

The Mole and Equations

This is the moment where the 'mole of moles' comes in. It's the equation from page 104 that makes it all work.

You Can Use Moles to Calculate Masses in Reactions

Remember those balanced equations back on page 100? Well, the **balancing** numbers (the chemical formulae of the reactants and products) tell you how much of each substance takes part in or is formed during the reaction.

For example:



In this reaction, **1 mole** of magnesium and **2 moles** of hydrochloric acid react together to form **1 mole** of magnesium chloride and **1 mole** of hydrogen gas.

You Can Balance Equations Using Reacting Masses

If you know the **masses** of the **reactants** and **products** that took part in a reaction, you can work out the **balanced symbol equation** for the reaction. Here are the steps you should take:

1. Write the **mass** of each substance by its **relative formula mass** for that the **number of moles**.
2. Write the **number of moles** of each substance by the **symbol number of moles** in the reaction.
3. If any of the numbers aren't whole numbers, multiply all the numbers by the same amount so that they all become whole numbers.
4. Write the **balanced symbol equation** for the reaction by putting these numbers in front of the chemical formulae.

EXAMPLE 1

81 g of zinc with CuSO_4 reacts completely with 0.80 g of carbon to form 32 g of carbon dioxide and 65 g of zinc. Write a balanced symbol equation for this reaction.



1. Work out the **mass** of each substance in the reaction.



2. Write the **number of moles** of each substance by its **symbol number of moles**.

Then, write the **number of moles** of each substance.



3. Check the **number of moles** of each substance. Write a **balanced symbol equation**.



4. The numbers are all whole numbers. In the next step, use the **balanced symbol equation** (straight away).



These numbers give the ratio of the masses of each substance in the reaction.



Where do moles live? Digaburrow...

The calculations on this page have lots of steps, so the best way to learn how to do them is to practice. Luckily, there are some questions below to get you started. Don't say I didn't warn you. Most of the questions are for you to try.

1. 16 g of H_2 reacts completely with 32 g of O_2 to produce 32 g of H_2O .
 $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
2. Calculate how many moles of each substance involved in the reaction were produced.
3. Use your answers to put up the **balanced symbol equation** for this reaction.

(1 mark)
(2 marks)

Limiting Reactants

Reactions don't go on forever — you need stuff in the reaction that can react. If one reactant gets **used up** in a reaction before the rest, then the reaction will **stop**. That reactant's called **limiting**.

Reactions Stop When One Reactant is Used Up

When some **magnesium carbonate** (MgCO_3) is placed into a beaker of **hydrochloric acid**, you can tell a **reaction** is taking place because you see lots of **bubbles of gas** being given off. After a while, the amount of **acid** **disappears** and the reaction **eventually stops**.

1. The reaction stops when all of one of the reactants is **used up**. Any other reactants are in **excess**. They're usually added in excess to **make sure** that the other reactant is used up.
2. The reactant that's **used up** in a reaction is called the **limiting reactant** (because it limits the amount of product that's formed).
3. The amount of product formed is **directly proportional** to the amount of **limiting reactant**. For example, if you **halve** the amount of limiting reactant the amount of product formed will also **halve**. If you **double** the amount of limiting reactant the amount of product will **double** (as long as it is still the limiting reactant).
4. This is because if you add **more reactant** there will be **more product particles** to take part in the reaction, which means **more product particles**.



The Amount of Product Depends on the Limiting Reactant

You can calculate the **mass of a product** formed in a reaction by using the **mass of the limiting reactant** and the **balanced symbol equation**.

The limiting reactant is the one that gets used up first. It's the one that limits the amount of product that can be formed.

1. Write out the **balanced symbol equation**.

2. Work out the **relative formula masses** (M_r) of the reactant and product you want.

3. Find out how many **moles** there are of the substance you know the mass of.

4. Use the **balanced symbol equation** to work out how many **moles** there'll be of the other substance. In this case, that's how many **moles of product** will be made of the mass of reactant.

5. Use the **number of moles** to calculate the **mass**.

EXAMPLE 2

Calculate the mass of aluminium oxide formed when 105 g of aluminium is burned in air.

1. Write out the **balanced symbol equation**.
 $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$
2. Calculate the **relative formula masses**.
 $4 \times 27 = 108$ (Al), $3 \times 32 = 96$ (O_2), $2 \times 102 = 204$ (Al_2O_3)
3. Calculate the **number of moles** of aluminium = 105 g.
 $\text{moles} = \frac{\text{mass}}{M_r} = \frac{105}{27} = 3.89$ (Aluminium has a M_r of 27)
4. Look at the **ratio of moles** in the equation.
If the equation says for the number of moles of aluminium, write down, **moles of Al**.
4 moles of Al react to produce 2 moles of Al_2O_3 .
So 3.89 moles of Al will react to produce 1.94 moles of Al_2O_3 .
5. Calculate the **mass** of 1.94 moles of aluminium oxide.
 $\text{mass} = \text{moles} \times M_r = 1.94 \times 102 = 198 \text{ g}$

'A Dash of Mad to the Head' — my favourite album by Mollie Jay

I loved it before, I'll love it again — practice makes perfect. So before you get stuck with a new problem, try these, or maybe you'll be home a cup of tea, have a go at the questions below.

1. The **balanced symbol equation** for the reaction between aluminium and potassium bromate is:
 $2\text{Al} + \text{KBrO}_3 \rightarrow \text{Al}_2\text{O}_3 + 3\text{KBr}$
Calculate the mass of potassium bromate produced when 13.5 g of aluminium reacts with an excess of potassium bromate.
 $2\text{Al} + \text{KBrO}_3 \rightarrow \text{Al}_2\text{O}_3 + 3\text{KBr}$

(1 mark)
(2 marks)

Key Stage 2 Science Revision Guide Cgp

Brendan G. Carr



Key Stage 2 Science Revision Guide Cgp:

The book delves into Key Stage 2 Science Revision Guide Cgp. Key Stage 2 Science Revision Guide Cgp is a vital topic that must be grasped by everyone, ranging from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Key Stage 2 Science Revision Guide Cgp, encompassing both the fundamentals and more intricate discussions.

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