



- Relation between ionisation constant ( $K_i$ ) and degree of ionisation ( $\alpha$ ):

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

If is applicable to weak electrolytes for which  $\alpha \ll 1$  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)  $\alpha$  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 :**

$$\text{pH} = 0.5 (\text{p}K_w + \text{p}K_a + \log c)$$

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

### Salt of weak base and strong acid:

$$\text{pH} = 0.5 (\text{p}K_w - \text{p}K_b - \log c)$$

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

### Salt of weak acid and weak base :

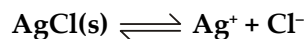
$$\text{pH} = 0.5 (\text{p}K_w - \text{p}K_a - \text{p}K_b)$$

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

### ➤ 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



Applying the law of chemical equilibrium, we have

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

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

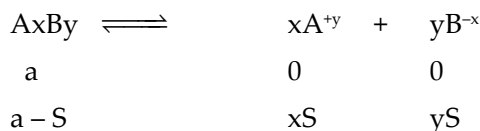
$K_{sp}$  = solubility product

$K_{sp}$  : 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 $K_{sp}$ and S

- General form



$$\begin{aligned} K_{sp} &= [\text{A}^{+y}]^x [\text{B}^{-x}]^y \\ &= [xS]^x \times [yS]^y = x^x \cdot S^x \cdot y^y \cdot S^y \end{aligned}$$

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

#### 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.