PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 18

Total Marks : 30

Max. Time : 41 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.3 to Q.8	(4 marks, 5 min.)	[24, 35]

1. 18 ml of mixture of acetic acid and sodium acetate required 6ml of 0.1 M NaOH for neutalization of the acid and 12 ml of 0.1 MHCl for reaction with salt, separately. If pK_a of the acid is 4.75, what is the pH of the mixture? [log2 = 0.3]

(A) 5.05 (B) 4.75 (C) 4.5 (D) 4.6

2. Blood is buffered with CO_2 and HCO_3^-. What is the ratio of the base concentration to the acid (i.e. CO_2(aq.) plus H_2CO_3) concentration to maintain the pH of blood at 7.4 ? The first dissociation constant of H_2CO_3 ($H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$) is 4.2×10^{-7} where the H_2CO_3 is assumed to include CO_2(aq.) i.e., dissolved CO_2. (log 2 = 0.3, log 3 = 0.48, log 7 = 0.85, antilog1.06 = 11.5)

(A) 10.7 (B) 1.8 (C) 10 (D) 12

3. Calculate hydrolysis constants for each of the following salt solutions. Compute also the pH of the solution and the percentage of hydrolysis.

(i) 0.05 M NaAc ; $K_a(HAc) = 2 \times 10^{-5}$.

(ii) 0.008 M NH_4 Cl ; $K_b(NH_3) = 2 \times 10^{-5}$.

(iii) 0.5 M Na_2S ; $K_a(HS^-) = 1.0 \times 10^{-15}$ [log (0.475) = - 0.32].

(iv) 0.64 M KCN : $K_a(HCN) = 4.0 \times 10^{-10}$.

(v) 0.40 M NH_4Ac

(vi) 0.003 M NH_4 CN

4. Calculate pH of the buffer solution containing 0.15 moles of NH_4OH and 0.25 moles of NH_4Cl . K_b for NH_4OH is 2×10^{-5} .

5. Determine the concentration of H_3O^+ ion in a mixture of 0.06 M CH_3COOH & 0.04 M CH_3COONa at 25ºC, dissociation constant of $CH_3COOH = 1.84 \times 10^{-5}$.

6. Calculate the hydrogen ion concentration in a solution containing 0.04 mole of acetic acid and 0.05 moles of sodium acetate in 500 ml of the solution. Dissociation constant for acetic acid is 1.8×10^{-5} .

7. Calculate the pH of solution of given mixtures. [log (1.8) = 0.26]

(a) 2 gm CH_3COOH + 4.1 gm CH_3COONa in 100 ml of mixture , $K_a = 1.8 \times 10^{-5}$.

(b) 5 ml of 0.1 M NH_4OH + 250 ml of 0.1 M NH_4Cl , $K_b = 1.8 \times 10^{-5}$.

8. Calculate the moles of pyridinium chloride (C_6H_5NHCl) which should be added to 500 ml solution of 0.4 M pyridine (C_5H_5N) to obtain a buffer of pH = 5 , K_b for pyridine is 1.5×10^{-9} .

Answer Key

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1. (A) 2. (A)

3.

	K_h	pH	%Hydrolysis
(i)	5×10^{-10}	8.7	0.01%
(ii)	5×10^{-10}	5.7	0.025%
(iii)	10.0	13.68	95%
(iv)	2.5×10^{-5}	11.60	0.625%
(v)	2.5×10^{-5}	7.0	0.5%
(vi)	1.25	9.35	52.8%

4. 9.08 5. 2.76×10^{-5} mol Lt^{-1}. 6. 1.44×10^{-5} M. 7. (a) 4.92 (b) 7.56

8. 0.3 mole of C_5H_5NHCl should be added to 500 ml solution of C_5H_5N.

Hints & Solutions

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1. From the information, $\frac{[\text{salt}]}{[\text{acid}]} = 2$; so, $pH = pKa + \log \frac{[\text{salt}]}{[\text{acid}]} = 5.05$.

2. $7.4 = (7 - \log 4.2) + \log \frac{[B]}{[A]} \Rightarrow \log \frac{[B]}{[A]} = 1.03 \Rightarrow \frac{[B]}{[A]} = 10.7$

3.

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5. $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$.

$$1.84 \times 10^{-5} = \frac{0.04}{0.06} \times [H^+].$$

$$[H^+] = \frac{3}{2} \times 1.84 \times 10^{-5} = 2.76 \times 10^{-5}\ M.$$

8. $$pOH = pK_b + \log\frac{[n_{salt}]}{[n_{acid}]}$$

Since, pH = 5 ; pOH = 9.

$$9 = 8.824 + \log\frac{[n_{salt}]}{0.2\text{mol}}.$$

$$0.176 = \log\frac{[n_{salt}]}{0.2\text{mol}}$$

$[n_{salt}] = 0.3$ mole.