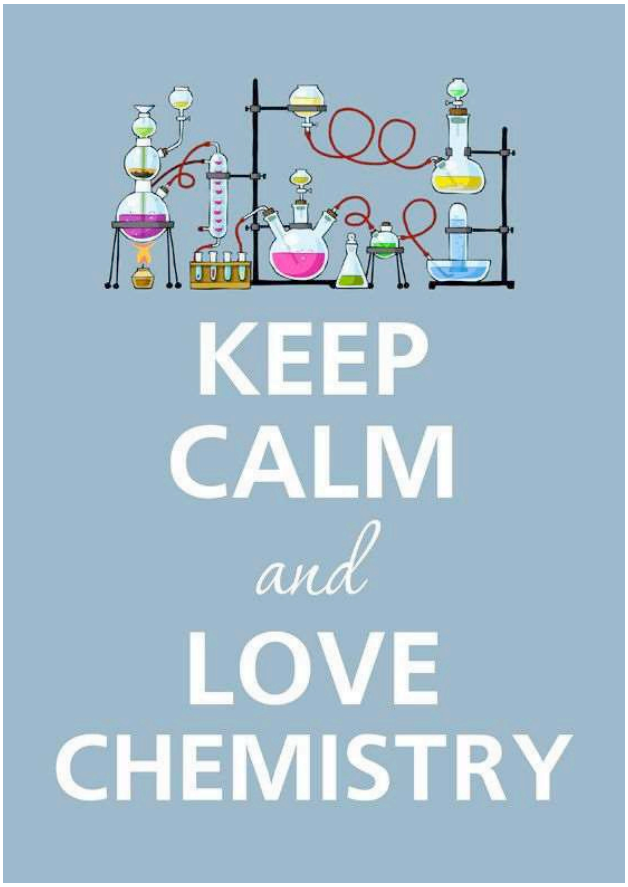
So you want to study Chemistry?

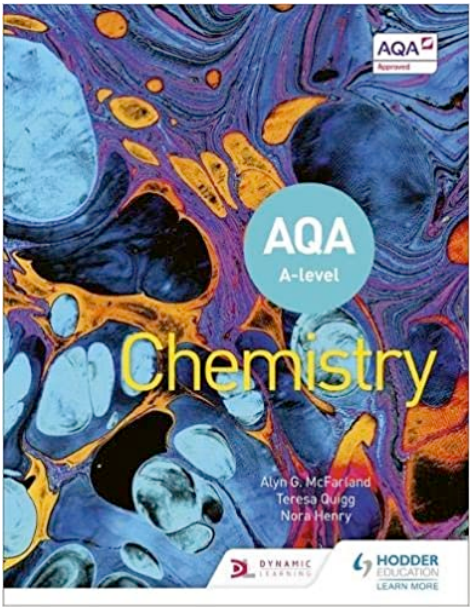
This booklet contains a programme of activities and resources to prepare you to start an A level in Chemistry in September. It is aimed to be used after you complete your GCSE, throughout the remainder of the summer term and over the summer holidays to ensure you are ready to start your course in September. The work needs to be completed by the first lesson back in September.



Essential Books you must get.

An essential book that you will be instructed to use in study periods

ISBN-10
1382008570



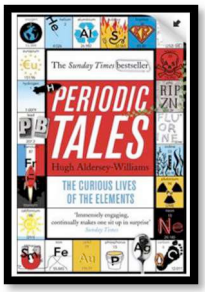
An example of a AQA approved text book covering year1 and 2.

ISBN-10
1510469834

Book Recommendations to read or refer to.

(may be available in your local Library)

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

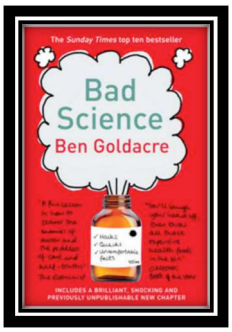


ISBN-10: 0141041455

http://bit.ly/pixlchembook1

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

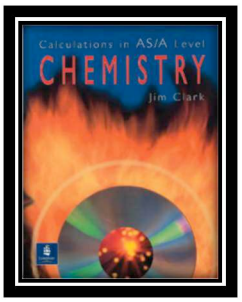


ISBN-10: 000728487X

http://bit.ly/pixlchembook3

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'.

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



ISBN-10: 0582411270

http://bit.ly/pixlchembook4

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.

Videos to watch online

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/x2igjq_Rough-Science_rough-science-full-series/1#video=xxw6pr or

http://bit.ly/pixlchemvid1b

https://www.youtube.com/watch?v=lUoDWAt259I

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 come of the cooler properties of mercury.

http://bit.ly/pixlchemvid2

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

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

Questions you want Chemistry to answer:

Think of at least 3 big questions you would like your studies in A-level Chemistry to answer.

Chemistry topic 1 – 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.

http://bit.ly/pixlchem7

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

This website has a download; it is safe to do so:

http://bit.ly/pixlchem8

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

1) $Na + H_2O \rightarrow NaOH + H_2$

2) $KOH + H_2SO_4 \rightarrow K_2SO_4 + H_2O$

3) $Mg(NO_3)_2 + NaOH \rightarrow Mg(OH)_2 + NaNO_3$

4) $NO + H_2O + O_2 \rightarrow HNO_3$

5) $C_5H_{12} + O_2 \rightarrow CO_2 + H_2O$

6) $Br_2 + NaI \rightarrow NaBr + I_2$

7) $K_2CO_3 + HNO_3 \rightarrow KNO_3 + CO_2 + H_2O$

Key problems in Chemistry, topic 2 – Oxidation and reduction

At GCSE you know that oxidation is adding oxygen to an atom or molecule and that reduction is removing oxygen, or that oxidation is removing hydrogen and reduction is adding hydrogen. You may have also learned that oxidation is removing electrons and reduction is adding electrons.

Question 1)

Define each

1. **Oxidation**
2. **Reduction**
3. **Oxidizing agent**
4. **Reduction agent**

STEP	EXAMPLE 1	EXAMPLE 2
1. Calculate oxidation states on each side of the equation.	$VO^{2+} \rightarrow VO_2^+$ V +4 V +5	$BrO_3^- \rightarrow Br_2$ Br+5 Br 0
2. Balance the element changing oxidation state.	$VO^{2+} \rightarrow VO_2^+$ *V already balanced*	$2\ BrO_3^- \rightarrow Br_2$ *2 Br on right so need 2 BrO_3^- on left*
3. Sort out electrons. If the oxidation state becomes more negative then it gains electrons. If the oxidation state becomes more positive then electrons are lost.	$VO^{2+} \rightarrow VO_2^+ + e^-$ *V becomes 1 more positive so 1 electron lost*	$2\ BrO_3^- + 10\ e^- \rightarrow Br_2$ *2x Br become 5 more negative so 10 electrons gained*
4. Sort out Os. For every O gained/lost, add/remove one H_2O molecule.	$VO^{2+} + H_2O \rightarrow VO_2^+ + e^-$ *1 less O on left so add 1 H_2O on the left*	$2\ BrO_3^- + 10\ e^- \rightarrow Br_2 + 6\ H_2O$ *6 more O on left so need 6 H_2O on the right*
5. Sort out Hs. For every H gained/lost, add/remove one H^+ ion.	$VO^{2+} + H_2O \rightarrow VO_2^+ + e^- + 2\ H^+$ *2 less H on right so add 2 H^+ to right*	$2\ BrO_3^- + 10\ e^- + 12\ H^+ \rightarrow Br_2 + 6\ H_2O$ *12 less H on left so add 12 H^+ to left*
6. Check – if the total electric charge on the left equals that on the right then it is probably correct. If it is not then you know you have gone wrong!	*Left = 2+, 0 = 2+* *Right = 1+, 1-, 2+ = 2+*	*Left = 2-, 10-, 12+ = 0* *Right = 0, 0 = 0*

a) $Na \rightarrow Na^{+}$ .....

b) $Pb^{4+} \rightarrow Pb^{2+}$ .....

c) $H_2 \rightarrow H^{+}$ .....

d) $Br^{-} \rightarrow Br_2$ .....

e) $Cr_2O_7^{2-} \rightarrow Cr^{3+}$ .....

f) $SO_4^{2-} \rightarrow S$ .....

h) $SO_4^{2-} \rightarrow SO_2$ .....

i) $N_2 \rightarrow NO_3^{-}$ .....

j) $IO_3^{-} \rightarrow I_2$ .....

k) $Hg^{2+} \rightarrow Hg_2^{2+}$ .....

l) $VO^{2+} \rightarrow VO_2^{+}$ .....

m) $S_2O_3^{2-} \rightarrow S$ .....

n) $NO_3^{-} \rightarrow NO_2^{-}$ .....

Chemistry topic 3 – Isotopes and mass

You will remember that an isotopes are elements that have differing numbers of neutrons. Hydrogen has 3 isotopes; ৪ ৪

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

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

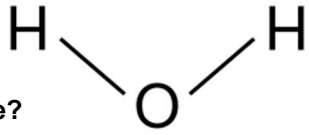
Given the percentage of each isotope you can calculate the mean mass which is the accurate atomic mass for that element.

Q3.3 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%**

Chemistry topic 4 – 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

Q4.1 Draw a dot and cross diagram to show the bonding in a molecule of aluminium chloride ($AlCl_3$)

Q4.2 Draw a dot and cross diagram to show the bonding in a molecule of ammonia (NH_3)

Q4.3 Explain the physical properties of methane based on its structure and bonding.(CH_4)?

Q5 Draw a dot and cross diagram to show the bonding in ammonium Chloride (NH_4Cl)

Chemistry topic 5 – 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:

http://bit.ly/pixlpertab

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

Now that we have our chemical equations balanced, we need to be able to use them in order to work out masses of chemicals we need or we can produce.

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

Mg + S MgS

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 ($6.02 \times 10_{23}$!!!!), 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

Q5.1 Answer the following questions on moles.

a) **How many moles of phosphorus pentoxide (P_4O_{10}) are in 85.2g?**
b) **How many moles of potassium in 73.56g of potassium chlorate (V) ($KClO_3$)?**
c) **How many moles of water are in 249.6g of hydrated copper sulfate(VI) ($CuSO_4.5H_2O$)? For this one, you need to be aware the dot followed by $5H_2O$ means that the molecule comes with 5 water molecules so these have to be counted in as part of the molecules mass.**
d) **What is the mass of 0.125 moles of tin sulfate ($SnSO_4$)?**
e) **If I have 2.4g of magnesium, how many g of oxygen(O_2) will I need to react completely with the magnesium? $2Mg + O_2$ MgO**

Chemistry topic 6 – Solutions and concentrations

In chemistry a lot of the reactions we carry out involve mixing solutions rather than solids, gases or liquids.

You will have used bottles of acids in science that have labels saying 'Hydrochloric acid 1M', this is a solution of hydrochloric acid where 1 mole of HCl, hydrogen chloride (a gas) has been dissolved in 1dm_3 of water.

The dm_3 is a cubic decimetre, it is actually 1 litre, but from this point on as an A level chemist you will use the dm_3 as your volume measurement.

http://bit.ly/pixlchem10

http://www.docbrown.info/page04/4_73calcs11msc.htm

Q7.1

a) **What is the concentration (in mol dm_{-3}) of 9.53g of magnesium chloride ($MgCl_2$) dissolved in 100cm_3 of water?**
b) **What is the concentration (in mol dm_{-3}) of 13.248g of lead nitrate ($Pb(NO_3)_2$) dissolved in 2dm_3 of water?**
c) **If I add 100cm_3 of 1.00 mol dm_3 HCl to 1.9dm_3 of water, what is the molarity of the new solution?**
d) **What mass of silver is present in 100cm_3 of 1moldm_{-3} silver nitrate ($AgNO_3$)?**
e) **The Dead Sea, between Jordan and Israel, contains 0.0526 moldm_{-3} of Bromide ions (Br^-), what mass of bromine is in 1dm_3 of Dead Sea water?**

Chemistry topic 7 – 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, the next page in the series (page 5) describes how to work out the concentration of the unknown.

http://bit.ly/pixlchem11

http://www.bbc.co.uk/schools/gcsebitesize/science/triple_aqa/further_analysis/analysing_substances/revision/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 25.00cm_3 sample of the unknown sulfuric acid was titrated with 0.100$moldm_{-3}$ sodium hydroxide and required exactly 27.40cm_3 for neutralisation. What is the concentration of the sulfuric acid?

Step 1: the equation $2NaOH + H_2SO_4 \quad Na_2SO_4 + 2H_2O$

Step 2; the ratios 2 : 1

Step 3: how many moles of sodium hydroxide 27.40cm_3 =

0.0274dm_3 number of moles = c x v = 0.100 x 0.0274 = 0.00274

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

for every 2 NaOH there are 1 H_2SO_4 so, we must have 0.00274/2 =0.00137 moles of H_2SO_4

Step 5: Calculate concentration. concentration = moles/volume in dm_3 = 0.00137/0.025 = 0.0548 $moldm_{-3}$

Here are some additional problems, which are harder, ignore the questions about colour changes of indicators.

http://bit.ly/pixlchem12

http://www.docbrown.info/page06/Mtestsnotes/ExtraVolCalcs1.htm

Use the steps on the last page to help you

Q8.1 A solution of barium nitrate will react with a solution of sodium sulfate to produce a precipitate of barium sulfate.

$Ba(NO_3)_2(aq) + Na_2SO_4(aq) \quad BaSO_4(s) + 2NaNO_3(aq)$

What volume of 0.25$moldm_{-3}$sodium sulfate solution would be needed to precipitate all of the barium from 12.5cm_3 of 0.15 $moldm_{-3}$ barium nitrate.

6) $Br_2 + 2\,NaI \rightarrow 2\,NaBr + I_2$

7) $K_2CO_3 + 2\,HNO_3 \rightarrow 2\,KNO_3 + CO_2 + H_2O$