Daily Tutorial Sheet-11	Numerical Value Type

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

$pH = 10 \Rightarrow [OH^-] = 10^{-2}$ (at $K_w = 10^{-12}$)

On mixing $H^+ + OH^- \rightleftharpoons H_2O$

$\therefore$ pH of resulting solution 6.

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

$H^+ + HCO_3^- \longrightarrow H_2CO_3$

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

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

128.(3.317)

In pure water $C_6H_5COOAg \rightleftharpoons \underset{(s-x)}{C_6H_5COO^-} + \underset{s}{Ag^+}$

$\underset{s-x}{C_6H_5COO^-} + H_2O \rightleftharpoons \underset{x}{C_6H_5COOH} + \underset{x}{OH^-}$

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

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

In buffer $C_6H_5COOAg \rightleftharpoons \underset{(s'-x')}{C_6H_5COO^-} + \underset{s'}{Ag^+}$

$C_6H_5COO^- + H^+ \rightleftharpoons C_6H_5COOH$

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

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

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

129.(5.74) $pH = \dfrac{pKa_1 + pKa_2}{2} = \dfrac{2.28 + 9.2}{2} = 5.74$

130.(3.56) $pH = pK_1 + \log\dfrac{[In^-]}{[HI_n]}$; $5 = pK_1 + \log\dfrac{75}{25}$

$pK_1 = 4.523$

$K_1 = 3 \times 10^{-5}$

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

131.(0.04) $K_{sp} = [Mg^{2+}][OH^-]^2$

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

$K_b = \dfrac{[NH_4^+][OH^-]}{[NH_3]}$ So $[NH_4^+] = 0.04\,M$

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

After neutralization of HCl ; Volume would double.

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

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

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

$pH = 3.03$

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

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

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

So $9c = 1.1$ or $c = \dfrac{1.1}{9}$

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

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

$5 = pK_a + \log\dfrac{10c_2}{(c_1v_1 - 10c_2)}$ .... (i)

$6 = pK_a + \log\dfrac{20c_2}{(c_1v_1 - 20c_2)}$ .... (ii)

$c_1v_1 = 22.5c_2$

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

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

$Al(OH)_3 \rightleftharpoons \underset{y}{Al^{3+}} + \underset{(2x+3y)}{3OH^-}$

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

So $x >> y$

$2x + 3y \approx 2x$

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

$x = 10^{-4}$

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

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

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

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

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

136.(4) $pOH = pK_b + \log\frac{[salt]}{[base]}$

$[salt] = [base]$

$pOH = pK_b$

$pOH = 10 \quad \Rightarrow \quad pH = 14 - 10 = 4$

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

$$Pb(OH)_2 \rightarrow \underset{s}{Pb^{2+}}(aq) + \underset{2s}{2OH^-}(aq)$$

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

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

$$Pb(OH)_2 \rightarrow \underset{s'}{Pb^{2+}}(aq) + \underset{10^{-6}}{2OH^-}(aq) \text{ [in buffer solution of } pH = 8]$$

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

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

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

	CH_3COOH	$+ NaOH \longrightarrow$	CH_3COONa	$+ H_2O$
mm before reaction	$0.1 \times V$	$0.1 \times V$	0	0

$$[CH_3COONa] = \frac{0.1 \times V}{2V} = \frac{0.1}{2} = 0.05\,M$$

For hydrolysis of CH_3COO^-

$CH_3COO^- + H_2O$	$\rightleftharpoons CH_3COOH$	$+ OH^-$
1	0	0
$(1-h)$	h	h

$$[OH^-] = c \cdot h = c\sqrt{\frac{K_H}{c}} = \sqrt{\frac{K_w \times c}{k_a}} = \sqrt{\frac{10^{-14} \times 0.05}{1.9 \times 10^{-5}}} = 5.12 \times 10^{-6}$$

$pOH = 5.29 \quad \Rightarrow \quad pH = 8.71$

139.(1.89)

$$Ag^+ + 2NH_3 \rightleftharpoons \left[Ag(NH_3)_2\right]^+$$

$$K_f = \frac{\left[Ag(NH_3)_2\right]^+}{[Ag^+][NH_3]^2} = 1 \times 10^8$$

$$[AgNO_3] = [Ag^+]_{initially} = 0.750\,M$$

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

$$\left[Ag(NH_3)_2\right]^+ = 0.750 - 5 \times 10^{-8} = 0.750$$

$$1 \times 10^8 = \frac{0.750}{5 \times 10^{-8} \times [NH_3]^2}$$

$$\left[NH_3\right]^2 = 0.15$$

$\left[NH_3\right]$ in solution at equilibrium $= 0.39\,M$

$\left[NH_3\right]$ added $= 0.39 + \left[NH_3\right]$ needed to convert 0.750 M Ag^+ to $\left[Ag(NH_3)_2\right]^+$

$= 0.39 + 2 \times 0.750 = 1.89\,mol$

140.(5.7033)

pH of buffer is given by

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

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

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

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

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

Now the two buffers $\left[(\text{I: NaA} = 0.05\,M \text{ and HA} = 0.5\,M) \text{ and } (\text{II : NaA} = 5\,M \text{ and HA} = 0.5\,M)\right]$

Are mixed in equal proportion.

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

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

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