

Summer work for Chemistry

This pack contains a programme of activities and resources to prepare you to start an A level in Chemistry in September. It is aimed to be used after you complete your GCSE, throughout the remainder of the summer term and over the Summer Holidays to ensure you are ready to start your course in September.

Recommended reading

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.

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!

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.

Research activities

Use your online searching abilities to see if you can find out as much about the topic as you can. Remember it you are a prospective A level chemist, you should aim to push **your** knowledge.

You can make a 1-page summary for each one you research using Cornell notes:

<http://coe.jmu.edu/learningtoolbox/cornellnotes.html>

Task 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?

Task 2: Why is copper sulfate blue?

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

Task 3: Aspirin

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

Pre-Knowledge Topics

Chemistry topic 1 – 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. Atomic number = 3, electrons = 3, arrangement 2 in the first shell and 1 in the second or 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://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: 1s², 2s², 2p⁶ etc.

Q1 Write out the electron configuration of:

- a) Ca b) Al c) S d) Cl e) Ar f) Fe g) V h) Ni i) Cu j) Zn k) As

Q2 Extension question, can you write out the electron arrangement of the following **ions**:

- a) K⁺ b) O²⁻ c) Zn²⁺ d) V⁵⁺ e) Co²⁺

Chemistry topic 2 – 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://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://www.chemguide.co.uk/atoms/bonding/shapes.html#top>

Q.1 Draw a dot and cross diagram to show the bonding in a molecule of aluminium chloride (AlCl₃)

Q.2 Draw a dot and cross diagram to show the bonding in a molecule of ammonia (NH₃)

Q3 What is the shape and the bond angles in a molecule of methane (CH₄)?

Chemistry topic 3 – Chemical equations

Balancing chemical equations is the stepping stone to using equations to calculate masses in chemistry. There are loads of websites that give ways of balancing equations and lots of exercises in balancing. Some of the equations to balance may involve strange chemical, don't worry about that, the key idea is to get balancing right.

Useful websites:

<http://www.chemteam.info/Equations/Balance-Equation.html>

<https://phet.colorado.edu/en/simulation/balancing-chemical-equations>

Chemistry topic 4 – Measuring chemicals – the mole

From this point on you need to be using an A level periodic table, not a GCSE one you can view one here:

https://secondaryscience4all.files.wordpress.com/2014/08/filestore_aqa_org_uk_subjects_aqa-2420-w-trb-pts_ds_pdf.png

The **mole** is the chemists equivalent of a dozen, atoms are so small that we cannot count them out individually, we weigh out chemicals.

For example: magnesium + sulfur → magnesium sulfide



We can see that one atom of magnesium will react with one atom of sulfur, if we had to weigh out the atoms we need to know how heavy each atom is. From the periodic table: Mg = 24.3 and S = 32.1

If I weigh out exactly 24.3g of magnesium this will be 1 mole of magnesium, if we counted how many atoms were present in this mass it would be a huge number (6.02×10^{23} !!!!), if I weigh out 32.1g of sulfur then I would have 1 mole of sulfur atoms. So 24.3g of Mg will react precisely with 32.1g of sulfur, and will make 56.4g of magnesium sulfide. Here is a comprehensive page on measuring moles, there are a number of descriptions, videos and practice problems. You will find the first 6 tutorials of most use here, and problem sets 1 to 3.

<http://bit.ly/pixlchem9>

<http://www.chemteam.info/Mole/Mole.html>

Q1 Answer the following questions on moles.

- How many moles of phosphorus pentoxide (P₄O₁₀) are in 85.2g?
- How many moles of potassium in 73.56g of potassium chlorate (V) (KClO₃)?
- How many moles of water are in 249.6g of hydrated copper sulfate(VI) (CuSO₄·5H₂O)? For this one, you need to be aware the dot followed by 5H₂O means that the molecule comes with 5 water molecules so these have to be counted in as part of the molecules mass.
- What is the mass of 0.125 moles of tin sulfate (SnSO₄)?
- If I have 2.4g of magnesium, how many g of oxygen(O₂) will I need to react completely with the magnesium? 2Mg + O₂ → MgO

Chemistry topic 5 – Titrations

One key skill in A level chemistry is the ability to carry out accurate titrations, you may well have carried out a titration at GCSE, at A level you will have to carry them out very precisely **and** be able to describe in detail how to carry out a titration - there will be questions on the exam paper about how to carry out practical procedures.

You can read about how to carry out a titration here:

<http://bit.ly/pixlchem11>

http://www.bbc.co.uk/schools/gcsebitesize/science/triple_aqa/further_analysis/analysing_substances/revisio_n/4/

Remember for any titration calculation you need to have a balanced symbol equation; this will tell you the ratio in which the chemicals react.

E.g. a titration of an unknown sample of sulfuric acid with sodium hydroxide.

A 25.00cm³ sample of the unknown sulfuric acid was titrated with 0.100mol dm⁻³ sodium hydroxide and required exactly 27.40cm³ for neutralisation. What is the concentration of the sulfuric acid?

Step 1: the equation $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Step 2; the ratios 2 : 1

Step 3: how many moles of sodium hydroxide 27.40cm³ = 0.0274dm³

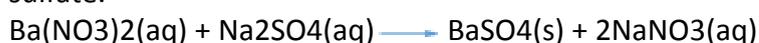
number of moles = $c \times v = 0.100 \times 0.0274 = 0.00274$ moles

step 4: Using the ratio, how many moles of sulfuric acid

for every 2 NaOH there are 1 H₂SO₄ so, we must have $0.00274/2 = 0.00137$ moles of H₂SO₄

Step 5: Calculate concentration. concentration = moles/volume \approx in dm³ = $0.00137/0.025 = 0.0548 \text{ mol dm}^{-3}$

Q A solution of barium nitrate will react with a solution of sodium sulfate to produce a precipitate of barium sulfate.



What volume of 0.25mol dm⁻³ sodium sulfate solution would be needed to precipitate all of the barium from 12.5cm³ of 0.15 mol dm⁻³ barium nitrate?

Places to visit

- Are there any chemical or chemistry based businesses in your area? A big ask, but one that could be really beneficial to you, write them a letter explaining that you are taking A level chemistry and you want to see how chemistry is used in industry and you would like to visit / have some work experience.
- You could visit your nearest science museum. They often have special exhibitions that may be of interest to you. https://en.wikipedia.org/wiki/List_of_science_museums#United