

MAT Guide

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What is it?

The Mathematics Admissions Test (MAT) is a test administered by both the University of Oxford and Imperial College London as **one of many** steps for shortlisting candidates for interview. Typically 40% of students reach the interview stage, and of those that reach the interview, 33% are successful. The MAT is judged holistically together with other details found on your UCAS application: including your personal statement, any extenuating circumstances, your predicted grades and others.

How well do you need to do?

We can't emphasise this enough, you must recognise that the MAT is just one part of a holistic assessment of your mathematical ability and potential. That being said, if you were to average the marks over the last 3 years of results (2016-18):

- Average of all applicants: 51
- Average of interviewed candidates: 67.5
- Average of successful candidates: 73.2

Unlike A Levels there is no UMS for the MAT, with raw marks out of 100, so expect to see some changes year on year. Some years exams are harder than others, so don't worry!

What do you need to know?

The MAT is designed to test the depth of your knowledge, not its breadth. Hence the syllabus (linked just below) should be mostly covered after studying 4 terms of A-level Maths (or equivalent).

https://www.maths.ox.ac.uk/system/files/attachments/syllabus_1.pdf

Also, no calculators, formula sheets or dictionaries are permitted during the test. So make sure you have all the necessary formulae for the topics in the syllabus **memorised**. Go online and make a list of any formulae you think are relevant to the specification, and make sure you know them.

The test lasts for 2:30h and is split into 2 main sections. Question 1 consists of 10 multiple choice questions, each worth 4 marks. Depending on which course you're applying for, you'll then be asked to do 4 of Questions 2, 3, 4, 5, 6 or 7, and this will be made clear on the front of the question paper. These 4 questions are a longer format, and worth 15 marks each, making 100 marks in total.

Tips & Tricks

Tips on multiple choice questions

One significant portion of the paper consists of 10 multiple choice questions. Marks will be given only for correct answers for those questions but candidates are encouraged to write their rough work in the space between questions so it is possible examiners will look at it to get an idea how one might approach those questions.

However, since it is multiple choice, the option to choose the right answer by elimination is viable and indeed optimal in certain cases. One typical question in the paper is to identify the graph of a function or curve from 5 possible options. In questions like this, you can approach it by taking some points on the curve and seeing on which graphs they are present, thinking how the curve or function behaves as one of the variables tends to infinity, whether the function is increasing or decreasing on certain intervals etc. Another typical question might ask you to calculate the minimum or maximum value of an expression. For example, if the question asks for the minimum and you find an example where the value is smaller than 4 of the options, you can safely deduce the answer can only be the other option.

Tips on writing out proofs

Proofs are one of the most important parts of University mathematics. However, they are not typically emphasised in A-Level or equivalent education. Examiners will not be looking for the same level of rigour as they would from a University student, but they will still look for some indicators for the applicant's potential in this area. For the multiple choice part of the question, getting the right answer is the most important thing. However, for the rest of the paper, the process is actually more important than the answer. Try to make clear exactly how you arrived at a solution. If you can, explain exactly what you are trying to calculate before doing it. If you introduce new variables, make it clear what they are supposed to represent.

One thing that seems counterintuitive for people who did mathematics at A Level or equivalent is to use words. Mathematics is typically thought to use only numbers and symbols. However, just including a simple "thus", "therefore" or "because" between lines explaining how a statement can be deduced from another can do wonders to improve the readability of the proof.

Graph Sketching 101

Graph sketching can feel quite intimidating when you first see it because there are so many possible options. However, this is a skill that you will likely be tested on both in the MAT as well as in an interview. There are two key parts to this, first how to graph a function, and second how the graph can change under transformations.

When graphing a function, you'll usually first want to get it into a form you can make sense of. This is often either rearranging to get $y = f(x)$, or first factorising to get $(p(y) + q(x))^n = c$ (e.g. see MAT 2018 Q1). Once you've done this, here are some things to think about.

1. Where does $f(x) = 0$, so we know the graph touches the x-axis here
2. Does $f(x)$ have a denominator which equals 0 somewhere, so there's an asymptote
3. What is the y-intercept, $f(0)$
4. What happens when x gets very positive or very negative or reaches the edge of the graph if you're asked to plot on a fixed interval.
5. Can you easily spot where the graph should be positive or negative
6. If differentiating isn't going to be too time-consuming, can you differentiate and set this to 0, so you know where the stationary points are.

It's also a really good idea to familiarise yourself with common functions (check the [syllabus](#)) and their graphs (sin, cos, tan, exp, log or ln) to have an idea of how they look and **why**.

E.g. $y = f(x)\sin(g(x))$

sine tells us this function is oscillatory

$f(x)$ tells us how the graph's amplitude changes

$g(x)$ tells us how the graph's frequency changes (how quickly it oscillates)

Also for those seeking a challenge... an interesting theorem that you'll see in your 1st year is the 'Squeeze Theorem/Sandwich Theorem'. This can help you with your graph sketching when you're trying to find particular limits of functions... work through [Khan Academy's little course](#) to get a flavour for this useful little theorem.

Often the questions will ask about transforming graphs. Common transformations include:

- $y = f(x - a)$ shifts the graph to the right by a , $y = f(x) - a$ shifts the graph down by a
- $y = f(-x)$ reflects the graph in the y-axis, $y = -f(x)$ reflects the graph in the x-axis
- $y = f(ax)$ horizontally stretches the graph by $1/a$, $y = af(x)$ vertically stretches by a
- $x = f(y)$ rotates the graph 90 degrees clockwise

A really helpful resource are the books by L. Bostock and S. Chandler. It's a really old A-level textbook, but I'm yet to encounter a better one. It goes through curve sketching really well, with some fantastic examples

1. Mathematics: The Core Course for A-Level (Chapter 11)
2. Further Pure Mathematics (Chapter 12) - *again if you'd like a challenge!*

A free and interactive online tool is [Desmos](#). You can challenge yourself to sketch some graphs and check your answers here, or look at some graphs and try to explain why they're the shape that they are.

How to prepare

There are so many resources out there to help prepare for the MAT, and how you prepare is always going to be different from person to person.

Summer Holidays

So whilst you're reading books and drafting your personal statement - you can always take a break and do some actual problem-solving! In the summer holidays, I began by working through some interesting STEP questions from Steven Siklos' "Advanced Problems in Mathematics", which can be downloaded for free here (<https://www.openbookpublishers.com/product.php/342/advanced-problems-in-mathematics--preparing-for-university?342/advanced-problems-in-mathematics--preparing-for-university>). I found these questions much more interesting, in most cases more advanced and the hints helped provide an 'in' for the harder questions - so you always learnt something new. Note that the style is very different to MAT questions, so it's more helpful to get your mind flexible with mathematical thinking.

The other resource available to help stretch your mind with some tricky maths problems are the UKMT's Senior Maths Challenge and Senior Team Maths Challenge questions - which are more similar to the MAT's MCQs, as well as their BMO1 and Mentoring Scheme questions - which are more involved and hence similar to the longer questions of the MAT.

Autumn Term (1st half) and Half-Term Holidays

I used this time to transition from STEP questions to the MAT. There are many ways to approach preparing for MAT papers, the next two paragraphs offer two alternative tactics you may want to consider!

Method 1

I tried a couple of MAT papers without adhering strictly to the time so that I could become comfortable with the style of questions and establish how I ought to manage my time (see section below!). After that, I then completed all the other available papers to time. I can't stress how important it is to time your past papers, you want to go into the exam with a clear idea of how long to allocate for each question. Of course, this varies from person to person but the general idea remains the same. Avoid moving onto a new past paper without having marked and thoroughly analysed the previous one - it's a waste of a paper. You're missing out on key lessons and insights you could have gone into your next paper already knowing. What does thoroughly analysed mean? It means go through the solutions, making sure you understand every single line. If there's anything you don't understand, even if you solved the question correctly, document all these doubts, go to your teacher and have them cleared.

Method 2

Another possible approach you can take is starting with doing all the multiple questions for three or four past papers to get a feel at them and then transitioning to doing the full questions for the same past papers. You can even prepare by choosing a theme each day. For example, you could choose to prepare for the geometry questions by doing 3 or 4 of them in one day and then check the solutions. Even with this approach, you should still leave a suitable number of past papers for timed practice.

If you're looking for more resources to look at, the PAT papers begin with a maths section, however, these questions are typically far, far easier than the MAT questions, but no harm in looking at them nonetheless! Never let yourself get bored of solving questions, if you do - move onto an olympiad or STEP question, work on it for a while and come back to the MAT, you'll find the approach far more refreshing and less brain-numbing!

The Exam

Managing your time during the exam

The MAT is a very different type of exam from the school exams most of you will be used to because you don't need to get nearly everything right to do well, as is reflected in the average marks mentioned above. This style is more like Maths at university, too. However, this means that time management very important, because whilst getting stuck on one question won't matter too much, spending lots of your time on it and leaving you less time for others could be a problem.

The 100 marks in 2:30h works out at 1.5 minutes per mark. This means that a rough guide would be to spend around an hour on the multiple choice, and about 20 minutes per question on the long answer questions, leaving some time for checking at the end. So if you're spending more than 10 minutes on a multiple choice question, it's probably best to move on and come back to it at the end if you have time. It's really important to do some past papers in timed conditions, both as practice, but also to think about tweaking this split to your personal preference. You may be naturally better at multiple choice questions or long answer questions, and it's sensible to adjust your time management based on this. At the start of your exam, make sure you can see the clock, and maybe consider taking in a basic watch to help you keep track of the time.

After the exam

Just chill! It doesn't matter how it's gone, just remember that you prepared to the best of your ability. Remember (3rd time!) this test is part of a holistic assessment so a low MAT score is not the be all and end all, in the same way that a high MAT score is not a guarantee of admittance. If you are successful in being offered an interview, you'll typically be notified of this 2 weeks beforehand.

Useful websites/resources

[Oxford Mathematics Department Website](#) - The website includes past papers from the last 10 or so years, alongside solutions and exam feedback. It also explains **how to register for the test** and includes additional resources for preparation to the ones that are suggested in this guide

[Underground Mathematics](#)

[NRICH Advanced Problem Solving modules](#)

[STEP support programme](#)

[FMSP problem solving events](#)

[Dr Frost Maths: MAT Preparation Resources](#)

[STEP videos from the Further Maths Centre at Warwick](#)