

Stoichiometry

→ Concentration terms

$$\rightarrow M (\text{molarity}) = \frac{\text{no. of moles (n)} \times 1000}{V (\text{in ml})} = \frac{(\rho \times V) \times d \times 10}{\text{GMW of solute}}$$

d = density

$$M \propto \frac{1}{\text{temp}}$$

$$\rightarrow m (\text{molality}) = \frac{\text{no. of moles of solute}}{\text{mass of solvent (in kg)}}$$

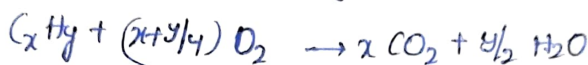
$$m = \frac{1000 \times M}{1000 \times d - MM'}$$

$M' = \text{molecular weight of solute}$

$$M_{H_2O_2} = \frac{V.S \text{ of } H_2O_2}{11.2}$$

$$\rightarrow N (\text{Normality}) = \frac{\text{no. of equivalents of solute}}{\text{Volume (in L)}} \quad \text{Eqwt} = \frac{\text{GMW}}{n\text{-factor}}$$

$$\% \text{ purity} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$



$$n = \frac{wt}{GMW} = \frac{wt}{GAW} \quad N_A = 6.023 \times 10^{23} \quad n = \frac{\text{vol of substance (at STP)}}{22.4 \text{ L (at STP)}}$$

$$\rightarrow \text{no. of molecules} = \text{no. of moles} \times N_A$$

$$\rightarrow \text{no. of atoms} = \text{no. of moles} \times \text{atomicity} \times N_A$$

$$\% C = \frac{12}{44} \times \frac{\text{wt of } CO_2}{\text{wt of organic compound}} \times 100$$

$$\rightarrow \text{Eq. wt of organic compound} \Rightarrow \frac{W_{\text{comp}}}{E_{\text{comp}}} = \frac{W_a}{8}$$

$$\rightarrow \text{strength (g/L)} = M \times \text{molecular weight of compound}$$

$$\rightarrow M = 0.1 \text{ deci molar}$$

Volumetric analysis:

$$\rightarrow n = \frac{W}{GMW} = M \times V (\text{L}) = \frac{M \times V (\text{mL})}{1000}$$

$$n_{\text{eq}} = \frac{W}{\text{Eq. Wt}} = N \times V (\text{L}) = Z \times M \times V (\text{L}) = Z \times n$$

$$\rightarrow N_1 V_1 + N_2 V_2 + N_3 V_3 + \dots = N \times V (\text{resulting})$$

$$\rightarrow n_{\text{eq}} (A) = n_{\text{eq}} (A) - n_{\text{eq}} (B)$$

$$n_{\text{eq}} (B) = n_{\text{eq}} (B) - n_{\text{eq}} (A)$$

acid(A) > base(B)

base(B) > acid(A)

Milliequivalent law

$$N_1 V_1 = N_2 V_2 \quad \text{for any reaction}$$

$$M_1 V_1 = M_2 V_2$$

⇒ Titrations — procedure of determining the conc. of soln. by carefully measured volume to react with known amount of substance — known amount of conc.

Titreant: Reagent which is added from a buret to react.

Non redox reactions: Equivalent law = $n_{eq_1} = n_{eq_2}$

→ Acid-base titrations: millieq of acid = millieq of base.

→ double indicator acid-base titration:



To know end point we use indicators

phenolphthalein pH range 8.3 - 10

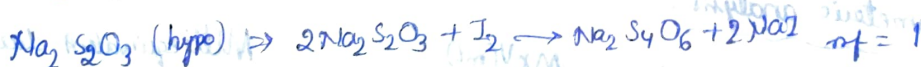
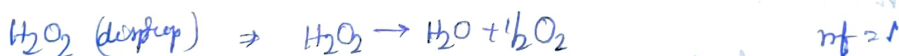
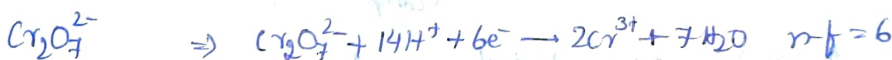
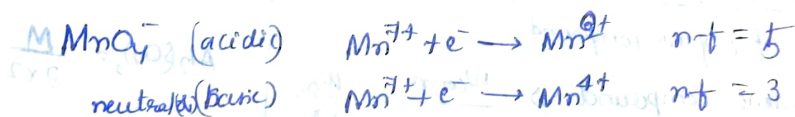
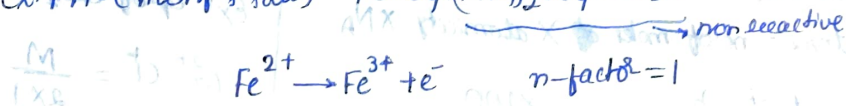
methyl orange 3.1 - 4.4

→ Precipitation titration: meq of NaCl = meq of $AgNO_3$ = meq of AgCl

Redox reactions:

meq of oxidizing agent used = meq of reducing agent reacted

Ex: FAS (Mohr's salt) $FeSO_4 \cdot (NH_4)_2 SO_4 \cdot 6H_2O$



⇒ Volume strength of H_2O_2

$$i) \quad 10 \text{ Vol. of } H_2O_2 = 0.893 M = 1.786 N = 3.036\% \text{ (w/v)} = 30.36 \text{ (g/l)} \quad 10 \text{ lit of } H_2O_2 \Rightarrow 11.0 \text{ of } H_2O_2 \Rightarrow \text{gas at STP per lit}$$

$$ii) \quad V_{O_2} = Vol. \times \text{Volume of } H_2O_2 \text{ soln}$$

$$iii) \quad V.S = 5.6 \times N = 11.2 \times M$$

iv) 30% of (w/v) of H_2O_2 is called perhydrol.

$$\left(\% \text{ strength of } H_2O_2 = \frac{17}{56} \times \text{Volume strength} \right)$$

v) V.S of perhydrol = 100 ml

vi) 112 vol of $H_2O_2 = 1M \Rightarrow 2N$

$$= 3.4\% (w/v)$$

vii) Eq. wt of $H_2O_2 = 17$

V.S	% (w/v)	M	N
5.6	1.7	0.5	1
11.2	3.4	1	2
22.4	6.8	2	4
10	3	0.893	1.786

→ Degree of hardness $\Rightarrow \frac{\text{wt of } CaCO_3(g)}{\text{wt of } H_2O(g)} \times 10^6 \text{ ppm}$

$$= \frac{\text{wt of salt}}{\text{mwt of salt}} \times \frac{10^6}{\text{wt of } H_2O} \text{ ppm}$$

162(g) of $Ca(HCO_3)_2$

146(g) of $Mg(HCO_3)_2$

111(g) of $CaCl_2$

95(g) of $MgCl_2$

136(g) of $CaSO_4$

120(g) of $MgSO_4$

$\} = 100g \text{ of } CaCO_3$

Types Titrations

- If $KMnO_4$ is used in titration → permanganometry
- If $K_2Cr_2O_7$ is used → dichromometry
- If I_2 is involved → iodometry

a) Calculation of no. of $Fe_{0.94}O$

$$(2 \times 0.94) + (-2 \times 1) = 0 \Rightarrow x = \frac{2}{0.94} = \frac{200}{94}, \text{ If } Fe_{0.94}O \xrightarrow{\Delta} Fe_2O_3$$

$$\text{then } n\text{-factor} = \left(3 - \frac{200}{94}\right) \times 0.94$$

$$n_f = 0.76$$

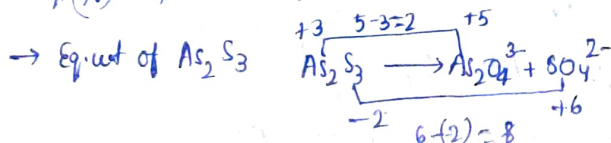
$$\text{ppm} = \frac{\text{mass of solute} \times 10^6}{\text{mass of soln.}}$$

$$\text{ppb} = \frac{\text{mass of solute} \times 10^3}{\text{mass of soln.}}$$

→ % (w/w) \Rightarrow 10% of glucose soln \Rightarrow 10g of glucose in 100g of soln.

% (w/v) \Rightarrow 25% of glucose soln \Rightarrow 25g of glucose in 100 ml of soln.

% (v/v) \Rightarrow 20% of ethanol soln \Rightarrow 20ml of ethanol in 100ml of soln.



n-factor

$$\text{of } As = 2 \times 2 = 4$$

$$\text{of } S = 8 \times 3 = 24$$

$$\text{of } As_2S_3 = 24 + 4 = 28$$

$$\text{Eq. Mol. wt.} = M/28$$