

Since both are present in mixture and therefore,

$[\text{H}^+] \text{ by HCOOH} = [\text{H}^+] \text{ by CH}_3\text{COOH}$

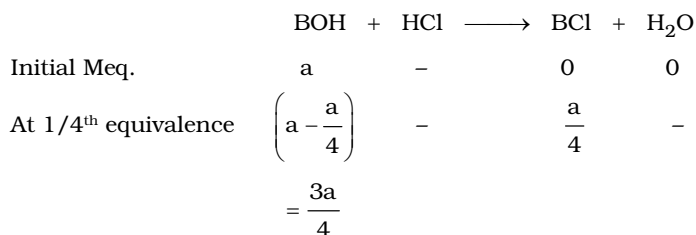
$C_1\alpha_1 = C_2\alpha_2$

$\sqrt{K_{a_1} \times C_1} = \sqrt{K_{a_2} \times C_2}$

$\sqrt{2.4 \times 10^{-4} \times 0.5} = \sqrt{1.8 \times 10^{-5} \times C_2}$

$\therefore C_{\text{CH}_3\text{COOH}} = 6.666 \text{ M}$

154. Let, 'a' Meq. of BOH is initially present



At this point, pH = 9.24

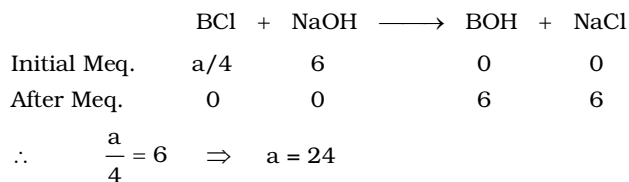
$\therefore \text{pOH} = 14 - 9.25 = 4.76$

$\therefore \text{pOH} = \text{pK}_b + \log \frac{[\text{BCl}]}{[\text{BOH}]}$

$4.76 = \text{pK}_b + \log \frac{a/4}{3a/4} = \text{pK}_b - \log 3$

$\therefore \text{K}_b = 5.79 \times 10^{-6}$

When further 6 Meq. of base was added



Now, total Meq. of BOH in 50 ml solution = $\left(a - \frac{a}{4}\right) + 6 = 18 + 6 = 24$

$\therefore \text{Molarity of BOH} = \frac{24}{50} \text{ M} = 0.48 \text{ M}$

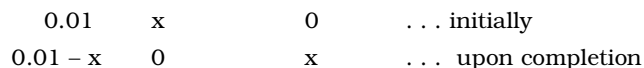
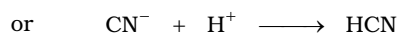
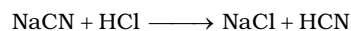
$[\text{OH}^-] = \sqrt{5.77 \times 10^{-6} \times 0.48} = 1.664 \times 10^{-3}$

$\therefore \text{pOH} = -\log(1.664 \times 10^{-3}) = 2.778$

$\therefore \text{pH} = 14 - 2.778 = 11.222$

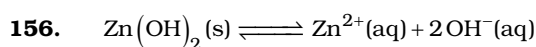
155. $\text{pH} = \text{pK}_a + \log \frac{[\text{salt}]}{[\text{acid}]}$

Let x mole of HCl ($x < 0.01$) be added



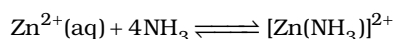
Thus, $8.5 = -\log(4.0 \times 10^{-10}) + \log \frac{(0.01 - x)}{x}$

Upon solving $x = 8.85 \times 10^{-3} \text{ M}$



$$K_{\text{sp}} = [\text{Zn}^{2+}][\text{OH}^-]^2 = 1.8 \times 10^{-17}$$

And for the complex formation



$$K_{\text{stability}} = \frac{[\text{Zn}(\text{NH}_3)_4]^{2+}}{[\text{Zn}^{2+}][\text{NH}_3]^4}$$

Since the value of $K_{\text{stability}}$ is too high it may be assumed that all of Zn^{2+} is complexed.

$\therefore$ If x be the molar solubility of $\text{Zn}(\text{OH})_2$ in 1 M solution, then at equilibrium

$$[\text{NH}_3] = 1 - 4x, [\text{OH}^-] = 2x, \text{ and } [\text{Zn}(\text{NH}_3)_4]^{2+} = x$$

$\therefore K_{\text{sp}}\{\text{Zn}(\text{OH})_2\} = [\text{Zn}^{2+}](2x)^2 = 4x^2[\text{Zn}^{2+}] \dots (\text{a})$

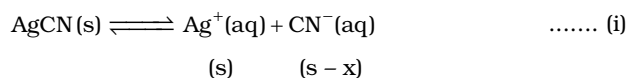
and $K_{\text{stability}} = \frac{x}{(1 - 4x)^4 [\text{Zn}^{2+}]} \dots (\text{b})$

Multiplying (a) & (b) we get

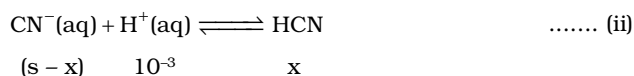
$$K = K_{\text{sp}} \cdot K_{\text{stability}} = \frac{4x^3}{(1 - 4x)^4} = 4x^3 \text{ (approximately)}$$

$\therefore 4x^3 = 1.8 \times 10^{-17} \times 1.64 \times 10^{10} \text{ or } x = 4.19 \times 10^{-3} \text{ moles / lit}$

157. Here actually two situations arise



$\therefore K_{\text{sp}}(\text{AgCN}) = s(s - x)$



and $\frac{1}{K_a} = \frac{x}{(s - x) \times 10^{-3}}$

$$\therefore \frac{K_{sp}}{K_a} = \frac{s \cdot x}{10^{-3}} = \frac{1.2 \times 10^{-16}}{4.8 \times 10^{-10}} = \frac{1}{4} \times 10^{-6} = 2.5 \times 10^{-7}$$

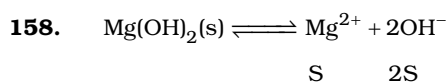
$$\text{or } s \cdot x = 2.5 \times 10^{-10} \quad \text{or } x = \frac{2.5 \times 10^{-10}}{s}$$

$$\therefore s \left(s - \frac{2.5 \times 10^{-10}}{s} \right) = 1.2 \times 10^{-16}$$

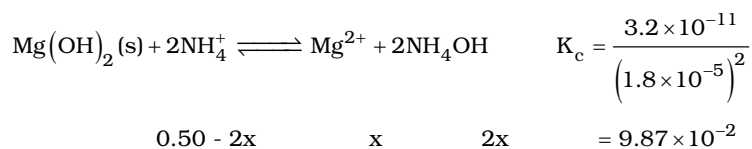
$$\text{or } s^2 - 2.5 \times 10^{-10} = 1.2 \times 10^{-16}$$

$$\text{or } s^2 = 2.5 \times 10^{-10} + 1.2 \times 10^{-16} \approx 2.5 \times 10^{-10}$$

$$\therefore s = 1.6 \times 10^{-3} \text{ mol / lit}$$



$$K_{sp} = S(2S)^2 = 4S^3 = 4(2 \times 10^{-4})^3 = 3.2 \times 10^{-11} \text{ M}^3$$



$$\frac{x(2x)^2}{(0.50)^2} = 9.87 \times 10^{-2} \quad \therefore \quad x = 0.1833 \text{ M}$$