GCSE REVISION 9
Calculations 2

1 Give the formula of the following ionic substances.

a) aluminium chloride **$AlCl_3$**

b) potassium sulfide **K_2S**

c) sodium sulfate **Na_2SO_4**

d) calcium nitrate **$Ca(NO_3)_2$**

e) magnesium hydroxide **$Mg(OH)_2$**

f) iron(II) oxide **FeO**

2 Calculate the relative formula mass of the following substances.

a) fluorine, F_2 **2(19) = 38**

b) iron(III) nitrate, $Fe(NO_3)_3$ **56 + 3(14) + 9(16) = 242**

3 Calcium oxide is made from the thermal decomposition of calcium carbonate: $CaCO_3 \rightarrow CaO + CO_2$

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

moles $CaCO_3$ = $\frac{500}{100}$ = 5

moles CaO = 5

mass CaO = 56 x 5 = 280 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.

% yield = 100 x $\frac{250}{280}$ = 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.

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

4 What mass of oxygen reacts with 270 g of aluminium? $4Al + 3O_2 \rightarrow 2Al_2O_3$

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

moles O_2 = $\frac{3}{4}$ x 10 = 7.5

mass O_2 = 32 x 7.5 = 240 g

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

a) 3 moles of oxygen, O_2

volume O_2 = 24 x 3 = 72 dm^3

b) 22 g of carbon dioxide, CO_2

moles CO_2 = $\frac{22}{44}$ = 0.5

volume CO_2 = 24 x 0.5 = 12 dm^3

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

$$N_2 + 3H_2 \rightarrow 2NH_3$$

volume H_2 = 10 x 3 = 30 dm^3

7 5.6 g of iron (Fe) reacts with 24 g of bromine (Br_2) 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.

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

moles Br_2 = $\frac{24}{160}$ = 0.15

ratio moles Fe : moles Br_2 = 0.1 : 0.15 = 2 : 3

$2Fe + 3Br_2 \rightarrow 2FeBr_3$

8 25.0 cm^3 of a solution of citric acid, which is represented by H_3T in the equation, reacted with 26.4 cm^3 of 0.100 mol dm^{-3} sodium hydroxide solution in a titration.

$$H_3T + 3NaOH \rightarrow Na_3T + 3H_2O$$

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

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

mol H_3T = $\frac{1}{3}$ x 0.00264 = 0.00088 mol

conc H_3T = $\frac{0.00088}{\frac{25.0}{1000}}$ = 0.0352 mol/dm^3

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

conc H_3T = 0.0352 x 226 = 7.96 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		