

Some thoughts on preparing for Oxford Mathematics exams

It is likely that Oxford Mathematics exams will be different from your school mathematics exams, so it is worth taking some time to think about how best to prepare for them.

Sources of information

Your tutors will advise you about revision and exam preparation. The department holds 'examination forums' in Trinity term, one for Prelims and one for Finals (Parts A and B), to provide advice on revision techniques and to give further details about the format of the exams. There is a list of helpful websites at the end of this document.

- The Examination Conventions give useful information about how each exam is marked and how the overall results are decided. You will also get a letter from the Chairman of Examiners giving you more information about the exams, please be sure to read it.
- The course synopses give the syllabus for each course. This tells you what you are expected to know, and in particular which bits of bookwork you need to learn.
- The Examiners' reports for each examination can be useful when you are trying questions. You can see what the Examiners were looking for, and get some idea of how those who took the exam did on particular questions.
- Past exam papers give a good guide to the typical format and content of exam questions. But take care, the syllabus for a course may have changed significantly, or the course may be new, so if in doubt ask your tutors about the most suitable past paper or specimen questions.

For each course make sure that you have to hand, in one place and in an organised manner, your lecture notes, the problem sheets, your solutions, your notes from tutorials, the course synopsis and in due course your own revision notes and your work on past paper questions.

In your first two years, your revision is likely to be guided by your tutors. In Parts B and C the department runs *consultation sessions* each Trinity term to help with revision. Each course will have at least one set of consultation sessions with a class tutor, and you can drop in to ask questions you may have relating to your revision or past papers-

Some thoughts on revision

Different people learn most effectively in different ways, so these notes cannot give a 'one size fits all' guide, but instead we give some suggestions for how you might approach your revision. Many first-year undergraduates have not had to revise much for maths exams in the past, but now that you are at university you will certainly need to revise carefully. It is worth thinking actively about *how* you are revising, and perhaps experimenting with different strategies to find what works best for you.

Revision in the Christmas and Easter vacations. Research shows that learning happens most effectively when students repeatedly revisit material, perhaps with increasing gaps between each visit. It is therefore well worth revising and consolidating your understanding of the topics covered in Michaelmas term and in Hilary term during the subsequent vacations as this should make your summer revision much easier, as well as helping you to grasp new material in the next courses. Most colleges set their students *collections*

(internal college exams) at the beginning of Hilary term and Trinity term, as a way to encourage students to revise over the vacations and to give some practice at Oxford-style exams. This is also a good way to get feedback on your progress. Lectures finish well before the summer exams start, but most students start their summer revision before the lectures finish.

Balance your revision across all the courses. Don't spend all your time on the paper you find hardest, or on the one you find most interesting. This may require quite a lot of self-discipline! Some people find it helpful to draw up a (realistic) revision timetable and then to stick to it, others take a more fluid approach but are vigilant to make sure they are covering all the topics appropriately. Before drawing up a revision timetable, you might want to check with your tutors whether there are any key dates (such as deadlines for handing in work on past paper questions or tutorials to discuss particular topics) so that you can factor those in. It is definitely not a good use of time to keep redrawing revision timetables because things have gone awry.

Exam question format. A typical exam question will have some *bookwork*, asking you to reproduce material (definitions, statements of results, proofs of results) from your lecture notes, and some *unseen material* asking you to demonstrate your understanding and problem-solving skills by applying your knowledge to questions that you haven't seen before. It is therefore important that your revision includes both work on learning material from your lecture notes and time spent tackling questions.

Use exam questions early in your revision. A classic mistake that some students make is to think "First I'll understand and learn the material, and then I'll tackle the past exam questions." This is never a good plan, because understanding and learning material can expand to fill all your revision time. First remind yourself of the key points and results of the course, but then move on to work on understanding and learning *alongside* tackling past paper questions. Use the questions to aid your revision. They may seem challenging at first, but practising them should help you to get better. You will not be able to get good marks by just relying on bookwork, so make sure you work on the problem solving too.

Learning proofs and definitions. You will need to know definitions, and statements and proofs of theorems, so that you can reproduce them. You will be expected to have learned a large quantity of material for the exams, and almost nobody is able to learn that much material 'by rote' – rather, you need to use your understanding to enable you to remember the material. Knowing why the definitions are as they are, what the theorems are about, how the material fits together, will all help. Once you properly understand a proof, then you can identify the one or two or three key ideas, and focus on those. With practice, you can then reproduce the whole proof, because you have learned those key landmarks and you can fill in the intermediate steps almost on autopilot. That understanding will also give you methods to use in unseen problems.

You might find it helpful to write summary notes to give you an overview of a particular course. Similarly you might want to write notes on proofs highlighting the key steps.

Keep reviewing what you have learned. There are many ways to do this effectively, but they all have in common that you have to be *active* in your revision. Simply rereading notes is very unlikely to lead to effective learning. Instead, test your understanding, and then fill in gaps as you discover them. Some people like to do this using flashcards, either physically on paper or electronically (using software such as Anki). Some people like to put post-it notes round the bathroom mirror as prompts to check their understanding while cleaning their teeth. Some people like to practise stating definitions and results and working through proofs while walking: perhaps you can go through the same proof on a particular route round the college

gardens, so that in an exam you can mentally walk that route and remember that looking at a certain bush means you need to use a particular mathematical idea. Some people like to draw mind maps, connecting ideas in the course and highlighting shared features of particular proofs. You have to experiment to find what works for you. Just make sure that it is *active* revision, not passively reading notes or highlighting parts of your notes. (Highlighting notes may be helpful, but is unlikely to be the only strategy you need.)

Tackling past exam questions will also test your understanding and recall. If necessary, use your notes as you work on questions at first, with the aim of moving to solving questions without notes. If you do use notes, make sure you do so carefully. It is entirely possible to copy a definition or proof from your notes to your solution without it passing through, let alone lodging in, your brain. Instead, if you look at a question and realise that you don't yet know the relevant piece of bookwork, then go and look it up in your notes. Work on it, review it, then put away your notes, and do something else for a few minutes. Only then should you go back to your exam question and try to write out your solution. If you manage, then great, if not, then you can repeat the process again. It all takes time, but it does mean that you are actively learning, and that is always time well spent.

Timed papers. As the exams approach, your tutors will probably ask you to test the effectiveness of your revision (and get exam practice) by tackling some past exam papers as if under exam conditions. These may be less important for some students, but if you get nervous in exams or have issues with time-management doing timed papers needs to be a key part at some stage of your revision.

Practicalities relating to exams

It is best to minimise the number of surprises on the day of an exam. You cannot know the questions in advance, but you can know just about everything else in advance. You might want to check the following.

- When your exam starts, and how early you need to arrive there.
- Where your exam is and how much time to allow to get there. You might want to visit beforehand, to check that you know exactly where it is and how to get there. The university gives students an opportunity to sit a mock exam in the genuine exam venue (see <https://www.ox.ac.uk/students/academic/exams/mocks>).
- What you need to wear, and what you are allowed and need to take with you. (See <https://www.ox.ac.uk/students/academic/exams/guidance>)
- What the format of the exam will be. How long? How many questions? Are there rules on the number of questions you can tackle from each section? Do you need to start each question in a new booklet? (This is all given in the *rubric*, the set of instructions on the front of each exam paper.)
- If you have alternative arrangements for your exams (for example extra time), check with your college exactly what the arrangements are, and make sure that you are comfortable with them.

Make sure that your body clock is aligned with your exam timetable in advance. You want to be alert and fresh for the start of your exam, not bleary-eyed from a late night or getting up unaccustomedly early. Get into a good sleep routine, eat sensibly, get some exercise. There is research that shows that last-minute cramming is not only ineffective, it can even be counterproductive. In the last few days before exams, focus on staying calm, on consolidating your revision, and on staying fit and healthy so that you can focus throughout all your papers.

Some thoughts on exam technique

You should talk to your tutors about exam technique and about your strategies for answering questions, and they will be able to give you targeted advice. Here are a few general pointers.

The examiners are not trying to catch you out. They are not interested in what you don't know or don't understand. Rather, they would like you to demonstrate what you *do* know and understand. If you're writing out a proof that you know, be careful to include all the details so that you get credit for them. (Of course, if you don't know what you are doing then you are free to bluff!) If the question says "You may assume such-and-such theorem provided you state it clearly", and you know the theorem, then state it clearly and claim the corresponding mark(s). There will probably be some parts of some questions that you find difficult or cannot manage to do in the time. But make sure that you get as much credit as you can for the things that you *can* do.

Choosing questions. For many students, university exams are the first time they have had to choose which questions to attempt. Spend a few minutes at the start of the exam reading each question carefully and fully. Don't start a question simply because you can do the first part – the rest of the question might turn out to be more problematic. If it helps, jot down notes on the question paper as you read through, to jog your memory later in the exam. Pick the question you like most to start with, there is no need to tackle questions in the order they appear on the paper. You might like to practise choosing questions as you work on past papers, to sharpen your sense of which questions you find most approachable.

Plan your time carefully. It is generally easier to get the first five marks on a question than to get the last five, so it is more sensible to attempt the required number of questions than to spend a long time trying to finish off the last part of a question where you are stuck. Make sure you know how far through the exam you are, and if necessary move on to start another question. You can always return to a question later on if you have time.

Answer the question that has been set, not the one you wish had been set. Examiners want to give credit for understanding, but they can only give marks for answering the given questions.

Don't omit parts of a question by mistake! Students in an exam situation are naturally nervous and it is easy to skip a part. If it helps, tick off each part of the question as you complete it.

If you are stuck on a question, remember that the questions are set based on the syllabus. You could try asking yourself which part of the course or which theorem of the course might help. Often the bookwork set will be used in the unseen part of the question, and can be used to guide you as to which part of the course is relevant. Can you work backwards from a given answer or formula? What aspects of the given formula are familiar to you? Also if you can't prove what's asked in a middle part but can see how it would be used in a later part, then it's fine to assume the given answer and proceed to the later part. Students sometimes give up on a question when they are stuck on one part, but often they would have been able to make progress on subsequent parts nonetheless. Give yourself some time to think, try not to panic.

If you are still stuck it might be sensible to move on to later parts of the question or to another question. Your subconscious is an effective solver of problems!

Explain what you are doing fully. Examiners can only give credit for what is on the page, not what they imagine might have been in your head when you wrote it. Give proper justifications, show your working,

define your notation, cite theorems carefully. Similarly take care checking off the hypotheses of a theorem when applying it; otherwise you are throwing away straightforward marks.

Set out your answer logically and legibly. Define any notation not already given in the question. If you make a mistake, put a single clear line through it and carry on underneath. Make it clear what you want the examiner to read and what you don't, but don't spend time obliterating parts of your solution.

There are no formula books, so make sure you know any required formulae, including for example trig and integration formulae.

Read the rubric: Check beforehand what the rubric will be for each paper so that you have no surprises during the exam, but before the exam starts you should still take time to read through the rubric. Examiners cannot give credit for work that is outside the rubric.

Finally...

Take a minute to stop and think about how much mathematics you have learned and understood since the start of October. Pretty impressive, huh? Don't focus on the things you haven't learned. By the time of the exam, there is nothing you can do about that. Instead, concentrate on the things that you have achieved, that you are proud of. And now go and show the examiners what you can do. Examiners like seeing students demonstrate their mathematical understanding!

Useful links

Past exam papers: <https://www.maths.ox.ac.uk/members/students/undergraduate-courses/examinations-assessments/past-papers>

Specimen solutions to Part B exam papers: <https://www.maths.ox.ac.uk/members/students/undergraduate-courses/examinations-assessments/part-b-specimen-solutions>

Specimen solutions to Part C exam papers: <https://www.maths.ox.ac.uk/members/students/undergraduate-courses/examinations-assessments/part-c-specimen-solutions>

Examination conventions: <https://www.maths.ox.ac.uk/members/students/undergraduate-courses/examinations-assessments/examination-conventions>

Examiners' reports on past examinations: <https://www.maths.ox.ac.uk/members/students/undergraduate-courses/examinations-assessments/examiners-reports>

Course synopses: <https://www.maths.ox.ac.uk/members/students/undergraduate-courses/teaching-and-learning/handbooks-synopses>

University guidance on exams and revision: <https://www.ox.ac.uk/students/academic/guidance/skills/revision>

Counselling Service podcasts on exam preparation and revision: <https://www.ox.ac.uk/students/welfare/counselling/self-help/podcasts>