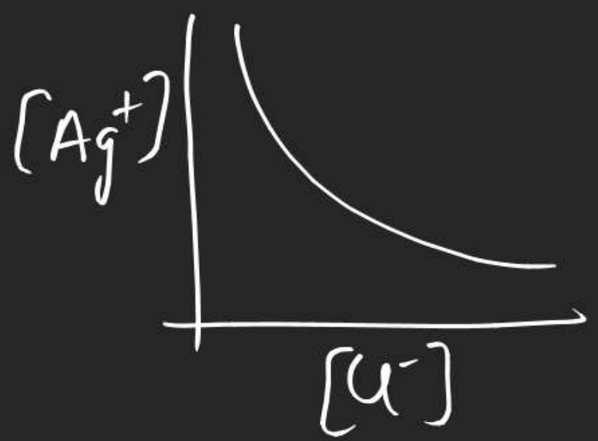
Nishant Jindal

$$\frac{7\,mg}{lit}$$

$$S = \frac{7 \times 10^{-3}}{100}$$

$$K_{sp} = 49 \times 10^{-10}$$

$$[Ag^+][Cl^-] = K_{sp}$$



$$a = [Ca^{2+}]$$

$$[Ca^{2+}][CO_3^{2-}] = 49 \times 10^{-10}$$

$$[Ba^{2+}][CO_3^{2-}] = K_{sp}$$

$$(0.1a)[CO_3^{2-}] = K_{sp}$$

$$\frac{(0.1a)[CO_3^{2-}]}{(a)[CO_3^{2-}]} = 49 \times 10^{-10}$$

Nishant Jindal

Effect of complex formation on solubility :→

K_{sp} $AgCl(s) \longrightarrow Ag^+ + Cl^-$

$S \quad x \quad S$

$K_{form} >> 1$ $Ag^+ + 2NH_3 \rightarrow Ag(NH_3)_2^+$

S	a	
0	a − 2S	S
x	a − 2S + 2x	S − x

$Ag^+ + NH_3 \rightarrow Ag(NH_3)^+ \quad K_{f_1} >> 1$

$Ag(NH_3)^+ + NH_3 \rightarrow Ag(NH_3)_2^+ \quad K_{f_2} >> 1$

$K_{sp} = x \times S = 10^{-10}$ —— (1)

$K_{form} = \dfrac{S}{x \times (a-2S)^2} = 10^6$ —— (2)

Q. find Solubility of AgCl in 2M NH_3 soln. Given $K_{sp}(AgCl) = 10^{-10}$

$K_{form} = 10^6$

$10^{-4} = \dfrac{S^2}{(a-2S)^2} \Rightarrow \dfrac{S}{a-2S} = 10^{-2}$

$S = 2 \times 10^{-2}$

$10^{-10} = S^2$

$10^{-5} = S$

Effect of hydrolysis on solubility :→

$$MA(s) \longrightarrow \underset{S}{M^+(aq)} + \underset{S-x}{A^-(aq)} \qquad K_{sp} = S(S-x)$$

$$\underset{S-x}{A^-} + H_2O \longrightarrow \underset{x}{HA} + \underset{10^{-9}}{OH^-} \qquad \frac{K_w}{K_a} = \frac{x \cdot 10^{-9}}{S-x}$$

① If given pH is due to a buffer soln.
let $pH = 5$ $[H^+] = 10^{-5}$ $[OH^-] = 10^{-9} \neq x$

② If given pH is due to salt itself
let $pH = 5$ $[H^+] = 10^{-5}$ $[OH^-] = 10^{-9} = x$

Nishant Jindal

Alternate method

$MA(s) \longrightarrow M^+(aq) + A^-(aq)$ $\quad K_{sp} = [M^+][A^-]$ —①

$A^- + H_2O \longrightarrow HA(aq) + OH^-(aq)$ $\quad \frac{K_w}{K_a} = \frac{[HA][OH^-]}{[A^-]}$ —② $\quad [HA] = \frac{K_w}{K_a}\frac{[A^-]}{[OH^-]}$

by mole balance

$S = [A^-] + [HA]$ —③

by charge balance

$[M^+] = [A^-] + [OH^-]$ —④

by eq ③

$S = [A^-]\left[1 + \frac{[H^+]}{K_a}\right]$

by eq ①

$K_{sp} = S \times \frac{S}{\left(1 + \frac{[H^+]}{K_a}\right)}$

$S = \sqrt{K_{sp}\left(1 + \frac{[H^+]}{K_a}\right)}$

$S = \sqrt{2 \times 10^{-10}\left(1 + \frac{10^{-3}}{10^{-8}}\right)}$

$= \sqrt{2 \times 10^{-10} \times 10^{5}} = \sqrt{20} \times 10^{-3}$

$10^{-4} = \sqrt{K_{sp}\left(1 + \frac{10^{-7}}{K_a}\right)}$

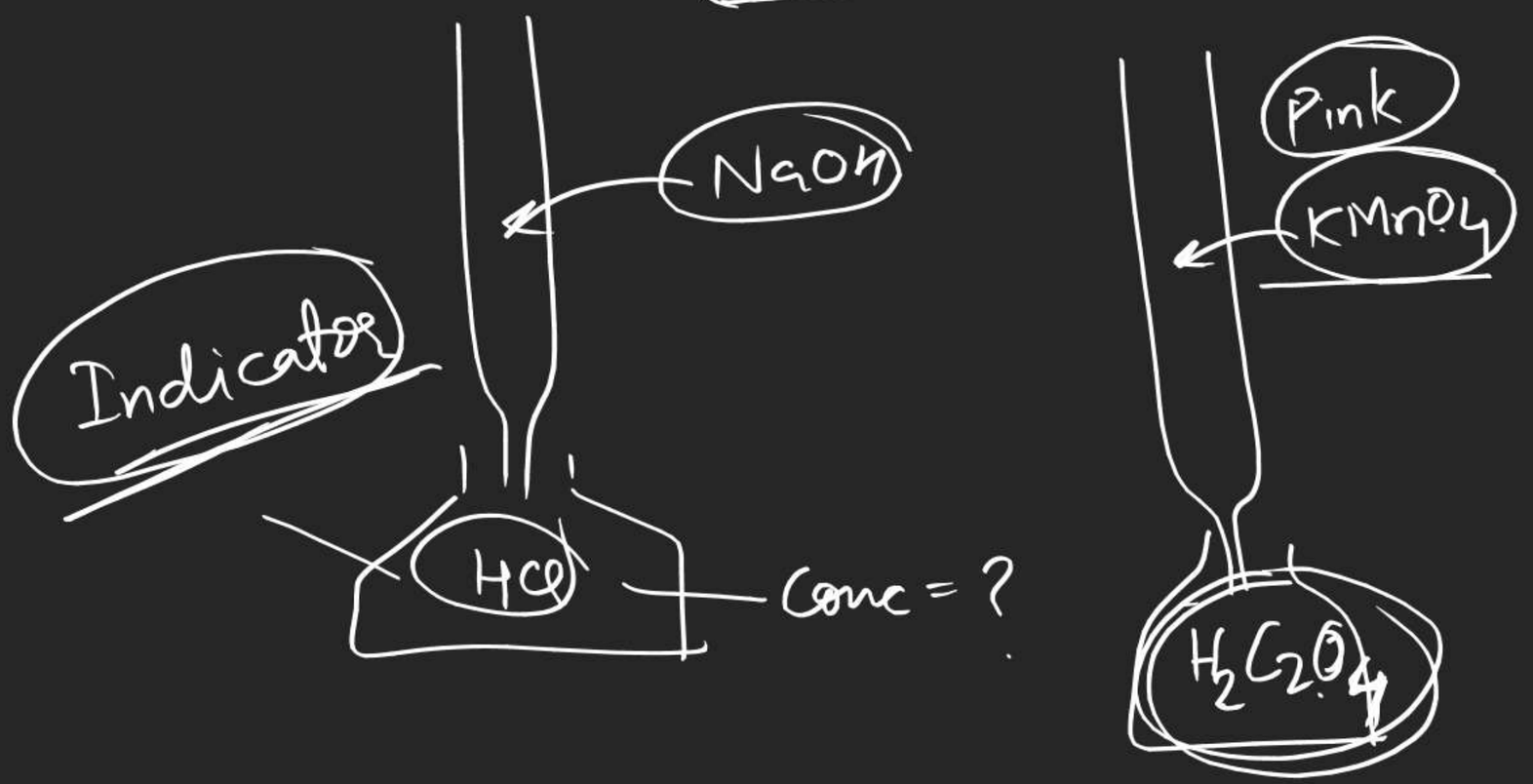
$10^{-3} = \sqrt{K_{sp}\left(1 + \frac{10^{-2}}{K_a}\right)}$

$10^{-2} = \frac{1 + 10^{-7}/K_a}{1 + 10^{-2}/K_a}$

Nishant Jindal

Indicators :→

Titration $M_1 V_1 n_1 = M_2 V_2 n_2$



colourless
Mn^{2+}

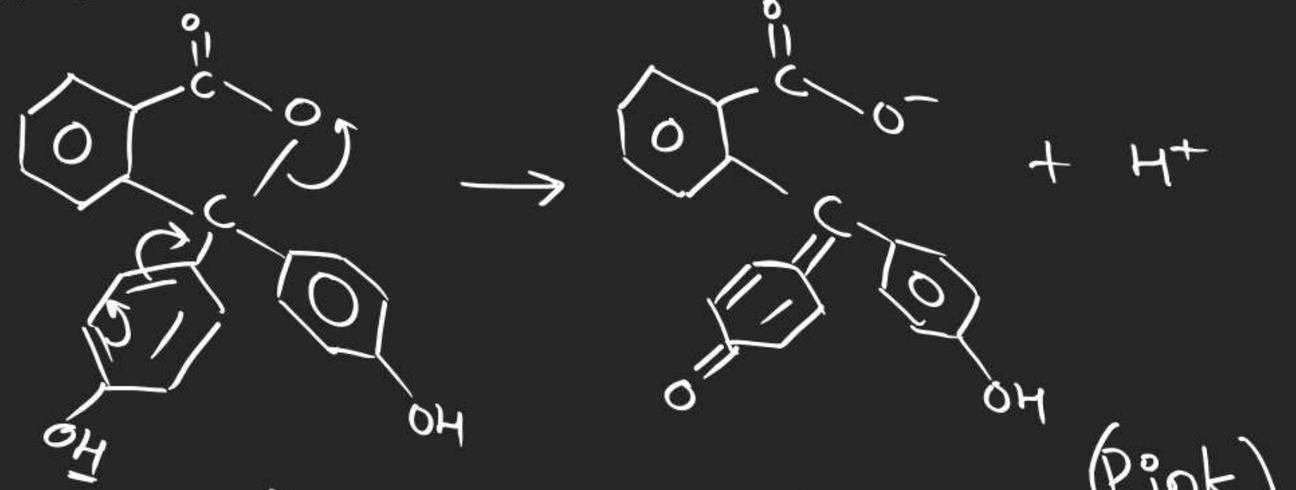
	4.4
4	20
4	16
84	400
4	336
887	6400
7	

$\sqrt{20} = 2\sqrt{5}$
$= 2 \times 2.23$
$= 4.46$

Nishant Jindal

Indicators:→ Indicator are used to determine the end point (equivalence point) of a titration process.

In acid-base titrations indicators are either weak organic acid or base having a characteristic of different colours in ionised and unionised form.



(colourless) phenolpthalein (Pink)

$$HIn \rightarrow H^+ + In^-$$

$$K_{In} = \frac{[H^+][In^-]}{[HIn]}$$

To observe the colour of In^-

$$[In^-]/[HIn] \geq 10$$

$$K_{In} = [H^+] \times \frac{[In^-]}{[HIn]}$$

$$pK_{In} = pH - \log \frac{[In^-]}{[HIn]}$$

$$pH = pK_{In} + \log \frac{[In^-]}{[HIn]}$$

$$pH \geq pK_{In} + 1$$

To observe the colour of HIn

$$[HIn]/[In^-] \geq 10$$

$$pH = pK_{In} - \log \frac{[HIn]}{[In^-]}$$

$$pH \leq pK_{In} - 1$$

$[HIn]$ — Mixed — $[In^-]$

$pK_{In}-1$ $\quad$ $pK_{In}+1$

pH range of indicator

8.3 — 10

Nishant Jindal

JEE - Adv