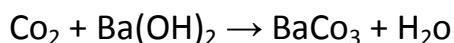


Ex/A 0.2011gm sample of an organic compound was burned in a stream of oxygen , and CO<sub>2</sub> produced in a solution of barium hydroxide.

Calculate the percentage of carbon in the sample if 0.500gm of BaCO<sub>3</sub> was formed .



Solution/

$$1 \text{ mol BaCO}_3 \equiv 197.0 \text{ gm}$$

$$\text{No. mol BaCO}_3 = 0.500 \text{ gm BaCO}_3 \times \frac{1 \text{ mol BaCO}_3}{197 \text{ gm BaCO}_3} = 2.538 \times 10^{-3}$$

mol BaCO<sub>3</sub>

$$1 \text{ mol BaCO}_3 \equiv 1 \text{ mol CO}_2 = 2.538 \times 10^{-3} \text{ mol}$$

$$1 \text{ mol CO}_2 \equiv 44.0 \text{ gm}$$

$$\text{Mass CO}_2 = 2.538 \times 10^{-3} \text{ mol CO}_2 \times \frac{44.0 \text{ gm}}{1 \text{ mol CO}_2}$$

$$= 0.1116 \text{ gm CO}_2$$

$$\text{M CO}_2\% = \frac{m \text{ CO}_2}{m \text{ comp}} \times 100$$

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

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<sub>3</sub>PO<sub>4</sub>. The phosphate was precipitated as MgNH<sub>4</sub>PO<sub>4</sub>·6H<sub>2</sub>O by addition of Mg<sup>+2</sup> followed by aqueous NH<sub>3</sub> . after being filtered and washed. The precipitate was converted to Mg<sub>2</sub>P<sub>2</sub>O<sub>7</sub>(222.57gm mol) by ignition at 1000 C<sup>0</sup> this residue weighed 0.2161gm. Calculate the percent P(30.974gm mol) in the sample.

Solution/

$$\text{No. mol MP} = 0.2161 \text{ gm MP} \times \frac{1 \text{ mol MP}}{222.57 \text{ gm MP}} = 9.71 \times 10^{-4} \text{ mol P}$$

$$1 \text{ mol MP} \equiv 2 \text{ mol P}$$

$$\text{No. mol P} = 1.94 \times 10^{-3} \text{ mol}$$

$$\text{Mass P} = 1.94 \times 10^{-3} \text{ mol} \times \frac{30.974 \text{ gm}}{1 \text{ mol}} = 0.0601 \text{ gm P}$$

$$\text{Percent P\%} = \frac{0.0601}{0.3516} \times 100 = 17.107 = 17.11\%$$

Ex/A 0.7151 gm sample of impure  $\text{Al}_2(\text{CO}_3)_3$  decomposed with HCl. The liberated  $\text{CO}_2$  was collected on calcium oxide and found to weight 0.0621 gm the percentage of (Al) in the sample ?

Solution/

$$1 \text{ mol CO}_2 \approx 44.0 \text{ gm}$$

$$\text{No. mol CO}_2 = 0.0621 \text{ gm CO}_2 \times \frac{1 \text{ mol CO}_2}{44.0 \text{ gm CO}_2} = 1.41 \times 10^{-3} \text{ mol}$$

$$1 \text{ mol Al}_2(\text{CO}_3)_3 \equiv 3 \text{ mol (CO}_2)$$

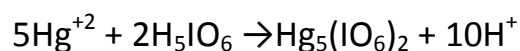
$$1 \text{ mol Al}_2(\text{CO}_3)_3 \equiv 2 \text{ mol (Al)}$$

$$\text{No. mol Al} = 1.41 \times 10^{-3} \text{ mol CO}_2 \times \frac{2 \text{ mol Al}}{3 \text{ mol CO}_2} = 0.94 \times 10^{-3} \text{ mol Al}$$

$$\text{Mass. Al} = 0.94 \times 10^{-3} \text{ mol} \times \frac{27 \text{ gm}}{1 \text{ mol}} = 0.025 \text{ gm Al}$$

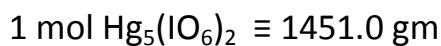
$$\% \text{ Al} = \frac{0.025 \text{ gm}}{0.7151 \text{ gm}} \times 100 = 3.5\%$$

Ex / the mercury in a 0.8142 gm sample was precipitated with an excess of paraper iodic acid  $\text{H}_5\text{IO}_6$



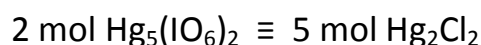
The precipitate was filtered free of precipitating agent , dried and weighed 0.4114 gm was recovered. Calculate the percentage of  $\text{Hg}_2\text{Cl}_2$  in the sample.

Solution /



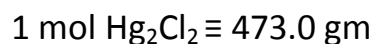
$$\text{No. mol Hg}_5(\text{IO}_6)_2 = 0.4114 \text{ gm Hg}_5(\text{IO}_6)_2 \times \frac{1 \text{ mol Hg}_5(\text{IO}_6)_2}{1451 \text{ gm Hg}_5(\text{IO}_6)_2}$$

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



$$\text{No. mol Hg}_2\text{Cl}_2 = 2.84 \times 10^{-4} \text{ mol Hg}_5(\text{IO}_6)_2 \times \frac{5 \text{ mol Hg}_2\text{Cl}_2}{2 \text{ mol Hg}_5(\text{IO}_6)_2}$$

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

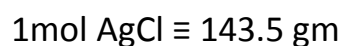
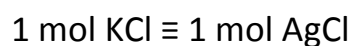
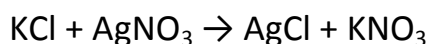


$$\text{Mass of Hg}_2\text{Cl}_2 = 7.10 \times 10^{-4} \text{ mol} \times 473.0 \text{ gm / mol} = 0.3358 \text{ gm}$$

$$\% \text{ Hg}_2\text{Cl}_2 = \frac{0.3358 \text{ gm}}{0.8142 \text{ gm}} \times 100 = 41.24 \%$$

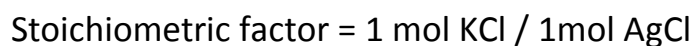
Ex / treatment of a 0.2500 gm sample of impure potassium chloride with an excess of  $\text{AgNO}_3$  resulted in the formation of 0.2191 gm of  $\text{AgCl}$ . Calculate the percentage of  $\text{KCl}$  in the sample.

Solution /



$$\text{No. mol AgCl} = 0.2191 \text{ gm AgCl} \times 1 \text{ mol AgCl} / 143.5 \text{ gm AgCl}$$

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



$$\text{No. mol KCl} = 1.53 \times 10^{-3} \text{ mol AgCl} \times \frac{1 \text{ mol KCl}}{1 \text{ mol AgCl}} = 1.53 \times 10^{-3} \text{ mol KCl}$$

$$1 \text{ mol KCl} \equiv 74.5 \text{ gm KCl}$$

$$\text{Mass KCl} = 1.53 \times 10^{-3} \text{ mol KCl} \times 74.5 \text{ gm / mol KCl} = 0.114 \text{ gm KCl}$$

$$\% \text{ KCl} = 0.114 \text{ gm} / 0.2500 \text{ gm} \times 100 = 45.6 \%$$

Ex/ A sample of impure magnetite ,  $\text{Fe}_3\text{O}_4$ , weighing 1.542 gm is dissolved ; the iron is oxidized to  $\text{Fe}^{+}$  and precipitated as  $\text{Fe}(\text{OH})_3$  . The precipitate is ignited to  $\text{Fe}_2\text{O}_3$ , giving a weight of 1.485 gm .Calculate the percentage of  $\text{Fe}_3\text{O}_4$  in the sample .

$$\text{No. mol Fe}_2\text{O}_3 = 1.485 \text{ gm Fe}_2\text{O}_3 \times \frac{\text{mol Fe}_2\text{O}_3}{159.7 \text{ gm Fe}_2\text{O}_3}$$

$$= 0.00930 \text{ mol Fe}_2\text{O}_3$$

This is equivalent to 2 / 3 as many moles of  $\text{Fe}_3\text{O}_4$  , since 2 moles  $\text{Fe}_3\text{O}_4$  will yield 3 moles  $\text{Fe}_2\text{O}_3$  when oxidized.

$$2 \text{ moles Fe}_3\text{O}_4 \equiv 3 \text{ moles Fe}_2\text{O}_3$$

$$\text{No. mol Fe}_3\text{O}_4 = 0.00930 \text{ mol Fe}_2\text{O}_3 \times \frac{2 \text{ mole Fe}_3\text{O}_4}{3 \text{ mole Fe}_2\text{O}_3} = 0.00620 \text{ moles Fe}_3\text{O}_4$$

$$\text{Weight Fe}_3\text{O}_4 \text{ in sample} = 0.00620 \text{ mole} \times 231.55 \text{ gm / mole}$$

$$= 1.437 \text{ gm Fe}_3\text{O}_4$$

$$\text{Percentage Fe}_3\text{O}_4 = 1.437 \text{ gm} / 1.542 \text{ gm} \times 100 = 93.1 \%$$

### **Calculations involving concentrations of solutions**

- 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.

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

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

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

Ex/Express the concentration with weight percent of the solution  
weighting 25.0gm and contained in 200.0gm of sodium sulphate  $\text{Na}_2\text{SO}_4$ .  
Solution/

$$\begin{aligned} \%(w/w) &= \frac{\text{weight of solute}}{\text{weight of solution}} \times 100 \\ &= \frac{25.0\text{gm solute}}{200.0\text{gm solution}} \times 100 = 12.5\% \end{aligned}$$

Ex/Use the weight percent, calculate the concentration of the solution  
when 3gm  $\text{AgNO}_3$  dissolve in 1L distilled water ?

Solution/1L  $\text{H}_2\text{O} \rightarrow$  weight  $\text{H}_2\text{O}$

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

$$\text{Weight (H}_2\text{O)} = \text{density} \times \text{volume}$$

$$= \frac{1\text{gm}}{\text{cm}^3} \times 1\text{L} \times \frac{1000\text{ cm}^3}{\text{L}}$$

$$\text{Weight} = \text{weight} + \text{weight}$$

$$(\text{solution}) \quad (\text{solute}) \quad (\text{solvent})$$

$$= 3\text{gm} + 1000\text{gm} = 1003\text{gm}$$

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

Ex/Use the volume percent, calculate the concentration of the solution is prepared by addition 50.0ml methanol (CH<sub>3</sub>OH) to 200.0ml water?

Solution/

$$\text{Volume(solution)} = 50.0\text{ml} + 200.0\text{ml} = 250.0\text{ml}$$

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