Ionic Equilibrium - P

① Arrhenius – Acid : Donate H^+ ion in aq medium
– Base : Donate OH^- ion in aq medium

② Bronsted – Acid : H^+ donar is acid
– Base : H^+ acceptor is base

③ Lewis – Acid : e^- pair acceptor
– Base : e^- pair donar

- CB is formed by lousing H^+
- CA is formed by gaining H^+

Substance → Electrolyte ($\alpha = 0$) ; Non-electrolyte → Strong ($\alpha = 1$), Weak ($\alpha < 1$)

$\boxed{\text{Ostwald dilution law: } \alpha \propto \frac{1}{\sqrt{C}} \propto \sqrt{V} \propto \text{Diluti}}$

Common ion effect $= \alpha \downarrow$

Odd ion effect $= \alpha \uparrow$

- $pH = -\log[H^+]$
- $pOH = -\log[OH^-]$
- $K_w = K_{[H_2O]} = [H^+][OH^-]$ (10^{-14})
- $14 = pH + pOH$ (pK_w)

- conc of $H_2O = 55.55$
- At STP $[H^+] = [OH^-] = 10^{-7}$
- Ionisation constant of H_2O

$$K = \frac{[H^+][OH^-]}{[H_2O]} = 1.8 \times 10^{-16}$$

- Degree of dissociation of H_2O

$K_w = [OH^-][H^+]$

$10^{-14} = C^2\alpha^2 \Rightarrow \alpha = 1.8 \times 10^{-9}$

$\% \alpha = 1.8 \times 10^{-7}$

$\log 1 = 0$
$\log 2 = 0.3$
$\log 3 = 0.48$
$\log 4 = 0.60$
$\log 5 = 0.70$
$\log 6 = 0.80$
$\log 7 = 0.85$
$\log 8 = 0.90$
$\log 9 = 0.95$
$\log 10 = 1$

For water
$K_a / K_b = 1.8 \times 10^{-16}$
$pK_a / pK_b = 15.74$
$pK_a / pK_b = -1.74$

- For very dilute Acid/Base sol^n
  $C \le 10^{-7}$ $(10^{-7}, 10^{-8}, 10^{-9})$
  pH acid $\approx 6.7 - 6.99$
  pH base $\approx 7.01 - 7.3$

pH calculations

① Strong Acid

$[H^+] = [S_A]$ ← Normality

$pH = -\log[H^+]$

② Strong Base

$[OH^-] = [S_B]$ ← Normality

$pOH = -\log[OH^-]$

③ Mixture of 2 S_A or 2 S_B

$$N_R = \frac{N_1V_1 + N_2V_2}{V_{Total}}$$

if S_A then $N_R = [H^+]$
if S_B then $N_R = [OH^-]$
then $pH = -\log[H^+]$

④ Mixing S_A and S_B

$$N_R = \frac{(N_1V_1) - (N_2V_2)}{V_{Total}}$$

if $(NV)_{acid} > (NV)_{base}$ then $N_R = [H^+]$
if $(NV)_{base} > (NV)_{acid}$ then $N_R = [OH^-]$
if $(NV)_{acid} = (NV)_{base}$ then $pH = 7$

⑤ Weak monoprotic acid ~~/base~~

- $K_a = C\alpha^2$
- $[H^+] = C\alpha = \sqrt{K_aC}$

$pH = \frac{1}{2}pK_a - \frac{1}{2}\log C$

⑥ Weak monoprotic base

- $K_b = C\alpha^2$
- $[OH^-] = C\alpha = \sqrt{K_bC}$

$pOH = \frac{1}{2}pK_b - \frac{1}{2}\log C$

⑦ Weak diprotic acid

- Overall $K_a = K_{a1} \times K_{a2}$
- $[H^+] = C\alpha = \sqrt{K_aC}$

$pH = \frac{1}{2}pK_{a1} - \frac{1}{2}\log C$

- $[A^{2-}] = K_{a2}$

⑧ Weak triprotic acid

- Overall $K_a = K_{a1} \times K_{a2} \times K_{a3}$
  $K_{a1} \gg K_{a2} \gg K_{a3}$

$$\frac{\text{Strength of } HA_1}{\text{Strength of } HA_2} = \frac{[H^+]_1}{[H^+]_2} = \frac{C_1\alpha_1}{C_2\alpha_2} = \frac{\sqrt{K_{a1}C_1}}{\sqrt{K_{a2}C_2}}$$