



**GUILDFORD COUNTY  
SCHOOL  
A-LEVEL  
CHEMISTRY HANDBOOK**





# Your Chemistry Learning Journey

In order to be a successful Chemistry student you will need to develop various skills, attitudes, attributes, and behaviours. These are all apart of your ‘Learning Journey’. Any student can achieve the very highest quality work and grades; **improvement and excellence is achieved through commitment, focus and effort.**

In the table below you can see some broad descriptions of steps that you might take on your journey. We have called these steps **Novice, Proficient, Accomplished, and Mastery**. It is possible that you will start your journey at Novice or Proficient level, and it is hoped that by the end of your course you will be working at Accomplished or Mastery level. The sooner you work at the higher levels the better your time on the course and, therefore, your outcomes will be.

SKILL LEVEL	DESCRIPTION
Limited	Level of knowledge and understanding varies <b>significantly across major areas of the specification and the motivation to address this is currently lacking</b> . Demonstrates poor time management and is often behind with work. Seems to have little real interest in the subject and is not <b>particularly proactive in asking questions or seeking answers</b> . Lacks the ability or motivation to work with any real degree of independence. Is unlikely to be successful in the study of Chemistry without a change of attitude and application.
Novice	Can <b>work well under teacher direction</b> and with some degree of independence. Knowledge and understanding varies significantly across major areas of the specification and this is an area that would need to be addressed before attaining basic level in Chemistry. To reach basic level student needs to demonstrate that <b>he/she can prioritise</b> . In addition a student working towards this level has to <b>learn to be more resourceful and resilient and to be proactive</b> in asking questions and seeking solutions to problems. <b>It is important that an adequate amount of time is spent on addressing difficult concepts and appropriate revision strategies are employed.</b>
Proficient	Working with a <b>higher degree of independence</b> in addition to working well under teacher direction. A competent student <b>manages time reasonably well, asks good questions and is proactive in seeking answers</b> . He/She is a good communicator and collaborates with others well, recalling and using <b>scientific knowledge that reflects his/her ability from within the constraints of the specification</b> . He/She shows <b>good understanding of the principles and concepts used and can apply knowledge reasonably well in familiar contexts</b> . He/She can plan investigations, has good observation skills, can <b>gather accurate, precise and reliable data</b> when carrying out practical work and has the <b>ability to draw informed conclusions</b> .

SKILL LEVEL	DESCRIPTION
Accomplished	<p>To become confident students need to work with a high degree of independence, to manage time very effectively, to formulate and ask very good questions and to demonstrate that he/she is keen to learn more. He/She needs to become practically adept, a very good communicator, to collaborate effectively with others and be confident to take risks. Students need to recall and use scientific knowledge that reflects the content of the exam specification and to show very good understanding of the principles and concepts covered. He/She needs to select only appropriate information from which to solve problems. A confident student can bring together fundamental principles from different content areas of the subject and demonstrates a reasonable understanding of the relationships between these. He/She can carry out calculations well and can apply knowledge to familiar contexts and is beginning to do so effectively in unfamiliar situations.</p>
Mastery	<p>Can recall and use scientific knowledge that goes beyond the constraints of the exam specifications and reflects his/her interests and aspirations. He/She needs to show excellent understanding of the principles and concepts used, selecting only appropriate information with which to solve problems. At this level students need to demonstrate an ability to work independently and to manage time very effectively. A fluent student has excellent practical skills, questions well, and is curious to find out more and proactive in relation to this. He/She is an effective communicator, collaborates well, and is creative and very confident to take risks. He/She can bring together fundamental principles from different content areas of the subject and demonstrates a clear understanding of the relationships between these. He/She can apply knowledge well in both familiar and unfamiliar contexts, demonstrating excellent understanding of the underlying relationships between physical quantities and can carry out all elements of extended calculations correctly and without guidance.</p>

## The Course

Year 1 Chemistry is not longer offered as a stand alone qualification at Guildford County School.

A-Level Chemistry is a two year course . You sit *all of your exams at the end of the second year*. You will not be able to sit some exams in January nor in the summer term of Year 12.

<b>Key Assessment Criteria</b>	<b>A-level Chemistry</b>
<b>Minimum assessment time</b>	6 hours
<b>Maximum number of exams</b>	3
<b>Coursework/controlled assessment?</b>	No
<b>Practical endorsement</b>	Yes
<b>Practical based marks on exams</b>	15%
<b>Maths (Higher tier GCSE) marks on exams</b>	20%

## Assessment Objectives

You will be assessed against the set of objectives listed in the table below.

<b>AO1</b>	Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures
<b>AO2</b>	Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: ·in a theoretical context ·in a practical context ·when handling qualitative data ·when handling quantitative data
<b>AO3</b>	Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to: ·make judgements and reach conclusions ·develop and refine practical design and procedures

# Mathematical Requirements

*A chemist who does not know mathematics is seriously handicapped.*

— Irving Langmuir

Quoted in Albert Rosenfeld, *Langmuir: The Man and the Scientist* (1962), 293.

20% of the overall assessment of A-level Chemistry will contain mathematical skills equivalent to Level 2 or above. This means that if your maths skills are not secure at a grade 7/8 or above on the higher tier GCSE paper, you may struggle with some parts of the course.

The table below shows The following tables illustrate some of the mathematical skills required. This list of examples is not exhaustive.

Area of Study	Mathematical skills
Arithmetic and numerical computation	Recognise and make use of appropriate units in calculation Recognise and use expressions in decimal and ordinary form Use ratios, fractions and percentages Estimate results Use calculators to find and use power, exponential and logarithmic functions
Handling data	Use an appropriate number of significant figures Find arithmetic means Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined Understand and use the symbols: =, <>, >, $\propto$ , $\sim$ , equilibrium sign Change the subject of an equation Substitute numerical values into algebraic equations using appropriate units for physical quantities Solve algebraic equations Use logarithms in relation to quantities that range over several orders of magnitude
Graphs	Translate information between graphical, numerical and algebraic forms Plot two variables from experimental or other data Determine the slope and intercept of a linear graph Calculate rate of change from a graph showing a linear relationship Draw and use the slope of a tangent to a curve as a measure of rate of change
Geometry and trigonometry	Use angles and shapes in regular 2D and 3D structures Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects Understand the symmetry of 2D and 3D shapes

## Practical Requirements

Practical work is at the heart of chemistry. You will be taught how to keep a lab book and will be given the opportunity to try and hone your manipulative skills and understanding of the processes of scientific investigation in a set of **required practicals**. The practical work will also contribute to your understanding and learning of the concepts in the course.



"I THINK THERE WAS A TYPO  
IN THE LAB INSTRUCTIONS."

*Chemistry is necessarily an experimental science: its conclusions are drawn from data, and its principles supported by evidence from facts.*

**MICHAEL FARADAY, 1791 TO 1867**

There are four main areas in which students practical skills will be examined: Independent thinking, Use and application of scientific methods and practices, Numeracy and the application of mathematical concepts in a practical context and Instruments and equipment.

At A-Level, at least 15% of the overall assessment will assess knowledge, skills and understanding in relation to practical work. Practical assessments have been divided into those that can be assessed in written exams and those that can only be directly assessed whilst students are carrying out experiments. A-level grades will be based only on marks from written exams. A separate endorsement of practical skills will be taken alongside the A-level. This will be assessed by teachers and will be based on direct observation of your competency in a range of skills that are not assessable in written exams.

## Practical Endorsement

The assessment of practical skills is a compulsory requirement of the course of study for A-level Chemistry. A separate endorsement of practical skills will appear on all students' certificates as a separately reported result, alongside the overall grade for the qualification. You will receive this practical endorsement if you demonstrate the required standard across all the requirements of the Common Practical Assessment Criteria (CPAC). This is assessed by your teacher over a minimum of 12 set practicals.

There are 5 competencies which you must master in order to receive the practical endorsement: Follows written procedures; Applies investigative approaches and methods when using instruments and equipment; Safely uses a range of practical equipment and materials; Makes and records observations; Researches, references and reports.

# A-Level Chemistry Assessment Structure

<b>Paper 1:</b> <b>Inorganic and Physical chemistry</b>	+	<b>Paper 2:</b> <b>Organic and Physical chemistry</b>	+	<b>Paper 3:</b> <b>Practical skills, data handling and synopsis</b>
<b>Content</b> <ul style="list-style-type: none"> <li>• Relevant practical skills</li> <li>• Inorganic chemistry:           <ul style="list-style-type: none"> <li>– Periodicity</li> <li>– Group 2, the alkaline earth metals</li> <li>– Group 7(17), the halogens</li> <li>– Properties of Period 3 elements and their oxides</li> <li>– Transition metals</li> <li>– Reactions of ions in aqueous solution</li> </ul> </li> <li>• Physical chemistry:           <ul style="list-style-type: none"> <li>– Atomic structure</li> <li>– Amount of substance</li> <li>– Bonding</li> <li>– Energetics I</li> <li>– Equilibria I</li> <li>– Redox</li> <li>– Thermodynamics</li> <li>– Equilibrium constant <math>K_p</math> for homogeneous systems</li> <li>– Electrode potentials and electrochemical cells</li> <li>– Acids and bases</li> </ul> </li> </ul>		<b>Content</b> <ul style="list-style-type: none"> <li>• Relevant practical skills</li> <li>• Organic chemistry:           <ul style="list-style-type: none"> <li>– Introduction to organic chemistry</li> <li>– Alkanes</li> <li>– Halogenoalkanes</li> <li>– Alkenes</li> <li>– Alcohols</li> <li>– Organic analysis</li> <li>– Optical isomerism</li> <li>– Aldehydes and ketones</li> <li>– Carboxylic acids and derivatives</li> <li>– Aromatic chemistry</li> <li>– Amines</li> <li>– Polymers</li> <li>– Amino acids, proteins and DNA</li> <li>– Organic synthesis</li> <li>– Nuclear magnetic resonance spectroscopy</li> <li>– Chromatography</li> </ul> </li> <li>• Physical chemistry:           <ul style="list-style-type: none"> <li>– Amount of substance</li> <li>– Bonding</li> <li>– Energetics II</li> <li>– Equilibria II</li> <li>– Kinetics</li> <li>– Rate equations</li> </ul> </li> </ul>		<b>Content</b> <ul style="list-style-type: none"> <li>• All content</li> <li>• All practical skills</li> </ul>
<b>How it's assessed</b> <ul style="list-style-type: none"> <li>• written exam: 2 hours</li> <li>• 105 marks</li> <li>• 35% of A-level</li> <li>• 105 marks, with a mixture of short and long answer questions</li> </ul>		<b>How it's assessed</b> <ul style="list-style-type: none"> <li>• written exam: 2 hours</li> <li>• 105 marks</li> <li>• 35% of A-level</li> <li>• 105 marks, with a mixture of short and long answer questions</li> </ul>		<b>How it's assessed</b> <ul style="list-style-type: none"> <li>• written exam: 2 hours</li> <li>• 90 marks</li> <li>• 30% of A-level</li> <li>• 40 marks of questions on practical techniques and data analysis</li> <li>• 20 marks of questions testing across the specification</li> <li>• 30 marks of multiple choice questions</li> </ul>

## **Suggestions for Further Reading**

Advanced level study is not about doing the minimum requirement; it's about going the extra mile. In fact, because you've chosen your A Level subjects - and you enjoy them - and you're following fewer subjects than at KS4, you're expected to tackle more complex issues and study them in greater depth.

In this respect, it's unlikely that one textbook – particularly in a complex subject like Chemistry - will provide you with enough reading material to help you master the content and skills needed and go on to achieve a high grade.

Academic reading (or 'reading to learn') is more challenging because:

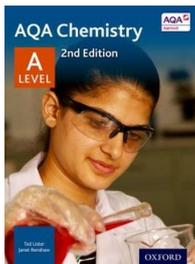
- You have a lot of material to read
- You have to engage with the content to really understand challenging concepts in Chemistry

You should be doing wider reading to:

- Broaden and extend knowledge
- Research a specific assignment
- Keep interest in subject alive and to place it in context of the wider world

Some suggested materials are listed on the next page. This is by no means an exhaustive list, you should be looking for your own resources, using the ones listed as a starting guide.

## Textbook (required):



You may wish to purchase the textbook as a hard copy, however, you will also have access to an online copy of this textbook via Kerboodle, provided by the school.

***AQA A Level Chemistry (2nd edition)***, Lister T, Renshaw J; Oxford University Press (including Nelson Thornes), ISBN-13: 978-0-19-835182-5

## Recommended additional reference textbooks:

### Year 12

CGP Head Start to A-level Chemistry ISBN: 9781782942801

CGP A-Level Chemistry: Essential Maths Skills ISBN: 9781782944720

Moles, Formulae and Equations, Edexcel Press UG004373

### Year 13

Calculations for A-Level Chemistry, Ramsden, Stanley Thornes 0 7487 1594 0

Introduction to Advanced Chemistry, Earl and Wilford, John Murray 0 7195 8587 2

### Both Years 12 and 13

CGP A-Level Chemistry for AQA: Year 1 & 2 Student Book with Online Edition ISBN: 9781789080476

Advanced Chemistry, Clugston & Flemming, Oxford UP0 19 914633 0

A-Level Chemistry (4th Edition), Ramsden, Stanley Thornes 0 7487 5299 4

AS and A Level Chemistry through Diagrams, Lewis, Oxford UP0 19 914198 3

Calculations in AS/A Level Chemistry, Clark, Longman 0 582 41127 0

Chemistry in Context, Hill and Holman, Nelson 0 17 448191 8

Chemistry in Context - Laboratory Manual and Study Guide, Nelson 0 17 448231 0

Complete A-Level Chemistry, Kelly, Collins Educational 0 00 322325 6

Understanding Chemistry, Lister and Renshaw, Nelson Thornes 0748739585

## Revision Guides and Workbooks

AQA A Level Chemistry Revision Guide, Oxford University Press, ISBN: 978-0-19-835184-9

CGP A-Level Chemistry: AQA Year 1 & 2 Complete Revision & Practice with Online Edition ISBN: 9781789080292

CGP A-Level Chemistry: AQA Year 1 & 2 Exam Practice Workbook - includes Answers ISBN: 9781782949138

**NOTE: There are inspection copies of most of these books in the Chemistry preparation room.**

## Wider Reading On Popular Science:

- Mendeleev's Dream, Paul Strathern, Penguin 0 1402 8414 1
- The Periodic Table, Primo Levi, Penguin 0 1402 9661 1
- Stuff Matters: Exploring the Marvellous Materials That Shape Our Man-Made World, Mark Miodownik, Houghton Mifflin 0544236041
- Seven Elements that Changed the World: An Adventure of Ingenuity and Discovery, John Browne, Pegasus 1605985406
- Molecules of Murder – Criminal Molecules and Classic Cases – John Emsley RSC Publishing, ISBN 978-0-85404-965-3
- Molecules at an Exhibition (The Science of Everyday Life) – John Emsley OUP, ISBN 978-0-19-286206-8
- Nature's Building Blocks: An A-Z guide to the elements – J. Emsley OUP, ISBN: 978-0-19850-340-8
- The Science of Chocolate – S. T. Beckett RSC 2008, ISBN 978-0-85404-970-7
- Why Chemical Reactions Happen – James Keeler and Peter Wothers OUP, ISBN 978-0-19924-973-2
- A Short History of Nearly Everything – Bill Bryson Black Swan, ISBN 978-0-55-299704-1
- How to Fossilise Your Hamster (and other amazing experiments for the armchair scientist) – Mick O'Hare Profile Books, ISBN: 978-1-84668-044-1
- Why don't Penguin's Feet Freeze? : (and 114 other questions) – Mick O'Hare Profile Books, ISBN: 978-1-86197-876-9
- 13 Things That Don't Make Sense – Michael Brooks Profile Books 2009, ISBN 978-1861978172

## Magazines, Websites and Journals:

- Exam Board: <https://www.aqa.org.uk/subjects/science/as-and-a-level/chemistry-7404-7405>
- ChemGuide: [www.chemguide.co.uk](http://www.chemguide.co.uk)
- ChemMatters, American Chemical Association: [www.acs.org/chemmatters](http://www.acs.org/chemmatters)
- The New Scientist (available in the school library)
- ChemRevise: <https://chemrevise.org/revision-guides/>
- Chemical and engineering News <https://cen.acs.org/index.html>

## Other Activities:

- Subscribe to the RSC Chemnet for current developments in Chemistry and Science, as well as loads of university information and seminars. <https://edu.rsc.org/eic/science>
- Networking/ChemNet/ Attend lectures and seminars on topics that interest you in Chemistry at UCL. [www.chem.ucl.ac.uk](http://www.chem.ucl.ac.uk) (News and Events)
- Spend a day at the Science Museum – it's free! Keep an eye out for special exhibitions. [www.sciencemuseum.org.uk](http://www.sciencemuseum.org.uk)
- Visit The Faraday Museum at the Royal Institution- This grand building has been home to 14 Nobel prizewinners, and housed the laboratories of some of the world's greatest scientific minds. <https://www.rigb.org/visit-us/faraday-museum>
- Old Operating Theatre, Museum and Herb Garret Predating anaesthetics and anti-septics, it is the oldest surviving surgical theatre in Europe. Access to the attic is through a narrow 52-step spiral staircase. <http://oldoperatingtheatre.com/>
- Attend a Royal Society Lecture on a subject which interests you! They have plenty of recording of past lectures to explore during the pandemic lockdown. <https://royalsociety.org/science-events-and-lectures/>
- The College's 130 annual lectures and events are free and open to all. The College has been recording its lectures since the 1980s and we live stream all lectures for those unable to attend in person. There are now over 2,000 lectures freely available online on this website and on [YouTube](https://www.gresham.ac.uk/lectures/?subject=science). <https://www.gresham.ac.uk/lectures/?subject=science>
- Attend an online Lockdown lecture from Imperial College <http://www.imperial.ac.uk/whats-on/> or keep an eye out for future lectures.