

What is the Equivalent weight of  $Al_2(SO_4)_3$ .

$$\begin{array}{rcl}
 Al & \text{---} & 27 \times 2 = 54 \\
 S & \text{---} & 32 \times 3 = 96 \\
 O & \text{---} & 16 \times 12 = 192 \\
 \hline
 & & 342
 \end{array}$$

Molecular weight of  $Al_2(SO_4)_3 = 342$

Valence of  $Al_2(SO_4)_3 = 6$

$$\text{Equivalent weight of } Al_2(SO_4)_3 = \frac{342}{6} = 57$$

$$\frac{342}{6} = 57$$

2.7) How many Equivalents are there in 500 g  $KMnO_4$ ?

$$1 \text{ g Equivalent of } KMnO_4 = \frac{\text{molecular weight}}{\text{valency}} = \frac{158}{5} = 31.6 \text{ g of } KMnO_4$$

Molecular weight of  $KMnO_4 = 158.02$

K - 39.09

Mn - 54.93

O<sub>4</sub> - 64.00

$$= 158.02$$

$$\begin{array}{r}
 44.5 \\
 52.6 \times 15 \\
 \hline
 789.0 \\
 45.2 \times 15 \\
 \hline
 678
 \end{array}$$

$$\begin{array}{r}
 31.6 \times 16 \\
 \hline
 505.6
 \end{array}$$

$$\begin{array}{r}
 79 \times 15 \\
 \hline
 1185 \\
 5) 158 (31.6 \\
 \underline{15} \\
 8 \\
 \underline{5} \\
 30 \\
 \underline{30} \\
 0
 \end{array}$$

$$\begin{array}{r}
 105 \\
 135 \\
 \hline
 118 \\
 13 \\
 105 \\
 \hline
 118
 \end{array}$$

31.6 g of  $KMnO_4$   
500 g of  $KMnO_4$

$$\begin{array}{r}
 \text{---} \quad 1 \text{ g Equivalent of } KMnO_4 \\
 \text{---} \quad ? \\
 \hline
 500 \times 1 \\
 \hline
 31.6
 \end{array}$$

$$\begin{array}{r}
 32) 500 (15.62 \\
 \underline{32} \\
 180 \\
 \underline{160} \\
 200 \\
 \underline{192} \\
 8
 \end{array}$$

15.62 g Equivalents

8.8 The analysis of magnesite ore are obtained from Chalk Hill area, Salem district, yields 81%  $MgCO_3$ , 14%  $SiO_2$  and 5%  $H_2O$  (by weight), convert the analysis into mole %.

Component	wt. %
$MgCO_3$	81
$SiO_2$	14
$H_2O$	5

28 14 - 60 14  
 45 14 -

Total.

Batch: 100 Kg ore.

Component	wt, kg.	Mol. wt.	Kmol.	Mol fraction	mole %
$MgCO_3$	81	84.305	0.96	0.657	65.7
$SiO_2$	14	60.08	0.23	0.157	15.7
$H_2O$	5	18	0.27	0.184	18.4
			1.46		100.00%

Mg - 24.305  
 C - 12.000  
 O<sub>3</sub> - 48.000  
 84.305

SiO<sub>2</sub> - 28.08  
 O<sub>2</sub> - 32.00  
 60.08

0.657  
 0.157  
 0.184  
 1.018

Kmol =  $\frac{wt}{mol. wt.}$

84) 810 (0.96  
 756  
 540  
 504  
 360

60) 140 (0.23  
 120

18) 50 (0.27  
 36  
 140  
 126

146) 960 (0.657  
 876  
 840  
 730  
 1100

146) 230 (0.157  
 146  
 840  
 730  
 110

146) 270 (0.184  
 146  
 1240  
 1168  
 72  
 584

2.9 The analysis of a sample of glass yields 7.8%  $\text{Na}_2\text{O}$ , 7.0%  $\text{MgO}$ , 9.7%  $\text{ZnO}$ , 2.0%  $\text{Al}_2\text{O}_3$ , 8.5%  $\text{B}_2\text{O}_3$  and 65.1%  $\text{SiO}_2$  (by weight). Convert this composition into mole %

Components	Wt-%	Wt, kg	Mol. wt.	Kmol.	mole-%
$\text{Na}_2\text{O}$	7.8	7.8	62	$\frac{7.8}{62} = 0.1258$	12.58 7.84 ✓
$\text{MgO}$	7.0	7.0	40.3	$\frac{7.0}{40.3} = 0.1736$	17.36 10.82 ✓
$\text{ZnO}$	9.7	9.7	81.39	$\frac{9.7}{81.39} = 0.11917$	11.917 7.43 ✓
$\text{Al}_2\text{O}_3$	2.0	2.0	102.00	$\frac{2}{102} = 0.0196$	1.96 1.22 ✓
$\text{B}_2\text{O}_3$	8.5	8.5	101.60	$\frac{8.5}{101.6} = 0.0836$	8.36 5.21 ✓
$\text{SiO}_2$	65.0	65.0	60.08	$\frac{65}{60.08} = 1.0818$	67.46 ✓
				1.60357	100.00
	100.0				

$$\begin{array}{r} \text{Na}_2 - 46 \\ \text{O} - 16 \\ \hline 62 \end{array}$$

$$\begin{array}{r} \text{Zn} - 65.39 \\ \text{O} - 16.00 \\ \hline 81.39 \end{array}$$

$$\begin{array}{r} \text{Al}_2 - 54 \\ \text{O}_3 - 48 \\ \hline 102 \end{array} \quad \frac{27}{27} = \frac{54}{54}$$

$$\begin{array}{r} \text{Mg} - 24.305 \\ \text{O} - 16.000 \\ \hline 40.305 \end{array}$$

$$\begin{array}{r} \text{B}_2 - 21.6 \\ \text{O}_3 - 80.0 \\ \hline 101.6 \end{array}$$

$$\begin{array}{r} \text{Si} - 28.08 \\ \text{O}_2 - 32.00 \\ \hline 60.08 \end{array}$$

$$\text{Kmol} = \frac{\text{wt}}{\text{mol. wt.}}$$

$$\begin{array}{r} 620 \overline{) 780} \quad (0.1258) \\ \underline{620} \\ 1600 \\ \underline{1240} \\ 03600 \\ \underline{3100} \\ 05000 \\ \underline{4960} \\ 0040 \end{array}$$

$$\begin{array}{r} 403 \overline{) 700} \quad (0.1736) \\ \underline{403} \\ 2970 \\ \underline{2821} \\ 01490 \\ \underline{1209} \\ 02810 \\ \underline{2418} \\ 0392 \end{array}$$

$$\begin{array}{r} 814 \overline{) 970} \quad (0.111) \\ \underline{814} \\ 1560 \\ \underline{814} \\ 7460 \\ \underline{7324} \\ 01360 \\ \underline{814} \\ 46 \end{array}$$

Q.10

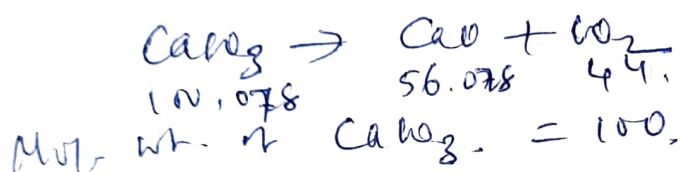
A sample of seawater contains 35000 ppm solids. Express the concentration of the solids as the weight percentage.

$$\frac{35000}{10,00000} \times 100$$

$$= 3.5 \%$$

Q.11

A sample of millidite limestone, obtained from Porbandar, Gujarat, is found to contain 54.5% CaO (by wt). If this CaO is present as  $\text{CaCO}_3$  in the limestone find the content of  $\text{CaCO}_3$  in the limestone.



$$\begin{array}{r} 40.078 \\ 12.000 \\ 48.000 \\ \hline 100.078 \end{array}$$

Mol. wt. of CaO

$$\begin{array}{l} \text{Mol. wt. of CaO} = 56.078 \\ \text{Mol. wt. of CO}_2 = 44.00 \end{array}$$

$$\begin{array}{r} \text{CO}_2 \\ 12.00 \\ 32.00 \\ \hline 44.00 \end{array}$$

$$\begin{array}{r} 40.078 \\ 16.000 \\ \hline 56.078 \end{array}$$

Basis: 100 kg  $\text{CaCO}_3$  limestone

CaO content of limestone = 54.5 kg

$$56.078 \text{ kg CaO} \quad \text{—————}$$

$$54.5 \text{ kg CaO} \quad \text{—————}$$

$$100.078 \text{ kg CaCO}_3$$

2

$$\frac{54.5 \times 100.078}{56.078} = 97.26\%$$

Q.12

Calculate the available nitrogen in the following

(a) Commercial ammonium Sulphate (96% pure)



(b) pure sodium nitrate (100%)



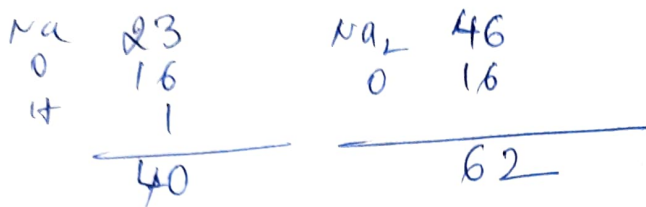


Q.13

A sample of caustic soda flakes contain 74.6 %  $\text{Na}_2\text{O}$  (by wt), Find the purity of the flakes



Basis: 100 kg Caustic Soda flakes.



100 kg flakes contain 74.6 kg  $\text{Na}_2\text{O}$ .

62 kg  $\text{Na}_2\text{O}$  ————— 80 kg NaOH

74.6 kg  $\text{Na}_2\text{O}$  ————— ?  $\frac{74.6 \times 80}{62}$

96.25 kg NaOH.

Q.14

Nitric acid and water forms a maximum boiling azeotrope containing 62.2 mole-% water (boiling point temperature = 403.6 K (130.6°C)). Find the composition of the azeotrope by weight.

Basis: 100 kmol azeotropic mixture

Contains 62.2 kmol water

$\begin{array}{r} 100.0 \\ 62.2 \\ \hline 37.8 \end{array}$

$$\text{kmol} = \frac{\text{wt}}{\text{molar wt}}$$

$$\text{wt of water} = 62.2 \times 18$$

$$= 1119.6$$

$$37.8 \text{ kmol HNO}_3$$

$$\text{wt of HNO}_3 = 37.8 \times 63$$

$$= 2381.4$$

$$\text{Total wt} = 3501$$

$$31.97 \% \text{ water by wt.}$$

$$(100 - 31.97) = 68.03 \% \text{ HNO}_3 \text{ by wt.}$$

$\begin{array}{r} 3 \\ 198 \\ \hline 1111 \\ 14 \\ 48 \\ \hline 63 \end{array}$