Syllabus

Cambridge IGCSE Mathematics
Syllabus code 0580
Cambridge IGCSE Mathematics (with coursework)
Syllabus code 0581
For examination in June and November 2011

UNIVERSITY of CAMBRIDGE
International Examinations

Note for Exams Officers: Before making Final Entries, please check availability of the codes for the components and options in the E3 booklet (titled "Procedures for the Submission of Entries") relevant to the exam session. Please note that component and option codes are subject to change.

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Note:

In sections 3 and 4, vertical lines are used to indicate where clarification has been added to this syllabus.

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 students from 150 countries enter Cambridge examinations every year. What makes educators around the world choose Cambridge?

Recognition

Cambridge IGCSE is internationally recognised by schools, universities and employers as equivalent to UK GCSE. Cambridge IGCSE is excellent preparation for A/AS Level, the Advanced International Certificate of Education (AICE), US Advanced Placement Programme 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 Centres, plus teacher training (online and face-to-face) and student 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 students. They not only build understanding and knowledge required for progression, but also learning and thinking skills that help students become independent learners and equip them for life.

Not-for-profit, part of the University of Cambridge

CIE is part of Cambridge Assessment, a not-for-profit organisation 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.

Cambridge IGCSE Mathematics is structured with a Coursework option and is ideal for candidates of all abilities. There are number of mathematics syllabuses at both IGCSE and A & AS Level offered by CIE – further information is available on the CIE website at **www.cie.org.uk**.

1.3 Cambridge International Certificate of Education (ICE)

Cambridge ICE is the group award of the International General Certificate of Secondary Education (IGCSE). It requires the study of subjects drawn from the five different IGCSE subject groups. It gives schools the opportunity to benefit from offering a broad and balanced curriculum by recognising 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 falls into 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 Centre

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 Centre

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

2. Assessment at a glance

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Syllabus 0580 (without coursework)

Core curriculum *Grades available: C–G*	**Extended curriculum** *Grades available: A*–E*
Paper 1 1 hour Short-answer questions. Candidates should answer each question. Weighting: 35%	**Paper 2** 1½ hours Short-answer questions. Candidates should answer each question. Weighting: 35%
Paper 3 2 hours Structured questions. Candidates should answer each question. Weighting: 65%	**Paper 4** 2½ hours Structured questions. Candidates should answer each question. Weighting: 65%

Syllabus 0581 (with coursework)

Core curriculum *Grades available: C–G*	**Extended curriculum** *Grades available: A*–E*
Paper 1 1 hour Short-answer questions. Candidates should answer each question. Weighting: 30%	**Paper 2** 1½ hours Short-answer questions. Candidates should answer each question. Weighting: 30%
Paper 3 2 hours Structured questions. Candidates should answer each question. Weighting: 50%	**Paper 4** 2½ hours Structured questions. Candidates should answer each question. Weighting: 50%
Paper 5 Coursework. Weighting: 20%	**Paper 6** Coursework. Weighting: 20%

0581 is not available to private candidates.

2. Assessment at a glance

- Candidates should have an electronic calculator for all papers, possibly used in conjunction with four-figure tables for trigonometric functions. Algebraic or graphical calculators are not permitted. Three significant figures will be required in answers except where otherwise stated.
- Candidates should use the value of π from their calculators if their calculator provides this. Otherwise, they should use the value of 3.142 given on the front page of the question paper only.
- Tracing paper may be used as an additional material for each of the written papers.
- For syllabus 0581, the Coursework components (papers 5 and 6) will be assessed by the teacher using the criteria given in this syllabus. The work will then be externally moderated by CIE. Teachers may not undertake school-based assessment of Coursework without the written approval of CIE. This will only be given to teachers who satisfy CIE requirements concerning moderation and who have undertaken special training in assessment before entering candidates. CIE offers schools in-service training via the *Coursework Training Handbook*.
- For 0581, a candidate's Coursework grade cannot lower his or her overall result. Candidates entered for Syllabus 0581 are graded first on Components 1+3+5 or 2+4+6 and then graded again on Components 1+3 or 2+4. If the grade achieved on the aggregate of the two written papers alone is higher then this replaces the result achieved when the Coursework component is included. In effect, no candidate is penalised for taking the Coursework component.

3. Syllabus aims and assessme

3.1 Syllabus aims

The aims of the curriculum are the same for all candidates. The aims are set out below and describe the educational purposes of a course in Mathematics for the IGCSE examination. They are not listed in order of priority.

The aims are to enable candidates 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 number, 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. recognise 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 generalise 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 co-operative 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.

3.2 Assessment objectives and their weighting in the exam papers

The two assessment objectives in Mathematics are:

A Mathematical techniques

B Applying mathematical techniques to solve problems

A description of each assessment objective follows.

A Mathematical techniques

Candidates should be able to:

1. organise, 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. recognise 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.

B Applying mathematical techniques to solve problems

In questions which are set in context and/or which require a sequence of steps to solve, candidates should be able to:

10. make logical deductions from given mathematical data;
11. recognise patterns and structures in a variety of situations, and form generalisations;
12. respond to a problem relating to a relatively unstructured situation by translating it into an appropriately structured form;
13. analyse 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.

Weighting of assessment objectives

The relationship between the assessment objectives and the scheme of assessment is set out in the tables below.

	Paper 1 (marks)	Paper 2 (marks)	Paper 3 (marks)	Paper 4 (marks)
A: Mathematical techniques	42–48	28–35	78–88	52–65
B: Applying mathematical techniques to solve problems	8–14	35–42	16–26	65–78

	Core assessment	Extended assessment
A: Mathematical techniques	75–85%	40–50%
B: Applying mathematical techniques to solve problems	15–25%	50–60%

The relationship between the main topic areas of Mathematics and the assessment is set out in the table below.

	Number	Algebra	Space & shape	Statistics & probability
Core (Papers 1 & 3)	30–35%	20–25%	30–35%	10–15%
Extended (Papers 2 & 4)	15–20%	35-40%	30–35%	10–15%

3.3 Exam combinations

Candidates can combine each of these syllabuses with any other CIE syllabus, except:

- syllabuses with the same title at the same level
- 0607 IGCSE International Mathematics

Please note that IGCSE, Cambridge International Level1/Level 2 Certificates and O Level syllabuses are at the same level.

4. Curriculum content

Candidates may follow either the Core curriculum only or the Extended curriculum which involves both the Core and Supplement. Candidates aiming for Grades A*–C should follow the Extended Curriculum.

Centres are reminded that the study of mathematics offers opportunities for the use of ICT, particularly spreadsheets and graph-drawing packages. For example, spreadsheets may be used in the work on Percentages (section 11), Personal and household finance (section 15), Algebraic formulae (section 20) Statistics (section 33), etc. Graph-drawing packages may be used in the work on Graphs in practical situations (section 17), Graphs of functions (section 18), Statistics (section 33), etc. It is important to note that use or knowledge of ICT will **not** be assessed in the examination papers.

Centres are also reminded that, although use of an electronic calculator is permitted on all examination papers, candidates should develop a full range of mental and non-calculator skills during the course of study. Questions demonstrating the mastery of such skills may be asked in the examination.

As well as demonstrating skill in the following techniques, candidates will be expected to apply them in the solution of problems.

1. Number, set notation and language	
Core Identify and use natural numbers, integers (positive, negative and zero), prime numbers, square numbers, common factors and common multiples, rational and irrational numbers (e.g. π, $\sqrt{2}$), real numbers; continue a given number sequence; recognise patterns in sequences and relationships between different sequences, generalise to simple algebraic statements (including expressions for the nth term) relating to such sequences.	**Supplement** Use language, notation and Venn diagrams to describe sets and represent relationships between sets as follows: Definition of sets, e.g. $A = \{x: x \text{ is a natural number}\}$ $B = \{(x,y): y = mx + c\}$ $C = \{x: a \leqslant x \leqslant b\}$ $D = \{a, b, c, \ldots\}$
	Notation Number of elements in set A — $n(A)$ "…is an element of…" — $\in$ "…is not an element of…" — $\notin$ Complement of set A — A' The empty set — $\varnothing$ Universal set — $\mathscr{E}$ A is a subset of B — $A \subseteq B$ A is a proper subset of B — $A \subset B$ A is not a subset of B — $A \nsubseteq B$ A is not a proper subset of B — $A \not\subset B$ Union of A and B — $A \cup B$ Intersection of A and B — $A \cap B$

4. Curriculum content

2. Squares and cubes	
Core Calculate squares, square roots, cubes and cube roots of numbers.	
3. Directed numbers	
Core Use directed numbers in practical situations (e.g. temperature change, flood levels).	
4. Vulgar and decimal fractions and percentages	
Core Use the language and notation of simple vulgar and decimal fractions and percentages in appropriate contexts; recognise equivalence and convert between these forms.	
5. Ordering	
Core Order quantities by magnitude and demonstrate familiarity with the symbols $=, \neq, >, <, \geqslant, \leqslant$	
6. Standard form	
Core Use the standard form $A \times 10^n$ where n is a positive or negative integer, and $1 \leqslant A < 10$	
7. The four rules	
Core Use the four rules for calculations with whole numbers, decimal fractions and vulgar (and mixed) fractions, including correct ordering of operations and use of brackets.	
8. Estimation	
Core Make estimates of numbers, quantities and lengths, give approximations to specified numbers of significant figures and decimal places and round off answers to reasonable accuracy in the context of a given problem.	

4. Curriculum content

9. Limits of accuracy	
Core Give appropriate upper and lower bounds for data given to a specified accuracy (e.g. measured lengths).	**Supplement** Obtain appropriate upper and lower bounds to solutions of simple problems (e.g. the calculation of the perimeter or the area of a rectangle) given data to a specified accuracy.
10. Ratio, proportion, rate	
Core Demonstrate an understanding of the elementary ideas and notation of ratio, direct and inverse proportion and common measures of rate; divide a quantity in a given ratio; use scales in practical situations; calculate average speed.	**Supplement** Express direct and inverse variation in algebraic terms and use this form of expression to find unknown quantities; increase and decrease a quantity by a given ratio.
11. Percentages	
Core Calculate a given percentage of a quantity; express one quantity as a percentage of another; calculate percentage increase or decrease.	**Supplement** Carry out calculations involving reverse percentages, e.g. finding the cost price given the selling price and the percentage profit.
12. Use of an electronic calculator	
Core Use an electronic calculator efficiently; apply appropriate checks of accuracy.	
13. Measures	
Core Use current units of mass, length, area, volume and capacity in practical situations and express quantities in terms of larger or smaller units.	
14. Time	
Core Calculate times in terms of the 24-hour and 12-hour clock; read clocks, dials and timetables.	
15. Money	
Core Calculate using money and convert from one currency to another.	

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16. Personal and household finance	
Core Use given data to solve problems on personal and household finance involving earnings, simple interest and compound interest (knowledge of compound interest formula is not required), discount, profit and loss; extract data from tables and charts.	
17. Graphs in practical situations	
Core Demonstrate familiarity with Cartesian co-ordinates in two dimensions, interpret and use graphs in practical situations including travel graphs and conversion graphs, draw graphs from given data.	**Supplement** Apply the idea of rate of change to easy kinematics involving distance-time and speed-time graphs, acceleration and deceleration; calculate distance travelled as area under a linear speed-time graph.
18. Graphs of functions	
Core Construct tables of values for functions of the form $ax + b$, $\pm x^2 + ax + b$, a/x ($x \neq 0$) where a and b are integral constants; draw and interpret such graphs; find the gradient of a straight line graph; solve linear and quadratic equations approximately by graphical methods.	**Supplement** Construct tables of values and draw graphs for 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 form a^x where a is a positive integer; estimate gradients of curves by drawing tangents; solve associated equations approximately by graphical methods.
19. Straight line graphs	
Core Interpret and obtain the equation of a straight line graph in the form $y = mx + c$; determine the equation of a straight line parallel to a given line.	**Supplement** Calculate the gradient of a straight line from the co-ordinates of two points on it; calculate the length and the co-ordinates of the midpoint of a straight line segment from the co-ordinates of its end points.
20. Algebraic representation and formulae	
Core Use letters to express generalised numbers and express basic arithmetic processes algebraically, substitute numbers for words and letters in formulae; transform simple formulae; construct simple expressions and set up simple equations.	**Supplement** Construct and transform more complicated formulae and equations.

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21. Algebraic manipulation	
Core Manipulate directed numbers; use brackets and extract common factors.	**Supplement** Expand products of algebraic expressions; factorise where possible expressions of the form $ax + bx + kay + kby$, $a^2x^2 - b^2y^2$; $a^2 + 2ab + b^2$; $ax^2 + bx + c$ manipulate algebraic fractions, e.g. $\frac{x}{3} + \frac{x-4}{2}$, $\frac{2x}{3} - \frac{3(x-5)}{2}$, $\frac{3a}{4} \times \frac{5ab}{3}$, $\frac{3a}{4} - \frac{9a}{10}$, $\frac{1}{x-2} + \frac{2}{x-3}$ factorise and simplify expressions such as $\frac{x^2 - 2x}{x^2 - 2x + 6}$
22. Functions	
	Supplement Use function notation, e.g. $f(x) = 3x - 5$, $f: x \mapsto 3x - 5$ to describe simple functions, and the notation $f^{-1}(x)$ to describe their inverses; form composite functions as defined by $gf(x) = g(f(x))$
23. Indices	
Core Use and interpret positive, negative and zero indices.	**Supplement** Use and interpret fractional indices, e.g. solve $32^x = 2$
24. Solutions of equations and inequalities	
Core Solve simple linear equations in one unknown; solve simultaneous linear equations in two unknowns.	**Supplement** Solve quadratic equations by factorisation, completing the square or by use of the formula; solve simple linear inequalities.
25. Linear programming	
	Supplement Represent inequalities graphically and use this representation in the solution of simple linear programming problems (the conventions of using broken lines for strict inequalities and shading unwanted regions will be expected).

26. Geometrical terms and relationships	
Core Use and interpret the geometrical terms: point, line, parallel, bearing, right angle, acute, obtuse and reflex angles, perpendicular, similarity, congruence; use and interpret vocabulary of triangles, quadrilaterals, circles, polygons and simple solid figures including nets.	**Supplement** Use the relationships between areas of similar triangles, with corresponding results for similar figures and extension to volumes and surface areas of similar solids.
27. Geometrical constructions	
Core Measure lines and angles; construct a triangle given the three sides using ruler and pair of compasses only; construct other simple geometrical figures from given data using protractors and set squares as necessary; construct angle bisectors and perpendicular bisectors using straight edges and pair of compasses only; read and make scale drawings.	
28. Symmetry	
Core Recognise rotational and line symmetry (including order of rotational symmetry) in two dimensions and properties of triangles, quadrilaterals and circles directly related to their symmetries.	**Supplement** Recognise symmetry properties of the prism (including cylinder) and the pyramid (including cone); use the following symmetry properties of circles: (a) equal chords are equidistant from the centre (b) the perpendicular bisector of a chord passes through the centre (c) tangents from an external point are equal in length.
29. Angle properties	
Core Calculate unknown angles using the following geometrical properties: (a) angles at a point (b) angles at a point on a straight line and intersecting straight lines (c) angles formed within parallel lines (d) angle properties of triangles and quadrilaterals (e) angle properties of regular polygons (f) angle in a semi-circle (g) angle between tangent and radius of a circle.	**Supplement** Use in addition the following geometrical properties: (a) angle properties of irregular polygons (b) angle at the centre of a circle is twice the angle at the circumference (c) angles in the same segment are equal (d) angles in opposite segments are supplementary; cyclic quadrilaterals.

30. Locus	
Core Use the following loci and the method of intersecting loci for sets of points in two dimensions: (a) which are at a given distance from a given point (b) which are at a given distance from a given straight line (c) which are equidistant from two given points (d) which are equidistant from two given intersecting straight lines.	
31. Mensuration	
Core Carry out calculations involving the perimeter and area of a rectangle and triangle, the circumference and area of a circle, the area of a parallelogram and a trapezium, the volume of a cuboid, prism and cylinder and the surface area of a cuboid and a cylinder.	**Supplement** Solve problems involving the arc length and sector area as fractions of the circumference and area of a circle, the surface area and volume of a sphere, pyramid and cone (given formulae for the sphere, pyramid and cone).
32. Trigonometry	
Core Interpret and use three-figure bearings measured clockwise from the North (i.e. 000°–360°); apply Pythagoras' theorem and the sine, cosine and tangent ratios for acute angles to the calculation of a side or of an angle of a right-angled triangle (angles will be quoted in, and answers required in, degrees and decimals to one decimal place).	**Supplement** Solve trigonometrical problems in two dimensions involving angles of elevation and depression; extend sine and cosine values to angles between 90° and 180°; solve problems using the sine and cosine rules for any triangle and the formula area of triangle = $\frac{1}{2}ab\sin C$, solve simple trigonometrical problems in three dimensions including angle between a line and a plane.
33. Statistics	
Core Collect, classify and tabulate statistical data; read, interpret and draw simple inferences from tables and statistical diagrams; construct and use bar charts, pie charts, pictograms, simple frequency distributions, histograms with equal intervals and scatter diagrams (including drawing a line of best fit by eye); understand what is meant by positive, negative and zero correlation; calculate the mean, median and mode for individual and discrete data and distinguish between the purposes for which they are used; calculate the range.	**Supplement** Construct and read histograms with equal and unequal intervals (areas proportional to frequencies and vertical axis labelled 'frequency density'); construct and use cumulative frequency diagrams; estimate and interpret the median, percentiles, quartiles and inter-quartile range; calculate an estimate of the mean for grouped and continuous data; identify the modal class from a grouped frequency distribution.

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34. Probability	
Core Calculate the probability of a single event as either a fraction or a decimal (not a ratio); understand and use the probability scale from 0 to 1; understand that: *the probability of an event occurring = 1 – the probability of the event not occurring*; understand probability in practice, e.g. relative frequency.	**Supplement** Calculate the probability of simple combined events, using possibility diagrams and tree diagrams where appropriate (in possibility diagrams outcomes will be represented by points on a grid and in tree diagrams outcomes will be written at the end of branches and probabilities by the side of the branches).
35. Vectors in two dimensions	
Core Describe a translation by using a vector represented by e.g. $\begin{pmatrix} x \\ y \end{pmatrix}$, $\overrightarrow{AB}$ or **a**; add and subtract vectors; multiply a vector by a scalar.	**Supplement** Calculate the magnitude of a vector $\begin{pmatrix} x \\ y \end{pmatrix}$ as $\sqrt{x^2 + y^2}$. (Vectors will be printed as $\overrightarrow{AB}$ or **a** and their magnitudes denoted by modulus signs, e.g. $\lvert \overrightarrow{AB} \rvert$ or $\lvert \mathbf{a} \rvert$. In their answers to questions candidates are expected to indicate **a** in some definite way, e.g. by an arrow or by underlining, thus $\overrightarrow{AB}$ or $\underline{a}$) Represent vectors by directed line segments; use the sum and difference of two vectors to express given vectors in terms of two coplanar vectors; use position vectors
36. Matrices	
	Supplement Display information in the form of a matrix of any order; calculate the sum and product (where appropriate) of two matrices; calculate the product of a matrix and a scalar quantity; use the algebra of 2×2 matrices including the zero and identity 2×2 matrices; calculate the determinant and inverse $\mathbf{A}^{-1}$ of a non-singular matrix **A**
37. Transformations	
Core Reflect simple plane figures in horizontal or vertical lines; rotate simple plane figures about the origin, vertices or midpoints of edges of the figures, through multiples of 90°; construct given translations and enlargements of simple plane figures; recognise and describe reflections, rotations, translations and enlargements.	**Supplement** Use the following transformations of the plane: reflection (M); rotation (R); translation (T); enlargement (E); shear (H); stretch (S) and their combinations (if M(a) = b and R(b) = c the notation RM(a) = c will be used; invariants under these transformations may be assumed.) Identify and give precise descriptions of transformations connecting given figures; describe transformations using co-ordinates and matrices (singular matrices are excluded).

4. Curriculum content

4.1 Grade descriptions

Grade Descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of a candidate's performance in the examination may be balanced by a better performance in others.

Grade F

At this level, candidates are expected to identify and obtain necessary information. They would be expected to recognise if their results to problems are sensible. An understanding of simple situations should enable candidates to describe them, using symbols, words and diagrams. They draw simple, basic conclusions with explanations where appropriate.

- With an understanding of place value, candidates should be able to perform the four rules on positive integers and decimal fractions (one operation only) using a calculator where necessary. They should be able to convert between fractions, decimals and percentages for the purpose of comparing quantities between 0 and 1 in a variety of forms, and reduce a fraction to its simplest form. Candidates should appreciate the idea of direct proportion and the solution of simple problems involving ratio should be expected. Basic knowledge of percentage is needed to apply to simple problems involving percentage parts of quantities. They need to understand and apply metric units of length, mass and capacity, together with conversion between units in these areas of measure. The ability to recognise and continue a straightforward pattern in sequences and understand the terms multiples, factors and squares is needed as a foundation to higher grade levels of applications in the areas of number and algebra.
- At this level, the algebra is very basic involving the construction of simple algebraic expressions, substituting numbers for letters and evaluating simple formulae. Candidates should appreciate how a simple linear equation can represent a practical situation and be able to solve such equations.
- Knowledge of names and recognition of simple plane figures and common solids is basic to an understanding of shape and space. This will be applied to the perimeter and area of a rectangle and other rectilinear shapes. The skill of using geometrical instruments, ruler, protractor and compasses is required for applying to measuring lengths and angles and drawing a triangle given three sides.
- Candidates should be familiar with reading data from a variety of sources and be able to extract data from them, in particular timetables. The tabulation of the data is expected in order to form frequency tables and draw a bar chart. They will need the skill of plotting given points on a graph and reading a travel graph. From a set of numbers they should be able to calculate the mean.

Grade C

At this level, candidates are expected to show some insight into the mathematical structures of problems, which enables them to justify generalisations, arguments or solutions. Mathematical presentation and stages of derivations should be more extensive in order to generate fuller solutions. They should appreciate the difference between mathematical explanation and experimental evidence.

- Candidates should now apply the four rules of number to positive and negative integers, fractions and decimal fractions, in order to solve problems. Percentage should be extended to problems involving calculating one quantity as a percentage of another and its application to percentage change. Calculations would now involve several operations and allow candidates to demonstrate fluent and efficient use of calculators, as well as giving reasonable approximations. The relationship between decimal and standard form of a number should be appreciated and applied to positive and negative powers of 10. They should be familiar with the differences between simple and compound interest and apply this to calculating both.
- Candidates now need to extend their basic knowledge of sequences to recognise, and in simple cases formulate, rules for generating a pattern or sequence. While extending the level of difficulty of solving linear equations by involving appropriate algebraic manipulation, candidates are also expected to solve simple simultaneous equations in two unknowns. Work with formulae extends into harder substitution and evaluating the remaining term, as well as transforming simple formulae. The knowledge of basic algebra is extended to the use of brackets and common factor factorisation. On graph work candidates should be able to plot points from given values and use them to draw and interpret graphs in practical situations, including travel and conversion graphs and algebraic graphs of linear and quadratic functions.
- Candidates are expected to extend perimeter and area beyond rectilinear shapes to circles. They are expected to appreciate and use area and volume units in relation to finding the volume and surface area of a prism and cylinder. The basic construction work, with appropriate geometrical instruments, should now be extended and applied to accurate scale diagrams to solve a two-dimensional problem. Pythagoras theorem and trigonometry of right-angled triangles should be understood and applied to solving, by calculation, problems in a variety of contexts. The calculation of angles in a variety of geometrical figures, including polygons and to some extent circles should be expected from straightforward diagrams.
- Candidates should be able to use a frequency table to construct a pie chart. They need to understand and construct a scatter diagram and apply this to a judgement of the correlation existing between two quantities.

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Grade A

At this level, candidates should make clear, concise and accurate statements, demonstrating ease and confidence in the use of symbolic forms and accuracy or arithmetic manipulation. They should apply the mathematics they know in familiar and unfamiliar contexts.

- Candidates are expected to apply their knowledge of rounding to determining the bounds of intervals, which may follow calculations of, for example, areas. They should understand and use direct and inverse proportion. A further understanding of percentages should be evident by relating percentage change to change to a multiplying factor and vice versa, e.g. multiplication by 1.03 results in a 3% increase.
- Knowledge of the four rules for fractions should be applied to the simplification of algebraic fractions. Building on their knowledge of algebraic manipulation candidates should be able to manipulate linear, simultaneous and quadratic equations. They should be able to use positive, negative and fractional indices in both numerical and algebraic work, and interpret the description of a situation in terms of algebraic formulae and equations. Their knowledge of graphs of algebraic functions should be extended to the intersections and gradients of these graphs.
- The basic knowledge of scale factors should be extended to two and three dimensions and applied to calculating lengths, areas and volumes between actual values and scale models. The basic right-handed trigonometry knowledge should be applied to three-dimensional situations as well as being extended to an understanding of and solving problems on non-right angled triangles.
- At this level, candidates should be able to process data, discriminating between necessary and redundant information. The basic work on graphs in practical situations should be extended to making quantitative and qualitative deductions from distance/time and speed/time graphs.

5. Coursework: guidance for ce[illegible]s

The Coursework component provides candidates with an additional opportunity to show their ability in Mathematics. This opportunity relates to all abilities covered by the Assessment Objective, but especially to the last five, where an extended piece of work can demonstrate ability more fully than an answer to a written question.

Coursework should aid development of the ability

- to solve problems,
- to use mathematics in a practical way,
- to work independently,
- to apply mathematics across the curriculum,

and if suitable assignments are selected, it should enhance interest in, and enjoyment of, the subject.

Coursework assignments should form an integral part of both IGCSE Mathematics courses: whether some of this Coursework should be submitted for assessment (syllabus 0581), or not (syllabus 0580), is a matter for the teacher and the candidate to decide. A candidate's Coursework grade cannot lower his or her overall result.

5.1 Procedure

(a) Candidates should submit one Coursework assignment.

(b) Coursework can be undertaken in class, or in the candidate's own time. If the latter, the teacher must be convinced that the piece is the candidate's own unaided work, and must sign a statement to that effect (see also Section 5.4 Controlled Elements).

(c) A good Coursework assignment is normally between 8 and 15 sides of A4 paper in length. These figures are only for guidance; some projects may need to be longer in order to present all the findings properly, and some investigations might be shorter although all steps should be shown.

(d) The time spent on a Coursework assignment will vary, according to the candidate. As a rough guide, between 10 and 20 hours is reasonable.

5.2 Selection of Coursework assignments

(a) The topics for the Coursework assignments may be selected by the teacher, or (with guidance) by the candidates themselves.

(b) Since individual input is essential for high marks, candidates should work on different topics. However, it is possible for the whole class to work on the same topic, provided that account is taken of this in the final assessment.

(c) Teachers should ensure that each topic corresponds to the ability of the candidate concerned. Topics should not restrict the candidate and should enable them to show evidence of attainment at the highest level of which they are capable. However, topics should not be chosen which are clearly beyond the candidate's ability.

(d) The degree of open-endedness of each topic is at the discretion of the teacher. However, each topic selected should be capable of extension, or development beyond any routine solution, so as to give full rein to the more imaginative candidate.

(e) The principal consideration in selecting a topic should be the potential for mathematical activity. With that proviso, originality of topics should be encouraged.

(f) Some candidates may wish to use a computer at various stages of their Coursework assignment. This should be encouraged, but they must realise that work will be assessed on personal input, and not what the computer does for them. Software sources should be acknowledged.

5.3 Suggested topics for Coursework assignments

Good mathematical assignments can be carried out in many different areas. It is an advantage if a suitable area can be found which matches the candidate's own interests.

Some suggestions for Coursework assignments are:

A mathematical investigation

There are many good investigations available from various sources: books, the Internet, etc. The objective is to obtain a mathematical generalisation for a given situation.

At the highest level, candidates should consider a complex problem which involves the co-ordination of three features or variables.

An application of mathematics

Packaging – how can four tennis balls be packaged so that the least area of card is used?

Designing a swimming pool

Statistical analysis of a survey conducted by the candidate

Simulation games

Surveying – taking measurements and producing a scale drawing or model

At the highest level, candidates should consider a complex problem which involves mathematics at grade A. (See the section on grade descriptions.)

Teachers should discuss assignments with the candidates to ensure that they have understood what is required and know how to start. Thereafter, teachers should only give hints if the candidate is completely stuck.

Computer software packages may be used to enhance presentation, perform repetitive calculations or draw graphs.

5.4 Controlled elements

(a) The controlled element is included to assist the teacher in checking

(i) the authenticity of the candidate's work,

(ii) the extent of the candidate's learning of Mathematics, and its retention,

(iii) the depth of understanding of the Mathematics involved,

(iv) the ability to apply the learning to a different situation.

(b) The element must be carried out individually by the candidates under controlled conditions, but may take any appropriate form, provided that the results are available for moderation, e.g.

a timed or untimed written test,

an oral exchange between the candidate and the teacher,

a parallel investigation or piece of work,

a parallel piece of practical work, or practical test including a record of the results,

a written summary or account.

6. Coursework assessment cri

6.1 Scheme of assessment for Coursework assignments

(a) The whole range of marks is available at each level. The five classifications each have a maximum of 4 marks, awarded on a five-point scale, 0, 1, 2, 3, 4. For Coursework as a whole, including the controlled element, a maximum of 20 marks is available. Participating schools should use the forms at the back of the syllabus on which to enter these marks.

(b) Assignments are part of the learning process for the candidates, and it is expected that they will receive help and advice from their teachers. The marks awarded must reflect the personal contributions of the candidates, including the extent to which they use the advice they receive in the development of the assignments.

(c) The way in which the accuracy marks are allocated will vary from one assignment to another. Numerical accuracy, accuracy of manipulation in algebra, accuracy in the use of instruments, care in the construction of graphs and use of the correct units in measuring, are all aspects which may need consideration in particular assignments.

(d) If a candidate changes his or her level of entry during the course, Coursework already completed and assessed by the teacher will have to be reassessed according to the new entry option before moderation. A candidate being re-entered at the higher level (Extended curriculum) must be given the opportunity to extend any assignment already completed before it is re-assessed.

(e) The use of ICT is to be encouraged; however, teachers should not give credit to candidates for the skills needed to use a computer software package. For example, if data is displayed graphically by a spreadsheet, then credit may be given for selecting the most appropriate graph to draw and for its interpretation.

(f) Further information about the assessment of Coursework is given in the Coursework Training Handbook and at training sessions.

The following tables contain detailed criteria for the award of marks from 0 to 4 under the five categories of assessment (overall design and strategy, mathematical content, accuracy, clarity of argument and presentation, controlled element). For the Coursework component as a whole, a maximum of 20 marks is available.

6. Coursework assessment cri

Overall design and strategy

Assessment Criteria	Core	Extended
Much help has been received. No apparent attempt has been made to plan the work	0	0
Help has been received from the teacher, the peer group or a prescriptive worksheet. Little independent work has been done. Some attempt has been made to solve the problem, but only at a simple level. The work is poorly organised, showing little overall plan.	1	0
Some help has been received from the teacher or the peer group. A strategy has been outlined and an attempt made to follow it. A routine approach, with little evidence of the candidate's own ideas being used.	2	1
The work has been satisfactorily carried out, with some evidence of forward planning. Appropriate techniques have been used; although some of these may have been suggested by others, the development and use of them is the candidate's own.	3	2
The work is well planned and organised. The candidate has worked independently, devising and using techniques appropriate to the task. The candidate is aware of the wider implications of the task and has attempted to extend it. The outcome of the task is clearly explained.	4	3
The work is methodical and follows a flexible strategy to cope with unforeseen problems. The candidate has worked independently, the only assistance received being from reference books or by asking questions arising from the candidate's own ideas. The problem is solved, with generalisations where appropriate. The task has been extended and the candidate has demonstrated the wider implications.	4	4

6. Coursework assessment cri

Mathematical content

Assessment Criteria	Core	Extended
Little or no evidence of any mathematical activity. The work is very largely descriptive or pictorial.	0	0
A few concepts and methods relevant to the task have been employed, but in a superficial and repetitive manner.	1	0
A sufficient range of mathematical concepts which meet the basic needs of the task has been employed. More advanced mathematical methods may have been attempted, but not necessarily appropriately or successfully.	2	1
The concepts and methods usually associated with the task have been used, and the candidate has shown competence in using them.	3	2
The candidate has used a wide range of Core syllabus mathematics competently and relevantly, plus some mathematics from beyond the Core syllabus. The candidate has developed the topic mathematically beyond the usual and obvious. Mathematical explanations are concise.	4	3
A substantial amount of work, involving a wide range of mathematical ideas and methods of Extended level standard or beyond. The candidate has employed, relevantly, some concepts and methods not usually associated with the task in hand. Some mathematical originality has been shown.	4	4

6. Coursework assessment cri

Accuracy

N.B. The mark for Accuracy should not normally exceed the mark for Mathematical Content.

Assessment Criteria	Core	Extended
Very few calculations have been carried out, and errors have been made in these. Diagrams and tables are poor and mostly inaccurate.	0	0
Either correct work on limited mathematical content **or** calculations performed on a range of Core syllabus topics with some errors. Diagrams and tables are adequate, but units are often omitted or incorrect.	1	0
Calculations have been performed on all Core syllabus topics relevant to the task, with only occasional slips. Diagrams are neat and accurate, but routine; and tables contain information with few errors. The candidate has shown some idea of the appropriate degree of accuracy for the data used. Units are used correctly.	2	1
All the measurements and calculations associated with the task have been completed accurately. The candidate has shown an understanding of magnitude and degree of accuracy when making measurements or performing calculations. Accurate diagrams are included, which support the written work.	3	2
Careful, accurate and relevant work throughout. This includes, where appropriate, computation, manipulation, construction and measurement with correct units. Accurate diagrams are included which positively enhance the work, and support the development of the argument. The degree of accuracy is always correct and appropriate.	4	3 or 4*

*According to the mark for mathematical content.

6. Coursework assessment cri

Clarity of argument and presentation

Assessment Criteria	Core	Extended
Haphazard organisation of work, which is difficult to follow. A series of disconnected short pieces of work. Little or no attempt to summarise the results.	0	0
Poorly presented work, lacking logical development. Undue emphasis is given to minor aspects of the task, whilst important aspects are not given adequate attention. The work is presented in the order in which it happened to be completed; no attempt is made to re-organise it into a logical order.	1	0
Adequate presentation which can be followed with some effort. A reasonable summary of the work completed is given, though with some lack of clarity and/or faults of emphasis. The candidate has made some attempt to organise the work into a logical order.	2	1
A satisfactory standard of presentation has been achieved. The work has been arranged in a logical order. Adequate justification has been given for any generalisations made. The summary is clear, but the candidate has found some difficulty in linking the various different parts of the task together.	3	2
The presentation is clear, using written, diagrammatic and graphical methods as and when appropriate. Conclusions and generalisations are supported by reasoned statements which refer back to results obtained in the main body of the work. Disparate parts of the task have been brought together in a competent summary.	4	3
The work is clearly expressed and easy to follow. Mathematical and written language has been used to present the argument; good use has been made of symbolic, graphical and diagrammatic evidence in support. The summary is clear and concise, with reference to the original aims; there are also good suggestions of ways in which the work might be extended, or applied in other areas.	4	4

6. Coursework assessment cri

Controlled element

Assessment Criteria	Core	Extended
Little or no evidence of understanding the problem. Unable to communicate any sense of having learned something by undertaking the original task.	0	0
Able to reproduce a few of the basic skills associated with the task, but needs considerable prompting to get beyond this.	1	0
Can answer most of the questions correctly in a straightforward test on the project. Can answer questions about the problem and the methods used in its solution.	2	1
Can discuss or write about the problem, in some detail. Shows competence in the mathematical methods used in the work. Little or no evidence of having thought about possible extensions to the work or the application of methods to different situations.	3	2
Can talk or write fluently about the problem and its solution. Has ideas for the extension of the problem, and the applicability of the methods used in its solution to different situations.	4	3 or 4*

*Dependent on the complexity of the problem and the quality of the ideas.

6.2 Moderation

Internal Moderation

When several teachers in a Centre are involved in internal assessments, arrangements must be made within the Centre for all candidates to be assessed to a common standard. It is essential that within each Centre the marks for each skill assigned within different teaching groups (e.g. different classes) are moderated internally for the whole Centre entry. The Centre assessments will then be subject to external moderation.

External Moderation

External moderation of internal assessment will be carried out by CIE. The internally moderated marks for all candidates must be received at CIE by 30 April for the May/June examination and by 31 October for the November examination. These marks may be submitted either by using MS1 mark sheets or by using Cameo as described in the Handbook for Centres.

Once CIE has received the marks, CIE will select a sample of candidates whose work should be submitted for external moderation. CIE will communicate the list of candidates to the Centre, and the Centre should despatch the Coursework of these candidates to CIE immediately. Individual Candidate Record Cards and Coursework Assessment Summary Forms (copies of which may be found at the back of this syllabus booklet) must be enclosed with the Coursework.

Further information about external moderation may be found in the *Handbook for Centres* and the *Administrative Guide for Centres*.

7. Appendix

7.1 Resources

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

Resources are also listed on CIE's public website at **www.cie.org.uk**.

Access to teachers' email discussion groups and suggested schemes of work may be found on the CIE Teacher Support website at **http://teachers.cie.org.uk**. This website is available to teachers at registered CIE Centres.

MATHEMATICS
Individual Candidate Record Card
IGCSE 2011

Please read the instructions printed overleaf and the General Coursework Regulations before completing this form.

Centre Number						Centre Name		June/November	**2**	**0**	**1**	**1**
Candidate Number						Candidate Name		Teaching Group/Set				

Title(s) of piece(s) of work:			
Classification of Assessment		Use space below for Teacher's comments	Mark awarded
Overall design and strategy	(max 4)		
Mathematical content	(max 4)		
Accuracy	(max 4)		
Clarity of argument and presentation	(max 4)		
Controlled element	(max 4)		
		Mark to be transferred to Coursework Assessment Summary Form	TOTAL (max 20)

INSTRUCTIONS FOR COMPLETING INDIVIDUAL CANDIDATE RECORD CARDS

1. Complete the information at the head of the form.
2. Mark the item of Coursework for each candidate according to instructions given in the Syllabus and Training Handbook.
3. Enter marks and total marks in the appropriate spaces. Complete any other sections of the form required.
4. The column for teachers' comments is to assist CIE's moderation process and should include a reference to the marks awarded. Comments drawing attention to particular features of the work are especially valuable to the Moderator.
5. Ensure that the addition of marks is independently checked.
6. **It is essential that the marks of candidates from different teaching groups within each Centre are moderated internally.** This means that the marks awarded to all candidates within a Centre must be brought to a common standard by the teacher responsible for co-ordinating the internal assessment (i.e. the internal moderator), and a single valid and reliable set of marks should be produced which reflects the relative attainment of all the candidates in the Coursework component at the Centre.
7. Transfer the marks to the Coursework Assessment Summary Form in accordance with the instructions given on that document.
8. Retain all Individual Candidate Record Cards and Coursework which **will be required for external moderation**. Further detailed instructions about external moderation will be sent in late March of the year of the June Examination and in early October of the year of the November examination. See also the instructions on the Coursework Assessment Summary Form.

Note: These Record Cards are to be used by teachers only for candidates who have undertaken Coursework as part of their IGCSE.

MATHEMATICS
Coursework Assessment Summary Form
IGCSE 2011

Please read the instructions printed overleaf and the General Coursework Regulations before completing this form.

Centre Number						Centre Name		June/November	2	0	1	1

Candidate Number	Candidate Name	Teaching Group/ Set	Title(s) of piece(s) of work	Total Mark (max 20)	Internally Moderated Mark (max 20)

Name of teacher completing this form		Signature		Date							
Name of internal moderator		Signature		Date							

A. INSTRUCTIONS FOR COMPLETING COURSEWORK ASSESSMENT SUMMARY FORMS

1. Complete the information at the head of the form.
2. List the candidates in an order which will allow ease of transfer of information to a computer-printed Coursework mark sheet MS1 at a later stage (i.e. candidate index number order, where this is known; see item B.1 below). Show the teaching group or set for each candidate. The initials of the teacher may be used to indicate group or set.
3. Transfer each candidate's marks from his or her Individual Candidate Record Card to this form as follows:
   (a) Where there are columns for individual skills or assignments, enter the marks initially awarded (i.e. before internal moderation took place).
   (b) In the column headed 'Total Mark', enter the total mark awarded before internal moderation took place.
   (c) In the column headed 'Internally Moderated Mark', enter the total mark awarded *after* internal moderation took place.
4. Both the teacher completing the form and the internal moderator (or moderators) should check the form and complete and sign the bottom portion.

B. PROCEDURES FOR EXTERNAL MODERATION

1. University of Cambridge International Examinations (CIE) sends a computer-printed Coursework mark sheet MS1 to each centre (in late March for the June examination and in early October for the November examination) showing the names and index numbers of each candidate. Transfer the total internally moderated mark for each candidate from the Coursework Assessment Summary Form to the computer-printed Coursework mark sheet MS1.
2. The top copy of the computer-printed Coursework mark sheet MS1 must be despatched in the specially provided envelope to arrive as soon as possible at CIE but no later than 30 April for the June examination and 31 October for the November examination.
3. CIE will select a list of candidates whose work is required for external moderation. As soon as this list is received, send the candidates' work with the corresponding Individual Candidate Record Cards, this summary form and the second copy of the computer-printed mark sheet(s) (MS1), to CIE. Indicate the candidates who are in the sample by means of an asterisk (*) against the candidates' names overleaf.
4. CIE reserves the right to ask for further samples of Coursework.
5. If the Coursework involves three-dimensional work then clear photographs should be submitted in place of the actual models.

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