



A-level

Pure Mathematics

Maths
'A' level

General Introduction

Welcome to your 'A' level Mathematics course. This General Introduction should provide you with all the information you need to make a successful start to your studies.

The Specification (or Specification)

This course has been designed to give you a full and thorough preparation for the AS level or A level Mathematics specifications, set by the Assessment and Qualifications Alliance (AQA).

The **Subject Code** for entry to the AS only award is **5361** or **5366**.

The **Subject Code** for entry to the Advanced level award (AS + A2) is **6361** or **6366**. Full details are given below.

Private Candidates

The AQA specification is open to private candidates. Private candidates should contact AQA for a copy of *'Information for Private Candidates'*.



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Arrangement of Modules

OOL's 'A' level Maths courses are divided into six separate modules. Each module corresponds to a written examination paper and a "unit" in the AQA specification. There are three units for an AS level and three more for A2 level (see below for details).

Textbooks

It is essential that you acquire the following textbook to support your AS-level studies:

Sam Boardman, Tony Clough, David Evans: *Pure Core Maths 1 & 2* (Heinemann, 2nd ed., ISBN: 978-0435513306).

If you go on to A2-level (the 2nd year), you will also need the second book in the Heinemann series:

Sam Boardman, Tony Clough, David Evans: *Pure Core Maths 3 & 4* (Heinemann, 2nd ed., ISBN: 978-0435513313).

If you are taking the **Mechanics** (Applied Maths) options, you will also need (for both AS and A2):

L. Bostock and S. Chandler, *Mathematics – Mechanics and Probability* (Nelson Thornes, ISBN 0-8595-0141-8)

If you are taking the **Statistics** options, you will also need:

Roger Williamson, et al., *Statistics 1* (Heinemann, ISBN 978-0435513382) (for AS level), and

Roger Williamson et al, *Advancing Maths for AQA: Statistics 2* (Heinemann, ISBN: 978-0435513399) (for A2)

If you are taking **Pure** Mathematics 'A' level, you will also need:

Sam Boardman, Tony Clough, David Evans, *Further Pure Mathematics 1 (Advancing Maths for AQA)* (Heinemann, 2nd ed., ISBN 978-0435513344)

For the FP2 paper (only), you will also need to download the free supporting text from the AQA site, currently located at:

<http://store.aqa.org.uk/qual/pdf/AQA-MFP2-TEXTBOOK.PDF>

One easy way of acquiring the other accompanying textbooks is through the Oxford Open Learning website (www.ool.co.uk).

General Information

In the past few years there have been many changes in Mathematics, at 'O' level, now GCSE, and at 'A' level. In the 1960s "Modern Mathematics" was introduced and the new specifications involving this threw out much of the old traditional work. This was fine for the very able students, but those who found Mathematics less easy had many problems, since these modern specifications contained topics which were difficult to relate to practical ideas.

After experimenting with these new specifications, the examination boards introduced courses containing the best of the modern topics, together with the traditional ones which are still relevant. Nowadays, instead of a wide range of possible specifications, each examination board tends to offer a core specification of basic mathematics, together with a set of more diverse options which the student can choose from.

Pre-Requisite Experience

In order to study this course, you are expected to have a knowledge of mathematics up to a good 'O' level or GCSE standard. Just a mere pass is not usually a sufficient basis on which to progress to 'A' level. In particular you are expected to have a good grasp of algebra — equations, factors, fractions, and, especially, the manipulation of formulae. These are topics which are frequently encountered in all aspects of this course, and it will be assumed that you have a sound knowledge of them. You should know, in geometry, the triangle and circle properties, together with the tests for similar and congruent triangles. The trigonometrical definitions of sine, cosine and tangent, together with Pythagoras' theorem, should be known.

If your Maths skills were acquired a number of years ago, it might be an idea to purchase a GCSE Maths revision book to help refresh your memory.

Electronic Calculators

All examining boards now recommend, or actually require, that a calculator is used in most examinations. The specification specifies the type of calculator allowed. It is recommended (although not absolutely essential) that you acquire and use a graphical calculator which is permitted in all AQA papers except the first one. You may be at a disadvantage if you only have a calculator of a "scientific" type, with functions which include \sin , \cos , \tan and their inverses, in both degrees and radians, $\sqrt{\quad}$, x^y , e^x , $\log_a x$, $\ln x$, etc.

In this course you should use a calculator for all questions requiring a numerical answer, unless you are specifically told to leave answers in surd (root) form. Having said that, the usual preference of examiners is for answers to be left in fractional, rather than decimal form (i.e. *not* using a calculator); especially if this avoids rounding. Final answers should normally be given to three significant figures in an exam, but, during your working, keep intermediate values to as great a degree of accuracy as your calculator will allow. Some answers in this course are given to a larger number of significant figures, where it seems appropriate. You should show in your working any necessary explicit formula you use to calculate your answer. Marks may be deducted for lack of essential working. All steps in working should be shown.

Using the Course Materials

No textbook can take the place completely of an actual lesson, so, when studying this course, the lesson notes will add to, or expand, the text of the book, and you should study both together. The lesson notes will indicate at which points you should work from the book, and the exercises you should attempt.

At the start of each book there is a section on the use of the book which includes a list of notations, and instructions for answering multiple-choice exercises. You should study the list of notations carefully, and also refer to the notations which are listed in the specification of the examination board. Occasionally there will be slight variations in notation, so it is important to realise this, and, if two alternative notations are given, be able to recognise and use either.

As you follow the lesson notes, you will be told when to refer to the book, which sections to study, and which exercises to attempt. The textbooks contain very many worked examples. In order to save space, and so include all these, often lines of working have been omitted from the solutions. You should perform these lines yourself, as you follow through the examples. In general, always keep a pen and paper, and your calculator, beside you, as you work through the course.

Activities and Practice Exercises

The books also contain many exercises to be worked. The numerical solutions to these are given at the end of the books. Graphical solutions are not included, but they will be given to a selection of examples at the end of any appropriate lesson. When you have worked through the questions in an exercise, check your answers with those given. If you have made any mistakes, look through the question again, trying to see where you went wrong. If you still cannot see how to get the correct answer, ask your tutor for help, and he or she will show you your mistake.

There is no need to work every question of every exercise, but try to pick out a variety of different types. If, however, you find a topic more difficult, then try more of the questions set on it, to give you practice in overcoming the problems.

At the end of each chapter there are usually multiple-choice and miscellaneous exercises covering the whole chapter. You will be told when to attempt these, in the lesson notes. The AQA specification does not include a multiple-choice paper, but it is still a good idea to attempt the multiple-choice exercises in the books.

The miscellaneous exercises provide an excellent selection of questions covering the work of that chapter. They usually contain a large number of questions, and there is no need to attempt every one. However, the questions in them are often taken from past 'A' level examinations. The source of these are indicated at the end of the question. It is always helpful to acquire copies of the most recent examination papers. Exams change from year to year, and this will give you a better idea of what to expect.

Where necessary, the lessons also include Activities to provide additional practice or help with difficult points. These Activities include space underneath for you to attempt your answer. Having done so, the correct answer will be found at the end of that particular lesson.

Tutor-Marked Assignments

After a group of lessons you will find a tutor-marked assignment, and you will be told at which stage to work this. It should be attempted only when you are satisfied that you have completely studied and mastered the lessons to which it relates. It is best to attempt assignments under examination conditions, however it is not obligatory. Your answers to these assignments should be sent to your tutor for marking, and, when they are returned to you, suggested answers will be sent with them.

At this level of mathematics, there is rarely just one "right" method for solving a problem, however. The suggested answers will give one way, usually, but not always, the shortest. The method you have used may well be completely different. Your tutor will indicate whether it is as good on your test-paper when it is returned.

Experience shows that students who do submit assignments are much more successful than those who don't. It is your primary means of gaining individualised help, of sorting out problems and maintaining motivation.

To conclude, this is no easy, armchair, subject. Much depends on your ability to work hard, and puzzle out any problems. When you encounter difficulties, try the problem again, working the problem

out in various ways, until you suddenly see the correct method. Always work the assignments without assistance, and send in an attempt at every question, however badly you think you might have done. Only then can your tutor see what your difficulties are, and help you to overcome them.

The 'AS' level and 'A' level System

The Advanced Subsidiary (AS) Level

Advanced Subsidiary (AS) courses may be used in one of two ways:

As a final qualification, allowing candidates to broaden their studies and to defer questions about specialism;

As the first half (50%) of an Advanced Level qualification, which must be completed before an Advanced Level award can be made.

Advanced Subsidiary is designed to provide an appropriate assessment of knowledge, understanding and skills expected of candidates who have completed the first half of a full Advanced Level Qualification.

The Advanced Level (AS + A2)

The Advanced Level examination is in two parts:

Advanced Subsidiary (AS) - 50% of the total award;

A second examination, called A2 - 50% of the total award

Most Advanced Subsidiary and Advanced level courses are modular. The AS level normally comprises three teaching and learning modules and the A2 comprises a further three teaching and learning modules. These modules generally match the Units of Assessment (or Exam Papers).

Examination Flexibility

The new style 'A' levels allow for more flexibility in the taking of exams. The two most popular options are:

AS is completed at the end of one year and A2 at the end of the second year;

AS and A2 are completed at the end of the same year.

Both of these options are open to students following this course as it is divided into two halves and follows the same modular sequence as the specification.

AQA Aims

The aims of this course are the same as the aims listed in the AQA specification. Please refer to the AQA website for full details. The stated aims for this subject are for the student to:

- a. develop their understanding of mathematics and mathematical processes in a way that promotes confidence and fosters enjoyment;
- b. develop abilities to reason logically and recognise incorrect reasoning, to generalise and to construct mathematical proofs;
- c. extend their range of mathematical skills and techniques and use them in more difficult unstructured problems;
- d. develop an understanding of coherence and progression in mathematics and of how different areas of mathematics can be connected;
- e. recognise how a situation may be represented mathematically and understand the relationship between 'real world' problems and standard and other mathematical models and how these can be refined and improved;
- f. use mathematics as an effective means of communication;
- g. read and comprehend mathematical arguments and articles concerning applications of mathematics;
- h. acquire the skills needed to use technology such as calculators and computers effectively, recognise when such use may be inappropriate and be aware of limitations;
- i. develop an awareness of the relevance of mathematics to other fields of study, to the world of work and to society in general;
- j. take increasing responsibility for their own learning and the evaluation of their own mathematical development.

Grading and Shelf-Life

For the full 'A' level qualification, there is a 6-grade scale: A* (A-starred), A, B, C, D and E. Candidates who fail to reach the minimum standard for Grade E will be recorded as U (unclassified). For the AS-only qualification, there's a 5-grade scale, with A (not A*) as the top grade.

The **shelf-life** of the results, prior to the award of the qualification, is limited only by the shelf-life of the current specification.

Maths 'A' level and Pure Maths 'A' level

The AQA Specification

The grid below shows the AQA specification (or specification) numbers:

	AS	AS + A2
Maths (Pure & Applied)	5361	6361
Maths (Pure & Statistics)	5361	6361
Pure Maths	5366	6366

In fact, specification 5361/6361 includes a number of different variants but these are the only ones available from OOL.

(1) Pure & Applied (5361/6361)

	Unit Entry Code	Unit Name	Duration of Exam	Marks as % of total 'A' level
AS	MPC1	Pure Core 1	90 mins	16.67%
	MPC2	Pure Core 2	90 mins	16.67%
	MM1B	Mechanics 1	90 mins	16.67%
A2	MPC3	Pure Core 3	90 mins	16.67%
	MPC4	Pure Core 4	90 mins	16.67%
	MM2B	Mechanics 2	90 mins	16.67%

(2) Pure & Statistics (5361/6361)

	Unit Entry Code	Unit Name	Duration of Exam	Marks as % of total 'A' level
AS	MPC1	Pure Core 1	90 mins	16.67%
	MPC2	Pure Core 2	90 mins	16.67%
	MS1B	Statistics 1	90 mins	16.67%
A2	MPC3	Pure Core 3	90 mins	16.67%
	MPC4	Pure Core 4	90 mins	16.67%
	MS2B	Statistics 2	90 mins	16.67%

(3) Pure & (Further) Pure (5366/6366)

	Unit Entry Code	Unit Name	Duration of Exam	Marks as % of total 'A' level
AS	MPC1	Pure Core 1	90 mins	16.67%
	MPC2	Pure Core 2	90 mins	16.67%
	MFP1	Further Pure 1	90 mins	16.67%
A2	MPC3	Pure Core 3	90 mins	16.67%
	MPC4	Pure Core 4	90 mins	16.67%
	MFP2	Further Pure 2	90 mins	16.67%

As well as these three basic routes, it is also possible to “mix and match” for the A2 optional paper – in other words, to select *another* AS option. Of course, this cannot be the same one you have already taken at AS level!

Thus if you have taken the Mechanics option (Unit MM1B) for AS, you could now take the AS Statistics option (Unit MS1B) as your A2 option, or vice versa. Please see the specification for the full range of alternatives. Unless you wish to specialise in one particular area of mathematics, this may be the “easiest” route to a good grade for some candidates.

Full details of all these units are contained within the specification, which all students should study carefully, e.g. by obtaining it from the AQA website:

www.aqa.org.uk/qual/gceasa/mathematics.html

You will also find Specimen Question Papers and Mark Schemes for all units. These should form a key part of your revision for the examination.

Calculators

Candidates are permitted to use graphical calculators in all examinations except the first one (MPC1), where no calculator is permitted.

Studying the Specification

You should be sure to acquire your own copy of the specification, either via the AQA Publications Dept or from the website www.aqa.org.uk. The specification can be purchased from

AQA Publications
Unit 2, Wheel Forge Way,
Trafford Park
Manchester
M17 1EH

(tel: 0870-410-1036)

or downloaded from www.aqa.org.uk/qual/pdf/AQA6321WSP.pdf.

We advise that you obtain a copy of the specification so that you can assess which topics you have covered in the most detail and which ones you will feel happiest about in the exam. AQA can also provide advice booklets on your course, including 'Supplementary Guidance for Private Candidates'. As you approach the examination, it will also be helpful to purchase and tackle past papers from AQA.

It will also help greatly with all your studies if you can print off a copy of AQA's *Formulae and Statistical Tables* which can currently be found at www.aqa.org.uk/qual/pdf/formulae.pdf.

Using the Internet

All students would benefit from access to the Internet. You will find a wealth of information on all the topics in your course. As well as the AQA website (www.aqa.org.uk), you should get into the habit of checking the Oxford Open Learning site (www.ool.co.uk) where you may find news, additional resources and interactive features as time goes by. If you have not already done so, you may register for your free copy of *How to Study at Home*, our 200-page guide to home learning, or enrol on further courses. Put it on your Favourites list now!

Good luck with your studies!

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A-level

Pure Mathematics

Maths 'A' level

Pure Maths: Modules PC1 & PC2 Introduction

These modules cover all the topics in the Pure Core Units 1 & 2 of the specification. These units are compulsory for all students of AQA AS level Maths.

Textbook

You will need the following textbook:



Sam Boardman, Tony Clough, David Evans: *Pure Core Maths 1 & 2* (Heinemann, 2nd ed., ISBN: 0-43-551330-3).

The Arrangement of Lessons: Module PC1

Lesson	Subject	Reading
1	Algebra Review	Ch. 1, pp. 1-12
2	Surds	Ch. 2, pp. 13-27
3	Straight Lines	Ch. 3, pp. 28-51
4	Quadratic Equations and Functions TMA A	Ch. 4, pp. 52-69
5	Polynomials	Chs. 5-6, pp. 70-98
6	Further Algebra	Ch. 7, pp. 99-113
7	The Coordinate Geometry of the Circle TMA B	Ch. 8, pp. 114-136
8	Differentiation (1)	Chs. 9-10, pp. 137-165
9	Differentiation (2)	Ch. 11, pp. 166-184
10	Integration (1) TMA C	Ch. 12, pp. 185-203

Module PC2

Lesson	Subject	Reading
1	Indices and Further Differentiation	Chs. 1-2, pp. 207-238
2	Further Integration	Ch. 3, pp. 239-252
3	Trigonometry (1) TMA D	Ch. 4, pp. 253-278
4	Transformations of Graphs	Ch. 5, pp. 279-287
5	Trigonometry (2)	Ch. 6, pp. 288-302
6	Binomial Expansions and Arithmetic Series TMA E	Chs. 7-8, pp. 303-336
7	Trigonometry (3)	Chs. 9-10, pp. 337-358
8	Logarithms and Geometric Series TMA F TMA G (Practice Exam for PC1/2)	Chs. 11-12, pp. 359-384

The Examination Structure

This information is correct at the time of publication but may be subject to change. Prior to the examination, students should contact the exam board for the latest information.

Module (M) PC1

This module is assessed by means of a written paper of 1 hour 30 minutes.

It is worth 33.3% of the total AS marks (or 16.67% of the total 'A' level marks).

All questions are compulsory.

A calculator is **not** permitted in this examination.

The following topics are amongst those covered:

- algebra
- coordinate geometry
- differentiation
- integration

Module (M) PC2

This module is assessed by means of a written paper of 1 hour 30 minutes.

It is worth 33.3% of the total AS marks (or 16.67% of the total 'A' level marks).

All questions are compulsory.

A graphical calculator may be used in the examination.

This module develops topics from PC1 and includes:

- algebra and functions
- sequences and series
- trigonometry
- exponentials and logarithms
- differentiation
- integration

Formulae for AS and 'A' Level Maths Specifications

This is a list of the formulae which relate to the Core modules, PC1-PC4, and which candidates are expected to remember. These formulae will *not* be included in the AQA formulae booklet. Do not worry if you do not understand them at the outset of your course.

Quadratic Equations

$$ax^2 + bx + c = 0 \text{ has roots } \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Laws of Logarithms

$$\log_a x + \log_a y \equiv \log_a(xy)$$

$$\log_a x - \log_a y \equiv \log_a \left(\frac{x}{y} \right)$$

$$k \log_a x \equiv \log_a(x^k)$$

Trigonometry

In the triangle ABC :

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{area} = \frac{1}{2}ab\sin C$$

$$\cos^2 A + \sin^2 A \equiv 1$$

$$\sec^2 A \equiv 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A \equiv 1 + \cot^2 A$$

$$\sin 2A \equiv 2\sin A \cos A$$

$$\cos 2A \equiv \cos^2 A - \sin^2 A$$

$$\tan 2A \equiv \frac{2 \tan A}{1 - \tan^2 A}$$

Differentiation

Function	Derivative
x^n	nx^{n-1}
$\sin kx$	$k\cos kx$
$\cos kx$	$-k\sin kx$
e^{kx}	ke^{kx}
$\ln x$	$\frac{1}{x}$
$f(x) + g(x)$	$f'(x) + g'(x)$
$f(x)g(x)$	$f'(x)g(x) + f(x)g'(x)$
$f(g(x))$	$f'(g(x))g'(x)$

Integration

Function	Integral
x^n	$\frac{1}{n+1}x^{n+1} + c, n \neq -1$
$\cos kx$	$\frac{1}{k}\sin kx + c$
$\sin kx$	$-\frac{1}{k}\cos kx + c$
e^{kx}	$\frac{1}{k}e^{kx} + c$
$\frac{1}{x}$	$\ln x + c, x \neq 0$
$f(x) + g(x)$	$f(x) + g(x) + c$
$f(g(x))g'(x)$	$f(g(x)) + c$

Area

$$\text{area under a curve} = \int_a^b y dx, y \geq 0$$

Vectors

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} \cdot \begin{bmatrix} a \\ b \\ c \end{bmatrix} = xa + yb + zc$$

There is also an Appendix of mathematical notation given in the AQA specification and you should be familiar with all the standard symbols by the end of the course.