

**Revision questions for module CD5 (H)**1] What is the **atomic mass** of :

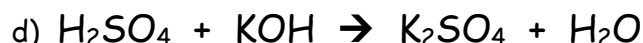
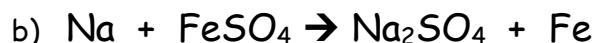
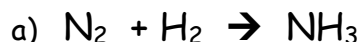
a) Sodium (Na) ?

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                                  |
|-----------------------------|---------------------------------------------------|---------------------------|-----------------------------------------------|
| <b>* example *</b><br>Water | <b>H<sub>2</sub>O</b>                             | 2 × H<br>1 × O            | (2 × 1) = 2 +<br>(1 × 16) = 16<br><b>= 18</b> |
| Calcium carbonate           | <b>CaCO<sub>3</sub></b>                           | 1 × Ca<br>1 × C<br>3 × O  | (a) ?                                         |
| (b) ?                       | <b>CuO</b>                                        | (c) ?                     | (d) ?                                         |
| Ammonium carbonate          | <b>(NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub></b> | (e) ?                     | (f) ?                                         |
| Copper sulphate (crystals)  | <b>CuSO<sub>4</sub>.5H<sub>2</sub>O</b>           | (g) ?                     | (h) ?                                         |

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

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

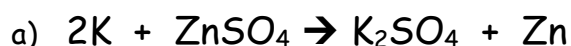
4] Calculate the masses of each of the following: —————→

a) 1 mole of Carbon dioxide (**CO<sub>2</sub>**) ?b) 0.5 moles of Aluminium chloride (**AlCl<sub>3</sub>**) ?c) 0.15 moles of Nickel sulphate (**NiSO<sub>4</sub>**) ?d) 0.02 moles of Sodium hydrogen carbonate (**NaHCO<sub>3</sub>**) ?**Method:**

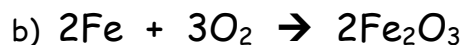
1] Calculate formula mass

2] Mass = No. of moles x Formula mass

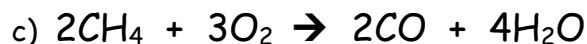
5] Using the equations given, decide:



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



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



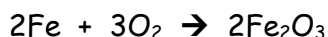
How many moles of oxygen are needed to produce 4 moles of water ?

**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 ?

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) ?**

$$\begin{aligned}\text{Moles} &= \text{Mass} / \text{Formula mass} \\ &= 10\text{g} / 56 = \mathbf{0.18 \text{ moles of iron in 10g}}\end{aligned}$$

**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:**

$$\begin{aligned}\text{Mass} &= \text{No of moles of iron oxide} \times \text{Formula mass of iron oxide} \\ &= 0.18 \text{ moles} \times 160 = 28.8 \text{ grams}\end{aligned}$$

$$\begin{aligned}\text{Formula .Mass (Fe}_2\text{O}_3) &= (2 \times \text{Fe}) + (3 \times \text{O}) \\ &= (2 \times 56) + (3 \times 16) \\ &= 160\end{aligned}$$

**So, 10 grams of Fe will form 28.8 grams of Fe<sub>2</sub>O<sub>3</sub> .**

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



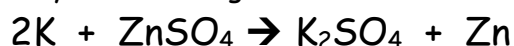
- b) What mass of Carbon monoxide (CO) will be formed when 25 grams of methane (CH<sub>4</sub>) reacts with oxygen ?



- c) What mass of water will be formed when 25 grams of methane (CH<sub>4</sub>) reacts with oxygen ?  
[ use the equation in Q6b ]

|                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Percentage yield = <math>\frac{\text{Mass of the product in a reaction (actual yield)}}{\text{Predicted mass (yield) of product}} \times 100</math></b></p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|

- 7] a) What is the % yield of potassium sulphate (ZnSO<sub>4</sub>) if the actual yield in the practical was 15grams and the predicted yield was 30 grams ?



- 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) ?



- 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.



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.



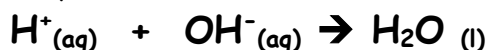
- How would you get solid, dry calcium sulphate ( $\text{CaSO}_4$ ) from the solution that is formed?
- How could you collect and measure the amount of hydrogen produced?
- Suggest 3 ways in which you could speed up the reaction.
- Calculate the percentage yield of calcium sulphate?
- Suggest 2 reasons why the % yield is NOT 100%?

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

- Sulphuric acid + sodium hydroxide  $\rightarrow$  \_\_\_\_\_ + water
- Nitric acid + Potassium hydroxide  $\rightarrow$  \_\_\_\_\_ + water
- Hydrochloric acid + Calcium hydroxide  $\rightarrow$  \_\_\_\_\_ + water

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

11] Explain what this equation tells you:



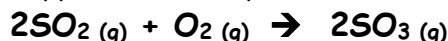
12] Complete these symbol equations (and name the missing chemical):

- $\text{CuO} + \text{H}_2\text{SO}_4 \rightarrow$  \_\_\_\_\_  $+ \text{H}_2\text{O}$
- \_\_\_\_\_  $+ \text{HCl} \rightarrow \text{NH}_4\text{Cl} + \text{H}_2\text{O}$
- $\text{Ca}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow$  \_\_\_\_\_  $+ 2\text{H}_2\text{O}$
- $\text{MgO} + 2$  \_\_\_\_\_  $\rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O}$

13]  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$

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

- What type of chemical reaction is this?
- What does the "odd" arrow in the middle tell us?
- When  $\text{SO}_3$  forms, the reaction vessel gets hotter. What does this tell you about the reaction?  
Is the reaction that forms  $\text{SO}_3$  likely to be helped if you raise the temperature?
- Is the back ( $2\text{SO}_3(\text{g}) \rightarrow 2\text{SO}_2(\text{g}) + \text{O}_2(\text{g})$ ) part of this reaction likely to be helped if you increase or decrease the temperature?
- At  $50^\circ\text{C}$  the yield of  $\text{SO}_3$  is 75%. At  $200^\circ\text{C}$  it's 35% and at  $600^\circ\text{C}$  it's 16%. The actual operating temperature (when this is done in industry) is  $450^\circ\text{C}$ . Suggest why, when the yield is poor at this temp?
- If an extremely high pressure of 1,000 atmospheres was used, the yield of  $\text{SO}_3$  would be 100%.  
Give 2 reasons why this pressure is NOT used?
- How might a catalyst help to save money when this reaction is done in industry?
- The reaction that you want to happen in industry (ie/ the one that makes money) is:



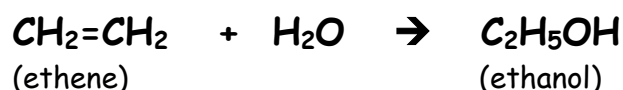
What could be done with unreacted sulphur dioxide and oxygen (left over at the end) to save money?

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

14] Ammonium phosphate  $(\text{NH}_4)_3\text{PO}_4$  and Ammonium nitrate  $\text{NH}_4\text{NO}_3$  are both used as fertilisers. Ammonium phosphate is less soluble in water than Ammonium nitrate.

- Give 2 reasons why farmers have to use fertilisers ?
- Why is it important that fertilisers are soluble in water ?
- Why might it be a slight advantage for the phosphate to be slightly less soluble than the nitrate when it is put on fields ?
- Write the chemical equation for the Haber process (by which ammonia is made in industry).
- Write a word equation for a reaction that you could carry out to form ammonium nitrate from ammonium hydroxide ( $\text{NH}_4\text{OH}$  - an alkali).
- Both fertilisers supply the key element nitrogen to plants - what is it used for ?
- What are the other 2 key elements that plants need most ?
- Describe 2 ways in which nitrogen compounds get into the soil "naturally".
- 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:



The reaction is carried out at  $70^\circ\text{C}$ , 70 atmospheres pressure (70 times normal atmospheric pressure), a solid acid catalyst and the water is added in the form of steam.

- What is the source of the ethene ?
- 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 ?
- This is called an ADDITION reaction. Suggest why ?
- Describe another reaction that can be used to manufacture ethanol.