ENTRANCE EXAM

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# MAT

Maths Admissions Test

## SECTION BREAKDOWN

The MAT is comprised of one 2.5 hour long paper worth a total of 100 marks. Students are not permitted to use a calculator. The questions will cover topics learned up to and including first year A-Level Maths. Knowledge of topics from A-Level Further Maths is not required.

There are 7 questions in total but students should only attempt the five needed for their specific course. Questions 1, 2, 3, 4, 5 should be answered by Oxford applicants for Maths, Maths and Stats, or Maths and Philosophy, as well as non-Oxford Applicants for any Maths course at Imperial or Warwick. Questions 1, 2, 3, 5, 6 should be answered by Oxford applicants for Maths and Computer Science. Questions 1, 2, 5, 6, 7 should be answered by Oxford applicants for Computer Science or Computer Science and Philosophy.

Question 1 should be answered by all students. This question has 10 multiple choice questions, each worth 4 marks. Although showing your working is recommended, marks are given for right answers only.

Questions 2-7 are worth 15 marks each. These questions have a lot of parts that build on each other. Students will be marked for their working out.

## USEFUL LINKS

The Oxford Maths MAT page has everything you need to prepare for the MAT. This includes every past paper with solutions, feedback, and notes, as well more information on the MAT in general. The Maths Institute will also be holding weekly livestreams for MAT preparations over the summer.

You can find this all at:
https://www.maths.ox.ac.uk/study-here/undergraduate-study/maths-admissions-test

## WHAT IS THE MAT?

The Maths Admissions Test is an exam for students applying for Maths, Computer Science, or any of their joint schools. The aim of the test is to shortlist candidates for interviews. The MAT aims to test a student's understanding of topics and asks questions that tests an applicant's critical thinking skills.

## PREPARATION TIPS

The first thing an applicant should do is to go over and understand everything in the MAT syllabus. This will include many topics learnt in A-Level Maths. Once that is done, the main way to get ready for the MAT is by doing past papers. There are 15 past papers going back to 2007 as well as two specimen papers. Attempt the papers in chronological order, as the papers get a little harder each year.

It is best to do these past papers in exam conditions. This means timed and without looking at notes or other resources. This may be challenging to do straight away, so doing the earlier papers untimed and with notes is fine. Try to avoid doing this for later papers.

## WHAT IS CONSIDERED TO BE A "GOOD SCORE"?

The MAT is used primarily to shortlist candidates for interviews. As a result, there is no "pass" mark. The average mark for all applicants is usually around 45-55 marks. The average for shortlisted applicants is usually around 60-70 marks. If you are getting 65 marks consistently on past papers, you should be fine.

However, there is no certainty on being shortlisted. Students who scored as low as 20 have been shortlisted, and students who scored as high as 70 have not, though both of these are unlikely. The process for being shortlisted factors additional circumstances into account.

# BREAKDOWN OF HOW TO ANSWER EACH TYPE OF QUESTION

## How do I answer Question 1?

- Each part in this question will give a mathematical statement as well as 5 choices for an answer. These parts will vary greatly in topics, though there is usually at least one question about how an equation looks like when it is plotted, and many questions about finding the solutions to equations.

- For each part, it is somewhat easy to deduce the answer from one of 3 choices. From here, you can use properties of the statement to find the solution.

- To use an example similar to a previous MAT question, take the equation x3-75x=100 with choices being a) no solution, b) one solution, c) two solutions, d) three solutions, or e) infinitely many solutions.

- Since this is a cubic equation, we know the solution must be either b, c or d. From there, we can draw a simple sketch of the problem and use calculus to find a local maximum, allowing us to see where the lines y=x and y=x3-75x cross. Of course, there are many other ways to solve this question.

- One tip for time management is to spend at most an hour on this question, so 6 minutes per part. You should not rush this question, as that is a definite way to make silly mistakes, but the longer questions usually require more time to think about.

- Do not leave any of these parts unanswered. If at the end of the test you still have some parts left blank, it is better to guess the answer than to not answer at all.

## How do I answer the longer questions?

Questions 2-7 tend to be longer questions that cover multiple different topics from the MAT syllabus. Each have multiple parts that build on earlier parts of the question. The first few parts ask you to use the information given to prove something. These parts are usually quite straightforward and tend to be similar to problems seen in A-Level Maths.

Later parts of the question may need answers to the previous parts to answer them. It may take some time to figure out what the next step may be. At this point, sketching graphs, working on simpler versions of the problem, or looking at different cases of the problem may help to unearth some new information.

This is Question 2 from the 2016 paper for an example:

**2.** For **ALL APPLICANTS.**

Let

$$A(x) = 2x + 1, \qquad B(x) = 3x + 2.$$

(i) Show that $A(B(x)) = B(A(x))$.

(ii) Let $n$ be a positive integer. Determine $A^n(x)$ where

$$A^n(x) = \underbrace{A(A(A \cdots A}_{n \text{ times}}(x) \cdots ).$$

Put your answer in the simplest form possible.

The first two parts ask you to directly use the information given to answer these parts. They may need some time to think through, but are quick once you know what is being asked of you.

A function $F(x) = 108x + c$ (where $c$ is a positive integer) is produced by repeatedly applying the functions $A(x)$ and $B(x)$ in some order.

(iii) In how many different orders can $A(x)$ and $B(x)$ be applied to produce $F(x)$? Justify your answer.

(iv) What are the possible values of $c$? Justify your answer.

(v) Are there positive integers $m_1, \ldots, m_k, n_1, \ldots, n_k$ such that

$$A^{m_1}B^{n_1}(x) + A^{m_2}B^{n_2}(x) + \cdots + A^{m_k}B^{n_k}(x) = 214x + 92 \qquad \text{for all } x?$$

Justify your answer.

The last three parts build on what you found in parts (i) and (ii). For example, part (iii) uses part (i) which shows that A and B commute. Similarly, part (ii) is helpful in answering part (iv).

Part (v) is usually the hardest part, and may need the student to find a “trick” to solve it. One way to proceed would be experiment with the information given further and find any patterns.

Not every section needs to be answered with maths alone. A well written explanation of what you have found is also a valid answer and may even take less time than trying to show it mathematically.

Candidates should spend about 20-25 minutes on each long question. If an applicant gets stuck on a certain question for a significant amount of time, it would be best to move ahead to another question and return later if there is time.