



# CALCULATIONS MIXTURE 3

- 1) a) How many moles in 5.74 kg of calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$ .  $M_r = 164$      $\text{moles} = \frac{5740}{164} = 35 \text{ mol}$
- b) What is the mass of 0.025 moles of methane,  $\text{CH}_4$ ?     $16 \times 0.025 = 0.40 \text{ g}$

- 2) a) What maximum mass of ammonia that can be made when 11.2 g of nitrogen reacts with an excess of hydrogen?     $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$

$$\text{moles N}_2 = \frac{11.2}{28} = 0.40 \text{ mol}$$

$$\text{moles NH}_3 = 0.40 \times 2 = 0.80 \text{ mol}$$

$$\text{mass NH}_3 = 17 \times 0.80 = 13.6 \text{ g}$$

- b) In a reaction, 3.0 g of ammonia was formed from 11.2 g of nitrogen. Calculate the percentage yield.

$$\% \text{ yield} = \frac{3.0}{13.6} \times 100 = 22.1\%$$

- 3) Calculate the percentage atom economy to make ethanol ( $\text{C}_2\text{H}_5\text{OH}$ ) by fermentation of glucose.     $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$



$$M_r \quad 180 \quad 46$$

$$\text{Mass} \quad 180\text{g} \quad 2(46)\text{g}$$

$$\% \text{ atom economy} = \frac{2(46)}{180} \times 100 = 51.1\%$$

- 4) What volume of hydrogen gas is formed, measured at room temperature and pressure, when 0.36 g of magnesium reacts with sulfuric acid?     $\text{Mg} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2$

$$\text{moles Mg} = \frac{0.36}{24} = 0.015 \text{ mol}$$

$$\text{moles H}_2 = 0.015 \text{ mol}$$

$$\text{volume H}_2 = 24 \times 0.015 = 0.36 \text{ dm}^3$$

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

$$\text{volume O}_2 = 5 \times 100 = 500 \text{ cm}^3$$

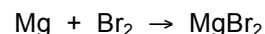
- 6) 4.2 g of lithium (Li) reacts with 2.8 g of nitrogen (N<sub>2</sub>). Find the simplest molar ratio in which lithium reacts with nitrogen.

$$\text{Moles of Li} = \frac{4.2}{7} = 0.60 \text{ mol} \qquad \text{Moles of N}_2 = \frac{2.8}{28} = 0.10 \text{ mol}$$

$$\text{Reacting ratio Li : N}_2 = 0.60 : 0.10 = 6 : 1$$



- 7) Magnesium reacts with bromine to form magnesium bromide. When 1.2 g of magnesium reacts with 2.0 g of bromine, which is the limiting reagent and what mass of magnesium bromide is formed?



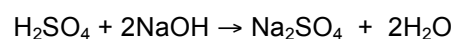
$$\text{moles Mg} = \frac{1.2}{24} = 0.050 \text{ mol}$$

$$\text{moles Br}_2 = \frac{2.0}{160} = 0.0125 \text{ mol}$$

**Br<sub>2</sub> is limiting reagent and so 0.0125 mol of MgBr<sub>2</sub> is formed**

$$\text{Mass MgBr}_2 = 184 \times 0.0125 = 2.3 \text{ g}$$

- 8) Find the concentration of sulfuric acid 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 26.5 cm<sup>3</sup> 0.100 mol/dm<sup>3</sup> sodium hydroxide solution in a titration.



$$\text{moles NaOH} = 0.100 \times \frac{26.5}{1000} = 0.00265 \text{ mol}$$

$$\text{moles H}_2\text{SO}_4 = \frac{0.00265}{2} = 0.001325 \text{ mol}$$

$$\text{concentration H}_2\text{SO}_4 \text{ in mol/dm}^3 = \frac{0.001325}{\frac{25}{1000}} = 0.053 \text{ mol/dm}^3$$

$$\text{concentration H}_2\text{SO}_4 \text{ in g/dm}^3 = 0.053 \times 98 = 5.19 \text{ g/dm}^3$$

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			Which numbers are part of formula		