SOLUBILITY

$$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$$

$$K_{sp} = [Ag^+][Cl^-] = 1.6 \times 10^{-10}$$

$$[Ag^+] = [Cl^-] = 1.3 \times 10^{-5}$$

a) 500 mL OF A $CaCl_2$ SOL (8.0×10^{-6} M)
300 mL OF A $AgNO_3$ SOL (4.0×10^{-3} M)

$$[Cl^-] = 2 \times \frac{5}{8}(8.0 \times 10^{-6}\ M) = 1.00 \times 10^{-5}\ M$$

$$[Ag^+] = \frac{3}{8}(4.0 \times 10^{-3}\ M) = 1.5 \times 10^{-3}\ M$$

$$Q = 1.5 \times 10^{-8}\ M > K_{sp}$$

$\Rightarrow [Ag^+]$ AND $[Cl^-] \downarrow \Rightarrow$ ppt $AgCl(s)$

$\boxed{\text{COMMON-ION EFFECT}}$

b) $AgCl(s)$ IS ADDED TO 1.00 L OF A 0.100 M SOL OF $NaCl$.

IF S IS THE SOLUBILITY OF $AgCl(s)$

$$[Ag^+] = S$$

$$[Cl^-] = 0.100 + S$$

$$K_{sp} = S(0.100 + S) \cong 0.100\,S$$

$$S = 1.6 \times 10^{-9}\,M \ll 0.100$$

$$S \lll 1.3 \times 10^{-5}\,M \text{ (IN WATER)}$$

IN GENERA IF $[Cl^-] \uparrow \Rightarrow [Ag^+] \downarrow$

EFFECT OF pH ON SOLUBILITY

CONSIDER $Zn(OH)_2(s)$

$$Zn(OH)_2(s) \rightleftharpoons Zn^{2+}(aq) + 2OH^-(aq)$$

$$K_{sp} = [Zn^{2+}][OH^-]^2$$

IF X IS THE SOLUBILITY OF $Zn(OH)_2(s)$,

WE HAVE

$$[Zn^{2+}] = X$$

$$[OH^-] = 2X$$

$$K_{sp} = 4X^3 \Rightarrow X = \sqrt[3]{\frac{K_{sp}}{4}}$$

$$X = [Zn^{2+}] = \sqrt[3]{\frac{4.5 \times 10^{-17}}{4}} = 2.2 \times 10^{-6} M$$

$$[OH^-] = 4.4 \times 10^{-6} M \Rightarrow pOH = 5.35$$

$$\boxed{pH = 8.65}$$

IF WE BUFFER THE SOLUTION TO CONTROL THE pH

$$K_{sp} = [Zn^{2+}][OH^-]^2$$

BUT

$$K_w = [H_3O^+][OH^-]$$

OR

$$[Zn^{2+}] = \frac{K_{sp}}{K_w^2}[H_3O^+]^2$$

$$= \frac{4.5 \times 10^{-17}}{1.0 \times 10^{-28}}[H_3O^+]^2$$

$$= 4.5 \times 10^{11} [H_3O^+]^2$$

$$\boxed{[Zn^{2+}] = 4.5 \times 10^{11} \times 10^{-2pH}}$$

AT $pH = 6.00 \Rightarrow [Zn^{2+}] = 0.45\ M \uparrow$