



GCSE REVISION 13

Calculations 3

1 Give the formula of the following ionic substances.

a) copper(II) oxide **CuO**

c) aluminium nitrate **Al(NO₃)₃**

b) calcium hydroxide **Ca(OH)₂**

d) lithium carbonate **Li₂CO₃**

2 Calculate the relative formula mass of the following substances.

a) nitrogen, N₂ **2(14) = 28**

b) calcium nitrate, Ca(NO₃)₂ **40 + 2(14) + 6(16) = 164**

3 What mass of hydrogen reacts with 140 g of nitrogen to make ammonia? $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$

$$\text{moles N}_2 = \frac{140}{28} = 5$$

$$\text{moles H}_2 = 3 \times 5 = 15$$

$$\text{mass H}_2 = 15 \times 2 = 30 \text{ g}$$

4 Calcium hydroxide is made by reaction of calcium oxide with water: $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$

a) Calculate the maximum mass of calcium hydroxide that could be formed from 1.12 kg of calcium oxide.

$$\text{moles CaO} = \frac{1120}{56} = 20$$

$$\text{moles Ca(OH)}_2 = 20$$

$$\text{mass Ca(OH)}_2 = 20 \times 74 = 1480 \text{ g}$$

b) In a reaction, 1440 g of calcium hydroxide was formed from reaction of 1.12 kg of calcium oxide with water. Calculate the percentage yield for this reaction.

$$\% \text{ yield} = 100 \times \frac{1440}{1480} = 97.3\%$$

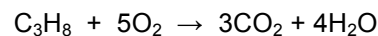
c) Suggest one reason why the yield was less than 100%.

- reaction is reversible / incomplete
- some products lost
- other reactions may take place

5 Calculate the atom economy to make titanium in this reaction: $\text{TiCl}_4 + 2\text{Mg} \rightarrow \text{Ti} + 2\text{MgCl}_2$

$$\% \text{ atom economy} = 100 \times \frac{48}{190 + 2(24)} = 20.2\%$$

6 What volume of oxygen gas is needed to react with 4 dm³ of propane with complete combustion, with the volume of all gases measured at the same temperature and pressure?



$$5 \times 4 = 20 \text{ dm}^3$$

7 Calculate the volume of the following gases at room temperature and pressure.

a) 2.5 moles of carbon dioxide, CO₂ **volume CO₂ = 24 x 2.5 = 60 dm³**

b) 10 g of argon, Ar **moles Ar = $\frac{10}{40} = 0.25$ volume Ar = 24 x 0.25 = 6 dm³**

8 5.1 g of the vanadium (a transition metal, symbol = V) reacts with 4.0 g of oxygen (O₂) to make an oxide of vanadium. Calculate the moles of vanadium and oxygen and use this to determine the balanced equation for the reaction.

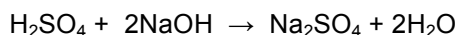
$$\text{moles V} = \frac{5.1}{51} = 0.1$$

$$\text{moles O}_2 = \frac{4.0}{32} = 0.125$$

$$\text{ratio moles V : moles O}_2 = 0.1 : 0.125 = 4 : 5$$



9 25.0 cm³ of a solution of sodium hydroxide was neutralised by 23.6 cm³ of 0.400 mol dm⁻³ sulfuric acid in a titration.



a) Calculate the concentration of the sodium hydroxide in mol/dm³. Give your answer to 3 significant figures.

$$\text{mol H}_2\text{SO}_4 = 0.400 \times \frac{23.6}{1000} = 0.00944 \text{ mol}$$

$$\text{mol NaOH} = 2 \times 0.00944 = 0.01888 \text{ mol}$$

$$\text{conc NaOH} = \frac{0.01888}{\frac{25.0}{1000}} = 0.755 \text{ mol/dm}^3$$

b) Calculate the concentration of the sodium hydroxide in g/dm³. Give your answer to 3 significant figures.

$$\text{conc NaOH} = 0.755 \times 40 = 30.2 \text{ g/dm}^3$$

Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Can work out mass from moles			Deduce molar reacting ratio from mass		
Shows suitable working			Can work out % atom economy			Work out moles for solutions		
Can write ionic formulae			Can work out % yield			Convert mol/dm ³ to g/dm ³		
Can work out <i>M_r</i>			Understands why yield < 100%			Does not round too much		
Work out moles from mass			Work out gas volume from mass or mol			Can use sig figs		
Use equation to find reacting moles			Understands reacting gas volumes			Gives units		