Syllabus

Cambridge IGCSE Mathematics (US)
Syllabus Code 0444
For Examination in 2012

UNIVERSITY of CAMBRIDGE
International Examinations

Contents

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1. Introduction

1.1 Why Choose Cambridge?

University of Cambridge International Examinations (CIE) is the world's largest provider of international qualifications. Around 1.5 million candidates from 150 countries enter Cambridge examinations every year. What makes educators around the world choose Cambridge?

Recognition

Cambridge International General Certificate of Secondary Education (IGCSE) is internationally recognized by schools, universities, and employers as equivalent to UK GCSE. Cambridge IGCSE is excellent preparation for GCE A and AS Levels, the Advanced International Certificate of Education (AICE), the US Advanced Placement Program, and the International Baccalaureate (IB) Diploma. Learn more at **www.cie.org.uk/recognition**.

Support

CIE provides a world-class support service for teachers and exams officers. We offer a wide range of teacher materials to Centers, plus teacher training (online and face-to-face) and candidate support materials. Exams officers can trust in reliable, efficient administration of exams entry and excellent, personal support from CIE Customer Services. Learn more at **www.cie.org.uk/teachers**.

Excellence in Education

Cambridge qualifications develop successful candidates. They build not only understanding and knowledge required for progression to college, work, or further examinations, but also learning and thinking skills that help candidates become independent learners and equip them for life.

Nonprofit, Part of the University of Cambridge

CIE is part of Cambridge Assessment, a nonprofit organization, and part of the University of Cambridge. The needs of teachers and learners are at the core of what we do. CIE invests constantly in improving its qualifications and services. We draw upon education research in developing our qualifications.

1. Introduction

1.2 Why Choose Cambridge IGCSE Mathematics?

Cambridge IGCSE Mathematics is accepted by universities and employers as proof of mathematical knowledge and understanding. Successful IGCSE Mathematics candidates gain lifelong skills, including:

- the development of their mathematical knowledge;
- confidence by developing a feel for numbers, patterns, and relationships;
- an ability to consider and solve problems and present and interpret results;
- communication and reason using mathematical concepts;
- a solid foundation for further study.

1.3 Cambridge International Certificate of Education (ICE)

Cambridge ICE is the group award of the IGCSE. It requires the study of subjects drawn from the five different IGCSE subject groups. It gives Centers the opportunity to benefit from offering a broad and balanced curriculum by recognizing the achievements of students who pass examinations in at least seven subjects, including two languages, and one subject from each of the other subject groups.

The Cambridge portfolio of IGCSE qualifications provides a solid foundation for higher-level courses such as GCE A and AS Levels and the International Baccalaureate Diploma as well as excellent preparation for employment.

A wide range of IGCSE subjects is available and these are grouped into five curriculum areas. Mathematics (0444) falls in Group IV, Mathematics.

Learn more about ICE at **www.cie.org.uk/qualifications/academic/middlesec/ice.**

1.4 How Can I Find Out More?

If You Are Already a Cambridge Center

You can make entries for this qualification through your usual channels, e.g., CIE Direct. If you have any queries, please contact us at **international@cie.org.uk**.

If You Are Not a Cambridge Center

You can find out how your organization can become a Cambridge Center. Email us at **international@cie.org.uk**. Learn more about the benefits of becoming a Cambridge Center at **www.cie.org.uk**.

2. Assessment at a Glance

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This qualification is assessed via two components.
Candidates who have followed the Core curriculum take components 1 and 3.
Candidates who have followed the Extended curriculum take components 2 and 4.

Component	Weighting	Raw mark	Nature of assessment
1 Written paper **1 hour** Short-answer questions based on the Core curriculum. Calculators are **not** permitted. *Grades available: C–G*	35%	56	External
2 Written paper **1 hour, 30 minutes** Short-answer questions based on the Extended curriculum. Calculators are **not** permitted. *Grades available: A*–E*	35%	70	External
3 Written paper **2 hours** Structured questions based on the Core curriculum. Electronic calculators are required.† *Grades available: C–G*	65%	104	External
4 Written paper **2 hours, 30 minutes** Structured questions based on the Extended curriculum. Electronic calculators are required.† *Grades available: A*–E*	65%	130	External

† Algebraic or graphic calculators are **not** permitted.
The mathematical formulae provided in the written papers is given in the appendix.

Combining This with Other Syllabi

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

- syllabi with the same title (or the title Mathematics) at the same level

2. Assessment at a Glance

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3. Syllabus Goals and Objectives

3.1 Goals

Cambridge IGCSE Mathematics syllabus is designed as a two-year course for examination at age 16-plus. The goals of this syllabus should enable students to:

1. develop their mathematical knowledge and oral, written, and practical skills in a way which encourages confidence and provides satisfaction and enjoyment;
2. read mathematics, and write and talk about the subject in a variety of ways;
3. develop a feel for numbers, carry out calculations, and understand the significance of the results obtained;
4. apply mathematics in everyday situations and develop an understanding of the part which mathematics plays in the world around them;
5. solve problems, present the solutions clearly, check and interpret the results;
6. develop an understanding of mathematical principles;
7. recognize when and how a situation may be represented mathematically, identify and interpret relevant factors and, where necessary, select an appropriate mathematical method to solve the problem;
8. use mathematics as a means of communication with emphasis on the use of clear expression;
9. develop an ability to apply mathematics in other subjects, particularly science and technology;
10. develop the abilities to reason logically, to classify, to generalize, and to prove;
11. appreciate patterns and relationships in mathematics;
12. produce and appreciate imaginative and creative work arising from mathematical ideas;
13. develop their mathematical abilities by considering problems and conducting individual and cooperative enquiry and experiment, including extended pieces of work of a practical and investigative kind;
14. appreciate the interdependence of different branches of mathematics;
15. acquire a foundation appropriate to their further study of mathematics and of other disciplines.

3. Syllabus Goals and Objectives

3.2 Assessment Objectives

The examination will test the ability of candidates to:

1. organize, interpret, and present information accurately in written, tabular, graphical, and diagrammatic forms;
2. perform calculations by suitable methods;
3. use an electronic calculator and also perform some straightforward calculations without a calculator;
4. understand systems of measurement in everyday use and make use of them in the solution of problems;
5. estimate, approximate, and work to degrees of accuracy appropriate to the context and convert between equivalent numerical forms;
6. use mathematical and other instruments to measure and to draw to an acceptable degree of accuracy;
7. interpret, transform, and make appropriate use of mathematical statements expressed in words or symbols;
8. recognize and use spatial relationships in two and three dimensions, particularly in solving problems;
9. recall, apply, and interpret mathematical knowledge in the context of everyday situations.
10. make logical deductions from given mathematical data;
11. recognize patterns and structures in a variety of situations, and form generalizations;
12. respond to a problem relating to a relatively unstructured situation by translating it into an appropriately structured form;
13. analyze a problem, select a suitable strategy, and apply an appropriate technique to obtain its solution;
14. apply combinations of mathematical skills and techniques in problem solving;
15. set out mathematical work, including the solution of problems, in a logical and clear form using appropriate symbols and terminology.

4. Curriculum Content

Candidates may follow either the Core Curriculum or the Extended Curriculum. Candidates aiming for Grades A*–C should follow the Extended Curriculum.

1.	Number—Core curriculum	Notes / Exemplars
1.1	Knowledge of: natural numbers, integers (positive, negative, and zero), prime numbers, square numbers, rational and irrational numbers, real numbers. Use of symbols: $=, \neq, \leqslant, \geqslant, <, >$	
1.2	Use of the four operations and parentheses.	Applies to integers, fractions, and decimals.
1.3	Multiples and factors, including, greatest common factor, least common multiple.	GCF and LCM will be used and knowledge of prime factors is assumed.
1.4	Ratio and proportion.	
1.5	Language and notation of fractions, decimals, and percentages; recognize equivalences between decimals, fractions, ratios, and percentages and convert between them. Order quantities given in different forms by magnitude, by first converting into same form.	
1.6	Percentages, including applications such as interest and profit.	Excludes reverse percentages. Includes both simple and compound interest.
1.7	Meaning and calculation of exponents (powers, indices) including positive, negative, and zero exponents. Rules for exponents. Scientific notation (Standard Form) $a \times 10^n$ where $1 \leqslant a < 10$ and n is an integer.	e.g., work out 4^{-3} as a fraction. e.g., work out $2^4 \times 2^{-3}$ Convert numbers in and out of scientific notation. Calculate with values in scientific notation.

4. Curriculum Content

1.	Number—Extended curriculum	Notes / Exemplars
1.1	Knowledge of: natural numbers, integers (positive, negative, and zero), prime numbers, square numbers, rational and irrational numbers, real numbers. Use of symbols: $=, \neq, \leqslant, \geqslant, <, >$	Understand that the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a non-zero rational number and an irrational number is irrational.
1.2	Use of the four operations and parentheses.	Applies to integers, fractions, and decimals.
1.3	Multiples and factors, including, greatest common factor, least common multiple.	GCF and LCM will be used and knowledge of prime factors is assumed.
1.4	Ratio and proportion.	
1.5	Language and notation of fractions, decimals, and percentages; recognize equivalences between decimals, fractions, ratios, and percentages and convert between them. Order quantities given in different forms by magnitude, by first converting into same form.	
1.6	Percentages, including applications such as interest and profit.	Includes reverse percentages. Includes both simple and compound interest. Includes percentiles.
1.7	Meaning and calculation of exponents (powers, indices) including positive, negative, zero and fractional exponents. Rules for exponents. Scientific notation (Standard Form) $a \times 10^n$ where $1 \leqslant a < 10$ and n is an integer.	e.g., $5^{\frac{1}{2}} = \sqrt{5}$ Evaluate 5^{-2}, $100^{\frac{1}{2}}$, $8^{-\frac{2}{3}}$ Work out $2^4 \times 2^{-3}$ Convert numbers in and out of scientific notation. Calculate with values in scientific notation.

4. Curriculum Content

1.	Number—Core curriculum	Notes / Exemplars
1.8	Radicals, calculation of square root and cube root expressions.	e.g., the area of a square is 54.76 cm^2. Work out the length of one side of the square. Find the value of the cube root of 64.
1.9	Quantities—choose and interpret units and scales, define appropriate quantities (including money). Estimating, rounding, decimal places, and significant figures—choose a level of accuracy appropriate for a problem.	Also relates to graphs and geometrical measurement topics. Includes converting between units, e.g., different currencies.
1.10	Calculations involving time: seconds (s), minutes (min), hours (h), days, months, years including the relation between consecutive units.	1 year = 365 days. Includes familiarity with both 24-hour and 12-hour clocks and extraction of data from dials and schedules.
1.11	Speed, distance, time problems.	

2.	Algebra—Core curriculum	Notes / Exemplars
2.1	*Extended Curriculum only.*	
2.2	*Extended Curriculum only.*	
2.3	Create expressions and create and solve linear equations, including those with fractional expressions.	Explain each algebraic step of the solution. May be asked to interpret solutions to a problem given in context.
2.4	Exponents (indices).	Includes rules of indices with negative indices. Simple examples only, e.g., $q^3 \times q^{-4}$, $8x^5 \div 2x^2$

4. Curriculum Content

1.	Number—Extended curriculum	Notes / Exemplars
1.8	Radicals, calculation and simplification of square root and cube root expressions.	e.g., simplify $\sqrt{200} + \sqrt{18}$ Write $(2 + \sqrt{3})^2$ in the form $a + b\sqrt{3}$
1.9	Quantities—choose and interpret units and scales, define appropriate quantities (including money). Estimating, rounding, decimal places, and significant figures—choose a level of accuracy appropriate for a problem.	Also relates to graphs and geometrical measurement topics. Includes converting between units, e.g., different currencies.
1.10	Calculations involving time: seconds (s), minutes (min), hours (h), days, months, years including the relation between consecutive units.	1 year = 365 days. Includes familiarity with both 24-hour and 12-hour clocks and extraction of data from dials and schedules.
1.11	Speed, distance, time problems.	

2.	Algebra—Extended curriculum	Notes / Exemplars
2.1	Writing, showing, and interpretation of inequalities on the real number line.	
2.2	Create and solve linear inequalities.	e.g., Solve $3x + 5 < 7$ Solve $-7 \leqslant 3n - 1 < 5$
2.3	Create expressions and create and solve linear equations, including those with fractional expressions.	Explain each algebraic step of the solution. May be asked to interpret solutions to a problem given in context.
2.4	Exponents (indices).	Includes rules of indices with negative and fractional indices. e.g., simplify $2x^{\frac{3}{2}} \times 5x^{-4}$

4. Curriculum Content

2.	Algebra—Core curriculum	Notes / Exemplars
2.5	Rearrangement and evaluation of simple formulae.	e.g., make r the subject of: • $p = rt - q$ • $w = \frac{r - t}{y}$ e.g., when $x = -3$ and $y = 4$, find the value of xy^2.
2.6	Create and solve simultaneous linear equations in two variables algebraically.	
2.7	Identify terms, factors, and coefficients.	
2.8	Expansion of parentheses (simple examples only). Simplify expressions.	e.g., expand and simplify $4(5c - 3d) - 7c$
2.9	Factorization: common factor only.	e.g., $6x^2 + 9x = 3x(2x + 3)$
2.10	*Extended Curriculum only.*	
2.11	*Extended Curriculum only.*	

4. Curriculum Content

2.	Algebra—Extended curriculum	Notes / Exemplars
2.5	Rearrangement and evaluation of formulae.	Formulae may include indices or cases where the subject appears twice. e.g., make r the subject of • $V = \frac{4}{3}\pi r^3$ • $p = \frac{2r - 3}{r + s}$ e.g., $y = m^2 - 4n^2$ Find the value of y when $m = 4.4$ and $n = 2.8$
2.6	Create and solve simultaneous linear equations in two variables algebraically and graphically.	*See functions 3.2*
2.7	Identify terms, factors, and coefficients. Interpret algebraic expressions.	e.g., interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.
2.8	Expansion of parentheses, including the square of a binomial. Simplify expressions.	e.g., expand $(2x - 5)^2 = 4x^2 - 20x + 25$
2.9	Factorization: common factor difference of squares trinomial four term.	$6x^2 + 9x = 3x(2x + 3)$ $9x^2 - 16y^2 = (3x - 4y)(3x + 4y)$ $6x^2 + 11x - 10 = (3x - 2)(2x + 5)$ $xy - 3x + 2y - 6 = (x + 2)(y - 3)$
2.10	Algebraic fractions: simplification, including use of factorization addition or subtraction of fractions with linear denominators multiplication or division and simplification of two fractions.	e.g., simplify $\frac{4x^2 - 9}{8x^2 - 10x - 3}$, $\frac{3}{2x + 1} - \frac{4}{x}$, $\frac{7x}{4y^2} \div \frac{21x}{8}$
2.11	Create and solve quadratic equations by: inspection factorization using the quadratic formula completing the square.	e.g., $x^2 = 49$ $2x^2 + 5x - 3 = 0$ $3x^2 - 2x - 7 = 0$ Write $x^2 - 6x + 9$ in the form $(x - a)^2 + b$ and state the minimum value of the function. Quadratic formula will be given.

4. Curriculum Content

2.	Algebra—Core curriculum	Notes / Exemplars
2.12	*Extended Curriculum only.*	
2.13	Continuation of a sequence of numbers or patterns; recognize patterns in sequences; generalize to simple algebraic statements, including determination of the n^{th} term.	e.g., find the n^{th} term of: • 5 9 13 17 21 • 2 4 8 16 32
2.14	*Extended Curriculum only.*	

3.	Functions—Core curriculum	Notes / Exemplars
3.1	Use function notation. Knowledge of domain and range. Mapping diagrams.	
3.2	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the co-ordinate plane. Construct tables of values for functions of the form $ax + b$, $\pm x^2 + ax + b$, $\frac{a}{x}$ $(x \neq 0)$ where a and b are integral constants; draw and interpret such graphs. Solve associated equations approximately by graphical methods.	
3.3	Write a function that describes a relationship between two quantities.	e.g., $C(x) = 50{,}000 + 400x$ models the cost of producing x wheelchairs. Write a function that represents the cost of one wheelchair.
3.4	*Extended Curriculum only.*	

4. Curriculum Content

2.	Algebra—Extended curriculum	Notes / Exemplars
2.12	Solve simple rational and radical equations in one variable, and discount any extraneous solutions.	e.g., solve $\sqrt{x} + 2 = 6$, $x^{-3} = 27$, $2y^4 = 32$
2.13	Continuation of a sequence of numbers or patterns; recognize patterns in sequences; generalize to simple algebraic statements, including determination of the n^{th} term.	e.g., find the n^{th} term of: • 5 9 13 17 21 • 2 4 8 16 32 • 2 5 10 17 26
2.14	Express direct and inverse variation in algebraic terms and use this form of expression to find unknown quantities.	e.g., $y \propto x$, $y \propto \sqrt{x}$ $y \propto \frac{1}{x}$, $y \propto \frac{1}{x^2}$

3.	Functions—Extended curriculum	Notes / Exemplars
3.1	Use function notation. Knowledge of domain and range. Mapping diagrams.	
3.2	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the co-ordinate plane. Construct tables of values and construct graphs of functions of the form ax^n where a is a rational constant and $n = -2, -1, 0, 1, 2, 3$ and simple sums of not more than three of these and for functions of the type a^x where a is a positive integer. Solve associated equations approximately by graphical methods.	
3.3	Write a function that describes a relationship between two quantities.	e.g., $C(x) = 50{,}000 + 400x$ models the cost of producing x wheelchairs. Write a function that represents the cost of one wheelchair.
3.4	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	e.g., given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

4. Curriculum Content

3.	Functions—Core curriculum	Notes / Exemplars
3.5	Recognition of the following function types from the shape of their graphs: linear $f(x) = ax + b$ quadratic $f(x) = ax^2 + bx + c$ reciprocal $f(x) = \frac{a}{x}$ Interpret the key features of the graphs—to include intercepts; intervals where the function is increasing, decreasing, positive, negative; relative maxima and minima; symmetries; end behavior.	Some of *a, b, c* may be 0
3.6	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	e.g., if the function $h(n)$ gives the number of person-hours it takes to assemble *n* engines in a factory, then the positive integers would be an appropriate domain for the function.
3.7	*Extended Curriculum only.*	
3.8	*Extended Curriculum only.*	

4. Curriculum Content

3.	Functions—Extended curriculum	Notes / Exemplars
3.5	Recognition of the following function types from the shape of their graphs: linear f(x) = $ax + b$ quadratic f(x) = $ax^2 + bx + c$ cubic f(x) = $ax^3 + bx^2 + cx + d$ reciprocal f(x)= $\frac{a}{x}$ exponential f(x) = a^x with $0 < a < 1$ or $a > 1$ trigonometric f(x) = $a\sin(bx)$; $a\cos(bx)$; $\tan x$ Interpret the key features of the graphs—to include intercepts; intervals where the function is increasing, decreasing, positive, negative; relative maxima and minima; symmetries; end behavior and periodicity.	Some of a, b, c and d may be 0 Including period and amplitude.
3.6	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	e.g., if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.
3.7	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.	e.g., average speed between 2 points e.g., use a tangent to the curve to find the slope
3.8	Behavior of linear, quadratic, and exponential functions linear f(x) = $ax + b$ quadratic f(x) = $ax^2 + bx + c$ exponential f(x) = a^x with $0 < a < 1$ or $a > 1$	Observe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. Use the properties of exponents to interpret expressions for exponential functions, e.g., identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.

3.	Functions—Core curriculum	Notes / Exemplars
3.9	*Extended Curriculum only.*	
3.10	*Extended Curriculum only.*	
3.11	*Extended Curriculum only.*	
3.12	Description and identification, using the language of transformations, of the changes to the graph of $y = f(x)$ when $y = f(x) + k$, $y = k\,f(x)$, $y = f(x + k)$ for $f(x)$ given in section 3.5.	Where k is an integer.
3.13	*Extended Curriculum only.*	

4.	Geometry—Core curriculum	Notes / Exemplars
4.1	Vocabulary: acute, obtuse, right angle, reflex, equilateral, isosceles, congruent, similar, regular, pentagon, hexagon, octagon, rectangle, square, kite, rhombus, parallelogram, trapezoid, and simple solid figures.	
4.2	Definitions: Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	

4. Curriculum Content

3.	Functions—Extended curriculum	Notes / Exemplars
3.9	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	e.g., find the function or equation for the relationship between x and y x | –2 0 2 4 y | 3 5 7 9
3.10	Simplification of formulae for composite functions such as f(g(x)) where g(x) is a linear expression.	e.g., f(x) = 6 + 2x, g(x) = 7x, f(g(x)) = 6 + 2(7x) = 6 + 14x
3.11	Inverse function f^{-1}.	Find an inverse function. Solve equation of form f(x) = c for a simple function that has an inverse. Read values of an inverse function from a graph or a table, given that the function has an inverse.
3.12	Description and identification, using the language of transformations, of the changes to the graph of y = f(x) when y = f(x) + k, y = k f(x), y = f(x + k) for f(x) given in section 3.5.	Where k is an integer.
3.13	Graph the solutions to a linear inequality in two variables as a half-plane (region), excluding the boundary in the case of a strict inequality. Graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.	e.g., identify the region bounded by the inequalities $y > 3$, $2x + y < 12$, $y \leqslant x$.

4.	Geometry—Extended curriculum	Notes / Exemplars
4.1	Vocabulary: Know precise definitions of acute, obtuse, right angle, reflex, equilateral, isosceles, congruent, similar, regular, pentagon, hexagon, octagon, rectangle, square, kite, rhombus, parallelogram, trapezoid, and simple solid figures.	
4.2	Definitions: Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	

4. Curriculum Content

4.	Geometry—Core curriculum	Notes / Exemplars
4.3	Line and rotational symmetry in 2D.	e.g., know properties of triangles, quadrilaterals, and circles directly related to their symmetries.
4.4	Angles around a point. Angles on a straight line and intersecting straight lines. Vertically opposite angles. Alternate and corresponding angles on parallel lines. Angle properties of triangles, quadrilaterals, and polygons. Interior and exterior angles of a polygon.	Proof of properties will not be tested, but candidates should be able to use these properties to find unknown angles.
4.5	Construction. Make formal geometric constructions with compass and straight edge only. Copy a segment; copy an angle; bisect a segment; bisect an angle; construct perpendicular lines, including the perpendicular bisector of a line segment. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. Construct the inscribed and circumscribed circles of a triangle. Construct a tangent line from a point outside a given circle to the circle. Angle measurement in degrees. Read and make scale drawings.	

4. Curriculum Content

4.	Geometry—Extended curriculum	Notes / Exemplars
4.3	Line and rotational symmetry in 2D and 3D.	e.g., know properties of triangles, quadrilaterals, and circles directly related to their symmetries. Recognize symmetry properties of the prism and the pyramid.
4.4	Angles around a point. Angles on a straight line and intersecting straight lines. Vertically opposite angles. Alternate and corresponding angles on parallel lines. Angle properties of triangles, quadrilaterals, and polygons. Interior and exterior angles of a polygon.	Proof of properties will not be tested, but candidates should be able to use these properties to find unknown angles.
4.5	Construction. Make formal geometric constructions with compass and straight edge only. Copy a segment; copy an angle; bisect a segment; bisect an angle; construct perpendicular lines, including the perpendicular bisector of a line segment. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. Construct the inscribed and circumscribed circles of a triangle. Construct a tangent line from a point outside a given circle to the circle. Angle measurement in degrees. Read and make scale drawings.	

4.	Geometry—Core curriculum	Notes / Exemplars
4.6	Vocabulary of circles. Properties of circles: • tangent perpendicular to radius at the point of contact • angle in a semicircle	
4.7	Similarity. Calculation of lengths of similar figures.	Use scale factors and/or angles to check for similarity.
4.8	*Extended Curriculum only.*	

4.	Geometry—Extended curriculum	Notes / Exemplars
4.6	Vocabulary of circles. Properties of circles: • tangent perpendicular to radius at the point of contact • tangents from a point • angle in a semicircle • angles at the center and at the circumference on the same arc • cyclic quadrilateral Use the following symmetry properties of a circle: • equal chords are equidistant from the center • the perpendicular bisector of a chord passes through the center • tangents from an external point are equal in length	
4.7	Similarity. Calculation of lengths of similar figures. Area and volume scale factors.	Use scale factors and/or angles to check for similarity. Use of the relationships between areas of similar figures and extension to volumes and surface areas of similar solids.
4.8	Congruence. Use the definition of congruence to show that two triangles are congruent if, and only if, corresponding pairs of sides and corresponding pairs of angles are congruent.	Justify why two triangles are congruent with geometric reasons and reference to ASA, SAS, SSS, or RHS.

4. Curriculum Content

5.	Transformations and vectors—Core Curriculum	Notes / Exemplars
5.1	Vector notation: directed line segment $\overrightarrow{AB}$; component form $\begin{pmatrix} x \\ y \end{pmatrix}$	
5.2	*Extended Curriculum only.*	
5.3	*Extended Curriculum only.*	
5.4	*Extended Curriculum only.*	
5.5	*Extended Curriculum only.*	
5.6	Transformations on the cartesian plane: translation, reflection, rotation, enlargement (dilation). Description of a translation using column vectors.	Representing and describing transformations.
5.7	*Extended Curriculum only.*	
5.8	*Extended Curriculum only.*	

4. Curriculum Content

5.	Transformations and vectors—Extended curriculum	Notes / Exemplars
5.1	Vector notation: **a**; directed line segment $\overrightarrow{AB}$; component form $\begin{pmatrix} x \\ y \end{pmatrix}$ use appropriate symbols for vectors and their magnitudes	e.g., **v**, |**v**|
5.2	Find the components of a vector by subtracting the co-ordinates of an initial point from the co-ordinates of a terminal point. Use position vectors.	See also section 5.6, translations using column vectors.
5.3	Calculate the magnitude of a vector $\begin{pmatrix} x \\ y \end{pmatrix}$ as $\sqrt{(x^2 + y^2)}$.	
5.4	Add and subtract vectors.	Both algebraic (component) and geometric (parallelogram rule) addition/subtraction.
5.5	Multiply a vector by a scalar.	e.g., $\left\lvert 3\begin{pmatrix} -4 \\ 3 \end{pmatrix}\right\rvert = 3(5) = 15$ $c\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} cx \\ cy \end{pmatrix}$ If $c\lvert\mathbf{v}\rvert \neq 0$, the direction of $c\mathbf{v}$ is either along **v** (for $c > 0$) or against **v** (for $c < 0$).
5.6	Transformations on the cartesian plane: translation, reflection, rotation, enlargement (dilation), stretch. Description of a translation using column vectors.	Representing and describing transformations.
5.7	Inverse of a transformation.	
5.8	Combined transformations.	e.g., find the **single** transformation that can replace a rotation of 180° around the origin followed by a translation by vector $\begin{pmatrix} 4 \\ -2 \end{pmatrix}$.

4. Curriculum Content

6.	Geometrical measurement—Core curriculum	Notes / Exemplars
6.1	Units: mm, cm, m, km mm^2, cm^2, m^2, ha, km^2 mm^3, cm^3, ml, cl, l, m^3 g, kg	All units will be metric; conversion between units is expected. Units of time as given in section 1.10.
6.2	Perimeter and area of rectangle, triangle, and compound shapes derived from these. Area of trapezoid and parallelogram.	Formula will be given for area of triangle.
6.3	Circumference and area of a circle. Arc length and area of sector.	Formulae will be given for circumference and area of a circle. From sector angles in degrees and simple examples only.
6.4	Surface area and volume of a prism (in particular, cuboid, and cylinder). Surface area and volume of a sphere.	Formulae will be given for the lateral surface area of cylinder and the surface area of a sphere, and the volume of a prism, a cylinder and a sphere.
6.5	*Extended Curriculum only.*	
6.6	Use geometric shapes, their measures, and their properties to describe objects.	e.g., modeling a tree trunk or a human torso as a cylinder.

4. Curriculum Content

6.	Geometrical measurement—Extended curriculum	Notes / Exemplars
6.1	Units: mm, cm, m, km mm^2, cm^2, m^2, ha, km^2 mm^3, cm^3, ml, cl, l, m^3 g, kg	All units will be metric; conversion between units expected. Units of time as given in section 1.10.
6.2	Perimeter and area of rectangle, triangle, and compound shapes derived from these. Area of trapezoid and parallelogram.	
6.3	Circumference and area of a circle. Arc length and area of sector.	From sector angles in degrees only.
6.4	Surface area and volume of a prism and a pyramid (in particular, cuboid, cylinder, and cone). Surface area and volume of a sphere.	Formulae will be given for the lateral surface area of a cylinder and a cone, the surface area of a sphere, and the volume of a pyramid, a cone and a sphere.
6.5	Areas and volumes of compound shapes.	Involving combinations of the shapes in section 6.4.
6.6	Use geometric shapes, their measures, and their properties to describe objects.	e.g., modeling a tree trunk or a human torso as a cylinder.

4. Curriculum Content

7.	Co-ordinate geometry—Core curriculum	Notes / Exemplars
7.1	Plotting of points and reading from a graph in the cartesian plane.	
7.2	Distance between two points.	Questions on this topic would be structured via diagrams.
7.3	Midpoint of a line segment.	Questions on this topic would be structured via diagrams.
7.4	Slope of a line segment.	
7.5	Interpret and obtain the equation of a straight line as $y = mx + b$.	e.g., obtain the equation of a straight line graph given a pair of co-ordinates on the line.
7.6	Slope of parallel line. Find the equation of a line parallel to a given line that passes through a given point.	

8.	Trigonometry—Core curriculum	Notes / Exemplars
8.1	Use trigonometric ratios and the Pythagorean Theorem to solve right-angled triangles in applied problems.	Problems involving bearings may be included. Know angle of elevation and depression.
8.2	*Extended Curriculum only.*	
8.3	*Extended Curriculum only.*	

4. Curriculum Content

7.	Co-ordinate geometry—Extended curriculum	Notes / Exemplars
7.1	Plotting of points and reading from a graph in the cartesian plane.	
7.2	Distance between two points.	e.g., use co-ordinates to compute the perimeters of polygons and areas of triangles using the distance formula.
7.3	Midpoint of a line segment. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	
7.4	Slope of a line segment.	
7.5	Interpret and obtain the equation of a straight line as $y = mx + b$. Interpret and obtain the equation of a straight line as $ax + by = d$ (a, b, and d are integers)	e.g., obtain the equation of a straight line graph given a pair of co-ordinates on the line.
7.6	Slope of parallel line. Find the equation of a line parallel to a given line that passes through a given point. Slope of perpendicular line. Find the equation of a line perpendicular to a given line that passes through a given point.	

8.	Trigonometry—Extended curriculum	Notes / Exemplars
8.1	Use trigonometric ratios and the Pythagorean Theorem to solve right-angled triangles in applied problems. Know the exact values for the trigonometric ratios of 0°, 30°, 45°, 60°, 90°.	Problems involving bearings may be included. Know angle of elevation and depression.
8.2	Extend sine and cosine values to angles between 0° and 360°. Explain and use the relationship between the sine and cosine of complementary angles. Graph and know the properties of trigonometric functions.	
8.3	Sine Rule.	Formula will be given. ASA, SSA (ambiguous case included where the angle is obtuse).

8.	Trigonometry—Core curriculum	Notes / Exemplars
8.4	*Extended Curriculum only.*	
8.5	*Extended Curriculum only.*	

9.	Probability—Core curriculum	Notes
9.1	Probability P(*A*) as a fraction, decimal, or percentage. Significance of its value, including using probabilities to make fair decisions.	Includes an understanding that the probability of an event occurring = 1 – the probability of the event not occurring. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not"). The knowledge and use of set notation is not expected.
9.2	Relative frequency as an estimate of probability.	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation, e.g., a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?
9.3	Expected number of occurrences.	
9.4	*Extended Curriculum only.*	
9.5	Possibility diagrams. Tree diagrams including successive selection with or without replacement.	Simple cases only.

8.	Trigonometry—Extended curriculum	Notes / Exemplars
8.4	Cosine Rule.	Formula will be given. SAS, SSS.
8.5	Area of triangle.	Formula will be given.

9.	Probability—Extended curriculum	Notes / Exemplars
9.1	Probability P(*A*) as a fraction, decimal, or percentage. Significance of its value, including using probabilities to make fair decisions.	Includes an understanding that the probability of an event occurring = 1 – the probability of the event not occurring. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not"). The knowledge and use of set notation is not expected.
9.2	Relative frequency as an estimate of probability.	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation, e.g., a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?
9.3	Expected number of occurrences.	
9.4	Combining events: the addition rule P(*A* or *B*) = P(*A*) + P(*B*) – P(*A* and *B*) the multiplication rule P(*A* and *B*) = P(*A*) × P(*B*).	
9.5	Possibility diagrams. Tree diagrams including successive selection with or without replacement.	

4. Curriculum Content

10.	Statistics—Core curriculum	Notes / Exemplars
10.1	Reading and interpretation of graphs or tables of data.	
10.2	Discrete and continuous data.	
10.3	Compound bar chart, dot plots, line graph, pie chart, simple frequency distributions, scatter diagram.	
10.4	Mean, mode, median, and range from lists of discrete data.	
10.5	*Extended Curriculum only.*	
10.6	*Extended Curriculum only.*	
10.7	*Extended Curriculum only.*	
10.8	Understanding and description of correlation (positive, negative, or zero) with reference to a scatter diagram. Straight line of best fit (by eye) through the mean on a scatter diagram.	

10.	Statistics—Extended curriculum	Notes / Exemplars
10.1	Reading and interpretation of graphs or tables of data.	
10.2	Discrete and continuous data.	
10.3	Compound bar chart, dot plots, line graph, pie chart, simple frequency distributions, scatter diagram.	
10.4	Mean, mode, median, and range from lists of discrete data. Mean, modal class, median, and range from grouped and continuous data.	The term *estimated mean* may be used in questions involving grouped continuous data.
10.5	Histograms with frequency density on the vertical axis.	Includes histograms with unequal class intervals.
10.6	Cumulative frequency table and curve and box plots. Median, quartiles, percentiles, and inter-quartile range.	
10.7	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (inter-quartile range) of two or more different data sets.	
10.8	Understanding and description of correlation (positive, negative, or zero) with reference to a scatter diagram. Straight line of best fit (by eye) through the mean on a scatter diagram.	

5. Additional Information

5.1 Guided Learning Hours

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

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

5.2 Recommended Prerequisites

We recommend that candidates who are beginning this course should have previously studied an appropriate Junior High school mathematics program.

5.3 Progression

IGCSE Certificates are general qualifications that enable candidates to progress either directly to employment or to proceed to further qualifications.
Candidates who are awarded grades C to A* in IGCSE Mathematics are well prepared to follow courses leading to AS and A Level Mathematics or the equivalent.
Candidates must study the extended curriculum to be able to progress on to AS Level Mathematics.

5.4 Component Codes

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

5.5 Grading and Reporting

IGCSE results are shown by one of the grades A*, A, B, C, D, E, F, or G, indicating the standard achieved, Grade A* being the highest and Grade G the lowest. "Ungraded" indicates that the candidate's performance fell short of the standard required for Grade G. "Ungraded" will be reported on the statement of results but not on the certificate. For some language syllabi CIE also reports separate oral endorsement grades on a scale of 1 to 5 (1 being the highest).

5. Additional Information

5.6 Resources

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

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

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

6. Appendix

6.1 Mathematical Formulae for Core Components 1 and 3

Area, A, of triangle, base b, height h.	$A = \frac{1}{2}bh$
Area, A, of circle, radius r.	$A = \pi r^2$
Circumference, C, of circle, radius r.	$C = 2\pi r$
Lateral surface area, A, of cylinder of radius r, height h.	$A = 2\pi rh$
Surface area, A, of sphere of radius r.	$A = 4\pi r^2$
Volume, V, of prism, cross-sectional area A, length l.	$V = Al$
Volume, V, of cylinder of radius r, height h.	$V = \pi r^2 h$
Volume, V, of sphere of radius r.	$V = \frac{4}{3}\pi r^3$

6. Appendix

6.2 Mathematical Formulae for Extended Components 2 and 4

For the equation $ax^2 + bx + c = 0$ $\quad x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Lateral surface area, A, of cylinder of radius r, height h. $\quad A = 2\pi rh$

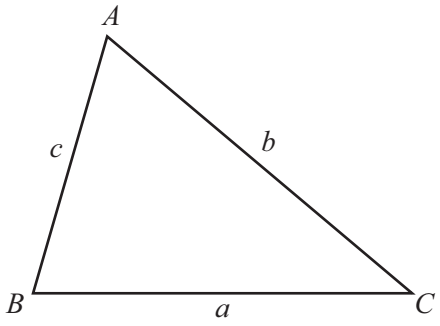
Lateral surface area, A, of cone of radius r, sloping edge l. $\quad A = \pi rl$

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

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

Volume, V, of cone of radius r, height h. $\quad V = \frac{1}{3}\pi r^2 h$

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



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

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

$$\text{Area} = \tfrac{1}{2}bc\sin A$$

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