

Chemistry

A level Chemistry studies the material world, and through chemistry we can describe and explain questions such as: "what happens when sugar dissolves in tea?"; "why is mercury a liquid at room temperature?"; "how do we make plastics?"; "what can we do about global warming?"; "how and why will I be affected if oil runs out?".

From baking a cake to recharging a mobile phone, chemistry is involved in everything we do; and our lives are inextricably influenced by many aspects of chemistry. Chemistry will continue to be at the forefront of responding the needs of society; with chemists central to making advances in designing new materials, efficient energy use, drug development, and technology, to name but a few.

A level Chemistry courses cover a wide variety of basic concepts such as the structure of the atom; the interaction of matter and energy; how to control reactions; patterns in the Periodic Table; understanding carbon-based molecules.

Recommended Reads

1. **Periodic Tales: The Curious Lives of the Elements** (Paperback) Hugh Aldersey-Williams

This book covers the chemical elements, where they come from and how they are used. There are loads of fascinating insights into uses for chemicals you would have never even thought about.

2. **The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine** (Hardback) Marty Jopson

The title says it all really, lots of interesting stuff about the things around you home!

3. **Bad Science** (Paperback) Ben Goldacre

Here Ben Goldacre takes apart anyone who published bad / misleading or dodgy science – this book will make you think about everything the advertising industry tries to sell you by making it sound 'sciency'.

4. **Calculations in AS/A Level Chemistry** (Paperback) Jim Clark

If you struggle with the calculations side of chemistry, this is the book for you. Covers all the possible calculations you are ever likely to come across. Brought to you by the same guy who wrote the excellent chemguide.co.uk website.

5. **Salter's Advanced Chemistry: Chemical Storylines**

Do not feel you need to buy the latest edition (unless you are doing Salters chemistry!) You can pick up an old edition for a few pounds on ebay, gives you a real insight into how chemistry is used to solve everyday problems from global pollution through feeding to world to making new medicines to treat disease.

Recommended Video Clips

1. **Rough science – the Open University – 34 episodes available**

Real scientists are 'stranded' on an island and are given scientific problems to solve using only what they can find on the island. Great fun if you like to see how science is used in solving problems. There are six series in total. <http://bit.ly/pixlchemvid1a>

http://www.dailymotion.com/playlist/x2iqjq_Rough-Science_rough-science-full-series/1#video=xxw6pr

2. A thread of quicksilver – The Open University

A brilliant history of the most mysterious of elements – mercury. This program shows you how a single substance led to empires and war, as well as showing you some of the cooler properties of mercury.

<http://bit.ly/pixlchemvid2>

<https://www.youtube.com/watch?v=t46lvTxHHTA>

3. 10 weird and wonderful chemical reactions

10 good demonstration reactions, can you work out the chemistry of any... of them?

<http://bit.ly/pixlchemvid3>

<https://www.youtube.com/watch?v=0Bt6RPP2ANI>

Chemistry in the Movies

1. Dantes Peak 1997: Volcano disaster movie.

Use the link to look at the Science of acids and how this links to the movie.

<http://www.open.edu/openlearn/science-maths-technology/science/chemistry/dantes-peak>

<http://www.flickclip.com/flicks/dantespeak1.html>

<http://www.flickclip.com/flicks/dantespeak5.html>

2. Fantastic 4 2005 & 2015: Superhero movie

Michio Kaku explains the “real” science behind fantastic four <http://nerdist.com/michio-kaku-explains-the-real-science-behind-fantastic-four/>

<http://www.flickclip.com/flicks/fantastic4.html>

Task

Research two of the following topics. Make one page of notes covering a topic of your choice.

1. The chemistry of fireworks

What are the component parts of fireworks? What chemical compounds cause fireworks to explode? What chemical compounds are responsible for the colour of fireworks?

2. Task 2: Why is copper sulfate blue?

Copper compounds like many of the transition metal compounds have got vivid and distinctive colours – but why?

3. Task 3: Aspirin

What was the history of the discovery of aspirin, how do we manufacture aspirin in a modern chemical process?

4. Task 4: The hole in the ozone layer

Why did we get a hole in the ozone layer? What chemicals were responsible for it? Why were we producing so many of these chemicals? What is the chemistry behind the ozone destruction?

Task: Electronic structure, how electrons are arranged around the nucleus

A periodic table can give you the proton / atomic number of an element, this also tells you how many electrons are in the **atom**.

You will have used the rule of electrons shell filling, where:

The first shell holds up to 2 electrons, the second up to 8, the third up to 8 and the fourth up to 18 (or you may have been told 8).

pr	7
	Li
	lithium
	3

Atomic number = 3, electrons = 3, arrangement 2 in the first shell and 1 in the second

Li = 2,1

At **A level** you will learn that the electron structure is more complex than this, and can be used to explain a lot of the chemical properties of elements.

The 'shells' can be broken down into 'orbitals', which are given letters: 's' orbitals, 'p' orbitals and 'd' orbitals.

You can read about orbitals here:

<http://bit.ly/pixlchem1>

<http://www.chemguide.co.uk/atoms/properties/atomorbs.html#top>

Now that you are familiar with s, p and d orbitals try these problems, write your answer in the format:

$1s^2$, $2s^2$, $2p^6$ etc.

- Write out the electron configuration of:
 - Ca
 - Al
 - S
 - Cl
 - Ar
 - Fe
 - V
 - Ni
 - Cu
 - Zn
 - As
- Extension question, can you write out the electron arrangement of the following **ions**:
 - K^+
 - O^{2-}
 - Zn^{2+}
 - V^{5+}
 - Co^{2+}

Task: Isotopes and mass

You will remember that an isotopes are elements that have differing numbers of neutrons. Hydrogen has 3 isotopes; H_1^1 H_1^2 H_1^3

Isotopes occur naturally, so in a sample of an element you will have a mixture of these isotopes. We can accurately measure the amount of an isotope using a **mass spectrometer**. You will need to understand what a mass spectrometer is and how it works at A level. You can read about a mass spectrometer here:

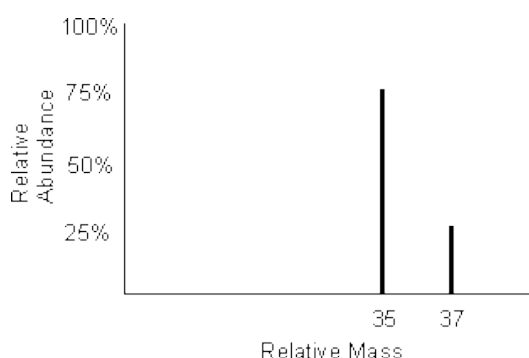
<http://bit.ly/pixlchem3>

<http://www.kore.co.uk/tutorial.htm>

<http://filestore.aqa.org.uk/resources/chemistry/AQA-7404-7405-TN-MASS-SPECTROMETRY.PDF>

1. What must happen to the atoms before they are accelerated in the mass spectrometer?
2. Explain why the different isotopes travel at different speeds in a mass spectrometer.

A mass spectrum for the element chlorine will give a spectrum like this:



75% of the sample consist of chlorine-35, and 25% of the sample is chlorine-37.

Given a sample of naturally occurring chlorine $\frac{3}{4}$ of it will be Cl-35 and $\frac{1}{4}$ of it is Cl-37. We can calculate what the **mean** mass of the sample will be:

$$\text{Mean mass} = \frac{75}{100} \times 35 + \frac{25}{100} \times 37 = 35.5$$

If you look at a periodic table this is why chlorine has an atomic mass of 35.5.

<http://www.avogadro.co.uk/definitions/ar.htm>

An A level periodic table has the masses of elements recorded much more accurately than at GCSE. Most elements have isotopes and these have been recorded using mass spectrometers.

GCSE

11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9
27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17

A level

10.8 B 5 boron	12.0 C 6 carbon	14.0 N 7 nitrogen	16.0 O 8 oxygen	19.0 F 9 fluorine
27.0 Al 13 aluminium	28.1 Si 14 silicon	31.0 P 15 phosphorus	32.1 S 16 sulphur	35.5 Cl 17 chlorine

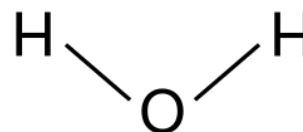
Given the percentage of each isotope you can calculate the mean mass which is the accurate atomic mass for that element.

3. Use the percentages of each isotope to calculate the accurate atomic mass of the following elements.
 - a. Antimony has 2 isotopes: Sb-121 57.25% and Sb-123 42.75%
 - b. Gallium has 2 isotopes: Ga-69 60.2% and Ga-71 39.8%
 - c. Silver has 2 isotopes: Ag-107 51.35% and Ag-109 48.65%
 - d. Thallium has 2 isotopes: Tl-203 29.5% and Tl-205 70.5%
 - e. Strontium has 4 isotopes: Sr-84 0.56%, Sr-86 9.86%, Sr-87 7.02% and Sr-88 82.56%

Task: The shapes of molecules and bonding

Have you ever wondered why your teacher drew a water molecule like this?

The lines represent a covalent bond, but why draw them at an unusual angle?



If you are unsure about covalent bonding, read about it here:

<http://bit.ly/pixlchem5>

<http://www.chemguide.co.uk/atoms/bonding/covalent.html#top>

At A level you are also expected to know how molecules have certain shapes and why they are the shape they are.

You can read about shapes of molecules here:

<http://bit.ly/pixlchem6>

<http://www.chemguide.co.uk/atoms/bonding/shapes.html#top>

1. Draw a dot and cross diagram to show the bonding in a molecule of aluminium chloride (AlCl_3)
2. Draw a dot and cross diagram to show the bonding in a molecule of ammonia (NH_3)
3. What is the shape and the bond angles in a molecule of methane (CH_4)?