an indication of the standards of achievement candidates awarded particular grades are likely to show. Weakness in one aspect of the examination may be balanced by a better performance in some other aspect.

Grade descriptions for Cambridge O Level Additional Mathematics will be published after the first assessment of the syllabus in 2025.

Changes to this syllabus for 2025, 2026 and 2027

The syllabus has been reviewed and revised for first examination in 2025.

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

Changes to syllabus content

- The wording of learning outcomes has been updated and notes and examples included, to clarify the depth of teaching.
- The subject content has been refreshed and updated. Significant changes to content have been summarised below.
  - The Indices and surds topic has been removed from the subject content (this is now assumed knowledge).
  - A new topic on Coordinate geometry of the circle has been added to the subject content.
- Other content has been added, removed or clarified within topics; you are advised to read the subject content in the syllabus carefully for details.
- The teaching time has not changed.
- The List of formulas provided in the examinations has been updated.
- The Command words have been updated.
- A section on mathematical conventions has been provided.
- The wording of the learner attributes has been updated to improve clarity.
- The aims have been updated and clarified.

Changes to assessment (including changes to specimen papers)

- The wording of the assessment objectives (AOs) has been updated. There are no changes to the knowledge and skills being assessed for each AO.
- A non-calculator assessment has been introduced to build candidates' confidence in working mathematically without a calculator.
  - Paper 1 is now a non-calculator paper, calculators are **not** allowed in the exam.
  - Calculators are still allowed in Paper 2.
- The questions in the examinations are the same standard as in the existing assessment.
- Mark schemes have been updated to award more marks for working where appropriate, in line with other Cambridge Mathematics qualifications.
- The specimen assessment materials have been updated to reflect the changes to the assessment.

In addition to reading the syllabus, you should refer to the updated specimen assessment materials. The specimen papers will help your students become familiar with exam requirements and command words in questions. The specimen mark schemes show how students should answer questions to meet the assessment objectives.

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

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