



# My Maths Cloud

## A Level Maths Explained

*All You Need To Know*

$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \dots$   
 $y = e^{kx}$   
 $\frac{dy}{dx} = f'(x) e^{kx}$   
 $\Rightarrow \int f'(x) e^{kx} dx = e^{kx} + c$   
 $N(t) = \frac{ae^{kt}}{1+be^{kt}}$   
 $U_n = a + (n-1)d$   
 $S_n = \frac{n}{2} [2a + (n-1)d]$

$\sum_{i=1}^n i = \frac{n(n+1)}{2}$   
 $\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$   
 $\int y \frac{dx}{dt} dt$

$\text{Area} = \int_a^b f(x) dx$   
 $\sin 2x = \sin(x+x)$   
 $= \sin x \cos x + \cos x \sin x$   
 $= 2 \sin x \cos x$   
 $\sigma_x = \sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$   
 $\bar{x} = \frac{\sum f x}{n}$

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## 1.1 AS and A Level Brief

An A level (“advanced level”) is the most common qualification offered to UK students between the ages of 16 and 18 years old. An A level course typically takes two years (years 12-13). A student who only completes the first year of a full A level will obtain a AS level (“advanced subsidiary level”) qualification. AS is only taken if a student is considering dropping Maths (when studying four subjects and dropping to the required three). If a student is taking A Level Math, they will usually sit 3 exams at the end of their second year. (unless taking Further maths also – see section 1.2).

The content covered in an A Level course is now similar across all the main UK exam boards AQA, Edexcel, OCR and OCR MEI). The change to make all content similar across exam boards was made in 2017. In contrast, international versions of the A level exam are offered by Cambridge and Edexcel and these versions differ in how the exam is structured and still offer modular exams.

Each exam board has its own paper format at the end of the year

- Pearson/Edexcel GCE (UK) A Level:  
There are three equally weighted exams at the end of the whole course, as follows:
  - Paper 1: 2 hours long, questions on **pure maths** topics, all questions compulsory
  - Paper 2: 2 hours long, questions on **pure maths** topics, all questions compulsory
  - Paper 3: 2 hours long, questions on **mechanics and statistics**, all questions compulsory
  
- Pearson/Edexcel IAL (International) A Level: These exams are modular  
There are six equally weighted 1.5 hour exams at the end of the whole course, as follows:
  - P1 (pure)
  - P2 (pure)
  - P3 (pure)
  - P4 (pure)
  - choose ANY out of
    - M1 (mechanics) AND S1 (statistics)
    - M1 (mechanics) AND D1 (decision)
    - M1 (mechanics) and M2 (mechanics)
    - S1 (statistics) and D1 (decision)
    - S1 (statistics) and S2 (statistics)
  
- AQA A Level:  
There are three equally weighted exams at the end of the whole course, as follows:
  - Paper 1: 2 hours long, questions on **pure maths** topics, all questions compulsory
  - Paper 2: 2 hours long, questions on **mechanics** topics, all questions compulsory
  - Paper 3: 2 hours long, questions on **statistics**, all compulsory
  
- OCR A Level:  
There are three equally weighted exams at the end of the whole course, as follows:
  - Paper 1: 2 hours long, questions on **pure maths** topics, all questions compulsory
  - Paper 2: 2 hours long, questions on **pure and statistics** topics, all questions compulsory
  - Paper 3: 2 hours long, questions on **pure and mechanics**, all compulsory
  
- Cambridge (CAIE International) A Level: These exams are modular  
There are four equally weighted exams (not necessarily taken at the end of the whole course) as follows:
  - P1 (pure)
  - P3 (pure)
  - Choose ANY out of
    - P4 (mechanics) AND P5 (prob and stats 1)
    - P5 (prob and stats 1) AND P6 (prob and stats 2)

To see these paper combinations in more detail go to the document called “A Level Paper Combinations and Options.”

## 1.2 Further AS and Further A Level Brief

Further Maths is like an add-on to the main maths A level. You won't be able to take Further Maths unless you are also taking A Level Maths, but it doesn't matter whether sequentially or concurrently. Obviously, you need A Levels maths to understand Further Maths, but schools tend to choose their preferred order of teaching the content and when the exams are taken. A Level Maths' exams can be completed in the first or second year of study. Content-wise, some schools teach

all of A Level in year 12 and Further Maths content in year 13, and some schools try to do both alongside each other over the 2 years. Exam-wise, some students sit A Level Maths in year 12 and then sit Further Maths in year 13, straight after. Some sit all exams in the final year.

### 1.3 What Is The Order Of Difficulty Of The Different Exam Boards

The A level exam boards in order of difficulty from least to greatest are as follows AQA, Edexcel, OCR, OCR MEI and Cambridge.

### 1.4 Can I Do The Whole A Level Course In One Year?

Some students will take the two-year course in one year. As mentioned above, this is usually only Further Maths students whose schools choose for them to do this. I would not recommend this for a student not doing further maths unless they already have covered a significant amount of post-GCSE Maths. They would need algebra skills of at least GCSE level 9 (A\*) standard and a willingness to spend at least 2 hours a night on Maths work outside class. The same applies to Further Maths, only more so!

### 1.5 How Is The New Syllabus Different to the old Syllabus pre 2017?

A Level:

Beforehand you could have just specialised in Statistics (S1 and S2) or just specialised in Mechanics (M1 and M2). Now the new syllabus for A levels forces you to cover both Statistics AND mechanics. This is not the case for Edexcel IAL and Cambridge though. You can still specialise.

Further:

Beforehand you could have picked from some of the regular A Level Modules for your Further Modules: S1, S2, M1, M2, D1, D2, whereas now you must choose from the Further options only.

In addition, Edexcel have made the interesting decision of allowing schools/students to choose only pure maths content for Further. The Further Pure options will include topics like number theory and group theory. So, 100% pure content is an option for Further but there are other options that include up to 50% applied content.

So, a student who chooses this pure only option would go through the whole of A Level maths having only done the equivalent amount of applied content as M1 & S1 in the old spec. This is quite different to the old Edexcel spec that required 50% applied content for Further. I'm not sure whether I like the idea of students starting a maths degree having possibly done so little applied maths at A Level!

### 1.6 What Pre-Requisites Do I Need?

Enjoyment of mathematics and problem-solving are essential in order to undertake A level Mathematics with confidence. If you get less than a grade 6 or 7 (grade B) at GCSE, A level Mathematics is likely to be beyond you, and even with a 7 you should ask for your teachers' advice on whether you have the general 'feel' for algebra which A level Mathematics requires. If you are considering Further Mathematics as well, a real enthusiasm and aptitude for mathematics is essential, and a grade 9 (A\*) at GCSE would be advisable. For the strong mathematician, Further Maths can be the 'icing on the cake' of their A level programme. However, as with Maths, check that your teachers support your choice.

There's also the question of how your college teaches Further Maths as mentioned already. Some push Further Maths students through all of A level Mathematics in the first year (including the exam), and spend upper sixth on Further Maths. This is tough but enables you to do two non-Maths A levels alongside. If you study both Maths subjects for two years, and can therefore only take one non-Maths A level you need to consider whether this is over-narrowing your general academic development.

### 1.7 What Background Knowledge Do I Need?

There are a few topics that will significantly improve the start of your time in A-Level mathematics.

- The 3 ways of solving a quadratic – factorising, quadratic formula and completing the square
- Surds
- Indices
- The gradient of a line versus the gradient of a curve

- Trigonometry and a solid understanding of the unit circle
- curve sketching

## 1.8 Where Can A Maths A Level Lead?

Mathematics is a highly respected A level and supports progression to a wide range of degree courses and careers. All science-based degrees require good maths skills, and so too do Engineering and many Computing and Economics-based and Social Science degrees.

Further Mathematics is excellent preparation for degrees involving a lot of maths work and is actually required for some degree courses. Many university maths departments encourage students to take Further Maths at A level as it introduces a wider range of pure and applied content, such as matrices and complex numbers. Having said this, Further Maths is very useful if you want to study maths at university, but it usually isn't required. However, there are exceptions: Warwick and Cambridge both require Further Maths if you want to take a maths degree. Other useful pre-requisite subjects for a maths degree include physics, economics or computer science.

## 1.9 What Is A Level Mathematics About?

A level Mathematics is often thought of as a subject of complicated calculations. However, calculations form only a small part of this rigorous discipline which requires clear thinking and the development of specific ideas into generalised solutions.

On one hand A level Mathematics deals with highly abstract topics which require considerable imagination combined with the discipline of 'proof'. On the other hand mathematics underpins virtually all the practical developments in science, IT and economics which have formed our modern world.

A level Mathematics gives you the opportunity to study topics such as geometry, calculus and trigonometry (pure mathematics) and to use these ideas within the 'applied' topics such as mechanics and statistics. Mechanics is strongly linked to physics and builds on ideas of motion and forces to work out how and why objects move. Statistics allows us to make sense of the complex and variable world around us via analytical methods in order to draw reliable conclusions from 'sets' of information.

You can develop a yet deeper and broader understanding of mathematical concepts by studying Further Mathematics as a separate A level qualification. There are a wide variety of topics and applications of mathematics which can be studied at this level, and there is usually scope for tailoring the topics covered to your particular interests.

## 1.10 What Kind of Topics Are Involved?

Pure mathematics, which develops algebraic and geometrical reasoning, underpins the other disciplines. The work you do in and out of class will develop your ability to produce well-reasoned answers to extended questions. Although maths is highly logical, it also requires imagination and determination to work well on your own.

You need an enthusiasm for problem-solving, a willingness to try a variety of approaches and the tenacity to keep going in the hunt for possible solutions to awkward problems. Then you need to be disciplined in showing how you arrived at the problem's answer. Working on problems is the surest way to develop the knowledge and intuition required to do well.

You will also study aspects of 'applied maths': the disciplines of mechanics and statistics which require mathematical modelling to make sense of real-life problems. You will learn how to model real-life situations in mathematical terms, how models are refined and how to identify limitations within this process. You will be expected to use technology where appropriate; for example, the use of spreadsheets and graphical calculators to support statistical analysis. In addition, strong skills in algebraic manipulation are vital.