Revision questions for module CD5 (H)

1] What is the **atomic mass** of :

a) Sodium (Na) ? b) Oxygen (O) ? c) Copper (Cu) ?

2] What should go in the empty boxes (a – h) in this table ?

Name	Formula	Atoms present in compound	Formula mass
**** example **** Water	H_2O	2 x H 1 x O	(2 x 1) = 2 + (1 x 16) = 16 = **18**
Calcium carbonate	$CaCO_3$	1 x Ca 1 x C 3 x O	(a) ?
(b) ?	CuO	(c) ?	(d) ?
Ammonium carbonate	$(NH_4)_2CO_3$	(e) ?	(f) ?
Copper sulphate (crystals)	$CuSO_4.5H_2O$	(g) ?	(h) ?

3] **Balance** these chemical equations (the formulae of the individual compounds are correct and should NOT be changed).

a) $N_2 + H_2 \rightarrow NH_3$

b) $Na + FeSO_4 \rightarrow Na_2SO_4 + Fe$

c) $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

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

e) $Fe_2O_3 + CO \rightarrow Fe + CO_2$

f) What types of chemical reactions are taking place in (b) , (c) and (d) ? (they're all different !)

4] Calculate the masses of each of the following:

Method:
1] Calculate formula mass
2] Mass = No. of moles x Formula mass

a) 1 mole of Carbon dioxide (CO_2) ?

b) 0.5 moles of Aluminium chloride ($AlCl_3$) ?

c) 0.15 moles of Nickel sulphate ($NiSO_4$) ?

d) 0.02 moles of Sodium hydrogen carbonate ($NaHCO_3$) ?

5] Using the equations given, decide:

a) $2K + ZnSO_4 \rightarrow K_2SO_4 + Zn$

How many moles of potassium (K) will react with 1 mole of zinc sulphate ?

b) $2Fe + 3O_2 \rightarrow 2Fe_2O_3$

How many moles of iron oxide are formed when 1 mole of iron is reacted with oxygen ?

c) $2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$

How many moles of oxygen are needed to produce 4 moles of water ?

Note
Calculating mass of a product, when you know the mass of a reactant and the equation for the reaction.

Example Q
What mass of Iron oxide is formed when 10 grams of iron react with oxygen ?

$$2Fe + 3O_2 \rightarrow 2Fe_2O_3$$

Answer:

1] What is the Formula mass of the known substance (iron) ?

F.M. (Fe) = 56 (it's an element, so you can get it straight from the periodic table)

2] How many moles of the known substance (iron) are there in the mass given in the question (10 g) ?

Moles = Mass / Formula mass
= 10g / 56 = **0.18 moles** of iron in 10g

3] Look at equation:

2 moles of iron form 2 moles of iron oxide. So, 1 mole of iron forms 1 mole of iron oxide.
Our 0.18 moles of iron will form **0.18 moles of iron oxide**.

4] Work out the mass of that many moles of the product:

Mass = No of moles of iron oxide x Formula mass of iron oxide
= 0.18 moles x 160 = 28.8 grams

Formula .Mass (Fe_2O_3) = (2 x Fe) + (3 x O)
= (2 x 56) + (3 x 16)
= **160**

So, 10 grams of Fe will form 28.8 grams of Fe_2O_3 .

6] a) What mass of Copper will be formed when, 5 grams of copper sulphate reacts completely with Zinc ?

$$Zn + CuSO_4 \rightarrow Zn\,SO_4 + Cu$$

b) What mass of Carbon monoxide (CO) will be formed when 25 grams of methane (CH_4) reacts with oxygen ?

$$2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$$

c) What mass of water will be formed when 25 grams of methane (CH_4) reacts with oxygen ?
[use the equation in Q6b]

Percentage yield = Mass of the product in a reaction (actual yield) / Predicted mass (yield) of product x 100

7] a) What is the % yield of potassium sulphate ($ZnSO_4$) if the actual yield in the practical was 15grams and the predicted yield was 30 grams ?

$$2K + ZnSO_4 \rightarrow K_2SO_4 + Zn$$

b) What is the % yield of Copper, if 10 grams of copper sulphate is reacted with Zinc and 3 grams of copper are formed in the experiment (predicted yield of copper = 4g) ?

$$Zn + CuSO_4 \rightarrow Zn\,SO_4 + Cu$$

c) In the following reaction, 20 grams of methane were reacted with oxygen and this was expected to produce 35 grams of carbon monoxide (CO) and 45 grams of water.

$$2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$$

In the experiment, only 18 grams of carbon monoxide formed. What was the % yield of CO ?

8] *An experiment was carried out as follows:*

12 grams of calcium metal (in large pieces) were reacted with 1M sulphuric acid. This formed 17 grams of calcium sulphate and some hydrogen gas . The expected yield of calcium sulphate was 23 grams.

$$Ca + H_2SO_4 \rightarrow Ca\,SO_4 + H_2$$

a) How would you get solid, dry calcium sulphate ($Ca\,SO_4$) from the solution that is formed ?
b) How could you collect and measure the amount of hydrogen produced ?
c) Suggest 3 ways in which you could speed up the reaction.
d) Calculate the percentage yield of calcium sulphate ?
e) Suggest 2 reasons why the % yield is NOT 100% ?

9] Predict the name of the product of each of these reactions :

a) Sulphuric acid + sodium hydroxide → _____ + water
b) Nitric acid + Potassium hydroxide → _____ + water
c) Hydrochloric acid + Calcium hydroxide → _____ + water

10] Suggest why it might be a good idea to lemon juice on a wasp sting ?

11] Explain what this equation tells you:

$$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$$

12] Complete these symbol equations (and name the missing chemical):

a) $CuO + H_2SO_4 \rightarrow$ _____ $+ H_2O$
b) _____ $+ HCl \rightarrow NH_4Cl + H_2O$
c) $Ca(OH)_2 + H_2SO_4 \rightarrow$ _____ $+ 2H_2O$
d) $MgO + 2$_____ $\rightarrow Mg(NO_3)_2 + H_2O$

13] $2SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2SO_{3\,(g)}$

This reaction shows the formation of sulphur trioxide from sulphur dioxide.

a) What type of chemical reaction is this ?
b) What does the "odd" arrow in the middle tell us ?
c) When SO_3 forms, the reaction vessel gets hotter. What does this tell you about the reaction ? Is the reaction that forms SO_3 likely to be helped if you raise the temperature ?
d) Is the back ($2SO_{3\,(g)} \rightarrow 2SO_{2\,(g)} + O_{2\,(g)}$) part of this reaction likely to be helped if you increase or decrease the temperature ?
e) At 50°c the yield of SO_3 is 75%. At 200°c it's 35% and at 600°c it's 16%. The actual operating temperature (when this is done in industry) is **450 °c**. Suggest why, when the yield is poor at this temp ?
f) If an extremely high pressure of 1,000 atmospheres was used, the yield of SO_3 would be 100%. Give 2 reasons why this pressure is NOT used ?
g) How might a catalyst help to save money when this reaction is done in industry ?
h) The reaction that you want to happen in industry (ie/ the one that makes money) is:

$$2SO_{2\,(g)} + O_{2\,(g)} \rightarrow 2SO_{3\,(g)}$$

What could be done with unreacted sulphur dioxide and oxygen (left over at the end) to save money ?

i) If unreacted sulphur dioxide leaked into the air, what environmental problems might it cause ?

14] Ammonium phosphate $(NH_4)_3PO_4$ and Ammonium nitrate NH_4NO_3 are both used as fertilisers. Ammonium phosphate is less soluble in water than Ammonium nitrate.

a) Give 2 reasons why farmers have to use fertilisers ?
b) Why is it important that fertilisers are soluble in water ?
c) Why might it be a slight advantage for the phosphate to be slightly less soluble than the nitrate when it is put on fields ?
d) Write the chemical equation for the Haber process (by which ammonia is made in industry).
e) Write a word equation for a reaction that you could carry out to form ammonium nitrate from ammonium hydroxide (NH_4OH – an alkali).
f) Both fertilisers supply the key element nitrogen to plants – what is it used for ?
g) What are the other 2 key elements that plants need most ?
h) Describe 2 ways in which nitrogen compounds get into the soil "naturally".
i) How does "Eutrophication" occur and why is it such a bad thing ?

15] Ethanol (a solvent for glues and paints) is produced by this chemical reaction in industry:

$$\underset{\text{(ethene)}}{CH_2{=}CH_2} + H_2O \rightarrow \underset{\text{(ethanol)}}{C_2H_5OH}$$

The reaction is carried out at 70°c , 70 atmospheres pressure (70 times normal atmospheric pressure), a solid acid catalyst and the water is added in the form of steam.

a) What is the source of the ethene ?
b) Even with these conditions, only about 4% of the ethene is converted into ethanol. Suggest what happens to the (96%) unused ethene to make the process economical ?
c) This is called an ADDITION reaction. Suggest why ?
d) Describe another reaction that can be used to manufacture ethanol.