- Relation between ionisation constant (K_i) and degree of ionisation (α):

$$K_i = \frac{\alpha^2}{(1-\alpha)V} = \frac{\alpha^2 C}{(1-\alpha)} = \text{(Ostwald's dilution law)}$$

If is applicable to weak electrolystes for which $\alpha << 1$ then

$$\alpha = \sqrt{K_i V} = \sqrt{\frac{K_i}{C}} \text{ or } V\uparrow C\downarrow \alpha\uparrow$$

Common ion effect :

- By addition of X mole/L of a common ion, to a weak acid (or weak base) α becomes equal to

$$\frac{K_a}{X} = \left(\text{or } \frac{K_b}{X}\right) \text{[where } \alpha = \text{degree of dissociation]}$$

- i. If solubility product > ions product then the solution unsaturated and more of the substance can be dissolved in it.

  ii. If ionic product > solubility product the solution is super saturated (principle of precipitation).

- **Salt of weak acid and strong base :**

  $pH = 0.5\ (pK_w + pK_a + \log c)$

  $$h = \sqrt{\frac{K_h}{c}}\ ;\ K_h = \frac{K_w}{K_a} \quad \text{(h = degree of hydrolysis)}$$

  Salt of weak base and strong acid:

  $pH = 0.5\ (pK_w - pK_b - \log c)$

  $$h = \sqrt{\frac{K_w}{K_b \times c}}$$

  Salt of weak acid and weak base :

  $pH = 0.5\ (pK_w - pK_a - pK_b)$

  $$h = \sqrt{\frac{K_w}{K_a \times K_b}}$$

- ## Solubility Product

Classification of salt on the basis of their solubility

i. Soluble, Solubility **> 0.1 M**

ii. Slightly Soluble, **0.01 M < Solubility < 0.1 M**

$$\mathbf{AgCl(s) \rightleftharpoons Ag^+ + Cl^-}$$

Applying the law of chemical equilibrium, we have

$$K_C = \frac{[Ag^+][Cl^-]}{[AgCl(s)]} \text{ or } \mathbf{K_C \times [AgCl(s)] = [Ag^+]\ [Cl^-]}$$

$$\mathbf{[Ag^+]\ [Cl^-] = K_C \times constant = K_{sp}}$$

$\mathbf{K_{sp}}$ = solubility product

$\mathbf{K_{sp}}$: product of molar concentrations of the ions (formed in the saturated solution at a given temperature) raised to the power equal to the number of times each ion occurs in the balanced equation for solubility equilibrium.

- ## Application of Solubility Product

1. Relation Between Ksp and S

- **General form**

$AxBy \rightleftharpoons$	xA^{+y}	+	yB^{-x}
a	0		0
a – S	xS		yS

$$K_{sp} = [A^{+y}]^x\ [B^{-x}]^y$$
$$= [xs]^x \times [ys]^y = x^x.s^x.\ y^y.s^y$$

$$\boxed{K_{sp} = x^x\ y^y\ S^{(x+y)}}$$

2. Predicting precipitation in reactions :

(a) If $Q_{sp} < K_{sp}$, the solution is unsaturated.

(b) If $Q_{sp} > K_{sp}$, the solution is supersaturated and precipitation takes place.

(c) If $Q_{sp} = K_{sp}$, the solution is just saturated and no precipitation takes place.