

Department of Earth Sciences  
University of Cambridge



**PART IB EARTH SCIENCES B  
COURSE GUIDE 2021-22**

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# 1. Introduction to the Course

**Earth Sciences 'B'** will introduce you to the physical and chemical principles that 'solid Earth' mineralogists, petrologists, geophysicists and geochemists use to understand how the Earth works, formed and differentiated; and how it has subsequently evolved. This course principally focusses on the interior of our (and other) planet(s), what it is made of, and how tectonics shapes our surface environment. This course has important links to applications such as Natural Hazards and Sustainable Earth Resources. This is a self-contained course and you will find that, as the year goes on, there are important links between the different elements that are taught in each term. Earth Sciences B will provide you with some of the background that you will need for Part II & III Earth Sciences, and in particular for any advanced courses in metamorphic and igneous petrology; volcanology; mineralogy, geophysics and tectonics.

The skills that you will develop through the year will not only be intellectual (for example, in understanding theoretical elements of the course); but also practical (in particular, the ability to recognise and identify minerals in thin section and hand specimen; to interpret rock textures and model datasets). You will also be exposed to case studies of a number of important geological regions (including the Himalayas and the British Tertiary Volcanic Province). These examples will help you develop the essential geological skills of weighing up different sets of observations; comparing them with simple models and thereby developing an understanding of how these regions have evolved through time, and the processes that have controlled this evolution.

This year we continue to face special challenges in teaching and learning associated with the Covid-19 pandemic. We intend to deliver the course as normal, with in-person lectures and practicals, with the addition of lecture recording in the lecture theatre. Note that if the pandemic situation deteriorates this may change. We continue this year with **assessed practicals**, which will take place in Michaelmas and Lent terms. An important communication channel, which you must keep a day-to-day eye on, is the [ESB Moodle page](#), where important announcements will be posted, sometimes at short notice. You will find a **laptop and/or tablet device** invaluable this year for accessing and getting the most out of the teaching material. Please see page 13 for a message from our librarian, Sarah Humbert, on arrangements for this year. Please read the information in this guide carefully. Above all, I hope that you enjoy the course.

Prof Marie Edmonds (Course Coordinator)  
[me201@cam.ac.uk](mailto:me201@cam.ac.uk)

## 2. How to get the most out of the course

**Communications** will take place through the [ESB Moodle page](#). Please check this page regularly and carefully.

**Lectures** will cover the essential parts of the course. Lectures will be in person in the Tilley Lecture Theatre in Earth Sciences. Lectures will also be recorded using the lecture capture facilities in the Tilley, and uploaded to Moodle. Handouts may be accessed on Moodle.

**Practicals** take place in the ESB lab (2<sup>nd</sup> floor, South Wing); of which you will attend 3 per week, one per lecture. In the practical sessions you will develop your petrological skills and learn how to tackle real geological maps. A key element of the practical teaching is the interaction with the demonstrators, who will give you guidance on the problems in hand. Answers to the practicals will be made available on Moodle at the end of each practical session.

**Field trips** will take place at Easter (to Cornwall), and in the early summer (to Skye, Scotland). Field trips are important in augmenting the lecture and practical material; and in developing the field skills (including observation, measurement, note-taking and mapping) that you will need for your independent field projects later next year.

**Supervisions** will provide the usual mixture of past-Tripes questions, practical material, question sheets and discussion. During the Michaelmas and Lent terms, weekly question sheets are circulated; the answers are available a week later. These question sheets contain a variety of questions designed to encourage you to think and to practise your newly learned skills. A petrographic series of hand specimens and thin sections has been developed with narrated videos (you can find these on Moodle) which you will find useful for supervision work.

**Reading** beyond the lectures will be essential if you are to develop a full understanding of the material that is being covered in the course. Your College library should have all the standard textbooks from your reading lists. If not, ask the library to order them through your Director of Studies or supervisor.

### **Igneous and Metamorphic Rock Reference Series**

There is an extensive reference series of rocks and minerals (both hand specimens and thin sections) in the ESB laboratory. You should be able to work through the material on your own and in supervisions throughout the year. Details of the igneous rock reference series are available on Moodle.

### 3. What happens when? Lectures, practicals and reading lists

The [lecture and practical list](#) for Part IB Earth Sciences B can be found on the ESB Moodle page.

Lectures take place Mon, Wed, Fri at 9 am in the Tilley Lecture Theatre, on the ground floor of the south wing of Earth Sciences. There are 24 lectures in a term. Lectures 1-3 happen in week 1, lectures 4-6 in week 2 etc. Lectures will be recorded using in-theatre lecture capture, and uploaded onto Moodle.

Practicals take place in the 1B ESB laboratory, on the second floor of the south wing of the Earth Science Building [*enter through the south wing door of the Department and go up stairs. On the 2<sup>nd</sup> floor the ESB lab is the first room on your right*]. You will attend 3 per week:

- The first at either Mon 11 am until 1 pm, or Tue 10 am until 12 am;
- The second at either Wed 11 am until 1 pm, or Thu 10 am until 12 am;
- The third at either Fri 11 am until 1 pm, or Sat 10 am until 12 am.

You can sign up to a particular slot [here](#) (this link is also accessible on the Moodle page). You must stick to these slots every week.

**Important:** there may be short notice changes to practical arrangements, e.g. in the event of a department shut down, or if the lecturer cannot attend. You must check the Moodle page for announcements regularly, and you will likely receive an email.

The timing of **question sheets** becoming available for download on Moodle is indicated on the lecture list, as are the map practicals. The question sheet answers will become available a week later.

The ESB reading list is available on Moodle.

The 1B timetable will be available on Moodle; however, you can also set up your own personal timetable based on your subject and practical choices, using the online University [Timetable](#).

Please email Helen Averill (hpd20@cam.ac.uk) or Mitha Madhu (mm853@cam.ac.uk) if there are any problems with accessing these documents or the Moodle site.

## 4. Field Courses

### Southwest England:

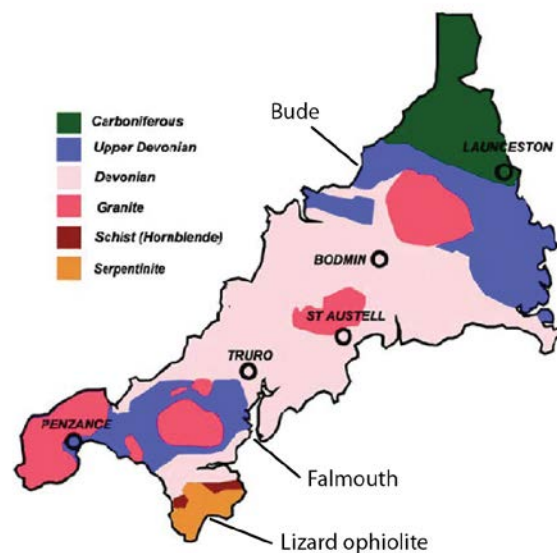
As well as being in a very beautiful part of the country, the rocks of Cornwall are world famous. The main purpose of the trip is to visit some of the most important localities, both to reinforce aspects of the ESB course, from the perspective of igneous and metamorphic rocks in the field, and to understand the relationships between them in the context of their tectonic setting.



The sedimentary rocks of Devon and Cornwall are Devonian to Carboniferous in age, having been deposited on a rifted continental basement on the northern margin of the Rheic ocean. They include basic igneous and sedimentary rocks that were metamorphosed up to greenschist facies in the northern zone of the Variscan orogen. This zone also includes the Lizard ophiolite complex, representing a fragment of oceanic crust. The Cornish granites were

formed by melting of continental crust at the end of the Variscan orogeny. These granites host economic deposits of tin, lead, tungsten (and even some uranium), formed from hydrothermal fluids.

*Geology of Cornwall*





*Gabbroic vein cutting peridotite in the Lizard ophiolite. The red selvedge surrounding the vein is Fe-stained serpentinised olivine. The original orthopyroxene of the peridotite in the vein walls has been dissolved by the depressurizing basaltic liquid passing through the fracture, while olivine has been precipitated.*

During the trip we spend a few days looking at the Lizard ophiolite and granite intrusions from a base in Falmouth and a few days looking at the spectacular folding and metamorphism of Devonian rocks from a base in Bude. An interesting and instructive time is had by all!

22 March to 1 April 2022. There will be two parties. One party spends the first week in Dorset (Weymouth), then moves to Cornwall (Bude then Falmouth) on Sunday 27 March. The other party does the reverse (Falmouth then Bude then Weymouth). We strongly advise students taking a second year earth sciences course to attend the whole field trip but a decision to attend in part must be made beforehand. However, 'A-only' students should at least come to Dorset and Bude and 'B-only' students at least to Bude and Falmouth. If you opt to do the whole trip and then drop out part way through, you will be liable for additional costs in the order of £250 towards accommodation and transport.

**Isle of Skye:** Friday 24 June, for those who did not go on the IA mapping course, or Monday 27 June, for those who did, course ends on Saturday 9 July 2022.

## 5. Examinations and assessment

### *Theory examinations*

Theory examinations will make up 60% of the total mark. There are two theory papers, each of three hours duration, each worth 30% of the total mark. Each paper is divided into two sections of five questions. You need to do two questions from each section.

### *Practical examination and assessed practicals*

The practical examination and assessed practicals together will make up 40% of the total mark.

The **practical examination** takes place during the exam period in Easter term, and will be worth 20% of the total mark.

There will be two **assessed practicals**, described below, each worth 10% of the total mark.

1. Crystallography and optics. This assessed practical will become available (in the laboratory and on Moodle) at the beginning of week 7 in Michaelmas term. The deadline for submission is the last day of week 8 i.e. **1 December at 5 pm**.
2. Geological map. This assessed practical will become available at the beginning of week 7 in Lent term. The deadline for submission is the last day of week 8 i.e. **16 March at 5 pm**.

Assessed practicals should be submitted via the Moodle site (navigate to the lecture/practical block and find the link there) by 5 pm on the due date. Please submit a single pdf. Where sketches and drawings are included, these can be hand drawn and scanned/photographed and inserted into the pdf. Please familiarise yourself with how to do this a few days in advance of the first assessment.

**If the assessed practical is submitted late** by up to 24 hours, then it will only be possible to achieve 8/10 marks; up to 48 hours late the maximum marks achievable will be 6/10 marks; submitting it more than 48 hours late will mean no marks are given. If there are circumstances you wish to be taken into account as to why you missed or submitted an assessed practical late, this should be done via your college tutor, communicating with the Teaching Support Manager Helen Averill ([hpd20@cam.ac.uk](mailto:hpd20@cam.ac.uk)) and Marie Edmonds, course coordinator ([me201@cam.ac.uk](mailto:me201@cam.ac.uk)).

### *Exam marking*

Anonymised marking of the theory and practical examinations, and the assessed practicals, is done by an independent panel of three examiners, not necessarily staff who have taught the course in that year. No marks are awarded for missed questions. Mark schemes are given in the next section. The marks will be scaled and combined with the theory examination marks in the proportions indicated above.

The raw total mark out of 100% (encompassing both theory and assessed practical marks) is used to rank candidates by order-of-merit. The raw marks are then scaled ('norm-referenced') such that approximately 60% of candidates get a mark of 60 or above. The minimum marks for a pass, third, 2.2, 2.1 and first are 40, 50, 60 and 70 respectively. In a

small subject cohort like IB Earth Sciences, there is some flexibility in these percentages and therefore in where examiners choose class borderlines. The examiners carefully scrutinise the marks of candidates close to borderlines, to ensure that you are awarded the subject class deserved by your exam performance.

You are then given a *subject rank percentile* (SRP) according to your ranking in IB Earth Sciences A. If  $r$  is your ranking (1 = top) and  $c$  is the class size, then your SRP is  $100 \times (c+1-r)/c$ . So, if the class size is 50, then the person ranked top gets an SRP of 100, the second person 98, and so on down to the bottom person who gets 2. The SRP is used below in assigning your overall NST class.

The first estimate of your overall NST class is the median of your three subject classes. There is a table of all possible outcomes at [www.natsci.tripos.cam.ac.uk/exams/marks-ib](http://www.natsci.tripos.cam.ac.uk/exams/marks-ib). A second measure is the arithmetic mean of your SRPs; candidates with an average percentile rank of  $\geq 80\%$  will be given a first, those between 80% and 40% a 2.1 and those between 40% and 20% a 2.2. Where the two methods produce different outcomes, you are placed in the higher of the two resulting classes.

Your College Director of Studies receives a breakdown of your marks into a theory and practical score for each subject.



## 5. Marking Criteria

*Mark scheme for theory examinations*

<b>%</b>	<b>Class</b>	<b>Criteria</b>
90-100	1	Brilliant answer. Exceptional understanding of subject and relevant literature. Outstanding critical analysis, full of insight Excellent organized, expressed and illustrated
80-89		Excellent understanding of subject. Answer goes well beyond lectures. Effective critical analysis and grasp of relevant literature Well organized, expressed and illustrated.
70-79		Very good understanding of course material. Sound evidence of outside reading. Some critical analysis. Well organized, expressed and illustrated.
60-69	2.1	Sound to good understanding of course material. Limited use of extra-course material. May contain minor factual errors or omissions. Well organized, coherent and adequately illustrated.
50-59	2.2	Based entirely on course material. Lacks some detail in content. Contains significant factual errors or omissions. Some deficiencies in organization, style or illustration.
40-49	3	Based imperfectly on course material. Contains numerous factual errors or omissions Answer has merit but lacks a sound structure. Concepts poorly expressed and illustrated..
30-39	Fail	Inadequate content, some maybe irrelevant. Poorly organized, expressed and illustrated
20-29		An attempt at the question, but lacking most relevant content.
10-19		An answer with only isolated glimpses of relevant content.
0-9		A nearly worthless or irrelevant answer.
<i>Expectations of appropriate 'critical analysis' and 'relevant literature' will vary from year to year of the Tripos</i>		

*Mark scheme for assessed practical 1*

<b>Mark</b>	<b>Criteria</b>
9-10	Excellent answers. Demonstrates advanced understanding of crystal structures, symmetry and/or optics.
7-8	Very good answers. Demonstrates a correct and consistent understanding of crystallography and optics.
5-6	Competent answers. Demonstrates a basic understanding of crystallography and optics but with some errors/omissions.
3-4	Poor answers. Demonstrates an incomplete understanding of crystallography and optics. Questions attempted, but with significant errors/omissions.
1-2	Brief and poorly presented answers demonstrating a broad lack of understanding. Questions attempted, but there are many errors/omissions.
0	Little of value in the answers.

*Mark scheme for assessed practical 2*

<b>Mark</b>	<b>Criteria</b>
9-10	Excellent answers. Demonstrates advanced understanding of geological maps, including a well-constructed and accurate cross section and correct interpretation of boundaries and 3D structure.
7-8	Very good answers. Demonstrates a correct and consistent understanding of geological maps, including a largely accurate cross section and sensible interpretation of boundaries and 3D structure.
5-6	Competent answers. Demonstrates a basic understanding of geological maps. Cross section and interpretation of boundaries and 3D structure attempted but with some errors/omissions.
3-4	Poor answers. Demonstrates an incomplete understanding of geological maps. Cross section and interpretation of boundaries and 3D structure attempted, with significant errors/omissions.
1-2	Brief and poorly presented answers demonstrating a broad lack of understanding. Cross section and interpretation of boundaries and 3D structure attempted, but there are many errors/omissions.
0	Little of value in the answers.

## 6. Laboratory Safety and Code of Conduct

### General safety

- Food or drink must **not** be consumed in the ESB lab, with the exception of water in a capped bottle.
- To allow unobstructed passage around laboratories all students' personal possessions must be stowed under the benches.
- If the fire alarm sounds, you will hear a very loud continuously ringing bell. On the instructions of the demonstrator in charge of the class, you must leave the building and assemble on the lawn by the Department of Archaeology & Anthropology. Do not stop to collect personal belongings and do not re-enter the building until the fire brigade has given the all-clear.

### Equipment and practical material

- Bench lamps must be lifted by their bases, not by the arms. Lifting by the arms can damage the pivoting mechanism.
- You will be instructed in the use of microscopes, and these instructions must be followed. Do not move microscopes at all unless strictly necessary. Dragging the microscopes causes vibration and optics misalignment.
- When using microscopes and computers, check your seating position to ensure that you are at the correct height and, to avoid eye strain, look across the lab to allow your eyes to change focus every 20 minutes or so.
- Glass microscope slides must be treated with care. They are easily broken; some are irreplaceable, and all are expensive to replace.
- Handle ALL specimens with care. Many are of museum display quality and are irreplaceable. *Do not mark or scratch them.*
- Ensure that all specimens, microscope slides, etc. are returned to the correct tray or drawer after use, and that any microscopes and bench lights are turned off before you leave the lab.

## 7. Part II Project

Those of you who go on to take Part II Earth Sciences will normally do a mapping project next summer. You will be assigned a supervisor in the second half of the Lent Term based on your chosen mapping area. There will be two safety sessions relating to mapping projects, usually in February and June. Further information will be circulated nearer the time. You might apply to a number of University funds, to help you with the costs of fieldwork, which have closing dates early in the Lent Term. **More information will be available later in Michaelmas term.**

Another option for Part II is to progress via the Physical Sciences route. By reading **Part II Physical Sciences**, you can continue to develop a broader knowledge of the sciences than a Part II single subject may provide. You can continue to study Earth Sciences via this route, and are not required to do a mapping project for this course. Instead you are required to submit a 5,000-word dissertation which is submitted in April 2022. Further information can be found on the [NST Physical Sciences website](#).

## 8. Libraries

Your College library should have all the standard textbooks from your reading lists. If not, ask them to order them. You may need the support of your Director of Studies or supervisor.

In order to adhere to social distancing rules and to keep us all safe the library will not be available to 1Bs as a study or social space.

You will be invited to attend an introduction to the library session on either 19, 20 or 21 October. This will involve a tour of the library highlighting resources available to you. Details of how to register will be sent to you at the beginning of term.

Coming in to the library for browsing will not be an option, with the exception of access to the map room if absolutely necessary and by prior appointment only.

Borrowing items may be slightly more difficult than in previous years but **all items are available as before**. Contact the library for any questions or requests and to make arrangements for pick up or returns: [libraryhelp@esc.cam.ac.uk](mailto:libraryhelp@esc.cam.ac.uk) or [sih24@cam.ac.uk](mailto:sih24@cam.ac.uk) Other arrangements are being set up or looked into; e.g. a chat box on the library web pages or daily Zoom sessions. I really want to 'meet' as many of you as possible.

Please don't hesitate to contact me if you have any questions or suggestions.

Sarah Humbert  
Earth Sciences Librarian

## 9. Feedback Processes

- Your most productive route for criticisms of the course is through the current lecturer or demonstrators. This particularly applies to day-to-day hitches, which can then be rectified immediately.
- You will have the individual opportunity to comment on the courses through the on-line questionnaires after each course component. Please use this opportunity. Your responses do significantly affect our planning of the following years' course.
- The Teaching Liaison Committee has a representative from each of the courses taught in Earth Sciences, and meets about once a term. These meetings concentrate on broader problems of the structure, content and operation of courses.
- If none of these routes seems satisfactory, please feel free to contact the Earth Sciences B Course Coordinator, Marie Edmonds (me201@cam.ac.uk), the Teaching Support Manager, Helen Averill (hpd20@cam.ac.uk) or the Director of Teaching, Nick Butterfield (njb1005@cam.ac.uk).

### Complaint procedures

If you are unhappy with the experience you have received from the department, faculty, service or staff member, the University has a Student Complaint Procedure for you to use in order to try and resolve the situation. All information regarding the Student Complaint Procedure can be found on the [Student Complaints web page](#).

At a local level if any issues arise which need action details should be passed on to the Teaching Support Manager or discussed with your Director of Studies in the department.

### Examination review procedure

The University has robust policies in place to ensure that all examination results are accurate. However, something unusual may have taken place in the examination and you may want to check that the examiners were aware of the circumstances and that they have been taken into account. If you have any concerns about examination results you can request a review using the Examination Review Procedure, details of which can be found on the [Examination reviews web page](#).

## 10. Earth Sciences and Disability

We are committed to making our courses accessible to *all* students. You should have received help or advice about any disability that might have a substantial and long-term adverse effect on your ability to follow the course or take the examinations; for instance, dyslexia or colour blindness.

If there is any new information about any relevant disability that we should know in order to provide you with the support required to complete your course, please inform your Tutor, your College Director of Studies or Supervisor in Earth Sciences and the Teaching Administrator, Helen Averill [hpd20@cam.ac.uk](mailto:hpd20@cam.ac.uk). They will discuss with the course organisers the appropriate ways in which you can be helped to get the most out of this year's teaching.

## 11. Department of Earth Sciences: Plagiarism Statement

(This is a shortened and more subject-specific version of the University statement at <http://www.admin.cam.ac.uk/univ/plagiarism/students/statement.html>)

### Definition and scope

*Plagiarism is defined as submitting as one's own work, irrespective of intent to deceive, that which derives in part or in its entirety from the work of others without due acknowledgement.*

Plagiarism is the unacknowledged use of the work of others as if this were your own original work. It is always wrong and a breach of academic integrity, whether in supervision exercises, project reports, exam answers or published papers. The University regards plagiarism as a serious offence. The penalties for plagiarism may be severe and may lead to failure to obtain your degree. The University reserves the right to check any submitted work for plagiarism, and can do so with increasingly sophisticated software.

*The golden rule is that there should be no doubt as to which parts of your work are your own original work and which are the rightful intellectual property of someone else.*

Plagiarism may be due to copying (using another person's language or ideas as if they are your own) or collusion (where collaboration is concealed to gain unfair advantage).

### Methods and media

Methods of plagiarism include:

- Quoting directly another person's language, data or illustrations without clear indication that the authorship is not your own and without due acknowledgement of the source.
- Paraphrasing the critical work of others without due acknowledgement. Changing words or their order does not avoid plagiarism, if you are using someone else's original ideas without acknowledgement.
- Using ideas taken from someone else without reference to the originator.
- Cutting and pasting from the Internet to make a pastiche of online sources.
- Colluding with another person, including another candidate (other than as explicitly permitted for joint project work).
- Submitting as your own work research that has been contributed by others to a joint project.
- Submitting work that has been done in whole or in part by someone else on your behalf (such as commissioning work from a professional agency);
- Submitting work that you have already submitted for a qualification at another institution or for a publication without declaring it and clearly indicating the extent of overlap.
- Deliberately reproducing someone else's work in a written examination.

Plagiarism can occur with respect to all types of sources and in all media:

- not just text, but also figures, photographs, computer code etc,
- not just material published in books and journals, but also downloaded from websites or drawn from other media,
- not just published material but also unpublished works, including lecture handouts and the work of other students.



## Avoiding plagiarism

The conventions for avoiding plagiarism in the Earth Sciences are as follows:

- When presenting the views and work of others, cite the source in ways such as ‘...as shown by Jones (1938)’.
- If quoting a secondary source, to which you have not gained access, make this clear in ways such as ‘...Hailstone (1802) as discussed by Marr (1916, p. 176).’
- If quoting text verbatim, use quotation marks or indented text and a citation; e.g. “Many of the great movements above described, appear to have been produced by an action both violent and of short duration.” (Sedgwick 1836).
- If using an exact or redrawn copy of a figure from another work, cite the work in the figure caption; e.g. ‘redrawn from Hughes (1866).’
- If incorporating data into a figure from another source, cite the source in the figure caption; e.g. ‘orientation data taken from Whittington (1938).’
- Collaboration with staff or other students during project research may arise during, for instance, Part II or Part III projects. If there is likely to be any doubt as to who contributed which parts of submitted work, make this clear in the text wherever necessary; e.g. ‘Prof. I.N. McCave supplied the comparative data on contourites in table 3.’
- Wherever a source is cited, the full bibliographic reference – including title, journal, volume and page numbers – must be given at the end of the report or essay, except in an essay done in exam conditions. Candidates are not required to make full citations in written examinations but should reference where appropriate.

## Checking for Plagiarism

The University subscribes to Turnitin UK software which provides an electronic means of checking work for originality and is widely used in UK universities. Visit the Departmental website to find the document explaining how Turnitin UK will be used by the Department of Earth Sciences and which explains the implications of submitting your work to the software. Written work will only be checked if a candidate is suspected of plagiarism.

Any graduate student submitting written work suspected of plagiarism may also have their material checked using Turnitin.

## 12. NST Approved Calculators

For Natural Sciences Tripos examinations Parts IA, IB, II and III (where a calculator is allowed), you will be permitted to use only the standard University calculator CASIO fx 115 (any version), CASIO fx 570 (any version) or CASIO fx 991 (any version). Each such calculator must be marked in the approved fashion.

Standard University calculators, marked in the approved fashion, will be on sale at the beginning of Full Michaelmas Term 2021 at £20 for the fx991ES plus from the Department of Chemistry, Part IA Laboratory preparation room or from the Main Stores in the Bragg Building at the Cavendish for around the same price. You are strongly advised to purchase a calculator at the beginning of term.

Students already possessing a CASIO fx 115 (any version) or CASIO fx 570 (any version) or Casio fx991 (any version) will be able to have it marked appropriately, at no cost in the Department of Chemistry, Part IA Laboratory. Calculators meeting these criteria can be marked in term time right up to the beginning of the exam period, not just in the Michaelmas term.