**Mandatory task for**

**A Level Chemistry students**

**Get ready for your A-level Chemistry studies!**

**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 and the fourth up to 18 (or you may have been told 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 the 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.

**Q1.1 Write out the electron configuration of:**

**a) Ca b) S c) Cl d) Fe**

**Q1.2 Extension question, can you write out the electron arrangement of the following *ions*:**

**a) K+ b) O2-**

**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.

At A level we use the idea of ***oxidation number*** a lot!

You know that the metals in group 1 react to form ions that are +1, i.e. Na+ and that group 7, the halogens, form -1 ions, i.e. Br-.

We say that sodium, when it has reacted has an oxidation number of +1 and that bromide has an oxidation number of -1.

All atoms that are involved in a reaction can be given an oxidation number.

An element, Na or O2 is always given an oxidation state of zero (0), any element that has reacted has an oxidation state of + or -.

As removing electrons is **reduction**, if, in a reaction the element becomes **more** negative it has been reduced, if it becomes more positive it has been oxidised.

-5 0 +5

 You can read about the rules for assigning oxidation numbers here:

<http://www.dummies.com/how-to/content/rules-for-assigning-oxidation-numbers-to-elements.html>

Elements that you expect to have a specific oxidation state actually have different states, so for example you would expect chlorine to be -1, it can have many oxidation states: NaClO, in this compound it has an oxidation state of +1

There are a few simple rules to remember:

Metals have a + oxidation state when they react.

Oxygen usually has an oxidation state of -2 (except in hydrogen peroxide)

Hydrogen has an oxidation state of +1 (except metal hydrides)

The charges in a molecule must cancel.

Examples: Sodium nitrate, NaNO3 sulfate ion, SO42-

 Na +1 3x O2- 4xO2- and 2- charges ‘showing’

 +1 -6 -8 -2

To cancel: N = +5 S = +6

**Q2.1 Work out the oxidation state of the underlined atom in the following:**

**a) MgC­O3 b) NaClO3 c) KMnO4**

**Chemistry topic 3 – 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**.

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 = 75 x 35 + 25 x 37 = 35.5

 100 100

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 A level**

 

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

**Q3.1 Use the percentages of each isotope to calculate the accurate atomic mass of the following elements.**

1. **Antimony has 2 isotopes: Sb-121 57.25% and Sb-123 42.75%**
2. **Silver has 2 isotopes: Ag-107 51.35% and Ag-109 48.65%**

**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://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>

**Q4.1 Draw a dot and cross diagram to show the bonding in a molecule of ammonia (NH3)**

**Q4.2 What is the shape and the bond angles in a molecule of methane (CH4)?**

**Chemistry topic 5 – 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 chemicals, don’t worry about that, the key idea is to get balancing right.

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

**Q5.1 Balance the following equations**

**a. H2 + O2 🡪 H2O**

**b. S8 + O2 🡪 SO3**

**c. C10H16 + CI2 🡪 C + HCl**

**Chemistry topic 6 – 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-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 x 1023!!!!), 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://www.chemteam.info/Mole/Mole.html>

**Q6.1 Answer the following questions on moles.**

1. **How many moles of phosphorus pentoxide (P4O10) are in 85.2g?**
2. **What is the mass of 0.125 moles of tin sulfate (SnSO4)?**
3. **If I have 2.4g of magnesium, how many g of oxygen (O2) will I need to react completely with the magnesium? 2Mg +O2 🡪 2MgO**

**Chemistry topic 7 – 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 1dm3 of water.

The dm3 is a cubic decimetre, it is actually 1 litre, but from this point on as an A level chemist you will use the dm3 as your volume measurement.

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

**Q7.1 Answer the following questons.**

1. **What is the concentration (in mol dm-3)of 9.53g of magnesium chloride (MgCl2) dissolved in 100cm3 of water?**
2. **What is the concentration (in mol dm-3)of 13.248g of lead nitrate (Pb(NO3)2) dissolved in 2dm3 of water?**
3. **What mass of silver is present in 100cm3 of 1moldm-3 silver nitrate (AgNO3)?**

**Chemistry topic 8 – 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://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 25.00cm3 sample of the unknown sulfuric acid was titrated with 0.100moldm-3 sodium hydroxide and required exactly 27.40cm3 for neutralisation. What is the concentration of the sulfuric acid?

**Step 1**: the equation 2NaOH + H2SO4 🡪 Na2SO4 + 2H2O

**Step 2**; the ratios 2 : 1

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

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 H2SO4 so, we must have 0.00274/2 =0.00137 moles of H2SO4

**Step 5**: Calculate concentration. concentration = moles/volume 🡨in dm3 = 0.00137/0.025 = ***0.0548moldm-3***

<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(NO3)2(aq) + Na2SO4(aq) 🡪 BaSO4(s) + 2NaNO3(aq)**

**What volume of 0.25moldm-3sodium sulfate solution would be needed to precipitate all of the barium from 12.5cm3 of 0.15moldm-3 barium nitrate?**

**Chemistry topic 9 – Organic chemistry – functional groups**

At GCSE you would have come across **hydrocarbons** such as alkanes (ethane, etc) and alkenes (ethene, etc). You may have come across molecules such as alcohols and carboxylic acids. At A level you will learn about a wide range of molecules that have had atoms added to the carbon chain. These are called functional groups, they give the molecule certain physical and chemical properties that can make them incredibly useful to us.

Here you are going to meet a selection of the functional groups, learn a little about their properties and how we give them logical names.

You will find a menu for organic compounds here:

<http://www.chemguide.co.uk/orgpropsmenu.html#top>

And how to name organic compounds here:

<http://www.chemguide.co.uk/basicorg/conventions/names.html#top>

Using the two links see if you can answer the following questions:

**Q9.1 Halogenoalkanes**

**What is the name of this halogenoalkane?**

**Q9.2 Alcohols**

**How could you make ethanol from ethene?**

**Q9.3 Aldehydes and ketones**

**Draw the structures of a) propanal b) propanone**

**Chemistry topic 10 – Acids, bases, pH**

At GCSE you will know that an acid can dissolve in water to produce H+ ions, at A level you will need a greater understanding of what an acid or a base is.

Read the following page and answer the questions

<http://www.chemguide.co.uk/physical/acidbaseeqia/theories.html#top>

**Q10.1 What is your new definition of what an acid is?**

**Q10.2 How does ammonia (NH3) act as a base?**

<http://www.chemguide.co.uk/physical/acidbaseeqia/acids.html#top>

**Q10.3 Ethanoic acid (vinegar) is a weak acid, what does this mean?**