Ex/A 0.2011gm sample of an organic compound was burned in a stream of oxygen , and CO_2 produced in a solution of barium hydroxide.

Calculate the percentage of carbon in the sample if 0.500gm at BaCo3 was formed .

$$Co_2 + Ba(OH)_2 \longrightarrow BaCo_3 + H_2o$$

Solution/

$$1 \text{ mol } BaCo_3 \equiv 197.0gm$$

No . mol $BaCo_3$ = 0.500 gm $BaCo_3$ × $\frac{1\ mol\ BaCo3}{197gm\ BaCo3}$ $=2.538\times10^{-3}$ mol $BaCo_3$

1 mol $BaCo_3$ ≡ 1 mol Co_2 = 2.538×10^{-3} mol

1 mol Co_2 ≡ 44.0gm

Mass Co_2 = 2.538×10^{-3} ~~mol Co_2~~ × $\frac{44.0gm}{\cancel{1\ mol\ CO2}}$

= 0.1116 gm Co_2

M Co_2% = $\frac{m\ CO2}{m\ comp}$ × 100

% = $\frac{0.1116}{0.2011}$ × 100 = 55.49 %

Ex/A 0.3516 gm sample of a commercial phosphate detergent was ignited at a red heat to destroy the organic matter . the residue was then taken up in hot HCl, which converted the P to H_3po_4. The phosphate was precipitated as $MgNH_4Po_4.6H_2o$ by addition of Mg^{+2} followed by aqueous NH_3 . after being filtered and washed. The precipitate was converted to $Mg_2p_2o_7$(222.57gm mol) by ignition at 1000 C^0 this residue weighed 0.2161gm.Calculate the percent P(30.974gm mol) in the sample.

Solution/

No . mol MP = 0.2161~~gm MP~~ × $\frac{1\ mol\ MP}{222.57\ \cancel{gm\ MP}}$ = 19.418×10^{-4} mol P

1 mol MP ≡ 2 mol P

No . mol P = 30.774 gm

Mass P = 19.418×10^{-4} ~~mol~~ × $\frac{30.974gm}{\cancel{mol}}$ = 0.06015 gm P

Percent P% = $\frac{0.06015}{0.3516}$ × 100 = 17.107 = 17.11%

Ex/A 0.7151 gm sample of impure $Al_2(Co_3)_3$ decomposed with HCl. The liberated Co_2 was collected on calcium oxide and found to weight 0.0621 gm the percentage of (Al) in the sample ?

Solution/

1 mol Co_2 ≈ 44.0 gm

No . mol Co_2 = 0.0621 ~~gm Co_2~~ × $\frac{1\ mol\ CO2}{44.0\ \cancel{gm\ CO2}}$ = 1.411×10^{-3} mol

1 mol $Al_2(Co_3)_3$ ≡ 3 mol(Co_2)

1 mol $Al_2(Co_3)_3$ ≡ 2 mol (Al)

No . mol Al = 1.411×10^{-3} ~~mol Co_2~~ × $\frac{2\ mol\ Al}{3\ \cancel{mol\ CO2}}$ =0.941×10^{-3} mol Al

Mass . Al = 0.041×10^{-3} ~~mol~~ × $\frac{234gm}{\cancel{1\ mol}}$ =0.22 gm Al

% Al = $\frac{0.22\ gm}{0.7151gm}$ × 100 = 30.76 %

Ex / the mercury in a 0.8142 gm sample was precipitated with an excess of paraper iodic acid H_2IO_6

$$5Hg^{+2} + 2H_5IO_6 \rightarrow Hg_5(IO_6)_2 + 10H^+$$

The precipitate was filtered free of precipitating agent , dried and weighed 0.4114 gm was recovered. Calculate the percentage of Hg_2Cl_2 in the sample.

Solution /

$$1 \text{ mol } Hg_5(IO_6)_2 \equiv 1451.0 \text{ gm}$$

No.mol $Hg_5(IO_6)_2$ = 0.4114gm $Hg_5(IO_6)_2$ x $\frac{1 \text{ mol Hg5(IO6)2}}{1451\ gm \text{ Hg5(IO6)2}}$

$= 2.84 \times 10^{-4}$ mol

2 mol $Hg_5(IO_6)_2$ ≡ 5 mol Hg_2Cl_2

No.mol Hg_2Cl_2 = 2.84×10^{-4} ~~mol $Hg_5(IO_6)_2$~~ x $\frac{5\ mol\text{Hg2Cl2}}{2\ \cancel{mol\text{Hg5(IO6)}}2}$

$= 7.10 \times 10^{-4}$ mol

1 mol Hg_2Cl_2 ≡ 473.0 gm

Mass of Hg_2Cl_2 = 7.10×10^{-4} ~~mol~~ x 473.0 gm / ~~mol~~ = 0.3358 gm

% Hg_2Cl_2 = $\frac{0.3358\ gm}{0.8142\ gm}$ x 100 = 41.24 %

Ex / treatment of a 0.2500 gm sample of impure potassium chloride with an excess of $AgNO_3$ resulted in the formation of 0.2191 gm of AgCl. Calculate the percentage of KCl in the sample.

Solution / $KCl + AgNO_3 \rightarrow AgCl + KNO_3$

1 mol KCl ≡ 1 mol AgCl

1mol AgCl ≡ 143.5 gm

No.mol AgCl = 0.2191 gm AgCl x 1 mol AgCl / 143.5 gm AgCl

$= 1.53 \times 10^{-3}$ mol AgCl

Stoichiometric factor = 1 mol KCl / 1mol AgCl

No. mol KCl = 1.53 x10^{-3} ~~mol AgCl~~ x $\frac{1 \text{ mol KCl}}{1 \cancel{mol\ AgCl}}$ =1.53 x10^{-3} mol KCl

1 mol KCl ≡ 74.5 gm KCl

Mass KCl = 1.53 x10^{-3} ~~mol KCl~~ x 74.5 gm / ~~mol KCl~~ = 0.114 gm KCl

% KCl = 0.114 gm / 0.2500 gm x 100 = 45.6 %

Ex/ A sample of impure magnetite , Fe_3o_4, weighing 1.542 gm is dissolved ; the iron is oxidized to $Fe^{+}$and precipitated as $Fe(OH)_3$. The precipitate is ignited to Fe_2O_3, giving a weighet of 1.485 gm .Calculate the percentage of Fe_3o_4 in the sample .

No.mol Fe_2O_3 = 1.485mol ~~gm Fe_2O_3~~ x $\frac{mol\text{Fe2O3}}{159.7\ \cancel{gm\ \text{Fe2O3}}}$

= 0.00930 mol Fe_2O_3

This is equivalent to 2 / 3 as many moles of Fe_3o_4 , since 2 moles Fe_3o_4 will yield 3 moles Fe_2O_3 when oxidized.

2 moles Fe_{34} ≡ 3 moles Fe_2O_3

No.molFe_3O_4= 0.00930 ~~moleFe_2O_3~~ x $\frac{2\ mole\text{Fe3O4}}{3\ \cancel{mole\text{Fe2O3}}}$ =0.00620 moles Fe_3o_4

Weight Fe_3O_4 in sample = 0.00620 mole x 231.55 gm / mole

= 1.437 gm Fe_3O_4

Percentage Fe_3O_4 = 1.437 gm / 1.542 gm x 100 = 93.1 %

<u>Calculations involving concentrations of solutions</u>

1- Physical methods :- the simplest ways of expressing the strength of a solution are in terms of the amount of solute present per unit amount of solvent or solution. Such methods are known as physical methods because they are based only on physical measurements of weight or volume and do not take into account the chemical reactions of the solute.

The more widely used physical methods are :

1- Grams solute per liter (or 1000ml) solution gm/L(solution) gm/1000ml(solution).
2- Grams solute per liter (or 1000ml) solvent. gm/L(solvent) gm/1000ml (solution).
3- Grams solute per unit weight of solution gm/gm (solution)
4- Grams solute per unit weight of solvent gm/gm(solvent)

1- Percentage methods.

Weight percent (w/w) = $\frac{mass\ solute}{mass\ solution} \times 100\%$

Volume percent (v/v) = $\frac{volume\ solute}{volume\ solution} \times 100\%$

Weight / volume percent (w/v) = $\frac{mass\ solute,g}{volume\ solution,ml} \times 100\%$

Ex/Express the concentration with weight percent of the solution weighting 200.0gm and contained in 25.0gm of sodium sulphate Na_2So_4.

Solution/

$$\%(w/w) = \frac{weight\ of\ solute}{weight\ of\ solution} \times 100$$

$$= \frac{25.0gm\ solute}{200.0gm\ solution} \times 100 = 12.5\%$$

Ex/Use the weight percent, calculate the concentration of the solution when 3gm $AgNo_3$ dissolve in 1L distilled water ?

Solution/1L H_2o → weight H_2o

$$Density = \frac{weight}{volume}$$

Weight (H_2o) = density × volume

$$= \frac{1gm}{cm3} \times 1L \times \frac{1000\ cm3}{L}$$

Weight = weight + weight

(solution) (solute) (solvent)

= 3gm + 1000gm = 1003gm

$$(w/w)\% = \frac{3gm}{1003gm} \times 100 = 0.299\% \rightarrow 0.3\%$$

Ex/Use the volume percent, calculate the concentration of the solution is prepared by addition 50.0ml methanol (CH_3OH) to 200.0ml water?

Solution/

Volume(solution) = 50.0ml + 200.0ml = 250.0ml

$$V/V\ \% = \frac{50\ ml}{250\ ml} \times 100 = 20.0\ \%$$