

Daily Tutorial Sheet-11

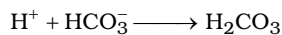
Numerical Value Type

126.(6) $\text{pH} = 2 \Rightarrow [\text{H}^+] = 10^{-2}$
 $\text{pH} = 10 \Rightarrow [\text{OH}^-] = 10^{-2}$ (at $K_w = 10^{-12}$)

On mixing $\text{H}^+ + \text{OH}^- \rightleftharpoons \text{H}_2\text{O}$

$\therefore$ pH of resulting solution 6.

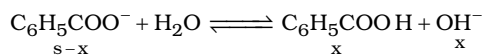
127.(2.04) pH of NaHCO_3 solution = 9 (initial)



Number of millimoles of HCl remaining = $1 - 0.1 = 0.9$ m moles

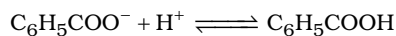
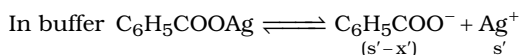
$$\text{pH} = -\log(9 \times 10^{-3}) = -2 \log 3 + 3 = -0.954 + 3 = 2.04$$

128.(3.317)



$$s(s-x) = 2.5 \times 10^{-13}$$

$$\frac{x^2}{s-x} = \frac{10^{-14}}{(6.46 \times 10^{-5})} \longrightarrow \text{Get } s$$



$$s'(s'-x') = 2.5 \times 10^{-13}$$

$$\frac{s'(s'-x') \times 10^{-3.19}}{x'} = 6.46 \times 10^{-5} \longrightarrow \text{Get } s'$$

$$\frac{s'}{s} = 3.317$$

129.(5.74) $\text{pH} = \frac{\text{pK}_{a1} + \text{pK}_{a2}}{2} = \frac{2.28 + 9.2}{2} = 5.74$

130.(3.56) $\text{pH} = \text{pK}_1 + \log \left[\frac{[\text{In}^-]}{[\text{HI}_n]} \right]; 5 = \text{pK}_1 + \log \frac{75}{25}$

$$\text{pK}_1 = 4.523$$

$$\text{K}_1 = 3 \times 10^{-5}$$

$$\text{pH} = 4.52 + \log \frac{10}{90} = 4.52 - 0.954 = 3.56$$

131.(0.04) $\text{K}_{\text{sp}} = [\text{Mg}^{2+}][\text{OH}^-]^2$

$$[\text{OH}^-] = \sqrt{\frac{2.5 \times 10^{-11}}{0.01}} = 5 \times 10^{-5}$$

$$\text{K}_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]} \quad \text{So} \quad [\text{NH}_4^+] = 0.04 \text{ M}$$

132.(2.03) Initial $[H^+] = 0.1$ [from weak acid H^+ can be neglected]

After neutralization of HCl ; Volume would double.

$$\text{Hence } [CH_3COOH] = \frac{0.1 \times 20}{40} = 0.05$$

$$[H^+] = \sqrt{K_a \cdot C}$$

$$[H^+] = 9.48 \times 10^{-4}$$

$$pH = 3.03$$

$$\Delta pH = (3.03 - 1) = 2.03$$

133.(11) For buffer capacity of 0.1, we should have $\frac{c + 0.1}{c - 0.1} = 10$

$c \rightarrow$ concentration of wA or salt in buffer solution $c + 0.1 = 10c - 1$

$$\text{So } 9c = 1.1 \text{ or } c = \frac{1.1}{9}$$

$$\text{So moles required for 90 ml solution} = \frac{1.1}{9} \times 90 \times 10^{-3} = 11 \text{ m moles}$$

134.(5.1) Let initial com HA and NaOH be c_1 and c_2 and initial volume of HA = v_1 ml

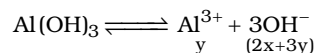
$$5 = pK_a + \log \frac{10c_2}{(c_1v_1 - 10c_2)} \quad \dots\dots\dots (i)$$

$$6 = pK_a + \log \frac{20c_2}{(c_1v_1 - 20c_2)} \quad \dots\dots\dots (ii)$$

$$c_1v_1 = 22.5c_2$$

$$5 = pK_a + \log \frac{10c_2}{22.5c_2 - 10c_2} = pK_a + \log 0.8 \quad \Rightarrow \quad pK_a = 5 + 0.096 = 5.1$$

135.(80) $Mg(OH)_2 \rightleftharpoons Mg^{2+} + 2OH^-$
 $\quad \quad \quad x \quad \quad \quad (2x+3y)$



Since K_{sp} of $Mg(OH)_2 > K_{sp}$ of $Al(OH)_3$

So $x \gg y$

$$2x + 3y \approx 2x$$

$$4 \times 10^{-12} = [Mg^{2+}][OH^-]^2 = x \times (2x)^2$$

$$x = 10^{-4}$$

$$1 \times 10^{-33} = [Al^{3+}][OH^-]^3$$

$$10^{-33} = y(2x)^3$$

$$y = \frac{10^{-21}}{8}$$

$$\frac{x}{y} = 8 \times 10^{17}$$

$$8 \times 10^{17} \times 10^{-18} = 80$$

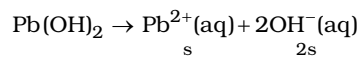
$$136.(4) \quad \text{pOH} = \text{pK}_b + \log \frac{[\text{salt}]}{[\text{base}]}$$

$$[\text{salt}] = [\text{base}]$$

$$\text{pOH} = \text{pK}_b$$

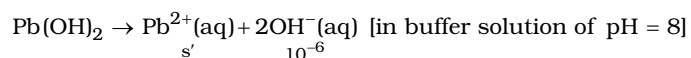
$$\text{pOH} = 10 \Rightarrow \text{pH} = 14 - 10 = 4$$

$$137. (1.2 \times 10^{-3} \text{ mol/L})$$



$$K_{\text{sp}} = 4s^3 = 4(6.7 \times 10^{-6})^3$$

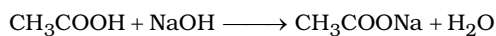
$$K_{\text{sp}} = 1.2 \times 10^{-15}$$



$$K_{\text{sp}} = s'(10^{-6})^2 = 1.2 \times 10^{-15}$$

$$s' = 1.2 \times 10^{-3} \text{ mol/L}$$

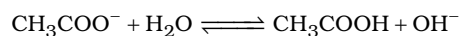
138.(8.71) Suppose V mL of 0.1 N acid and 0.1 N NaOH are used at equivalence point



$$\begin{array}{ccccccc} \text{mm before reaction} & 0.1 \times V & 0.1 \times V & & 0 & & 0 \end{array}$$

$$[\text{CH}_3\text{COONa}] = \frac{0.1 \times V}{2V} = \frac{0.1}{2} = 0.05 \text{ M}$$

For hydrolysis of $\text{CH}_3\text{COO}^{-}$

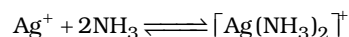


$$\begin{array}{ccc} 1 & 0 & 0 \\ (1-h) & h & h \end{array}$$

$$[\text{OH}^{-}] = c \cdot h = c \sqrt{\frac{K_{\text{H}}}{c}} = \sqrt{\frac{K_{\text{w}} \times c}{K_{\text{a}}}} = \sqrt{\frac{10^{-14} \times 0.05}{1.9 \times 10^{-5}}} = 5.12 \times 10^{-6}$$

$$\text{pOH} = 5.29 \Rightarrow \text{pH} = 8.71$$

139.(1.89)



$$K_{\text{f}} = \frac{[\text{Ag}(\text{NH}_3)_2]^{+}}{[\text{Ag}^{+}][\text{NH}_3]^2} = 1 \times 10^8$$

$$[\text{AgNO}_3] = [\text{Ag}^{+}]_{\text{initially}} = 0.750 \text{ M}$$

$$[\text{Ag}^{+}]_{\text{left}} = 5 \times 10^{-8}$$

$$[\text{Ag}(\text{NH}_3)_2]^{+} = 0.750 - 5 \times 10^{-8} = 0.750$$

$$1 \times 10^8 = \frac{0.750}{5 \times 10^{-8} \times [\text{NH}_3]^2}$$

$$[\text{NH}_3]^2 = 0.15$$

$$[\text{NH}_3] \text{ in solution at equilibrium} = 0.39 \text{ M}$$

$$\begin{aligned} [\text{NH}_3]_{\text{added}} &= 0.39 + [\text{NH}_3]_{\text{needed to convert } 0.750 \text{ M Ag}^{+} \text{ to } [\text{Ag}(\text{NH}_3)_2]^{+}} \\ &= 0.39 + 2 \times 0.750 = 1.89 \text{ mol} \end{aligned}$$

140.(5.7033)

pH of buffer is given by

$$\text{pH} = -\log K_a + \log \frac{[\text{Conjugate base}]}{[\text{Acid}]}$$

$$\text{For I : } 4 = -\log 10^{-5} + \log \frac{[\text{Conjugate base}]}{0.5}$$

$$[\text{Conjugate base}] = 0.05 \text{ M} = [\text{salt}]$$

$$\text{For II : } 6 = -\log 10^{-5} + \log \frac{[\text{Conjugate base}]}{0.5}$$

$$[\text{Conjugate base}] = [\text{salt}] = 5 \text{ M}$$

Now the two buffers [(I: NaA = 0.05 M and HA = 0.5 M) and (II : NaA = 5 M and HA = 0.5 M)]

Are mixed in equal proportion.

$$\text{Thus, new conc. of NaA in mixed buffer} = \frac{(0.05) \times V + (5 \times V)}{2V} = \frac{5.05}{2} \text{ M}$$

$$\text{New conc. of HA in mixed buffer} = \frac{0.5V + 0.5V}{2V} = 0.5 \text{ M}$$

$$\text{Thus, pH} = -\log 10^{-5} + \log \frac{5.05}{2 \times 0.5} = 5 + 0.7033 = 5.7033$$