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Revision Checklist for O-Level Additional Mathematics 4037

Guide for Students

UNIVERSITY of CAMBRIDGE
International Examinations

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REVISION CHECKLIST for O Level Additional Mathematics 4037

A guide for students

How to use this guide
This guide describes what you need to know about the O Level Additional Mathematics examination.

It will help you plan your revision programme for the examinations and it will explain what the examiners are looking for in your written solutions. It can also be used to help you revise by using the tick boxes in Section 3, 'What you need to know', to check what you know and which topics you have covered.

The guide contains the following sections:

Section 1 - How will you be tested?
This section will give you information about the two papers that you have to sit.

Section 2 - What will be tested?
This section describes the areas of knowledge, understanding and skills that the Examiners will test you on.

Section 3 - What you need to know
This shows the syllabus content in a simple way so that you can check:

- what you need to know about each topic
- how much of the syllabus you have covered

Section 4 - Examination Information
This section gives you some details about what you need to do in the examination.

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Section 1 - How you will be tested?

1.1 The Examination Papers you will take

You will take two papers, Paper 1 and Paper 2.

1.2 About the papers

- Each paper is two hours long and is worth 80 marks.
- Any topic can be tested either on Paper 1 or Paper 2.
- Each paper consists of between ten and twelve questions of varying length.
- Each of the questions is worth varying marks.
- You are expected to answer all the questions, but you will be given a choice of two alternatives in the last question, only one of which you will be expected to answer.
- Each alternative in the last question will be worth the same number of marks, in the range of ten to twelve marks.

Section 2 - What will be tested?

The full syllabus, which your teacher will have, lists the assessment objectives in detail. However, you should note that you must be able to:

- Use tables, graphs and diagrams.
- Understand and use mathematical data, symbols and terminology.
- Write answers in symbols, numbers and words.
- Use an electronic calculator.
- Understand numerical, algebraic and spatial concepts and relationships.
- Recognise the appropriate mathematical procedure for solving a given problem.
- Express given problems in mathematical terms and apply the appropriate mathematical methods to solve them.
- Express answers to the appropriate degree of accuracy as stated on the front of the exam paper or in the question if different.
- Recognise scientific notation for the expression of compound units e.g. 5 ms^{-1} for 5 metres per second.

You will also be expected to have knowledge of CIE's Ordinary Level Mathematics Syllabus D (or an equivalent Syllabus) as it is assumed knowledge. Techniques you have learned for the Ordinary Level Mathematics examination may be required to help you answer questions on the Additional Mathematics Ordinary Level papers.

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Section 3 - What you need to know

This is a table which describes the topics you may be tested on in the exam. It is arranged in 15 topic areas. You can use the table throughout your Additional Mathematics course to check the topic areas you have covered. You can also use it as a revision guide. When you think you have good knowledge of a topic, you can tick the appropriate box in the checklist column. The main headings in the column headed 'Topics' are followed by the details of what you should know.

You can test yourself as follows:

- Cover up the details with a piece of paper.
- Try to remember the details
- When you have remembered the details correctly, put a tick in the appropriate box.

If you use a pencil to tick the boxes, you can retest yourself whenever you want to by simply rubbing out the ticks. If you are using the table as a check list of which topics you have covered, you can put a tick in the column next to the appropriate bullet point.

The column headed 'Comments' can be used to:

- Add further information about the details for each bullet point.
- Note relevant page numbers from your text books.
- Note relevant parts of your own personal notes.
- Add learning aids.
- Highlight areas of difficulties.
- Highlight areas about which you need to ask your teacher.

Section 4: - Examination information

This section gives you some details about what you need to do in the exam.

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For examinations taken from 2009:
What you need to know

Topic	You should be able to:	Check	Comments
1. Set language and notation	• Use set language and notation, and Venn diagrams to describe sets and represent relationships between sets as follows: A = {x : x is a natural number } $B = \{(x, y) : y = mx + c\}$ $C = \{x : a \le x \le b\}$ $D = \{a, b, c, ...\}$ • Understand and use the following notation: Union of A and B $A \cup B$ Intersection of A and B $A \cap B$ Number of elements in set A n(A) "…is an element of…" $\in$ "…is not an element of…" $\notin$ Complement of set A A' The empty set $\varnothing$ Universal set $\mathscr{E}$ A is a subset of B $A \subseteq B$	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	

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	A is a proper subset of *B* $A \subset B$ *A* is not a subset of *B* $A \quad B$ *A* is not a proper subset of *B* $A \not\subset B$	☐ ☐ ☐	

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Topic	You should be able to:	Check	Comments
2. Functions	• Understand the terms: - Function - Domain - Range (Image set) - One - one function - Inverse function - Composition of functions	☐ ☐ ☐ ☐ ☐ ☐	
	• Use the notation: $f(x) = \sin x$	☐	
	$f : x \mapsto \lg x \quad (x > 0)$	☐	
	$f^{-1}(x)$	☐	
	$f^2(x) \quad [= f(f(x))]$	☐	
	• Understand the relationship between $y = f(x)$ and $y = \lvert f(x) \rvert$, where $f(x)$ may be linear, quadratic or trigonometric.	☐ ☐	
	• Explain in words why a given function is a function or why it does not have an inverse.	☐	
	• Find the inverse of a one – one function and form composite functions.	☐	
	• Use sketch graphs to show the relationship between a function and its inverse.	☐	

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Topic	You should be able to:	Check	Comments
3. Quadratic functions	• Find the maximum and minimum values of the quadratic function $f : x \mapsto ax^2 + bx + c$, by any method.	☐	
	• Use the maximum or minimum value of $f(x)$ to sketch the graph or determine the range of the given domain.	☐	
	• Know the conditions for $f(x) = 0$ to have	☐	
	(i) two real roots,	☐	
	(ii) two equal roots,	☐	
	(iii) no real roots,	☐	
	and the related conditions for a given line to (i) intersect a given curve,	☐	
	(ii) be a tangent to a given curve	☐	
	(iii) not intersect a given curve.	☐	
	• Solve quadratic equations for real roots and find the solution set for quadratic inequalities.	☐	

Topic	You should be able to:	Check	Comments
4. Indices and Surds	• Perform simple operations with indices	☐	
	• Perform simple operations with surds, including rationalising the denominator.	☐	
5. Factors of polynomials	• Know and use the remainder theorem.	☐	
	• Know and use the factor theorem.	☐	
	• Find factors of polynomials.	☐	
	• Solve cubic equations.	☐	
6. Simultaneous equations	• Solve simultaneous equations in two unknowns with at least one linear equation.	☐	

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Topic	You should be able to:	Check	Comments
7. Logarithmic and exponential functions	• Know simple properties and the graphs of logarithmic functions, including $\ln x$. • Know simple properties and the graphs of exponential functions, including e^x. (Series expansions are not required) • Know and use the laws of logarithms (Including change of base of logarithms) • Solve equations of the form $a^x = b$	☐ ☐ ☐ ☐	

Topic	You should be able to:	Check	Comments
8. Straight line graphs	• Interpret the equation of a straight line graph in the form $y = mx + c$ • Transform given relationships, including $y = ax^n$ and $y = Ab^x$, to straight line form and hence determine unknown constants by calculating the gradient or intercept of the transformed graph. • Solve questions involving the mid-point and length of a line. • Know and use the condition for two lines to be parallel or perpendicular.	☐ ☐ ☐ ☐ ☐	
9. Circular measure	• Solve problems involving: - the arc length, - and sector area - of a circle, including the knowledge - and use of radian measure.	☐ ☐ ☐ ☐	

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Topic	You should be able to:	Check	Comments
10. Trigonometry	• Know the six trigonometric functions of angles of any magnitude - sine ☐ - cosine ☐ - tangent ☐ - secant ☐ - cosecant ☐ - cotangent ☐		
	• Understand: - amplitude and ☐ - periodicity and ☐ - the relationships between graphs of e.g. $\sin x$ and $\sin 2x$ ☐		
	• Draw and use the graphs of $y = a\sin(bx) + c$, ☐ $y = a\cos(bx) + c$, ☐ $y = a\tan(bx) + c$, ☐ where *a* and *b* are positive integers and *c* is an integer. ☐		
	• Use the relationships $\frac{\sin A}{\cos A} = \tan A$, ☐		

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	$\frac{\cos A}{\sin A} = \cot A,$	☐	
	$\sin^2 A + \cos^2 A = 1,$	☐	
	$\sec^2 A = 1 + \tan^2 A,$	☐	
	$\operatorname{cosec}^2 A = 1 + \cot^2 A.$	☐	
	• Solve simple trigonometric equations involving the six trigonometric functions and the above relationships. (not including general solutions of trigonometric equations)	☐	
	• Prove simple trigonometric identities.	☐	

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Topic	You should be able to:	Check	Comments
11. Permutations and combinations	• Recognise and distinguish between a permutation - case and - a combination case. • Know and use the notation *n*! (with 0! = 1) and the expressions for - permutations of *n* items taken *r* at a time and - combinations of *n* items taken *r* at a time. - Answer simple problems on arrangement and selection (Cases with repetition of objects, or with objects arranged in a circle or involving both permutations and combinations, are excluded)	☐ ☐ ☐ ☐ ☐	

Topic	You should be able to:	Check	Comments
12. Binomial expansions	• Use the Binomial Theorem for expansion of $(a+b)^n$ for positive integral *n*. • Use the general term $\binom{n}{r}a^{n-r}b^r, 0 < r \leq n$ (knowledge ot the greatest term and properties of the coefficients is not required)	☐ ☐	

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Topic	You should be able to:	Check	Comments
13. Vectors in 2 dimensions	• Use vectors in any form e.g. $\begin{pmatrix} a \\ b \end{pmatrix}$, $\overrightarrow{AB}$, **p**, a**i** + b**j.** • Know and use - position vectors, - unit vectors. • Find - the magnitude of a vector, - add and subtract vectors and - multiply vectors by scalars. • Compose velocities and resolve velocities. • Use relative velocity including solving problems on interception. (but not closest approach)	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
Topic	**You should be able to:**	**Check**	**Comments**
14. Matrices	• Display information in the form of a matrix of any order and - interpret the data in a given matrix. • Solve problems involving the calculation of - the sum of two matrices, and the product (where appropriate) of - two matrices and - interpret the results. • Calculate the product of a scalar quantity and a matrix. • Use the algebra of 2 × 2 matrices (including the zero and identity matrix).	☐ ☐ ☐ ☐ ☐ ☐ ☐	

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	• Calculate - the determinant of a non-singular 2 × 2 matrix, - the inverse of a non-singular 2 × 2 matrix and - solve simultaneous line equations.	☐ ☐ ☐	

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Topic	You should be able to:	Check	Comments
15. Differentiation and integration	• Understand the idea of a derived function.	☐	
	• Use the notations $f'(x)$	☐	
	$f''(x)$	☐	
	$\frac{dy}{dx}$	☐	
	$\frac{d^2y}{dx^2} \quad \left[= \frac{d}{dx}\left(\frac{dy}{dx}\right) \right]$	☐	
	• Use the derivatives of the standard functions x^n (for any rational n)	☐	
	$\sin x$,	☐	
	$\cos x$,	☐	
	$\tan x$,	☐	
	e^x,	☐	
	$\ln x$,	☐	
	together with - constant multiples of the above,	☐	
	- sums of the above, and	☐	
	- composite functions of the above.	☐	
	• Differentiate	☐	

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	- products of functions, - quotients of functions.	☐ ☐	
	• Apply differentiation to - gradients, - tangents, - normals, - stationary points, - connected rates of change, - small increments, - approximations and - practical maxima and minima problems.	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
	• Discriminate between maxima and minima by any method.	☐	
	• Understand integration as the reverse process of differentiation.	☐	
	• Integrate sums of terms in powers of x excluding $\frac{1}{x}$.	☐	
	• Integrate functions of the form $(ax+b)^n$, (excluding $n = -1$) e^{ax+b}, $\sin(ax+b)$, $\cos(ax+b)$.	☐ ☐ ☐	
	• Evaluate definite integrals and - apply integration to the evaluation	☐	

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	of plane areas. • Apply differentiation and integration to kinematics problems that involve - displacement of a particle moving in a straight line with variable or - constant acceleration, - velocity of a particle moving in a straight line with variable or - constant acceleration, and - acceleration of a particle moving in a straight line with variable or constant acceleration. • Use *x-t* graphs *v-t* graphs.	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	

Please note that this does not replace the official syllabus or show any order of study.

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Section 4: Examination Information

In the examination

- Take care to read the instructions on the front of your examination paper carefully.
- You should take into the examination a scientific calculator.
- You may use this calculator at all times unless a particular question forbids it, or non use of a calculator is implied by the wording of the question e.g. you may be asked to give an **exact** answer or leave your answer in a given surd form.
- Answers should be written in blue or black ink (except for graphs and diagrams which may be done in pencil).
- It is essential that you show as much working as possible in all questions in both papers, as marks are awarded for showing the method of solution that you have used in a question.
- Always make sure that you give your answers to the required level of accuracy, non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees. This means you should be doing your working correct to at least 4 significant figures for non-exact numerical work and at least 2 decimal places for work involving angles in degrees. Note that angles in radians can be given in terms of π if appropriate or decimals correct to 3 significant figures.
- Points on graphs should be plotted as accurately as possible.
- You must make sure that you have written the question number by your working for a particular question, particularly if you do your questions out of order or if you do different parts of a question in different parts of your paper.
- Make sure work is fastened together securely (but not in such a way that the examiner will have difficulty reading it) and also in order.