GCSE

in

Additional Mathematics

S P E C I F I C A T I O N

(Amended June 2004)

For first teaching from Autumn 2004

For first examination in 2005

FOREWORD

This booklet contains CCEA's Additional Mathematics Specification for first teaching from Autumn 2002. It will be examined for the first time in Summer 2004.

This specification has been developed following the changes made to the GCSE Mathematics syllabus from 2002, and following the introduction of the new AS Level Mathematics in September 2000.

This new specification is largely based on the current GCSE Additional Mathematics syllabus which will be examined for the last time in Summer 2003; however, changes have been made to both the subject content and the mode of assessment.

CONTENTS

1 INTRODUCTION

A knowledge of GCSE Higher Tier Mathematics will be assumed.

- The Additional Mathematics specification is intended to cater for those students who require a knowledge of mathematics beyond GCSE Higher Tier Mathematics and who are capable of working beyond the limits of the GCSE mathematics specification.

- The Additional Mathematics specification is designed to broaden the experience of students whose mathematical ability is above average and who:

  (i) will follow mathematical courses at AS/A Levels; or

  (ii) will follow courses at AS/A Level that require mathematics beyond GCSE; or

  (iii) wish to extend their knowledge of mathematics.

- The scheme of examination is a broad based scheme of assessment in which candidates are required to take two written papers.

- Questions of a more searching nature may be set which may include use of assumed knowledge based on relevant parts of the GCSE Mathematics Higher Tier specification.

- Candidates will be required to use electronic calculators. As a minimum, the calculators should have the functions +, −, ×, ÷, √, single memory, sin x, cos x, tan x, $1/x$, y^x, log x. Candidates are advised to record intermediate steps of calculations to secure full credit.

- In delivering the specification for Additional Mathematics the objectives of the cross-curricular themes, especially ICT, should be promoted. Students should be encouraged to use ICT, especially spreadsheets, databases, graphics and design packages.

- Practical activities appropriate to the understanding of the topics of the specification should be included in teaching and learning schemes.

2 AIMS

This course in Additional Mathematics aims to enable pupils to:

- extend the foundation from which they may embark on higher studies in mathematics.
- extend the base in mathematics from which they can progress to higher studies in subjects other than mathematics such as science, geography, technology, business, which contain a significant requirement in mathematics beyond GCSE.
- develop further their mathematical knowledge by enhancing their ability to read mathematics and to write and talk about the subject – in short to further their liking for mathematics.
- develop mathematical concepts, skills and experiences through practical activities which reflect life and living and which are associated with the application of mathematics in a range of subjects.
- develop their mathematical abilities by considering and solving problems individually and through co-operative enquiry and experiment.
- apply a broader range of mathematics to a variety of situations associated with living and working in modern day society.
- appreciate the role that mathematics plays in the world around them.
- enhance their use of mathematics as a means of graphical communication.
- appreciate the need for clear expression in communicating their mathematical ideas.
- enhance their appreciation of the interrelationship between different areas of mathematics.
- appreciate further patterns and relationships in mathematics.
- gain a greater insight and understanding of the principles on which mathematical topics are based.
- develop their ability to reason logically, to classify, to generalise and to draw valid conclusions.
- design and develop mathematical models from which they can investigate situations and solve problems.

3 ASSESSMENT OBJECTIVES

The scheme of assessment will test the ability of all candidates to:

- recall, apply and interpret mathematical knowledge in a variety of contexts.
- set out mathematical work, including the solution of problems, in a logical and clear form using appropriate symbols and terminology.
- organise, interpret and present information accurately in written, tabular, graphical and diagrammatic form.
- perform calculations by suitable methods.
- use an electronic calculator.
- understand systems of measurement in scientific use and make use of them in the solution of problems.
- estimate, approximate and work to degrees of accuracy appropriate to the context.
- recognise patterns and structures in a variety of situations, and form generalisations.
- interpret, transform and make appropriate use of mathematical statements expressed in words or symbols.
- recognise and use spatial relationships in two and three dimensions, particularly in solving problems.
- analyse a problem, select a suitable strategy and apply an appropriate technique to obtain its solution.
- apply combinations of mathematical skills and techniques in problem solving.
- make logical deductions from given mathematical data.
- respond to a problem relating to a relatively unstructured situation by translating it into an appropriately structured form.

4 SCHEME OF ASSESSMENT

Grades Available

The grades available for Additional Mathematics will be E–A*.

The scheme of assessment will comprise **two** written papers each of **two hours** duration.

Examination Components

There will be two papers:

Paper 1	Pure Mathematics	2 hours	50%
Paper 2	Mechanics Statistics	} 2 hours	25% 25%

Paper 1 (Pure Mathematics)

This paper will examine topics in Pure Mathematics. All questions must be answered.

Normally the question paper will include up to twelve questions. Questions will be awarded between four and sixteen marks. The total marks for the paper will be 100.

Paper 2 (Mechanics and Statistics)

This paper will examine topics in Mechanics and Statistics. All questions must be answered.

Normally the question paper will include up to twelve questions. There will be equal numbers of questions in Mechanics and Statistics. Questions will be awarded between four and sixteen marks. The total marks for each of Mechanics and Statistics will be 50, making the total for the paper 100.

For both papers a supplementary answer booklet containing skeleton tables and/or graphs will be provided if appropriate.

5 SUBJECT CONTENT

5.1 PURE MATHEMATICS

	Content	*Comment*
1	Addition, subtraction, multiplication and division of rational algebraic fractions with linear denominators.	
2	Formation and solution of equations in:	
	(a) one variable	Linear and quadratic and simple products of these, eg $x(x^2 - 3x + 2) = 0$.
	(b) two or three variables	Including up to three linear equations in three unknowns and one linear and one quadratic equation in two unknowns.
3	Matrices – addition, subtraction and multiplication.	Matrix multiplication is non-commutative. Non-square matrices are included.
	det **A**, $\mathbf{A}^{-1}$ for 2×2 matrices and matrix methods for the solution of 2 linear simultaneous equations.	The significance of det **A** = 0 is included.
4	Logarithms as a natural evolution from indices. Simple use of the laws of logarithms.	eg understanding that $8 = 2^3 \Leftrightarrow \log_2 8 = 3$ $\log ab = \log a + \log b$ $\log a/b = \log a - \log b$ $\log a^n = n \log a$ Change of base is not included.
	Solution of equations of the form $a^{f(x)} = b$ (a, b constants).	For simple functions f(x) eg f$(x) = 2x + 3$.
	Use of log graphs to estimate constants a and n in relations of the form $y = ax^n$ where a set of values for x and y is given.	
5	Sine, cosine and tangent for angles of any magnitude. Drawing and interpretation of the graphs of these functions.	

	Solution of simple trigonometric equations in a given range.	eg $\sin 2x = 0.5$ $\quad 0° \le x \le 180°$ $\cos\left(\frac{1}{2}x - 30°\right) = 0.8 \quad -180° < x \le 180°$
6	Solution of triangles including their areas.	The use of cosine rule, sine rule (including the ambiguous case) and Area = $\frac{1}{2}ab \sin C$
	Three figure bearings.	Application to 2 dimensional problems only.
	Three dimensional trigonometry.	Involving right-angled triangles only.
7	Differentiation of powers and sums of powers of x.	Including negative indices, but excluding fractional indices.
	Application of differentiation to gradients, tangents and maximum and minimum turning points.	Points of inflexion are not included. Normals are not included. Maximum/minimum questions will relate only to curves and curve sketching.
8	Elementary curve sketching.	eg $y = f(x)$ where $f(x)$ is a polynomial in x of degree n, where $n = 1, 2, 3$; in the case $n = 3$, $f(x)$ will have x as a common factor.
9	Integration of powers and sums of powers of x.	Including negative indices but excluding fractional indices and $\int x^{-1}\mathrm{d}x$
	Application of definite integration to find the area under a curve.	Area enclosed between a curve, the x-axis and the ordinates $x = a$ and $x = b$. Combinations of positive and negative areas will not be examined.

5.2 MECHANICS

Content		*Comment*
1	The concept of a vector and its representation by a directed line segment. Multiplication of a vector by a scalar. Sum and difference of vectors.	Candidates should be familiar with the notation $\overrightarrow{AB}$, **a** and $\underline{a}$. The forms $\begin{pmatrix} a \\ b \end{pmatrix}$ and a**i** + b**j** are both required.
2	Force as a vector and the units of force. Resolution of forces into components. Resultant of a set of forces acting at a point.	Problems will involve a maximum of four separate forces.
3	Equilibrium of a particle.	Problems will involve a maximum of four separate forces.
4	Moments and the principle of moments; equilibrium of a rigid body.	Turning effects of coplanar forces. Centre of gravity of uniform rods. Solution to problems involving hinges or a ladder leaning against a wall is beyond the scope of this specification. Candidates should appreciate concurrency property for three non-parallel forces in equilibrium.
5	The concept of friction.	Limiting friction = μR, where R is the normal reaction and μ is the coefficient of friction. Any externally applied forces acting on a body on an inclined plane (eg the tension in a string) will be parallel to the plane. The "angle of friction" concept is not included.
6	Displacement/time and velocity/time graphs and their applications.	
7	Constant acceleration formulae.	
8	Application of Newton's laws of motion, including **F** = m**a**.	Straight line motion only. Motion of a body on an inclined plane.
	Motion of connected bodies.	Restricted to two connected bodies, where both bodies move either horizontally or vertically.

5.3 STATISTICS

	Content	*Comment*
1	The meaning of the following terms: population, sample, discrete variable, continuous variable.	An understanding of these terms is considered as the basis for this specification.
2	Class limits, class boundaries, class width, mid-value of classes, age distribution. Histograms of varying class widths using frequency density.	Note the exceptional case of age groupings when age is given in completed years, eg 5–9 years means $5 \leq \text{age} < 10$ years.
3	Knowledge and use of mean, median, mode, range, standard deviation and variance. Calculation of mean, median and standard deviation from data which may be given in the form of a grouped frequency distribution.	Interquartile range is excluded.
4	Use of Venn diagrams and probability trees to illustrate conditional probability, independent events and mutually exclusive events.	The calculation of a conditional probability will be from tree diagrams or Venn diagrams only.
5	Time series: seasonal variation, cyclic variation, random variation, secular trend. Use of moving averages; extrapolation.	The plotting of original data will be given.
6	Bivariate analysis; scatter diagrams, correlation, line of best fit.	The plotting of original data will be given. Line of best fit should be drawn by eye, passing through the point (mean of x, mean of y). Equation of line of best fit in the form $y = a + bx$, where a and b are determined graphically.
7	Calculation and interpretation of Spearman's rank correlation coefficient.	In the case of tied ranks the number of ties will be small. Use of $r = 1 - \frac{6\sum d^2}{n(n^2-1)}$ is expected.