Mathematics, Pure 7362

ALTERNATIVE ORDINARY LEVEL

This subject may be taken at both the May/June and January examinations.

Introduction

This syllabus has been constructed so that it assumes knowledge of the topics contained in the syllabus for the subject Mathematics (Syllabus B) at Ordinary level and broadly extends this work. It has been constructed to emphasise the importance of a common core of Pure Mathematics at this level and no distinction has been made between so-called "modern" and "traditional" mathematics.

Aims

The aims of the syllabus are:

(i) to provide a broad conspectus of mathematics for those who may not study mathematics beyond this level or for those whose course of study requires a knowledge of mathematics beyond Ordinary level;

(ii) to provide a course of study for those whose mathematical competence may have developed early, and who have a maturity equivalent to that of one year beyond Ordinary level;

(iii) to enable students to acquire knowledge and skills with confidence, satisfaction and enjoyment;

(iv) to develop the understanding of mathematical reasoning and processes, and the ability to relate different areas of mathematics;

(v) to develop resourcefulness in solving problems.

Objectives

The objectives of the examination are to test the ability to:

(i) demonstrate a confident knowledge of the techniques of pure mathematics specified in the syllabus;

(ii) apply a knowledge of mathematics to the solutions of problems for which an immediate method of solution is not available and which may involve knowledge of more than one topic of the syllabus;

(iii) write clear and accurate mathematical solutions.

The Examination

There will be two papers each of 2 hours, carrying equal weighting. Each paper will consist of approximately eleven compulsory questions to be answered in an answer book. Each paper may contain questions from any part of the syllabus and the solution of any question may require knowledge of more than one section of the syllabus.

Questions will be set in SI units.

Candidates are expected to have available a calculator with at least the following keys:

$$+, -, \times, \div, \pi, x^2, x, \sqrt{x}, \frac{1}{x}, x^y; \ln x, e^x$$

sine, cosine and tangent and their inverses in degrees and decimals of a degree, and in radians; memory.

Notation

In addition to the notation listed for Ordinary level Mathematics Syllabus B, the following notation will be used:

$\mathbb{N}$	the set of positive integers and zero, $\{0, 1, 2, 3, \ldots\}$
$\mathbb{Z}$	the set of integers, $\{0, \pm 1, \pm 2, \pm 3, \ldots\}$
$\mathbb{Z}^+$	the set of positive integers, $\{1, 2, 3, \ldots\}$
$\mathbb{Q}$	the set of rational numbers
$\mathbb{Q}^+$	the set of positive rational numbers, $\{x : x \in \mathbb{R}\ x > 0\}$
$\mathbb{R}$	the set of real numbers
$\mathbb{R}^+$	the set of positive real numbers, $\{x : x \in \mathbb{R}\ x > 0\}$
$\mathbb{R}_0^+$	the set of positive real numbers and zero, $\{x : x \in \mathbb{R}\ x \geq 0\}$
$\lvert x \rvert$	the modulus of x $\begin{cases} x \text{ for } x \geq 0 \\ -x \text{ for } x < 0 \end{cases}$
$\approx$	is approximately equal to
$\mathbf{A}^{-1}$	the inverse of the non-singular matrix **A**
$\mathbf{A}^{\mathrm{T}}$	the transpose of the matrix **A**
$\det \mathbf{A}$	the determinant of the square matrix **A**
$\sum_{r=1}^{n} \mathrm{f}(r)$	$\mathrm{f}(1) + \mathrm{f}(2) + \ldots + \mathrm{f}(n)$
$\binom{n}{r}$	the binomial coefficient $\begin{cases} \dfrac{n!}{r!(n-r)!} \text{ for } n \in \mathbb{R}^+ \\ \dfrac{n(n-1)\ldots(n-r+1)}{r!} \text{ for } n \in \mathbb{R} \end{cases}$
$\ln x$	the natural logarithm of x, $\log_e x$
$\lg x$	the common logarithm of x, $\log_{10} x$
$\mathrm{f}'(x)$, $\mathrm{f}''(x)$, $\mathrm{f}'''(x)$	the first, second and third derivatives of $\mathrm{f}(x)$ with respect to x
$\lvert \mathbf{a} \rvert$	the magnitude of **a**
$\lvert \overrightarrow{AB} \rvert$	the magnitude of $\overrightarrow{AB}$

Syllabus

In drawing up the syllabus, attention has been paid to the contents of Ordinary level Mathematics Syllabus B 7361 and candidates will be expected to have a thorough knowledge of the contents of that syllabus; questions will be set involving work which includes topics covered in that syllabus which are appropriate in standard for Alternative Ordinary level. An enhancement of the ability to carry out simple arithmetic and algebraic manipulation will be expected, including the ability to change the subject of a formula and to evaluate numerically the value of any variable in a formula, given the values of the other variables. The use and notation of set theory will be adopted wherever appropriate.

SYLLABUS	NOTES
1. Use and properties of indices and logarithms including change of base.	
The functions a^x and $\log_b x$ (where b is a natural number greater than unity).	A knowledge of the shape of the graphs of a^x and $\log_b x$ is expected, but not a formal expression for the gradient.
2. The quadratic function.	
Simple examples involving functions of the roots of a quadratic equation.	Forming an equation with given roots
3. Identities	
The factor and remainder theorems. Solutions of equations, extended to include a linear and quadratic equation in two variables. Simple inequalities, linear and quadratic. The geometrical representation of linear inequalities in two variables.	The solution of a cubic equation containing at least one rational root may be set. The emphasis will be on simple questions designed to test fundamental principles. Simple problems on linear programming may be set.
4. Graphs of polynomials and rational functions with linear denominators.	The concepts of asymptotes parallel to the co-ordinate axes are expected.
The solution of equations (which may include transcendental functions) by graphical methods.	Non-graphical iterative methods are not required to be studied.
5. Arithmetic and geometric series. Use of the Σ notation.	The Σ notation may be employed wherever its use seems desirable.
6. Use of the binomial series $(1+x)^n$.	Use of the series when (i) n is a positive integer (ii) n is rational and $\|x\| < 1$.
7. Scalar and vector quantities. The addition and subtraction of coplanar vectors and the multiplication of a vector by a scalar. Components and resolved parts of a vector. Position vector. Unit vector.	Knowledge of the fact that if $a_1\alpha + b_1\beta = a_2\alpha + b_2\beta$, where α and β are non-parallel vectors, then $a_1 = a_2$ and $b_1 = b_2$, is expected.
Use of vectors to establish simple properties of geometrical figures.	The 'simple properties' will, in general, involve collinearity and concurrency. Questions will be of a more searching nature than those set in Ordinary level Mathematics (Syllabus B).

SYLLABUS	NOTES
8. Rectangular cartesian co-ordinates.	
Distance between two points. Point dividing a line in a given ratio.	
The straight line and its equation.	The $y = mx + c$ and $y - y_1 = m(x - x_1)$ forms of the equation of a straight line are expected to be known.
Condition for two lines to be parallel or to be perpendicular.	
9. Differentiation and integration of sums of multiples of powers of x (excluding integration of $1/x$), sin ax, cos ax, e^{ax}. Differentiation of a product, quotient and simple cases of a function of a function.	No formal proofs of the results for sin ax, cos ax and e^{ax} will be required.
Applications to simple linear kinematics and to determination of areas and volumes. Maxima and minima. The equations of tangents and normals to the curve $y = f(x)$.	The volumes will be obtained only by revolution about the co-ordinate axes. f(x) may be any function which the candidates are expected to be able to differentiate.
Application of calculus to rates of change and connected rates of change.	The emphasis will be on simple examples to test principles. A knowledge of $\delta y \approx \frac{dy}{dx}\delta x$ for small δx, is expected.
10. The three basic trigonometric ratios of angles of any magnitude (in degrees or radians) and their graphs.	
Applications to simple problems in two or three dimensions (including angles between a line and a plane and between two planes).	
Use of the sine and cosine formulae.	
The identity $\cos^2\theta + \sin^2\theta = 1$.	
The use of the basic addition formulae of trigonometry.	General proofs of the sine and cosine formulae will not be required.
	Formal proofs of basic formulae will not be required. Long questions, explicitly involving excessive manipulation, will not be set.

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Coursework guidance notes, specimen examination papers and copies of past examination papers can be obtained from:

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