Cambridge Assessment

O Level

Mathematics

Session: 1984
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Subject Syllabus
SS9(HCO)
1984
Mathematics

For All Centres

GENERAL CERTIFICATE OF EDUCATION
SCHOOL CERTIFICATE
HIGHER SCHOOL CERTIFICATE

EXAMINATION SYLLABUSES FOR

1984

MATHEMATICAL SUBJECTS

UNIVERSITY OF CAMBRIDGE
LOCAL EXAMINATIONS SYNDICATE
INTERNATIONAL EXAMINATIONS

June 1982

2/82/9-5M/F&J

NOTES

Syllabus Revision

The following syllabuses have recently been introduced:
O. and S.C. Mathematics (Syllabus D)—first examination, 1981
A. and H.S.C. Mathematics (Syllabus A) **9200**
A. and H.S.C. Further Mathematics (Syllabus A) **9219**
A. and H.S.C. Pure Mathematics **9208** } —first examination, 1982

The two O. and S.C. subjects Mathematics (Syllabuses B and C) will be examined for the last time in November 1983 for Home and Caribbean Centres and in November 1984 for Overseas Centres which enter candidates in November only. The syllabuses for these subjects are not printed in this booklet and centres taking the November 1984 examination should consult the 1983 syllabus for details of content.

Mathematical Tables

Mathematical tables will be provided for use in the examination. The tables provided are *The Cambridge Elementary Mathematical Tables* (*Second Edition*) and further copies may be obtained from the Cambridge University Press, Pitt Press Buildings, Trumpington Street, Cambridge, and through booksellers.

Slide Rules

The use of slide rules is permitted in all Mathematical subjects except **4001**, **4004/1** and **4099**, but candidates using them should state this on their scripts (SR after a calculation is sufficient) and should be warned of the possible loss of accuracy involved. All formulae or other data given on slide rules must be securely covered up before these are taken into the examination room.

Electronic Calculators

1. At **all centres** the use of electronic calculators is **prohibited** in Ordinary Level and S.C. Mathematics Syllabus D Paper 1 (4004/1) and in the Certificate in Arithmetic (4099).
2. At **all centres** the use of silent electronic calculators is **permitted** in Advanced Level and H.S.C. (Principal) Mathematics, Pure Mathematics and Further Mathematics (9200, 9202, 9208, 9219 and 9220) and in A.O./H.S.C. (Subsidiary) Statistics (8180).
3. At **Home and Caribbean** centres (including overseas centres taking the June examinations) the use of silent calculators is **also permitted** in Ordinary Level Mathematics Syllabus D Paper 2 (4004/2) and in AO Level Additional Mathematics (8175).
4. **Centres in Overseas Areas** are asked to refer to circulars, issued by the Syndicate at regular intervals, for the latest arrangements concerning the use of calculators in Ordinary Level and S.C. Mathematics and Additonal Mathematics and in H.S.C. (Subsidiary) Mathematics.

Lists of Formulae etc.

Candidates entered for AO and S.C. Additional Mathematics/H.S.C. (Subsidiary) Mathematics and AO/H.S.C. (Subsidiary) Statistics will be provided in the examination with a list of formulae MF (Add) 1.

Candidates entered for any A. level or H.S.C. (Principal) Mathematical Subject will be provided in the examination with a list of formulae MF 4.

Further copies of both lists of formulae can be obtained from The Secretary, Syndicate Buildings, Cambridge, CB1 2EU.

Candidates entered for AO or H.S.C. (Subsidiary) Statistics will be provided in the examination with a Poisson probability chart. Details of how to obtain extra copies of this chart are given as a footnote on p. 40.

Mathematical Instruments

Apart from the usual mathematical instruments, candidates may use flexicurves in all the examinations. In addition, candidates taking Advanced level or H.S.C. subjects may use stencils for drawing conic sections, provided that the stencils do not bear formulae not included on the list of formulae provided for use in the examinations.

Mathematical Notation

The G.C.E. Boards in the United Kingdom have collaborated in the production of a list of mathematical notation to be used in the examination papers set by them. The list is given on pp. 44–47 and will be used for the first time in the 1983 examinations. Where appropriate, the changes have been adopted in this booklet.

Some of the symbols in the list will be different from those currently used in the papers set by the Syndicate but it is not expected that any teachers or any candidates will experience any difficulties in using the new symbols.

MATHEMATICS SYLLABUS D (4004)

(*May not be taken with* **4001, 4003** *or any Mathematical subject at Advanced level*)

ORDINARY LEVEL AND SCHOOL CERTIFICATE

Introduction

The syllabus demands understanding of basic mathematical concepts and their applications, together with an ability to show this by clear expression and careful reasoning.

In the examination, importance will be attached to skills in algebraic manipulation and to numerical accuracy in calculations.

Units

The decimal system will be used in all questions involving British (or other) currency.

SI units will be used in questions involving mass and measures: the use of the centimetre will continue.

The 24-hour clock will be used for quoting times of the day: for example, 3.15 a.m. will be denoted by 03 15; 3.15 p.m. by 15 15.

Candidates will be expected to be familiar with the solidus notation for the expression of compound units, e.g. 5 cm/s for 5 centimetres per second, 13·6 g/cm³ for 13·6 grams per cubic centimetre.

Scheme of Papers

In the examination, two papers will be set, each carrying 100 marks.

Paper 1 (2½ hours) will consist of about 30 questions and candidates will be allowed no choice. Multiple Choice questions will not be set. **Neither mathematical tables nor slide rules nor calculators will be allowed to be used in this paper.**

Paper 2 (2½ hours) will consist of two sections: Section A (40 marks) will contain five questions on the more elementary parts of the syllabus, to be attempted by all candidates; Section B (60 marks) will contain eight questions of which candidates will be required to answer five. Omission of essential working will result in loss of marks. Mathematical tables, slide rules (where appropriate) and calculators (in those areas where they are allowed) may be used.

Each paper may be set on the whole syllabus. The Cambridge Elementary Mathematical Tables will be available for Paper 2.

Notes are included with the syllabus to clarify certain sections and to act as a guide to teachers.

Detailed Syllabus

SYLLABUS	NOTES
	Although questions which specifically require the use of logarithm tables will not be set, candidates not using calculators in paper 2 will need to use logarithm tables as an aid to calculation.
Development of number and place value. The real number line.	Candidates will be expected to be familiar with the following terms: natural numbers, integers (positive, negative and zero), prime numbers and factors, rational and irrational numbers.
The ideas of ordering. Common arithmetic processes.	Familiarity with $=$, $\neq$, $>$, $<$, $\geqslant$, $\leqslant$. The 'four rules' and combination of them by use of brackets.

Vulgar and decimal fractions. Ratio and percentage. Direct and inverse proportion; proportional parts. Square roots and reciprocals. Approximations, estimates of error, limits of accuracy, significant figures, decimal places, use of the standard form $A \times 10^n$ where n is a positive or negative integer, and $1 \leqslant A < 10$. Scales and simple map problems. Simple financial transactions, profit and loss, simple interest. Arithmetic problems.	Including conversions from one to the other. Financial transactions to include foreign exchange. Problems involving pounds and pence; mass, measures, densities; the Celsius (centigrade) scale of temperature; speeds.
Length, area and volume, mensuration of the rectangle, triangle, parallelogram, trapezium, cuboid, circle, cylinder, sphere, pyramid, cone and prism. Arc length and sector area as fractions of circumference and area of circle.	Necessary formulae will be given for the sphere, pyramid and cone.
Idea and notation of a set. Subsets. Union and intersection of sets.	Sets will be denoted by upper-case letters and elements of a set by lower-case letters. Sets are described by either listing the elements or by definition, 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 — $A \subseteq B$ B is contained in A — $A \supseteq B$ The negations of $\subseteq$, $\supseteq$ — $\nsubseteq$, $\nsupseteq$ Union of A and B — $A \cup B$ Intersection of A and B — $A \cap B$
Venn diagrams.	As illustrations and their use in simple logical problems.
The basic processes of algebra. Expression of an arithmetical generalisation in a formula and of a physical situation in mathematical symbols. Interpretation, evaluation and easy manipulation of formulae.	Including change of subject of a formula.

Integral and fractional indices, positive, negative and zero indices.
Factors of expressions in the form $ax+bx$; $ax+bx+kay+kby$; a^2-b^2; $a^2\pm 2ab+b^2$; ax^2+bx+c.
Simple algebraic fractions.
Solution of simple linear equations, quadratic equations and pairs of simultaneous linear equations.
Rectangular coordinates in two dimensions.
Linear, square and reciprocal relations.
Graphs of $y = ax^n$ where $n = -2, -1, 1, 2, 3$ and simple sums of these.
Simple direct, inverse, and joint variation.
The approximate solution of equations by graphical methods.
Graphical representation of inequalities by shading.

Solutions of quadratic equations by factorisation and *either* by use of the formula *or* by completing the square.

In representing inequalities graphically, candidates should use the following conventions:
(i) unwanted regions should be shaded,
(ii) boundary lines of the required region should be broken for strict inequalities and solid when the equality is included.

The solution of simultaneous linear equations and inequalities by graphical methods and their use in linear programming.
Gradient.
Calculation of the gradient of a straight line from the coordinates of two points on it.
Equation of a straight line in the form $y = mx+c$.
The estimation of gradients of graphs by drawing tangents and of the areas under graphs, e.g. by counting squares or by the trapezium rule.
The idea of rate of change.
Applications to easy kinematics involving distance-time and speed-time graphs.

Similarity and congruency.
Relationships between areas of similar triangles, with corresponding results for similar figures and extension to volumes of similar solids.

In the geometrical section of the syllabus:
(i) no proofs of theorems will be required,
(ii) questions may be set requiring simple logical deductions from given data.

Properties of angles at a point and angles made with parallel lines.
Angle properties of polygons.
Locus as a set of points in two or three dimensions.
Simple constructions including angle bisector and perpendicular bisector which may involve intersecting loci.

Any accurate method using normal geometrical instruments will be allowed with the following exceptions:
(i) protractors may not be used to bisect angles
(ii) the midpoint of a line may not be found by measurement.
Candidates will not be required to construct angles of 90°, 60°, 45° etc using ruler and compasses only.

Rotational and line symmetry in two dimensions.
The symmetries of regular polygons; symmetry properties of triangle (isosceles, equilateral), quadrilateral (trapezium, kite, parallelogram, rhombus, rectangle, square), prism (including cylinder), pyramid (including cone).
Symmetry properties of circles.

Equal chords equidistant from centre.
The perpendicular bisector of a chord passes through the centre of a circle.
A tangent is perpendicular to the radius at the point of contact.
Tangents from an external point are equal in length.

The angle at the centre of a circle is twice the angle at the circumference; the angle in a semicircle is a right angle; angles in the same segment are equal and angles in opposite segments are supplementary.

Applications of the theorem of Pythagoras.

Idea of a vector as a translation represented by $\begin{pmatrix} x \\ y \end{pmatrix}$, $\overrightarrow{AB}$ and $\mathbf{a}$; addition of vectors, multiplication by a scalar; magnitude of a vector $\begin{pmatrix} x \\ y \end{pmatrix}$ as $\sqrt{x^2+y^2}$.

Vectors will be in two dimensions only. In question papers, vectors will be printed as $\overrightarrow{AB}$, $\mathbf{a}$, and their magnitudes denoted by modulus signs, e.g. $|\overrightarrow{AB}|$, $|\mathbf{a}|$.
In their answers to questions, candidates are expected to indicate $\mathbf{a}$ in some definite way, e.g. by an arrow or by underlining. Thus $\vec{a}$ or a or $\underline{a}$.

The representation of vectors by directed line segments.
The sum and difference of vectors,

and their use in expressing the vectors in terms of two coplanar vectors. Position vectors. Use of the results (i) $\mathbf{a} = \mathbf{b} \Rightarrow \lvert\mathbf{a}\rvert = \lvert\mathbf{b}\rvert$ and $\mathbf{a}$ parallel to $\mathbf{b}$; (ii) $h\mathbf{a} = k\mathbf{b} \Rightarrow \mathbf{a}$ parallel to $\mathbf{b}$; or $h = 0$ and $k = 0$, in proving properties of equivalence, parallelism, and incidence in rectilinear figures.	
Matrices of any order; their addition and multiplication where appropriate. Multiplication of a matrix by a scalar quantity. Algebra of 2×2 matrices including identity and zero matrices, determinant of a matrix and inverse of a non-singular matrix.	
The transformations of the plane: reflection (M), rotation (R), translation (T), enlargement (E), shear (H), and stretching (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. Candidates will be expected to give precise descriptions of transformations used.
Recognition of the transformations connecting given direct or oppositely congruent figures, including the use of coordinates. The use of matrices to represent transformations.	Singular matrices are excluded.
The sine, cosine and tangent of an acute angle. Solution of right-angled triangles. Simple applications to three-dimensional problems.	In Paper 1, values of ratios needed for the question will be given. Calculations of the angle between two planes or of the angle between a straight line and a plane will not be set.
The extension of the sine and cosine ratios to angles between 90° and 180°. Use of the sine and cosine rules for any triangle. Area of triangle $= \frac{1}{2}ab \sin C$. Applications to problems using true bearings.	Bearings measured clockwise from the north, i.e. 000°–360°.
The Earth considered as a sphere: latitude and longitude, distances in nautical miles and kilometres along parallels of latitude and along meridians, speed in knots and km/h.	

Graphical representation of numerical data by bar chart, frequency polygon, pie chart and histogram (area of rectangle representing frequency). Cumulative frequency diagrams.	Candidates may be expected to give reasons for the method of representation they use.
Averages: mean; median; mode. Estimation of median and quartiles: interquartile range. Modal class.	Including use of assumed mean.
Simple probability.	Including applications of the sum and product laws.