

Chemistry
'A' level

Introduction

Welcome to your 'A' level Chemistry course. This introduction will serve as a guide to what you can expect from the course, and it will show you how to plan your study of this course effectively. Take your time to read this introduction thoroughly before you start the lessons.

The course is designed to prepare students for the Chemistry specification/syllabus set by Pearson/Edexcel.

The Edexcel **Subject Code** for entry to the **AS only** award is **8CHO**.
The Edexcel **Subject Code** for entry to the **A-level** Advanced Level award is **9CHO**.

The specification is open to Private Candidates. If you are just sitting the AS exam, 8CHO, this is a written exam only; you will not need the practical endorsement and you should be able to book this exam as a Private Candidate at any centre that usually accepts external candidates.

If you wish to take the full A-level, 9CHO, then you can only book the exam at a centre that is able to offer you the practical endorsement, even though you may not wish to take it. Oxford Open Learning can advise you on the best way to book the full A-level (please ask your Student Adviser).



Arrangement of Lessons and Textbook References

Module/Topic 1: Atomic Structure and the Periodic Table		
	Lesson title	Req'd Reading <i>Book 1</i>
Lesson 1	The Atom	pp. 12-31
Lesson 2	Ionisation Energies	pp. 108-116
Tutor Marked Assignment A		
Module/Topic 2 (B): Bonding and Structure; Periodicity		
Lesson 3	Chemical Bonding	pp. 38-76
Lesson 4	Intermolecular Forces	pp. 60-65
Lesson 5	Structure and Periodicity	pp. 49, 68-76
Tutor Marked Assignment B		
Module/Topic 3: Redox (1)		
Lesson 6	Redox (1)	pp. 81-91
Module/Topic 4 (A): Inorganic Chemistry and the Periodic Table		
Lesson 7	Group 1 and 2 Elements	pp. 94-107
Lesson 8	The Halogens	pp. 108-116
Tutor Marked Assignment C		
Module/ Topic 5: Formulae, Equations and Amounts of Substance		
Lesson 9	The Mole and Mole Calculations	pp. 119-134
Lesson 10	Chemical Calculations in the Laboratory	pp. 119-136
Tutor Marked Assignment D		
Module/Topic 6: Organic Chemistry (1)		
Lesson 11	Introduction to Organic Chemistry	pp. 150-151
Lesson 12	Hydrocarbons – alkanes and alkenes	pp. 176-183
Lesson 13	Alkenes	pp. 184-199
Lesson 14	Halogenalkanes	pp. 202-211
Lesson 15	Alcohols	pp. 212-221
Tutor Marked Assignment E		
Module/Topic 7: Modern Analytical Techniques (1)		
Lesson 16	Modern Analytical Techniques	pp. 225-258
Tutor Marked Assignment F		
Module/ Topic 8: Energetics (1)		
Lesson 17	Energy and Chemical Reactions	pp. 237-248
Lesson 18	Hess's Law and Bond Enthalpies	pp. 248-258
Tutor Marked Assignment G		
Module/Topic 9: Kinetics (1)		
Lesson 19	Kinetics	pp. 262-273

Module/Topic 10: Equilibrium (1)		
Lesson 20	Equilibrium (1)	pp. 274-285
Tutor Marked Assignment H		
Tutor Marked Assignments I and J – Practice Exams		

2nd Year Course - to be confirmed

The 2nd Year course is still in development at the time of publication of the AS course. Below is a very provisional listing of lessons:

Lesson 21	Practicals: Analysing and Evaluating	
Lesson 22	Kinetics Revisited	
Lesson 23	Equilibrium (2)	
Lesson 24	Acids and Bases	
Lesson 25	More Organic Chemistry	
Lesson 26	Carbonyl Chemistry	
Lesson 27	Aromatic Chemistry	
Lesson 28	Amines and Amino Acids	
Lesson 29	Polymers	
Lesson 30	Organic Identification Techniques	
Lesson 31	Thermodynamics	
Lesson 32	Periodicity	
Lesson 33	Redox Equilibrium	
Lesson 34	Transition Elements	
Lesson 35	Solutions	
Lesson 36	Synoptic Assessment	
Lesson 37	Practical Skills	

Textbooks

The textbook that you need to acquire and which is referred to throughout the AS (1st Year) course is:

Graham Curtis, Andrew Hunt and Graham Hill, *Edexcel A Level Chemistry Book 1* Hodder Education, ISBN-13: 978-1471807466

The corresponding book for the 2nd Year course is:

Graham Curtis and Andrew Hunt, *Edexcel A Level Chemistry Book 2* Hodder Education, ISBN-13: 978-1471807497

You might save a little money by buying the two texts combined into a single book (ISBN-13: 978-1510469983).

These books have been specifically written to cover all the requirements of the Edexcel AS and A-level Chemistry specifications. They are full of

good, up-to-date questions and you are encouraged to tackle these as well as the ones you will find in this course.

Edexcel A Level Chemistry Book 1 is the only textbook that you will need for the AS course but, from time to time, you may wish to go into more depth on a particular topic. There are many good A-level textbooks that can help you or give you a different perspective. You might opt for the Pearson texts, e.g. *Edexcel AS/A level Chemistry Student Book 1 + ActiveBook* (Edexcel GCE Science 2015; ISBN: 978-1447991168)

If you are resuming study of chemistry some years after taking your GCSE, you may find that you need reminding of some basic facts. You can do no better than to use *Edexcel GCSE (9-1) Chemistry Student Book* (Pearson/Edexcel) by Mark Levesley et al (ISBN: 978-1292120218).

Some of you may come to chemistry fully equipped with all the mathematical skills that you need, whereas for others the calculations for AS chemistry will prove a challenge. If you find yourself in need of some remedial work on your maths, the excellent guide *Maths for A-level Chemistry* by Stephen Doyle (Illuminate ISBN: 1908682901) will provide help on everything from rearranging equations to drawing graphs.

Online Resources for Chemistry A-level

If you have access to the internet you can make good use of many fine chemistry sites to help with your studies. Using a search engine will not be very productive as it will bring up a range of sites of varying quality and use.

The best supporting online resource for this subject is Boomer Chemistry. Its homepage is at <http://www.boomerchemistry.com>. There are numerous links to this site during the course.

We can also recommend the videos produced by Dr Sarah Sephton which may be accessed at www.ool.co.uk/ca0005a. These offer excellent practical explanations of various skills and topics. It is well worth getting to know what is available there.

A number of other sites may be worth checking out:

Chemsoc <http://www.chemsoc.org>

This is the education site of the Royal Society of Chemistry and will provide you with excellent material on all aspects of chemistry. This site invites you to input your level of study when requesting information and thus provides material at just the right level.

American Chemical Society <http://www.acs.org>

This is the site of the American Chemical Society. Again, you are invited to put in your level of study, so for AS level, use the middle/high school option.

New Scientist <http://www.newscientist.com>

An outstanding and award-winning site that will help you relate your studies to current research. Unlike other magazines in the field, *New Scientist* articles are written in such a way that any A-level student will understand them.

Virtlab <http://www.virtlab.com>

This website is a virtual laboratory where a range of experiments can be sampled on line. You do need to register first but it is a free resource.

S-cool <http://www.s-cool.co.uk>

One of the best revision sites for AS Chemistry.

The Edexcel Specifications

Edexcel AS Specification: Summary of Content

Note: All AS exams must be taken in the same examination series. The AS is a 'stand-alone' qualification. You cannot at a later date add on A-level papers and convert it to a full A level.

- Exam questions will test students' knowledge and understanding of the relevant specification topics.
- Each paper will also assess students' knowledge and understanding of experimental methods, based on the core practicals in the specification.
- Question types: multiple choice, short and long answer questions (up to 6 marks), and calculations.
- Questions assessing students' use of mathematical skills will make up 20% of the exam papers.

AS Paper 1 – Core Inorganic and Physical Chemistry

80 marks 50% weighting 1 hour 30 minutes

Topic 1: Atomic Structure and the Periodic Table

Topic 2: Bonding and Structure

Topic 3: Redox (1)

Topic 4: Inorganic Chemistry and the Periodic Table

Topic 5: Formulae, Equations and Amounts of Substance

AS Paper 2 – Core Organic and Physical Chemistry

80 marks 50% weighting 1 hour 30 minutes

Topic 2: Bonding and Structure
Topic 5: Formulae, Equations and Amounts of Substance
Topic 6: Organic Chemistry (1)
Topic 7: Modern Analytical Techniques (1)
Topic 8: Energetics (1)
Topic 9: Kinetics (1)
Topic 10: Equilibrium (1)

The A-level Specification

The A-level specification consists of three written examination papers which are compulsory and a practical endorsement which is strongly recommended but is not a requirement. The A-level grade is awarded from the marks gained in the 3 written papers. This is your actual grade, regardless of the practical. On your certificate there will be a separate award for the Practical Endorsement. If you opt to take it and you satisfactorily complete the practical tasks, your certificate will show "Pass". If you decline to take the Practical Endorsement, which you are allowed to do, this will be indicated on your certificate as a "U" for ungraded. Either a "Pass" or a "U" for the practical does not have any effect on your actual A-level grade.

- Exam questions will test students' knowledge and understanding of the relevant specification topics and experimental methods based on the core practicals in the specification.
- Paper 3 will also assess students' knowledge and understanding of experimental methods, based on the core practicals in the specification.
- Question types: multiple choice, short and long answer questions (up to 6 marks), and calculations.
- Questions assessing students' use of mathematical skills will make up 20% of the exam papers.

A-level Paper 1 – Advanced Inorganic and Physical Chemistry

90 marks 30% weighting 1 hour 45 minutes

Topic 1: Atomic Structure and the Periodic Table
Topic 2: Bonding and Structure
Topic 3: Redox (1)
Topic 4: Inorganic Chemistry and the Periodic Table
Topic 5: Formulae, Equations and Amounts of Substance
Topic 8: Energetics (1)
Topic 10: Equilibrium (1)

Topic 11: Equilibrium (2)
Topic 12: Acid-base Equilibria
Topic 13: Energetics (2)
Topic 14: Redox (2)
Topic 15: Transition Metals

A-level Paper 2 – Advanced Organic and Physical Chemistry

90 marks 30% weighting 1 hour 45 minutes

Topic 2: Bonding and Structure
Topic 3: Redox (1)
Topic 5: Formulae, Equations and Amounts of Substance
Topic 6: Organic Chemistry (1)
Topic 7: Modern Analytical Techniques (1)
Topic 9: Kinetics (1)
Topic 16: Kinetics (2)
Topic 17: Organic Chemistry (2)
Topic 18: Organic Chemistry (3)
Topic 19: Modern Analytical Techniques (2)

A level Paper 3 – General and Practical Principles in Chemistry

120 marks 40% weighting 2 hours 30 minutes

- All topics across the full A-level specification.
- Half of the paper will focus on testing students' knowledge and understanding of practical skills and techniques.

A-level Practical Endorsement - optional assessment

- Students *may* decline to complete the 12 practical activities, although exam-entering centres must always offer the option to complete them.
- The award on the Endorsement does not affect the A-level grade but students should be aware that written paper questions will test theoretical practical knowledge.
- For some degree courses, it will be essential to complete the Endorsement, but for others it will not matter. You must check.

Practical skills - Edexcel's requirements

Practical work is central to any study of chemistry. For this reason, the specification includes 16 core practical activities which form a thread linking theoretical knowledge and understanding to practical scenarios.

In following this thread, students will build on practical skills learned at GCSE, becoming confident practical chemists, handling apparatus competently and safely. Using a variety of apparatus and techniques, they should be able to design and carry out both the core practical activities and their own investigations, collecting data which can be analysed and used to draw valid conclusions.

One important aspect of practical work is the ability to evaluate and manage potential risks. The variety of different practical techniques and scenarios in the core practical activities give students scope to consider risk management in different contexts.

Students should also consider the ethical issues presented by their work in the laboratory, which might include consideration for using minimum quantities of resources, such as through microscale procedures; the safe disposal of waste materials, especially from organic reactions; and appropriate consideration for other people involved in their own work or who is working nearby.

Also central to the development of practical skills is the ability to communicate information and ideas through the use of appropriate terminology and ICT. Being able to communicate clearly the findings of practical work is arguably as important as the collection of accurate data.

In carrying out practical activities, students will be expected to use their knowledge and understanding to pose scientific questions which can be investigated through experimental activities. Such activities will enable students to collect data, analyse it for correlations and causal relationships, and to develop solutions to the questions posed.

Be aware that questions within written examination papers will aim to assess the knowledge and understanding that students gain while carrying out practical activities, within the context of the 16 core practical activities, as well as in novel practical scenarios.

The written papers will test the skills of students in planning practical work – both in familiar and unfamiliar applications – including risk management and the selection of apparatus, with reasons. As part of data handling, students will be expected to use significant figures appropriately, to process data and to plot graphs. In analysing outcomes and drawing valid conclusions, students should critically consider methods and data, including assessing measurement uncertainties and errors.

Examination papers will also provide the opportunity for students to evaluate the wider role of the scientific community in validating new knowledge and the ways in which society as a whole uses science to inform decision making. Within this, they could be asked to consider the implications and applications of chemistry in terms of associated benefits and risks. Students may also be asked to evaluate methodology, evidence and data and resolve conflicting evidence.

Success in questions that indirectly assess practical skills within written papers will come more naturally to those candidates who have a solid foundation of laboratory practice and who, having carried them out, have a thorough understanding of practical techniques. The 16 core practicals will provide the basis from which some of the Paper 3 examination questions will be drawn.

Teachers should note that the completion of the 16 core practical activities can also provide evidence of competence for the Science Practical Endorsement and that evidence must be provided for the 12 practical techniques listed in Appendix 5c of the specification through a minimum of 12 core practical activities.

Here is the list in summary form for ease of reference:

1. Measuring the molar volume of a gas
2. Preparation of a standard solution from a solid acid
3. Finding the concentration of a solution of hydrochloric acid
4. Investigation of the rates of hydrolysis of halogenoalkanes
5. The oxidation of ethanol
6. Chlorination of 2-methylpropan-2-ol with concentrated hydrochloric acid
7. Analysis of some inorganic and organic unknowns
8. To determine the enthalpy change of a reaction using Hess's Law
9. Finding the K_a value for a weak acid
10. Investigating some electrochemical cells
11. Redox titration
12. The preparation of a transition metal complex
- 13a and 13b: Following the rate of the iodine-propanone reaction by a titrimetric method and investigating a 'clock reaction' (Harcourt-Esson, iodine clock)
14. Finding the activation energy of a reaction
15. Analysis of some inorganic and organic unknowns
16. The preparation of aspirin.

Practical Endorsement

As you'll see from the assessment models, exam papers will feature questions allowing students to demonstrate investigative skills in the context of the core practicals.

Students' skills and technical competency when completing practical work will be assessed by teachers. This will form the basis for the award of a Practical Endorsement at A level. (This is separate to the A-level grade and, if awarded, will be reported as a 'Pass' on A-level certificates for students who achieve it.)

The assessment of practical skills is a requirement of the course of study for A-level qualifications in biology, chemistry and physics. It will appear on all students' certificates as a separately reported result, alongside the

overall grade for the qualification. The arrangements for the assessment of practical skills will be common to all awarding organisations.

For those who opt to take the Practical Endorsement, there will be a minimum of 12 practical activities to be carried out by each student which, together, meet the requirements of Appendices 5b (Practical skills identified for direct assessment and developed through teaching and learning) and 5c (Use of apparatus and techniques) from the prescribed subject content, published by the Department for Education.

Teachers will assess students against Common Practical Assessment Criteria (CPAC) issued by the awarding organisations. The CPAC are based on the requirements of Appendices 5b and 5c of the subject content requirements published by the Department for Education, and define the minimum standard required for the achievement of a pass.

Each student will keep an appropriate record of their practical work, including their assessed practical activities.

Students who demonstrate the required standard across all the requirements of the CPAC will receive a 'pass' grade.

There will be no separate assessment of practical skills for AS qualifications.

Students will answer questions in the AS and A level examination papers that assess the requirements of Appendix 5a (Practical skills identified for indirect assessment and developed through teaching and learning) from the prescribed subject content, published by the Department for Education. These questions may draw on, or range beyond, the practical activities included in the specification.

The structure within each lesson: how to study

Front page

The front page of each lesson shows:

- **The title.**
- **Aim(s)** for the lesson. These set out the position that you should reach after working through the lesson; keep these in mind while reading the lesson material.
- **Context.** This gives a very brief summary and shows how the lesson fits in with the rest of the course.
- **Reading.** The individual references for each lesson.

Lesson notes

There then follow the notes; these are an outline of the subject material to be studied in the lesson. Read the notes carefully several times until you feel that you have understood the broad outline of the theory involved, and then tackle the reading references. The textbook may deal with the subjects in greater detail, and, as with the notes, you will probably need to read the passages several times.

Activities

Most activities in the course follow the notes, but others are placed in the notes at the relevant point. Activities are indicated as follows:

Activity 1

Investigate how a nucleus is held together, particularly how the binding energy of the nucleus relates to Einstein's equation, $E = mc^2$.

Sometimes here will be a box underneath in which you can jot down your answers. The pencil symbol indicates that you should make your own notes in the space provided. Suggested Answers to the Activities are generally to be found at the end of the lesson.

Tutor-marked Assignments

After every two lessons or so there is a tutor-marked assignment. These are in 'A' level examination style and should be carried out under timed conditions to give you examination practice. These tests will thoroughly check your understanding of the previous few topics. You should send your answers to these tests to your tutor, who will return your marked script, together with a set of suggested answers.

Revision

Do **not** leave all your revision until the end of the course. You will need to revise thoroughly for your examination, but frequent revision throughout the course is **essential**. Plan your revision sensibly, and re-read as you feel necessary, if your knowledge is beginning to fade.

Checking the syllabus

As you know, this course has been written to cover the contents of the **Edexcel A-level specification 9CH0** or **AS level (8CH0)** which are available to download (you will need an Adobe Acrobat reader on your computer) at:

<http://www.ool.co.uk/ca0012> (A-level, 9CH0), or

<http://www.ool.co.uk/ca0012b> (AS, 8CH0)

You should read the syllabus throughout the course, so either keep a copy on your computer or print it out. If you do not have access to the internet, the syllabus is available by post from Pearson/Edexcel.

Past papers

Edexcel now makes all (but the very last set) of past papers available online for free download at:

<http://www.ool.co.uk/ca0013>

Your tutor

You have a lot of resources to help you in your studies; your course file, textbook, internet resources and your tutor. You should make good use of your tutor to help you with any difficulties that you may have during the course.

And finally... very good luck with your studies.

Author: Andrew Wilkins, with adaptations from OOL resources

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