A1 More Moles

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| **Essential Content** | **Additional Guidance** | **☺** | **😐** | **☹** |
| * mass, volume of solution, concentration
 | * be able to perform calculations involving the mass of a substance, the number of moles and the molar mass
* be able to perform calculations involving the concentration (molarity) of a solution, the number of moles and volume of the solution
* be able to perform calculations involving the concentration of a solution in g dm-3, the mass of the substance dissolved and volume of solution
* be able to determine whether a reactant is a limiting reagent or in excess
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| * reacting quantities
 | * be able to calculate quantities of masses for substances reacting or produced, using balanced chemical equations, moles and molar mass
* be able to calculate quantities of concentration for reacting substances, using balanced chemical equations, moles and volume
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| * percentage yields.
 | * be able to calculate percentage yield of a product from the actual yield (experimental mass) and the theoretical yield (predicted mass)

**(NB an understanding of atom economy is not required)** |  |  |  |

In this topic we will review your work on moles calculations and look at percentage yields and limiting reagents.

Review of work on first topic in moles

Below is the formula triangle for working out moles given the mass

Draw the triangle for working out the moles of a solution

We can use these to work out reacting masses as well as percentage yields.

Reacting masses (using solids)

1. What mass of hydrogen is needed to react with 40 g of copper oxide?

CuO + H2 → Cu + H2O

2) What mass of oxygen reacts with 192 g of magnesium?

2 Mg + O2 → 2 MgO

3) What mass of sulfur trioxide is formed from 96 g of sulfur dioxide?

2 SO2 → 2 SO3 + O2

4) What mass of carbon monoxide is needed to react with 480 kg of iron oxide?

Fe2O3 + 3 CO → 2 Fe + 3 CO2

Reacting masses (using solutions) Remember to change everything into dm3 to start.

1. Calculate the number of moles
2. 25 cm3 of 0.50 mol dm-3 HCl.
3. 250 cm3 of 0.25 mol dm-3 HCl
4. 25 cm3 of 0.10 mol dm-3 AgNO3
5. 22 cm3 of 1.0 mol dm-3 NaOH

**TITRATION CALCULATIONS**

1. 12.5 cm3 of 0.5 mol dm-3 sulfuric acid neutralised 50cm3 of a solution of sodium hydroxide. What is the concentration of the alkali in mol dm-3?

H2SO4 + 2NaOH 🡪 2H2O + Na2SO4

1. 25.0 cm3 of calcium hydroxide solution was neutralised by 24.0 cm3 of 1.0 mol dm-3 solution of hydrochloric acid. What is the concentration of the alkali in mol dm-3 ?

Ca(OH)2 + 2HCl 🡪 CaCl2 + 2H2O

1. 25.0 cm3 of a solution of sodium carbonate required 17.5 cm3 of 0.05 mol dm-3 solution of sulfuric acid to neutralise it. Calculate the concentration of the sodium carbonate solution in both mol dm-3

Na2CO3 + H2SO4 🡪 Na2SO4 + CO2 + H2O

1. (extension) 2.5 g of anhydrous sodium carbonate were made up to 500 cm3 of aqueous solution. How many cm3 of 0.1 mol dm-3 hydrochloric acid will be needed to neutralise completely 25.0 cm3 of this solution?

Na2CO3 + 2HCl 🡪 2NaCl + CO2 + H2O

Percentage Yield Calculations

In a reaction not all the reactants turn into the desired products, some get lost or side reactions occur that reduce the yield. We need to be able to calculate this percentage yield.

There are 2 steps

Step 1 – Calculate the max mass possible

Step 2 – Use the equation Actual mass x100 = percentage yield

 Max mass

Eg

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| --- |
| Ammonia is made by reacting hydrogen with nitrogenN2 + 3H2 🡪 2NH3.  |
| a) Calculate the mass of ammonia that can be formed from 12.0 g of hydrogen.   |
| b) 20.3 g of ammonia was formed in this reaction. Calculate the percentage yield.   |

1. Iron is made by the reduction of iron III oxide with carbon monoxide

Fe2O3 + 3CO 🡪 2Fe + 3CO2

1. Calculate the mass of iron that can be formed from 126g of Iron III oxide
2. 78.5g of Iron was formed. Calculate the % yield
3. Chlorine can be made by the electrolysis of sodium chloride solution

2NaCl + 2H2O 🡪 2NaOH + Cl2 + H2

1. Calculate the mass of Chlorine that can be formed from 50.0g of NaCl
2. 25.0g of chlorine was formed calculate the percentage yield
3. Chromium is a useful metal, it is extracted from chromium III oxide by a reaction with Aluminium

Cr2O3 + 2Al 🡪 2Cr + Al2O3

1. Calculate the mass of chromium that can be formed from 1.25kg of chromium oxide
2. 756g of chromium was actually formed. Calculate the percentage yield
3. Titanium is made by the reaction of titanium chloride with sodium

TiCl4 + 4Na 🡪 Ti + 4NaCl

1. Calculate the mass of Titanium that can be formed from 10.0 kg of Titanium chloride
2. 1950g was formed, calculate the percentage yield

