O Level

Mathematics

Session: 1974
Type: Syllabus
Code: 450

NOTE ON THE ORDINARY LEVEL AND SCHOOL CERTIFICATE ALTERNATIVE SYLLABUSES

There are three syllabuses for Ordinary Level and School Certificate Mathematics, Alternatives A, B and C, and the intention is that they should be of equal weight.

The Alternative A syllabus is arranged in separate sections for Arithmetic, Geometry and Algebra. There will be one paper on each of these sections. Questions on Trigonometry will be included as an alternative to some of the questions on Arithmetic.

The Alternative B syllabus is an alternative syllabus in Mathematics as distinct from syllabuses in separate sections. There will be two papers and each paper may contain questions on any part of the syllabus.

The Alternative C syllabus includes some material which has recently been increasingly taught in schools, and is intended to facilitate its introduction.

MATHEMATICS ALTERNATIVE A (450)

ORDINARY LEVEL AND SCHOOL CERTIFICATE

SCHEME OF PAPERS

There will be three papers.

(*a*) *Arithmetic.* (1½ hours.) The paper will include, as alternatives to a few of the questions on Arithmetic, easy questions on numerical Trigonometry.

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

(*b*) *Geometry.* (2 hours.)

(*c*) *Algebra.* (1½ hours.) A limited number of questions may be set involving a knowledge of simple geometrical properties.

Units

The decimal system will be used in all questions involving British currency.

S.I. 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 grammes per cubic centimetre.

DETAILED SYLLABUS

Arithmetic

Candidates should be familiar with the following monetary systems: pounds and pence; dollars and cents; francs and centimes. Problems involving mass and measures. Addition, subtraction, multiplication and division applied to numerical calculations. Fractions and decimals. Proportion and proportional parts. Extraction of square roots. Averages, percentages, simple and compound interest; profit and loss. Elementary mensuration of the triangle, the circle, the rectangular block, the cylinder and the sphere. Problems on speeds. Graphs from numerical and statistical data. The use of logarithm tables.

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.

In the School Certificate examination, special question papers in which the currency of the country concerned is used in questions dealing with money, are provided for some areas (see School Certificate Regulations).

Trigonometry

Sine, cosine and tangent of acute and obtuse angles; use of the trigonometrical tables. Use of the sine and cosine formulae for a triangle and the formula $\frac{1}{2}bc \sin A$. One simple three-dimensional problem may be set.

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. 9), 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 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. 9–12), 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.

Geometry Schedules

Schedule A. (Practical)

A (i)

Bisection of angles and of straight lines.
Construction of perpendiculars to straight lines.
Construction of an angle equal to a given angle.
Construction of angles of 60°, 45°, and 30°.
Construction of parallels to a given straight line.
Simple cases of the construction from sufficient data of triangles and quadrilaterals.
Division of straight lines into a given number of equal parts or into parts in any given proportions.

A (ii)

Construction of a triangle equal in area to a given polygon.
Construction of tangents to a circle and of common tangents to two circles.
Construction of circumscribed, inscribed and escribed circles of a triangle.

A (iii)

Simple cases of the construction of circles from sufficient data.
Construction of a square equal in area to a given polygon.
Construction of a fourth proportional to three given straight lines and a mean proportional to two given straight lines.
Construction of regular figures of 3, 4, 6, or 8 sides in or about a given circle.

Schedule B. (Theoretical)

In this schedule 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.

B (i)

Angles at a Point

If a straight line stands on another straight line, the sum of the two angles so formed is equal to two right angles; and the converse.
If two straight lines intersect, the vertically opposite angles are equal.

Parallel Straight Lines

When a straight line cuts two other straight lines, and
(i) a pair of alternate angles are equal,
or (ii) a pair of corresponding angles are equal,
or (iii) a pair of interior angles on the same side of the cutting line are together equal to two right angles,
then the two straight lines are parallel; and the converse.

Straight lines which are parallel to the same straight line are paralle to one another.

Triangles and Rectilinear Figures

The sum of the angles of a triangle is equal to two right angles.

In a polygon of n sides, the sum of the interior angles is equal to $2n-4$ *right angles.*

If the sides of a convex polygon are produced in order, the sum of the angles so formed is equal to four right angles.

If two triangles have two sides of the one equal to two sides of the other, each to each, and also the angles contained by those sides equal, the triangles are congruent.

If two triangles have two angles of the one equal to two angles of the other, each to each, and also one side of the one equal to the corresponding side of the other, the triangles are congruent.

If two sides of a triangle are equal, the angles opposite to these sides are equal; and the converse.

If two triangles have the three sides of the one equal to the three sides of the other, each to each, the triangles are congruent.

If two right-angled triangles have their hypotenuses equal, and one side of the one equal to one side of the other, the triangles are congruent.

If two sides of a triangle are unequal, the greater side has the greater angle opposite to it; and the converse.

Of all the straight lines that can be drawn to a given straight line from a given point outside it, the perpendicular is the shortest.

The opposite sides and angles of a parallelogram are equal, each diagonal bisects the parallelogram, and the diagonals bisect each other.

If a pair of opposite sides of a quadrilateral are equal and parallel, it is a parallelogram.

The straight line drawn through the middle point of one side of a triangle parallel to another side bisects the third side.

The straight line joining the middle points of two sides of a triangle is parallel to the third side, and equal to one-half of it.

If there are three or more parallel straight lines, and the intercepts made by them on any straight line that cuts them are equal, then the corresponding intercepts on any other straight line that cuts them are also equal.

B (ii)

Areas

Parallelograms on the same base and between the same parallels are equal in area.

Triangles on the same or equal bases and of the same altitude are equal in area.

Equal triangles on the same or equal bases are of the same altitude.

In a right-angled triangle, the square described on the hypotenuse is equal to the sum of the squares described on the sides containing the right angle; and the converse.

Loci

The locus of a point which is equidistant from two fixed points is the perpendicular bisector of the straight line joining the two fixed points.

The locus of a point which is equidistant from two intersecting straight lines consists of the pair of straight lines which bisect the angles between the two given lines.

The Circle

A straight line drawn from the centre of a circle to bisect a chord which is not a diameter, is at right angles to the chord; conversely, the perpendicular to a chord from the centre bisects the chord.

There is one circle, and one only, which passes through three given points not in a straight line.

Equal chords of a circle are equidistant from the centre; and the converse.

The tangent at any point of a circle and the radius through the point are perpendicular to each other.

The tangents to a circle from an external point are equal.

If two circles touch, the point of contact lies on the straight line through the centres.

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

Angles in the same segment of a circle are equal; and, if the line joining two points subtends equal angles at two other points on the same side of it, the four points lie on a circle.

The angle in a semicircle is a right angle; and the converse.

The opposite angles of any quadrilateral inscribed in a circle are supplementary; and the converse.

B (iii)

Areas

The square on a side of a triangle is greater or less than the sum of the squares on the other two sides, according as the angle contained by those sides is obtuse or acute. The difference is twice the rectangle contained by one of the two sides and the projection on it of the other.

In any triangle, the sum of the squares on any two sides is equal to twice the square on half the third side together with twice the square on the median which bisects the third side.

The Circle

In equal circles (or, in the same circle) (i) if two arcs subtend equal angles at the centres, they are equal; (ii) conversely, if two arcs are equal, they subtend equal angles at the centre.

In equal circles (or, in the same circle) (i) if two chords are equal, they cut off equal arcs; (ii) conversely, if two arcs are equal, the chords of the arcs are equal.

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.

If two chords of a circle intersect either inside or outside the circle the rectangle contained by the parts of the one is equal to the rectangle contained by the parts of the other.

Proportion: Similar Triangles

(Proofs which are applicable only to commensurable magnitudes will be accepted.)

If a straight line is drawn parallel to one side of a triangle, the other two sides are divided proportionally; and the converse.

If two triangles are equiangular their corresponding sides are proportional; and the converse.

If two triangles have one angle of the one equal to one angle of the other and the sides about these equal angles proportional, the triangles are similar.

If a perpendicular is drawn from the right angle of a right-angled triangle to the hypotenuse, the triangles on each side of the perpendicular are similar to the whole triangle and to each other.

The internal bisector of an angle of a triangle divides the opposite side internally in the ratio of the sides containing the angle, and likewise the external bisector externally.

The ratio of the areas of similar triangles is equal to the ratio of the squares on corresponding sides.