Advice on Preparing for Exams in Parts IA, IB and II of the Mathematical Tripos

These guidance notes are intended for all mathematics undergraduates, to assist with preparations for exams. The focus is on academic and educational matters, while further information on more practical arrangements will follow in due course.

Introduction

The examination timetable for Parts IA, IB and II is summarised in the Appendix; see https://www.cambridgestudents.cam.ac.uk/your-course/examinations/all-students-timetable

Exams will be held in person and students are expected to be present in Cambridge.

The University has announced that normal residency requirements will apply from the start of Easter Term 2022: https://www.cam.ac.uk/coronavirus/students/academic-year-2021-22/teaching-and-learning/guidance-on-exceptional-circumstances-2021-22
Any student who thinks they may be unable to fulfil these requirements is advised to contact their College Tutor and Director of Studies as soon as possible.

Contingency plans will be in place for any students who are unavoidably prevented from sitting exams in person due to local or international public health restrictions. These contingency plans will involve timed and invigilated online exams, with papers taken according to the same timetable. Further details will be circulated in due course.
The Faculty is committed to maintaining academic integrity and assessing all students fairly.

Students with approved examination access arrangements (e.g. extra time) should check with their Colleges to confirm details.

The general University "Guide to Examinations" should be updated shortly:
https://www.cambridgestudents.cam.ac.uk/your-course/examinations

Assessment, alpha and beta grades, and merit marks

Full descriptions of the examination structure for Parts IA, IB and II, including marking, and classing, can be found in the *Schedules* booklet https://www.maths.cam.ac.uk/undergrad/files/schedules.pdf (students may also find it helpful to look back at the *Guide to Courses* booklets and other resources available at https://www.maths.cam.ac.uk/undergrad/course). Some further details are summarised in the Appendix.

There are four exam papers for each Tripos part, with each paper consisting of both ***short*** questions (Section I) and ***long*** questions (Section II). Short questions are intended to be accessible to any student who has studied the course material conscientiously whereas long questions are intended to be more challenging.

Short questions are marked out of 10, with a ***beta*** quality grade for a mark of 7 or more. Long questions are marked out of 20, with a ***beta*** quality grade for a mark in the range 10-14 (inclusive), and an ***alpha*** quality grade for a mark of 15 or more.

In classing candidates, examiners use a *merit mark* that is defined by taking the total *raw mark* and adding additional credit for each beta quality grade and more additional credit for each alpha quality grade. This means that an answer that is substantially complete and correct will result in significantly more credit than several fragmentary attempts that produce the same total raw mark.

How to prepare: an overview and some key points

Aims and approaches that will help you prepare well for the exams might be summarised as follows:

(a) Learn the material in each course thoroughly, referring to your lecture notes and supervision work (covering definitions, theorems, proofs, standard techniques, applications and examples).

(b) Work through a good number of past exam questions to (i) test and improve your knowledge and understanding; (ii) practice explaining what you know clearly and concisely; (iii) practice solving unseen problems as effectively as possible.

(c) Develop approaches that will help you in an exam environment, i.e. *exam strategies* or *techniques* that will allow you to make the most of what you've accomplished in (a) and (b).

You should be concentrating on (b) throughout the Term, on a timetable consistent with your revision supervisions. It is reasonable to expect to focus more on (a) earlier in the Term, but you should continue to strengthen and deepen your understanding of the courses throughout your revision. Similarly, while you may focus more on (c) as the exams draw nearer, helpful strategies might be developed more easily by establishing good habits as you prepare for each supervision.

The following sections labelled **A**, **B** and **C** contain more detailed advice regarding points (a), (b) and (c). This guidance relies heavily on feedback received from students over a number of years, as well on the experiences of supervisors and examiners. However, **there is no suggestion that the guidance is fully comprehensive or complete.** Furthermore **it is important for you to find what works well for *you*** - **students are not all the same!** As always, rely on your Directors of Studies and supervisors for further advice: they know you best.

In addition to the purely academic considerations above, there is one more very important goal:

(d) Maintain a healthy balance of work, relaxation and rest throughout the Term.

(i) Be as focussed as possible in your revision work to make the best possible use of your time.

(ii) Take regular breaks from work for exercise or just to get some fresh air.

(iii) Keep to healthy patterns of eating and sleeping - work requires energy! - don't skip meals or carry on working too late into the night.

(iv) Keep in touch with friends and family.

(v) Support your fellow students but treat your own wellbeing as a top priority - don't let concerns and anxieties of others weigh on you and stress you out.

(vi) When you are finding work challenging, **remember that you are studying at Cambridge because you are good at mathematics**.

(vii) When work is going well, **remember that you are allowed to enjoy revision!**

In summary: work hard and do your best but stay healthy.

A. Advice on learning course material

Make sure you have a full set of notes to work from (fill in any gaps as soon as you can) and learn the material in each course as thoroughly as possible. Although lecture recordings will continue to be available online until after the exams, you will probably find it much too awkward and time consuming to consult recordings frequently during revision, rather than relying on your own notes.

Some basic points to keep in mind:

(i) Understanding (not just memorising) is vital. As you learn, think about the key concepts and results, and the main steps and crucial ideas needed in proofs or applications.

(ii) Precision and accuracy are important - you must get the details right. Learn definitions carefully and be sure you know the conditions for a theorem to hold or the circumstances in which a method can be applied.

(iii) Work through some examples and review relevant supervision problems as you study each section of the course. Build up a stock of useful examples, non-examples, or counterexamples.

(iv) Resist any temptation to leave out sections of notes as you study. Examiners set questions that test as much of the course as is reasonably possible, so the more consistent your coverage of the material, the better.

(v) For an important result, try writing out an account and seeing how far you can get without peeking at your notes. Then try again!

(vi) If a proof or derivation can be done in slightly different ways, choose and refine your approach so that you can reproduce it quickly and with confidence under exam conditions.

(vii) Don't spend too long just learning notes without also tackling Tripos questions.

B. Advice on working through Tripos questions

(i) Working without your notes
Attempting questions without consulting your notes is the best preparation for exams, but you need to be able to reproduce standard material without re-inventing the wheel. Go back to your notes and refresh your memory when you need to (you may have to do this quite frequently at first), but *learn* the material that you couldn't recall or reconstruct. Don't get into the bad habit of relying on your notes to finish a question *without* filling in the gaps in your knowledge.

(ii) Speed, accuracy and quality
Once you feel confident making decent attempts, time yourself on individual questions. Speed is important - you obviously want to cover ground and gain as many marks as possible on each paper - but you need to maintain accuracy. Don't rush the more routine parts of questions (e.g. by missing out too many steps) since this can lead to silly errors that will cost you marks. You should also be prepared to take some time to think through a harder problem, or to complete a lengthier calculation: don't give up too soon if there seems a decent chance of finishing a question and gaining an extra quality mark.

(iii) Read the question!
Read each question carefully and remember that your aim is **to do everything that you are asked, but not to do more than is necessary**. It is easy to misread a question if it looks superficially like one you've seen before (especially in an exam, when you may be feeling nervous), or to miss out small parts entirely (then you'll certainly lose marks). Look out for conditions that can make a big difference (e.g. "non-negative, "invertible", "abelian"). It is also important to think how the various parts

of a question might be related and to make the most of any hints - examiners will have considered the wording very carefully! A common pattern is for a question to start with some bookwork (perhaps of the "state and prove" variety) followed by an unseen problem that can be solved by applying earlier results or related ideas. Sometimes the connections between different parts of a question are less obvious, however; and sometimes there are *no* connections.

(iv) How much detail is needed in an answer?
Be guided by the style adopted in the course and the context of the question, i.e. use common sense. A good guide for bookwork is to use the same level of detail given in lectures. A good guide for problems is to use standard results as needed, unless the question specifically asks for more. If you are asked to verify something, then it may be appropriate to answer directly with an elementary calculation, rather than appealing to a more sophisticated and general result.

(v) Revision supervisions
These are a very important part of the revision process. Make the most of them by preparing thoroughly and paying close attention to any feedback that your supervisor has to offer. Most supervisors will be able to look in detail at about two years' worth of questions (there may not be enough time to discuss more). However, you can also ask about specific questions (perhaps giving notice in advance) or about topics in the course that you are finding difficult to understand. You might consult with your supervision partner about points that you'd like to raise.

(vi) How many past questions?
There is no hard and fast rule, but a reasonable recommendation is that you should aim to cover **around 3-5 years of past questions** before the exams. You can seek further guidance and advice from your supervisor or Director of Studies.

C. Advice on exam strategy

The following suggestions may involve planning ***well before*** the exams and in some cases they are extensions of points made earlier.

(i) Timed mocks
As part of your revision, set yourself some timed, three-hour mock papers. You are likely to benefit most from taking these under exam conditions - don't be tempted to peek at your notes or check your phone! Working under time pressure in this way will help you develop a sense of how to pace yourself over three hours and how much time it is reasonable to spend trying to finish a particular question (to get an alpha or beta) before moving on to something new.

(ii) Know what to expect
Make sure that you are familiar with how questions are distributed across papers and how many questions of each kind you can submit (see the Appendix for a summary and the *Schedules* booklet for full details). You will receive, well in advance of the exam, a copy of the *rubric* for each paper which specifies how many answers you can submit as well as other more procedural matters. Read this carefully and ask your Director of Studies if you have any questions.

(iii) Be alert!
It is very important that you are well rested and alert so that you are able to concentrate as fully as possible during each paper. The best way to achieve this is to maintain a healthy pattern of work, relaxation and rest throughout the Term. Once the exams are under way, rest well and be cautious about working too much between papers - this can be counterproductive.

(iv) Choose questions wisely
At the start of the exam, look over the whole paper to identify questions that you can do well on (and note **B (iii)** above) - chose questions because they seem doable rather than because they seem interesting! When selecting long questions, try to see your way through the more challenging or

problem-related parts to anticipate what will be involved. Long questions offer the possibility of alpha grades which give substantial credit, but **it is the merit mark that is important in classing candidates** and you shouldn't underestimate the credit available from short questions. Some students find that attempting a short question or two right at the start of the exam provides a good way of settling nerves.

(v) Presentation and clarity
There are no bonus marks for calligraphy, but **you must write legibly and clearly** (on one side of the script paper only), something you can practice throughout your revision. Present your arguments on the page so as to make the logical structure as clear as possible, and don't miss out steps that might seem simple but are likely to be part of a full answer (see also **B (ii)** above). Jotting down calculations or ideas in rough can be helpful (paper is provided for this purpose), but don't waste time by working too extensively in rough and then copying up a "neat version". There is nothing wrong with handing in answers that contain crossings out or corrections, as long as these are clear and easy to follow so that the meaning is unambiguous.

(vi) Don't panic!
Being faced with challenging questions and a strict time constraint can feel overwhelming, but remember to breathe, stay calm, and simply do your best. If you are finding the questions particularly difficult, there are probably many others taking the exam along with you who are feeling exactly the same. Keep in mind that generations of students have gone through this experience and lived to tell the tale (some of them may even be marking your questions). If you are really worried about how a paper has gone, contact your DoS for advice, but try to put the experience behind you and approach the next paper as positively as you can.

On behalf of the Faculty - good luck with your exams!

Director of Undergraduate Education
Faculty of Mathematics
April 2022

Appendix – Exam timetable and further details on assessment

Exam timetable

Papers 1, 2, 3, 4 for each Tripos part have been scheduled as follows.

Part IA: 9:00 Thu 2 June; 1:30 Fri 3 June; 9:00 Mon 6 June; 1:30 Wed 8 June.

For the Mathematics with Physics option in Part IA, paper 4 is replaced by the NST Physics paper, scheduled for 1:30 Sat 11 June.

Part IB: 9:00 Tue 7 June; 9:00 Wed 8 June; 1:30 Thu 9 June, 1:30 Fri 10 June.

Part II: 1:30 Mon 6 June; 1:30 Tue 7 June; 9:00 Thu 9 June; 9:00 Fri 10 June.

The venue for all exams in Parts IA, IB and II will be the University Sports Centre
https://www.cambridgestudents.cam.ac.uk/your-course/examinations/undergraduate-exam-information/exam-sites/sports-hall

Further details on papers and numbers of questions

Part IA: On each paper there are four short (Section I) and eight long (Section II) questions divided equally between two courses, as follows.

Paper 1: Vectors and Matrices, Analysis I
Paper 2: Differential Equations, Probability
Paper 3: Groups, Vector Calculus
Paper 4: Numbers and Sets, Dynamics and Relativity

On each paper, candidates may obtain credit for attempts on all four short questions and at most five long questions, of which no more than three may be on the same lecture course.

Part IB: The distribution of questions on papers can be found in the *Schedules* booklet.
On each paper, candidates may obtain credit for attempts on at most four short (Section I) questions and at most six long (Section II) questions

Part II: On each paper there are ten short (Section I) questions, one on each C course. The distribution of long (Section II) questions for C and D courses can be found in the *Schedules* booklet.
On each paper, candidates may obtain credit for attempts on at most six short questions and any number of long questions.

Further details on merit marks and classification

Corresponding to the primary classification criteria, the examiners consider the quantity M_1 at the first/upper second borderline, and the quantity M_2 at the upper second/lower second and lower second/third borderlines, where

$$M_1 = 30\alpha + 5\beta + m - 120\,, \qquad M_2 = 15\alpha + 5\beta + m\,,$$

and where m is the total raw mark, α is the number of alpha quality grades and β is the number of beta quality grades. The merit mark M is defined by $M = M_1$ for candidates in the first class, or for candidates in the upper second class with $\alpha \geq 8$, and by $M = M_2$ otherwise. For the great majority of candidates,

$$M = M_1 \quad \text{for} \quad \alpha \geq 8\,, \qquad M = M_2 \quad \text{for} \quad \alpha \leq 8\,.$$

The Faculty Board recommends approximate percentages of candidates for each class:

30% firsts; 70-75% upper seconds and above; 90-95% lower seconds and above; 5-10% thirds and below;

examiners exercise academic judgement in setting borderlines.

For further details, see the *Schedules* booklet.