GCSE REVISION 13
Calculations 3

1 Give the formula of the following ionic substances.

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

b) calcium hydroxide **$Ca(OH)_2$**

c) aluminium nitrate **$Al(NO_3)_3$**

d) lithium carbonate **Li_2CO_3**

2 Calculate the relative formula mass of the following substances.

a) nitrogen, N_2 **2(14) = 28**

b) calcium nitrate, $Ca(NO_3)_2$ **40 + 2(14) + 6(16) = 164**

3 What mass of hydrogen reacts with 140 g of nitrogen to make ammonia? $N_2 + 3H_2 \rightarrow 2NH_3$

moles N_2 = $\frac{140}{28}$ = 5

moles H_2 = 3 x 5 = 15

mass H_2 = 15 x 2 = 30 g

4 Calcium hydroxide is made by reaction of calcium oxide with water: $CaO + H_2O \rightarrow Ca(OH)_2$

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

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

moles $Ca(OH)_2$ = 20

mass $Ca(OH)_2$ = 20 x 74 = 1480 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.

% yield = 100 x $\frac{1440}{1480}$ = 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: $TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$

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

6 What volume of oxygen gas is needed to react with 4 dm^3 of propane with complete combustion, with the volume of all gases measured at the same temperature and pressure? $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

5 x 4 = 20 dm^3

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

a) 2.5 moles of carbon dioxide, CO_2 **volume CO_2 = 24 x 2.5 = 60 dm^3**

b) 10 g of argon, Ar **moles Ar = $\frac{10}{40}$ = 0.25** **volume Ar = 24 x 0.25 = 6 dm^3**

8 5.1 g of the vanadium (a transition metal, symbol = V) reacts with 4.0 g of oxygen (O_2) to make an oxide of vanadium. Calculate the moles of vanadium and oxygen and use this to determine the balanced equation for the reaction.

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

moles O_2 = $\frac{4.0}{32}$ = 0.125

ratio moles V : moles O_2 = 0.1 : 0.125 = 4 : 5

$4V + 5O_2 \rightarrow 2V_2O_5$

9 25.0 cm^3 of a solution of sodium hydroxide was neutralised by 23.6 cm^3 of 0.400 mol dm^{-3} sulfuric acid in a titration.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

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

mol H_2SO_4 = 0.400 x $\frac{23.6}{1000}$ = 0.00944mol

mol NaOH = 2 x 0.00944 = 0.01888 mol

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

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

conc NaOH = 0.755 x 40 = 30.2 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 M_r			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		