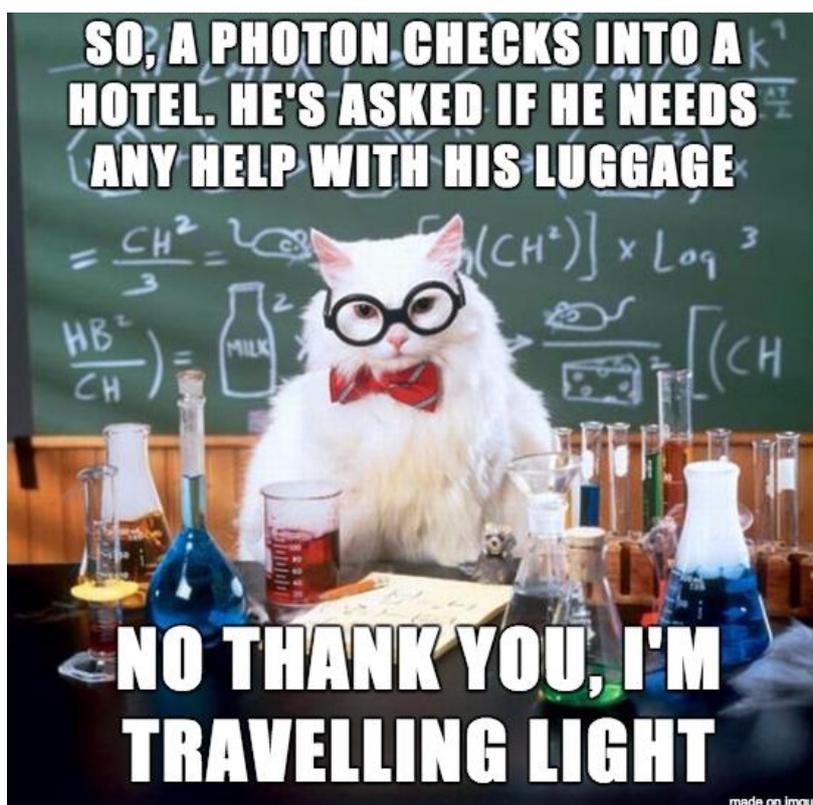




# Pre-IB Chemistry Transition Assignment 2

Topics 1-5



## Instruction

Please complete the questions. Resources are included to remind/help you answer them.

## 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).

7
Li
lithium
3

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://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.

**Q1.1** 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

**Q1.2** 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)  $Co^{2+}$

### 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!

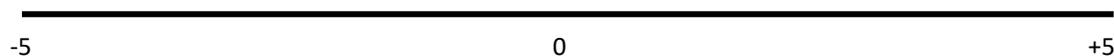
You know that the metals in group 1 react to form ions that are +1, i.e.  $Na^+$  and that group 7, the halogens, form -1 ions, i.e.  $Br^-$ .

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 O<sub>2</sub> 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.



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>

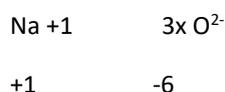


Elements that you expect to have a specific oxidation state actually have different states, so for example you would expect chlorine to be -1, it can have many oxidation states: NaClO, in this compound it has an oxidation state of +1

There are a few simple rules to remember:

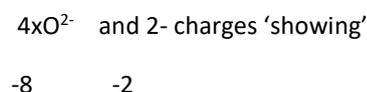
- Metals have a + oxidation state when they react.
- Oxygen is 'king' it always has an oxidation state of -2
- Hydrogen has an oxidation state of +1 (except metal hydrides)
- The charges in a molecule must cancel.

Examples: Sodium nitrate, NaNO<sub>3</sub>



To cancel: N = +5

sulphate ion, SO<sub>4</sub><sup>2-</sup>



S = +6

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

- a) MgCO<sub>3</sub>      b) SO<sub>3</sub>      c) NaClO<sub>3</sub>      d) MnO<sub>2</sub>      e) Fe<sub>2</sub>O<sub>3</sub>      f) V<sub>2</sub>O<sub>5</sub>  
 g) KMnO<sub>4</sub>      h) Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup>      i) Cl<sub>2</sub>O<sub>4</sub>

### 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**. 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:



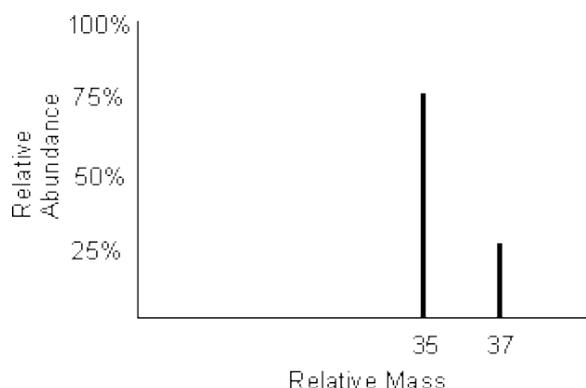
<http://bit.ly/pixlchem3>  
<http://www.kore.co.uk/tutorial.htm>  
<http://bit.ly/pixlchem4>  
<http://filestore.aqa.org.uk/resources/chemistry/AQA-7404-7405-TN-MASS-SPECTROMETRY.PDF>



**Q3.1** What must happen to the atoms before they are accelerated in the mass spectrometer?

**Q3.2** 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>B</b> boron 5	12 <b>C</b> carbon 6	14 <b>N</b> nitrogen 7	16 <b>O</b> oxygen 8	19 <b>F</b> fluorine 9
27 <b>Al</b> aluminium 13	28 <b>Si</b> silicon 14	31 <b>P</b> phosphorus 15	32 <b>S</b> sulfur 16	35.5 <b>Cl</b> chlorine 17

A level

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

- Antimony has 2 isotopes: Sb-121 57.25% and Sb-123 42.75%
- Gallium has 2 isotopes: Ga-69 60.2% and Ga-71 39.8%
- Silver has 2 isotopes: Ag-107 51.35% and Ag-109 48.65%
- Thallium has 2 isotopes: Tl-203 29.5% and Tl-205 70.5%
- 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:

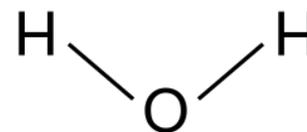
<http://bit.ly/pixlchem6>

<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 ( $\text{AlCl}_3$ )

**Q4.2** Draw a dot and cross diagram to show the bonding in a molecule of ammonia ( $\text{NH}_3$ )

**Q4.3** What is the shape and the bond angles in a molecule of methane ( $\text{CH}_4$ )?



## 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 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>



**Q5.1** Balance the following equations:

