Kinetic Theory of Gases

Critical constants :-

For one mole of Vander wall's gas the equation of state is

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT \quad \text{- - - - - (1)} \quad \text{[V= Molar volume]}$$

$$PV - Pb + \frac{a}{V} - \frac{ab}{V^2} = RT$$

$$PV^3 - PV^2 b + aV - ab = RTV^2$$

$$V^3 - V^2 b + \frac{aV}{P} - \frac{ab}{P} = \frac{RTV^2}{P}$$

$$V^3 - \left(b + \frac{RT}{P}\right) V^2 - \frac{a}{p} v - \frac{ab}{p} = 0 \text{- - - - - (2)}$$

Follow Class……………………..

On increasing the temperature 3 roots come closer an ultimately they become identical at critical temperature under this condition V= V_c

$$(V - V_c) = 0 \text{ - - - - - } (3)$$

$$b + \frac{RT_c}{P_c} = 3V_c$$

$$\frac{a}{P_c} = 3V_c^2$$

$$\frac{ab}{P_c} = V_c^3$$

$$\mathbf{P_c = \frac{a}{27b^2}}$$

$$\mathbf{V_c = 3b}$$

$$\mathbf{T_c = \frac{8a}{27Rb}}$$

Follow class…………

Ionic equilibria

Buffer solution:

These are solutions which resist changes in their p^H values when small amount of the acid or bases are added to them.

$CH_3COOH + CH_3COONa \rightarrow$ Acidic buffer

$NH_4OH + NH_4Cl \rightarrow$ alkaline buffer

P^H of Buffer:

Consider a buffer containing a weak acid and its salt A^- ionization of weak acid may be represented as-

$HA + H_2O \leftrightarrow H_3O^+ + A^-$

$K_a = \frac{[H_3O^+][A^-]}{[HA]}$

$[H_3O^+] = K_a \frac{[HA]}{[A^-]}$

Initial concentration of acid C_a and salt C_s. The concentration of unionized acid is $C_a - H_3O^+$. The solution is electrically neutral hence $[A^-] = C_s + H_3O^+$.

$[H_3O^+] = K_a \frac{[C_a - H_3O^+]}{[C_s + H_3O^+]}$

$$[H_3O^+] = K_a \frac{C_a}{C_s}$$

$pH = pK_a + \log \frac{[Salt]}{[Acid]}$

This is known as the Henderson equation.

Similarly, for a mixture of a weak base and its salt

$OH^- = K_b \frac{[Base]}{[Salt]}$

$pOH = pK_b + \log \frac{[Salt]}{[Base]}$

where K_b is the ionization constant of the base

Follow class……………….

Electrolytic Conductance

Equivalent conductance and Molar conductance:

Equivalent conductance:

This two terms are important for conductance of solution. Equivalent conductance of an electrolyte is defined as the conductance of volume of solution containing 1gm equivalent of the electrolyte placed between two parallel electrode unit distances apart.

Conductance of all ions produced by 1 gm equivalent of electrolyte in given volume of solution called as equivalent conductance.

Conductance of $1cm^3$ solution = k

Conductance of V cm^3 solution = kV

Volume of solution containing N gm equiv = 1000mL

Volume of solution containing 1 gm equiv = $\frac{1000}{N}$ mL

$\Lambda = k\times \frac{1000}{N}$

Follow class…………..