Cambridge Assessment

O Level

Mathematics

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UNIVERSITY OF CAMBRIDGE
LOCAL EXAMINATIONS SYNDICATE

SYLLABUSES

MATHEMATICS
FURTHER MATHEMATICS

GENERAL CERTIFICATE
OF EDUCATION
(Home Centres only)

OVERSEA SCHOOL CERTIFICATE

OVERSEA HIGHER SCHOOL
CERTIFICATE

Correspondence should be addressed to
THE SECRETARY, SYNDICATE BUILDINGS, CAMBRIDGE
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N.B. These syllabuses are identical with those contained in the previous pamphlet Subject Syllabus M, dated February 1955, except for minor changes which are shown by black lines in margins.

SCHEME OF PAPERS

G.C.E. Mathematics (Ordinary Level), Alternative A
Oversea S.C. Mathematics, Alternative A

There will be three papers.

(*a*) *Arithmetic.* (2 hours.) The paper will include, as alternatives to a few of the questions on Arithmetic, easy questions on numerical Trigonometry. See p. 6

[*For special oversea papers see Oversea S.C. Regulations.*]

(*b*) *Geometry.* (2½ hours.) See pp. 6–7.

(*c*) *Algebra.* (2 hours.) A limited number of questions may be set involving a knowledge of simple geometrical properties. See p. 7.

G.C.E. Mathematics (Ordinary Level), Alternative B
Oversea S.C. Mathematics, Alternative B

There will be two papers (each 2½ hours), both to be taken. Each paper may contain questions on any part of the syllabus, and the solution of any question may require knowledge of more than one branch of the syllabus; a high standard of accuracy will be expected. Each paper will consist of two sections. The first section will contain five questions, to be attempted by all candidates, on the more elementary parts of the syllabus. The second section will include a variety of questions and a choice will be allowed. For syllabus see pp. 7–11.

G.C.E. Additional Mathematics (Ordinary Level)
Oversea H.S.C. Mathematics (Subsidiary)

There will be one paper (3 hours), divided into Section A, **Pure Mathematics** (6 questions); Section B, **Mechanics** (4 questions), **Statistics** (4 questions), and **Pure Mathematics** (4 questions). Candidates must not answer more than four questions from Section B. For syllabus see pp. 12–13.

Oversea S.C. Additional Mathematics

(see pp. 18–19)

DETAILED SYLLABUSES

G.C.E. Mathematics (Ordinary Level),
Oversea S.C. Mathematics
Alternative A
(see also p. 3)

Arithmetic

Candidates should be familiar with the British and metric systems of weights and measures and with the following monetary systems: pounds, shillings, and pence; francs and centimes; dollars and cents. In the special papers for Indian Centres (see Oversea School Certificate Regulations), rupees and annas will take the place of pounds, shillings, and pence. The use of algebraic symbols and methods will be permitted.

Addition, subtraction, multiplication, and division applied to numerical calculation, vulgar and decimal fractions, and the extraction of square roots; proportion and proportional parts; calculation of averages, percentage, simple and compound interest; profit and loss; stocks and shares (excluding brokerage). Elementary mensuration; candidates will be required to know simple formulae for determining volumes and areas associated with the rectangular block, the circular cylinder, and the sphere.

Candidates may be required to give results to a specified degree of approximation, but the use of contracted methods of multiplication and division is not essential; the use of logarithms will be allowed unless forbidden in certain questions.

Geometry

The paper in Geometry will contain questions on Practical and on Theoretical Geometry.

The questions on **Practical Geometry** will be set on the constructions contained in Schedule A (see p. 20), together with easy extensions of them. In cases where the validity of a construction is not obvious, the reasoning by which it is justified may be required. Every candidate must provide himself with a ruler graduated in inches and tenths of an inch, and in centimetres and millimetres, a set square, a protractor, compasses, and a fairly hard pencil. All figures must be drawn accurately and distinctly. Questions may be set in which the use of the set square or of the protractor is forbidden.

The questions on **Theoretical Geometry** will consist of theorems contained in Schedule B (see pp. 20–23), together with questions upon these theorems, easy deductions from them, and arithmetical illustrations. Any proof of a proposition will be accepted which appears to the examiners to form part of a systematic treatment of the subject; **the order in which the theorems are stated in Schedule B need not be followed.** In the proof of theorems and deductions from them, the use of hypothetical constructions will be permitted.

Questions will be set on Schedules A (i), A (ii), A (iii) and B (i), B (ii), B (iii). The use of algebraical symbols and (in the solution of riders) of trigonometrical ratios is permitted; the use of trigonometry in theorems is not permitted.

Algebra

Elementary algebraic operations; formulae expressing arithmetical generalisation; change of subject of a formula; factors, fractions. The *use* of fractional and negative indices and the elementary theory of logarithms. Calculation by logarithms to base 10 with the use of four-figure tables. Solution of linear equations involving not more than two unknowns and quadratic equations involving only one unknown; the solution of simultaneous equations, one linear and one quadratic, involving two unknowns; and simple problems leading to such equations. The *use* of the remainder theorem; ratio and proportion; variation. Graphs and their simple applications. Arithmetical and finite geometrical progressions.

Trigonometry

Questions on numerical plane Trigonometry which can be easily solved by use of the right-angled triangle and the trigonometrical tables; other methods of solution will be accepted. One simple three-dimensional problem may be set.

G.C.E. Mathematics (Ordinary Level),
Oversea S.C. Mathematics
Alternative B
(see also p. 3)

Unless the terms of a question impose specific limitations,

(*a*) a candidate may use any appropriate method;

(*b*) tables of logarithms, trigonometrical functions, squares and square roots, etc., may be used wherever they give the required degree of accuracy; a slide rule cannot be expected to give sufficient accuracy;

(*c*) T-squares, set squares, graduated rulers, diagonal scales, protractors and compasses may be used.

Numbers

The ordinary processes of Arithmetic.

The British and Metric systems of weights, measures, and money; densities; temperature scales (centigrade and Fahrenheit); speeds.

Fractions, decimals; proportion and proportional parts; calculation of averages, percentage, and simple (but not compound) interest.

Use of common logarithms and square-root tables.

Significant figures.

(Questions may be set on the applications of these processes to problems of everyday life in the home and community including straightforward financial transactions, but such questions will not involve complicated operations or the knowledge of uncommon technical terms. The "long rules" for the extraction of square roots and the determination of H.C.F. are not included in the syllabus.)

Mensuration

The rectangle, triangle, and figures derived from them, including easy extensions to three dimensions.

The circle (including the length of an arc in terms of the angle at the centre), cylinder, cone and sphere.

(Questions may involve knowledge of the altitude and centre of an equilateral triangle and the ratio of the sides of the right-angled isosceles triangle and the 30°, 60°, 90° triangle.)

Algebraic Symbols, Expressions and Equations

Statement of rules (e.g. area = length × breadth, temperature C/100 = (F − 32)/180) and generalisations of arithmetical relations (e.g. pressure × volume = constant) in symbols; the interpretation of statements given in symbolic form.

Evaluation of algebraic expressions; change of subject in a formula.

The use of indices.

(Only simple examples of fractional and negative indices will be set; candidates may be expected to understand the use of indices to express such numbers as $3{\cdot}74 \times 10^8$ or $1{\cdot}35 \times 10^{-6}$. Only simple manipulation of surds will be required.)

Common factors, factors of $(a^2 - b^2)$ and of such extensions as occur in mensuration. Factors of trinomial expressions. Simple fractions. Simple equations, quadratic equations, and simultaneous linear equations in two variables.

Graphs, Variation, Functionality

Graphs from numerical and statistical data.

Translation into symbols of relations such as "y is inversely proportional to x", "V varies as x^3", and their illustration by sketch-graphs.

The idea of a function of a variable and its graphical representation.

Graphical treatment of the functions:

$$y = Cx + D; \quad y = Bx^2 + Cx + D; \quad y = Ax^3 + Cx + D;$$
$$y - D = E/x; \quad y - D = F/x^2.$$

The gradients of these graphs, determined by drawing.

Plane Geometry and Trigonometry

The following schedule is arranged in a definite sequence†. The THEOREMS form a logical backbone of the course, in relation to which the remaining definitions and properties included take their place. Candidates may be asked to prove any of the theorems in *italics*; they will not be asked to prove any of the theorems in ordinary type. Knowledge of the converses of the theorems (when valid) is expected, but their proofs will not be asked for. In proving any theorem, the preceding theorems (whether in italics or not) may be assumed and need not be proved. Apart from the theorems in *italics*, candidates will not be expected to have learnt any formal proofs. If proofs of other properties covered by the syllabus are required, they will be set as riders. Candidates might, for example, be asked to prove as a rider on congruent triangles that the diagonals of a kite are at right angles. Teachers are thus free to use intuitive or practical methods of establishing the truth of many properties covered by the syllabus, which have in the past been brought within the logical treatment. Riders will be straightforward and will be worded so as to make clear not only what is to be proved but also what is to be assumed.

Angles and parallel lines

Degrees, angles of elevation and depression, bearings.

The properties of adjacent and vertically opposite angles; the properties of parallel lines, corresponding, alternate, and conjoined angles.

Triangles and parallelograms

THEOREM: the sum of the angles of a triangle is two right angles.

The property of the exterior angles of a triangle and of a polygon.

Congruence. The isosceles triangle.

† The positions in the sequence of the sections on Similarity, Area and the circle may be varied.

The properties of the angles, sides, and diagonals of the parallelogram, rhombus, rectangle, square, trapezium and kite.

THEOREM: if there are three or more parallel straight lines and the intercepts made by them on a transversal are equal, the intercepts made on any other transversal are equal.

† *Similarity*

THEOREMS: if a straight line parallel to one side of a triangle meets the other sides, these sides are divided proportionally; and the converse.

Similarity of triangles; definitions of the cosine, sine, and tangent of an angle, acute or obtuse.

THEOREM: the sine rule for any triangle.

† *Area*

THEOREM: parallelograms on the same base and between the same parallels have equal areas.

THEOREMS: determining the areas of the rectangle, *parallelogram, and triangle (including* $\frac{1}{2}bc \sin A$).

Pythagoras' theorem

THE THEOREM OF PYTHAGORAS; (if the method of similar triangles is used, candidates must first prove that the perpendicular from the right angle to the hypotenuse makes two triangles similar to the whole) and the converse.

THEOREM: $a^2 = b^2 + c^2 - 2bc \cos A$ *for any triangle.*

† *The circle*

The symmetrical properties of chords.

THEOREM: the angle which an arc of a circle subtends at the centre is double that which it subtends at any point of the remaining part of the circumference.

THEOREM: the angle in a semicircle is a right angle.

THEOREM: angles in the same segment are equal.

THEOREM: angles in opposite segments are supplementary.

Perpendicularity of tangent and radius.

THEOREM: if two circles touch, the point of contact is on the line of centres.

THEOREM: the tangents to a circle from an external point are equal.

THEOREM: if a straight line touch a circle, and from the point of contact a chord be drawn, the angles which this chord makes with the tangent are equal to the angles in the alternate segments.

Three-dimensional Geometry

Parallel lines, parallel planes, normal to a plane, angle between a line and a plane, angle between two planes. Questions may be asked involving a knowledge of the forms of the cube, rectangular block, pyramid, tetrahedron, prism wedge, circular cone, sphere and circular cylinder.

† The positions in the sequence of the sections on Similarity, Area and the circle may be varied.

Knowledge of the following loci and of the method of intersection of loci:

Locus of points in two or three 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.

Locus of points in two dimensions

(*d*) which are equidistant from two given lines;

(*e*) at which a given segment of a straight line subtends a given angle.

Applied Geometry

In this section great importance will be attached to neatness and accuracy. The use of a protractor and of set squares (e.g. in drawing parallels) will be allowed, unless expressly prohibited in any particular question. The use of parallel rulers will not be allowed. In drawing plans and elevations, the use of drawing boards and T-squares will be allowed, but is not considered essential.

Solution of triangles by the use of the sine and cosine rules and trigonometrical tables.

The following constructions, using straight edge and compasses only:

bisection of angles and straight lines;

construction of perpendiculars to straight lines, of an angle equal to a given angle, and of angles of 60°, 45°, and 30°;

simple cases of the construction from sufficient data of triangles, quadrilaterals, and circles, including circumscribed and inscribed circles of a triangle;

division of straight lines into a given number of equal parts or into parts in any given proportions.

Scale drawing.

Simple problems in three dimensions soluble by analysis into plane figures.

There will be a choice of questions involving the application of scale drawing or trigonometry to the following:

(i) simple map problems, scales, contour lines, slopes;

(ii) navigation—determination of position by two bearings, the nautical mile and the knot, triangle of velocities, drift, course, track;

(iii) latitude and longitude, great and small circles on a sphere;

(iv) heights and distances;

(v) construction of plans and elevations.