CALCULATE THE CONCENTRATION

4.6.1

Chemists use the concept of the mole to calculate the amounts of chemicals involved in a reaction.

(a) Define *mole*.

.....

[1]

(b) 3.0 g of magnesium was added to 12.0 g of ethanoic acid.

$Mg + 2CH_3COOH \rightarrow (CH_3COO)_2Mg + H_2$

The mass of one mole of Mg is 24 g.

The mass of one mole of CH_3COOH is 60 g.

(i) Which one, magnesium or ethanoic acid, is in excess? You must show your reasoning.

.....

[3]

(ii) How many moles of hydrogen were formed?

.....

[1]

(iii) Calculate the volume of hydrogen formed, measured at r.t.p.

.....

[2]

(c) In an experiment, 25.0 cm^3 of aqueous sodium hydroxide, 0.4 mol / dm^3, was neutralised by 20.0 cm^3 of aqueous oxalic acid, $H_2C_2O_4$.

$$2NaOH + H_2C_2O_4 \rightarrow Na_2C_2O_4 + 2H_2O$$

Calculate the concentration of the oxalic acid in mol / dm^3.

(i) Calculate the number of moles of NaOH in 25.0 cm^3 of 0.4 mol / dm^3 solution.

.....

[1]

(ii) Use your answer to **(i)** and the mole ratio in the equation to find out the number of moles of $H_2C_2O_4$ in 20 cm^3 of solution.

.....

[1]

(iii) Calculate the concentration, mol / dm^3, of the aqueous oxalic acid.

.....

[2]

(a) Avogadro's Number of particles
or formula mass in grams
or 6×10^{23} particles accept atoms, ions and molecules
or as many particles as there are carbon atoms in 12.00g of ^{12}Ca
ANY one **[1]**

(b) **(i)** moles of Mg = 3/24 = 0.125
moles of CH_3COOH = 12/60 = 0.200
magnesium is in excess

OR 3.0g of magnesium react with 15g of acid
only 12.0 g of acid present
magnesium is in excess **[3]**

(ii) **Mark conseq to (i) but NOT to any simple integer**
moles of H_2 = 0.1 **[1]**

(iii) **Mark conseq to (ii) but NOT to any simple integer**
Volume of hydrogen = 0.1 x 24
= 2.4 dm^3 **[2]**

(c) **(i)** moles of NaOH = 25/1000 x 0.4 = 0.01 **[1]**

(ii) **Mark conseq to (i) but NOT to any simple integer**
moles of acid = 0.01/2 = 0.005 **[1]**

(iii) **Mark conseq to (ii) max 10M**
concentration of acid = 0.005 x 1000/20 **[1]**
= 0.25 mol/dm^3 **[1]**

4.6.2

In the first experiment, the maximum volume of oxygen produced was 96 cm^3 measured at r.t.p. Calculate the concentration of the aqueous hydrogen peroxide in mol/dm^3.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

number of moles of O_2 formed = ... [1]

number of moles of H_2O_2 in 40 cm^3 of solution = ... [1]

concentration of the aqueous hydrogen peroxide in mol/dm^3 = ...

..... [1]

number of moles of O_2 formed = 0.096/24 = 0.004 (1)
number of moles of H_2O_2 in 40 cm^3 of solution = 0.004 × 2 = 0.008 (1)

concentration of the hydrogen peroxide in mol/dm^3 = 0.008/0.04 = 0.2 (1) [3]