# NATURAL SCIENCES TRIPOS PART IB

# BIOCHEMISTRY AND MOLECULAR BIOLOGY

## Aim of the practicals

Progress in science is achieved through observation and experiment. Biochemistry (and its close cousin, molecular biology) is an experimental science that advances from well-thought out investigations in the laboratory. No serious student should neglect the opportunities which this course provides to appreciate this fact. Your course includes experiments for you to gain some insight into how laboratory investigations are carried out and how data are processed and interpreted. To obtain useful results an experiment should be designed to answer a definite question and the detailed planning should be sufficiently rigorous to exclude adventitious errors. The course gives you the opportunity to plan some experiments for yourselves. You should benefit from the practicals in three ways:

(i) You will learn a variety of experimental techniques, all of which are currently used in biochemical research. The practicals have been designed to complement the lectures and fit in with their sequence as far as possible. The hands-on experience should link to the mental framework provided by the lectures, and give you a deeper understanding and more realistic perspective of the topics discussed.

(ii) You will learn to handle experimental data effectively, and to extract the maximum information content without falling into the trap of over-interpretation.

(iii) You will be helped when it comes to the data handling questions in the Tripos examination. A collection of question papers from the last three years is included in this handbook.

## The Demonstrators

Demonstrators are there to help you. The senior demonstrator will be a member of the Staff of the Biochemistry Department - often a lecturer in your course. The assistant demonstrators will be graduate students working for a PhD research degree, or post-doctoral research workers who have recent and sympathetic memories of the difficulties felt by studying the subject. Rely on them not only to sort out practical difficulties but to help you make sure you understand what the experiments are about and what your results mean. They may well also be able to help you understand theoretical or lecture material.

## Discussions

As the class size is relatively small, discussion of the practical work will be informal and will normally take place in the laboratory at the end of the experimental work. Demonstrators will be on hand at these occasions and you are urged to make the most of these discussions and take an active part in them.

## Safety and care in the laboratory

PLEASE be careful in the laboratory. Attend to your own safety and that of others around you: this is a statutory obligation - a matter of law.

PLEASE also extend your consideration to the equipment in the laboratory. Most of it is costly to repair or replace.

Policy, rules, and guidance on safety are given on the pages headed 'Safety in the Biochemistry Part I Teaching Laboratory'. You **must** read this before coming to the first practical. At the end of those pages, there is a declaration form which you must sign to acknowledge that you have read the document and will abide by the rules set out. The form will be collected at the first practical.

## Practical sheets

You are given comprehensive notes for each practical. They are colour-coded according to purpose.

### Green sheets

The GREEN SHEETS set the context and state the learning objectives for each practical. If appropriate, they will indicate the lecture handout material that you might want to review before reading the practical notes. The **practical notes must be read before you come to the practical.**

### White sheets

The WHITE SHEETS contain the experimental plan and instructions. These are not a recipe to be read for the first time when you are faced with the experiment. Make a practice of scanning them in advance, a day or two before the practical. Not to take in every detail, which will only make sense when you have the apparatus in front of you but to get an overview of the planned experiment. Once in the laboratory, the senior demonstrator will give a brief introduction and you should then read and follow the instructions carefully. Take a few minutes to read through the instructions again at the beginning of the practical - don't just dive in, no matter how busy everyone else looks. Always try to think out the principles of what you are doing as you go along, and to understand what is going on in the procedures you carry out. Ask the demonstrators - they may well ask you first!

Probably the most important contribution you can make to the success of your experiments is in making up reaction mixtures. THINK about what you are adding, so you add the CORRECT components. MEASURE and DISPENSE the volume of component reagents ACCURATELY using the semi-automatic GILSON PIPETTES provided.

### Blue sheets

The BLUE SHEETS are for processing the data and also contain questions about the practical to help you understand what you have done, and why. They are a form of

self-assessment - we don't take them in and give marks, but demonstrators can advise and comment on your efforts. You will find them helpful when preparing for the end of year exam, so it is important to get them filled out properly. Going from raw numbers that come straight off an instrument to a meaningful calculated result is found quite difficult by most students, and may be tested in the examination. So take advantage of the help available. You should complete the Blue Sheets during the practical if that is feasible, or as soon after as possible after each practical. Bring your calculators to each session. Graph paper is available if you don't have your own. Compare your results against the yellow sheets (see below) or discuss with a demonstrator.

**Yellow sheets**
The YELLOW SHEETS contain specimen results and, where relevant, examples of how to analyse them. They will generally be handed out either at the end of the practical or at the appropriate discussion period.

**Pink sheets**
The PINK SHEETS contain important background material related to several practicals and practical aspects of biochemistry. They are put at the front of the book of practical notes as appendices to this introduction. They include an introduction to units, to pH and buffers, and to the principles of spectrophotometry. Try and have a brief look at them before your first practical. Raise any difficulties with your supervisor or a demonstrator.

## Recording your results

You should bring your own notebook or loose-leaf book along to the practical. In each experiment plan what observations you will make. Record your results and interpretations directly into the notebook as you go along rather than on scraps of paper that will surely get lost. Also record any arguments and conclusions from your data if there is not enough space for these on the summary sheets. We have given you these notes in a binder so that you can incorporate your own pages.

You should endeavour to complete this writing up of your argument and conclusions during the experiment itself. There is no need to write out again what is already in your practical sheets. Concentrate on ensuring that you get down the key arguments and conclusions. Any writing up after the experiment is not expected to take more than about an hour for a day's practical, but it is important to do it at once while the experiment is still fresh in your mind.

The results of an experiment are often best recorded graphically as well as numerically. So far as possible the graph is best drawn while you are doing the experiment as you go along, so that in doubtful regions points may be repeated or additional ones obtained. The conventional way of plotting a graph is to plot the dependent variable (the thing you measure) on the ordinate (vertical axis) against the independent variable (the thing you fix) on the abscissa (horizontal axis). Remember

to label the axes with the quantity being plotted and units involved. Remember, too, that the way you plot a graph shows your interpretation of the experiment. Consult Appendix 1 on "Units" for further guidance.

Your notebooks are not "marked" as part of a "summative assessment" or examination. Rather they are to help you get to grips with each practical as you do

it and write it up so that you still understand it when it comes to revision later in the year. To help with this, we ask you to complete the Blue Sheets (see above). If you feel all at sea, or if your Blue Sheets are full of blank spaces make a point of asking a demonstrator for help.

## Journal Clubs

There are two Journal Clubs, one on a molecular topic and the other more cell biological. You will be given a published paper, with some guidance notes and questions, to analyse during the week before the practical session in which you critically evaluate its merits in a small group directed by one of the Biochemistry staff. Most students find this a challenging but worthwhile exercise, since it gives exposure to the raw material of the scientific literature.

## The Course Website

We provide a website for the Biochemistry & Molecular Biology course using the CamTools software package, which you will be familiar with from your NST Part IA courses. It is accessed from https://camtools.caret.cam.ac.uk/portal/ and requires a Raven log-in. We provide information about the course and on-line access to some course materials resources. You will be registered for the site once we have collected your User IDs at practical registration.

Some course information will also be available via the Biochemistry Department at http://www.bioc.cam.ac.uk/teaching/bmb/index.html

## Examinations

General advice on examination skills and on the criteria used for marking and classing have been drawn up by the Faculty of Biology and the Management Committee for the Natural Sciences Tripos. They can be found by following links from these web sites

http://www.bio.cam.ac.uk/sbs/facbiol/currentss.html
http://www.cam.ac.uk/cambuniv/natscitripos/current.html

Some more specific information relating to the Biochemistry & Molecular Biology examination is given next. Copies of recent past papers are provided on Camtools. Answers to the data-handling questions in Paper 3 have been sent to your supervisors: it's better for you to try the questions before looking at the answers! Earlier BMB papers are available in the bound collections in college libraries

### NST Part IB Biochemistry & Molecular Biology

The examination consists of three papers, each of three hours' duration, and each paper carries equal marks.

Paper 1 consists of five sections, and students should answer one question from each section. Sections A and B will be based on lectures in the Michaelmas Term, Sections C and D on lectures in the Lent Term and Section E on the Easter Term lectures. Each section will carry equal marks.

Paper 2 consists of two sections. Section A is made up of roughly 14 short-answer factual questions based on the whole lecture course, and carrying equal marks. Students should attempt all questions in Section A. Section B consists of 4-5 essay questions of a more general and wide-ranging nature than those in Paper 1, from which students need to answer two. These can be perceived as "open ended" questions in which the student may be asked to develop an issue that was not specifically dealt with in the lectures, but is based on the material taught in the lectures. Sections A and B will carry equal marks.

Paper 3 is concerned with practical techniques covered in the practical classes and journal clubs, as well as other material in the practical section of the course handbook and experimental techniques covered in the lecture course. There are three sections. Sections A and B each contain 2-3 questions while Section C consists of one longer subdivided question. Sections A, B, and C will carry equal marks. All questions in Paper 3 should be attempted.

When answering essay questions, take particular care that you have absorbed what the question is specifically asking for. It is a common fault for candidates to react unthinkingly to a "trigger word" and simply write all they know in response. Take a little time to reflect, rather than leaping straight in.

The examiners will have regard to the style and methods of candidates' answers. You should write legibly and not adopt note form unless specifically requested to do so. Helpful diagrams are welcome as part of an essay. You are perfectly free to use abbreviations that are standard scientific vocabulary without definition (for example G6P, ATP, DNA, RNA).