Painsley Catholic College

Chemistry - Transition for Applied Science

Get ready for Applied Science!
A guide to help you get ready for your Chemistry topics in AQA applied science.
For any extra information please contact Miss Bradley,
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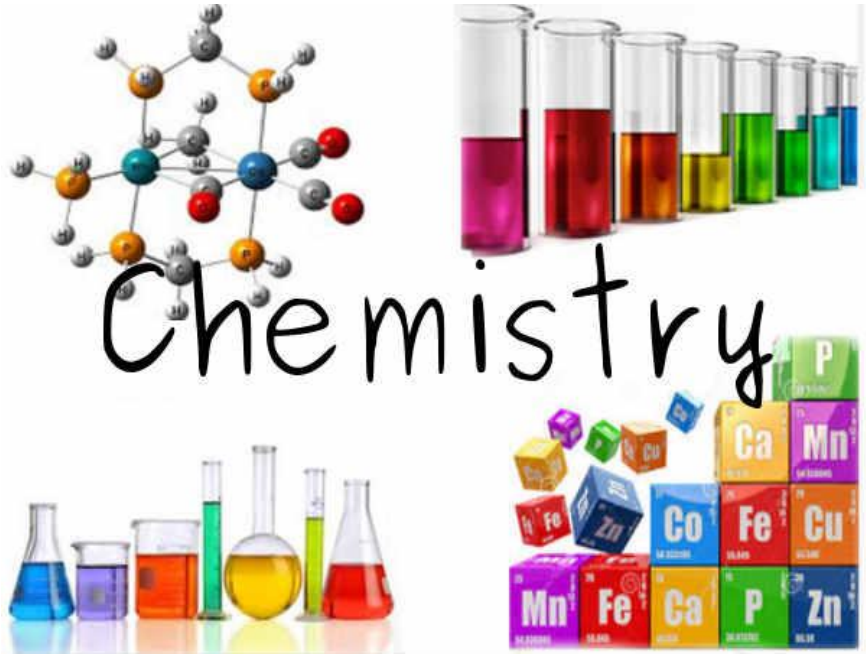
Specification link : https://www.aqa.org.uk/subjects/science/applied-general/science

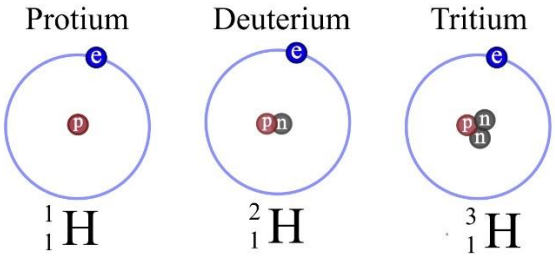
What is included:

- Week 3 – Isotopes mass and electronic structure (1 hour)
- Week 3 - tasks 1-3 (2 hours)
- Week 4 – balancing equations, the mole and relative atomic mass (30 mins)
- Week 4 - tasks 1-3 (2.5 hours)



Week 3 – Isotopes, mass and electronic structure (1 hour)

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



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://bit.ly/pixlchem4

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

Task 1: (40 mins) answer the 3 questions below

Q1.1 What must happen to the atoms before they are accelerated in the mass spectrometer?

Q1.2 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 ¾ of it will be Cl-35 and ¼ of it is Cl-37.

We can calculate what the mean mass of the sample will be:

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

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

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

Q1.3 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 2: (20 mins) Define the following terms:

Atom:

Ion:

Compound:

Mixture:

Molecule:

Identify which are elements, compounds or molecules:

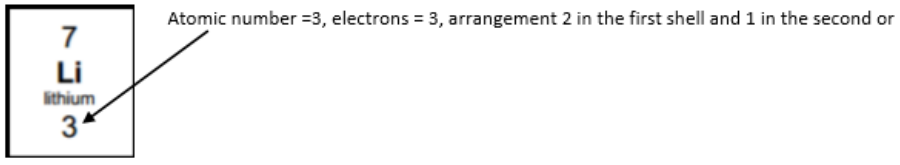
O_2, Na, CO_2, K, Ca, H_2, H_20, CH_4, Cl_2

Task 3: (1 hour) Read through the information and complete the questions about electronic structure

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).



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:

1s2, 2s2, 2p6 etc.

Q1.1 complete the table

Particle	Atom or ion	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
$^{23}Na^{+}$	ion	11	23	11	12	10	$[2,8]^{+}$
^{23}Na							
$^{40}Ca^{2+}$							
	atom	9	19				
				17	20	18	
				17	18	18	
		19	39			18	
				18	22	18	
		1	1			0	
					5		$[2]^{2+}$

Q1.2 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

Q1.3 Extension question, can you write out the electron arrangement of the following ions:

a) K^{+} b) O^{2-} c) Zn^{2+} d) V^{5+} e) Co^{2+}

Week 4 – Balancing equations, the mole and relative atomic mass. (30 mins)

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 chemicals, 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

Task 1: (50 mins) Balance the following equations

a. $H_2 + O_2 \rightarrow H_2O$

b. $S_8 + O2 \rightarrow SO_3$

c. $HgO \rightarrow Hg + O_2$

d. $Zn + HCl \rightarrow ZnCl_2 + H_2$

e. $Na + H_2O \rightarrow NaOH + H_2$

f. $C_{10}H_{16} + Cl_2 \rightarrow C + HCl$

g. $Fe + O_2 \rightarrow Fe_2O_3$

h. $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$

i. $Fe_2O_3 + H_2 \rightarrow Fe + H_2O$

j. $Al + FeO \rightarrow Al_2O_3 + Fe$

(30 mins) 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-trbptds_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 (6.02×10^{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

Task 2: (40 mins) 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 +O2 -> MgO

Task 3: (30 mins) Use a Periodic Table to work out the relative formula mass of the following compounds:

e.g. NaOH : Na + O + H = 23 + 16 + 1 = 40

a) F_2 .....

b) Fe .....

c) H_2SO_4 .....

d) Al_2O_3 .....

e) $Mg(OH)_2$ .....

f) $Al(NO_3)_3$ .....