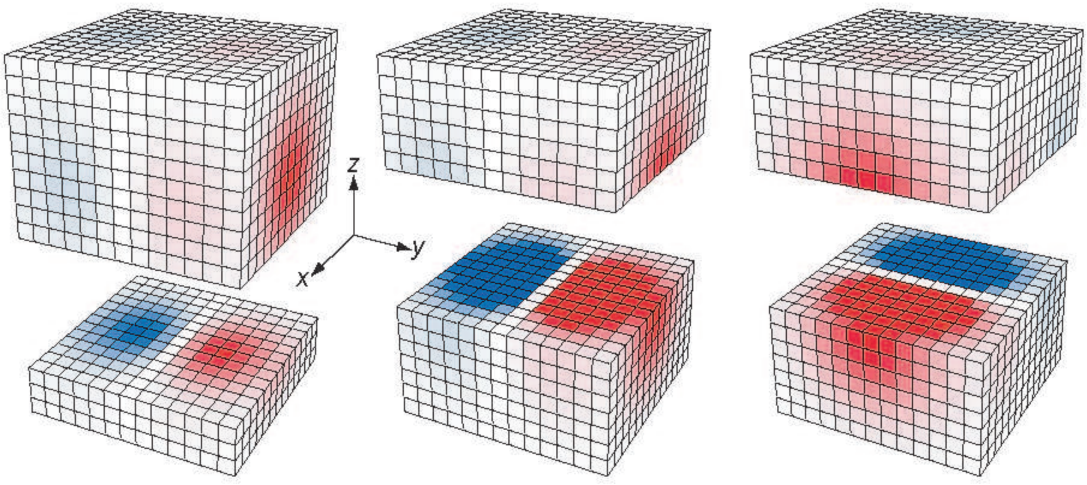
UNIVERSITY OF CAMBRIDGE

Yusuf Hamied Department of Chemistry

IA Chemistry:
A Guide to the Course



Academic Year 2025/2026

The Department of Chemistry endeavours to develop an inclusive, supportive and intellectually stimulating environment for our undergraduate community.

Athena SWAN is an ongoing program to address the underrepresentation of women in the sciences. The Silver Award recognises the progress that the Department has made in recent years, and the actions that benefit not only our female students, but all our undergraduate chemists.

Information about activities and profiles will appear inside the front cover of your lecture handouts.

IA Chemistry 2025/26

IA Chemistry lectures are at 09:00 in the Bristol-Myers Squibb (BMS) Lecture Theatre

Michaelmas			
1	9/10	Th	
	10/10	Fr	PDW
	11/10	Sa	
	13/10	Mo	PDW
	14/10	Tu	
	15/10	We	PDW
2	16/10	Th	
	17/10	Fr	PDW
	18/10	Sa	
	20/10	Mo	PDW
	21/10	Tu	
	22/10	We	PDW
3	23/10	Th	
	24/10	Fr	PDW
	25/10	Sa	
	27/10	Mo	PDW
	28/10	Tu	
	29/10	We	PDW
4	30/10	Th	
	31/10	Fr	PDW
	1/11	Sa	
	3/11	Mo	PDW
	4/11	Tu	
	5/11	We	PDW
5	6/11	Th	
	7/11	Fr	PDW
	8/11	Sa	
	10/11	Mo	PDW
	11/11	Tu	
	12/11	We	PDW
6	13/11	Th	
	14/11	Fr	PDW
	15/11	Sa	
	17/11	Mo	PDW
	18/11	Tu	
	19/11	We	PDW
7	20/11	Th	
	21/11	Fr	PDW
	22/11	Sa	
	24/11	Mo	DAL
	25/11	Tu	
	26/11	We	DAL
8	27/11	Th	
	28/11	Fr	DAL
	29/11	Sa	
	1/12	Mo	DAL
	2/12	Tu	
	3/12	We	DAL

Lent			
1	22/1	Th	
	23/1	Fr	DAL
	24/1	Sa	
	26/1	Mo	DAL
	27/1	Tu	
	28/1	We	DAL
2	29/1	Th	
	30/1	Fr	DAL
	31/1	Sa	
	2/2	Mo	DAL
	3/2	Tu	
	4/2	We	DAL
3	5/2	Th	
	6/2	Fr	DAL
	7/2	Sa	
	9/2	Mo	DAL
	10/2	Tu	
	11/2	We	DAL
4	12/2	Th	
	13/2	Fr	JHK
	14/2	Sa	
	16/2	Mo	JHK
	17/2	Tu	
	18/2	We	JHK
5	19/2	Th	
	20/2	Fr	JHK
	21/2	Sa	
	23/2	Mo	JHK
	24/2	Tu	
	25/2	We	JHK
6	26/2	Th	
	27/2	Fr	JHK
	28/2	Sa	
	2/3	Mo	JHK
	3/3	Tu	
	4/3	We	JHK
7	5/3	Th	
	6/3	Fr	SL
	7/3	Sa	
	9/3	Mo	SL
	10/3	Tu	
	11/3	We	SL
8	12/3	Th	
	13/3	Fr	SL
	14/3	Sa	
	16/3	Mo	SL
	17/3	Tu	
	18/3	We	SL

Easter			
1	30/4	Th	
	1/5	Fr	DAB
	2/5	Sa	
	4/5	Mo	DAB
	5/5	Tu	
	6/5	We	DAB
2	7/5	Th	
	8/5	Fr	DAB
	9/5	Sa	
	11/5	Mo	DAB
	12/5	Tu	
	13/5	We	DAB
3	14/5	Th	
	15/5	Fr	DAB
	16/5	Sa	
	18/5	Mo	DAB
	19/5	Tu	
	20/5	We	DAB
4	21/5	Th	
	22/5	Fr	DAB
	23/5	Sa	
	25/5	Mo	DAB
	26/5	Tu	
	27/5	We	DAB

Contents

1 Introduction

The Part IA course is designed to mesh with typical pre-University courses in chemistry and the topics considered have been chosen to illustrate the fundamental principles of the subject in such a way as to be relevant to any scientist interested in molecular processes; the course also lays the foundations for further study of chemistry in subsequent years. The topics are presented in a way which cuts across the traditional divisions of the subject so as to show the manner in which widely differing parts of the subject are interrelated.

Study of Chemistry at A-level or a near equivalent is a prerequisite for Part IA Chemistry. A knowledge of Mathematics to A-level is desirable, but not absolutely essential.

There are three parts to the course: lectures, practicals and supervisions.

- **Lectures** are organised by the Department; there are three per week throughout the Michaelmas and Lent Terms and for the first four weeks of the Easter Term. Lectures are at 09:00 on Mondays, Wednesdays and Fridays, and are held in the Bristol–Myers Squibb Lecture Theatre in the Department of Chemistry, Lensfield Rd.

- **Practicals** are also organised by and held in the Department; they are compulsory. Broadly speaking, you will attend one session each fortnight; further details are given on page 8. It is essential that you register for practicals at the start of the year.
- **Supervisions** are organised by your College Director of Studies, who you should contact if you have any difficulties in this area.

This booklet gives further details of these three parts of the course, together with important information about the examinations and other aspects of the course. Please take time to read the booklet and do keep it in a safe place for future reference.

2 Collection of course materials

Students should come to the Department (located on Lensfield Road) between 09:00 and 12:00, or between 14:00 and 17:00, on Tuesday 7th October to collect various materials (handouts, practical manuals etc.) which they will need for the course. Please enter the building via the doors which face onto the Scott Polar Institute/Catholic Church.

3 Website and Moodle

Up to date information, news and other teaching related material can be found on the teaching web site: www.ch.cam.ac.uk/teaching.

In common with other IA NST courses, we will also be using *Moodle* for posting course materials: www.vle.cam.ac.uk. If you find that you do not have access to the Chemistry part of Moodle, please email the Teaching Office on teaching.office@ch.cam.ac.uk.

4 Synopses of the Lecture Courses

Michaelmas Term

Shapes and structures of molecules: 19 lectures

Prof. Peter Wothers

The aim of this course is to answer two questions: 'How do we find out the shapes and structures of molecules'? and 'Why do molecules have the shapes, structures and properties they do'?.

Chemists use different kinds of spectroscopy to answer the first question, and the course will consider two of these in some detail: nuclear magnetic resonance (NMR) and infra-red (IR). The aim is to give you an understanding of the basis of the technique and then to go on to use this understanding to interpret spectra in terms of molecular structures.

The second question is answered by introducing elementary quantum mechanics which is the basis of the modern description of chemical bonding. The aim is to give you an understanding of how the idea of a wavefunction arises in quantum mechanics and the significance of such functions in understanding the behaviour of electrons in atoms and molecules.

We then go on to consider how such wavefunctions can be constructed for a range of molecules of different complexities and what the consequences are in terms of shape and reactivity of the occupancy of these electronic wavefunctions. The aim is to enable you to understand and rationalise key aspects of molecular structure.

Topics Introduction to molecular structure, spectroscopy and the electromagnetic spectrum. Illustration of the basic information derivable from different techniques. NMR spectroscopy as a tool for identifying atom type. Chemical shifts and coupling illustrated for different nuclei. Infra-red spectroscopy as a tool for determining bond type. Relation of vibrational frequency to bond strength and atomic mass. Structural problems solved by joint application of NMR and IR spectroscopy.

Quantum mechanics: energy levels and wavefunctions; interpretation of the wavefunction. Electrons in atoms: the shapes and energies of orbitals. Multi-electron atoms: shielding and penetration. Electrons in molecules, bonding and antibonding orbitals, bonding in diatomic molecules, bond polarity and strength, magnetic properties. Extension to larger systems, hybrid orbitals and conjugation.

Reactions and mechanisms in organic chemistry: 14 Lectures

Prof. Deborah Longbottom

Organic chemistry comprises a great diversity of structures and functional groups, which can undergo a wide variety of chemical reactions. The principle aim of this course is to develop a good understanding of those reactions, using the concepts of mechanism and 'curly arrows'. Some unifying concepts will be introduced to provide a rationale that will enable you to explain and predict a variety of reactions that proceed by different mechanisms. Several reaction types will then be covered and a logical approach as to how to plan the synthesis of unfamiliar molecules will be discussed throughout. Course participants will also be given the opportunity to attempt questions during lectures and hear guide solutions from the course lecturer.

Topics General topics include: context – the history of organic synthesis and why it is still important today; why molecules react – the role of energy, orientation and orbital occupancy; reaction mechanisms – bond forming and breaking; how these are described using curly arrows.

Specific topics will then follow, which apply the general principles already laid out:

Addition to the carbonyl group: formation of hydrates, hemiacetals and acetals.

Substitution at the carbonyl group, including the concept of leaving group ability, as related to acidity, basicity and pK_a.

Nucleophilic substitution at saturated carbon: S_N1 and S_N2 reaction processes.

Double bond formation (C=C) *via* elimination.

Electrophilic attack on π bonds thus generated.

The disconnection approach to organic synthesis: planning the synthesis of something unfamiliar with familiar tools.

How to approach an organic chemistry question (course or examination).

Lent Term

Reactions and mechanisms in organic chemistry: *continued*

Energetics and equilibria: 9 Lectures

Prof. James Keeler

In the physical and chemical world some things 'happen naturally' and some do not. A cup filled with hot tea warms up and the tea cools off, petrol burns to carbon dioxide and water, gases mix and fill the space available to them – but the reverse of these events are never observed to happen 'naturally'. Water and carbon dioxide do not spontaneously form hydrocarbons, and your tea never gets hotter at the expense of a cooler cup.

It turns out that there is one universal law which describes why some things happen spontaneously and some do not – the Second Law of Thermodynamics. In these lectures we will investigate where this law comes from and how it is connected with a quantity called entropy. We will go on to see that entropy has a strong connection with the microscopic nature of matter.

The Second Law is very fundamental, but it is also leads on to very practical relationships that can be used to describe chemical equilibrium and how this is affected by factors such as temperature and pressure. In the second part of the course the idea of Gibbs energy (sometimes called free energy) will be introduced, and we will go on to see how this is a very convenient description of chemical equilibrium.

It will enable us, for example, to put familiar ideas such as Le Chatelier's Principle on a firm and quantitative footing and to understand the equilibria between phases. The course will close with a discussion of electrochemical cells and their applications.

Topics Natural processes, the Second Law of Thermodynamics and the concept of entropy; reversible and irreversible processes, equilibrium. Entropy seen in terms of the microscopic properties of matter. Practical formulation for chemistry in terms of the Gibbs energy. How to describe chemical equilibrium and how it is influenced by pressure and temperature; the central equation $\Delta_r G^\circ = -RT \ln K$. Electrochemical cells: description in terms of the Nernst equation and applications.

Kinetics of chemical reactions: 6 Lectures

Prof. Steven Lee

In this course we will investigate how it is possible to determine the mechanism of a reaction and some of the factors that influence it. The main tool will be the study of the kinetics of the reaction, that is how fast it proceeds and how this rate is affected by temperature, concentration and other factors such as solvent type.

We will begin with the simplest reactions, 'elementary reactions', which take place as a result of a single molecular encounter. Two theories for describing such processes will be discussed, and in the course of the discussion the key ideas of activation energy and the reaction energy profile will be introduced. We will then go on to describe how a reaction mechanism can be thought of as a series of elementary steps, and how the kinetics of such a scheme can be analysed using the steady state hypothesis and other tools.

Examples from many different areas of chemistry will be given, from conventional organic reactions and enzyme kinetics through to atmospheric chemistry. We will also consider how the raw data of chemical kinetics, that is the measurement of concentration as a function of time, can be obtained and how such data can be interpreted in terms of rate laws. As chemical reactions cover a vast range of timescales, considerable ingenuity is needed in their measurement.

Topics What do we mean by rate of reaction, rate constants and rate laws? Theories about reaction rates: potential energy profiles, reaction coordinates and collisions. Experimental determination of rate laws: fitting data to rate laws and obtaining data for different timescales. Complex reactions and reaction mechanisms: rate determining steps, pre-equilibrium hypothesis, steady-state approximation and their applications. Chain reactions.

Easter Term

Inorganic and materials chemistry: 12 Lectures

Dr Daniel Beauregard

With over one hundred elements to use, the number and types of different inorganic compounds are effectively limitless. From ceramics which conduct electricity as well as a metal to compounds which spontaneously ignite in air, chemists can create substances for almost any application. In order to understand the compounds, we need to look at the structures and properties of the elements themselves and how they bond with each other. Crucial to this is an understanding of the periodic table. These lectures draw on ideas from all the previous parts of the course.

Topics Why are most of the elements metals? Why are others semiconductors and others non-metals? What exactly is a metal anyway? These are some of the questions answered in the first part of the course which looks at the properties of the elements and how they relate to their positions in the periodic table and ultimately their electronic structures.

The second part of the course explores the different types of bonding possible between the elements, from pure covalent to pure electrostatic and examines the advantages and limitations of each model. Once the nature of the bonding itself is understood, it is possible to appreciate the different reactions the compounds undergo.

5 Recommended books for Part IA Chemistry

Before buying any books for yourself, we recommend that you borrow them from a library so you can see whether or not you like the style. These recommended books should all be in your College Library; if they are not, please suggest that they be obtained. The designations in brackets [. . .] are the class marks used to identify the books in the Chemistry Department Library, and you should find these texts shelved separately as the *Blue Book* collection in Unit 17, on the right hand side as you enter the library.

Reading Lists Online (RLO)

The link below gives access to the online reading lists for all the Chemistry courses. They have been compiled to follow the structure of the Course Guides. Each one includes a record of the borrowable items held in the Cambridge University Libraries' collections (including the Chemistry Library) and those accessible as eBook titles.

www-library.ch.cam.ac.uk/reading-lists-online-rlo

General texts

Keeler J. and Wothers P. *Why chemical reactions happen*, Oxford, 2003. [QD501.K44]
Keeler J. and Wothers P. *Chemical structure and reactivity: an integrated approach*, either edition, OUP. [QD461.K44]

Physical chemistry

Atkins P.W. *The Elements of Physical Chemistry*, any edition, OUP. [QD453.A85]
Atkins P.W. *Physical Chemistry*, OUP, (any edition). [QD453.A85]

Organic chemistry

Clayden J., Greeves N., Warren S. and Wothers P. *Organic Chemistry*, OUP, either edition, 2002 or 2012. [QD251.O74]
Solomons T.W.G, Fryhle C.B and Snyder S. A. *Organic Chemistry*, Wiley, 12th Edn, 2016. [QD251.S65]
Carey F.A. *Organic Chemistry*, McGraw Hill, 10th Edn, 2017. [QD251.C37]
(earlier editions of both of these texts are perfectly acceptable)
Sykes P. *Guidebook to Mechanism in Organic Chemistry*, Longman, 6th Edn, 1986 [QD476.S95]
Warren S. *Chemistry of the Carbonyl Group*, Wiley 1974. [QD305.A6.W37]
Klein D.R. *Organic Chemistry*, Wiley, 2nd Edn, 2015. [QD253.2.K54]
Dickens, T.K. and Warren, S. *Chemistry of the carbonyl group*. Wiley, Rev. Ed. 2018. [QD305.A6. D53 2018]

Inorganic chemistry

Housecroft, C. E. and Sharp, A. E. *Inorganic Chemistry*,Pearson, 5th Edn, 2018. [QD151.H68 2018]
Wulfsberg, G. *Inorganic Chemistry*, University Science Books. [QD151.W85]
Mingos, E.M.P. *Essentials of Inorganic Chemistry Volumes 1 and 2*, Volume 1 (1995) and Volume 2 (1998) OUP, 1995. [QD151.M56]
For reference: Cotton F.A. and Wilkinson G. *Advanced Inorganic Chemistry*, Wiley, 6th Edn, 1999. [QD151.C68]
For reference: Greenwood N.N. and Earnshaw A. *Chemistry of the Elements*, Pergamon, 1984. [QD466.G74], 2nd Edn and ebook available.
Henderson E. *Main Group Chemistry*, Royal Society of Chemistry 2000 [QD152.3.H46]

Spectroscopy

Williams D.H. and Fleming I. *Spectroscopic Methods in Organic Chemistry*, McGraw Hill, 5th Edn, 1995. [QD272.S6.W55]

Kinetics

Cox B.G. *Modern Liquid Phase Kinetics*, (Oxford Chemistry Primers 21), OUP, 1994. [QD502.C69]
Pilling M.J. and Seakins P.W. *Reaction Kinetics*, (Oxford Science Publications), OUP, 1995. [QD502.P55]

Energetics

Price G.J. *Thermodynamics of Chemical Processes*, (Oxford Chemistry Primers 58), OUP, 1998. [QD504.P75] 2nd Edn. (2019) available.
Atkins P.W. *The Second Law*, (Scientific American Library) Freeman, 1994 (an excellent account of the history, background and applications of the Second Law) [QC311.5.A85]

Mathematics for chemists

Tebbutt P. *Basic Mathematics for Chemists*, Wiley, 2nd Edn. 1998. [QA37.2.T43]

6 Practical classes

Practicals take place in the Part IA Laboratory; to find this, enter the Department from the doors facing the Scott Polar Institute and Catholic Church, turn left, go through the turnstiles and double doors up the short flight of steps, turn left again and then follow the short corridor round to the right.

It is vital that you are registered for practicals at the start of the Michaelmas Term so that you have a 'slot' in your timetable. Your Director of Studies should have done this for you using the on-line registration system. If you have not been registered, or need to change your practical slot, please consult the technical staff in the prep. room, which is located just outside the Part IA Laboratory.

When you register you will be assigned to a group and given a regular day of the week on which to attend the class, which runs 11:00–13:00 and then 14:00–17:00 (on some days some students may have a lecture at 12:00, but even with this there will be ample time to complete the practical). You should attend the practical class every other week and you will be given the date of your first class when you register. (It may help in understanding the rota of practicals to know that for these purposes 'weeks' are considered to begin on Thursdays, with the first week beginning on the first Thursday of Full Term, that is 9th October).

You will also be assigned to a group of approximately 15 students, which will be under the care of one particular demonstrator who will usually be a first year PhD student. Normally you can expect to remain in the same practical group and with the same time-table slot throughout the year. If you need to change this for some reason, you should inquire with the technical staff in the prep. room.

The experiments and exercises that you will undertake in the Practical Class have been designed and sequenced so that they fit in as closely as possible with the lecture course. As it takes two weeks for the whole class to complete a single practical session, this synchronisation cannot be very precise. However, it should always be the case that any background theory you need to do an experiment should already have been covered in the lectures by the time you do the experiment.

Note: *During the Michaelmas term 2025, the Part IA practical laboratory is unavailable, due to crucial refurbishment work which is ongoing in the Department. However, there will be relevant and interesting alternatives to the practical classes, and as soon as the laboratory is available again,you will be wecomed back in.*

As the chemistry practicals run once every other week for each student, you will still be allocated your specific day but, during the first term, these will run during the afternoon, not from 11:00 am as per the usual schedule. The topics to be covered are:

1. Introduction to Cambridge Study Skills (Weeks 1-2)
2. Infrared (IR) of Polymers (Weeks 3-4)
3. Atomic Emission Spectra (Weeks 5-6)
4. Twelve Principles of Green Chemistry (Weeks 7-8)

We hope that you will get a lot out of these replacement sessions, which should be both educational and enjoyable!

Prof. Peter Wothers is the member of the academic staff responsible for the IA practical class; Dr Yuko Kumeda (yk405@cam.ac.uk) is the technician in charge of the class and all enquiries should be addressed to Dr Yuko Kumeda in the first instance.

Attendance at practical classes is compulsory; you will lose marks from your final total if you do not complete and hand in the accounts of your practical work. If you are unable to attend your practical on the usual day, for example through illness or other good cause, you may come in on another day provided that there is sufficient space and equipment available. If you are unable to make up a missed practical session, you should ask your Director of Studies or Tutor to complete a missed practical form (the link is available at www.ch.cam.ac.uk/teaching/resources); we may be able to award you an average mark for a session that you missed with good cause.

7 Scientific computing

The IA NST Mathematics course includes a short course, with some associated assessed exercises, titled *Scientific Computing*. This course provides an introduction to computing for physical scientists and will be taught in *Scientific Python*. We recommend that you follow this course diligently, especially if you plan to take Chemistry A in the second year, since the skills you will learn in the Scientific Computing course will be directly relevant for Chemistry A.

8 Library

www-library.ch.cam.ac.uk

The Chemistry Department Library is not routinely open to our first year students. Part IA students can apply for daytime only access to the Chemistry Library, on the recommendation of your College Director of Studies (DoS). Please visit the Access to the Library website www-library.ch.cam.ac.uk/access-library for details. Part IA students cannot borrow books from the Library.

Comprehensive guidance on the Library collections, services, and much more can be found on the Chemistry Library website at:

www-library.ch.cam.ac.uk

9 Plagiarism

Plagiarism is defined as submitting as one's own work that which derives in part or in its entirety from the work of others without due acknowledgement. It is both poor scholarship and a breach of academic integrity. The University views plagiarism as a serious matter and, under Discipline Regulation 6, has the power to take disciplinary action against those found guilty of plagiarising the work of others.

The general university statement on plagiarism, and further general advice on plagiarism and how to avoid it, is given on the University's plagiarism and good academic practice website www.educationalpolicy.admin.cam.ac.uk/plagiarism-and-academic-misconduct. Generally the Department follows the advice and policies set out by the University. This section gives further guidance as to how these policies apply to study in the Department of Chemistry.

Supervision work and Tripos questions

The majority of questions set as supervision work and in Tripos examinations take the form of problems to be solved. In presenting their solutions to these problems students are not expected to quote the source or authority of the facts, theories and concepts they use to formulate their solutions.

Continuously assessed work (principally practical work)

Here the rules against plagiarism are especially relevant as they prohibit copying and colluding. Basing a write-up on data or answers provided by another student is an example of plagiarism (or, more simply, cheating). The following rules apply to all continuously assessed work

- Unless otherwise instructed, you must work alone. Where you are permitted to work in a group, the names of those you have worked with must be stated on your practical write-up.
- The write-up must be entirely your own work. In particular, you may not use spreadsheets or templates prepared by others.
- It is expressly forbidden to invent, falsify or modify data, spectra or observations, or to use data, spectra or samples obtained from other persons unless authorised to do so by a Senior Demonstrator.
- Where data from other sources is quoted in a write-up, the source must be identified.

The following summarizes succinctly the key point:

> *The Golden Rule: The examiners must be in no doubt as to which parts of your work are your own original work, and which are the rightful property of someone else.*

10 Guidance on using GenAI in undergraduate Chemistry studies

Artificial intelligence (AI) encompasses a wide range of sub-specialities with distinct and overlapping research areas, tasks, technologies and applications. Generative AI (GenAI), and specifically a sub-type—Large Language Models (LLMs, including ChatGPT, Claude, CoPilot, and DeepSeek amongst others), have been the subject of debate in higher education institutions as the pros and cons of using software of this type are considered.

Students studying undergraduate chemistry are permitted to make appropriate use of GenAI tools to support their personal study, research and formative work. In some cases, using GenAI can aid your learning very effectively, but much like other aspects of academic practice, you should think about GenAI and related software as options within a wider tool set. GenAI is not, and never will be, an effective replacement for developing skills or understanding in your subject area or bypassing critical thinking processes.

The undergraduate chemistry course at Cambridge has been carefully designed to illustrate the fundamental principles of the subject and lay the foundations for further study of chemistry: the more you engage with the teaching and other resources available to you, the more you will learn and develop as a chemist.

Some important principles to bear in mind when using GenAI tools and websites are as follows:

1. GenAI tools can commonly produce incorrect or unsubstantiated information and as such should always be verified from trusted and reliable sources.
2. Consider thoughtful use of GenAI and associated software where possible, making appropriate use to support your own development, using the most effective tool for the

task at hand, and using efficient prompt-engineering to reduce the amount of iteration necessary.

3. Be aware of the limitations, inconsistencies and biases that can exist within GenAI tools and data sets, and exercise caution when deciding to use information provided by software.
4. Be accountable and take responsibility for how, when, and why **you** decide to use generated materials or information from GenAI software. Remember, if you submit something that is GenAI generated and it is wrong, this is not the software's fault. Using GenAI is easy; checking everything is hard.
5. Be aware that there are restrictions on sharing material with restricted copyright (such as lecture handouts, pre-publication research information and other confidential or personal information) with any GenAI tool.
6. Be aware of the environmental impact of your use of GenAI tools and behave accordingly.

11 Supervisions

Supervisions are organised for you by your College Director of Studies. The exact arrangements vary from college to college and from supervisor to supervisor but, broadly speaking, you should expect to receive between six and eight supervisions in the Michaelmas and Lent Terms, and between two and four in the Easter Term.

Each lecture course is accompanied by a problems sheet from which your supervisor will ask you to complete a number of questions. You may also be set additional questions, perhaps from past examination papers. For each supervision you should expect to prepare some written work, to hand it in for marking in advance of the supervision and to receive it back, marked and with written comments from your supervisor, within a reasonable time.

Know who your supervisor is and how to contact them. Supervision work, which should have the pages secure and clearly marked with your name and the name of your supervisor, can be handed into Reception or, out of hours, posted through the letterbox to the right of the West end entrance doors.

If you are unhappy with your supervision arrangements, or are having other difficulties, you should not hesitate to contact your College Director of Studies or Tutor. They are there to help.

12 Examinations

There is one three-hour written paper, taken towards the end of the Easter Term; the time-table for examinations is published later in the year. The paper will be of three hours duration and will contain six questions; candidates must answer all six questions, which will carry equal weight. Every lecture course will be examined in the paper, with individual questions mainly drawing on material from a particular lecture course.

There is no data or formula book provided. The values of any physical constants needed to answer a particular question will be given on the paper. A simple periodic table is also included in the examination paper. Past examination papers together with suggested answers (covering the past 10 years) are available on the IA Chemistry section of *Moodle*.

The marks obtained on the written paper are combined with marks obtained from the assessed practicals; usually 80% of the final mark is for the theory and 20% for the practicals. Practical marks are subject to moderation by the Examiners.

The Senior Examiner for Part IA Chemistry is Prof. Peter Wothers.

Disclosure of examination marks

It is the responsibility of your College to disclose to you the marks which you have been awarded in the examinations. This information is provided to your College by the Examiners; it is not available to you directly from the Department.

In the case of Part IA Chemistry, the marks which are disclosed routinely are a total for the theory paper and a total for the practical part of the course. Your College will also receive a note of your marks on a question-by-question basis.

How to approach a Cambridge Tripos examination

For most students, Cambridge written examinations are very different in style to those they have been used to at school or college, so it is important that you both understand this change and prepare yourself for a different style of examination. It is absolutely vital that, ahead of the examinations, you familiarize yourself with the style of the questions and spend some time practising some past papers.

The first point to understand is that Cambridge examinations are designed to be challenging to even the best students – the average mark for a Chemistry written paper is about 65%, very few students achieve marks of over 80%, but there will be significant numbers with marks below 50%. At school or college many students will have been used to regularly achieving marks over 90%, so it takes some adjustment in approach to deal with a Cambridge examination.

All of the questions involve solving a problem of some kind, and to do this successfully you will need both factual information and – most importantly – an understanding of the underlying chemical principles which are being applied in the question. You can expect the questions to be similar in style to those you have done as exercises associated with the lecture course or to past exam questions, but the questions you will be confronted with in your examination will certainly not be the same as those you have seen before. You certainly cannot 'learn' the answers to the questions: you will need to work them out using your understanding of chemical principles.

Each question is usually split into parts, with one part leading on from the other. However, each part is likely to involve more than one step, so although the questions are structured, they are not likely to be quite as structured as you are used to.

Many students find the biggest difficulty with a Cambridge examination is that they run out of time. This is a reflection of the difficulty of the questions, which may not only require you to write more than you are used to, but may also need quite a bit of thought before you can start to answer them.

It is for this reason that you need to be very careful about dividing your time equally between the questions on the examination paper. On the Chemistry paper there are six questions to answer, each with equal weight, so 30 minutes should be allocated to each. All those involved in marking examination papers will tell you that the greatest number of marks are achieved in the early stages of answering a question. Therefore, carrying on beyond 30 minutes in the hope that 'the answer' will suddenly pop out, and hence gain you the final few marks, is not a good strategy. Far better to move on to the next question and gain the straightforward marks for this.

Each Part IA Chemistry exam question is marked out of 20.

Most questions are subdivided into parts, and the approximate number of marks available for each part is shown at the side of the question. It is important to pay attention to this. If a part receives 2 marks, then clearly only a very short answer is expected – not a page of explanation. No matter how much you write, the maximum number of marks will still be 2.

In setting the questions the examiners will have in mind a particular answer. However, full credit is given for any answer which the examiner deems reasonable, even if it is not the answer that he or she originally had in mind – there is no one right answer.

For many questions, a well-constructed and labelled diagram, accompanied by a few well thought out sentences, is all that is required, and is indeed the best way to structure an answer.

If you make a mistake in your answer, simply cross it out and carry on; under no circumstances should you use 'TippEx' or other such products. It may be that you have crossed out the 'right' answer, or at least a valid approach, in which case the Examiner may be inclined to give some credit. On the whole, the examinations are marked in a generous way; there is no negative marking.

Finally, you should try to write as legibly and clearly as you can, simply because this will help the examiner to read and mark what you have written. Use a good quality black or blue pen that makes a medium width line (not a very fine line, which is harder to read). You may draw diagrams in pencil and use colour for these, if it seems helpful. However, the main part of your answers should be written in pen. Do not crowd the page with text and diagrams – rather, leave some space so as to improve legibility.

If you want further advice on how to approach Cambridge examinations, then you should approach your Director of Studies or supervisor.

Criteria for assessment

At the end of the year you will be awarded a mark and a class. The Natural Sciences Tripos Committee gives specific guidance on the relationship between marks and classes, and on the expected distribution of candidates amongst the classes.

The final mark will be made up of 20% derived from the marks awarded in the practical course and 80% from the marks achieved in the end of year examination. The marking scheme used in the practical course is not designed to differentiate strongly between candidates and, as a result, the spread of marks is quite narrow and the average mark is quite high. Candidates who do not complete the experiments will, therefore, put themselves at a significant disadvantage.

In contrast, the examination is a strong discriminator. In the examination, marks are awarded for any reasonable answer – it is not necessary to give the 'expected answer' in order to gain credit. In addition, marking is on the whole quite generous, and there is certainly no negative marking.

13 Chemistry Consultative Committee

The Chemistry Consultative Committee consists of representatives of students and academic staff. It meets towards the end of each term and is a forum for the discussion of all aspects of teaching in the Department. Student representatives are elected during the Michaelmas term; comments and suggestions can be passed on to them so that they can be discussed at the next meeting. The minutes of previous meetings are to be found on the IA Moodle site and the composition of the committee can be found on the teaching website

www.ch.cam.ac.uk/committees/consultative-committee

Feedback

Prof. Bill Nolan is *Director of Teaching* in the Chemistry Department. He will be pleased to hear any comments, criticisms and suggestions regarding all aspects of the teaching offered by the Department. His office is G31 and he may also be contacted via the staff pigeon holes or EMAIL at wpn1000@cam.ac.uk.

14 Looking ahead: Chemistry in the second year and beyond

In the second year there are two chemistry courses offered. *Chemistry A* is concerned with topics in theoretical and physical chemistry, concentrating on molecular quantum mechanics and its application to the understanding of molecular structure and reactivity. *Chemistry B* is concerned with topics in organic and inorganic chemistry, with particular emphasis on structure determination, organic mechanism, main group and transition metal chemistry. The course also includes an introduction to biological chemistry.

If you are intending to specialise in chemistry in the third (and possibly fourth) year you should take both Chemistry A and Chemistry B so as to have the broadest grounding in chemical topics. Those taking physical sciences subjects, such as Physics, Materials Science or Earth Sciences may find that Chemistry A complements their studies. Likewise, those taking biological subjects with a more molecular emphasis may find that Chemistry B is a useful subject to take alongside their main choices.

For Chemistry A it is desirable that you have taken the *Mathematics* course in Part IA NST; the *Mathematical Biology* course is sufficient preparation, although you will find that you need to read up on one or two extra concepts. There is no mathematical requirement for Chemistry B.

You can specialise in Chemistry in the third year (Part II) and in the fourth year (Part III). After the third year you can graduate in the usual way, and this is the route which students who are embarking on a career not directly related to chemistry often take. Those intending to pursue chemistry after they graduate, typically by taking a research degree, need to stay on for the fourth year, after which they graduate with a BA and an MSci.

You should note that in order to proceed to Part III you need to achieve at least a II.1 in Part II Chemistry.

15 Further details of the department

In order to access areas of the Department other than the lecture theatres you will need your University card so that you can pass the turnstiles and various internal doors. You should therefore make it a point to *always* bring your card with you when you come to the Department.

We hope that during the registration process for the practical classes we will be able to collect all of the information we need to make sure that everyone has the appropriate access. If you find that your access rights are different to others in your year group, or access suddenly stops, please contact Mifare Admin (mifareadmin@ch.cam.ac.uk). It is helpful if you provide with your enquiry: (1) your name as it appears on the card; (2) the issue number which can be found on the back of your card (written as ab123/issue number); (3) the expiry date shown on the front. However, please do not do this until after the first week of term, as it will take some time in order for the whole system to settle down. Please note that undergraduates will *not* be given access to research areas. If you need to meet supervisors and so on, you will need to arrange for them to meet you in a general access area. Make sure you know who they are and how to contact them, so Security can help you locate them if necessary.

Your card will give you access to the building from 08:00–20:00 Monday - Friday and Saturday 08:00–16:00 Outside these times you are not permitted to be in the Department unless some specific arrangement has been made. If you remain in the Department after 20:00 you risk becoming trapped by the security doors and/or the turnstiles.

We regret that, because of space limitations, the Departmental Cybercafe is not open to Part IA students.