

# UNIT # 07 (PART - II)

## IONIC EQUILIBRIUM

## EXERCISE # 1

9.  $\text{pH} = 1$   $\text{pH} = 2$   
 $[\text{H}^+] = 0.1$   $[\text{H}^+] = 0.01$   
 $V = 50$   $V = 50$
- $[\text{H}^+] \text{ of mixture } = [\text{H}^+] = \frac{N_1 V_1 + N_2 V_2}{V_1 + V_2} \Rightarrow \frac{50(0.1 + 0.01)}{100}$   
 $[\text{H}^+] \Rightarrow \frac{0.11}{2} \Rightarrow 0.055$   
 $\text{pH} = 1.26$
11.  $\text{pH} = 7$   $[\text{H}^+] = 10^{-7}$ ,  $[\text{OH}^-] = 10^{-7}$   
 new pH after addition of base  
 $\text{pH} = 12$   $[\text{H}^+] = 10^{-12}$   
 $[\text{OH}^-] = 10^{-2}$   
 $[\text{OH}^-] \text{ concentration increase } 10^5 \text{ times.}$
13. Relative strength  $= \sqrt{\frac{K_{a1}}{K_{a2}}} = \sqrt{\frac{3 \times 10^{-4}}{1.8 \times 10^{-5}}} \Rightarrow 4 : 1$
16.  $\text{HCOOH} + \text{KOH} \xrightarrow{40\text{mL}, 0.5\text{M}} \text{HCOOH} + \text{H}_2\text{O}$   
 after reaction is forms Buffer solution
- $[\text{HCOOH}] = \frac{10}{90}$   $[\text{HCOOK}] = \frac{10}{90}$
- $\text{pH} = \text{pK}_a + \log \frac{[\text{salt}]}{[\text{acid}]}$   $\text{pH} = \text{pK}_a$
- $\text{pH} = 4 - \log (1.8)$   $\text{pH} = 3.75$
19. Let weak acid is HA its sodium salt is NaA  
 $K_a = \frac{K_w}{K_b}$   $K_b = \text{CH}^2 \Rightarrow 0.1$   $(0.03)^2$   
 $K_a = \frac{10^{-14}}{9 \times 10^{-5}}$   $K_a = \approx 1 \times 10^{-10}$
22.  $\text{CH}_3\text{COOH} + \text{NaOH} \longrightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$   
 100 mL, 0.4 M 100 mL, 0.2 M  
 40 20  
 After reaction
- $[\text{CH}_3\text{COOH}] = \frac{20}{250}$ ,  $[\text{CH}_3\text{COONa}] = \frac{20}{200}$
- $\text{pH} = \text{pK}_a + \log \frac{[\text{salt}]}{[\text{acid}]}$
- $\text{pH} = \text{pK}_a$   $[\text{H}^+] = K_a = 1.8 \times 10^{-5}$
24.  $\text{CH}_3\text{COONa} + \text{HCl} \longrightarrow \text{CH}_3\text{COOH} + \text{NaCl}$   
 at equivalence the  $[\text{CH}_3\text{COOH}] = \frac{20}{200} \Rightarrow 0.1$
- $\text{pH} = \frac{1}{2} \text{pK}_a - \frac{1}{2} \log C$   
 $\text{pH} = \frac{1}{2} [5 \log 2 - \log 10^{-3}]$   
 $\text{pH} = \frac{1}{2} [6 - \log 2] \Rightarrow \text{pH} = 3 - \log \sqrt{2}$

28.  $\text{pH} = \text{pK}_a + \log \frac{[\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]}$   
 $7 = 7 - \log + \log \frac{[\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]} \Rightarrow \frac{[\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]} = 4$   
 $\% \text{HCO}_3^- = \frac{4}{5} \times 100 \Rightarrow 80 \%$
30.  $2\text{NaOH} + \text{H}_3\text{PO}_4 \longrightarrow \text{Na}_2\text{PO}_4$   
 50mL, 0.1M 60mL, 0.15  
 0 7.33  
 $\text{H}_3\text{PO}_4 \rightleftharpoons \text{H}^+ + \text{H}_2\text{PO}_4^-$   
 $[\text{mass H}^+ \text{ obtain from first ionization of } \text{H}_3\text{PO}_4]$   
 $\text{pH} = \frac{1}{2} \text{pK}_a - \frac{1}{2} \log C = \frac{1}{2} \text{pK}_a - \frac{1}{2} \log C$   
 $= 1.5 + 1.17 = 2.67$
32.  $\text{Mg}(\text{NO}_3)_2 + 2\text{NaF} \longrightarrow \text{MgF}_2 + 2\text{NaNO}_3$   
 2.5 5 0 2.5  
 $(\text{MgF}_2) = \frac{2.5}{35}$   
 $\text{MgF}_2 \longrightarrow \text{Mg}^{2+} + 2\text{F}^-$   
 Ionic product
41.  $\text{AgCNS} \rightleftharpoons \text{Ag}^+ + \text{CNS}^-$   
 $(1-\delta_1) \quad (\delta_1 + \delta_2) \quad \delta_1$   
 $\text{AgCl} \rightleftharpoons \text{Ag}^+ + \text{Cl}^-$   
 $(1-\delta_2) \quad (\delta_1 + \delta_2) \quad \delta_2$   
 $(K_w)_{\text{AgCNS}} = (\delta_1)(\delta_1 + \delta_2) \dots\dots\dots (i)$   
 $(K_w)_{\text{AgCl}} = (\delta_2)(\delta_1 + \delta_2) \dots\dots\dots (ii)$   
 add equation (i) and (ii)  
 $(\delta_1 + \delta_2)^2 = (K_w)_{\text{AgCNS}} + (K_w)_{\text{AgCl}}$   
 $(\delta_1 + \delta_2) = \sqrt{(K_w)_{\text{AgCNS}} + (K_w)_{\text{AgCl}}} = \sqrt{1.5 \times 10^{-12} + 1.7 \times 10^{-10}}$   
 $(\text{Ag}^+) = (\delta_1 + \delta_2) = 1.3 \times 10^{-5} \text{ divide eq. ii from i}$   
 $\frac{[\text{Cl}^-]}{[\text{CNS}^-]} = \frac{\delta_2}{\delta_1} = \frac{1.7 \times 10^{-10}}{1.0 \times 10^{-12}} \Rightarrow 1.7 \times 10^2$
47.  $\text{IP} > K_{sp}$   $\text{I.P.} = (\text{Ca}^{2+}) (\text{F}^-)^2$   
 $\text{I.P.} \Rightarrow (10^{-3}) (10^{-3})^2 \Rightarrow 10^{-9}$   $\text{IP} > K_{sp}$
53.  $\text{pH} = \text{p}^{100} + \log \frac{[\text{In}^-]}{[\text{HIn}]}$   $6 = 5 + \log \frac{[\text{In}^-]}{[\text{HIn}]}$   
 $\frac{[\text{In}^-]}{[\text{HIn}]} = 10$
54. At Half way  $[\text{HIn}] = [\text{In}^-]$   
 $\text{pH} = 5.5 + \log \frac{[\text{salt}]}{[\text{acid}]}$   $5.5 = \text{pK}_a + \log \frac{[\text{salt}]}{[\text{acid}]}$   
 $\log \frac{[\text{salt}]}{[\text{acid}]} = 0.75 \Rightarrow \frac{[\text{salt}]}{[\text{acid}]} = 5.62$

# Solutions Manual Module 11

**TD Snyder**

A red circular graphic with a gradient, appearing as a semi-circle or a partial circle, located to the right of the author's name.

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