6 Unit Specifications

6.1 INTRODUCTION TO ADVANCED MATHEMATICS, C1 (4751) AS

Objectives

To build on and develop the techniques students have learnt at GCSE so that they acquire the fluency required for advanced work.

Assessment

Examination (72 marks)
1 hour 30 minutes.
The examination paper has two sections.

Section A: 8-10 questions, each worth no more than 5 marks.
Section Total: 36 marks

Section B: three questions, each worth about 12 marks.
Section Total: 36 marks

Assumed Knowledge

Candidates are expected to know the content of Intermediate Tier GCSE*.

*See note on page 34.

Subject Criteria

The Units *C1* and *C2* are required for Advanced Subsidiary GCE Mathematics in order to ensure coverage of the subject criteria.

The Units *C1, C2, C3* and *C4* are required for Advanced GCE Mathematics in order to ensure coverage of the subject criteria.

Calculators

No calculator is allowed in the examination for this module.

In the MEI Structured Mathematics specification, graphical calculators are allowed in the examinations for all units except *C1*.

INTRODUCTION TO ADVANCED MATHEMATICS, C1		
Specification	**Ref.**	**Competence Statements**

*Competence statements marked with an asterisk * are assumed knowledge and will not form the basis of any examination questions. These statements are included for clarity and completeness.*

MATHEMATICAL PROCESSES

Proof

The construction and presentation of mathematical arguments through appropriate use of logical deduction and precise statements involving correct use of symbols and appropriate connecting language pervade the whole of mathematics at this level. These skills, and the Competence Statements below, are requirements of all the modules in these specifications.

Mathematical argument	C1p1	Understand and be able to use mathematical language, grammar and notation with precision.
	2	Be able to construct and present a mathematical argument.

Modelling

Modelling pervades much of mathematics at this level and a basic understanding of the processes involved will be assumed in all modules

The Modelling Cycle

The modelling cycle.	C1p3	Be able to recognise the essential elements in a modelling cycle.

INTRODUCTION TO ADVANCED MATHEMATICS, C1			
Ref.	**Notes**	**Notation**	**Exclusions**
C1p1	Equals, does not equal, identically equals, therefore, because, implies, is implied by, necessary, sufficient	$=, \neq, \therefore, \Rightarrow, \Leftarrow, \Leftrightarrow$	
2	Construction and presentation of mathematical arguments through appropriate use of logical deduction and precise statements involving correct use of symbols and appropriate connecting language.		
3	The elements are illustrated on the diagram in Section 5.2.		

INTRODUCTION TO ADVANCED MATHEMATICS, C1		
Specification	**Ref.**	**Competence Statements**
ALGEBRA		
The basic language of algebra.	C1a1	Know and be able to use vocabulary and notation appropriate to the subject at this level.
Solution of equations.	2	* Be able to solve linear equations in one unknown.
	3	Be able to change the subject of a formula.
	4	Know how to solve an equation graphically.
	5	Be able to solve quadratic equations.
	6	Be able to find the discriminant of a quadratic function and understand its significance.
	7	Know how to use the method of completing the square to find the line of symmetry and turning point of the graph of a quadratic function.
	8	* Be able to solve linear simultaneous equations in two unknowns.
	9	Be able to solve simultaneous equations in two unknowns where one equation is linear and one is of 2nd order.
	10	Know the significance of points of intersection of two graphs with relation to the solution of simultaneous equations.
Inequalities.	11	Be able to solve linear inequalities.
	12	Be able to solve quadratic inequalities.
Surds.	13	Be able to use and manipulate surds.
	14	Be able to rationalise the denominator of a surd.
Indices.	15	Understand and be able to use the laws of indices for all rational exponents.
	16	Understand the meaning of negative, fractional and zero indices.

INTRODUCTION TO ADVANCED MATHEMATICS, C1			
Ref.	**Notes**	**Notation**	**Exclusions**
	ALGEBRA		
C1a1	Expression, function, constant, variable, term, coefficient, index, linear, identity, equation.	$f(x)$	Formal treatment of functions.
2	Including those containing brackets and fractions.		
3	Including cases where the new subject appears on both sides of the original formula, and cases involving squares and square roots.		
4	Including repeated roots.		
5	By factorising, completing the square, using the formula and graphically.		
6	The condition for distinct real roots is: Discriminant > 0 The condition for repeated roots is: Discriminant = 0	Discriminant $= b^2 - 4ac$.	Complex roots.
7	The graph of $y = a(x + p)^2 + q$ has a turning point at: $(-p, q)$ and a line of symmetry $x = -p$		
8	By elimination, substitution and graphically.		
9	Analytical solution by substitution.		
10			
11	Including those containing brackets and fractions.		
12	Algebraic and graphical treatment of quadratic inequalities.		Examples involving quadratics which cannot be factorised.
13			
14	e.g. $\frac{1}{5+\sqrt{3}} = \frac{5-\sqrt{3}}{22}$		
15	$x^a \times x^b = x^{a+b}, x^a \div x^b = x^{a-b}, (x^a)^n = x^{an}$		
16	$x^{-a} = \frac{1}{x^a}, x^{\frac{1}{a}} = \sqrt[a]{x}$, $x^0 = 1$		

INTRODUCTION TO ADVANCED MATHEMATICS, C1		
Specification	**Ref.**	**Competence Statements**
COORDINATE GEOMETRY		
The coordinate geometry of straight lines.	C1g1	*Know the equation $y = mx + c$.
	2	Know how to specify a point in Cartesian coordinates in two dimensions.
	3	Know the relationship between the gradients of parallel lines and perpendicular lines.
	4	* Be able to calculate the distance between two points.
	5	* Be able to find the coordinates of the midpoint of a line segment joining two points.
	6	Be able to form the equation of a straight line.
	7	Be able to draw a line when given its equation.
	8	Be able to find the point of intersection of two lines.
The coordinate geometry of curves.	9	* Know how to plot a curve given its equation.
	10	Know how to find the point of intersection of a line and a curve.
	11	Know how the find the point(s) of intersection of two curves.
	12	Understand that the equation of a circle, centre (0, 0), radius r is $x^2 + y^2 = r^2$
	13	Understand that $(x-a)^2 + (y-b)^2 = r^2$ is the equation of a circle with centre (a,b) and radius r.
	14	Know that: – the angle in a semicircle is a right angle; – the perpendicular from the centre of a circle to a chord bisects the chord; – the tangent to a circle at a point is perpendicular to the radius through that point.

INTRODUCTION TO ADVANCED MATHEMATICS, C1			
Ref.	**Notes**	**Notation**	**Exclusions**
	COORDINATE GEOMETRY		
C1g1			
2			
3	For parallel lines $m_1 = m_2$. For perpendicular lines $m_1 m_2 = -1$.		
4			
5			
6	$y - y_1 = m(x - x_1)$, $ax + by + c = 0$, $\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$.		
7	By using gradient and intercept as well as by plotting points.		
8	By solution of simultaneous equations.		
9	By making a table of values.		
10			
11			Equations of order greater than 2.
12			
13			
14	These results may be used in the context of coordinate geometry.		Formal proofs of these results.

INTRODUCTION TO ADVANCED MATHEMATICS, C1		
Specification	**Ref.**	**Competence Statements**
POLYNOMIALS		
Basic operations on polynomials.	C1f1	Know how to add, subtract, multiply and divide polynomials.
The factor theorem.	2	Understand the factor theorem and know how to use it to factorise a polynomial.
	3	Know how to use the factor theorem to solve a polynomial equation.
	4	Know how to use the factor theorem to find an unknown coefficient.
The remainder theorem.	5	Understand the remainder theorem and know how to use it.
Graphs.	6	Know how to sketch the graphs of polynomial functions.
Binomial expansions.	7	Know how to use Pascal's triangle in the binomial expansion of $(a+x)^n$ where n is a positive integer.
	8	Know the notations ${}^nC_r$ and $\binom{n}{r}$, and their relationship to Pascal's triangle.
	9	Know how to use ${}^nC_r$ in the binomial expansion of $(a+b)^n$ where n is a positive integer.
CURVE SKETCHING		
Vocabulary.	C1C1	Understand the difference between sketching and plotting a curve.
Quadratic curves.	2	Know how to sketch a quadratic curve with its equation in completed square form.
Polynomial curves.	3	Know how to sketch the curve of a polynomial in factorised form.
Transformations.	4	Know how to sketch curves of the forms $y = \mathrm{f}(x) + a$ and $y = \mathrm{f}(x-b)$, given the curve of $y = \mathrm{f}(x)$.

INTRODUCTION TO ADVANCED MATHEMATICS, C1			
Ref.	**Notes**	**Notation**	**Exclusions**
	POLYNOMIALS		
C1f1	Expanding brackets and collecting like terms. Division by linear expressions only.		Division by non-linear expressions.
2	$f(a)=0 \Leftrightarrow (x-a)$ is a factor of $f(x)$.		
3	$f(a)=0 \Rightarrow x=a$ is a root of $f(x)=0$.		Equations of degree > 4.
4	Use of factors to determine zeros $(x-a)$ is a factor of $f(x) \Rightarrow f(a)=0$.		
5	The remainder when $f(x)$ is divided by $(x-a)$ is $f(a)$.		
6	By factorising.		Functions of degree > 4.
7			
8	The meaning of the term factorial.	${}^{n}C_{r}=\binom{n}{r}$ $=\frac{n!}{r!(n-r)!}$ $n!=1.2.3...n$ ${}^{n}C_{0}={}^{n}C_{n}=1$	
9			
	CURVE SKETCHING		
C1C1	Where appropriate, candidates will be expected to identify where a curve crosses the coordinate axes (in cases where the points of intersection are known or easily found), and its behaviour for large numerical values of x.		Asymptotes.
2	The curve $y=a(x+p)^2+q$ has a minimum at $(-p,q)$.		
3	Including cases of repeated roots.		Functions of degree > 4.
4	Vector notation may be used for a translation. Including working with sketches of graphs where functions are not defined algebraically. Other transformations are covered in C3f2-5.	$\binom{b}{a}$	