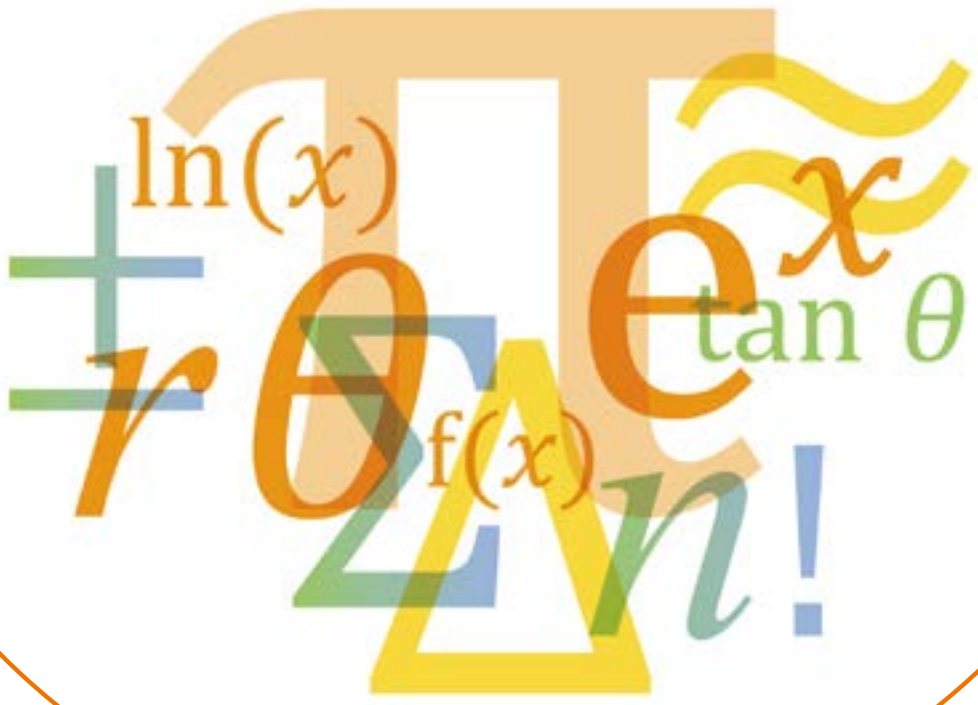
Cambridge Assessment International Education

Syllabus

Cambridge IGCSE™

Additional Mathematics (US) 0459

For examination in June and November 2020 and 2021.
This syllabus is available only to schools in Arizona in the USA.



Version 1

Cambridge Pathway

Why Choose Cambridge?

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

Our international qualifications are recognized by the world's best universities and employers, giving students a wide range of options in their education and career. As a not-for-profit organization, we devote our resources to delivering high-quality educational programs that can unlock learners' potential.

Our programs and qualifications set the global standard for international education. They are created by subject experts, rooted in academic rigor, 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 programs 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 an international education from Cambridge International.

"We think the Cambridge curriculum is superb preparation for university."

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 programs for students aged 5 to 19 is independently certified as meeting the internationally recognized standard, ISO 9001:2015. Learn more at **www.cambridgeinternational.org/ISO9001**

Contents

Changes to this syllabus

For information about changes to this syllabus for 2020 and 2021, go to page 23.

1 Why Choose This Syllabus?

Key Benefits

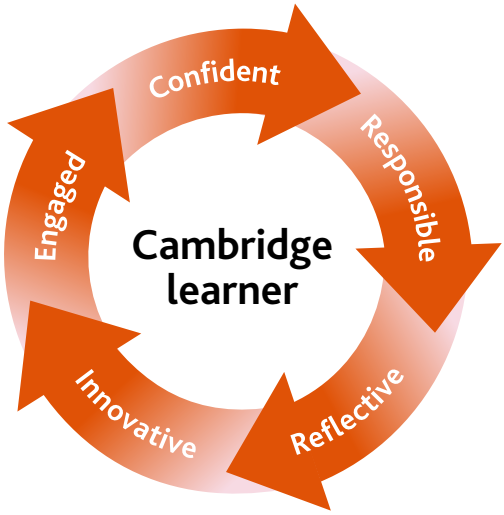
Cambridge IGCSE™ syllabi are created especially for international students. For over 25 years, we have worked with schools and teachers worldwide to develop syllabi that are suitable for different countries, different types of schools, and for learners with a wide range of abilities.

Cambridge IGCSE Additional Mathematics (US) allows students to:

- further develop their use of mathematical concepts and principles
- extend their mathematical skills and their use in more advanced techniques
- solve problems, present solutions logically, and interpret results
- develop a solid foundation for further study.

Our programs 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.

Our approach encourages learners to be:



"The strength of Cambridge IGCSE qualifications is internationally recognized and has provided an international pathway for our students to continue their studies around the world."

Gary Tan, Head of Schools and CEO, Raffles International Group of Schools, Indonesia

Recognition and Progression

The combination of knowledge and skills in Cambridge IGCSE Additional Mathematics (US) 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 IGCSEs 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 IGCSEs or equivalent to meet their entry requirements.

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

Supporting Teachers

We provide a wide range of practical resources, detailed guidance, and innovative training and professional development so that you can give your learners the best possible preparation for Cambridge IGCSE.

Teaching Resources

- School Support Hub **www.cambridgeinternational.org/support**
- Syllabus
- Scheme of work
- Learner guide
- Discussion forum
- Resource list
- Endorsed textbooks and digital resources

Exam Preparation Resources

- Question papers
- Mark schemes
- Example candidate responses to understand what examiners are looking for at key grades
- Examiner reports to improve future teaching

Support for Cambridge IGCSE

Training

- Face-to-face workshops around the world
- Online self-study training
- Online tutor-led training
- Cambridge Professional Development Qualifications

Community

You can find useful information, as well as share your ideas and experiences with other teachers, on our social media channels and community forums.

Find out more at **www.cambridgeinternational.org/social-media**

"Cambridge IGCSE is one of the most sought-after and recognized qualifications in the world. It is very popular in Egypt because it provides the perfect preparation for success at advanced level programs."

Mrs Omnia Kassabgy, Managing Director of British School in Egypt BSE

2 Syllabus Overview

Goals

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

The goals are to enable students to:

- consolidate and extend their elementary mathematical skills, and use these in the context of more advanced techniques
- further develop their knowledge of mathematical concepts and principles, and use this knowledge for problem solving
- appreciate the interconnectedness of mathematical knowledge
- acquire a suitable foundation in mathematics for further study in the subject or in mathematics-related subjects
- devise mathematical arguments and use and present them precisely and logically
- integrate information technology (IT) to enhance the mathematical experience
- develop the confidence to apply their mathematical skills and knowledge in appropriate situations
- develop creativity and perseverance in the approach to problem solving
- derive enjoyment and satisfaction from engaging in mathematical pursuits, and gain an appreciation of the beauty, power, and usefulness of mathematics.

Support for Cambridge IGCSE Additional Mathematics (US)

Our School Support Hub **www.cambridgeinternational.org/support** provides Cambridge schools with a secure site for downloading specimen and past question papers, mark schemes, grade thresholds, and other curriculum resources specific to this syllabus. The School Support Hub community offers teachers the opportunity to connect with each other and to ask questions related to the syllabus.

Content Overview

All students will study the following topics:

1 Number
2 Algebra
3 Functions
4 Geometry
5 Transformations and Vectors
6 Coordinate Geometry
7 Trigonometry
8 Probability
9 Statistics

The content of Cambridge International IGCSE Mathematics (US) (0444) is assumed as prerequisite knowledge for this qualification.

Calculators

The syllabus assumes that candidates will be in possession of an electronic calculator with scientific functions for both papers. Algebraic or graphic calculators are not permitted.

Candidates must show all necessary working; no marks will be given for unsupported answers from a calculator.

Non-exact numerical answers will be required to be given correct to three significant figures, or one decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

List of Formulas

The mathematical formulas and tables provided in the List of Formulas and Statistical Tables (MF25) is given in section 4 Details of the Assessment.

Assessment Overview

All candidates take two papers.

Candidates are eligible for grades A* to E. Grades F and G will not be available. Candidates who do not achieve the minimum mark for grade E will be unclassified.

All candidates take:	
Paper 1	2 hours 50%
80 marks	
Candidates answer all questions	
Scientific calculators are required	
Externally assessed	

and:	
Paper 2	2 hours 50%
80 marks	
Candidates answer all questions	
Scientific calculators are required	
Externally assessed	

Assessment Objectives

The assessment objectives (AOs) are listed below:

Candidates should be able to:

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

3 Subject Content

Candidates are expected to have followed the Extended Curriculum of the Cambridge IGCSE Mathematics (US) (0444).

Grades A* to E are available.

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

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

1	Number	Notes/Examples
Complex Numbers		
1.1	Understand the idea of a complex number, recall the meaning of the terms real part, imaginary part, modulus, argument, conjugate, and use the fact that two complex numbers are equal if and only if both real and imaginary parts are equal.	Know there is a complex number i such that $\text{i}^2 = -1$, and every complex number has the form $a + \text{i}b$ with a and b real.
1.2	Use the relation $\text{i}^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, multiply, and divide two complex numbers expressed in the form $x + \text{i}y$.	
1.3	Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.	
1.4	Represent complex numbers geometrically in the complex plane in rectangular and polar form, and convert between the rectangular and polar forms of a complex number.	
1.5	Understand in simple terms the geometrical effects of conjugating a complex number and of adding, subtracting, and multiplying two complex numbers, and use properties of this representation.	e.g., $\left(-1 + \sqrt{3\text{i}}\right)^3 = 8$ because $\left(-1 + \sqrt{3\text{i}}\right)$ has modulus 2 and argument 120°
1.6	Calculate the distance between numbers represented in the complex plane and the midpoint of a line segment.	
1.7	Solve quadratic equations with real coefficients that have complex solutions.	
1.8	Extend polynomial identities to the complex numbers.	e.g., rewrite $x^2 + 4$ as $(x + 2\text{i})(x - 2\text{i})$

1	Number	Notes/Examples
Indices and Radicals		
1.9	Perform simple operations with indices and with surds, including rationalizing the denominator.	
Matrices		
1.10	Display information in the form of a matrix of any order and interpret the data in a given matrix.	
1.11	Solve problems involving the calculation of the sum and product (where appropriate) of two matrices and interpret the results.	Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
1.12	Calculate the product of a scalar quantity and a matrix.	
1.13	Use the algebra of 2×2 matrices (including the zero and identity matrix).	
1.14	Calculate the determinant and inverse of a non-singular 2×2 matrix and solve simultaneous linear equations.	The determinant of a square matrix is non-zero if, and only if, the matrix has a multiplicative inverse.
1.15	Work with 2×2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.	

2	Algebra	Notes/Examples
Factors, Polynomials, and Rational Expressions		
2.1	Know and use the remainder and factor theorems to find factors of polynomials and solve cubic equations.	
2.2	Identify zeros of polynomials when suitable factorizations are available, use the zeros to construct a rough graph of the function defined by the polynomial, and know the Fundamental Theorem of Algebra.	
2.3	Express simple rational expressions in different forms including writing $\frac{a(x)}{b(x)}$ in the form $q(x)+\frac{r(x)}{b(x)}$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, by using inspection or long division and prove polynomial identities.	

2	Algebra	Notes/Examples
2.4	Add, subtract, multiply, and divide polynomial and rational expressions.	Understand that polynomials and rational expressions form a system analogous to the integers, namely, they are closed under the operation of addition, subtraction, and multiplication; add, subtract, and multiply polynomials and rational expressions.
Simultaneous Equations		
2.5	Solve simultaneous equations in two unknowns with at least one linear equation.	e.g., find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$

3	Functions	Notes/Examples
Functions		
3.1	Understand the terms: function, domain, range (image set), one-one function, inverse function and composition of functions.	
3.2	Use the notation $\mathrm{f}(x) = \sin x$, $\mathrm{f}: x \longmapsto \lg x$, $(x > 0)$, $\mathrm{f}^{-1}(x)$ and $\mathrm{f}^2(x)$ $[= \mathrm{f}(\mathrm{f}(x))]$.	
3.3	Understand the relationship between $y = \mathrm{f}(x)$ and $y = \lvert\mathrm{f}(x)\rvert$, where $\mathrm{f}(x)$ may be linear, quadratic, or trigonometric.	
3.4	Explain in words why a given function is a function or why it does not have an inverse and produce an invertible function from a non-invertible function by restricting the domain.	Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
3.5	Find the inverse of a one-one function and form composite functions, including verifying by composition that one function is the inverse of another.	
3.6	Use sketch graphs to show the relationship between a function and its inverse.	
3.7	Graph functions and show key features of the graph, including understanding points of intersection.	To include linear, quadratic, square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

3	Functions	Notes/Examples
3.8	Recognize even and odd functions from their graphs and algebraic expressions.	
3.9	Construct a function that describes a relationship between two quantities, including determining an explicit expression or a recursive relation, together with constant multiples, sums, and composites of functions.	e.g., • construct a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model • if $T(h)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time
3.10	Recognize that sequences are functions, which may be defined recursively and whose domain is a subset of the integers.	e.g., the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n + 1) = f(n) + f(n - 1)$ for $n \geqslant 1$
Logarithmic and Exponential Functions		
3.11	Understand and know simple properties and graphs of the logarithmic and exponential functions including $\ln x$ and e^x (series expansions are not required) including interpreting the parameters in a linear or exponential function in terms of a context.	
3.12	Know and use the laws of logarithms (including change of base of logarithms).	Simplify expressions and solve simple equations involving logarithms.
3.13	Solve equations of the form $a^x = b$, including use of logarithms to base 2, 10, or e.	e.g., • solve $5^x = 7$ • solve $2e^{3t} = 12$
3.14	Distinguish between situations that can be modeled with linear functions and with exponential functions.	

4	Geometry	Notes/Examples
4.1	Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if, and only if, corresponding pairs of sides and corresponding pairs of angles are congruent.	
4.2	Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motion.	

4	Geometry	Notes/Examples
4.3	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.	Candidates will be expected to know and use the following theorems in their proofs: Lines and angles: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints. Triangles: measure of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the line joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point; a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity. Parallelograms: opposite sides are congruent; opposite angles are congruent; the diagonals of a parallelogram bisect each other and conversely, rectangles are parallelograms with congruent diagonals.

5	Transformations and Vectors	Notes/Examples
5.1	Use vectors in any form, e.g. $\begin{pmatrix} x \\ y \end{pmatrix}$, $\overrightarrow{AB}$, $\mathbf{a}$, $x\mathbf{i} + y\mathbf{j}$.	
5.2	Know and use position vectors and unit vectors.	
5.3	Find the magnitude and direction of a vector, add and subtract vectors and multiply vectors by scalars; determine the magnitude and direction of the sum of two vectors.	
5.4	Compose and resolve velocities.	
5.5	Solve problems involving velocity and other quantities that can be represented by vectors and use relative velocity, including solving problems on interception (but not closest approach).	

6	Coordinate Geometry	Notes/Examples
Coordinate Geometry		
6.1	Interpret the equation of a straight line graph in the form $y = mx + c$.	
6.2	Use slope criteria for parallel and perpendicular lines to solve geometric problems with justification.	
6.3	Solve questions involving midpoint and length of a line.	e.g., to find the equation of a circle given the endpoints of the diameter
6.4	Use coordinates to prove simple geometric properties algebraically.	e.g., • determine whether a figure defined by four given points in the coordinate plane is a rectangle • determine whether the point $(1, \sqrt{3})$ lies on the circle which is centered at the origin and passes through the point $(0, 2)$
6.5	Derive the equation of a circle given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.	
6.6	Derive the equation of a parabola given a focus and directrix.	
6.7	Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.	

7	Trigonometry	Notes/Examples
7.1	Solve problems involving the arc length and sector area of a circle, including knowledge and use of radian measure.	Derive, using similarity, the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.
7.2	Know and use the three trigonometric functions of angles of any magnitude (sine, cosine, tangent).	
7.3	Determine geometrically the values of sine, cosine, tangent for $\frac{\pi}{3}$, $\frac{\pi}{4}$, and $\frac{\pi}{6}$. Express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.	
7.4	Understand the symmetry (odd and even) and periodicity of trigonometric functions.	
7.5	Understand amplitude and periodicity and the relationship between graphs of, e.g., $\sin x$ and $\sin 2x$.	

7	Trigonometry	Notes/Examples
7.6	Draw and use the graphs of $y = a\sin bx + c$ $y = a\cos bx + c$ $y = a\tan bx + c$ where a and b are positive integers and c is an integer.	
7.7	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.	
7.8	Prove and use the relationships $\frac{\sin\theta}{\cos\theta} = \tan\theta$ $\sin^2\theta + \cos^2\theta = 1$ and solve simple trigonometric equations involving the three trigonometric functions and the above relationships (not including general solution of trigonometric equations).	Includes the use of inverse trigonometric functions. May use inverse functions to solve trigonometric equations that arise in modeling contexts.
7.9	Prove and use the expansions of $\sin(A \pm B)$, $\cos(A \pm B)$, and $\tan(A \pm B)$ to solve simple trigonometric problems.	
7.10	Prove simple trigonometric identities.	

8	Probability	Notes/Examples
8.1	Understand and use the conditional probability of A given B as $\frac{P(A \text{ and } B)}{P(B)}$ or as the fraction of B's outcomes that also belong to A; interpret independence of A and B in relation to conditional probabilities and the product of probabilities.	e.g., compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer
8.2	Apply $P(A \text{ and } B) = P(A)P(B\|A) = P(B)P(A\|B)$ in simple situations, and interpret the answer in context.	
8.3	Use permutations and combinations to compute probabilities of compound events and solve problems.	
8.4	Define a random variable X by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions; and calculate $E(X)$ and $Var(X)$.	

8	Probability	Notes/Examples
8.5	Investigate the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. Find the expected payoff for a game of chance. Evaluate and compare strategies on the basis of expected values.	e.g., • find the expected winnings from a state lottery ticket • compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident
8.6	Analyze decisions and strategies using probability concepts.	e.g., product testing, medical testing, pulling a hockey goalie at the end of a game

9	Statistics	Notes/Examples
9.1	Understand the concept of sampling and recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.	
9.2	Use data from a sample survey to estimate a population mean or proportion; use data to compare two variables.	
9.3	Interpret differences in shape, center, and spread in the context of data sets, accounting for possible effects of outliers.	
9.4	Use standardized values and normal tables for normally distributed continuous data in determining probabilities as areas under the normal curve.	
9.5	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate.	
9.6	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.	
9.7	Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.	

9	Statistics	Notes/Examples
9.8	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. • Fit a function to the data; use functions (e.g., linear, quadratic, exponential) fitted to data to solve problems in the context of the data. • Informally assess the fit of a function by plotting and analyzing residuals. • Fit a linear function for a scatter plot that suggests a linear association. • Fit a function to the data; use functions fitted to data to solve problems in the context of the data. • Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	
9.9	Interpret the correlation coefficient of a linear fit and distinguish between correlation and causation.	

4 Details of the Assessment

All candidates will 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; no marks will be given to unsupported answers from a calculator.

Paper 1

2 hours, 80 marks

Candidates answer **all** questions.

This paper consists of questions of various lengths.

Scientific calculators are required.

This is a compulsory component for all candidates.

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

Paper 2

2 hours, 80 marks

Candidates answer **all** questions.

This paper consists of questions of various lengths.

Scientific calculators are required.

This is a compulsory component for all candidates.

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

List of Formulas and Statistical Tables for Papers 1 and 2

ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

TRIGONOMETRY

Identities

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

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

Formulas for ΔABC

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

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

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

THE NORMAL DISTRIBUTION FUNCTION

If Z has a normal distribution with mean 0 and variance 1 then, for each value of z, the table gives the value of $\Phi(z)$, where

$$\Phi(z) = P(Z \leq z).$$

For negative values of z use $\Phi(-z) = 1 - \Phi(z)$.

z	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
											ADD								
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359	4	8	12	16	20	24	28	32	36
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753	4	8	12	16	20	24	28	32	36
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141	4	8	12	15	19	23	27	31	35
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517	4	7	11	15	19	22	26	30	34
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879	4	7	11	14	18	22	25	29	32
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224	3	7	10	14	17	20	24	27	31
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549	3	7	10	13	16	19	23	26	29
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852	3	6	9	12	15	18	21	24	27
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133	3	5	8	11	14	16	19	22	25
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389	3	5	8	10	13	15	18	20	23
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621	2	5	7	9	12	14	16	19	21
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830	2	4	6	8	10	12	14	16	18
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015	2	4	6	7	9	11	13	15	17
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177	2	3	5	6	8	10	11	13	14
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319	1	3	4	6	7	8	10	11	13
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441	1	2	4	5	6	7	8	10	11
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545	1	2	3	4	5	6	7	8	9
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633	1	2	3	4	4	5	6	7	8
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706	1	1	2	3	4	4	5	6	6
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767	1	1	2	2	3	4	4	5	5
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817	0	1	1	2	2	3	3	4	4
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857	0	1	1	2	2	2	3	3	4
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890	0	1	1	1	2	2	2	3	3
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916	0	1	1	1	1	2	2	2	2
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936	0	0	1	1	1	1	1	2	2
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952	0	0	0	1	1	1	1	1	1
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964	0	0	0	0	1	1	1	1	1
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974	0	0	0	0	0	1	1	1	1
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981	0	0	0	0	0	0	0	1	1
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986	0	0	0	0	0	0	0	0	0

Command Words

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, generally using a calculator
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 evident/provide 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/examsofficers**

Before You Start

Previous Study

We recommend that learners starting this course should have studied a mathematics curriculum such as Cambridge IGCSE Mathematics and the Cambridge Lower Secondary program or equivalent national educational framework.

Guided Learning Hours

We design Cambridge IGCSE syllabi based on learners having about 130 guided learning hours for each subject during the course but this is for guidance only. The number of hours a learner needs to achieve the qualification may vary according to local practice and their previous experience of the subject.

Availability and Timetables

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**

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. To find out about the availability visit the syllabus page at **www.cambridgeinternational.org/igcse**

Combining with Other Syllabi

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

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

Cambridge IGCSE and Cambridge IGCSE (9–1) syllabi are at the same level.

Group Awards: Cambridge ICE

Cambridge ICE (International Certificate of Education) is a group award for Cambridge IGCSE. It allows schools to offer a broad and balanced curriculum by recognizing the achievements of learners who pass examinations in a range of different subjects.

Learn more about Cambridge ICE at **www.cambridgeinternational.org/cambridgeice**

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 one administrative zone determined by their location. Each zone has a specific timetable. Some of our syllabi 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/examsofficers**

Retakes

Candidates can retake the whole qualification as many times as they want to. This is a linear qualification so candidates cannot re-sit individual components.

Equality and Inclusion

We have taken great care to avoid bias of any kind in the preparation of this syllabus and related assessment materials. In compliance with the UK Equality Act (2010) we have designed this qualification to avoid any direct and indirect discrimination.

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

Candidates who cannot access the assessment of any component may be able to receive an award based on the parts of the assessment they have completed.

Information on access arrangements is in the *Cambridge Handbook* at
www.cambridgeinternational.org/examsofficers

Language

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

After the Exam

Grading and Reporting

Grades A*, A, B, C, D, E, F or G indicate the standard a candidate achieved at Cambridge IGCSE.

A* is the highest and G is the lowest. "Ungraded" means that the candidate's performance did not meet the standard required for grade G. "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 (result pending)
- X (no result)
- Y (to be issued)

These letters do not appear on the certificate.

Please note IGCSE Additional Mathematics (US) 0459 is only available at grades A* to E.

How Students and Teachers Can Use the Grades

Assessment at Cambridge IGCSE has two purposes.

- 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.
- 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

  – 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 IGCSE Additional Mathematics (US) will be published after the first assessment of the IGCSE in 2020. Find more information at **www.cambridgeinternational.org/igcse**

Changes to This Syllabus for 2020 and 2021

The syllabus has been updated. This is version 1, published February 2019.

Changes to syllabus content	• The order of the syllabus sections is updated. Please see the contents page of this syllabus. • A subject content overview is now included. Please see section 2 of this syllabus. • Information about the command words used in the assessment is now included. • The list of formulas now appears in section 4 Details of the Assessment. • Minor changes to the wording of some sections have been made to improve clarity.
Changes to assessment (including changes to specimen papers)	• The wording and layout of the front covers of the question papers have been updated to ensure our instructions are clearer for candidates. • The following statement now appears on the front cover of the specimen question papers: "You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator." A similar statement has been inserted into the syllabus, section 2 Syllabus overview and section 4 Details of the assessment. • All part questions are now numbered using the labeling (a), (b), (c), whether the parts are dependent or independent. Roman numerals will only be used for labeling further divisions within a part e.g. (a) (i). • The wording and layout of the front covers of the mark schemes have been updated. The generic wording has been updated.

In addition to reading the syllabus, teachers should refer to the updated specimen assessment materials.

The syllabus and specimen papers use our new name Cambridge Assessment International Education.

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

"While studying Cambridge IGCSE and Cambridge International A Levels, students broaden their horizons through a global perspective and develop a lasting passion for learning."

Zhai Xiaoning, Deputy Principal, The High School Affiliated to Renmin University of China

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