



# GCSE REVISION 18

## Calculations 4

- 1) a) How many moles in 33.0 kg of ammonium sulfate  $(\text{NH}_4)_2\text{SO}_4$ .  $M_r = 132$   $\text{moles} = \frac{33000}{132} = 250 \text{ mol}$   
b) What is the mass of 0.040 moles of oxygen,  $\text{O}_2$ ?  $32 \times 0.040 = 1.28 \text{ g}$

- 2) a) What maximum mass of methanol that can be made when 12 g of hydrogen reacts with an excess of carbon monoxide?  $\text{CO} + 2\text{H}_2 \rightarrow \text{CH}_3\text{OH}$

$$\text{moles H}_2 = \frac{12}{2} = 6 \text{ mol}$$

$$\text{moles CH}_3\text{OH} = 3 \text{ mol}$$

$$\text{mass CH}_3\text{OH} = 32 \times 3 = 96 \text{ g}$$

- b) In a reaction, 60 g of methanol was formed from 12 g of hydrogen. Calculate the percentage yield.

$$\% \text{ yield} = \frac{60}{96} \times 100 = 62.5\%$$

- 3) Calculate the percentage atom economy to make iron from iron(III) oxide by reaction with carbon monoxide.  $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$



$$M_r \quad 160 \quad 28 \quad 56$$

$$\text{Mass} \quad 160\text{g} \quad 3(28)\text{g} \quad 2(56)\text{g}$$

$$\% \text{ atom economy} = \frac{2(56)}{160+3(28)} \times 100 = 45.9\%$$

- 4) What volume of hydrogen gas is formed, measured at room temperature and pressure, when 0.65 g of zinc reacts with sulfuric acid?  $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$

$$\text{moles Zn} = \frac{0.65}{65} = 0.010 \text{ mol}$$

$$\text{moles H}_2 = 0.010 \text{ mol}$$

$$\text{volume H}_2 = 24 \times 0.010 = 0.24 \text{ dm}^3$$

- 5) What volume of carbon dioxide gas is formed when 100  $\text{cm}^3$  of propane gas burns (both gases are at room temperature and pressure)?  $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$

$$\text{volume CO}_2 = 3 \times 100 = 300 \text{ cm}^3$$

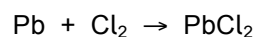
- 6) 0.595 g of tin (Sn) reacts with 0.71 g of chlorine (Cl<sub>2</sub>) to form tin chloride. Find the simplest molar ratio in which tin reacts with chlorine and use it to find the formula of the tin chloride. Finally, write a balanced equation for the reaction.

$$\text{Moles of Sn} = \frac{0.595}{119} = 0.005 \text{ mol} \qquad \text{Moles of Cl}_2 = \frac{0.71}{71} = 0.010 \text{ mol}$$

$$\text{Reacting ratio Sn : Cl}_2 = 0.005 : 0.010 = 1 : 2$$



- 7) Lead reacts with chlorine to form lead(II) chloride. When 6.21 g of lead reacts with 2.84 g of chlorine, which is the limiting reagent and what mass of lead(II) chloride is formed?



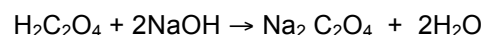
$$\text{moles Pb} = \frac{6.21}{207} = 0.030 \text{ mol}$$

$$\text{moles Cl}_2 = \frac{2.84}{71} = 0.040 \text{ mol}$$

**Pb is limiting reagent and so 0.030 mol of PbCl<sub>2</sub> is formed**

$$\text{Mass PbCl}_2 = 278 \times 0.030 = 8.34 \text{ g}$$

- 8) Find the concentration of oxalic acid (H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>) in mol/dm<sup>3</sup> and g/dm<sup>3</sup> given that 25.0 cm<sup>3</sup> of this solution reacts with 22.8 cm<sup>3</sup> 0.100 mol/dm<sup>3</sup> sodium hydroxide solution in a titration.



$$\text{moles NaOH} = 0.100 \times \frac{22.8}{1000} = 0.00228 \text{ mol}$$

$$\text{moles H}_2\text{C}_2\text{O}_4 = \frac{0.00228}{2} = 0.00114 \text{ mol}$$

$$\text{concentration H}_2\text{C}_2\text{O}_4 \text{ in mol/dm}^3 = \frac{0.00114}{\frac{25}{1000}} = 0.0456 \text{ mol/dm}^3$$

$$\text{concentration H}_2\text{C}_2\text{O}_4 \text{ in g/dm}^3 = 0.0456 \times 90 = 4.104 \text{ g/dm}^3$$

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