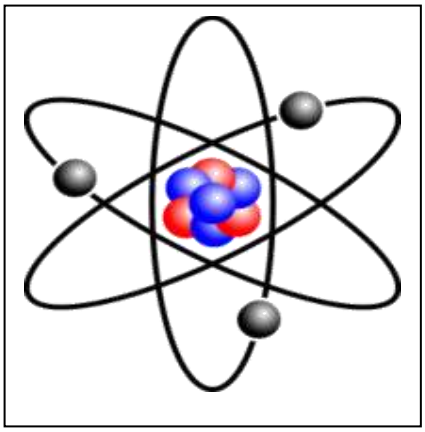
Wymondham High

Chemistry department.



GCSE to AS Induction Booklet.

The contents feature a set of tasks that you need to do before you start the AS chemistry course.

Complete the tasks as far as possible.

Put your answers on lined paper.

You will sit a test within the first two weeks of the autumn term to see how well you have done.

Resources you may like to use are:-

ChemGuide	**http://www.chemguide.co.uk/**
Knockhardy notes	**http://www.knockhardy.org.uk/sci.htm**
Knockhardy powerpoints	**http://www.knockhardy.org.uk/ppoints.htm**
MaChemGuy	**https://www.youtube.com/user/MaChemGuy**
Creative chemistry	**http://www.creative-chemistry.org.uk/**
Chemnotes	**http://www.chemnotes.org.uk/**
Chemrevise	**http://chemrevise.org/**
Chemsheets	**http://www.chemsheets.co.uk/**

10/06/2015

COURSE OUTLINE

Learners must complete both components (01 and 02).

Content Overview	Assessment Overview	
Content is split into four teaching modules: • Module 1 – Development of practical skills in chemistry • Module 2 – Foundations in chemistry • Module 3 – Periodic table and energy • Module 4 – Core organic chemistry Both components assess content from all four modules.	Breadth in chemistry (01)* 70 marks 1 hour 30 minutes written paper	**50%** of total AS level
	Depth in chemistry (02)* 70 marks 1 hour 30 minutes written paper	**50%** of total AS level

*Both components include synoptic assessment.

MEASUREMENTS IN CHEMISTRY

Mass

Convert the following into grams:

a) 0.25 kg

b) 15 kg

c) 100 tonnes

d) 2 tonnes

Volume

Convert the following into dm^3:

a) 100 cm^3

b) 25 cm^3

c) 50 m^3

d) 50000 cm^3

Tip – always use standard form for very large and very small numbers!

10/06/2015

What is a mole?

Atoms and molecules are very small – far too small to count individually!

It is important to know how much of something we have, but we count particles in MOLES because you get simpler numbers

$$1 \text{ mole} = 6.02 \times 10^{23} \text{ particles}$$

$(6.02 \times 10^{23}$ is known as Avogadro's number)

a) If you have 2.5×10^{21} atoms of magnesium, how many moles do you have?

b) If you have 0.25 moles of carbon dioxide, how many molecules do you have?

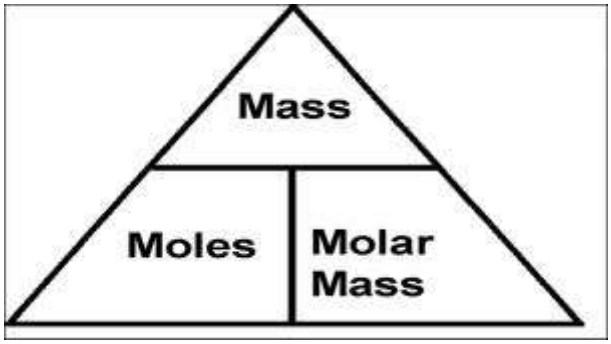
How can you work out how many moles you have?

a) From a measurement of **MASS**:

You can find the number of moles of a substance if you are given its **mass** and you know its **molar mass**:

number of moles = mass/molar mass

$n = m/m_r$



Mass MUST be measured in grams!

Molar mass has units of $gmol^{-1}$

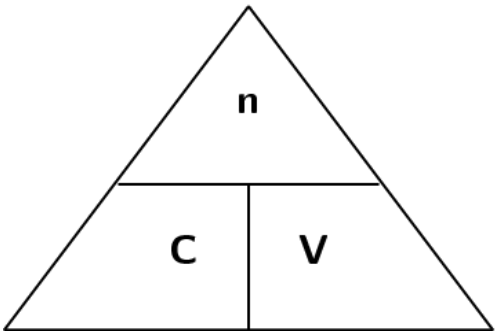
1. Calculate the number of moles present in:	2. Calculate the mass of:	3. Calculate the molar mass of the following substances:
a) 2.3 g of Na	a) 0.05 moles of Cl_2	a) 0.015 moles, 0.42 g
b) 2.5 g of O_2	b) 0.125 moles of KBr	b) 0.0125 moles, 0.50 g
c) 240 kg of CO_2	c) 0.075 moles of $Ca(OH)_2$	c) 0.55 moles, 88 g
d) 12.5 g of $Al(OH)_3$	d) 250 moles of Fe_2O_3	d) 2.25 moles, 63 g
e) 5.2 g of PbO_2	e) 0.02 moles of $Al_2(SO_4)_3$	e) 0.00125 moles, 0.312 g

a) From a measurement of AQUEOUS VOLUME:

You can find the number of moles of a substance dissolved in water (aqueous) if you are given the **volume** of solution and you know its **molar concentration**:

number of moles = aqueous volume x molar concentration

n = V x C



Aqueous volume MUST be measured in dm^3!

concentration has units of $moldm^{-3}$

If you know the molar mass of the substance, you can convert the molar concentration into a mass concentration:

Molar concentration ($moldm^{-3}$) x m_r = mass concentration (gdm^{-3})

1. Calculate the number of moles of substance present in each of the following solutions:	2. Calculate the molar concentration and the mass concentration of the following solutions:	3. Calculate the molar concentration and the mass concentration of the following solutions:
a) 25 cm^3 of 0.1 $moldm^{-3}$ HCl	a) 0.05 moles of HCl in 20 cm^3	a) 35 g of NaCl in 100 cm^3
b) 40 cm^3 of 0.2 $moldm^{-3}$ HNO_3	b) 0.01 moles of NaOH in 25 cm^3	b) 20 g of $CuSO_4$ in 200 cm^3
c) 10 cm^3 of 1.5 $moldm^{-3}$ NaCl	c) 0.002 moles of H_2SO_4 in 16.5 cm^3	c) 5 g of HCl in 50 cm^3
d) 5 cm^3 of 0.5 $moldm^{-3}$ $AgNO_3$	d) 0.02 moles of $CuSO_4$ in 200 cm^3	d) 8 g of NaOH in 250 cm^3
e) 50 cm^3 of 0.1 $moldm^{-3}$ H_2SO_4	e) 0.1 moles of NH_3 in 50 cm^3	e) 2.5 g of NH_3 in 50 cm^3

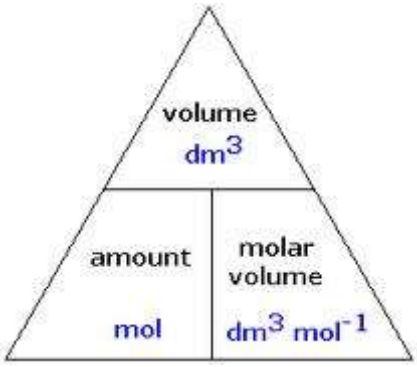
a) From a measurement of GASEOUS VOLUME:

You can find the number of moles of a gas if you are given the **volume** of the gas:

number of moles = volume / 24

n = V / 24

24 dm^3 is the volume occupied by 1 mole of any gas at room temperature and pressure



Volume MUST be measured in dm^3!

1. Calculate the number of moles present in:	2. Calculate the volume of gas occupied by:	3. Calculate the mass of the following gas samples:
a) 48 dm^3 of O_2	a) 0.05 moles of Cl_2	a) 48 dm^3 of O_2
b) 1.2 dm^3 of CO_2	b) 0.25 moles of CO_2	b) 1.2 dm^3 of CO_2
c) 200 cm^3 of N_2	c) 28 g of N_2	c) 200 cm^3 of N_2
d) 100 dm^3 of Cl_2	d) 3.2 g of O_2	d) 100 dm^3 of Cl_2
e) 60 cm^3 of NO_2	e) 20 g of NO_2	e) 60 cm^3 of NO_2

How many moles?

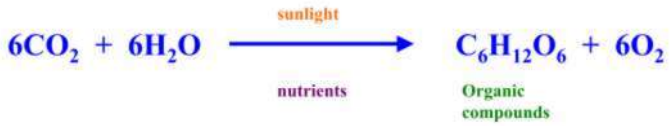
1) Jahin weighs a sample of $CaCO_3$ and records a mass of 5.0 g. How many moles of calcium carbonate are present?

2) Fatima measures out 50 cm^3 of 0.1 $moldm^{-3}$ hydrochloric acid. How many moles of hydrochloric acid are present?

3) Hussain collects 48 cm^3 of carbon dioxide in a gas syringe. How many moles of carbon dioxide are present?

5) Using Chemical Equations

Chemical Equations show the ratio in which different species react in a chemical equation.



This equation shows that **6** moles carbon dioxide of react with **6** mole of water to make **1** mole of glucose and **6** moles of oxygen.

6: 6: 1: 6

a) How many moles of water are needed to react with 0.03 moles of carbon dioxide?
b) How many moles of glucose can you make from 0.03 moles of carbon dioxide?
c) How many moles of oxygen can you make from 0.03 moles of carbon dioxide?

Equation 1: $Mg + 2\,HCl \rightarrow MgCl_2 + H_2$

a) How many moles of magnesium would be needed to react with 0.01 moles of hydrochloric acid?
b) How many moles of hydrogen could be produced from 0.01 moles of hydrochloric acid?

Equation 2: $2\,H_2S + 3\,O_2 \rightarrow 2\,SO_2 + 2\,H_2O$

a) How many moles of oxygen is needed to react with 0.5 moles of hydrogen sulphide?
b) How many moles of sulphur dioxide can be made from 0.5 moles of hydrogen sulphide?

Equation 3: $4\,K + O_2 \rightarrow 2\,K_2O$

a) How many moles of oxygen are needed to react with 0.05 moles of potassium?
b) How many moles of potassium oxide can be made from 0.05 moles of potassium?

Calculating Reacting Quantities from Chemical Equations

You perform these calculations in three steps:

- **calculate the number of moles of one of the substances (you will either be given the mass, or the aqueous volume and the concentration, or the gaseous volume)**
- **use the equation to work out the number of moles of the other substance**
- **use one of the mole relationships to work out the quantity you need**

1) What mass of hydrogen is produced when 192 g of magnesium is reacted with hydrochloric acid?

$$Mg + 2\,HCl \rightarrow MgCl_2 + H_2$$ (3)

2) What mass of oxygen is needed to react with 8.5 g of hydrogen sulphide (H_2S)?

$$2\,H_2S + 3\,O_2 \rightarrow 2\,SO_2 + 2\,H_2O$$ (3)

3) What mass of potassium oxide is formed when 7.8 g of potassium is burned in oxygen?

$$4\,K + O_2 \rightarrow 2\,K_2O$$ (3)

4) What mass of oxygen is required to oxidise 10 g of ammonia to NO?

$$4\,NH_3 + 5\,O_2 \rightarrow 4\,NO + 6\,H_2O$$ (3)

5) What mass of aluminium oxide is produced when 135 g of aluminium is burned in oxygen?

$$2\ Al + 3\ O_2 \rightarrow Al_2O_3$$ (3)

6) What mass of iodine is produced when 7.1 g of chlorine reacts with excess potassium iodide?

$$Cl_2 + 2\ KI \rightarrow 2\ KCl + I_2$$ (3)

7) What volume of hydrogen is needed to react with 32 g of copper oxide?

$$CuO + H_2 \rightarrow Cu + H_2O$$ (3)

8) What volume of oxygen is formed when 735 g of potassium chlorate decomposes?

$$2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$$ (3)

9) What volume of hydrogen is produced when 195 g of potassium is added to water?

$$2\ K + 2\ H_2O \rightarrow 2\ KOH + H_2$$ (3)

10) What mass of calcium carbonate is required to produce 1.2 dm^3 of carbon dioxide?

$$CaCO_3 \rightarrow CaO + CO_2$$ (3)

11) What mass of magnesium oxide is formed when magnesium reacts with 6 dm^3 of oxygen?

$$2\ Mg + O_2 \rightarrow 2\ MgO$$ (3)

12) What volume of carbon dioxide is produced when 5.6 g of butene (C_4H_8) is burnt?

$$C_4H_8 + 6\ O_2 \rightarrow 4\ CO_2 + 4\ H_2O$$ (3)

13) The pollutant sulphur dioxide can be removed from the air by reaction with calcium carbonate in the presence of oxygen. What mass of calcium carbonate is needed to remove 480 dm^3 of sulphur dioxide?

$$2\ CaCO_3 + 2\ SO_2 + O_2 \rightarrow 2\ CaSO_4 + 2\ CO_2$$ (3)

14) 25 cm^3 of a solution of sodium hydroxide reacts with 15 cm^3 of 0.1 mol/dm^3 HCl. What is the molar concentration of the sodium hydroxide solution?

$$HCl + NaOH \rightarrow NaCl + H_2O$$ (3)

Atomic structure and Ions. (1.1.1 Exercise 1 - Atomic Symbols)

Deduce the number of protons, neutrons and electrons in the following species:

1. $^{1}_{1}H$

2. $^{17}_{8}O$

3. $^{4}_{2}He^{2+}$

4. $^{132}_{54}Xe$

5. $^{27}_{13}Al^{3+}$

6. $^{235}_{92}U$

7. $^{1}_{1}H^{+}$

8. $^{45}_{21}Sc^{3+}$

9. $^{37}_{17}Cl^{-}$

10. $^{14}_{6}C$

We are assuming that you know about the structure of an atom.

Make sure you know the relative charge and mass of the three sub-atomic particles.

Understand what is meant by an 'isotope'.

Use the periodic table to write symbols for the following species:

11. 19 protons, 20 neutrons, 18 electrons

12. 8 protons, 8 neutrons, 10 electrons

13. 1 proton, 2 neutrons, 1 electron

14. 82 protons, 126 neutrons, 80 electrons

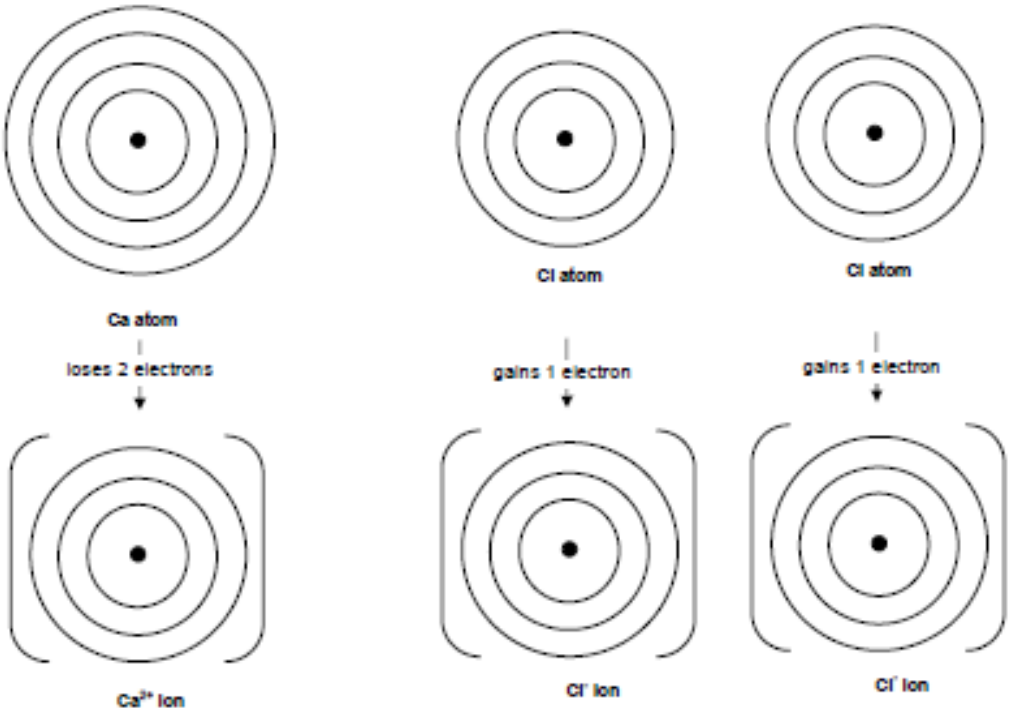
15. 53 protons, 74 neutrons, 54 electrons

Forming ionic compounds.

Look at a website like chemguide to remind you about ionic bonding. Try these questions.

1) Calcium atoms reacts with chlorine atoms to form the ionic compound calcium chloride. Calcium atoms each lose two electrons to form calcium ions. Chlorine atoms each gain one electron to form chloride ions. This means that calcium atoms react with chlorine atoms in the ratio of one calcium atom for every two chlorine atoms.

Complete the following diagram to show the electronic structure of the calcium and chlorine atoms and the calcium and chloride ions.



2) Complete this passage:
The elements in Group 1 of the Periodic Table are called the …….. They are all metals. When any Group 1 element reacts with a non-metal, an ionic compound is formed in which the metal ion has a…….. .. charge (e.g. Li+, Na+, K+, Rb+, Cs+) as the metal atom .. one electron.
The elements in Group 7 of the Periodic Table are called the …….. They are all non-metals. When any Group 7 element reacts with a metal, an ionic compound is formed in which the ion has a …… charge. (e.g. F-, Cl-, Br-, I-, called halide ions) as the non-metal ……..one electron.

3) When metals react with non-metals:

a) What happens to the metal atoms?
b) What happens to the non-metal atoms?
c) What type of substance is made?

Forming covalent substances.

Look at a website like chemguide to remind you about covalent bonding. Try these questions.

- **between atoms of the same element; (e.g. in N2, O2, diamond, graphite)**
- **between atoms of different elements on the RHS of table; (e.g. CO2, SO2)**
- **when one of the elements is in the middle of the table; (e.g. C, Si)**
- **consists of a shared pair of electrons, one electron coming from each atom**
- **atoms share to try and get an 'octet' of electrons**
- **leads to the formation of simple molecules and giant molecules (e.g. silica)**

Find out how to draw 'dot and cross' diagrams.

Draw 'dot and cross' diagrams of the following

1. **Methane CH_4**

Atom	Electron arrangement
H	1
C	6 (2, 4)
N	7 (2, 5)
O	8(2, 6)
F	9 (2, 7)
Cl	17 (2, 8, 7)

2. **Ammonia NH_3**

3. **Water H_2O**

4. **Oxygen O_2**

5. **Nitrogen N_2**

6. **Hydrogen Chloride HCl**

7. **Carbon dioxide CO_2**

8. **Ethane C_2H_6**

9. **Ethene C_2H_4**

10. **Chloroethane CH_3Cl**

11. **Methanol CH_3OH**

Formula of ionic compounds.

Find out how to work out the formula of an ionic compound when given the ions which it consists of.

positive ions				negative ions			
aluminium	Al^{3+}	lead	Pb^{2+}	bromide	Br^-	iodide	I^-
ammonium	NH_4^+	lithium	Li^+	carbonate	CO_3^{2-}	nitrate	NO_3^-
barium	Ba^{2+}	magnesium	Mg^{2+}	chloride	Cl^-	oxide	O^{2-}
calcium	Ca^{2+}	potassium	K^+	fluoride	F^-	sulfate	SO_4^{2-}
copper	Cu^{2+}	silver	Ag^+	hydrogencarbonate	HCO_3^-	sulphide	S^{2-}
hydrogen	H^+	sodium	Na^+	hydroxide	OH^-		
iron (II)	Fe^{2+}	zinc	Zn^{2+}				
iron (III)	Fe^{3+}						

You will need a periodic table to work some of these out.

1
a) sodium iodide
b) potassium oxide.
c) aluminium chloride
d) magnesium bromide
e) aluminium oxide
f) iron (II) oxide
g) iron (III) oxide
h) magnesium sulphide
i) copper fluoride
j) lithium iodide
k) barium bromide
l) zinc sulphide
m) lead iodide
n) iron (III) sulphide
o) magnesium oxide

2
a) sodium sulphate
b) calcium sulphate
c) magnesium hydroxide
d) zinc nitrate
e) copper carbonate
f) sodium hydroxide
g) potassium carbonate
h) iron (III) hydroxide
i) ammonium nitrate
j) ammonium hydroxide
k) iron (III) sulphate
l) aluminium nitrate
m) silver nitrate
n) calcium hydrogencarbonate
o) magnesium nitrate

3
a) rubidium bromide
b) strontium chloride
c) caesium selenide
d) calcium astatide
e) radium polonide
f) gallium fluoride
g) scandium (III) bromide
h) chromium (III) oxide
i) strontium iodide
j) lithium arsenide

4
a) ammonium astatide
b) caesium nitrate
c) strontium hydroxide
d) platinum (II) nitrate
e) cobalt (II) carbonate
f) copper (I) oxide
g) copper (II) oxide
h) francium telluride
i) gold (I) fluoride
j) rubidium sulphate

Balancing equations.

- **An equation is balanced when there are the same number of atoms of each type on both sides of the equation.**
- **An equation can only be balanced by putting numbers in front of formulas – you cannot change the formula itself.**
- **Equations can be written with state symbols: (s) = solid, (l) = liquid, (g) = gas, (aq) = aqueous (dissolved in water).**

How to balance an equation:

a) Calculate how many atoms of each type are on each side of the equation.
b) If the numbers are the same then the equation is balanced.
c) If the numbers are not the same, then numbers are put in front of the formulas (this adds more of that substance). You cannot change the formulas (this would make a different substance). Hint – start with unbalanced elements that only appear in one substance on each side of the equation.
d) Keep doing this until the equation is balanced.

e.g. $CH_4 + O_2 \rightarrow CO_2 + H_2O$

Questions

Put your final answers here although you may wish to do your working on a separate sheet of paper or on the back.

1) $Ca + O_2 \Longrightarrow CaO$

2) $Na_2O + H_2O \Longrightarrow NaOH$

3) $Al + O_2 \Longrightarrow Al_2O_3$

4) $Na + Cl_2 \Longrightarrow NaCl$

5) $Na_2CO_3 \Longrightarrow Na_2O + CO_2$

6) $K + O_2 \Longrightarrow K_2O$

7) $C_4H_8 + O_2 \Longrightarrow CO_2 + H_2O$

8) $Fe_2O_3 + HCl \Longrightarrow FeCl_3 + H_2O$

9) $F_2 + KBr \Longrightarrow KF + Br_2$

10) $C_5H_{12} + O_2 \Longrightarrow CO_2 + H_2O$

11) $NH_3 + O_2 \Longrightarrow NO + H_2O$

12) $HNO_3 \Longrightarrow NO_2 + H_2O + O_2$