



# GCSE REVISION 9

## Calculations 2

1 Give the formula of the following ionic substances.

- a) aluminium chloride  **$\text{AlCl}_3$**                       d) calcium nitrate  **$\text{Ca}(\text{NO}_3)_2$**   
b) potassium sulfide  **$\text{K}_2\text{S}$**                       e) magnesium hydroxide  **$\text{Mg}(\text{OH})_2$**   
c) sodium sulfate  **$\text{Na}_2\text{SO}_4$**                       f) iron(II) oxide  **$\text{FeO}$**

2 Calculate the relative formula mass of the following substances.

- a) fluorine,  $\text{F}_2$      **$2(19) = 38$**   
b) iron(III) nitrate,  $\text{Fe}(\text{NO}_3)_3$      **$56 + 3(14) + 9(16) = 242$**

3 Calcium oxide is made from the thermal decomposition of calcium carbonate:  $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$

- a) Calculate the maximum mass of calcium oxide that could be formed from heating 500 g of calcium carbonate.

$$\text{moles CaCO}_3 = \frac{500}{100} = 5$$

$$\text{moles CaO} = 5$$

$$\text{mass CaO} = 56 \times 5 = 280 \text{ g}$$

- b) In a reaction, 250 g of calcium oxide was formed from heating 500 g of calcium carbonate. Calculate the percentage yield for this reaction.

$$\% \text{ yield} = 100 \times \frac{250}{280} = 89.3\%$$

- c) Suggest two reasons why the yield was less than 100%.

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

- d) Calculate the atom economy to make calcium oxide from calcium carbonate by this reaction.

$$\% \text{ atom economy} = 100 \times \frac{56}{100} = 56.0\%$$

4 What mass of oxygen reacts with 270 g of aluminium?     $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$

$$\text{moles Al} = \frac{270}{27} = 10$$

$$\text{moles O}_2 = \frac{3}{4} \times 10 = 7.5$$

$$\text{mass O}_2 = 32 \times 7.5 = 240 \text{ g}$$

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

a) 3 moles of oxygen, O<sub>2</sub>

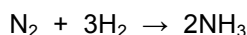
$$\text{volume O}_2 = 24 \times 3 = 72 \text{ dm}^3$$

b) 22 g of carbon dioxide, CO<sub>2</sub>

$$\text{moles CO}_2 = \frac{22}{44} = 0.5$$

$$\text{volume CO}_2 = 24 \times 0.5 = 12 \text{ dm}^3$$

6 What volume of hydrogen gas is needed to react with 10 dm<sup>3</sup> of nitrogen to make ammonia, with the volume of all gases measured at the same temperature and pressure?



$$\text{volume H}_2 = 10 \times 3 = 30 \text{ dm}^3$$

7 5.6 g of iron (Fe) reacts with 24 g of bromine (Br<sub>2</sub>) to make a compound containing iron and bromine only. Calculate the moles of iron and bromine and use this to determine the balanced equation for the reaction.

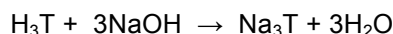
$$\text{moles Fe} = \frac{5.6}{56} = 0.1$$

$$\text{moles Br}_2 = \frac{24}{160} = 0.15$$

$$\text{ratio moles Fe : moles Br}_2 = 0.1 : 0.15 = 2 : 3$$



8 25.0 cm<sup>3</sup> of a solution of citric acid, which is represented by H<sub>3</sub>T in the equation, reacted with 26.4 cm<sup>3</sup> of 0.100 mol dm<sup>-3</sup> sodium hydroxide solution in a titration.



a) Calculate the concentration of the citric acid in mol/dm<sup>3</sup>. Give your answer to 3 significant figures.

$$\text{mol NaOH} = 0.100 \times \frac{26.4}{1000} = 0.00264 \text{ mol}$$

$$\text{mol H}_3\text{T} = \frac{1}{3} \times 0.00264 = 0.00088 \text{ mol}$$

$$\text{conc H}_3\text{T} = \frac{0.00088}{\frac{25.0}{1000}} = 0.0352 \text{ mol/dm}^3$$

c) Calculate the concentration of the citric acid in g/dm<sup>3</sup>. The relative formula mass of citric acid is 226. Give your answer to 3 significant figures.

$$\text{conc H}_3\text{T} = 0.0352 \times 226 = 7.96 \text{ g/dm}^3$$

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 <sup>3</sup> to g/dm <sup>3</sup>		
Can work out <i>M<sub>r</sub></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		